

Introduction: Heart Disease in an Elderly Population

David Fitchett MD¹ and Kenneth Rockwood MD²

¹ St Michael's Hospital, University of Toronto

² Dalhousie University, Halifax

Correspondence

David Fitchett
St Michael's Hospital
30 Bond St, Rm 7037
Toronto, ON M5B 1W8

Email: fitchettd@smh.toronto.on.ca

Demographics of Aging

Western society is aging. In 1900 only 4% of people in the USA were over 65 years old. By 2000 the proportion had risen to 14%, and by 2020 it is predicted that more than 20% will be over 65 years old(1). In Ontario it is estimated that the number of individuals over 65 years old will double in the next 20 years. Currently 11% of the over 60 years olds are over 80. However it is forecast that in the next 50 years 20% of the total population will be over 80 and the number of centenarians will increase 15 fold. Associated with the marked increase in the elderly population is an increase in life expectancy. Today a 65 year old man can expect to live 14.9 – 18.9 years, whereas the average 80 year old will survive an additional 7-9 years(2). Canadian women who are 60 years old have a 50% chance of surviving until age 80. However males aged 60 have a lower (38-48%) chance of living until age 80 as a result of the earlier impact of atherosclerosis and its subsequent cardiovascular complications.

Heart Disease: a disease of elderly people.

Cardiovascular disease is the leading cause of death today (36%), of which over half is attributable to ischemic heart disease. Ischemic heart disease, congestive heart failure, and atrial fibrillation are the three most common cardiac disorders encountered in an elderly population. Hospitalization rates for ischemic heart disease are four-fold more frequent in patients 75-84 years old, as compared to a 45-54 year old group (Hospital morbidity database, Canadian Institute for Health Information). Congestive heart failure is very much more frequent in the elderly, with 85% of patients with heart failure being older than 65 years(3). The prevalence of atrial fibrillation increases 3 fold in those aged >80 compared to patients < 65 years old (ref). Heart disease has a greater impact on the elderly than in a younger population. Mortality is greater (despite adjustment for a wide range of variables), and a multitude of complications are more likely to result in greater morbidity and a consequent decline in the quality of life. The impact of cardiovascular disease is compounded by reduced homeostatic reserves, increased co-morbidity, the frequent need for polypharmacy, and complex societal issues such as social deprivation, and devaluation of the aged. Despite the worse prognosis, the benefits of treatment are often enhanced in an elderly population. For many elderly patients, heart disease has been their first serious medical problem. Yet there is an attitude to link the elderly patient to disability, a deteriorating quality of life and consider them to be less deserving of aggressive medical treatment. The impact of an aging society on patient care resources is illustrated in Chapter 2.

Aging and the Cardiovascular System

Normal age related changes in the cardiovascular system are distinguished from age related pathology (eg atherosclerosis) that theoretically should be preventable. Age related changes in the heart result in a progressive loss of cardiac myocytes, hypertrophy of the remaining cells, increased accumulation of connective tissue, and in the very old the deposition of amyloid (4). Although systolic function is usually maintained, early diastolic function declines with age(5) resulting in higher left ventricular filling pressures at rest and during exercise, and a greater dependence upon atrial contraction to maintain adequate diastolic filling(6). A profound reduction of cells in the sino-atrial node and increase in fibrosis in the inter-nodal tracts and conduction system is seen with aging even in the absence of ischemic heart disease(7). An attenuated heart rate response to stress, including exercise and fever is observed with aging(8). Increased fibrosis and calcification of the aortic and mitral valves if sufficiently severe may result in valvular obstruction and incompetence. A reduction of the cushioning properties of the arterial system results from increased collagen deposition, and a loss of elastic fibres in both central and peripheral arteries(9). This causes a widening of the arterial pulse pressure, and an increase in systolic arterial pressure.

There is frequently an interaction between age related pathology and normal biological aging processes in the cardiovascular system. Consequently aging modifies the clinical presentation, the response to treatment and outcomes, such that observations from clinical trials in a younger population might not apply in the very old.

Definitions of “Elderly”

The consensus conference needed to define what is meant by an elderly population. That the term can be used in several ways and means different things to different people, is an indication that there is considerable heterogeneity in an older population. Practically, there are two useful ways to characterize elderly people – on the basis of their relative fitness and frailty, and by chronological age(10-13). Assessment of fitness and frailty can be made rapidly using indices such as shown in table 1, and is a practical guide to clinical decision-making in the individual patient. Chronological age, by contrast, is not a useful clinical guide in individual patients, with an unacceptably low sensitivity and specificity. Yet chronological age is a reasonable guide to the proportion of individuals who are relatively fit or frail, and provides information useful for population planning.

Although chronological age is currently the only characterization of outcomes in relationship to aging for epidemiological and clinical trials, there is a serious lack of evidence for the old-old patients above the age of 75 to 80. As the interaction between natural aging and age related disease is greatest in this population it may not be possible to extrapolate the results of clinical trials determined in younger populations. Importantly, this is the group where the benefit of many treatments is least clear. Furthermore the old-old are the group with the greatest increase in utilization and demand for health care resources.

The elderly population is not a homogeneous risk group, with a wide range of frailty and fitness for each chronological age range. The chief drivers of risk in elderly people are the number of co-morbid conditions, the extent of cognitive impairment, the degree of functional disability, and the degree of social support. Relative fitness and frailty is much more valuable than chronological age in determining the risk for adverse outcomes(12;14). Data from the Canadian Study of Health and Aging shows that a brief clinical measure which includes information about exercise, cognition and function in activities of daily living (Table 1) classifies relative fitness and frailty and relates to short and long term outcomes.(15;16). Whilst these principles apply to a general elderly population, there is no data currently available to show how they relate specifically to elderly cardiovascular patients. Furthermore there are no studies or guidelines which include an assessment of frailty and fitness in decision making algorithms for any cardiological management. Yet there is need to make decisions which take into account relative fitness and frailty, and until better data becomes available, the use of a fitness / frailty scale such as in Table 1 may be a less arbitrary way than clinical judgment alone.

The consensus conference documents have examined the available evidence for older populations (> 65 years old) in both epidemiological studies and clinical trials. Where possible, data has been separated to examine outcomes in younger (65-75 years) and older (> 75-80 years) populations. Although such sub-group analyses are clearly not conclusive, in the absence of studies directly examining the elderly, they are the only available evidence today.

Treatment Goals in Elderly Patients

Treatment goals in elderly patients may have different priorities compared to those in younger individuals. Improved quality of life clearly must be the first priority, with enhanced survival a secondary goal whenever possible. Many therapeutic strategies today aim to improve survival but have little effect on the quality of life. Examples include HMG co-reductase inhibitors (statins) for hypercholesterolemia, clopidogrel / ASA following an acute coronary syndrome, implantable automatic defibrillators for ventricular dysfunction, and coronary bypass surgery for three vessel coronary disease and left ventricular dysfunction (in the absence of limiting angina). Other treatments are principally aimed at improving survival, but also may improve quality of life if they prevent progression of the disease process eg: thrombolysis for acute ST segment elevation myocardial infarction, and angiotensin converting enzyme inhibitors for heart failure. Selection of treatment strategies in the elderly patient should take into account their impact on quality of life. Many treatments used to improve survival may have a greater potential adverse impact on the quality of life in the elderly patient compared to younger individuals, due to differences in drug metabolism and adverse events, drug interactions, wound healing, poor tolerance of surgical procedures, and impaired cognitive and psycho-social interactions.

For many old people there are worse outcomes than dying. Stroke dementia and the loss of independent living are justifiably feared. Unfortunately the anti-thrombotic, thrombolytic treatments as well as cardiac surgery, are associated with an increase in neurological complications with advancing age. Informed consent for treatments in the elderly person should include realistic estimates for the risk of non fatal complications especially stroke and important cognitive dysfunction.

Although most elderly patients are candidates for therapeutic strategies that can improve survival, it would be useful to assess the potential gain in life expectancy achievable. Currently there are few guidelines available to estimate the benefit in months or years of quality life saved by a treatment strategy in the individual patient. Boersma et al devised a simple tool to estimate the gain in life expectancy from thrombolysis(17). The model used patient age, time of treatment, estimated infarct size, history of prior infarction, and intra-cranial bleed risk to calculate the increase in life expectancy from thrombolysis. Although there are clear limitations from such analysis it does show that there is a very wide range of benefit from thrombolysis varying from increased 2 years survival in a 55 year old patient with an extensive infarction treated within three hours of symptom onset to no increase in life expectancy in the 75 year old patient with no high risk feature, other than age, (no prior infarction, anterior infarction, inferior infarction with RV involvement, heart failure and bundle branch block), presenting at 6-12 hours after symptom onset. Although similar tools could be developed for other treatments, it would be also be useful to incorporate frailty indices into the decision model.

Consensus Conference Goals

The Canadian Cardiovascular Consensus Conference for 2002 has brought together a wide range of experts to examine issues of the elderly patient with heart disease which impact both on the individual and on society. It is recognized that heart disease in the elderly is of immense concern to health care providers and payers. The growth of the elderly population, the high prevalence of heart disease, the limited evidence for treatment benefit, the disproportionate use of resources and the increasing cost of treatment heightens the need for an assessment of heart disease in the elderly population.

The Consensus Conference aims to examine the magnitude of the problem of heart disease in an elderly population today and make projections for the future. The choice of topics, selected by the conference chairman and discussed by the primary panel, aims to target issues that are more likely encountered in an older patient group. It is not an all-inclusive discussion of cardiology. Consequently there are subjects, which have few specific problems in an elderly population or are sufficiently uncommon as not to require inclusion. Hypertension, although a major cardiovascular disease in the elderly, was not included as a specific topic in this conference, as the Canadian Hypertension Society have recently addressed the issues of hypertension and the older patient (ref).

The subject matter and the recommendations of the consensus conference are directed towards a wide range of health professionals including physicians (including cardiologists, internists, geriatricians and family practitioners), nurses, and allied health workers (eg physiotherapists, pharmacists, dieticians, occupational therapists, and social workers). Consequently the primary and secondary includes cardiologists, geriatricians, family practitioners, epidemiologists, and pharmacists.

The recommendations of the consensus conference will be available as an executive summary, which will assist in the dissemination of the recommendations. Other tools which will be developed to facilitate implementation of the recommendations include: Consensus Conference slide show, Guideline Review and implementation courses, a Continuing Professional Development (CPD) Consensus Conference Web site, Patient education information, drug interaction check lists and links to other relevant web sites.

Levels of Recommendation and Evidence

The grading for levels of recommendation and evidence are those used by the American Heart Association and American College of Cardiology (Table 2).

Limitations of Consensus Recommendations

Support for the recommendations is frequently limited by a lack of clinical trials to provide direct evidence. Trials often include patients in their mid 60's in good health. Clinical trials rarely include the old-old >75-80 years old, who have more frailty, limited mobility, increased co-morbidity and are at risk from drug interactions consequent to the poly-pharmacy required to manage their multiple medical problems. Not only might the efficacy of treatment differ in the elderly, but also serious complications such as hypotension and hemorrhage are more likely. Unfortunately clinical trials are usually funded by the pharmaceutical industry that might have disincentives to study populations with high mortalities and adverse outcomes, as these complicate and increase the expense of the study. Consequently it is unlikely that trials will be specifically directed at the elderly population. Hopefully future clinical trials in the management of heart disease will include the old-old as well as younger populations.

Table 1: Clinical Assessment of Fitness and Frailty

<u>Grade</u>	<u>Description</u>	<u>Characteristics</u>
1.	Most fit	Moderate-high exercise
2.	Fit	Low level exercise
3.	Sedentary well	Includes treated co-morbid disease
4.	Isolated incontinence	Chiefly isolated urinary incontinence
5.	Mildly frail	Minimal cognitive impairment or impairment in complex care.
6.	Moderately frail	Intermediate self-care dependence or mild dementia
7.	Severely frail	Dependence in personal care More than mild dementia

Table 2: Levels of Recommendation of the Guidelines (ACC/AHA Format)

Class 1: Conditions for which there is evidence and / or general agreement that a given procedure / therapy is useful and effective

Class II: Conditions for which there is conflicting evidence and / or a divergence of opinion about the usefulness / efficacy of performing the procedure / therapy.

Class IIa: Weight of evidence/opinion is in favour of usefulness/efficacy.

Class IIb: Usefulness/efficacy is less well established by evidence/opinion.

Class III Conditions for which there is evidence and/or general agreement that a procedure/therapy is not useful/effective and in some cases may be harmful.

These recommendations are based upon the following levels of evidence:

Level A: The data were derived from multiple randomized clinical trials.

Level B The data were derived from single randomized or non randomized studies.

Level C: When the consensus opinion of experts was the primary source of recommendation.

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Canadian Cardiovascular Society Consensus Conference 2002

Management of Heart Disease in the Elderly Patient

Executive Summary

Chair: David Fitchett

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Secondary Panel: Arun Chockalingam, Gilles Dagenais, William Dalziel, George Fodor, Shaun Goodman, Charles Kerr, Barbara Power, Kevin Murphy and George Heckman

Introduction

David Fitchett and Kenneth Rockwood

Cardiovascular disease is a common, disabling and frequently fatal condition in the elderly. The most frequent cardiac disorders (ischemic heart disease, congestive heart failure and atrial fibrillation) are widespread in the increasing elderly population. Furthermore modern healthcare has delayed the onset of many cardiac conditions. Consequently as the population ages, the prevalence of heart disease is set to increase at epidemic proportions.

Co-morbidity and frailty increase with age and are largely responsible for the worse prognosis and increased mortality and morbidity of both cardiac illness and procedures in the elderly patient. However despite a worse prognosis, the benefits of treatment are often enhanced in the older population. The 2002 Canadian Cardiovascular Society Consensus Conference “Heart Disease and the Elderly” provides recommendations for the management of the most frequent cardiac problems encountered in an elderly patient. It stresses the importance of assessing frailty, co-morbidity, and quality of life as part of the clinical process to select the optimal management of the elderly patient. A major goal of this consensus conference is to identify treatments that are not optimally utilized in older patients. This is often due to a misconception that risks of treatment exceed the benefits. Alternatively there is a perception that the elderly patient has a short natural life expectancy, thus making the treatment less worthwhile.

The Consensus Conference primary panel has written documents to provide evidence and/or opinion to support recommendations for management of the most important cardiac disorders observed in elderly patients. The recommendations are assessed classes of support and levels of evidence according to the classification of the American College of Cardiology and American Heart Association.

Class I: Conditions for which there is evidence and / or general agreement that a given procedure / therapy is useful and effective

Class II: Conditions for which there is conflicting evidence and / or a divergence of opinion about the usefulness / efficacy of performing the procedure / therapy.

Class IIa: Weight of evidence/opinion is in favour of usefulness/efficacy.

Class IIb: Usefulness/efficacy is less well established by evidence/opinion.

Class III: Conditions for which there is evidence and/or general agreement that a procedure/therapy is not useful/effective and in some cases may be harmful.

These recommendations are based upon the following levels of evidence:

Level A: The data were derived from multiple randomized clinical trials.

Level B: The data were derived from single randomized or non-randomized studies.

Level C: When the consensus opinion of experts was the primary source of recommendation.

Anticipating the Need for and Utilization of Cardiovascular Medical Services in an Elderly Population

*Benjamin TB Chan, MD MPH MPA^{1,2,3,4,5}
Susan Schultz, MSc¹*

- The aging of the population will increase the potential need for cardiovascular services in the future.
- The effect of reductions in smoking have been partially offset by increased diabetes and obesity, which in turn may reflect inadequate exercise and poor diet. Nonetheless, the declining incidence of acute MI suggests that the overall risk factor profile has been improving for patients.
- A declining mortality rate from AMI may lead to an increased prevalence of disease, and may result in increased need for services related to chronic disease management.
- The growth in the use of cardiovascular health services has been rapid over the past decade, and growth rates have been particularly high among the elderly.
- The apparent increased indications for use of these services has been a far greater driver of utilization than potential changes in the prevalence of disease or aging of the population.
- The fact that rapid growth in use of these services *preceded* the publication of evidence confirming their effectiveness in the elderly raises concerns about how clinical evidence is incorporated into practice patterns. Given this history of rapid utilization growth in the absence of evidence, further scrutiny of the appropriateness of services provided may be warranted.
- The use of cardiovascular services is more heavily concentrated in the elderly compared to other health services, and the aging of the population may drive the use of these cardiovascular services upwards more rapidly than other health services.
- There is significant room to improve the primary and secondary prevention of heart disease, given rising obesity and diabetes, high physical inactivity, persistent (although declining) rates of smoking, rates of under-treatment of hypertension and variations in the use of statins and beta-blockers in post-AMI patients.

Table: Trends Affecting the Need for and Utilization of Health Services

Trends which may reduce need for and utilization of health services:

- * The prevalence of smoking is declining over time
- * The overall incidence of acute myocardial infarction is declining, probably because of better risk factor management and primary prevention
- * Need and utilization could be reduced with improved preventive measures (e.g. better adherence by physicians to guidelines on use of lipid-lowering agents)

Trends which may increase the need for and utilization of health services:

- * the incidence of ischemic heart disease is rising among the native population
- * the population is aging, and the prevalence and incidence of cardiovascular disease rises with age
- * the mortality rate from acute myocardial infarction is declining, which may increase number of AMI survivors and increase the prevalence of heart disease, particularly among the elderly
- * the prevalence of obesity and diabetes among Canadians is rising
- * the new, broader definition of AMI may have either no effect or may result in an increased need for services
- * the indications for a variety of cardiovascular appear to be broadening, particularly among the elderly

Acute Coronary Syndromes and the Elderly

David Fitchett and Peter Bogaty

Acute coronary syndromes (myocardial infarction and unstable angina) have an increasing prevalence in the older population. Furthermore, age is an independent predictor of mortality and re-infarction after an acute coronary event. The increased fatality and complications of acute coronary syndromes are largely due to greater co-morbidity, more advanced coronary artery disease and age related physiological changes in the coronary arteries and the myocardium.

ST segment Elevation Acute Coronary Syndromes

Recommendations:

- Thrombolytic therapy, promptly administered, is indicated in elderly patients who present within 12 hours of compatible symptoms and who have ST-segment elevation or left bundle branch block and do not have contraindications to thrombolysis. (Class I, C)
- Elderly patients at high risk of ICH (women, low body weight, hypertensive) should be considered for primary angioplasty when available in a timely fashion (< 90 minutes). (Class I, B). When primary angioplasty is not available for these patients, the risk / benefit of thrombolysis must be considered prior to treatment.
- No firm recommendation can be made as to the choice of thrombolytic agent in the elderly. However tPA or derivative (TNK-tPA or rPA) should be considered in patients with infarctions which appear to be large. (Class 2b B).
- A low dose heparin protocol (target PTT 40-50 seconds) following thrombolysis with r-tPA or derivative is preferable to minimize the risk of hemorrhage. (Class 2a, B)
- Until large randomized clinical trials are completed, which examine both safety and efficacy, the combination of low molecular weight heparin with thrombolysis should be avoided in an elderly population. (Class 3,B)
- The combination of half dose thrombolytic and abciximab should be avoided in the elderly (>70 years). (Class III, A)
- Primary angioplasty for acute ST segment elevation AMI is an acceptable alternative to thrombolysis in the elderly patient if it can be performed by experienced operators within 60-90 minutes of presentation. (Class I C)
- Primary angioplasty should be strongly considered when thrombolysis is contraindicated, when there is a high bleeding risk (e.g. small elderly hypertensive female), in the presence of shock or hemodynamic instability. (Class 1 C)

Non ST segment elevation ACS

- ASA is recommended for all elderly patients with acute coronary syndromes in the absence of contra-indications from bleeding or hypersensitivity. (Class 1 C)
- A heparin should be given to elderly patients with intermediate or high risk features. (Class 1, C)
- Enoxaparin can be used with an enhanced benefit compared to unfractionated heparin in older patients in the absence of renal insufficiency. (Class 2a, B)
- Clopidogrel should be considered for the treatment of older patients with high risk acute coronary syndromes. (Class 1, B)
- Glycoprotein IIb/IIIa inhibitors (tirofiban or eptifibatide) should be considered for elderly patients with very high risk features in whom an early cardiac catheterization is considered indicated at the time of admission. (Class 1, B)
- Early cardiac catheterization should be considered for elderly patients with very high risk features, or with high risk features, provided that co morbidity does not preclude revascularisation by either PCI or bypass surgery. (Class 1, B)

Long-term Treatment following ACS

Recommendations:

- Whether to use long term medications to improve survival and prevent recurrent ACS in the elderly should take into account competing risks from co-morbidity.
- ASA should be prescribed for an indefinite period for all elderly patients with coronary heart disease with or without a recent acute coronary syndrome, unless contra-indicated. (Class 1 B)
- Lipid lowering treatment, especially with a statin should be considered in most elderly patients after an ACS (Class 2a B)
- Beta adrenergic blockers should be prescribed to most elderly patients after both NSTEMI and STEMI myocardial infarction. The treatment period should be a minimum of 2 years. (Class 1 B)

Arrhythmias and the Elderly

Anne Gillis

Atrial Fibrillation

Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia and increases in prevalence with age. The prevalence of AF is approximately 2-3% in those > 65 years of age and 6-8% in those over 80 years of age. Management approaches consist of therapies to control the ventricular rate or therapies to restore and maintain sinus rhythm. Randomized trials have not demonstrated a superiority of Rhythm Control versus Rate Control in elderly patients with AF. The most devastating consequence of AF is stroke. Antithrombotic therapy should be initiated to prevent thromboembolism. Warfarin should be prescribed in patients at high risk of systemic thromboembolism. The INR should be maintained between 2-3 IU.

Recommendations:

- In the elderly, rate or rhythm control may be considered as the initial therapy for patients with AF at high risk for stroke (Class 1, Level of Evidence A).
- All elderly patients with AF should receive oral anticoagulant therapy to prevent thromboembolism unless contraindicated (Class 1, Level of Evidence A).
- In elderly patients at high risk of stroke, oral anticoagulation should be dose adjusted to maintain an INR between 2 and 3. The INR should be monitored at least weekly during initiation of oral anticoagulation and at least monthly when the INR is stable (Class 1, Level of Evidence A).

Symptomatic Bradycardia

Symptomatic bradycardia secondary to sinus node dysfunction or AV block is common in the elderly. Cardiac pacing alleviates symptoms and prevents syncope/falls. Physiologic pacing (atrial or dual chamber) has not been shown to reduce cardiac mortality or stroke but is associated with a significant reduction in AF. Pacemaker dependent patients are most likely to benefit from physiologic pacing.

Recommendations:

- Physiologic pacing and single chamber ventricular pacing result in equivalent rates of survival and stroke in the elderly. Physiologic pacing may be considered in the elderly patient with a predicted life expectancy of at least 3 years for the prevention of AF (Class 1, Level of Evidence A).
- Physiologic pacing could be considered in the elderly patient who is likely to be pacemaker dependent (Class II, Level of Evidence B).

Ventricular Tachyarrhythmias

Sustained ventricular tachycardia (VT) and ventricular fibrillation (VF) are the major causes of sudden cardiac death. These arrhythmias occur predominantly in the setting of left ventricular dysfunction. The average age of an ICD recipient is 65 years. Randomized clinical trials have demonstrated the superiority of the ICD over antiarrhythmic drug therapy for prevention of cardiac mortality in patients with symptomatic sustained VT/VF in the setting of left ventricular dysfunction. Clinical trials have also recently confirmed that the ICD reduces mortality compared to medical therapy in patients at risk for VT/VF. Subgroups most likely to benefit from ICD therapy are under evaluation.

Recommendations:

- Elderly patients surviving cardiac arrest or hemodynamically significant VT (not within three days of acute MI and not associated with a reversible/correctable cause) should be considered for an ICD (Class 1, Level of Evidence A).
- Elderly patients with minimally symptomatic VT and LVEF < 35% should be considered for an ICD (Class 1, Level of Evidence A).
- Elderly patients with minimally symptomatic VT and LVEF greater than 35% should receive either pharmacological therapy or an ICD (Class 1, Level of Evidence C).
- Elderly patients with a left ventricular ejection fraction < 0.30 in the setting of coronary artery disease and a life expectancy of ≥ 2 years could be considered for an ICD for the prevention of sudden death (Class II, Level of Evidence B).

Syncope/Falls

Syncope and or unexplained falls occur frequently in the elderly. In addition to brady or tachyarrhythmias, these events may be due to postural hypotension, neurocardiogenic mechanisms or carotid sinus hypersensitivity.

Recommendations:

- Elderly patients with recurrent unexplained syncope or recurrent unexplained falls should be referred to an internist, specialist in geriatric medicine or cardiologist for an expert opinion on management (Class 1, Level of Evidence C).
- Patients with recurrent syncope documented to be secondary to carotid sinus hypersensitivity (with a pause > 3s on carotid sinus massage) should receive a dual chamber pacemaker (Class I, Level of Evidence B).
- Patients with syncope in the setting of bifascicular block should be considered for a pacemaker (Class II, Level B).

Congestive Heart Failure and the Older Patient

Malcolm Arnold and Fraser Miller

Recommendations:

- Hospitals and health regions should be strongly encouraged to support the development of specialized heart failure programs, components of which may include in-patient consultation, out-patient clinics and outreach programs. (Class I, Level A)
- Educational efforts and interventions are recommended for family physicians to improve the early recognition, detection and diagnosis of heart failure amongst people at increased risk and who present with atypical symptoms. (Class I, Level C)
- Initial physical evaluation of each patient requires a detailed medical and social history and careful examination of both non-cardiovascular and cardiovascular signs including supine and erect blood pressure, mobility and exercise tolerance. Initial and ongoing screening for affect, function and cognition is required. In patients with cognitive impairment, education on the management of CHF should be directed at a cognitively intact caregiver. Particular attention must be paid to avoid inappropriate polypharmacy, potential drug interactions and inadvertent aggravation of co-morbid conditions. (Class I, Level C)
- Investigations should include an ECG, chest X-ray, Echo or other non-invasive assessment of heart size and function, CBC, electrolytes, renal function and others as indicated by history and physical examination. (Class I, Level C)
- Although the elderly have not been the primary focus of most heart failure clinical trials, sub-group analyses suggest that the results of such trials are applicable and current national heart failure guidelines should be applied. (Class I, Level A)
- ACE inhibitors, unless contraindicated by angioedema or bilateral renal artery stenosis, are recommended in all patients with heart failure, but can lower blood pressure and should be introduced in very low doses to avoid postural hypotension. The dose should be subsequently increased as tolerated to “clinical trial” doses. (Class I, Level A)
- Angiotensin receptor blockers are recommended in elderly patients with heart failure who are unable to tolerate angiotensin converting inhibitors because of cough or other side effects. Similar precautions should be applied with regard to renal function and angioedema. (Class I, Level A)
- Beta-blockers, unless otherwise contraindicated, are recommended in all patients with symptomatic heart failure, but should be used with greater caution in patients with a past history of syncope or suspected to be at an increased risk of sick sinus syndrome. (Class I, Level A)
- Spironolactone is recommended in all patients with severe heart failure without significant renal dysfunction as measured by creatinine clearance, but renal function and serum potassium require close monitoring. (Class I, Level A) Other diuretics are indicated in the lowest doses required to maintain stable weight and symptoms in all heart failure patients who have current or previous fluid retention. (Class I, Level B)

- Digoxin is recommended in patients who remain symptomatic in spite of optimized medical therapy including ACE-inhibitors (ARB if appropriate), beta blockade, and adequate diuresis. (Class 1, Level A) Caution must be exercised in the elderly who are at greater risk for digoxin toxicity and its complications, and normal serum digoxin levels should not be relied upon to rule out digoxin toxicity
- Patients' wishes for quality of living and end of life issues should be established and periodically reviewed as appropriate. (Class 1, Level C)
- It is strongly recommended that the appropriate changes in the health care system be implemented to improve appropriate home based care for elderly heart failure patients. (Class 1, Level C)
- Research is required to determine whether standard therapies for CHF can maintain functional capacity and cognition in older patients with CHF, as well as prevent institutionalization, hospitalization and reduce mortality (Class 1, Level C).

Percutaneous Coronary Interventions and Cardiac Surgery in the Elderly

Michelle M. Graham, William A. Ghali, and Raymond Cartier

An increasing number of elderly patients are being referred for revascularization procedures (CABG or PCI). Elderly patients undergoing CABG have more severe coronary disease, higher surgical urgency, and increased rates of peri-operative mortality and complications compared to younger patients. Similar observations have been made with respect to PCI. However, despite these negative outcomes, it has been observed that elderly patients undergoing revascularization experience significant improvements in quality of life, often greater than that seen with younger patients.

There is now more recent evidence that revascularization outcomes in elderly patients have significantly improved over time. Revascularisation by either PCI or CABG in the elderly results in significantly greater symptom relief, better quality of life and perhaps improved life expectancy in comparison to those treated with optimized medical therapy.

There are many issues complicating the use of invasive procedures in elderly patients with ischemic heart disease. The question of which elderly patient should undergo coronary angiography in the first place is difficult. Frailty and fitness must be assessed on an individual basis, and the risks and benefits of the procedure must be reviewed with the patient prior to proceeding. Once a decision is made to proceed with invasive assessment, the revascularization procedure of choice then becomes an issue. Direct comparison of PCI versus CABG suggests that long-term survival is comparable in certain anatomical subgroups of patients, albeit with increased repeat revascularization in the PCI patients. Many patients may not be ideal candidates for CABG on the basis of preference or frailty, but may tolerate attempted PCI, in many instances with good effect. Finally, regardless of the choice of revascularization modality, *optimized* medical therapy should be a priority in all patients.

Conclusions:

- Elderly patients have higher risks of morbidity and mortality early following revascularization procedures.
- Elderly patients who are revascularized have significantly improved quality of life following these procedures relative to patients who are not revascularized.
- Outcomes following revascularization procedures in elderly patients are improving over time.
- PCI is an acceptable, and sometimes preferred alternative to CABG in many elderly patients with ischemia.
- The use of revascularization procedures does not obviate the need to provide optimized medical therapy with attention to secondary prevention and vascular protection.

Recommendation:

The combination of recently published randomized trial data and observational data should be sufficiently compelling evidence to support a shift towards an aggressive treatment strategy in appropriate subsets of elderly patients. Age alone should not be viewed as a contraindication to these procedures (Class I, Level B).

Valvular Heart Disease in an Elderly Population

Chi-Ming Chow and Raymond Cartier

Recommendations:

- Symptoms, clinical presentation and physical signs of valvular heart disease in the elderly may differ from younger patients. Echocardiography should be performed in elderly patients suspected of having symptoms due to valvular heart disease to confirm the diagnosis and assess severity of the valve abnormalities. (Class 1 Level C)
- The operative risk of valvular surgery in the elderly is greater than in younger patients. Assessment of comorbid conditions and frailty are essential in determining the operative risk. (Class 1, level C)
- The choice of mechanical or bioprosthesis in the elderly should be individualized. The decision should depend upon patient preferences, risk of long-term anticoagulation, and predicted life expectancy. (Class 1, level C)
- Age alone should not be a deterrent to aortic valve replacement (AVR) in the elderly patient with symptoms attributable to aortic stenosis. (Class 1, level B)
- Symptomatic elderly patients with mitral regurgitation should be considered for mitral valve surgery. Mitral valve repair is preferred over replacement whenever possible. (Class 1 level B)
- Endocarditis in the elderly may present with nonspecific symptoms without fever. In an elderly patient presenting with new onset congestive heart failure, constitutional, or neurological symptoms, endocarditis should be considered as a possible diagnosis. (Class 1 level C)

Recommendations to Improve Benefit and Reduce Risk of Cardiovascular Drug Therapy Use by the Older Adult

Ruby Grymonpre, Richard Ogilvie and Paula Rochon

Risks for Adverse Drug Events in Older Patients:

Adverse Drug Events (ADEs) contribute to approximately 10% of hospitalizations in older adults and have been reported to prolong hospital stay and contribute to mortality. Compared with other drug categories, ADEs to cardiovascular drugs make up the largest number of events in older persons. It is likely that chronologic age is a weak independent predictor of risk for ADEs. Rather, factors commonly associated with aging including: *frailty, institutionalization, hepatic or renal disease, multiple diseases requiring multiple drugs, and multiple physicians*, correlate more strongly with ADE risk.

Recommendations:

- Due to an increased incidence of adverse events in older adults compared to younger individuals, cardiovascular therapy requires more frequent monitoring:
 - during warfarin therapy, target the lowest possible effective INR and regularly monitor INR and evidence of bleeding . (Class I Level B)
 - monitor renal function and electrolyte status before and during diuretic or angiotensin converting enzyme inhibitor (ACEI) therapy. (Class I Level B)
 - monitor for orthostatic hypotension in older patients taking most cardiovascular drugs (beta blockers, calcium channel blockers, ACEIs, diuretics, nitrates and other antihypertensive drugs) especially in combination with antidepressants, antipsychotics, and antiparkinsonian agents, by measuring lying and standing (or, if not tolerated, sitting) blood pressure, and questioning the patient. (Class I Level B)
 - monitor heart rate and worsening CHF with beta blockers, diltiazem, and verapamil. (Class I Level B)
- If an adverse event occurs with cardiovascular therapy of proven benefit at recognized target doses (e.g. beta-blockers, ACEIs), it is usually better to reduce the dose of the drug than to discontinue therapy. (Class I Level C)
- Evaluate the need for chronic NSAID, including cyclo-oxygenase 2 inhibitors (COX2 inhibitors) therapy, which can increase bleeding risk with warfarin, nephropathy with ACEIs and diuretics, hyperkalemia with ACEIs, and aggravate hypertension and congestive heart failure. (Class I Level B)
- Recognize the potential for drug-drug interactions involving warfarin (Tables 1,3 and 4):
 - Drugs which potentiate warfarin effects include several antibiotics (cotrimoxazole, erythromycin, isoniazid, fluconazole, miconazole, metronidazole, ciprofloxacin), amiodarone, and anti-inflammatory or analgesic drugs such as NSAIDs, including COX2 inhibitors, and acetaminophen (Class I Level B)
 - Drugs which inhibit warfarin effects include nafcillin, rifampin, cholestyramine, and carbamazepine. (Class I Level B)
 - Recognize the potential for drug-drug interactions particularly involving the cardiovascular drugs amiodarone, quinidine, digoxin, verapamil and lipid lowering drugs. (Class IIa Level B)

- Physicians and patients should be aware of possible health hazards and drug interactions when cardiovascular drugs are taken in combination with grapefruit juice, OTC medications or herbal preparations. (Tables 2-4) (Class IIa Level B)
- Patients on warfarin, digoxin or some lipid lowering drugs (simvastatin, likely atorvastatin, fluvastatin, lovastatin but not pravastatin) should not use herbal preparations including St. John's Wort. (Table 4) (Class IIb Level B)
- Be aware that diuretics, calcium channel blockers, beta blockers, disopyramide, or alpha blockers may aggravate certain types of urinary incontinence. (Class IIb Level C)
- Avoid hydrochlorothiazide in doses of more than 25 mg per day, reserpine (all use), methyldopa (all use), and propranolol (all use, except if indicated to control violent behavior). (Class III Level C)

Pharmacokinetic and Pharmacodynamic Changes in the Elderly

Aging significantly alters drug pharmacokinetics and pharmaco-dynamics:

Recommendation:

- In older individuals, most cardiovascular drugs require lower starting doses and slower upward titration either: (1) to the lowest effective dose to achieve the desired therapeutic effect or (2) for drugs where a target dose has been identified, to the recommended (or highest tolerated) dose. (Class I Level B)

Under-use of Beneficial Cardiovascular Therapy

Recommendation:

- Consider the patient rather than age alone; therapies may provide greater absolute benefit to older persons. Avoid under use and under dosing of beneficial cardiovascular therapy such as beta-adrenergic therapy post myocardial infarction or warfarin for stroke prevention with atrial fibrillation. (Class IIb Level B)

Stopping Cardiovascular Drug Therapy

Recommendation:

- Consider stopping cardiovascular drug therapy in older individuals when diagnosis is not confirmed and indication for therapy is uncertain. Digoxin and diuretics must be withdrawn with care, monitoring weight and signs and symptoms of heart failure on a daily basis. (Class IIa Level B)

General Prescribing Advice for the Physician

Quality prescribing, as outlined below, will help to ensure appropriate medication use in older adults.

Recommendation:

- Improve the Quality of Prescribing (Class I Level C)
 - Document the indication for a new drug therapy
 - Educate patients on the benefits and risks associated with the use of a new therapy
 - Maintain current medication lists in patient medical records
 - Document the response to therapy

Periodically review the need for a drug therapy

Strategies to Improve Adherence to Therapeutic Interventions

Medication nonadherence in older adults is costly and prevalent. More than 30% of hospitalizations due to congestive heart failure are related to medication and dietary nonadherence.

Recommendation:

- Use multiple strategies to improve adherence to drug therapy (Table 6) (Class IIa Level B)

Prevention of Cardiovascular Events in an Older Population

Joel Niznick and Steven Grover

Advancing age is one of the strongest risk factors for cardiovascular events in our population. Elderly patients with established vascular disease or longstanding type II diabetes are likely to derive the greatest benefit from interventions that aim to reduce the global cardiovascular risk. However many risk factors associated with cardiovascular disease decline in importance with advancing age. Until recently, clinical trials have not addressed risk factor control in the elderly either with or without established vascular disease. Evidence is now increasing to indicate that global vascular risk reduction is beneficial in the older population.

Recommendations:

Diet and obesity reduction:

- A reasonable diet is low in saturated fats and refined carbohydrates (e.g. refined grains, sugar and potatoes) supplemented by poly-unsaturated fats, fruits and vegetables (**Class II Level C**)
- Simple dietary instruction sheets should be made available for dissemination by physicians to patients (**Class II Level C**)
- Weight reduction should be encouraged for overweight patients of all ages

Exercise:

- Physical activity enhances well-being and is recommended both for primary and secondary prevention of cardiovascular disease. (See section 8 “Cardiac Rehabilitation and Secondary Prevention”)

Smoking cessation:

- Smoking cessation is to be encouraged in elderly patients with or without vascular disease. (**Class I Level A**)
- Both nicotine replacement therapy and other pharmacological agents are safe in elderly patients with cardiovascular disease. (**Class II Level C**)

Hypertension management:

Recommendations of the Canadian Hypertension Society for the management of hypertension in the elderly include:

- Anti-hypertensive therapy should be strongly considered if diastolic blood pressure readings average 90 mmHg or more in the presence of hypertensive target organ damage or other independent cardiovascular risk factors. (**Class I Level A**)
- Anti-hypertensive therapy should be prescribed for average diastolic blood pressures of 100 mmHg or more (grade A) or average systolic blood pressures of 160 mmHg or more (grade A) in patients without hypertensive target organ damage or other cardiovascular risk factors. (**Class I Level A**)
- Initial treatment of isolated systolic hypertension in the elderly should be with a thiazide diuretic at a low-dose (**Class I Level A**) or a long-acting di-hydropyridine calcium channel blocker (**Class I Level A**).

- Beta adrenergic blocking drugs should not be used as first line treatment for hypertension in the elderly due to their lack of any vascular protection **Level III Grade A**
- Blood pressure treatment targets in the elderly are < 140/90 for systolic + diastolic hypertension and < 140 mmHg for isolated systolic hypertension. **(Class I Level A)**

Hyperlipidemia:

- Treatment algorithms and targets for lipid management of elderly patients should be based on recommendations of the Working Group on Hypercholesterolemia and other Dyslipidemias.
- Intensive LDL lowering therapy is recommended for the elderly patient up to age 85 in the presence of cardiovascular, cerebrovascular or peripheral vascular disease or type II diabetes. **(Level I, Grade A)**
- Therapy with lipid lowering agent that has been shown to be safe and effective in the elderly population in large-scale clinical trials is recommended **(Level II, Grade A)**

Aside from dietary, lifestyle, exercise smoking cessation and other hygienic measures, specific pharmacological lipid lowering therapy is not recommended for the elderly patient in the absence of clinical cardiovascular, cerebrovascular, peripheral vascular disease, type II diabetes or multiple risk factors. **(Level II, Grade C)**

Prevention of Vascular Complications in Diabetes:

- Hypertension should be controlled aggressively to appropriate targets **(Level I, Grade A)**
- Aggressive LDL control is indicated to reduce cardiovascular and cerebrovascular outcomes **(Level I, Grade A)**
- Tight glucose control must be weighed against risks of hypoglycemia in elderly patient **(Level II, Grade C)**

Prevention of diabetes:

- Lifestyle measures such as weight reduction / control and exercise should be encouraged in all age groups.
- Blockade of the renin-angiotensin system in patients with cardiovascular disease or high risk hypertensive patients may reduce the incidence of diabetes **(Level II, Grade A)**

Stroke prevention:

- Stroke is important as a principle determinant of frailty. Measures to reduce CHD risk have the ancillary benefit of preventing stroke and dementia. These measures include aspirin (or clopidogrel), coumadin in atrial fibrillation, blood pressure control, lipid lowering and ACE inhibition in high-risk populations.

HRT:

- HRT is not recommended in any formulation for the sole purpose of preventing ischemic heart disease (IHD) in healthy women or women with multiple risk factors for IHD **(Level III, Grade A)**
- The initiation of conjugated estrogen with or without MPA in women with established IHD is not recommended for the prevention of future cardiac events or to slow the progression of coronary disease **(Level III, Grade A), Grade A)**

Cardiac Rehabilitation and Secondary Prevention for the Older Patient

Terry Kavanagh, Jean Triscott, William Dafoe, Neil McCartney

The clinical and psychological benefits of cardiac rehabilitation and secondary prevention programs have been well documented in younger patients (<65 years) suffering from coronary artery disease. Although less robust, there is evidence that cardiac rehabilitation is feasible, safe, effective, and particularly relevant to the older patient. This is a population in which coronary heart disease is the major cause of morbidity and mortality, and in which anxiety/depression, poor functional status, physical co-morbidity, and social isolation are all prevalent. For these individuals, cardiac rehabilitation offers an improvement in submaximal and maximal exercise capacity, alleviation of symptoms, enhanced mood state and quality of life, and modification of the risk factors for coronary disease.

The components of a comprehensive elderly-specific rehabilitation program are the same as for younger patients, with aerobic exercise training the mainstay, together with reduction of risk factors through education, counselling and behavioural modification.

However, the cardiopulmonary, musculoskeletal and cognitive changes which may accompany the aging process require that the exercise program avoid high-impact, high-intensity activities (walking is ideal), with slower progression, and longer time allowed for warm-up and cool-down. The addition of resistance training to aerobic training is advocated for low-risk patients, the aim being to halt or reverse the age-related loss of bone mineral density and muscle mass, and thus improve balance and ability to carry out tasks requiring significant arm and leg strength with greater ease.

In recent years there is increasing evidence that medically prescribed and supervised aerobic training for patients with non-edematous chronic heart failure can improve symptoms and enhance quality of life. This has particular relevance for the aging population, in whom the prevalence and incidence of CHF has been increasing over the past four decades.

Unfortunately, despite its proven benefit, cardiac rehabilitation in Canada suffers from inadequate funding, lack of consensus on program content and duration, poor regional distribution of services, and limited patient accessibility for young and old patients alike.

Recommendations:

- Physicians should recognize that the older patient may have a high level of physical and psychological disability following a coronary event, as well as greater co-morbidity, and should be considered for rehabilitation services. (1, Level of Evidence B)
- Elderly patients should be strongly encouraged to participate in a rehabilitation program, as the most powerful predictor of adherence to a rehabilitation program is the strength of the referring physician's recommendation. (1, Level of Evidence B)
- A comprehensive cardiac rehabilitation program should be considered for older cardiac patients. Such a program not only improves body dimensions and blood lipids, but also has been shown to improve quality of life, enhance mood state, and alleviate depression. (1, Level of Evidence B)
- Older coronary patients of both sexes should be considered as prime candidates for aerobic exercise training, since this has been shown to result in significant gains in submaximal and maximal effort tolerance, improvement in symptoms, a loss of body fat and an increase in lean body mass, all without increased risk of complications or adverse events (1, Level of Evidence B)

- When prescribing aerobic exercise for older cardiac patients, the initial training intensity should be low and progression gradual, with longer warm-up and cool-down and avoidance of high heat and humidity. Walking is the training mode of choice. (1, Level of Evidence C)
- Resistance training should be considered for low-risk older coronary patients, since it has the potential to reverse the loss of lean tissue associated with aging, increase muscle mass and strength, improve balance, and allow activities of daily living to be carried out with greater ease and safety. (1, Level of Evidence C)
- Low risk older patients with good ventricular function can commence supervised resistance training 4 to 6 weeks after starting aerobic exercise. Sessions should be carried out twice weekly, utilizing light weights (30% to 50% of 1 RM) with one set of 10-15 repetitions for major muscle groups. Blood pressure can be monitored in the non-exercising limb. (1, Level of Evidence C)
- It is recommended that, when dealing with older patients, home-based as well as center-based cardiac rehabilitation programs be considered and that cardiac rehabilitation personnel ensure good communication with the primary physician, cardiologist, and, on occasion, with geriatric services. (1, Level of Evidence C)
- Cardiac Rehabilitation Services are unevenly distributed across the country, vary considerably in the methods by which they are funded, and are virtually non-existent in some provinces. It is recommended that provincial health networks consider their respective cardiac rehabilitation needs, and implement a plan to provide an effective delivery infrastructure, based where possible, on health service funding. (1, Level of Evidence C)
- It is recommended that the effects of exercise training in older patients with chronic heart failure be further evaluated in the older patient. (1, Level of Evidence C)

Elderly Patients With Cardiac Disease: Quality of Life, End of Life, and Ethics

Paddy Rodney and Jonathan Howlett

Quality of Life in Elderly Patients With Cardiac Disease

Recommendations:

- Evaluate the quality of life of elderly patients with cardiac disease by serial measurements with a validated assessment tool. Establish standards in the use of the tool, and be aware that the tool will not provide *all* the information needed to understand the unique situation of every patient. (Class IIa, Level of Evidence B)
- Identify and treat comorbidities such as depression associated with cardiac disease in the elderly. (Class IIa, Level of Evidence B).
- Use qualitative interview techniques in elderly patients to evaluate their quality of life with the intent of identifying associated problems that require assessment and amelioration. These may include problems such as social or physical isolation, financial hardship, and loss of independence. (Class IIb, Level of Evidence C)

End of Life Issues in Elderly Patients With Cardiac Disease

Recommendations:

- Initiate discussions about end of life *early* in the illness trajectory of elderly patients with cardiac disease. (Class IIa, Level of Evidence B)
- Provide patients and their families with information about cardiac disease and its progression (appropriate to their language and reading ability). (Class IIa, Level of Evidence B)
- Lobby for access to palliative and hospice services for elderly patients with cardiac diseases in the final stages of their illness trajectory. (Class IIb, Level of Evidence C)
- Promote research on the issues elderly patients with cardiac diseases and their families face at the end of life. (Class IIb, Level of Evidence C)
- Promote research on interventions that can improve the quality of life for elderly patients with cardiac diseases (and their families) in the final stages of their illness trajectory. (Class IIb, Level of Evidence C)

Ethics and Elderly Patients With Cardiac Disease

Recommendations:

- Assess the patient's physical, psychological, social, cultural, and spiritual status as well as their own assessment of their quality of life and their wishes when making decisions about withholding or withdrawing treatment. The assessment should be done with input from the patient's family and other health care team members. (Class IIa, Level of Evidence B).

- Promote up to date and comprehensive levels of intervention and DNR guidelines in acute care, long term care, and community health care agencies. These policies ought to provide direction for clear documentation of the decisions reached as well as documentation of who participated in the decision making. (Class IIb, Level of Evidence C).
- Integrate palliative care into all levels of intervention, including critical care. Palliative care interventions ought to include comprehensive pain and symptom relief as well as emotional support for patients, families, and health care team members (Class IIa, Level of Evidence B).
- Encourage physicians and other health care team members to become familiar with their own province's or territory's legislation (or lack thereof) on advance directives. Where appropriate, advanced directives (including living wills) should be respected. (Class IIb, Level of Evidence C).
- Discuss advance directives early in the patient's illness trajectory whenever possible, especially prior to considering new interventions (eg. coronary bypass surgery). This discussion should include teaching about the patient's condition as well as teaching about the informational and proxy components of the advance directive (Class IIa, Level of Evidence B).

Ethical Decision Making

Recommendations:

- Promote the education of physicians and other members of the health care team about ethical theory and research on end of life issues, including models of ethical decision making. Such education should occur at entry- and continuing- education levels. (Class IIa, Level of Evidence C).
- Use a formal ethical decision making model in determining action for complex/conflicted situations (Class IIb, Level of Evidence C).
- Seek the assistance of an ethics consultant and/or an ethics committee promptly in situations where complexity and conflict make it difficult to reach a decision (Class IIb, Level of Evidence C).

Quality Care at the End of Life

Recommendations:

- Enhance communication skills to better attend to the needs of elderly cardiac patients and their families. Preparatory and continuing medical education programs in cardiac care ought to include content about communication at the end of life and related self-care requirements. (Class IIa, Level of Evidence B).
- Assess systemic barriers to communication that patients and family members face (eg. geographic isolation, language fluency, critical illness), and develop mechanisms to reduce the impact of these barriers (eg. teleconferencing, translated teaching pamphlets, regular family meetings). (Class IIb, Level of Evidence C).
- Promote multidisciplinary programs of treatment and care for the elderly patients with cardiac disease and their family members, particularly for those with a poor quality of life and/or approaching the end of life. The participation of nurses, social workers, occupational therapists, psychologists, dieticians, pharmacists, home workers and other health care providers can enhance the quality of care. (Class IIb, Level of Evidence C).

Contact Information

David Fitchett
St Michael's Hospital
30 Bond St, Room 7037
Toronto, ON M5B 1W8
Phone: (416) 864 - 5432
Email: fitchettd@smh.toronto.on.ca

Anne M. Gillis
Health Science Centre
3330 Hospital Drive N.W. Room 1634
Calgary, AB T2N 4N1
Phone: (403) 220 - 6841
Email: amgillis@ucalgary.ca

Michelle M. Graham
University of Alberta Hospital
8440-112 Street
Edmonton, Alberta T6G 2R7
Phone: (780) 407-1590
Email: mmgraham@cha.ab.ca

Ruby E. Grymonpre
University of Manitoba
50 Sifton Road
Winnipeg, MB R3T 2N2
Tel: (204) 474 - 6014
Email: grymonpr@ms.umanitoba.ca

Terrence Kavanagh
University of Toronto
5385 Yonge St
Toronto, ON M2N 5R7
Phone: (416) 229 - 6087
Email: terence.kavanagh@utoronto.ca

Ben Chan
ICES
2075 Bayview Avenue, Suite G-106
Toronto, ON, M4N 3M5
Phone: (416) 480 - 4706
Email: ben@ices.on.ca

Malcolm Arnold
London Health Sciences Centre
Room S226A
London, ON N6A 4G5
Phone: (519) 667 - 6650
Email: malcolm.arnold@lhsc.on.ca

Chi-Ming Chow
St. Michael's Hospital
30 Bond St
Toronto, ON M5B 1W8
Tel: (416) 360 - 4000
Email: cmchow@compuserve.com

Joel M Niznick
502-1355 Bank St
Ottawa, ON K1H 8K7
Tel: (613) 738 - 8098
Email: jniznick@magma.ca

Paddy Rodney
University of Victoria School of Nursing Lower
Mainland Campus
c/o Langara College, 5th Floor, Library Building,
100 West 49th Avenue
Vancouver BC V5Y 2Z6
Tel: (604) 323 - 5923
Email: prodney@uvic.ca

Anticipating the Need for and Utilization of Cardiovascular Medical Services in the Elderly

Benjamin TB Chan, MD MPH MPA ^{1,2,3,4,5}

Susan Schultz, MSc¹

1. Institute for Clinical Evaluative Sciences, Toronto
2. Department of Health Administration; University of Toronto
3. Department of Family and Community Medicine; University of Toronto
4. Department of Public Health Sciences, University of Toronto

Correspondence:

Dr. Ben Chan
Institute for Clinical Evaluative Sciences
2075 Bayview Avenue, Suite G-106
Toronto, ON M4N 3M5

E-mail: ben@ices.on.ca

Abstract

This review examines trends in the prevalence and incidence of heart disease, patterns of use of cardiovascular health services among the elderly, and the potential impact of an aging population in Canada on resource use. First, the incidence of acute myocardial infarction (AMI) is declining, which suggests a net improvement in risk factors for heart disease. Declining rates of smoking may account for this finding. Future population trends should be monitored closely, however, given evidence of increasing diabetes, obesity, physical inactivity and poor diet. AMI mortality rates are also declining, but improved survival may increase disease prevalence and service utilization in the elderly. The use of diagnostic tests for heart disease and revascularization procedures has grown rapidly over the past decade, particularly among the elderly. The expanding indications for these services in the elderly have driven utilization growth much more than population aging or possible changes in disease prevalence. Furthermore, use of these cardiovascular services is more heavily concentrated in the elderly compared to other health services, and the aging of the population may drive the use of these cardiovascular services upwards more rapidly than other health services. Further research should document primary prevention programs in Canada and monitor their impact; track changes in disease prevalence; model the relationship between prior risk factors and development of heart disease; profile the services used by heart disease patients; scan technologies currently being developed to consider their potential impact on resource use if accepted; and examine possible over- and under-utilization of health services.

Introduction

Canada's population is aging. Experts disagree on whether or not this aging phenomenon will place a severe burden on the sustainability of Canada's health care system^{1,2,3}. However, it is evident that the elderly use more health care resources than the younger population, their numbers are growing, and responsible stewardship of the health care system requires we anticipate and prepare for these future demands.

Anticipating the future is fraught with enormous uncertainty. Past trends do not reliably repeat themselves in the future. Technological developments may suddenly place new demands on the health care system, or may suddenly eliminate the need for an outdated service. External factors, such as the state of the economy, the environment, or social milieu may strongly influence demands on the system. Despite this uncertainty, it is important for planners to plan for the future. This involves examining trends in needs and utilization, analyzing what resources should be made available given different scenarios of how these trends might progress, and continually revising forecasts as new information becomes available.

This paper presents a conceptual model describing the need, demand and utilization of cardiovascular medical services in the elderly. It examines past trends in these variables, and considers what might happen to future demand if these trends continue. Lastly, it presents a brief scan of the literature on upcoming technologies and discusses how these technologies might influence future need and use of health services.

In addition to the issues of need, demand and utilization, planners must also consider the supply of health care services. The supply depends on the available personnel, the workload they are willing to assume given prevailing wages and working conditions, and technological inputs which may affect their productivity (e.g. available operating room time or diagnostic equipment). Planners are also interested in the model of care (i.e. mix of providers of different disciplines and their mode of interaction) that provides the best outcomes with the fewest resources. These issues are important considerations, but are beyond the scope of this paper.

Methods

This review examines literature selected from MedLine searches on cardiovascular disease and need, demand or utilization growth. Key documents from non-journal sources were reviewed, including publications from the Heart and Stroke Foundation of Canada, Statistics Canada, and Health Canada's Laboratory Centre for Disease Control. Some data analyses are also presented in this paper. The National Population Health Survey was used to expand on other previously published analyses of the prevalence and incidence of cardiovascular disease and its risk factors, and data from the Ontario Health Insurance Plan was used to update previously published analyses on the growth in use of key cardiovascular health services.

Defining Need, Demand and Utilization

Economists and social scientists have long struggled to define a conceptual framework for the demand for health care services. Rather than trying to decide definitively on the best available framework, we present here some basic, simplified concepts and refer the reader elsewhere for a richer discussion.^{4,5,6} The "need" for health care arises when a patient has a medical condition, and medical treatments exist which can improve that patient's health status. Need may also arise if a patient has the potential to acquire a disease, and a preventive health care service clearly reduces or eliminates the likelihood of developing the disease and suffering from lower health status as a result. The "demand" for health care arises when a patient desires a health care service. The "utilization" of health care services reflects the actual amount of services provided.

Figure 1 describes how these factors are inter-related. The main drivers of health care need include the potential for disease (as described above), and the incidence and prevalence of disease.* Incidence refers to a new case of disease (e.g. acute myocardial infarction), which may generate a need for health care services to improve outcomes (e.g. initial hospitalization, thrombolysis, etc.). From that moment on, however, the surviving patient will be deemed to have coronary artery disease and the patient will be counted in estimates of disease prevalence. This patient with chronic disease will have needs, which differ from those in the acute phase (e.g. long-term control of blood pressure, cholesterol or angina symptoms).

In all three phases of disease, services are 'needed' only if they are proven to offer a tangible net benefit[†] to the patient. Such benefits may be curative (eliminate disease), supportive (help the patient cope with the illness), or preventive. Prevention may be primary (reduce disease incidence), secondary (retard disease progression), or tertiary (reduce disability near end-stage of disease). Benefits may alternately be described in terms of improved quality of life, reduced mortality, or reduced anxiety and pain. New, proven technologies may generate sudden increases in potential need. The need for old technologies may also increase if new evidence arises which expands the indications under which the service is beneficial.

Disease, in any phase, may be affected by a host of patient factors, such as the patient's age and gender. Lifestyle behaviours such as diet, exercise and smoking may influence incidence and prevalence, and these behaviours may in turn be influenced by socio-economic status, the cultural milieu and environment. The education level of the patient may also affect the knowledge of disease and motivation for prevention.

Need is a prime determinant of the demand for health care. However, the translation of a potential need into a demand depends on the patient being aware of the potential benefits of a health care service given his or her disease status. A key source of such information is, of course, the patient's physician. The physician's propensity to advise the patient to demand a service depends on factors such as his or her knowledge of the service and the dissemination of information on its effectiveness. Other factors affecting demand may include any out-of-pocket or indirect costs to the patient associated with the service and ability to pay, the patient's ability to absorb information (e.g. language skills, education level), the patient's own perception of risks relative to benefits, and other information sources (e.g. media, advertising or word of mouth).

Demand is a key driver of utilization. Utilization, in turn, is constrained by the resources available in the system. In the Canadian context, the challenge for planners and governments is to set a level of health care resources, which meets the demands of patients, within the level of resources that ultimately those same patients as taxpayers are willing and able to spend on health care. Often, there are multiple services with proven benefits, each with varying degrees of cost-effectiveness, and a potential need for each of these services exists.

* Health care need may also be driven by patient symptoms, which may require medical services to rule out disease (e.g. chest pain). In the interest of simplicity, symptoms and disease are considered together as drivers of need.

[†] By net benefit, we mean that there is an overall positive impact after taking into account negative health impacts of the service, such as side effects.

Health care providers, planners and governments must make difficult choices about which of these options should be selected, given the resources available.

Within this framework, it is possible for services to be needed but neither demanded nor provided. This may occur if dissemination of information about the benefits of the service is poor, or if barriers to access to care exist (e.g. low income, language barriers, regional disparities in availability of personnel and technology). Conversely, it is possible for services to not be needed, yet demanded and provided. This may occur if the information disseminated has been misleading, or if the financial incentive to provide the service is strong. Some analysts also believe that a high supply of health care providers in a competitive labour market may induce patients to demand more services.⁷

Empirical Evidence on the Need for Health Care Services

Population aging

Canada's population is aging. From 2001 to 2016, Canada's population is projected to grow by 11%, from 31.0 to 34.4 million individuals. All of this growth, however, will occur in population over age 45. The population 45-64 years of age will rise by 33%, and the population 65 years and over by 45%. The population under age 45 is expected to decline by 5% (Figure 2).

Increasing age is a risk factor for heart disease. The National Population Health Survey can be used to identify individuals who report having heart disease diagnosed by a health professional. By these criteria, 3.5% of the Canadian population had heart disease in 1996, and the prevalence of disease rose steadily with age (Figure 3).

Assuming that population growth estimates are valid and that the age-sex specific prevalence of cardiovascular disease does not change, the number of individuals with cardiovascular disease is projected to increase by 41% from 2001 to 2016, from 1.07 to 1.50 million (Figure 4).

Modifiable risk factors

There are both encouraging and discouraging trends in lifestyle factors affecting the incidence and prevalence of disease. On the positive side, the percentage of Canadians who smoke has declined steadily, from 39% in 1977 to 24% in 1996/97.⁸ The rate of obesity, however, has increased substantially over the past 50 years in many developed countries⁹, and Canada is no exception. The proportion of individuals who are overweight (body mass index (BMI) >25 kg/m²) has risen from 40.0% in 1970-72 to 50.7% in 1998.¹⁰ The proportion obese (BMI > 30 kg/m²) has risen from 9.7% to 14.9% over the same time period.¹⁰

Obesity is important because of its influence on type II diabetes in the elderly, a major cardiac risk factor. The age-specific prevalence of type II diabetes has risen in the United States¹¹, Asia,^{12 13} the South Pacific,^{14 15 16 17} and Northern Europe^{18 19} over the past one to two decades, and researchers in these jurisdictions note that this trend is correlated with rising obesity. Recent Ontario data also show that the age-sex adjusted prevalence of diabetes has risen rapidly from 4.7% in 1995 to 6.2% in 1999²⁰. The incidence of diabetes, however, has remained stable (0.68% in 1995, 0.66% in 1999), suggesting that increased survival among diabetics has driven the recent rise in prevalence rather than an increase in new cases caused by worsening obesity.

Physical inactivity is a risk factor for heart disease,²¹ and even moderate exertion such as walking may be as beneficial as vigorous exercise in preventing heart disease in some groups.²² One study found that physical inactivity in Canada actually decreased from 1981 to 1998,²³ although overall rates of physical inactivity remained high, at 77% of women and 74% of men. One American study showed no change in physical activity levels during the 1990s²⁴, while an earlier study from 1986 to 1990 mirrored the Canadian findings of modest improvements in physical inactivity but a persistently high overall level of sedentary lifestyle.²⁵ The lack of a demonstrable increase in physical inactivity suggests that diet may be contributing more to the recent rise in obesity than lack of exercise. Nonetheless, the persistent high prevalence of inactivity suggests that there are important opportunities to prevent heart disease.

Another important risk factor for heart disease is low socio-economic status.^{26,27} There is no evidence, however, to describe how changes in socio-economic profile of the population over time lead to changes in disease prevalence.

Primary and secondary prevention

Primary prevention programs against obesity, smoking and physical inactivity exist across Canada, but there is little data cataloguing their deployment in the country and tracking their effectiveness. Some information, however, is available on management of hypertension. Hypertension is an important component of primary prevention of heart disease, and is generally the domain of primary care physicians.²⁸ One Canadian study suggests that 59% of hypertensive patients are undertreated in relation to the 2001 Canadian Hypertension Recommendations,²⁹ while one bi-national study suggests that hypertension is more poorly controlled in Canada than the United States, particularly among patients with concomitant diabetes.³⁰

Some data exist on secondary prevention through medications. Trial evidence suggests that lipid-lowering agents (statins) in patients with coronary artery disease can reduce subsequent coronary events and the downstream use of revascularization procedures by 23%³¹ to 37%³². Although Canadian data from the early 1990s showed low statin use³³, more recent Ontario data has demonstrated rising statin use among AMI patients over 65, from 7% in 1994/95 to 20% in 1996/97. Beta-blockers and ACE inhibitors have also been proven beneficial in post-AMI management.^{34,35} The use of these medications was 52% in 1996/97, with wide geographic variations in prescribing patterns. Although an optimal rate of prescribing could not be inferred from the administrative data used in these studies, the variations in prescribing raise the possibility of underuse in some areas. Another problem is drug compliance: among elderly Ontarians with chronic coronary artery disease who started lipid-lowering therapy, only 36% continued their medication two years later.³⁶

Overall trends in disease incidence and prevalence

One important marker of the incidence of heart disease is the hospitalization rate for AMI. This measure is useful because patients presenting with an AMI are almost always admitted. The indications for admission are clear and not easily influenced by hospital bed utilization management or physician discretion. The limitations of this measure, however, are that it excludes AMIs which are incorrectly diagnosed or which cause death before arrival to hospital.

In Quebec, the age-sex adjusted incidence of first AMI hospitalization dropped from 14.8 per 10,000 persons to 13.7 from 1988 to 1995.³⁷ In Ontario, the age-sex adjusted incidence of AMI hospitalization (including readmissions, transfers and recurrent AMIs) declined from a high of 27 per 10,000 in 1982 to a low of 24 in 1992,³⁸ and remained stable from 1992 to 1998. Similar declines were also noted for admissions for ischemic heart disease. In Nova Scotia, declines in AMI incidence were noted from 1984 to 1993.³⁹ The exception to the national trend towards declining AMI rates is the Native population. Among Ontario natives, the incidence of AMI has risen dramatically, from 11 admissions per 10,000 in 1982 to 47 in 1995.³⁸ Despite the fast growth rate in disease incidence in this portion of the population, however, the overall population rates have continued to decline.

Canadian trends mirror those in over 20 other countries participating in the World Health Organization's MONICA (monitoring trends and determinants in cardiovascular disease) project.⁴⁰ Studies from Sweden⁴¹, Denmark,⁴² Iceland,⁴³ Italy,⁴⁴ Australia and New Zealand⁴⁵ all demonstrate significant declines in the incidence of AMI in the late 1980s and early 1990s. The Swedish and Australian studies are particularly important because they captured not only hospitalizations but also AMI deaths occurring outside of hospital. In the United States, the incidence of first AMI has been relatively stable during this period, while recurrent AMI rates have decreased.⁴⁶ This finding, combined with the Ontario study, raise questions about whether past reductions in AMI incidence will continue, or whether we are about to reach a plateau in the incidence rate.

Longitudinal data on the prevalence of cardiovascular disease is scarce, both in Canada and abroad. The National Population Health Survey will be repeated in Canada every two years and will be an important information source of such information in the future. One possible marker of temporal trends in prevalence, however, is the hospitalization rate for congestive heart failure. Hospitalizations for CHF have been rising in Montreal, from 92 per 10,000 population in 1990/91 to 124 in 1997/98.⁴⁷ This study also showed that among women, the later-presenting syndrome of CHF is beginning to replace other cardiovascular diagnoses as the cause of death. Similar increases in CHF hospitalization are noted in the United States.⁵⁰ These trends suggest that the prevalence of chronic heart disease is rising, but further research is needed to validate this hypothesis. CHF hospitalization rates are strongly influenced by the underlying prevalence of CHF, but may also be affected by access to primary care⁴⁸ and the model of care delivery.⁴⁹

An increasing CHF prevalence may appear paradoxical given that CHF most commonly arises as a consequence of AMI,⁵⁰ and AMI incidence is decreasing. One explanation offered by analysts is that reduced mortality leads to more survivors with disease.⁵¹ In Canada, the age-sex adjusted mortality rates for ischemic heart disease and all cardiovascular diseases have dropped by more than half from 1969 to 1997.⁵² For acute myocardial infarction (AMI), the decline has been even more dramatic: two-thirds fewer deaths now occur compared to three decades ago (Figure 5). These declines in mortality are mirrored in most other industrialized countries.⁴⁰ This trend will be important to monitor, because the success of maximizing post-AMI treatment could potentially place increasing strains on health care systems around the world.

Other factors

The definition of AMI has undergone recent changes. The introduction of troponin markers for defining AMI results in some patients who would previously have been diagnosed with unstable angina now being diagnosed as AMI.⁵³ If these patients will now be considered to benefit from more intensive investigations and treatment, then the need for services will increase. Future research is needed to monitor whether or not this is occurring.

Change In Use of Existing Technologies

The use of cardiovascular medical and surgical interventions has grown rapidly over the past decade. Our past research has shown rapid growth in the use of non-invasive cardiac diagnostic tests in Ontario.^{54,55} The number of percutaneous coronary interventions (PCIs) and coronary artery bypass grafts (CABGs) performed in Canada have also grown rapidly, with the former outpacing the latter.⁵⁶

Figure 6 is an update of our previous research and shows the rate of growth of seven selected cardiovascular services, based on physician billing data from Ontario from 1992/93 to 1999/2000. The fastest growing services are percutaneous interventions and cardiac nuclear imaging. All of these services are growing well in excess of the typical growth rates in prevalence seen in Figure 4 attributable to aging of the population.

The use of these services is higher among the elderly. Figure 7 shows, for each service, the proportion performed on different age groups in 1999. Cardiologist consultations and valve surgeries had the highest concentration of all services performed on the elderly, followed by echocardiography, CABG, coronary catheterization, PCI, cardiac nuclear medicine and exercise stress testing. All of these cardiovascular services were more heavily concentrated among the elderly compared to other health services.

Utilization growth in these services among the elderly, particularly those over age 75, has been more rapid than among younger age groups (Table 1). The most dramatic increases in utilization among the elderly from 1995/96 to 1999/2000 have occurred for PCIs and cardiac catheterization. The next most important services in terms of growth in the elderly include nuclear cardiac imaging, CABG and valve replacement.

Why has utilization growth been so strong in all of these areas? In some cases, evidence-based guidelines may have encouraged utilization growth. Guidelines emphasizing the importance of risk-stratifying patients with coronary artery disease may have fuelled growth in non-invasive diagnostic tests such as exercise stress testing and nuclear cardiac imaging.^{57,58,59} The recommendation to monitor ejection fraction in patients with

congestive heart failure^{60,61} may have contributed to growth in echocardiography and radionuclide angiography. Evidence emerging in the 1990s about the benefits of early revascularization after AMI^{62,63} and its potential cost-effectiveness relative to medical management⁶⁴ may have led to higher PCI and CABG rates. Interestingly, however, revascularization rates in the elderly rose particularly fast in the 1990s despite the fact that the clinical trials reporting data at that time excluded the elderly.⁶⁵ Only recently has evidence emerged to suggest that revascularization benefits the elderly.⁶⁶ Larger trials will be needed to confirm these benefits.

Some analysts question the evidence regarding the benefits of these different procedures,^{67,68,69} noting that many studies tend to evaluate benefits on short-term rather than long-term outcomes. The benefits of CABG surgery, for example, depend heavily on patient selection and no long-term benefit and possibly harm is demonstrated in low-risk patients.⁷⁰ Concern has also been raised that medical treatment in most of the revascularization studies was non-standardized and sub-optimal.⁶⁷ These analysts believe that aggressive primary prevention may provide the greatest benefit in avoiding the need for these procedures.

Emerging Technologies

As noted above, when a new technology is introduced which provides a tangible health benefit, a potential need for that technology is generated. Table 1 lists upcoming cardiovascular interventions currently being reported in the literature. This table is not intended to be a comprehensive inventory of all such interventions, but is presented in order to encourage planners to consider the potential impacts on health care demands and resources needed to service these demands, if these technological developments become the standard of practice. In some cases, one might speculate that better identification of persons at risk (e.g. human genome mapping) could lead to better, more targeted prevention and lower demands on the system. In the case of improvements in existing surgery (e.g. minimally invasive surgery), the impact may be difficult to predict. The techniques may increase physician productivity and thereby reduce the number of physicians needed to provide the service. Such an effect, however, might be countered by increases in demand due to expanded indications for the service. In other cases, there might be a substitution of different types of providers. If non-invasive imaging modalities continue to improve (e.g. CT or MRI), there might be a reduced need for interventional cardiologists but an increased need for radiologists.

Key Points

This review highlights some key trends about the potential need and utilization of services among the elderly:

- a. The aging of the population will increase the potential need for cardiovascular services in the future.
- b. The effect of reductions in smoking has been partially offset by increased diabetes and obesity, which in turn may reflect inadequate exercise and poor diet. Nonetheless, the declining incidence of acute MI suggests that the overall risk factor profile has been improving for patients.
- c. A declining mortality rate from AMI may lead to an increased prevalence of disease, and may result in increased need for services related to chronic disease management.
- d. The growth in the use of cardiovascular health services has been rapid over the past decade, and growth rates have been particularly high among the elderly.
- e. The apparent increased indications for use of these services has been a far greater driver of utilization than potential changes in the prevalence of disease or aging of the population.
- f. The fact that rapid growth in use of these services *preceded* the publication of evidence confirming their effectiveness in the elderly raises concerns about how clinical evidence is incorporated into practice patterns. Given this history of rapid utilization growth in the absence of evidence, further scrutiny of the appropriateness of services provided may be warranted.
- g. The use of cardiovascular services is more heavily concentrated in the elderly compared to other health services, and the aging of the population may drive the use of these cardiovascular services upwards more rapidly than other health services.
- h. There is significant room to improve the primary and secondary prevention of heart disease, given rising obesity and diabetes, high physical inactivity, persistent (although declining) rates of smoking, rates of under treatment of hypertension and variations in the use of statins and beta-blockers in post-AMI patients.

Table 3 summarizes the results of this review by listing the various factors, which may increase or decrease future health care needs or utilization.

Recommendations on Future Research

a. Future research should document the primary prevention programs throughout Canada, and monitor their impact on the reduction of risk factors for heart disease.

In the short term, researchers could examine intermediate outcomes such as smoking rates or obesity in different regions or communities, and the relationship between these rates and the presence of prevention programs (e.g. smoking cessation or availability of nutritionists). Communities with better intermediate outcomes could be identified as best practices in disease prevention. Longer-term research could examine actual incidence rates of heart disease rather than these intermediate outcomes.

b. Further research should examine changes in the prevalence of cardiovascular disease over time.

Prevalence may have increased due to improvements in mortality from heart disease and increased survivorship. Or, prevalence may be reduced by improvements in the risk factor profile. This research may be accomplished through future analyses of longitudinal surveys such as the National Population Health Survey, using administrative data to validate self-reported disease status.

c. Further research should be conducted to develop demand prediction models examining the relationship between prior risk factors and the development heart disease. If the probability of an individual with a particular risk profile developing heart disease in the future can be measured, then this will allow planners to estimate more precisely the future prevalence of disease given the existing prevalence of risk factors in a community. Again, longitudinal surveys such as the NPHS may provide some of this information.

d. Further research should examine the relationship between the existence of heart disease and health service utilization. This type of research would examine the amount of health care resources used by patients who report having heart disease. Such information would help planners examine what the future health care needs would be given future projections of the prevalence of disease.

e. Policy-makers should conduct, on a regular basis, a scan of trends in the indications and acceptance of current and new technologies. Current technologies may experience a broadening of their indications. The evidence on the effectiveness of new technologies may solidify, leading to their acceptance. New technologies may add to or replace old technologies. Some new technologies may be complementary to old technologies and increase their use. Although these trends are very difficult to predict, policy-makers should consider and discuss the potential impacts on future resources needed should these technologies be proven beneficial.

f. Future research should examine both under-and over-utilizations of health care services. Over-utilization may occur if services are provided inappropriately (i.e. where there is no clearly defined benefit to the patient). This may include inappropriate prescribing, unnecessary repeat diagnostic tests, or aggressive testing or surgical interventions in low risk individuals. Research of this nature would require the development of appropriateness criteria and their implementation across the country. Under-utilization may occur if certain types of patients experience barriers to access to care, either because of lack of education about heart disease, hidden financial barriers, language barriers or lack of availability of physicians. Under-utilization of preventive measures should also figure prominently in this research.

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Table 1: Growth Rates in Utilization of Selected Cardiovascular Health Services from 1995/1996 to 1999/2000

Procedure	Growth Rates, 1995/1996-1999/2000						
	By Age				By Gender		Overall
	0-44	45-64	65-74	75+	Males	Females	
Angioplasty	25%	39%	56%	125%	58%	49%	55%
CABG	4%	8%	21%	70%	23%	29%	25%
Consultations with cardiologists	6%	6%	8%	15%	12%	13%	13%
Cardiac Catheterization	9%	44%	59%	122%	54%	63%	57%
Exercise Stress Test	12%	8%	19%	45%	16%	19%	18%
Echocardiography	13%	26%	33%	42%	31%	28%	30%
Electrophysiological Mapping	0%	-14%	3%	33%	4%	-5%	0%
Nuclear Cardiac Imaging	17%	11%	30%	74%	24%	33%	28%
Valve Replacement Surgery	18%	1%	23%	63%	23%	29%	26%

Source: Ontario Health Insurance Plan physician billing data

Table 2: Emerging Technologies in Cardiovascular Health Care

<p>Technologies that improve upon existing technologies</p> <p>Minimally Invasive Direct CABG / endoscopy surgery / robotic-assisted surgery⁷¹ Laser angioplasty to ablate stenoses⁷² Intracardiac echocardiography⁷³</p>
<p>Broadening indications for existing therapies or diagnostic tools</p> <p>Immediate revascularization after AMI and acute coronary syndromes⁶⁶ Cardiac Positron Emission Tomography^{74,75} Coronary angiography via contrast-enhanced computerized tomography (CT)⁷⁶ Cardiac Magnetic Resonance Imaging (MRI)⁷⁷</p>
<p>Fundamentally new treatments or diagnostic tools</p> <p>Enhanced genetic screening (human genome mapping) to identify patients at risk for cardiovascular disease⁷⁸ Gene therapy (insertion of selected DNA into somatic cells to correct defects)⁷⁹ Artificial hearts⁸⁰ Left-ventricular assist devices⁸¹ Tissue engineering⁸²</p>

Table 3: Trends Affecting the Need for and Utilization of Health Services

<p>Trends which may reduce need for and utilization of health services:</p> <ul style="list-style-type: none">* The prevalence of smoking is declining over time* The overall incidence of acute myocardial infarction is declining, probably because of better risk factor management and primary prevention* Need and utilization could be reduced with improved preventive measures (e.g. better adherence by physicians to guidelines on use of lipid-lowering agents)
<p>Trends which may increase the need for and utilization of health services:</p> <ul style="list-style-type: none">* the incidence of ischemic heart disease is rising among the native population* the population is aging, and the prevalence and incidence of cardiovascular disease rises with age* the mortality rate from acute myocardial infarction is declining, which may increase number of AMI survivors and increase the prevalence of heart disease, particularly among the elderly* the prevalence of obesity and diabetes among Canadians is rising* the new, broader definition of AMI may have either no effect or may result in an increased need for services* the indications for a variety of cardiovascular appear to be broadening, particularly among the elderly

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Management of Acute Coronary Syndromes in the Elderly

Peter Bogaty¹ and David Fitchett²

¹Quebec Heart Institute
Laval University

and

²St Michael's Hospital
University of Toronto

Correspondence:
David Fitchett
Division of Cardiology
St Michaels Hospital
30 Bond St
Ontario M5B 1W8

Email: fitchettd@smh.toronto.on.ca

Introduction:

The acute coronary syndromes, unstable angina and myocardial infarction are a major cause of morbidity and mortality in the older population. Four fifths of the annual deaths from coronary artery disease occur in patients over the age of 65. Although patients over 75 years of age constitute approximately 40% of admissions to hospital with myocardial infarction are, this age group accounts for 60% of the deaths (1). Age is the most important determinant of survival from an acute coronary syndrome whether the patient presents with(2) or without(3;4) electrocardiographic ST segment elevation.

The prevalence of acute coronary syndromes appears to be shifting towards the elderly.(5) From 1979 to 1994, the incidence of myocardial infarction increased in the elderly (especially women > 80 years old) compared to a decline in younger persons (especially males < 60 years old)(6). Although survival from myocardial infarction improved in younger patients, the high mortality rate in the elderly remains a significant concern (6). However improved survival in the elderly (> 80 years old) over this period is reported, especially in those receiving reperfusion therapy (7).

Retrospective data indicates that older patients with ACS have an excess of prior heart failure, coronary disease, renal insufficiency, and more are female (8). Furthermore there is a longer delay in seeking medical help, and fewer older, compared to younger patients, present with ST segment elevation ACS. Higher in-hospital and post discharge mortalities are observed in older patients with acute myocardial infarction who receive thrombolytic therapy, even after adjustment for confounding variables (9). Angiographic studies of the elderly (>75 years) with acute myocardial infarction (10)show more three vessel disease, higher left ventricular end diastolic pressure, lower left ventricular ejection fractions(11), yet similar initial TIMI 2-3 flow rates compared to a younger population. In the GISSI 2 study(9), patients >70 years old who died in hospital had an 86% incidence of cardiac rupture compared to a 19% incidence in those <60 years old. Larger infarct size did not entirely explain this difference.

Although chest pain is the most frequently reported symptom, an atypical clinical presentation of acute myocardial infarction is common in the elderly population.(12). Older patients are more likely to have dyspnoea, and neurological symptoms such as syncope, weakness or acute confusion as their principal complaint (13). Over the age of 85 years an atypical presentation is extremely common, and myocardial infarction should be considered as a possible diagnosis in the very old with any acute illness. Silent myocardial infarction occurs more frequently in the elderly with up to 60% of infarcts unrecognized in the very old. In the Framingham study 42% of myocardial infarctions were clinically unrecognized in men aged 75-84, compared to only 18% in the 45-54 year age group.

The increased mortality from acute coronary syndrome in the elderly is likely due to multiple factors that include important co-morbidity, extensive coronary artery disease, and impaired left ventricular systolic and diastolic function. Yet increased in-hospital mortality in the elderly is not completely explained(14). Other mechanisms that have been suggested include less catecholamine responsiveness, blunted ischemic preconditioning, and reduced age-related tolerance of myocardial ischemia. Factors that increase longer-term mortality (e.g. frailty, heart failure, peripheral vascular disease, diabetes and renal insufficiency) are more common in an older population and largely explain the high one-year mortality after AMI.

- Acute coronary syndromes have an increasing prevalence in the older population.
- Age is an independent predictor of mortality, re-infarction, heart failure and stroke after ACS.
- The increased fatality and complications of ACS are largely due to greater co- morbidity, more advanced coronary artery disease and age related physiological changes in the coronary arteries and the myocardium.
- Elderly patients more commonly have atypical symptoms and present later to medical attention.

- Standards of care of the elderly vary wider than those for a younger population. A challenge today is to encourage adherence to guidelines for secondary prevention of ACS in the older population, and reduce the wide disparity of quality of care.

This consensus report will focus on the management of the elderly patient with an acute coronary syndrome from acute care to long-term management. It will encourage evidence based (whenever available) management of the elderly population who carry the greatest burden of disease and CV mortality due to acute coronary syndrome.

Acute ST Segment Elevation Acute Coronary Syndrome

Thrombolysis in the Elderly

Large randomized clinical trials have demonstrated that thrombolytic therapy reduces mortality in patients with suspected acute myocardial infarction presenting with ST segment elevation or left bundle branch block. On this basis, guidelines strongly recommend thrombolytic therapy for the treatment of patients without contraindications who present within 12 hours of characteristic symptoms and have ST-segment elevation or left bundle branch block (15). However, despite thrombolytic therapy and not because of larger infarctions, elderly patients still have much higher mortality(16) and worse left ventricular function(11) than younger patients.

Although thrombolysis is similarly effective in establishing reperfusion in both older and younger patients, the elderly have an increased mortality in the first 24 hours compared to patients not receiving thrombolysis (11). This early hazard may result from increased risk from intra-cranial hemorrhage, cardiac rupture, reperfusion injury and arrhythmias in the older population (17). In addition elderly patients treated with thrombolytics may be disadvantaged by longer times to hospital presentation attributed to more frequent atypical symptoms, more frequent re-occlusion of infarct-related arteries and a greater risk of intracranial hemorrhage (18). Furthermore there is substantial evidence that the elderly are less likely to receive reperfusion therapy in general with as many as 46% of apparently eligible patients receiving no reperfusion therapy in Canada (Unpublished data from FASTRAC registry).

Clinical trials of thrombolytic therapy for acute myocardial infarction have included fewer than 10% of patients aged 75 years or older(17). No randomized trial has specifically evaluated thrombolytic therapy in older patients (≥ 75 years) and the generally accepted benefit in this population has recently been questioned (19-22). The Fibrinolytic Therapy Trialist's (FTT) Collaborative Group (17), in a meta-analysis of large randomized placebo controlled trials of thrombolysis for acute myocardial infarction prior to 1993, reported no benefit of thrombolytic therapy in older patients. (30 day mortality, thrombolysis: 24.3%, placebo: 25.3%). Subsequently the FTT data was reevaluated, restricting the analysis to patients with classic thrombolytic eligibility criteria (presentation within 12 hours of symptoms, and with ST-segment elevation or left bundle branch block)(23). The 3300 patients over 75 years of age with these criteria had a 15% reduction in mortality with thrombolysis (26.0% compared to control 29.4%, $p=0.03$). From this analysis, thrombolysis of patients over 75 years old results in 34 lives saved per 1000 patients treated, which is similar to the benefit observed in patients aged 65-74 years (40 lives saved per 1000) and over twice the mortality reduction in patients less than 55 years of age (16 lives saved per 1000). A Swedish registry suggested that thrombolysis in patients older than 75 years resulted in a lower combined one-year endpoint of death plus cerebral bleeding (24). The MITRA (Maximal Individual Therapy in Myocardial Infarction) registry suggested that the mortality reduction from reperfusion therapy was highest in the very elderly population (>85 years)(25).

Other retrospective cohort studies(20;26) (22) have suggested that thrombolysis in the "old old" > 75 -80 years old, may not be as beneficial as in younger patients. Furthermore competing risks in the elderly will reduce the gain in life expectancy from early treatment with thrombolysis: especially when treatment is administered late after the onset of symptoms (27). Concern about the benefit of thrombolysis in elderly patients has raised

awareness to assess the individual patient for benefit (location of MI, Killip class and timing of treatment) and bleeding risk (previous stroke, hypertension, sex and weight).

Hemorrhagic Complications of Thrombolysis in the Elderly

Thrombolytic therapy reduces mortality in patients with acute myocardial infarction, with a hazard of life threatening bleeding. Intracranial hemorrhage (ICH) occurs in 0.5-1.0% and is more frequent in the older patient, as well as females, hypertensives, those with a lighter body weight, and with a prior history of cerebrovascular disease.

Paradoxically, fibrin specific thrombolytic agents such as rt-PA, are associated with more ICH, yet less non-cerebral bleeding than non-fibrin specific agents such as streptokinase. Front loaded rt-PA results in ICH rates of 1.5-3.6% in the elderly (> 75 years) compared to 0.64-0.94% in the total population (17). Unfortunately ICH remains eight fold more frequent in women over 75 years old compared to men less than 65 years, despite the use of weight adjusted thrombolysis with tPA(28). Elderly female patients with low weight (<67kg), treated with rt-PA had ICH rates of 3.02% but TNK-tPA was associated with a trend to less ICH (1.14%)(29). Less hemorrhage appears to occur with lower dose anticoagulation with heparin as described in more recent AHA/ACC guidelines for concomitant anticoagulation. Although most elderly patients will benefit from thrombolysis, the risk / benefit ratio has to be evaluated on a case-by-case basis to optimize outcome.

Adjuvant Therapy with Thrombolysis in the Elderly

Aspirin should be given to older patients with acute myocardial infarction, as the absolute benefit from aspirin was greatest in patients over 70 years old(30). Unfractionated heparin is used with tPA, TNK-tPA and rPA, despite the lack of clear evidence for its routine use. An analysis of recent thrombolytic trials have suggested that lower weight adjusted doses of heparin may reduce ICH(31). Consequently the AHA/ACC guidelines have recommended a lower fully weight adjusted heparin regimen to be used in association with thrombolysis with rt-PA, TNK-tPA or rPA(15). This regimen has been tested in the ASSENT 3 (33) and ASSENT 3 PLUS (34) trials with demonstrated clinical efficacy and safety. Recent studies have examined the benefits of combined thrombolysis with glycoprotein IIb/IIIa inhibitors and/or low molecular weight heparin. In both ASSENT 3 (33) and GUSTO V (32) trials the combination of half dose thrombolytic and abciximab was associated with unacceptable ICH rates in the elderly(32;33). The low molecular weight heparin enoxaparin combined with TNK-tPA in the ASSENT 3 trial (33) resulted in a similar combined safety endpoint (death, reinfarction, refractory ischemia, intracranial hemorrhage, or major bleeding) in older patients (>75 years) as unfractionated heparin. Yet in this elderly population intracranial hemorrhage rates were double those observed with unfractionated heparin. The ASSENT 3 Plus trial (34) also demonstrated a substantial increase in hemorrhagic complications with thrombolysis and enoxaparin administered to elderly patients prior to arrival in hospital. Until future trials are completed which will retest the combination of a reduced dose of low molecular weight heparin enoxaparin and thrombolysis, unfractionated heparin should remain the anti-thrombotic of choice in the elderly population

Choice of Thrombolytic Agent in the Elderly

The GUSTO-1 trial demonstrated an absolute 1% reduction in 30-day mortality when alteplase (rt-PA) was compared to streptokinase(34). More recent trials evaluating the newer bolus agents, reteplase (rPA) and tenecteplase (TNK-tPA), show comparable benefits to rt-PA (35,36). However in the elderly, a greater reduction of 30 day mortality with rt-PA compared to streptokinase may be offset by more ICH. In the GUSTO 1 trial, patients aged >75 years receiving rt-PA had a trend to a lower combined 30 day mortality and disabling stroke rates than those receiving streptokinase (t-PA 20.2%, streptokinase 21.5%, ns). TNK-tPA combined with reduced dose heparin (AHA/ACC guidelines) as assessed in ASSENT 3 (33) and ASSENT 3 Plus (34) demonstrated a favourable risk profile for ICH compared to rt-PA in the very high-risk group of elderly low weight females (36) and is probably the best regime studied to date in the elderly.

Access to Thrombolysis in the Elderly:

Elderly patients with acute ST segment elevation myocardial infarction are less likely to receive thrombolysis than younger patients (25). Patients over 75 years old are half as likely to receive thrombolysis as those < 75 years old. (37). There is a reluctance to use thrombolysis in the older population, (38) not due to decreased eligibility. (25;39) but because of a perceived hazard of bleeding, However when the elderly do receive thrombolysis, administration is likely to be later than in younger patients(39,40).

Management of complications of acute myocardial infarction in the elderly

Cardiogenic shock following acute myocardial infarction occurs in up to 10% of patients. In the elderly, shock is more frequent and is associated with very poor survival (41). Although the SHOCK registry(42) did not demonstrate an early benefit from an aggressive revascularisation policy for patients older than 75 years, a more recent study(43) suggests that mortality has fallen substantially for patients above 65 years old from 80% in 1986-91 to 42-69% in 1993-97. The improved survival was attributed to more frequent early revascularisation, as well as the use of an aggressive medical regimen. However a Canadian series(44) showed mortality was reduced between 1989 and 1995 for patients less than 75 years old, yet no similar reduction was seen in those aged >75 years. On the basis of available data, elderly patients with cardiogenic shock should not be denied the possible benefit of an aggressive management strategy solely because of their age.

Primary Angioplasty in the Elderly

Primary angioplasty results in higher rates of coronary patency, and substantially less intra-cranial hemorrhage than thrombolysis. Clinical trials have shown better or similar survival with primary angioplasty compared to thrombolysis for patients with ST segment elevation acute myocardial infarction who present early after symptom onset and can receive percutaneous coronary intervention (PCI) within 60 minutes of presentation(45,46). Primary angioplasty is also the treatment of choice for patients with contraindications to thrombolysis and possible those presenting with cardiogenic shock. A recent study (47) randomized 87 elderly patients (>75 years old) to either primary PCI or thrombolysis with streptokinase (SK), and showed primary angioplasty was associated with a marked reduction in mortality at both 30 days (SK 20%, PCI 7% p=0.04) and one year (SK 29%, PCI 11% p=0.03). Clearly further community based and larger randomized studies in elderly patients are needed to confirm this remarkable result.

Subgroup analyses of several trials and registry data also indicate the feasibility and safety of primary angioplasty in older patients. The largest randomized trial (GUSTO-IIb) that compared primary angioplasty to thrombolysis included 1138 patients and showed a small but significant reduction of death/reinfarction/disabling stroke in the primary angioplasty group at 30 days(48), which was no longer significant after 6 months. An analysis of the GUSTO IIb trial showed that primary angioplasty had no incremental benefit in older compared to younger patients (49). Yet the PAMI 1 trial suggested that primary angioplasty was more beneficial in the elderly, compared to younger patients (45). A recent large observational study (50) that examined U.S. Medicare patients aged ≥ 65 years found similar adjusted 1-year mortality rates for patients receiving thrombolysis (odds ratio 0.84; 95% CI: 0.70 to 0.89) and patients receiving primary angioplasty (odds ratio 0.71; 95% CI: 0.61 to 0.83). Another analysis from the same observational study (51) evaluated primary angioplasty and thrombolysis in patients aged ≥ 65 years considered to be 'ideal for reperfusion therapy' (presentation within 6 hours of the onset of symptoms and ST elevation or left bundle branch block, without contraindications to thrombolysis) and showed there was no significant difference in 1-year survival between thrombolysis and primary angioplasty.

Recommendations:

Thrombolytic therapy, promptly administered, is indicated in elderly patients who present within 12 hours of compatible symptoms and who have ST-segment elevation or left bundle branch block and do not have contraindications to thrombolysis. (Class I, C)

- Elderly patients at high risk of ICH (women, low body weight, hypertensive) should be considered for primary angioplasty when available in a timely fashion (< 90 minutes). (Class I, B). When primary angioplasty is not available for these patients, the risk / benefit of thrombolysis must be considered prior to treatment.
- No firm recommendation can be made as to the choice of thrombolytic agent in the elderly. However tPA or derivative (TNK-tPA or rPA) should be considered in patients with infarctions, which appear to be large. (Class 2b B).
- A low dose heparin protocol (target PTT 40-50 seconds) following thrombolysis with r-tPA or derivative is preferable to minimize the risk of hemorrhage. (Class 2a, B)
- Until large randomized clinical trials are completed, which examine both safety and efficacy, the combination of low molecular weight heparin with thrombolysis should be avoided in an elderly population. (Class 3,B)
- The combination of half dose thrombolytic and abciximab should be avoided in the elderly (>70 years). (Class III, A)
- Primary angioplasty for acute ST segment elevation AMI is an acceptable alternative to thrombolysis in the elderly patient if experienced operators can perform it within 60-90 minutes of presentation. (Class I C)
- Primary angioplasty should be strongly considered when thrombolysis is contraindicated, when there is a high bleeding risk (e.g. small elderly hypertensive female), in the presence of shock or hemodynamic instability. (Class 1 C)

Acute Coronary Syndromes without ST segment elevation (NSTEMI ACS)

Patients who present with acute coronary syndromes without ST segment elevation (NSTEMI ACS) in comparison to those with ST segment elevation (STEMI ACS), are older, have more extensive coronary artery disease, yet less impaired left ventricular function(52), and greater early patency of the culprit coronary artery(53). In contrast to STEMI ACS where immediate thrombolysis or primary angioplasty results in a 20-40% reduction in mortality(17), patients without ST segment elevation (NSTEMI ACS) appear to derive no benefit from thrombolysis(54). However the patient with NSTEMI ACS is at high risk of recurrent ischemic events that may lead to myocardial infarction or death, and this appears to be especially true in the elderly patient(3) Consequently the goal of treatment is to prevent thrombotic re-occlusion of the culprit artery using anti-thrombotic and anti-platelet agents in association with a revascularisation strategy in high risk patients. Management strategies are determined by an assessment of the short-term risk, estimated from observations available at the time of the initial assessment (e.g. clinical findings, electrocardiogram, and biochemical markers) (55).

Management Options for NSTEMI ACS:

Proven management options for NSTEMI ACS patients include ASA, Clopidogrel, unfractionated heparin, low molecular weight heparin (LMWH), GP IIb/IIIa inhibitors (eptifibatid and tirofiban) and an early invasive approach to revascularisation. Clinical trials providing evidence for the efficacy of these therapies have usually

focused on the younger population with an average age of less than 65 years. Furthermore secondary analyses of the benefit and risk of treatment frequently compare patients greater and less than 65 years, and do not consider outcomes in the older population (i.e. > 75 years). As event rates are more frequent in the older patient it is likely that the absolute benefit of treatment will be greatest in this high-risk population provided that harmful secondary effects do not attenuate this benefit.

ASA remains the most cost effective treatment. Small clinical trials (479-1388 subjects) in unstable angina showed the efficacy of ASA, but did not either include elderly patients or analyze outcomes by patient age. However, as the absolute benefit of ASA in elderly STE MI patients is comparable with that observed in younger patients (30), it is likely that similar benefits will be achieved in patients with non-STE ACS as well?

Clopidogrel when added to ASA resulted in an 18.4% risk reduction of death, non-fatal myocardial infarction or stroke(56) (yet no significant reduction in cardiovascular mortality) during an average 9-month treatment period in patients with high risk NSTEMI ACS. The CURE trial(56) included 12,562 patients of all ages: with 49 % over 65, and 16% over 75 years old. Similar benefit was observed in patients above the age of 65 as compared to younger patients. When the benefit is examined in the 65-75 and > 75 year groups the absolute risk reduction (ARR) from clopidogrel is similar to that observed in the younger < 65 year old group (Primary endpoint {cardiovascular death, myocardial infarction or stroke} < 65 years: ARR 2.4% RR 0.68 (0.55-0.83), 65-74 years: ARR 1.8%, RR 0.85 (0.72-1.01), >75 years ARR 2.3% RR 0.87 (0.71-1.06) (Personal communication Mehta S). Although there was an overall 1% increase in major bleeding associated with the addition of clopidogrel to ASA, most of the excess in major bleeding is observed in the elderly. (Excess major bleeding from clopidogrel < 65 years 0.4%, 65-74 years 1.3%, > 75 years 1.9%). Thus special care must be taken to select elderly patients at higher risk of recurrent ischemic events for treatment with clopidogrel and avoid those with any increased risk of bleeding.

Heparin when added to ASA reduces 5-day death/ MI event rates by 39% in a meta-analysis of trials comparing heparin plus ASA to ASA alone (57). However in these trials no breakdown of either efficacy or bleeding rates by age is reported. Low molecular weight heparin is currently used in more approximately 30% of Canadian patients with NSTEMI ACS. (58) Compared to unfractionated heparin, LMWH is easier to administer, requires no monitoring, and in the case of enoxaparin is more effective in preventing both late and early events. A combined analysis of the ESSENCE / TIMI 11b trial (TESSMA) indicates a greater benefit of enoxaparin in patients > 65 years old (59), however no safety information stratified by age is currently available. This is concerning because of the enhanced anticoagulant effect of heparin in the elderly, females, and patients with low body weight (60). Furthermore the increased incidence of renal insufficiency in the elderly may enhance and prolong the anti-thrombotic effect of low molecular weight heparin. Increased anti-Xa activity is observed after both short-term and long-term dalteparin in patients > 70 years old compared to younger patients.(61)

Glycoprotein IIb/IIIa inhibitors tirofiban and eptifibatid are of value in the prevention of myocardial (re-)infarction in high risk NSTEMI ACS(62-64), especially when patients undergo early revascularisation. In contrast abciximab, a monoclonal antibody to the GP IIb/IIIa receptor provided no benefit for a similar group of NSTEMI ACS patients(65). Both the PRISM and PRISM Plus trials(66) demonstrated a significant reduction in 48 hour and 7 day (respectively) death / non fatal infarction / refractory ischemia for patients older than 65 years. An analysis of the PURSUIT trial(3) showed similar therapeutic benefits from eptifibatid in all age groups ranging from less than 50 to greater than 80 years old. However excessive bleeding appears to be greatest in patients aged more than 70 years.

Early Coronary Angiography: Despite worse short and long-term outcomes, the elderly are less likely to undergo coronary angiography(3) following a NSTEMI ACS. Recently two clinical trials have shown that early coronary angiography followed by revascularisation, results in improved outcomes. The FRISC 2 study(67) randomized 2457 patients to an invasive or conservative approach following five days treatment with the low molecular weight heparin dalteparin. After six months there was a 22% risk reduction in death / non-fatal MI,

despite an early hazard of increased events. All of the benefit of an early invasive strategy was observed in patients over 65 years old (1 year death /MI Conservative 19.5%, Invasive 12.5% p<0.03) compared to no apparent benefit in the younger patients (Conservative 8.8%, Invasive 9.9% ns). Although the TIMI 3B study showed no overall benefit for an invasive strategy, 6 month death / MI rates were reduced in patients > 65 years old (conservative 15.8%, invasive 10.5% p<0.05) compared to no benefit in the < 65 year old group (conservative 8.1%, invasive 8.1%)(68). The TACTICS / TIMI 18 study (69) compared invasive and conservative strategies in high risk NSTEMI ACS patients pre-treated with tirofiban prior to early coronary angiography and revascularisation. The invasive strategy reduced the risk of death / MI / re-hospitalization during the 6 month follow-up by 22%. In the 43% of patients > 65 years old, the benefit of an invasive strategy was similar to that observed in the younger group.

Management strategy according to risk stratification:

Risk assessment using clinical observations available at the initial evaluation permits selection of the most appropriate therapy: high-risk patients receive the most effective treatment, whereas those at low risk avoid unnecessary hazards. Guidelines published by the American College of Cardiology and American Heart Association(70) and the European Society of Cardiology(71) have emphasized the importance of early risk evaluation to direct treatment. Guidelines with a Canadian perspective developed by a consensus group, suggested treatment according to high, intermediate and low risk criteria (55).

How much should an increased risk of an adverse outcome based on age alone determine the treatment strategy? An elderly patient with chest pain, no previous cardiac history, non specific ECG abnormalities, and no CK-MB or troponin elevation, may have the same short-term risk of death or myocardial infarction as a young patient with ST segment depression and positive biomarkers. The treatment effect of most strategies shows a constant relative risk reduction over a wide range of baseline risk. However patients with acute coronary syndromes are not a homogeneous group. An important proportion of patients without objective signs (ECG ST segment shift, or increased biomarkers) have normal coronary arteries.

- Non ST segment elevation acute coronary syndromes in the elderly are associated with greater mortality and recurrent myocardial infarction than in younger patients.
- No clinical trial has directly addressed the efficacy and potential hazards of antithrombotic or anti-platelet agents for the management of NSTEMI ACS in the elderly. Thus recommendations can only be made from sub group analysis of clinical trials, usually comparing those older than 65 years with younger patients. Little information is available for the efficacy or risk of treatment in patients > 75 years old.
- Hemorrhagic complications of anti-thrombotic and anti-platelet therapy are usually greater with increasing patient age.

Recommendations:

- ASA is recommended for all elderly patients with acute coronary syndromes in the absence of bleeding or hypersensitivity contra-indications. (Class I C)
- A heparin should be given to elderly patients with intermediate or high-risk features. (Class I, C)
- Enoxaparin can be used with an enhanced benefit compared to unfractionated heparin in older patients in the absence of renal insufficiency. (Class IIa, B)
- Clopidogrel should be considered for the treatment of older patients with high-risk acute coronary syndromes. (Class I, B)

- Glycoprotein IIb/IIIa inhibitors (tirofiban or eptifibatide) should be considered for elderly patients with very high risk features in whom an early cardiac catheterization is considered indicated at the time of admission. (Class I, B)
- Early cardiac catheterization should be considered for elderly patients with very high-risk features, or with high-risk features, provided that co morbidity or frailty do not preclude revascularisation by either PCI or bypass surgery. (Class I, A)

Long term Management after Acute Coronary Syndromes

The management of patients who have had an acute coronary syndrome is focused on the prevention of a) adverse left ventricular remodeling and heart failure, b) recurrent ACS, and c) sudden cardiac death.

Beta-adrenergic blocking agents were shown more than 20 years ago to reduce mortality when given for periods of up to two years following a myocardial infarction. Although most trials excluded patients over the age of 70 years, recent retrospective cohort studies suggest that there are survival benefits from beta-blockade in eligible patients over the age of 75 years yet underutilization is widespread (72).

ACE inhibitors play an important role in the prevention of adverse ventricular remodeling and the prevention of heart failure after myocardial infarction. When started at least one month after an ACS in patients without a history of heart failure and LV ejection fraction > 40% ACE inhibitors reduce the risk of recurrent ACS and other vascular events (73). Patients at high risk of recurrent vascular events, who were given ramipril 10 mg daily for 4 years, were shown to have a 25% risk reduction of cardiovascular mortality and a 20% reduction of myocardial infarction. The absolute benefits from ramipril were amplified in the high-risk diabetic patient. Similar treatment benefits were observed in patients younger and older than 65 years.

ASA, Clopidogrel, and revascularisation have been shown to prevent recurrent acute coronary syndromes over the long term, and their application and efficacy in the elderly has been discussed above. Reduction of lipids plays a very important role in the prevention of recurrent ACS. Although this will be discussed in the section on Risk Factor Control and the Elderly, initiation of treatment with a statin should be considered for ACS patients

Recommendations:

- Whether to use of long-term medications to improve survival and prevent recurrent ACS in the elderly should take into account competing risks from co-morbidity.
- ASA should be prescribed for an indefinite period for all elderly patients with coronary heart disease with or without a recent acute coronary syndrome, unless contra-indicated. (Class 1 B)
- Beta-adrenergic blockers should be prescribed to most elderly patients after both NSTEMI and STEMI myocardial infarction. The treatment period should be a minimum of 2 years. (Class 1 B)
- Lipid lowering treatment, especially with a statin should be considered in most elderly patients after an ACS (Class 2a B)
- Angiotensin converting enzyme inhibition should be considered for most elderly patients with ACS to prevent recurrent ischemic events and to prevent adverse left ventricular remodeling in patients with important left ventricular dysfunction (LVEF < 40%) (Class 1 B)

Research Opportunities

Virtually no clinical trial for the management of acute coronary syndromes has specifically addressed the “old old” (>75 years), and many trials have excluded older patients. As the patho-physiology of acute coronary syndromes may differ with age it is possible that responses to treatment may differ both qualitatively and quantitatively with increased age. Over the past 15 years clinical trials have begun to include the elderly, and many recent studies have had no upper age cut-off. From sub-group analysis hypotheses can be generated to indicate possible treatment effects. However there is no substitute for randomized clinical trial to specifically address treatment issues in the elderly.

As the “elderly” are a very heterogeneous population it will become important to know how to predict both treatment efficacy and adverse outcomes, not just by age, but also by measures of frailty and co-morbidity. Clinical trials in the elderly should include stratified randomization according to these criteria.

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Arrhythmias and the Elderly

Anne M Gillis MD, FRCPC

The University of Calgary and the
Calgary Health Region, Calgary, Alberta, Canada

Dr Gillis is a Senior Scholar of the
Alberta Heritage Foundation for Medical Research.

Correspondence:

Dr. Anne M. Gillis
Rm. 1634, Health Science Centre
3330 Hospital Drive N.W.
Calgary, AB T2N 4N1

Email: amgillis@ucalgary.ca

Disorders of impulse formation and conduction are common in the elderly and may result in symptomatic bradycardia or tachycardia. Aging is associated with decreases in myocardial cell density within the sinus node, loss of atrial myocardial fibres in approaches to the sinus node and internodal myocardium, and deposition of amyloid and interstitial fibrosis in the atria and specialized conduction system (1,2). Such abnormalities can lead to sinus node exit block, sinus arrest or transient or persistent AV block. Fibrosis in the atria may result in areas of slow conduction - one of the factors required for maintenance of atrial fibrillation (AF) (2). The high incidence of annular calcification, hypertension and ischemic heart disease in the elderly also contribute to the development of electrophysiological abnormalities that predispose to the development of conduction system disease or ventricular tachyarrhythmias.

The elderly patient may present with palpitations, presyncope, unexplained falls, intermittent confusion, thromboembolic events, syncope or cardiac arrest. Some elderly patients are asymptomatic and the arrhythmia may be detected as an incidental finding on physical examination or during electrocardiographic monitoring. The investigation, management and clinical outcomes of AF, symptomatic bradycardia, ventricular tachyarrhythmias and syncope that are pertinent to the elderly will be reviewed. It is important to emphasize that clinical studies/clinical trials on the management of these conditions specifically in the elderly have been rarely undertaken. Accordingly, many factors including associated comorbidities likely to influence survival as well as the patient's functional capacity, cognitive function, quality of life and personal preferences related to treatment need to be considered when making decisions about investigations and management of a cardiac arrhythmia.

Atrial Fibrillation

AF is the most common sustained cardiac arrhythmia and increases in prevalence with age. The prevalence of AF is approximately 2-3% in those > 65 years of age and 6-8% in those over 80 years of age (3,4). AF is usually associated with structural heart disease but may occur in those without detectable heart disease. However, true "lone" AF is uncommon in the elderly.

The management of AF has been the subject of a Canadian Cardiovascular Consensus Conference in 1995 (5) and recent guidelines for the management of patients with AF have been published jointly by the American College of Cardiology, the American Heart Association and the European Society of Cardiology (6). A large number of recommendations related to the management of AF are covered in these documents. Thus, here only issues specific to the elderly will be highlighted.

Investigations:

The investigations required in a patient with AF include a careful history and physical examination, an ECG, an echocardiogram, and blood tests of thyroid function (7). Careful attention to documentation of hypertension is recommended as this disorder is frequently overlooked, yet in the setting of age > 75, independent of other cardiovascular risk factors, hypertension is associated with an increased risk of thromboembolism (8). About half of elderly patients with AF have hypertension (6). A chest radiograph is recommended if physical findings suggest an abnormality. In some circumstances, additional testing may be required including an exercise stress test, ambulatory ECG monitoring or transesophageal echocardiography.

Management of AF:

Management approaches consist of therapies to control the ventricular rate or therapies to restore and maintain sinus rhythm (9-11). The potential advantages of the restoration and maintenance of sinus rhythm treatment strategy include symptom control, prevention of thromboembolism and prevention of impairment in ventricular function. The disadvantage of this treatment strategy is antiarrhythmic drug-induced proarrhythmia e.g. torsade de pointes VT, sustained VT or VF, conversion of AF to atrial flutter with a rapid ventricular rate or aggravation of conduction system

disease (sinus arrest or AV block) (12). The advantage of the rate control approach is less drug toxicity. However, these drugs are sometimes ineffective in achieving rate control or are not well tolerated, and pacing in conjunction with AV node ablation may need to be considered (13,14).

A comparison of the rate versus rhythm control approaches in 252 patients in the Pharmacological Intervention in Atrial Fibrillation (PIAF) clinical trial revealed similar clinical results in relation to symptom control (15). Although exercise tolerance was reported to be better with rhythm control less than 50% of the study population could perform a six-minute walk test. Hospitalization was more frequent in the rhythm control group. The AFFIRM (Atrial Fibrillation Follow-up Investigation of Rhythm Management) Study results were recently presented (16). Over 4000 patients (mean age 70 years) were randomized to rate versus rhythm control and followed for a mean of 3.5 years. Overall survival was similar in both groups although there was a trend towards better survival in the rate control group. Stroke rates were similar in both groups. Most strokes occurred in patients who stopped taking warfarin or who had an INR < 2.0. Patients in the rhythm control group were more likely to be hospitalized. The Rate Control versus Electrical Cardioversion for Persistent Atrial Fibrillation (RACE) Study Group randomized 522 patients with persistent AF following a previous electrical cardioversion to rate control or rhythm control therapy (17). The primary endpoint (a composite of death from cardiovascular causes, heart failure, thromboembolic complications, bleeding, implantation of a pacemaker and severe adverse effects of drugs) was similar in the rate control group (17.2%) compared to the rhythm control group (22.6%). These studies have led to the conclusion that the rate control approach is not inferior to the rhythm control approach. Whether the results differ importantly in the more elderly portion of these study populations will require subgroup analysis.

Table 1 and Figure 1 summarize pharmacologic approaches to rate and rhythm control respectively. AFFIRM defined the adequacy of rate control as a mean heart rate < 100 beats per minute during a 6 minute walk test (11). Digoxin is not very effective as monotherapy for heart rate control and generally should not be considered as the initial drug of choice (6,18). β -blockers are preferred as the initial rate controlling therapy unless contraindicated. In the elderly, lower doses of combination therapy e.g. β -blockers and digoxin (19) or a calcium antagonist may be better tolerated. Although amiodarone may be more effective in preventing AF, it is associated with potentially significant side effects and may not be well tolerated in elderly (10). Accordingly, other Class I/III antiarrhythmic drugs could be considered as an initial rhythm control therapy unless contraindicated. A rate-controlling drug will usually need to be prescribed in addition to Class I/III drug therapy with the exception of sotalol. If amiodarone is prescribed the loading dose should be reduced (600 mg/day) and the maintenance dose should be low (e.g. 200 mg/5 days per week)

Cardioversion for persistent AF (> 48 hours duration) should be considered for at least the first episode of persistent AF (6). If the duration of the episode is uncertain and possibly > 48 hours duration, anticoagulant therapy should be prescribed for at least 4 weeks prior to planned cardioversion or a transesophageal echocardiogram should be performed just prior to the planned cardioversion (6). Cardioversion for subsequent episodes of persistent AF will be determined in part by the patient's symptoms.

Antithrombotic Therapy:

Perhaps the most devastating consequence of AF is stroke. The attributable risk of stroke in the patient with AF increases with age. The risk at age > 70 is 9.9 %/yr and at age > 80 is 23.5 %/yr (3).

Antithrombotic therapy should be initiated to prevent thromboembolism (20,21). The major clinical risk factors for stroke in the AF patient are summarized in Table 2. Age > 65 is a risk factor for thromboembolic events (6). The American College of Chest Physicians have classified all patients with nonvalvular AF > 75 years of age as high risk for thromboembolic events (22). The Stroke Prevention in AF Investigators have classified women with nonvalvular AF > 75 years of age at high risk for thromboembolism (20).

Many prospective randomized clinical trials have demonstrated the superiority of warfarin over aspirin for prevention of thromboembolic events in patients with AF (6,20,21,23). A meta-analysis of these trials has demonstrated the high efficacy of dose-adjusted oral anticoagulation for the prevention of both ischemic and hemorrhagic stroke (risk reduction 61%, 95% CI 47-71% vs placebo) (23). However, warfarin increases the risk of an intracerebral bleed or other major hemorrhagic events. Patient age and the intensity of anticoagulation are the strongest predictors of major bleeding events. The average age of patients in these randomized trials was 69 years and the average follow-up was between 1-2 years. The average age of the AF patient in clinical practice is approximately 75 years (24). Concern has been raised about the applicability of these trial results to the older patient population whose anticoagulation therapy is less closely monitored. Some data suggest that anticoagulation in the elderly at risk for thromboembolic events is underutilized but if INR values are kept between 2 and 3 the risk of major hemorrhage is not significantly increased compared to younger patients (6,25,26). However, in the elderly with uncontrolled hypertension, other major risk factors for hemorrhage or those who have frequent falls, warfarin therapy is relatively contraindicated. Some studies suggest that oral anticoagulation with warfarin is underutilized in elderly women despite the SPAF Investigators' observation that women > 75 years are at particularly high risk for thromboembolism (27,28). This risk needs to be factored against a higher risk of hemorrhage in elderly women on anticoagulant therapy.

The rhythm control approach may reduce the frequency of AF but not prevent all episodes of AF. In the AFFIRM Trial, more patients randomized to the rhythm control approach experienced cerebrovascular events compared to patients randomized to the rate control group. Patients in the rhythm control group were more likely to have anticoagulant therapy discontinued (16). These observations suggest that anticoagulant therapy should not be discontinued in the elderly patient with AF unless there is a medical contraindication for this therapy. Elderly patients usually require lower doses of warfarin to maintain a therapeutic INR – often 1-2 mg a day is adequate.

Patients with pacemakers, particularly ventricular pacemakers may develop AF over time. This is frequently unrecognized in the pacemaker population, particularly in patients with VVI pacemakers if the patient is paced all of the time. The physician needs to be vigilant to the possible development of AF in the pacemaker patient, particularly the patient who is not on warfarin (29).

Recommendations:

- In the elderly, rate or rhythm control may be considered as the initial therapy for patients with AF at high risk for stroke (Class 1, Level of Evidence A).
- All elderly patients with AF should receive oral anticoagulant therapy to prevent thromboembolism unless contraindicated (Class 1, Level of Evidence A).
- In elderly patients at high risk of stroke, oral anticoagulation should be dose adjusted to maintain an INR between 2 and 3. The INR should be monitored at least weekly during initiation of oral anticoagulation and at least monthly when the INR is stable (Class 1, Level of Evidence A).

Symptomatic Bradycardia

Symptomatic bradycardia is predominantly a disease of the elderly and is usually secondary to sinus node dysfunction (profound sinus bradycardia, sinus arrest and/or chronotropic incompetence) or to atrioventricular block (second degree AV block or complete AV block). The average age of a

patient with symptomatic bradycardia requiring a permanent pacemaker is 73 years (28). Patients may present with syncope, presyncope, intermittent confusion, an unexplained fall, fatigue or dizziness.

Investigations

The minimal investigations required in a patient with suspected bradycardia include a careful history and physical examination, an ECG and an echocardiogram to assess cardiac function. A rhythm strip should be performed during carotid sinus massage if no carotid bruits are heard on auscultation and there is no history of cerebrovascular disease. If symptoms are intermittent and an arrhythmia is suspected but not documented, additional investigations might include 24-48 hour ambulatory ECG monitoring, an event recorder, tilt table test, electrophysiologic study and/or an implantable loop recorder.

Management

Patients with symptomatic bradycardia not due to reversible causes (antiarrhythmic drugs, drug toxicity, evolving myocardial infarction) require a permanent pacemaker. The indications for cardiac pacing have recently been updated by a joint task force of the ACC and AHA (31). In this document only major issues pertinent to the elderly will be highlighted. Although these guidelines generally recommend implantation of a physiologic pacing system (DDD/R or AAI/R) in most patients without chronic AF, these guidelines were developed before the completion and publication of large prospective randomized clinical trials. The recommendation favouring physiologic pacing is based on many retrospective studies (32) and one small prospective study in patients with sinus node disease (33) reporting that physiologic pacing reduced cardiac morbidity and mortality compared to ventricular pacing. However, the putative benefits of physiologic pacing on cardiovascular mortality have not been confirmed in three recent prospective randomized trials: the Canadian Trial of Physiologic Pacing (CTOPP) (30,34), the Pacemaker Selection in the Elderly (PASE) Trial (35) and the Mode of Stimulation Trial (MOST) (36).

CTOPP randomized 2568 patients from a general pacemaker population (mean age 73 years) but without chronic atrial fibrillation to receive a ventricular or physiologic pacemaker (30). Patients were followed for a mean of 3.1 years. The annual rate of cardiovascular death or stroke, the primary outcome event, was 4.9 % in the physiologic pacing group and 5.5 % in the ventricular pacing group (relative risk reduction 9.4%, $p = \text{NS}$). The annual rate of new atrial fibrillation was significantly lower in the physiologic group (5.3%) compared to the ventricular group (6.6%, relative risk reduction 18%, $p = 0.046$). Overall mortality or hospitalizations for heart failure were not significantly different between the two groups. Given that the potential beneficial effects of pacing might be delayed, follow-up in CTOPP was extended for an additional 3 years (37). Cardiovascular stroke or death remained similar over 6 years of follow-up in the physiologic or ventricular pacing groups. However, patients randomized to physiologic pacing remained less likely to develop paroxysmal or permanent AF (5.7% vs 4.5 %, relative risk reduction 20 %, $p = 0.009$). Based on the long term CTOPP follow-up, the number of patients needed to treat for prevention of AF over the long term is 8 patients (personal communication CR Kerr). Similar results were reported by the MOST investigators who randomized over 2000 patients with sinus node dysfunction to DDDR versus VVIR pacing (36). Cardiovascular death or stroke was similar over 3 years of follow-up but AF was significantly reduced in the physiologic group compared to the ventricular group (21.4% vs 27.2 %, relative risk reduction 21%, $p = 0.008$). In both studies, the benefit of prevention of AF by physiologic pacing was delayed with effects beginning to appear between 1 and 2 years following pacemaker implantation (30,36,38).

Subgroup analysis in CTOPP identified that patients who were pacemaker dependent, i.e. those with an intrinsic heart rate at rest < 60 bpm who were likely to be paced the vast majority of the time, were most likely to benefit from physiologic pacing (39). Significant reductions in cardiovascular death or stroke, hospitalizations for heart failure and development of AF were observed in the pacemaker dependent patients treated with physiologic

pacing compared to ventricular pacing at the 3-year follow-up. This last analysis is a post hoc analysis and the observations require confirmation in a prospective study that is near completion (UKPACE).

Given that several prospective studies have confirmed that physiologic pacing prevents the development of AF in the elderly compared to ventricular pacing, this pacing modality should be considered in those patients with a life expectancy predicted to be > 3 years. In the absence of significant comorbidities likely to influence survival and the absence of significant limitations in functional or cognitive capacity, physiologic pacing could be considered for all elderly patients who are likely to be pacemaker dependent i.e. those with high grade AV block or those with persistent sinus bradycardia.

Recommendations:

- Physiologic pacing and single chamber ventricular pacing result in equivalent rates of survival and stroke in the elderly. Physiologic pacing may be considered in the elderly patient with a predicted life expectancy of at least 3 years for the prevention of AF (Class I, Level of Evidence A).
- Physiologic pacing could be considered in the elderly patient who is likely to be pacemaker dependent (Class II, Level of Evidence B).

Ventricular Tachyarrhythmias

Sustained ventricular tachycardia (VT) and ventricular fibrillation (VF) are the major causes of sudden cardiac death. These arrhythmias occur predominantly in the setting of left ventricular dysfunction. The average age of an ICD recipient is 65 years (40,41). Risk factors for sudden death secondary to VT/VF include left ventricular ejection fraction < 40%, frequent ventricular premature beats or nonsustained VT, low heart rate variability, increased QT interval dispersion and inducible sustained VT in patients with coronary artery disease (42).

Investigations

The investigations required in a patient with sustained VT or VF include a careful history and physical examination, 12 lead ECG, review of laboratory data at the time of presentation including serum electrolytes and creatinine, magnesium level, troponin or CK, review of relevant rhythm strips at presentation and assessment of LV function. VT/VF due to a secondary cause including acute ischemia, acute hemodynamic deterioration, hypokalemia or hypomagnesemia, and Class I/III antiarrhythmic drug therapy should be excluded. Coronary angiography is generally recommended to determine whether significant coronary artery disease requiring revascularization is present. Revascularization in the elderly is addressed in Chapter 5.

Management

First, therapy of coronary artery disease and/or congestive heart failure should be optimized. The indications for implantable cardioverter defibrillator (ICD) therapy have been published by a joint ACC/AHA task force (31) and they have been the subject of a Canadian Consensus Conference on Sudden Cardiac Death (43). Several randomized clinical trials have demonstrated the superiority of the ICD over antiarrhythmic drug therapy for prevention of cardiac mortality in patients with symptomatic sustained VT/VF in the setting of left ventricular dysfunction (40,41,44). More recently, clinical trials have also confirmed that the ICD reduces mortality compared to medical therapy in patients at risk for VT/VF (45-47). These trials were conducted in patients with significant left ventricular dysfunction (left ventricular ejection fractions < 30-40%). One subgroup analysis in CIDS suggested that patients most likely to benefit are those > 70 years of age with symptomatic heart failure and LVEF < 35% (48). However, the benefit

of ICDs in patients > 70 years was not confirmed in an AVID substudy (49). Whether patients with severe left ventricular dysfunction (LVEF < 0.20) benefit from ICD therapy has been the subject of debate.

The ICD is costly. Life expectancy in AVID and CIDS was prolonged by 0.24 years and 0.23 years respectively compared to drug therapy. The cost per life year saved was US \$114,917 and Can \$213,543 respectively (50). Identifying subgroups most likely to benefit can increase the cost-effectiveness of ICD therapy. If patients had 2 or more of the high risk factors identified in CIDS (age > 70 years, NYHA Class III/IV and /or LVEF \leq 0.35), the incremental cost of the ICD was reduced to Can \$65,195 per life year saved (48,50). In addition, associated comorbidities likely to influence survival, the patient's functional and cognitive status and overall quality of life need to be considered when making recommendations of treatment for VT/VF. Although multiple studies have demonstrated the superiority of the ICD over pharmacologic therapy for the treatment of hemodynamically significant VT/VF, ICD utilization in Canada in 2001 (56/million population) was significantly lower than the United States (228/million population) or Germany (80/million population). Whether this reflects lack of knowledge of clinical trial results, therapeutic conservatism despite knowledge of trial results or reluctance to refer patients because of the perception of cost or complexity of the therapy is uncertain.

The MADIT II Study results were recently published (47). The ICD was reported to significantly reduce mortality (31%) in patients with a prior myocardial infarction and LVEF < 0.30 compared to best heart failure therapy. Patients > 70 years of age were equally as likely to benefit from ICD therapy compared to younger patients. Only 10 % of the MADIT II patients were treated with amiodarone. It is possible that the benefit of the ICD in this study population will be tempered by the use of amiodarone (51,52). This hypothesis is being tested in the SCD-HeFT Study. Although a groundswell of support for increasing ICD utilization for primary prevention of VT/VF is arising, we need to identify the patients most likely to benefit from this therapy. Subgroup analyses in the MADIT II population have reported that patients with a history of AF and those with a QRS duration on the surface ECG > 0.15 ms were most likely to benefit from the ICD therapy (53). The development of simple, less expensive devices for primary prophylaxis along with more sensitive and specific tools for identifying patients at greatest risk of sudden cardiac death will be important in reducing the economic burden of this therapy. The benefit of the ICD on mortality did not begin to emerge until 1 year following device implantation (47). Hence, prophylactic ICDs should be considered in high-risk patients with a predicted survival of \geq 2 years.

Clinical trials comparing ICD therapy to pharmacologic therapy have not been conducted in the very elderly population. Thus, it is unclear whether the ICD confers survival benefits to the very elderly. Other issues that may determine a recommendation for ICD therapy in the very elderly include their ability to travel for follow-up (every 6 months) and their ability to tolerate shock therapy from the device. Sinus tachycardia or atrial fibrillation with a rapid ventricular rate may result in inappropriate shock therapies in up to 20 % of ICD recipients within the first year of implantation.

Recommendations:

- Elderly patients surviving cardiac arrest or hemodynamically significant VT (not within three days of acute MI and not associated with a reversible/correctable cause) should be considered for an ICD (Class 1, Level of Evidence A).
- Elderly patients with minimally symptomatic VT and LVEF < 35% should be considered for an ICD (Class 1, Level of Evidence A).
- Elderly patients with minimally symptomatic VT and LVEF greater than 35% should receive either pharmacological therapy or an ICD (Class 1, Level of Evidence C).

- Elderly patients with a left ventricular ejection fraction < 0.30 in the setting of coronary artery disease and a life expectancy of ≥ 2 years could be considered for an ICD for the prevention of sudden death (Class II, Level of Evidence B).

Syncope/Falls

Syncope and or unexplained falls occur frequently in the elderly (54-58). In addition to brady or tachyarrhythmias, these events may be due to postural hypotension, neurocardiogenic mechanisms or carotid sinus hypersensitivity.

Investigations:

The minimal investigations required in a patient with syncope or falls suspected to be of cardiovascular etiology include a careful history and physical examination, an ECG and an echocardiogram to assess cardiac function. A rhythm strip performed during carotid sinus massage (including during an upright tilt) may identify patients with carotid sinus hypersensitivity (59). This test is contraindicated in patients with carotid bruits or documented cerebrovascular disease. A careful history can usually exclude seizure disorders and identify neurocardiogenic syncope. If symptoms are intermittent and an arrhythmia or hypotension is suspected but not documented, additional investigations might include 24-48 hour ambulatory ECG monitoring, an event recorder, tilt table test, electrophysiologic study and/or an implantable loop recorder.

Management

The SAFE PACE investigators randomized 175 patients (mean age 73 years) presenting with non-accidental falls and documented carotid sinus hypersensitivity to a trial of physiologic pacing to no pacing (59). Falls, injuries due to falls and syncope were significantly reduced in the paced patients (66%, 70% and 40% respectively).

Elderly patients with bifascicular block and recurrent syncope have been demonstrated to have intermittent high grade block based on rhythms documented at the time of recurrent symptoms following insertion of an implantable loop recorder (56). This evidence supports the concept of empiric pacing to prevent recurrent syncope in patients presenting with syncope in the setting of bifascicular block.

Neurocardiogenic syncope in the elderly may be associated with autonomic dysfunction. Although β -blockers have been advocated as an initial therapy, the efficacy of β -blockers awaits the results of randomized clinical trials (60). Removal of agents likely to provoke hypotension is frequently problematic, as many of these patients have associated hypertension. Pacing may be beneficial in prevention of recurrent syncope although the benefit of this therapy has not been specifically assessed in the elderly (58,61).

Orthostatic hypotension is a common problem in the elderly. Primary treatment should focus on nonpharmacologic measures – adequate hydration, support stockings and avoidance of standing stationary for prolonged periods of time. When conservative measures fail, available drugs include alpha-1-adrenergic agonists (mainly midodrine) or plasma volume expanders (mainly fludrocortisone). These drugs may exaggerate existing hypertension and must be used cautiously.

Recommendations:

- Elderly patients with recurrent unexplained syncope or recurrent unexplained falls should be referred to an internist, specialist in geriatric medicine or cardiologist for an expert opinion on management (Class 1, Level of Evidence C).
- Patients with recurrent syncope documented to be secondary to carotid sinus hypersensitivity (with a pause > 3s on carotid sinus massage) should receive a dual chamber pacemaker (Class I, Level of Evidence B).
- Patients with syncope in the setting of bifascicular block should be considered for a pacemaker (Class II, Level B).

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Table 1. Clinical Risk Factors for Thromboembolism in Non Valvular Atrial Fibrillation

High Risk	Intermediate Risk	Low Risk
Age > 75 years	Age 65 – 75	Age < 65
History of hypertension	Diabetes mellitus	No risk factors
Left ventricular dysfunction	Coronary artery disease	
> 1 Intermediate risk factor	Hyperthyroidism	

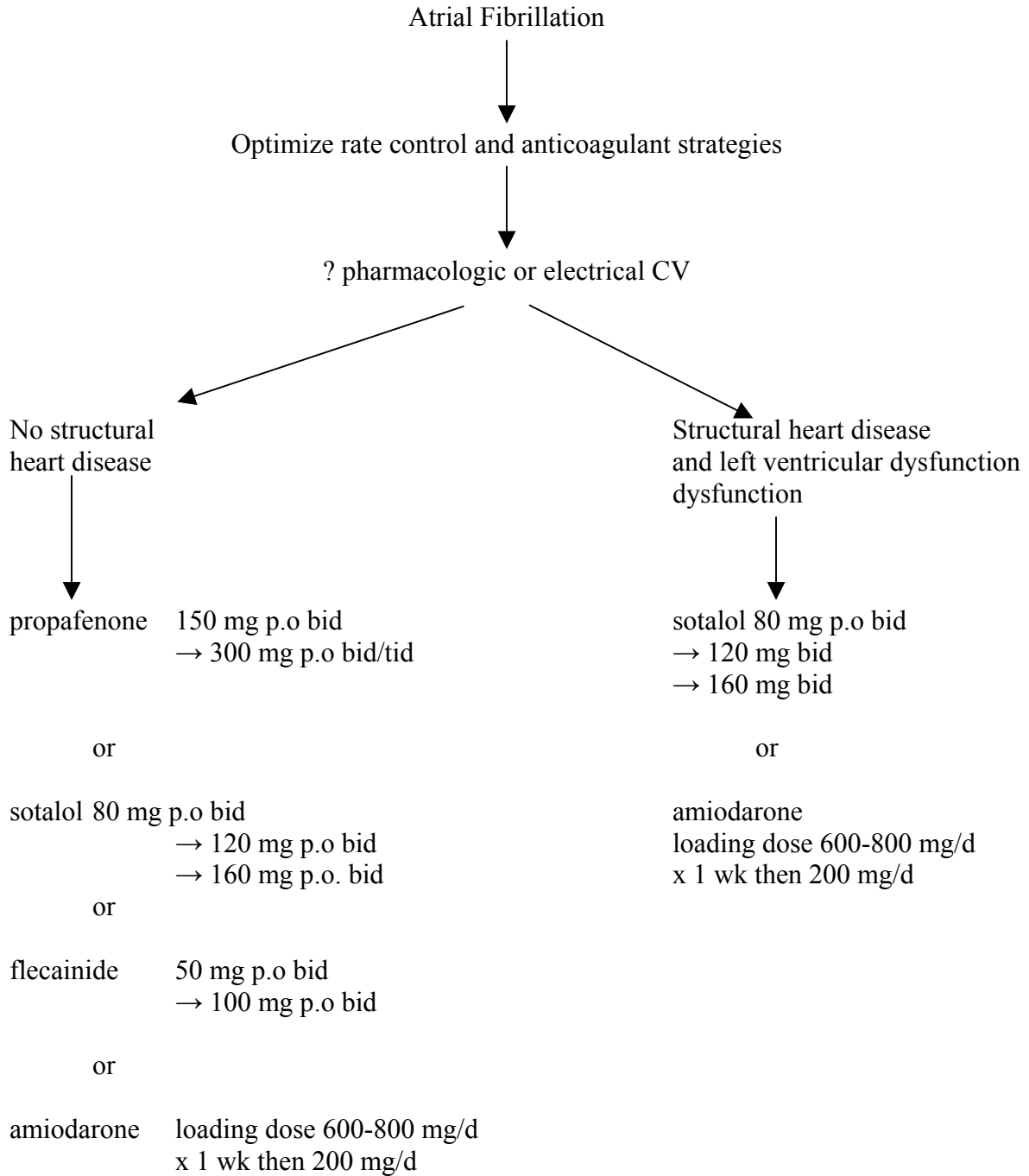
Data based on recommendations of the American College of Chest Physicians (22)

Table 2. Heart rate control for AF in the elderly

Goal: average HR ≤ 100 bpm with walking

β-blocker	metoprolol 25 mg p.o bid; ↑ to 50-100 mg p.o bid or atenolol 25 mg p.o once daily; ↑ to 50-100 mg/day or acebutolol 100-200 mg/bid or Consider combination β-blocker and digoxin
If β-blocker contraindicated consider: Ca ²⁺ channel blocker	diltiazem CD 120 mg p.o once daily; ↑180-240 mg once daily or verapamil SR 120 mg p.o once daily - bid; ↑ 240 mg once daily – bid or Consider combination calcium channel blocker and digoxin
If significant CHF or above drugs not tolerated: Digoxin	 0.0625-0.25 mg p.o daily; monitor electrolytes and creatinine
If rate controlling drugs ineffective or not tolerated consider VVIR pacemaker and AV junction ablation	

Figure 1. Approach to Rhythm Control in the Elderly



Congestive Heart Failure in the Elderly

Dr. Malcolm Arnold, University of Western Ontario

Dr. Fraser Miller, Ottawa, Ontario

Correspondence

Dr. Malcolm Arnold
Division of Cardiology
University of Western Ontario
London Health Sciences Centre
Victoria Campus
375 South St, Room S226A
London, ON N6A 4G5

Email: Malcolm.Arnold@lhsc.on.ca

It is estimated that over 350,000 Canadians suffer from congestive heart failure. As a clinical entity, it represents the only major cardiovascular syndrome expected to increase in incidence over the next twenty-five years.¹ Heart failure is currently the commonest hospital discharge diagnosis in patients over the age of 65 years. While recent Canadian guidelines have been published regarding the diagnosis and management of heart failure,² there are reasons to believe that particular attention is required with regard to their implementation in the elderly. Adherence rates to medical therapies recommended in previously published guidelines have been demonstrated to be lower in older patients.³ The elderly, and elderly women in particular have often been excluded from clinical trials in cardiovascular medicine and, therefore, strict application of 'evidence based' guidelines may not account for different characteristics and co-morbidities in this population.⁴ Thus, important opportunities exist for research and education regarding the special needs of older patients with heart failure. In aging populations, a variety of chronic diseases are more prevalent than in younger subjects. Typically, latent periods are long and symptoms, although often non-specific, should be carefully distinguished from normal aging.⁵ Identification of high-risk individuals may be beneficial, if interventions modify disease expression and the progression of disability.⁶ Quality of living, preservation of functional independence and cognitive function, as well as end of life issues may be more important for many than prolonged survival.

Elderly patients with heart disease and failure are more likely to be frail⁷ and cognitively impaired^{8,9}, are more likely to require home care, hospitalization, or institutionalization, and have an increased mortality.^{10,11,12,13,14,15} Cognitive impairment in heart failure is multifactorial as both conditions share common risk factors, including atherosclerosis, hypertension and diabetes mellitus. Hemodynamic abnormalities due to heart failure (including poor systolic dysfunction, low cardiac output and hypotension) are associated with cognitive impairment in hospitalized patients.^{16,17} Dehydration and electrolyte disturbances, which often arise from excessive diuresis, can predispose to delirium.¹⁸

The impact of frailty and cognitive impairment in elderly patients with CHF is significant. Such patients with CHF are more likely to present with atypical symptoms, such as delirium, functional decline, falls, immobility, nocturia and nocturnal incontinence.¹⁹ Cognitive impairment in patients with CHF has been associated with non-adherence to therapy, medication mismanagement, non-participation in outpatient treatment programs, accelerated functional decline and failure to recognize symptoms and seek medical attention in a timely manner.^{20,21,22,23,24}

Demographics:

Based on several recent population studies, the typical heart failure patient is elderly (often over the age of 80) and women are affected almost as frequently as men, unlike heart disease in younger individuals. The initial diagnosis is often made in hospital.^{11,25,26} Symptoms may be advanced at the time of initial diagnosis (NYHA III-IV). Co-morbid conditions such as renal dysfunction, COPD, arthritis, hypertension, diabetes and cognitive impairment or depression are common. Ischemic heart disease and hypertension are the most common etiologies of heart failure in this population.

Many elderly patients with heart failure (over 40-50% in some series) have preserved left ventricular systolic function (diastolic heart failure).²⁷ Abnormalities in left ventricular filling and/or relaxation result in elevated diastolic filling pressures, which are transmitted to the pulmonary and systemic venous circulations. Longstanding hypertension, particularly in elderly women may give rise to a form of (hypertensive) hypertrophic cardiomyopathy. Ischemia may precipitate acute pulmonary edema in spite of normal left ventricular systolic function. As diastolic function becomes progressively impaired, the left ventricle becomes increasingly dependent on atrial systole for adequate filling. Loss of atrial systole (atrial fibrillation) may precipitate acute pulmonary edema. While mortality rates for heart failure associated with preserved left ventricular systolic function are approximately half of that for patients with left ventricular systolic dysfunction, all cause- and CHF admissions to hospital are similar.²⁸ Large randomized trials in the treatment of heart failure associated with preserved left ventricular systolic function are lacking (although in progress) and current guidelines for the most part recommend aggressively treating the conditions thought to be responsible (hypertension, ischemia, arrhythmia).

Prognosis

Survival rates for elderly patients with heart failure typically average less than 35% at five years. Among community-dwelling elderly patients hospitalized for heart failure, one-year survival rates may be as low as 50%. In one retrospective study of very elderly (mean age 89yrs) long-term care residents hospitalized with CHF, one-year mortality was 87%.²⁹ Prognosis worsens with increasing New York Heart Association functional class. A variety of medical (blood pressure, co-morbidities, functional status)³⁰, social (marital status, social isolation)³¹, and psychosocial (in particular depression and self-rated health)^{32 33} factors have significant effects on survival. To what extent particular attention to these factors in the patient with heart failure may modify outcomes is an area worthy of further research.

Prevention and Screening

Screening for heart failure and treatment of patients at increased risk of developing heart failure are useful if interventions can modify the natural history of the condition and are safe and evidence-based.

Control of systolic hypertension in the elderly is important in the prevention of heart failure, especially in patients with a past history of myocardial infarction. The SHEP Trial³⁴ demonstrated that the risk of heart failure could be significantly attenuated in such patients by blood pressure lowering with a thiazide diuretic as first line therapy and similar findings were obtained recently in ALLHAT.³⁵ The SOLVD Prevention Trial demonstrated that treatment of asymptomatic left ventricular systolic dysfunction (LVEF<35%) with an angiotensin-converting enzyme inhibitor (enalapril 10 mg BID) could delay the expression of symptoms of heart failure by an average of eighteen months, but patients over the age of eighty were not randomized into this study.³⁶

Frail, elderly in-patients appear to be at elevated risk for iatrogenic heart failure (secondary to administration of fluids or blood products, or as a result of medication effect or procedural complications). Hospital mortality is particularly high in this group, and lengths of stay are prolonged.³⁷ Intravenous fluids need to be administered with caution and close monitoring. Commonly used drugs (all NSAIDS, thiazolidinediones and corticosteroids) may precipitate heart failure in patients not recognized to be at increased risk. Excess salt or fluid in the diet may cause fluid retention in susceptible individuals. Further research is needed to define at-risk populations and management strategies.

Diagnosis and Investigations

The goals of heart failure management include alleviation of symptoms, prevention of progression of disease and hospitalization, and where possible, maintenance of functional capacity and improvement in life expectancy. Symptoms of heart failure (fatigue, breathlessness) may be confused with normal aging. Delirium, a marked decline in functional status, recent onset of peripheral edema, or nocturnal symptoms (cough, dyspnea, nocturia, incontinence) warrant further investigations for heart failure. The evaluation of older patients suspected of having heart failure should attempt not only to confirm a clinical suspicion, but also document the presence of co-morbid conditions contributing to disability. All elderly patients with a diagnosis of heart failure should have a well-documented social history including their home environment, their caregivers, and their response to an emergency. Elderly patients with CHF should be screened for cognitive impairment and suitable tools include the Mini-Mental State Examination^{38,39}, and Clock test.⁴⁰ Hospitalizations are common and may be preventable.⁴¹ Frail or cognitively impaired elderly and complex heart failure patients should be referred to specialized services (e.g. comprehensive geriatric assessment, CHF clinics) where available.

The basic investigations for heart failure do not significantly differ in the older patient and include complete blood count, routine biochemistry, including renal and liver function tests, and thyroid-stimulating hormone assay (given a high prevalence of thyroid dysfunction in the elderly), chest x-ray and electrocardiogram. As in younger individuals there should be an objective assessment of left ventricular function.⁴² Patients presenting with acute pulmonary edema should undergo investigations and evaluation to determine contributing causes

(infection, ischemia, arrhythmia, medication changes or non-compliance). Other investigations would depend on the level of suspicion for other disorders based on the presenting history and physical. The appropriateness of referral for invasive investigations for coronary or valvular heart disease must be individualized: it should not be based on a consideration of chronological age alone, but should be based on an estimation of active life expectancy, anticipation of benefit and the risks associated with intervening. All elderly patients with heart failure should be offered pneumococcal and influenza vaccines.

Exercise and Lifestyle Modification

The theoretical benefits of exercise in heart failure include reduced neurohormonal activation, improved endothelial function and skeletal muscle physiology and improved perceived quality of life. Most studies demonstrating the benefits of exercise in heart failure have enrolled patients under the age of 60, and results cannot necessarily be extrapolated to frailer, older adults.⁴³ Because lower extremity strength is closely associated with independent living, it is reasonable, where possible to recommend some form of low intensity training even in very elderly patients. Education of patients and caregivers is advisable, particularly with regard to dietary changes (salt and fluid restriction) and the value of exercise. Financial constraints and living conditions may limit the range of foods available. Foods typically rich in sodium (canned soups, cured meats and frozen dinners) often represent a convenient source of calories, but may exacerbate heart failure. Home care nurses, dietitians, physical and occupational therapists, and social workers may offer valuable resources for maintaining older patients in the community. Medication surveillance, dietary advice, exercise prescription, energy conservation techniques and recommendations for assistive devices or referral to specialized services (day hospitals, day-away programs, CHF clinics) may provide crucial support to maintain patients in the community.

Drug Therapy in CHF

There are limited data regarding optimal drug therapy for heart failure in the very old (age >80). There is no reason to believe, on the other hand, that pharmacological therapy of heart failure in the elderly is inherently dangerous, although polypharmacy may pose certain hazards in an aging population. Small studies and subgroup analyses in large clinical trials have demonstrated the safety and efficacy of standard therapies in elderly patients with CHF and these have been reviewed in recent Canadian Guidelines.²

Diuretics should be prescribed in all patients with symptoms or signs of pulmonary or systemic congestion. Once daily dosing is preferable and monitoring of renal function and electrolyte balance should follow changes in therapy. Patients experiencing symptoms of hypo perfusion or worsening renal insufficiency during up-titration of neurohormonal blockade therapy should have the dose of diuretic divided or reduced. During long-term therapy, the dose of diuretic may have to be adjusted several times to allow up-titration of other drugs and to achieve the lowest dose compatible with stable weight and symptoms.

Digoxin was a mainstay of therapy in congestive heart failure although there have been reports of over-utilization in the elderly. These have been from trials, which have shown that as many as 75% of patients appeared to experience no adverse effects after digoxin was discontinued. These trials often did not include an assessment of left ventricular function or strict definitions of heart failure. Digitalis toxicity may present atypically in older subjects (falls, anorexia, depression, confusion) and may occur at “normal” serum levels.⁴⁴ The Digitalis Investigation Group (DIG) study evaluated the benefit of digoxin in patients with stable heart failure mainly due to left ventricular systolic dysfunction (LVEF < 45%) but a smaller ancillary study also evaluated patients with LVEF >45%. Twenty seven percent of patients in the main trial were >70yrs of age. While advancing age was an independent risk factor for complications of digoxin therapy (toxicity, hospitalization for toxicity), the benefits of therapy to reduce hospitalizations were maintained across all age groups.⁴⁵ Total mortality was not reduced. In the DIG study, digoxin dose was adjusted using an algorithm for age, sex, weight, and renal function⁴⁶. Despite this, post hoc analysis of the trial results found that women with CHF may be a greater risk of death if they taking digoxin⁴⁷. Careful use of digoxin, especially in those with significant renal dysfunction, may be helpful for symptomatic control and to reduce hospitalizations in those with severe symptoms and very poor heart function.

Angiotensin converting enzyme (ACE) inhibitors should be considered in all elderly patients with chronic heart failure although there are limited data on their effectiveness in older subjects. The CONSENSUS Trial⁴⁸ (enalapril) excluded patients over the age of 75, and the SOLVD⁴⁹ (enalapril) and SAVE⁵⁰ (captopril) trials excluded patients over the age of 80. The AIRE (ramipril) Trial⁵¹ did not exclude patients on the basis of age alone, and while there was a trend toward better outcomes in the population over the age of 65, numbers were not great enough to reach statistical significance. A recent small-randomized trial of 66 patients (mean age 81 yrs) with symptomatic systolic heart failure showed that perindopril was associated with a statistically significant 37-meter increase in 6-minute walking distance over 10 weeks.⁵² For a frail older person, the magnitude of this effect could mean the difference between being independent or housebound but the results need confirmed in a larger trial. Preliminary evidence from a non-randomized cohort study suggests that ACE inhibitors, compared to digoxin, may reduce the rate of functional decline in elderly patients (mean 85yrs) with heart failure after transfer to a nursing home from an acute care hospital.⁵³

Because of the importance of ACE-inhibitors in heart failure management, some caveats are helpful to maximize success. When introducing and uptitrating the dose of an ACE-inhibitor in the elderly, it is important to start with low doses and increase slowly towards target clinical trial doses (enalapril 10 mg bid, lisinopril 20mg od, ramipril 10 mg daily, captopril 50 mg tid) or a lesser maximally tolerated dose. The dose of diuretic may be reduced if there is no fluid retention to maintain stable blood pressure. In some elderly patients it may be helpful to separate the timing of the ACE-inhibitor and diuretic doses to avoid peak hemodynamic effects. Blood pressure should be measured standing as well as sitting or supine. Renal function and serum potassium should be followed and rechecked after changes in ACE-inhibitor or diuretic dose or with a significant change in clinical condition. A twenty percent increase in serum creatinine is not unexpected based on how the medications work and, if stable, is not sufficient reason in itself to discontinue the drug.

The Elite II Trial randomized only patients over the age of sixty and compared the ACE-inhibitor captopril with the angiotensin receptor blocker losartan. The trial failed to demonstrate the superiority of losartan in the elderly, but the drug tended to be better tolerated (fewer withdrawals due to cough).⁵⁴ The equivalence of angiotensin receptor blockers to ACE inhibitors in reducing mortality from CHF remains to be confirmed.⁵⁵ The addition of valsartan to an ACE-inhibitor may reduce heart failure hospitalizations particularly in those not on a beta-blocker.

Spironolactone in low doses (mean 26 mg/day) was investigated in the RALES Trial⁵⁶ which enrolled a population of patients (mean age 65yrs) with advanced (NYHA III-IV, LVEF <35%) heart failure, being treated with an ACE-inhibitor and loop diuretic, but excluded patients with renal impairment (creatinine >220micromoles/l) or other significant co-morbidities. Spironolactone significantly reduced mortality by 30% and hospitalizations for worsening heart failure by 35%, and significantly improved NYHA functional class. Thus, low doses of spironolactone are recommended in patients with severe heart failure despite optimized medical management. Gynaecomastia occurred in 10% of men. Note should also be taken that serum potassium and renal function were followed closely in the study at 1, 2, 3, 6, 9 and 12 months and 6 monthly thereafter. With this close surveillance, there was no excess of hyperkalemia or renal dysfunction. Unless hypokalemia (<3.5 mmol/l) is present, oral potassium supplements are not recommended.

Beta-blockers may also be useful in older patients, as the activation of the sympathetic nervous system appears to be proportionately greater than that of the renin-angiotensin system. On a background of ACE-inhibitors and other standard therapy at the time, beta-blockers improved survival by 30-35% and also improved left ventricular function. However, older patients have not been well represented in the large beta-blocker trials and withdrawal rates tended to be higher. Standard contraindications to beta-blocker use apply, including second or third degree heart block and significant reactive airways disease. Concerns about beta-blocker effects on cognition appear to be based more on anecdotal reports rather than rigorous scientific evidence and concerns about potential side effects should not deter physicians from treating elderly patients with symptomatic heart failure. The beta-blocker should be started in very low doses, increased slowly over several weeks to months, but target doses would be metoprolol 75mg bid, carvedilol 25 mg bid, and bisoprolol 10 mg od (these drugs

were studied in the recent major trials). Follow up should include monitoring of heart rate, blood pressure and symptoms, and adjustment in concomitant medications as required. If a side-effect attributable to the beta-blocker occurs, the drug may be reduced to the previously well tolerated dose for an extra few weeks and then uptitration repeated with a lesser incremental dose. Patients on a stable dose of beta-blocker, presenting with decompensated heart failure, may have their dose of beta-blocker reduced by 50% temporarily but generally the drug does not have to be discontinued permanently.

Many of the drugs used in the treatment of heart failure exhibit altered pharmacokinetics (e.g. digoxin) and pharmacodynamics (e.g. beta-blockers) in the elderly. Renal function typically declines with aging and a serum creatinine level, for example, of 80 mmol/l in a slender octogenarian does not necessarily imply normal renal function. Renal function can be evaluated using timed urine collections or estimated using methods such as the Cockcroft-Gault equation, and drug dosages adjusted accordingly.⁵⁷

Existing guidelines would appear to be reliable in patients up to the age of 80 years without significant comorbidities, but caution should be used in extrapolating these trials to older or sicker elderly patients. The elderly are at greater risk for complications of side effects (falls, fractures, renal failure) and care must be taken in initiating drug therapies known to influence blood pressure, electrolyte balance and renal function, even in the presence of normal indices of renal function. Elderly patients are particularly sensitive to hypotension associated with loop diuretics⁵⁸. There is also evidence to suggest that long-acting ACE inhibitors are associated with less first-dose hypotension than shorter acting preparations⁵⁹. Renal dysfunction that occurs when ACE inhibitors are introduced is generally attributable to over-diuresis or use of NSAIDs⁶⁰. In view of possible dangers of drug effects, and in the absence of clinical trials enrolling sufficient numbers of elderly subjects, agents should be slowly titrated to a maximally tolerated dose even if that be less than the 'clinical trial target dose'. Treatment programs should strive to simplify drug regimes by, for example, selecting drugs administered on a once daily basis, and emphasizing the avoidance of diuretic administration late in the day to reduce nocturia.

The concomitant use of drugs of limited value (e.g. NSAIDs⁶¹ for osteoarthritis), which may potentially worsen symptoms and complicate therapy, should be discouraged when safer alternatives (e.g. acetaminophen) exist.

CHF Clinics

There is clearly a need for expanding the role of CHF clinics in the management of frail elderly patients with CHF. High-risk patients in hospital can be identified with simple criteria and a comprehensive multi-dimensional assessment has been shown to significantly reduce subsequent hospitalizations and lengths of stay.⁶² Such clinics can also serve as a resource to families and local health care providers. Institutions and health care authorities should encourage the development of such clinics and the role of the clinic nurse as case manager. Where resources are available, geriatricians, rehabilitation specialists, dietitians, social workers, pharmacists, clergy and others can all play a valuable role.⁶³ Home-based care with visiting nurses or interactive telecommunications may be particularly well suited for rural areas.

Recommendations for future research and education:

Relatively little is known about the majority of elderly patients suffering from heart failure. Research is needed to better define the characteristics of the population and their special needs. Enhanced geriatric teaching in internal medicine and cardiology training programs has been advocated as a means of improving care of the elderly and stimulating an interest in research issues. There are significant co-morbidities such as depression, frailty and cognitive impairment which have been shown to impact significantly on adverse outcomes such as functional decline, home care service utilization, institutionalization, hospitalization and mortality. It is not known whether standard therapies have an effect on such outcomes. Clinical trials enrolling a broad spectrum of elderly patients should be encouraged.

Recommendations:

- Hospitals and health regions should be strongly encouraged to support the development of specialized heart failure programs, components of which may include in-patient consultation, out-patient clinics and outreach programs. (Class I, Level A)
- Educational efforts and interventions are recommended for family physicians to improve the early recognition, detection and diagnosis of heart failure amongst people at increased risk and who present with atypical symptoms. (Class I, Level C)
- Initial physical evaluation of each patient requires a detailed medical and social history and careful examination of both non-cardiovascular and cardiovascular signs including supine and erect blood pressure, mobility and exercise tolerance. Initial and ongoing screening for affect, function and cognition is required. In patients with cognitive impairment, education on the management of CHF should be directed at a cognitively intact caregiver. Particular attention must be paid to avoid inappropriate polypharmacy, potential drug interactions and inadvertent aggravation of co-morbid conditions. (Class I, Level C)
- Investigations should include an ECG, chest X-ray, Echo or other non-invasive assessment of heart size and
- function, CBC, electrolytes, renal function and others as indicated by history and physical examination.
- (Class I, Level C)
- Although the elderly have not been the primary focus of most heart failure clinical trials, sub-group analyses suggest that the results of such trials are applicable and current national heart failure guidelines should be applied. (Class I, Level A)

ACE inhibitors, unless contraindicated by angioedema or bilateral renal artery stenosis, are recommended in all patients with heart failure, but can lower blood pressure and should be introduced in very low doses to avoid postural hypotension. The dose should be subsequently increased as tolerated to “clinical trial” doses. (Class I, Level A)

- Angiotensin receptor blockers are recommended in elderly patients with heart failure who are unable to tolerate angiotensin-converting inhibitors because of cough or other side effects. Similar precautions should be applied with regard to renal function and angioedema. (Class I, Level A)
- Beta-blockers, unless otherwise contraindicated, are recommended in all patients with symptomatic heart failure, but should be used with greater caution in patients with a past history of syncope or suspected to be at an increased risk of sick sinus syndrome. (Class I, Level A)

Spirolactone is recommended in all patients with severe heart failure without significant renal dysfunction as measured by creatinine clearance, but renal function and serum potassium require close monitoring. (Class I, Level A) Other diuretics are indicated in the lowest doses required to maintain stable weight and symptoms in all heart failure patients who have current or previous fluid retention. (Class I, Level B)

- Digoxin is recommended in patients who remain symptomatic in spite of optimized medical therapy including ACE-inhibitors (ARB if appropriate), beta blockade, and adequate diuresis. (Class I, Level A) Caution must be exercised in the elderly who are at greater risk for digoxin toxicity and its complications, and normal serum digoxin levels should not be relied upon to rule out digoxin toxicity

- Patients' wishes for quality of living and end of life issues should be established and periodically reviewed as appropriate. (Class 1, Level C)
- It is strongly recommended that the appropriate changes in the health care system be implemented to improve appropriate home based care for elderly heart failure patients. (Class 1, Level C)
- Research is required to determine whether standard therapies for CHF can maintain functional capacity and cognition in older patients with CHF, as well as prevent institutionalization, hospitalization and reduce mortality (Class 1, Level C).

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Percutaneous Coronary Interventions and Cardiac Surgery in an Elderly Population

Michelle M. Graham MD1, William A. Ghali MD2,
and Raymond Cartier MD3,

1University of Alberta (Edmonton), 2University of Alberta (Calgary), 3University of Montreal

Correspondence:

Dr. Michelle M. Graham

Division of Cardiology, University of Alberta Hospital

8440-112 Street

Edmonton, Alberta T6G 2R7

Phone (780) 407-1590

FAX (780) 407-6452

Email mmgraham@cha.ab.ca

The management of elderly patients with symptomatic ischemic heart disease is challenging, and an increasing number of elderly patients are being referred for revascularization by percutaneous coronary intervention (PCI) or coronary artery bypass graft (CABG) surgery. Early randomized trials of revascularization excluded elderly patients, such that data from younger patients have had to be extrapolated to older age groups. Results specific to the elderly have most often been provided by small, single center series, which initially reported less successful revascularization and more adverse outcomes for this population[1-4]. In addition, the definition of “elderly patients” has been variable across studies, with many series reporting on patients over age 65, 70, 75, and 80 years of age.

1. Morbidity and Quality of Life Following Revascularization

In general, elderly patients undergoing CABG have greater disease severity and higher surgical urgency[5-8]. The incidence of peri-operative morbidity increases with increasing age, with atrial arrhythmias reported in 20-60%, renal insufficiency in 5-15%, congestive heart failure in 11-29%, and myocardial infarction in up to 16% of patients [9]. In a study of adverse cerebral outcomes post CABG, Roach et al found that 6.1% of a general population of patients experienced cerebral events ranging from subtle cognitive deficits to devastating focal injury. Age over 70 years was a predictor of outcome in this study [10]. Delirium is also common. In a Canadian prospective cohort study, Rolfson and colleagues found that 32% of a cohort of bypass surgery patients over age 65 experienced delirium, but that this was not associated with other adverse outcomes in the short term [11]. Finally, peri-operative mortality is higher in the elderly [12,13]. Similar observations have been made with respect to PCI, where the elderly (variably defined as over age 70 or age 75) have higher rates of procedural complications including myocardial infarction, and emergency CABG[14]. Increased restenosis and death have also been reported[15-17].

Revascularization is generally performed to relieve symptoms of ischemia and improve quality of life. Despite the higher rates of procedural complications, elderly patients undergoing CABG or PCI usually experience functional improvement, often greater than that seen in their younger counterparts [18-22]. Improved quality of life is seen even in the very elderly. In a study of 127 octogenarians, Fruitman and colleagues found that 95%

D of patients were New York Heart Association Class I or II at follow-up, with good relief of symptoms and quality of life scores equal to or better than those for a general population over the age of 65 [23].

2. Evidence for improved survival with revascularization procedures

R The combination of complications and poor outcomes have led some to question the value of aggressive revascularization in elderly patients[24]. However, there is evidence that outcomes are improving, beginning

with the Coronary Artery Surgery Study (CASS) Registry, where Gersh et al found long-term survival benefit with revascularization in patients over age 65; this was greatest in those patients considered to be at highest risk – those with severe symptoms of angina or heart failure, and patients with acute coronary syndromes[25].

A Further evidence is provided from observational studies examining outcomes of elderly patients undergoing

revascularization without associated data on medically treated controls. A retrospective study using the National Medicare database by Peterson et al [26] found that despite a higher risk profile, one-year mortality

I rates in patients over age 65 undergoing CABG from 1987-1990 had decreased by 19%. Hirose and colleagues

[27] reported a series of patients >75 years of age who underwent surgery between 1991 and 1998, and noted increased surgical risks, but long-term cardiac event-free survival was almost the same as that of a cohort of

younger patients. In a report from the National Cardiovascular Network using 1994-1998 data, Alexander and colleagues[28] found significantly higher in-hospital CABG mortality in 4743 octogenarian patients relative to

younger patients, coupled with twice the risk of peri-operative stroke or renal failure. However, they also noted

T that elderly patients without significant comorbidities had mortality rates approaching those seen in younger patients (4.2% v. 3.1%).

These recent improvements in the outcomes of CABG may arise partially from the mortality advantage and increasing use of internal mammary artery grafts, which have been shown to be equally beneficial in elderly and in younger patients[29-33]. In addition, new surgical techniques such as off-pump procedures (OPCAB) are attractive due to initial reports of diminished rates of stroke [34], perioperative atrial fibrillation, and need for blood transfusion [35,36]. Reduced use of intra-aortic balloon counterpulsation and decreased length of stay have also been reported [37]. However, there are conflicting data with regards to mortality with OPCAB

[34,38-40], and with a recent randomized trial found a small improvement in cognitive outcomes at three months, but the effects were limited and became negligible at one year [41]. The experience of the surgical team performing off-pump procedures does influence outcome as well [42]. Accordingly, the use of this procedure should only be recommended in appropriate centres.

Similar improvements in outcome have been demonstrated in patients undergoing PCI. Peterson et al [26] also noted a 22% reduction in one-year mortality after PCI during their analysis of 1987-1990 National Medicare data. Batchelor and colleagues[43] recently reported a large series of 7472 octogenarians who underwent PCI at National Cardiovascular Network Hospitals from 1994-1997. While there continued to be increased procedural risks relative to younger patients, including myocardial infarction, stroke, renal failure, and vascular complications, outcomes improved over the four years of observation. Ang and colleagues [44] also found that procedural and clinical outcomes after PCI are similar for patients in their eighth decade compared to those in their ninth decade.

3. Studies of revascularization versus medical therapy

Although comparisons of outcomes across age groups are informative, a more important comparison is that between elderly patients who undergo revascularization and those who are treated medically despite severe coronary artery disease. Recently, the only randomized trial of invasive versus medical therapy in elderly patients (the TIME trial) was published. This was a small trial of 305 patients over the age of 75, demonstrating greater benefit from revascularization (either PCI or CABG) relative to optimized medical therapy in terms of symptom relief and quality of life[45]. There was a significant reduction in major adverse cardiac events with revascularization, despite an immediate higher mortality in the invasive group, which subsequently had improved 6-month survival. However, this was a small trial with relatively short follow-up. Given the careful patient selection associated with clinical trials, important questions remain regarding the applicability of the TIME trial's findings to unselected patients receiving cardiac care.

DSollano and colleagues [46] compared the outcomes of a cohort of octogenarians undergoing CABG with those of a cohort of octogenarians treated medically and a subset of that cohort who were offered CABG but declined the procedure. They showed that the survival to 3 years was significantly higher in the CABG group (80% v. 64% in the medically managed group). A small German study of 398 patients over the age of 75 found that patients treated medically had a 5-year survival rate of 58% compared with 73% for PCI and 67% for CABG [47]. The Alberta Provincial Project for Outcomes Assessment in Coronary Heart Disease (APPROACH) [48] has recently examined a large series of over 6000 elderly patients with ischemic heart disease who were treated in the province of Alberta between 1995 and 1998. These patients were followed long-term regardless of whether they were treated medically or with revascularization. **A** Long-term (4-year) survival after adjustment for baseline characteristics (including cardiac risk factors, cardiac history, comorbidities, ejection fraction, and coronary anatomy) in 5198 patients between the ages of 70 and 79 years were 87.3% for CABG, 83.9% for PCI, and 79.1% for medical therapy ($p < 0.0001$). In 983 patients over the age of 80, adjusted survival rates were 77.4% with CABG, 71.6% with PCI, and 60.3% with medical therapy ($p < 0.0001$) [49]. Therefore, in this series of elderly patients from Alberta, revascularization was associated with better outcomes than was medical therapy alone. This benefit persisted after adjustment for severity of illness differences between groups. **T**

4. Caveats

There are many issues complicating the use of invasive procedures in elderly patients with ischemic heart disease. The question of which elderly patient should undergo coronary angiography in the first place is a difficult one. Frailty and fitness must be assessed on an individual basis, and the risks and benefits of the procedure must be reviewed with the patient prior to proceeding. As mentioned in the section on Acute Coronary Syndromes, cardiac catheterization should be considered in those patients with high-risk features. Patients with a more stable clinical picture should be considered for cardiac catheterization if disabling symptoms persist despite adequate medical therapy, or if there is objective evidence of significant ischemia.

Once a decision is made to proceed with invasive assessment, the revascularization procedure of choice then becomes an issue. Direct comparison of PCI versus CABG suggests that long-term survival is comparable in certain anatomical subgroups of patients, albeit with increased repeat revascularization in the PCI patients [50-56]. Many patients may not be ideal candidates for CABG on the basis of preference or frailty, but could likely tolerate attempted PCI, in many instances with good effect. This was demonstrated in the AWESOME trial, a randomized comparison of CABG versus PCI in 454 medically refractory patients with myocardial ischemia, anatomy appropriate for either revascularization procedure and at least one high-risk feature for adverse CABG outcomes (age >70, previous heart surgery, EF <35%, IABP pre-operatively, and MI within 7 days). Long-term survival was comparable among the 2 treatment strategies, with more frequent repeat revascularization in the PCI group. Although an analysis specific to elderly patient was not conducted, over half of the patients in this trial were over the age of 70 [57]. A registry consisting of eligible patients who refused randomization, and patients who were directed to PCI or CABG by physician preference (a total of 1977 patients) found similar results [58].

Finally, regardless of the choice of revascularization modality, medical therapy should be a priority in all patients. As mentioned in other chapters, the use of proven therapy such as beta blockers, aspirin, lipid lowering agents, and vascular protective agents should be optimized.

Summary:

Elderly patients have higher risks of morbidity and mortality early following revascularization procedures.

Elderly patients who are revascularized have significantly improved quality of life following these procedures relative to patients who are not revascularized.

Outcomes following revascularization procedures in elderly patients are improving over time.

PCI is an acceptable, and sometimes preferred alternative to CABG in many elderly patients with ischemia.

The use of revascularization procedures does not obviate the need to provide good medical therapy including attention to secondary prevention and vascular protection.

Recommendations:

The combination of recently published randomized trial data and observational data should be sufficiently compelling evidence to support a shift towards an aggressive treatment strategy in appropriate subsets of elderly patients. Age alone should not be viewed as a contraindication to these procedures (Class I, Level B).

Research Recommendations:

There is a need to develop cardiac registries across Canada to better evaluate outcomes in elderly patients with ischemic heart disease.

Resources should be directed into further research evaluating new PCI and CABG techniques that have the potential to reduce procedural mortality and complications. For PCI this includes drug-eluting stents to reduce or eliminate restenosis, and the use of newer antithrombotic agents. Evolving strategies to reduce stroke may broaden the indications for surgical revascularization. These include epi-aortic surgery, no-touch aortic techniques, and OPCAB.

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Valvular Heart Disease and the Elderly

CM Chow¹, T. Yau², R Cartier³

¹St Michael's Hospital, Toronto, ²Toronto General Hospital, ³Montreal Heart Institute

Correspondence

Chi-Ming Chow MDCM MSc FRCPC
Division of Cardiology
St Michael's Hospital
30 Bond St
Toronto, ON M5B 1W8

Email: cmchow@compuserve.com

Introduction

Valvular heart disease in the elderly is an important health issue. An increasing number of elderly patients with valve disease are coming to specialist medical attention consequent to the ageing of the population, the increasing use of echocardiography [1] and a greater acceptance of cardiac surgical procedures in the elderly. Today more than 30% of patients having valve surgery are more than 70 years old, and the proportion of patients aged >70 years has doubled over the past 10 years [2].

Calcific aortic stenosis and mitral regurgitation due to mitral valve prolapse are the most frequent valvular lesions seen in the elderly, although rheumatic mitral stenosis and aortic insufficiency are not uncommon [3,4]. This document will discuss the diagnosis and management of valvular heart disease in elderly patients with special focus on aortic stenosis and mitral regurgitation.

One of the major challenges in determining the optimal treatment for elderly patients with valvular heart disease is the lack of controlled clinical trial information. Consequently treatment guidelines are usually derived from registry and observational data. Medical treatment (including antibiotic prophylaxis[6]) and indications for surgical treatment in elderly patients with valvular heart disease are similar to those for younger patients[5]. However, there are special issues that affect the success of surgery and long-term outcomes, which need to be considered in an elderly patient.

Aortic Stenosis

Calcific aortic stenosis affecting the trileaflet aortic valve is the most common valvular heart lesion requiring surgery in the elderly. Congenital bicuspid valves and rheumatic disease are more commonly found in younger patients, yet may be responsible for aortic stenosis in the elderly. Although calcific aortic stenosis was once thought of as a degenerative lesion, it shares many similarities with atherosclerosis [7]. Both conditions are more common among men, older patients, in association with dyslipidemia, and both derive in part from an active inflammatory process [8]. Anginal chest pain is the most common presenting symptom in older patients, although 20% present with heart failure. One third of patients will have impaired left ventricular function and half significant coronary artery disease [9]. Elderly patients with aortic stenosis may present with frequent falls, which are due to unrecognized syncope and consequently are often ignored.

Assessment of the severity of aortic stenosis in the elderly by clinical findings alone can be difficult, resulting in both an under- and overestimation of the severity of the stenosis. Echocardiography provides an accurate assessment of valve stenosis and should be requested in elderly patients presenting with chest pain, dyspnoea or syncope who have a systolic murmur of possible aortic valve origin [1].

Symptomatic patients with hemodynamically significant aortic stenosis should be considered for aortic valve replacement irrespective of age, after taking into account comorbid conditions and frailty. Left ventricular dysfunction should not necessarily detract from a surgical approach, as valve replacement may be feasible with acceptable risks with a marked improvement of quality of life.

Mitral Regurgitation

The most common causes of significant mitral regurgitation in an elderly population are: a) Myxomatous degeneration of the mitral apparatus with resulting prolapse, b) Mitral annular calcification, and c) Papillary muscle dysfunction or tethering due to infarction or ischemia of the adjacent myocardium [10, 11].

Severe mitral regurgitation is often tolerated for many years in older patients without either symptoms or signs of heart failure. Yet the patient with dyspnea or heart failure who has clinical and echocardiographic evidence of severe mitral regurgitation should be evaluated for mitral valve surgery.

Objectives of Valvular Surgery in Elderly Patients

The relief of symptoms and improvement of quality of life are the primary goals of surgical management of valvular heart disease in an elderly patient. How symptoms interfere with lifestyle, and the likelihood of surgical success (both survival from surgery and improvement of symptoms) are important in the decision process. It is important to consider comorbid conditions (e.g. chronic obstructive pulmonary disease and renal insufficiency) that is more common in an older patient and may limit the success of surgery.

Evaluation of Operative Risk in Elderly Patients

Operative Mortality

Although operative mortality in elderly patients undergoing valvular surgery is greater than that in younger patients, surgical series have reported acceptable outcomes (mortality 5-17%), dependent on valve position and associated coronary bypass grafting [12, 14-17]. Comorbid conditions and frailty, rather than age itself, appear to be the primary determinants of peri-operative survival in these elderly patients.

Predictors of operative mortality and morbidity which apply to patients of all ages undergoing heart valve surgery include the presence of left ventricular dysfunction, associated coronary artery disease, pulmonary disease, renal insufficiency, endocarditis and the urgency of surgery [14, 15]. Renal dysfunction, a common problem in elderly patients is especially important in determining the outcome of all types of cardiac surgery. The frailty of an elderly patient (a more ambiguous factor that includes physical activity, cognitive function, and depression) is an important factor that will play a large role in determining perioperative mortality and long-term rehabilitation. Selection of elderly patients for surgery should be individualized and take into account both comorbid conditions and frailty.

Peri-operative Stroke

Peri-operative stroke is more frequent in elderly patients and has a major impact upon rehabilitation and survival. The post-operative stroke rate is significantly higher among patients undergoing combined valvular and CABG surgery (3.4%) when compared with patients undergoing either valvular (1.3%) or CABG surgery (1.2%) alone [13]. Female sex, prior neurological event, aortic atherosclerosis, diabetes, atrial fibrillation, and duration of cardiopulmonary bypass are recognized risk factors for post-operative stroke [13].

Long-term Morbidity

Elderly patients are particularly susceptible to lifestyle-altering long-term neurologic and renal morbidity. In fact, the possibility of these adverse outcomes is likely to influence an elderly patient making a decision to undergo surgery more than the risk of peri-operative mortality. Patients with mild or early signs of dementia may suffer a significant decline in their cognitive abilities, necessitating escalation of supportive care and increasing concerns about safety.

Selection of Bio- versus Mechanical Prostheses in Elderly Patients

Bioprosthetic valves are often favored in older patients, primarily because long-term anticoagulation is usually avoided. The durability of bioprosthetic valves has improved such that current prostheses have a projected structural valvular deterioration (SVD) of 15% at 10 years and less than 50% at 15 years. Thus for most elderly patients the chance of requiring valve re-replacement during their lifetimes is low. Yet as younger elderly patients (e.g. aged 65-75) with no frailty or comorbidity may have a natural life expectancy, which could be longer than that of a bioprosthesis, they should be given the choice of an either a bio- or mechanical prosthesis.

The risk of major and minor bleeding has been consistently greater in patients with mechanical valves compared to bioprostheses due to the greater need for oral anticoagulation. Whether the risks of long-term warfarin are disproportionately increased in elderly patients is controversial [16,17]. In the very old (> 80 years), advanced age and the intensity of anticoagulation are predictive of bleeding [18]. Attention should be paid to issues in elderly patients that may increase the risk of complications such as a tendency to falling, or drug interactions. Furthermore many elderly patients have difficulty with medication compliance due to inattentiveness or

memory problems, reduced dexterity and impaired visual acuity, which may limit the chance of maintaining anticoagulation within the therapeutic range. These issues may also be a factor in the choice of prosthesis, as the consequences of both inadequate and excessive anticoagulation may be severe for the patient with a mechanical valve.

Bioprosthetic valves are an excellent choice for most elderly patients, with reduced anticoagulation-related morbidity and more-than-adequate valve longevity. However approximately one-third of patients with bioprosthetic valves, particularly in the mitral position, will ultimately require long-term anticoagulation for conditions such as atrial fibrillation[2]. The avoidance of mechanical prostheses on the basis of age alone is probably not justified, as mechanical valves may be preferable in the fit elderly patient with excellent anticipated longevity. A suggested algorithm for valve selection [37] suggests that patients requiring anticoagulation due to atrial fibrillation or with other risk factors for thrombo-embolism usually receive a mechanical valve. For older patients who do not require anticoagulation, or have either contraindications to or unwilling to take oral anticoagulation, a bioprosthesis is the valve of choice in either aortic or mitral position. It is important to emphasize that the choice of prosthetic valves in the elderly should be individualized, with the decision based upon patient's preferences, risk of long-term anticoagulation, and predicted life expectancy.

Aortic Valve Replacement

Replacement of the aortic valve in the elderly may be associated with special technical problems related to small body size [19], the presence of pre-operative aortic regurgitation [20], and the size and type of valve prosthesis. An adequately large aortic prosthesis for the patient's body size may be limited by the small dimensions of the aortic root. Aortic prosthesis mismatch may have an adverse effect on operative survival and long term outcome [21, 22], yet may not be as important as thought previously[23].

Reports of mortality risk from combined aortic valve replacement and CABG vary widely (1.3% to 14.1%) but are generally higher than risk of CABG alone (0.8% to 3.1%). [24]. In one retrospective surgical series of patients more than 70 years old, overall operative mortality (4.2%) for patients aortic valve replacement alone was significantly lower than combined aortic valve replacement and coronary artery bypass surgery (8.8%)[25].

As the natural prognosis for patients with symptomatic aortic stenosis is poor, aortic valve replacement should be considered in all patients, irrespective of age, after considering comorbid conditions and frailty. For patients 70 to 89 years old reported operative mortalities are 6-11%, and 1, 5, 10 year survivals 90%, 70% and 40% respectively [23]. The quality of life after aortic valve replacement in patients 80-91 years old is reported as excellent and comparable to that predicted in a normal population aged > 75 years [20].

Patients with isolated aortic insufficiency who undergo aortic replacement generally have a worse outcome, with more congestive heart failure and greater mortality when compared to patients with isolated aortic stenosis. This is especially true when aortic regurgitation is associated with pre-operative heart failure or severe left ventricular dysfunction [26].

Mitral Valve Surgery

Mitral valve surgery can be offered to elderly patients with operative risks that are comparable to those in younger subjects [27]. Yet long-term complications such as embolism, recurrent mitral regurgitation, endocarditis and heart failure are more frequent in the elderly patient after mitral valve surgery, especially with associated left ventricular dysfunction. Elderly patients with NYHA class I-II symptoms and preserved left ventricular function who had mitral valve surgery, had similar seven-year outcomes as younger patients (90% vs. 93%). Mitral valve surgery in severely symptomatic patients or with poor left ventricular function is associated with an adverse outcome whatever the age. Consequently it has been suggested that mitral valve repair in elderly patients with severe mitral regurgitation should be considered before heart failure symptoms become advanced or LV function deteriorates [27]. However as many elderly patients tolerate mitral regurgitation for many years without deteriorating, it is important that there are indications for intervention

other than severe mitral regurgitation. These include heart failure symptoms, poorly tolerated recurrent atrial fibrillation, dilatation of the left ventricle, or worsening of left ventricular systolic function over time. Mitral valve repair is preferred to replacement whenever feasible for the management of severe mitral regurgitation. Mitral valve repair offers special benefits for the elderly as it spares the subvalvular apparatus and consequently preserves left ventricular systolic function, eliminates re-operation for bioprosthetic valve degeneration, avoids long-term anticoagulation and other prosthetic valve related complications, such as emboli, endocarditis, and dehiscence[28]. Despite the increased incidence of mitral annular calcification and fragility of mitral tissue associated with advanced age, mitral reconstruction is feasible in a significant proportion of patients with myxomatous valve disease. Grossi et al. [28] studied 278 patients above 70 years of age who underwent mitral valve repair. The in-hospital mortality for isolated mitral valve repair was 6.5%, and 17% when combined with coronary revascularization. When combined with another valve procedure the perioperative mortality was 13.2%. The 5-year freedom from late cardiac death was 100% in the isolated mitral valve repair group and 79.7% for mitral valve repair with a concomitant procedure (p=0.006). Repair failure was rare, with 5-year freedom from re-operation in 91.2%. Mean NYHA class improved from 3.3 to 1.7 postoperatively.

Severe mitral annular calcification, which is a common finding in the elderly, poses a particular challenge for mitral valve surgery. The heavily calcified annulus may cause difficulties in the seating of the prosthesis and result in later peri-prosthetic leakage. Debridement of the mitral annular calcification may leave a thin and friable annulus that contributes to ventricular perforation and risks of prosthetic dehiscence. Despite the frequent occurrence of mitral annular calcification and tissue fragility, mitral valve surgery is feasible in many elderly patients with an acceptable operative risk and satisfactory long-term results [29, 30]. Mitral regurgitation due to coronary artery disease may be successfully repaired in older patients. Bolling et al. [31] reported a series of 100 consecutive elderly patients 65 or older with ischemic mitral regurgitation who had undergone concomitant bypass surgery and mitral valve annuloplasty. There was a low peri-operative mortality (4%), medium term mortality (6%) and complication rates after a follow up of 25 months.

Infective Endocarditis

Infective endocarditis has increased in prevalence in the elderly. In a recent series the mean age of patients with infective endocarditis was 55 years, with approximately 50% aged more than 60 years old [32]. The relative increase of endocarditis in the elderly is attributable to a decreased incidence of rheumatic valvular disease in younger patients, the increased prevalence of calcific or degenerative valvular disease in an aging population, more frequent invasive therapeutic interventions (each with a risk of transient bacteremia), higher prevalence of prosthetic heart valves in elderly patients [33] and a greater incidence of poor dentition.

Calcific aortic stenosis, mitral valve prolapse and prosthetic heart valves are the sites most susceptible to infective endocarditis in the elderly. The pathogens responsible for infective endocarditis in the elderly are similar to those observed in younger patients [34].

The high mortality of infective endocarditis in the elderly is attributable to delays in diagnosis and treatment, and increased comorbidity [35, 36]. The clinical presentation is frequently nonspecific, with constitutional symptoms such as malaise, confusion, anorexia, and weight loss, which are often attributed to aging. Furthermore the febrile response is often blunted. New onset or worsening heart failure is common in elderly patients; hence unless there is a high element of suspicion, endocarditis may easily be overlooked. For any elderly patient with either unexplained constitutional symptoms (with or without fever), new onset or worsening heart failure, new or changing heart murmurs, blood cultures and echocardiography should be considered as part of the investigation.

Recommendations

- Symptoms, clinical presentation and physical signs of valvular heart disease in the elderly may differ from younger patients. Echocardiography should be performed in elderly patients suspected of having symptoms due to valvular heart disease to confirm the diagnosis and assess severity of the valve abnormalities. (Class 1 Level C)
- The operative risk of valvular surgery in the elderly is greater than in younger patients. Assessment of comorbid conditions and frailty are essential in determining the operative risk. (Class 1, level C)
- The choice of mechanical or bioprosthesis in the elderly should be individualized. The decision should depend upon patient preferences, risk of long-term anticoagulation, and predicted life expectancy. (Class 1, level C)
- Age alone should not be a deterrent to aortic valve replacement (AVR) in the elderly patient with symptoms attributable to aortic stenosis. (Class 1, level B)
- Symptomatic elderly patients with mitral regurgitation should be considered for mitral valve surgery. Mitral valve repair is preferred over replacement whenever possible. (Class 1 level B)
- Endocarditis in the elderly may present with nonspecific symptoms without fever. In an elderly patient presenting with new onset congestive heart failure, constitutional, or neurological symptoms, endocarditis should be considered as a possible diagnosis. (Class 1 level C)

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Cardiovascular Drug Therapy

Improving Benefits and Reducing Risks in the Older Adult

Ruby Grymonpre D Pharm¹, Richard Ogilvie MD², Paula Rochon MD²

¹University of Manitoba, ²University of Toronto

Correspondence

Dr. Ruby E. Grymonpre
Professor, Faculty of Pharmacy
50 Sifton Road
University of Manitoba
Winnipeg, MB R3T 2N2

Email: grymonpr@ms.umanitoba.ca

Risks for adverse drug events in older patients

More than one third (36-40%) of all prescriptions dispensed are for older people.^{1,2} Over 80% of older people use at least one prescribed drug, 40-75% report using at least one non-prescribed drug, and 14-40% use herbal products.¹⁻⁶ This polypharmacy, combined with multiple co-morbid conditions and age-related changes in drug disposition and response, places older individuals at an increased risk for adverse drug events (ADEs), including drug interactions.⁷ ADEs contribute to approximately 10% of hospitalizations in the elderly, and have been reported to prolong hospital stay and contribute to mortality.⁸⁻¹⁴ Compared with other drug categories, ADEs to cardiovascular drugs make up the largest number of events in elderly outpatients.^{3, 9, 10, 12, 15-23}

ADEs may present as non-specific symptoms and signs of conditions that are already common in the older patient (incontinence, immobility, mental impairment, physical instability and falls). Any new symptom should be considered as a potential adverse drug event. Orthostatic hypotension and risk for falls can increase with use of several cardiac drugs.^{16, 24-38} Other examples of potentially serious and costly ADEs include: bleeding disorders with agents affecting coagulation or platelet function;³⁹⁻⁴⁹ conduction defects or arrhythmias following use of antiarrhythmic agents; CHF or bradycardia following administration of beta-adrenergic blockers, diltiazem or verapamil,⁵⁰⁻⁶¹ and renal impairment and electrolyte disturbances associated with many drugs that alter blood pressure or cardiac function.⁶²⁻⁷⁸ Diuretics, alpha-blockers, calcium channel blockers; beta-blockers and several antiarrhythmic drugs can aggravate bladder incontinence.⁷⁹⁻⁹² Central nervous system effects including depression, dizziness, confusion, delirium, or cognitive impairment have been reported with lipophilic beta-blockers, digoxin, calcium blockers, loop diuretics, and several antiarrhythmic agents.^{93, 94}

Interactions involving 'narrow therapeutic index' cardiac drugs such as warfarin, amiodarone, verapamil and digoxin are another important cause of ADEs in older adults.⁹⁵⁻⁹⁹ Digoxin absorption is impaired when administered concomitantly with cholestyramine or colestipol. The clearance of digoxin is reduced and serum levels increased by its coadministration with amiodarone, diltiazem or verapamil. Warfarin is involved in many significant drug interactions as outlined in Table 1, 3 and 4. Grapefruit juice, over-the-counter (OTC) drugs and herbal preparations are increasingly recognized as interacting with cardiac drugs and causing ADEs. (Tables 2-4)^{4-6, 100-129}

Of equal importance is the risk of pharmacodynamic interactions in older adults. Drug combinations with anticholinergic (disopyramide), CNS (β blockers) or hypotensive (nitrates, calcium channel blockers, ACEIs, antihypertensives, diuretics) effects can be additive or synergistic. NSAIDs, including COX-2 inhibitors, may inhibit the effects of antihypertensives, aggravate CHF, increase the risk of hyperkalemia and nephrotoxicity with ACEIs and potassium sparing diuretics, and increase the risk of bleeding due to warfarin.^{75, 111-114, 130-145}

Various expert panels in Canada¹⁴⁶ and in the United States¹⁴⁷⁻¹⁵¹ have identified cardiovascular drug prescribing practices that are inappropriate in older adults including hydrochlorothiazide (doses of more than 25 mg per day should be avoided¹⁵²), methyldopa (all use should be avoided), propranolol (should be avoided; other beta blockers have less central nervous system penetration or more beta selectivity), reserpine (all use should be avoided), ticlopidine, dipyridamole, and disopyramide.

Predictors or clues to increased risk for adverse drug reactions in older patients include:

- Frailty
- Residence in long-term care
- Co-morbid conditions such as hepatic and renal disease
- Multiple disease conditions requiring multiple drugs
- Multiple physicians involved with the patient's care

Recommendations:

- Due to an increased incidence of adverse events in older adults compared to younger individuals, cardiovascular therapy requires more frequent monitoring:
 - ✓ during warfarin therapy, target the lowest possible effective INR and regularly monitor INR and evidence of bleeding. (Class I Level B)
 - ✓ monitor renal function and electrolyte status before and during diuretic or angiotensin converting enzyme inhibitor (ACEI) therapy. (Class I Level B)
 - ✓ monitor for orthostatic hypotension in older patients taking most cardiovascular drugs (beta blockers, calcium channel blockers, ACEIs, diuretics, nitrates and other antihypertensive drugs) especially in combination with antidepressants, antipsychotics, and antiparkinsonian agents, by measuring lying and standing (or, if not tolerated, sitting) blood pressure, and questioning the patient. (Class I Level B)
 - ✓ monitor heart rate and worsening CHF with beta-blockers, diltiazem, and verapamil. (Class I Level B)
- If an adverse event occurs with cardiovascular therapy of proven benefit at recognized target doses (e.g. beta-blockers, ACEIs), it is usually better to reduce the dose of the drug than to discontinue therapy (Class I Level C)
- Evaluate the need for chronic NSAID, including cyclo-oxygenase 2 inhibitor (COX2 inhibitor) therapy, which can increase bleeding risk with warfarin, nephropathy with ACEIs and diuretics, hyperkalemia with ACEIs, and aggravate hypertension and congestive heart failure. (Class I Level B)
- Recognize the potential for drug-drug interactions involving warfarin (Tables 1,3 and 4):
 - ✓ drugs which potentiate warfarin effects include several antibiotics (cotrimoxazole, erythromycin, isoniazid, fluconazole, miconazole, metronidazole, ciprofloxacin), amiodarone, and anti-inflammatory or analgesic drugs such as NSAIDs, including COX2 inhibitors, and acetaminophen (Class I Level B)
 - ✓ drugs, which inhibit warfarin effects, include nafcillin, rifampin, cholestyramine, and carbamazepine. (Class I Level B)
- Recognize the potential for drug-drug interactions particularly involving the cardiovascular drugs amiodarone, quinidine, digoxin, verapamil and lipid lowering drugs. (Class IIa Level B)
- Physicians and patients should be aware of possible health hazards and drug interactions when cardiovascular drugs are taken in combination with grapefruit juice, OTC medications or herbal preparations. (Tables 2-4) (ClassIIa LevelB)
- Patients on warfarin, digoxin or some lipid lowering drugs (simvastatin, likely atorvastatin, fluvastatin, lovastatin but not pravastatin) should not use herbal preparations including St. John's Wort. (Table 4) (Class IIb Level B)
- Be aware that diuretics, calcium channel blockers, beta-blockers, disopyramide, or alpha-blockers may aggravate certain types of urinary incontinence. (Class IIb Level C)
- Avoid hydrochlorothiazide in doses of more than 25 mg per day, reserpine (all use), methyldopa (all use), and propranolol (all use, except if indicated to control violent behavior). (Class III Level C)

Pharmacokinetic and pharmacodynamic changes in older individuals

Aging significantly alters drug pharmacokinetics and pharmacodynamics. Although, in the absence of severe malnutrition or disease, the rate and extent of drug absorption for cardiac drugs does not appear to change significantly with age,¹⁵³⁻¹⁵⁷ drug distribution and elimination are affected.

With aging, a decreased lean muscle mass: fat ratio results in a reduced volume of distribution (V_d) for hydrophilic drugs and increased V_d for lipophilic drugs.¹⁵⁸ Clinically, a reduced V_d means that lower loading

doses will be required to achieve a similar desired concentration and the drug's half-life ($t_{1/2}$) will be decreased. A reduced V_d in older adults has been reported for digoxin^{156, 159-164} whereas the V_d may be increased for amiodarone¹⁶⁵ and lidocaine.¹⁶⁶

The age-related changes in plasma proteins (i.e. reduced serum albumin and increased α_1 -acid glycoprotein), which bind acidic and basic drugs respectively, are rarely associated with clinically significant effects. Firstly, there is only a modest decline in serum albumin with age (less than 20% or 0.5 g/L per decade).¹⁶⁷ Secondly, for low clearance drugs, any increase in free fraction is quickly eliminated by an increase in metabolic clearance.¹⁶⁸⁻¹⁷⁰ The increased levels of α_1 acid glycoprotein in older adults are also usually not clinically significant.^{171, 172}

In older adults, the doses of drugs, which are renally eliminated, should be individualized. In healthy older adults, renal function is not significantly altered and but age-related declines have been frequently noted, probably as a result of common co-morbidities such as hypertension, atherosclerosis or diabetes.¹⁷³⁻¹⁷⁶ Most studies of older adults report a variable, progressive decline, with mean creatinine clearances declining at a rate of approximately 1% per year.^{173, 177-180} Due to a reduced muscle mass and creatinine production, the serum creatinine is an unreliable measure of renal function.¹⁷⁹ Measuring or calculating the creatinine clearance using, for example, the Cockcroft-Gault formula, provides a better estimate of renal function although this may underestimate renal function.¹⁷⁶ Cardiac drugs, which are renally eliminated and should be started at lower doses, include the 'water soluble' β blockers (atenolol, nadolol, sotalol¹⁸¹⁻¹⁹⁰), digoxin,^{156, 161, 191-204} and most ACEIs (excluding fosinopril which is eliminated by renal and biliary routes).²⁰⁵⁻²⁰⁷ However, 3 studies evaluating low dose versus high dose ACEI therapy in older adults found that subjects receiving 'target' (high) doses had better cardiac outcomes with an insignificant increase in adverse effects.²⁰⁸⁻²¹¹ With renal dysfunction (serum creatinine > 150 $\mu\text{m/L}$), thiazide diuretics will have reduced effects.⁶⁷

The effect of age on the metabolic clearance of drugs is not clearly established. The metabolic clearance of drugs with a high intrinsic clearance is reduced in older adults due to a reduced hepatic mass and blood flow.^{167, 212, 213} As a result of reduced clearance and/or increased bioavailability, the serum levels and risk for toxicity of high clearance drugs might be increased. High clearance cardiac drugs which should be started at lower doses and carefully titrated in older adults include: lidocaine (possibly, males only),^{166, 214} beta blockers propranolol, labetalol, and acebutolol,^{183-187, 215-217} and calcium channel blockers²¹⁸⁻²²¹ (disputed⁵⁷) including verapamil,^{27, 51, 53, 219, 222, 223} nifedipine,^{28, 219, 224, 225} diltiazem,^{50, 219, 226} amlodipine,²²⁷⁻²²⁹ felodipine,²³⁰ nitrendipine (possibly),²³¹⁻²³³ and nimodipine.²³⁴ Despite being high clearance drugs, metoprolol and carvedilol clearance/serum levels do not appear to change with age.^{181, 235-239}

The most significant age-related pharmacodynamic change is compromised homeostatic and counter-regulatory mechanisms usually resulting in an exaggerated drug response as described under Section 1. *Risk for Adverse*

Drug Events in Older Patients

- **Drug absorption is not altered in the absence of severe GI disorders or malnutrition**
- **Drug distribution can be altered by changes in body composition (lean muscle mass: fat ratio)**
- **Drug distribution is not usually altered by changes in plasma proteins**
- **Drug elimination can be reduced with age-related reductions in renal function.**
- **Serum creatinine poorly correlates with actual renal function**
- **Drug elimination can be reduced with age-related reductions in liver mass and blood flow**

Recommendation:

- **In older individuals, most cardiovascular drugs require lower starting doses and slower upward titration either: (1) to the lowest effective dose to achieve the desired therapeutic effect or (2) for drugs where a target dose has been identified, to the recommended (or highest tolerated) dose. (Class I Level B)**

Under-use of beneficial cardiovascular therapy

Under-use of beneficial drug therapy by older adults may be associated with increased morbidity, mortality, and reduced quality of life. This guideline outlines two examples of drug therapies for cardiovascular conditions where there is strong evidence of under-prescribing of beneficial therapy.

Beta-blocker Therapy Post-Myocardial Infarction

Studies demonstrate that older adults, including those at high-risk for poor outcomes, benefit from beta-blocker therapy post-myocardial infarction. In myocardial infarction survivors, beta-blocker use has been associated with a 14-43% reduction in mortality.^{240,241} Withholding beta-blocker therapy may be most harmful to older adults. One study found a 40% mortality reduction in patients at high-risk for complications (i.e. patient with heart failure, pulmonary disease, and diabetes) when prescribed beta-blocker therapy relative to those who were not prescribed this treatment (RR=0.60; 95% CI, 0.57 to 0.63).²⁴²

Despite ample evidence in the literature, observational studies continue to document under-prescribing of beta-blocker therapy to seniors.^{184, 242-244} One study found that almost half of older Ontario myocardial infarction survivors, especially if they were of advanced age or frail, did not receive beta-blocker therapy.²⁴³ Patients in the 85-year and older age group were more likely than younger patients (66 to 74 years) not to be dispensed beta-blocker therapy (adjusted odds ratio [OR] 2.8, 95% confidence interval [CI] 2.5-3.2). Having more comorbid conditions, as indicated by the Charlson score, was associated with an increased risk of not receiving beta-blocker therapy (aOR 1.5, 95% CI 1.3-1.8).

Using observational data, two groups^{184,244} have evaluated the benefit of lower doses of beta-blocker therapy for myocardial infarction survivors. Both studies support the strategy of initiating beta-blocker therapy at low dose and titrating up to the dose as tolerated.

Warfarin in Atrial Fibrillation

Warfarin is recommended in evidence-based guidelines for stroke prevention for older adults with atrial fibrillation²⁴⁵ but is often inappropriately prescribed to older adults in the long-term care setting.²⁴⁶⁻²⁴⁸ In one study,²⁴⁷ only 53% of older adults classified as being 'ideal' candidates for warfarin therapy (i.e. atrial fibrillation with no known risk factors for haemorrhage) were prescribed this therapy. Further, INR values were maintained in the therapeutic range only 51% of the time, placing patients at unnecessary risk for an adverse event due to INRs either above or below the therapeutic range.

Recommendation:

- **Consider the patient rather than age alone; therapies may provide greater absolute benefit to older individuals. Avoid under use and under dosing of beneficial cardiovascular therapy such as beta-adrenergic therapy post myocardial infarction or warfarin for stroke prevention with atrial fibrillation. (Class IIb Level B)**

Stopping unnecessary cardiovascular drug therapy

- ***Diuretics***

Diuretics are often prescribed in older persons for undocumented or questionable indications such as ankle edema without heart failure.²⁴⁹ Although data is limited, the use of diuretics in diastolic heart failure may be detrimental.²⁵⁰ The risks associated with diuretic therapy in older adults are significant and include electrolyte and metabolic disorders, volume depletion, genito-urinary complaints and drug interactions.²⁵⁰ Studies suggest that at least 30% of selected older persons can be successfully withdrawn from their diuretic therapy.²⁵¹⁻²⁶²

- In the frail older individual with multiple co-morbidities and drug use, consideration can be given to reducing the dose or discontinuing diuretic therapy.²⁵⁰ Factors which might predict *successful* withdrawal of diuretic therapy include: absence of a history of heart failure,^{252, 253, 255} and, when heart failure is present: diastolic dysfunction (definition LVEF > 40%),^{251, 258, 259} < 40 mg OD furosemide,²⁵⁸ concurrent use of ACE inhibitors,^{258, 260, 261} absence of history of hypertension,^{254, 258} absence of fluid retention symptoms,^{254, 262}

- ***Digoxin***

In the older persons, digoxin is beneficial in the management of heart failure due to systolic dysfunction unresponsive to ACE inhibitors and diuretics and for subjects with concomitant atrial fibrillation.²⁶³⁻²⁶⁵ When original indications for digoxin are not documented, questionable or when heart failure due to diastolic dysfunction is suspected, an attempt can be made to discontinue therapy.²⁶⁶⁻²⁷¹ Factors associated with *unsuccessful* withdrawal include: active symptoms of systolic heart failure,^{268, 272, 273} EF < 35%,²⁷³ greater cardiac enlargement,²⁷³ atrial fibrillation,^{268, 272} not taking ACE inhibitors,²⁷³ X-ray evidence of pulmonary congestion.²⁷²

Recommendation:

- **Consider stopping cardiovascular drug therapy in older individuals when diagnosis is not confirmed and indication for therapy is uncertain. Digoxin and diuretics must be withdrawn with care, monitoring weight and signs and symptoms of heart failure on a daily basis. (Class IIa Level B)**

General prescribing advice for the physician

Knight and Avorn²⁷⁴ identified 12 quality indicators for appropriate medication use in older adults. The rationale for the general prescribing indicators, as well as those specific to cardiovascular drug therapy, are summarized in Table 5. The indicators cite three cardiovascular therapies that warrant careful monitoring after they have been initiated (warfarin, diuretic, and angiotensin-converting enzyme inhibitor therapy).

Recommendation:

- **Improve the Quality of Prescribing (Table 5) (Class I Level C)**
 - ✓ Document the indication for a new drug therapy
 - ✓ Educate patients on the benefits and risks associated with the use of a new therapy
 - ✓ Maintain current medication lists in patient medical records
 - ✓ Document the response to therapy
 - ✓ Periodically review the need for a drug therapy

Strategies to improve adherence to therapeutic interventions

The prevalence of medication nonadherence in older adults is between 33% and 66%,^{275, 276} contributing to 10% of hospital and 25% of nursing home admissions.^{277, 278} More than 30% of hospitalizations due to congestive heart failure are related to nonadherence to dietary and medication interventions.^{279, 280} Patients who adhered to cholestyramine for hypercholesterolemia or beta-blockers for hypertension had greater reductions in cardiac risk compared to nonadherers.²⁸¹⁻²⁸³

Health behaviour, including medication adherence is influenced by various physical, economic, psychological and social factors.^{284, 285} Adherent behaviour is determined by perceived susceptibility to and seriousness of illness, perceived benefits of taking action, patient-physician relationship, as well as features of disease and therapeutic regimen. Patients might intentionally not adhere to a prescribed regimen due to side effects, perceived lack of efficacy, improvement or worsening in health status, drug costs, inconvenience, or intention to drink alcohol.²⁸⁶⁻²⁸⁸ Unintentional non-adherence due to forgetting, lack of knowledge, complex drug regimens, multiple care providers, vague label instructions, and inability to open childproof containers is especially common in older adults.^{276, 278, 289-292}

A multidimensional approach to improving adherence to therapeutic interventions, involving educational, behavioural, and patient-provider communication, is presented in Table 6.^{281, 293-319}

Recommendation:

- Use multiple strategies to improve adherence to drug therapy (Table 6) (Class IIa Level B)

Table 1. Potentially significant drug interactions involving warfarin^{97, 321}

Interacting drug	Mechanism of interaction
Reduced Anticoagulant Effect	
cholestyramine	Impaired absorption and increased elimination of warfarin. [Chronic use may also impair vitamin K absorption and enhance the anticoagulant effect.]
barbiturates, carbamazepine, chlordiazepoxide, phenytoin, primidone, rifampin, nafcillin	Induction of warfarin metabolism
Increased Anticoagulant Effect	
amiodarone, cimetidine, ciprofloxacin, clarithromycin, erythromycin, fluconazole, isoniazid, itraconazole, ketoconazole, lovastatin, metronidazole, miconazole, omeprazole, phenylbutazone, propafenone, propranolol, simvastatin, sulfinpyrazone, sulphonamides (cotrimoxazole)	Inhibition of warfarin metabolism
Increased bleeding risk	
acetaminophen	Unknown, possibly induced vitamin K metabolism ³²⁰
antiplatelets (clopidogrel)	Inhibits platelet aggregation
clofibrate	unknown mechanism
NSAIDs	Inhibits platelet aggregation; causes gastric erosions
COX2 inhibitors	Altered protein binding

Additional interactions involving warfarin are listed in Table 3 (OTC drugs) and Table 4 (herbal therapies)

Table 2: Cardiovascular drug substrates for CYP 3A4 and interactions with grapefruit juice¹

DRUG	INTERACTION ²			
	YES ³	?YES	?NO	NO
Antiarrhythmics				
Amiodarone	✓			
Quinidine		✓		
Calcium channel blockers				
Amlodipine	✓			
Felodipine	✓			
Nifedipine	✓			
Nimodipine	✓			
Diltiazem				✓
Verapamil				✓
HMG-CoA Reductase inhibitors				
Atorvastatin	✓			
Fluvastatin			✓	
Lovastatin	✓			
Pravastatin			✓	
Simvastatin	✓			
Other Cardiovascular Drugs				
Carvedilol		✓		
Losartan		✓		
Sildenafil		✓		

Table has been adapted from Kane GC et al¹⁰¹

Table 3. Examples of potential interactions involving non-prescription medications¹⁰⁹⁻¹¹⁴

Non-Prescription Drug	Interacting Drug	Possible Outcome
acetylsalicylic acid (Aspirin)	warfarin methotrexate ACE inhibitors ¹	<ul style="list-style-type: none"> bleeding methotrexate toxicity reduction of ACE inhibitor effect on blood pressure, MI² or CHF³
cimetidine	warfarin	<ul style="list-style-type: none"> bleeding
ibuprofen and other NSAIDs	warfarin drugs for heart failure or hypertension	<ul style="list-style-type: none"> bleeding reduction of efficacy with increased hypertension, renal failure or CHF
miconazole (vaginal)	warfarin	<ul style="list-style-type: none"> bleeding
phenylephrine, phenylpropanolamine, pseudoephedrine	monoamine oxidase inhibitors (e.g. tranlycypromine, phenelzine)	<ul style="list-style-type: none"> hypertensive crises

¹ Interactions between cardiac drugs and grapefruit or its juice are unpredictable and may vary in time and between individuals. They can occur as long as 24 hours after ingestion of grapefruit juice.

² “YES” and “NO” indicate published evidence of the presence or absence of an interaction with grapefruit juice; “?YES” and “?NO” indicate expected findings based on available data

³ increased serum concentrations; avoid concomitant administration. It is preferable for the patient to abstain from grapefruits or its juice rather than stop or adjust cardiac drug therapy

¹ ACE inhibitors: angiotensin converting enzyme inhibitors

² MI: myocardial infarction

³ CHF: congestive heart failure

Table 4. Examples of Potential Health Problems and Drug Interactions with Herbal Preparations ^{4-6, 115-129}

Potential Health Problem	Herbal Preparation
Enhanced bleeding potential <ul style="list-style-type: none"> • Potentiate warfarin • Decreased platelet aggregation • Increased fibrinolysis 	bilberry, danshen, devil's claw, dong quai, fenugreek, feverfew, ginger, ginkgo bilboa, kava, papaya extract, PC Spes, Spes and many other herbs used in traditional Chinese preparations
Reduced warfarin effect	garlic (high dose), ginseng (Panax),
Reduced plasma concentration of CYP3A4 substrates by inducing hepatic CYP3A4; also increases expression of P-glycoprotein, a multi-drug transporter <ul style="list-style-type: none"> • Reduced warfarin effect • Reduced simvastatin concentration • Reduced digoxin concentration 	St. John's Wort
Increased digoxin concentration	eleuthero (Siberian ginseng)
Hypertension, angina, myocardial infarction, stroke, arrhythmia, psychosis, memory loss	ephedra (ma huang), E.sinica, Sida cordifolia,, epitonin, coltsfoot, ginseng (Panax), licorice (glycyrrhiza glabra), yohimbine
Hypotension	pokeweed, Hua fo (contaminated with sildenafil)
First-degree heart block	Dong quai, hawthorn
Hypokalemia; potentiation of potassium loss by diuretics	licorice (glycyrrhiza glabra)
Enhanced water excretion and electrolyte disturbance	Goldenseal
Prolonged anesthesia	echinacea, cornflowers, creatine, kava, licorice (glycyrrhiza glabra), valerian
Hypoglycemia; enhanced sulphonylurea effect	bitter melon, fenugreek, garlic (high dose), ginkgo biloba, gymnema sylvestre
Delayed gastric emptying and drug absorption (Examples include acetaminophen, digoxin, glyburide, metformin)	guar gum
Heavy metal intoxication	Many Chinese, Indian and South-Asian herbal products and proprietary medicines
Contamination with active pharmaceutical agents	Many Chinese, Indian and South-Asian herbal products and proprietary medicines

Table 5. Quality Indicators for Appropriate Cardiovascular Medication Use in Older Adults

Indicator Title	Description	Rationale
Indication	When prescribing a new drug, the therapy should have a clearly defined indication documented in the medical record.	The medication may have been prescribed for an indication that was unclear or transient.
Patient Education	When prescribing a new drug, the patient or caregiver should be educated about the optimal use of the therapy and the anticipated adverse events.	Education may improve adherence, clinical outcomes, and alert patients or caregivers to potential adverse events
Medication List	Medical records (outpatient or hospital) should contain a current medication list. Patients should keep a current medication list on their person (alternately patient should bring actual pills and bottles to all appointments).	Allows identification and elimination of duplicate therapies, correct drug interactions, and streamline the drug regimen to improve adherence.
Response to Therapy	Every new drug prescribed as chronic therapy should have documentation of a therapeutic response within 6 months.	Provides a rationale for continuation of the therapy if effective or change or discontinuation if ineffective.
Periodic Drug Review	Annual drug regimen review.	Provides an opportunity to discontinue unnecessary therapy or add needed drug therapies
Monitoring Warfarin Therapy	When warfarin is prescribed, international normalized ratio (INR) should be evaluated.	Older adults are at high risk for drug toxicity that can be identified earlier if there is close monitoring for agents with a narrow therapeutic range.
Monitoring Diuretic Therapy	When a thiazide or loop diuretic therapy is prescribed, electrolytes should be checked within 1 week after initiation and at least annually.	Risk of hypokalemia due to diuretic therapy
Monitor Renal Function and Potassium in Patients Prescribed Angiotensin-Converting Enzyme Inhibitors.	If ACE inhibitor therapy is initiated, potassium and creatinine levels should be monitored within one week of initiation of therapy or change of dose.	Monitoring may prevent the development of renal insufficiency and hyperkalemia.

Table has been adapted from Knight et al.²⁷⁴

Table 6. Strategies to improve medication taking behaviour (adapted from Miller, NH³²²)

Educational Strategies

- Knowledge alone will not change behaviour³²³
- Lack of patient's understanding of medications relates to technical words, incomplete or illegible written instructions, lack of knowledge of regimen duration and importance of treatment³²³⁻³²⁵
- Combined use of written and verbal instruction may enhance adherence²⁹⁶
- Return demonstration of information (i.e. how to take pills) helps to evaluate comprehension.²⁹⁷
- Package inserts are important to individuals for risk/benefit information but often fail to provide benefits of treatment, they tend to overemphasize risks, and have little effect on self-reported behaviour.²⁸¹

Behavioural Strategies

- Simplifying regimens to once or twice daily and eliminating unnecessary medications increases adherence^{298-301, 303-305}
- Adherence enhancement requires that use of a combination of behavioural interventions (i.e., cues and rewards, tailoring, contracting, social support, goal-setting)^{306, 308}
- The use of social support interventions (i.e. pharmacists, nurses, family members) for instruction/follow-up show promise to enhance adherence^{294, 295, 309}
- Maintenance of most behaviours declines over time; constant questioning and follow-up are essential to ensure adequate adherence^{294, 302, 310}

Patient-Physician Communication

- Patient satisfaction with the provider is correlated with adherence³⁰⁷
- The likelihood of adherence is increased when the patient's expectations of a visit are matched by what actually occurs³¹¹
- Sincere warmth and concern, responding to questions, desire to influence adherence, and spending additional time with patients are important physician attributes^{296, 311}
- Physician awareness and training about adherence have positively influenced rates of patient adherence²⁹⁴

Medication Reminder System

- Encourage use of a medication reminder system. Although dose reminder cards,^{312, 313} and medication organizers³¹⁴⁻³¹⁸ improve medication taking, difficulties have been reported.^{314, 315, 319}

Monitoring Medication Adherence

- Pill counts, direct questioning of the patient, and monitoring for appropriate refills of repeat prescriptions provide some information. However, the following validated questionnaire may provide a more accurate picture:³²⁶
 - ✓ Do you ever forget to take your medicine(s)?
 - ✓ Are you careless at times about taking your medicine?
 - ✓ When you feel better, do you sometimes stop taking your medicine(s)?
 - ✓ Sometimes, if you feel worse when you take your medicine, do you stop taking it?

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Prevention of Cardiovascular Events in an Older Population

Correspondence

Joel Niznick MD FRCPC
Ottawa Cardiovascular Centre
502-1355 Bank St.
Ottawa, ON K1H 8K7

Email jniznick@ottawacvcentre.com

Prevention of Cardiovascular Events in the Elderly

Advancing age is one of the strongest risk factors for cardiovascular events in our population. Elderly patients with established vascular disease or longstanding type II diabetes are likely to derive the greatest benefit from interventions that aim to reduce the global cardiovascular risk. However many risk factors associated with cardiovascular disease decline in importance with advancing age. Until recently, clinical trials have not addressed risk factor control in the elderly either with or without established vascular disease. Evidence is now increasing to indicate that global vascular risk reduction is beneficial in the older population.

Canadian Cardiovascular Society Consensus Conferences in 1998 and 2000 have addressed the prevention of cardiovascular disease, both in a general, an elderly and a female population. The present document will summarize recommendations for secondary prevention in the elderly and provide updated data for the benefits of lipid management and blood pressure control in this population.

Geriovascular prevention may be defined as the prevention of all first and recurrent cardiovascular events in the elderly. This includes prevention of fatal and non-fatal stroke, fatal and non fatal ST elevation (STEMI) and non-ST elevation myocardial infarction (NSTEMI), transient ischaemic attack (TIA), reversible ischaemic neurologic deficit (RIND), acute coronary syndrome (ACS) and prevention of the need for revascularization: carotid endarterectomy or percutaneous intervention (PCI), coronary PCI or coronary bypass surgery and peripheral vascular surgery for occlusive disease and aortic aneurysms, and related hospitalizations and morbidity. Whereas in primary prevention of coronary heart disease (CHD) in the elderly, many risk factors decline in importance with advancing age, in the secondary prevention population i.e. those with established vascular disease, be it cerebrovascular, coronary or peripheral vascular disease, or longstanding type II diabetes, the attributable risk of various co-morbidities remains significant (1). Global cardiovascular risk assessment must necessarily give way to global “geriovascular” risk interventions in these high-risk populations targeting global cardiovascular risk reduction to yield the greatest benefits in terms of event and mortality reduction. (See Table 1) (2)

The goals of cardiovascular prevention in the elderly are not only to prevent morbidity and mortality but to preserve function and prevent frailty, to keep the well elderly well and to prevent the frail elderly from deteriorating and in so doing improve quality of life. In essence the goal is to postpone and compress the period of cardiovascular morbidity as much as possible to minimize disability (3). In order to accomplish this, we must more effectively and consistently prevent and treat diabetes, stroke and heart disease in the elderly.

Frailty has been defined as having a dependency on others for some activities of daily living or being at high risk to develop dependency. Fifteen percent of seniors can be categorized as being frail (4). Some of the key predictors of frailty include cardiovascular conditions. These potentially treatable and preventable conditions include a **history of diabetes** (odds ratio 1.54), **stroke with sequelae** (odds ratio 2.59) and **history of heart disease** (odds ratio 1.44). (5)

Care Gap

That there is a care gap in the delivery of cardiovascular preventative practices is well documented (See Table 2: Aspects of the care gap). The gap is greater in the elderly than in the general population. In the elderly the care gap is compounded by lack of evidence, fear of poly-pharmacy induced drug interactions and side effects, compliance and persistence issues, cost-efficacy issues and ethical regards.

Evidence Gap

The elderly can be divided into those for whom there is sufficient evidence to justify therapy. This would correspond to the “young elderly” between 65-75. Those for whom evidence may exist or be extrapolated, the “middle age elderly” between 75-85 and the “old elderly” for whom there is little or no evidence and in whom prudence and common sense must prevail. Most of the clinical trials of statins, beta-blockers, calcium blockers and ACE inhibitors in the prevention of cardiovascular disease have focused on those patients in the first tier and to a lesser extent in the second tier of the elderly. Newer trials are extending the age range of enrolment and

hence the applicability of the evidence. (See Table 3 Major Cardiovascular Clinical Trials: Age Ranges and Applicability to the Elderly).

Diet, Obesity, Exercise and Smoking Cessation

Diet, weight reduction, physical activity and smoking cessation form the cornerstone of any wellness initiative, be it geriovascular or in the general population. Unfortunately the lack of evidence of benefit and resources compromise applicability in a geriatric population.

Diet

Despite the notion that diet does and should make a difference in cardiovascular outcomes, a recent systematic review of 16 trials of cholesterol lowering dietary intervention trials on cardiovascular and total mortality showed no impact on overall mortality and marginal impact on cardiovascular disease mortality. (63) Dietary interventions are an adjunct to other evidence based interventions that truly impact cardiovascular outcome but particularly in the secondary prevention elderly population, should not be used as primary and exclusive therapy. In elderly patients malnutrition is a significant risk affecting as many as 30-60% of institutionalized and hospitalized patients, and 10-30% of the functionally dependent, free-living elderly. (59)

Exercise

The value of exercise has been discussed in the section on Cardiac Rehabilitation and Secondary Prevention in the Elderly. Excellent reviews of the subject are available both for primary (60) and secondary prevention (61) in the elderly population and for geriatric women (62). Benefits of exercise include reduced mortality, improved hypertension and diabetes control, lower incidence of depression, enhanced balance and mobility, reduced age related decline in age related exercise capacity and improved perception of general health status and life satisfaction. Unfortunately, resources remain insufficient to meet the needs of the secondary prevention population in this regard. (63) In the elderly in particular simple exercise prescription guidelines are required so that primary care providers can guide the elderly in this regard.

Smoking cessation

Advanced age does not diminish the benefits of smoking cessation, which include 25-50% mortality reduction in patients with cardiovascular disease who quit. As much as 50% of this benefit accrues in the first year of cessation. Smoking cessation benefits blood pressure control and lipid profile. Both nicotine replacement therapy and other pharmacological agents are safe in patients with cardiovascular disease, including the elderly. (64) Efficacy of primary care physician based smoking cessation interventions is in the range of 10-20% however specific training in smoking cessation interventions and counseling is advisable. (65)

Hypertension Management

Special challenges are faced in the diagnosis and management of hypertension in the elderly population. An increase in blood pressure was until recently considered a part of the normal ageing process. It is now recognized that increases in blood pressure (particularly systolic and pulse pressure) are associated with an increase in cardiovascular event rates. Systolic hypertension increases in prevalence with age. The SHEP study demonstrated that systolic hypertension (SBP > 160 mmHg) was present in 8% aged 60-69, 11% aged 70-79 and 22% over the age of 80. Both the recognition (especially of systolic hypertension) and management of hypertension in the elderly is sub-optimal. Although there is clear proof of the benefits of treating hypertension in the elderly patient, concerns of drug induced adverse events (especially from early anti-hypertensive medication), increased faints and falls, and hypotension induced myocardial ischemia or stroke have resulted in under-treatment of the hypertensive elderly patient. Postural hypotension increases in prevalence in older patients, yet a drop of SBP \geq 20mmHg after 3 minutes of standing was only observed in 12% of subjects enrolled in the SHEP study (43). It has been suggested that the CHS in future guidelines should return to devoting a section specifically to the issues of hypertension and the elderly population in order to focus attention on the GAP between recommendations and current clinical practice (10).

The majority of the clinical trials in hypertension are driven by reduction in stroke end-points to a greater extent than reduction of CHD events and mortality (66). More recent hypertension and dyslipidemia trials have not only extended the age of enrolment but also examined newer classes of medications (ARB's) and other endpoints such as development and progression of cognitive impairment. The latter is beyond the scope of this discussion but merits a thorough review in its own right.

The Canadian Hypertension Society issues annual recommendations for the management of hypertension. Recommendations are revised as evidence evolves. The 2001 recommendations removed the arbitrary classification of old and young persons at age sixty. This has resulted in a more aggressive threshold for initiating therapy in those over age sixty. Thresholds for initiation of therapy in diastolic hypertension, isolated systolic hypertension and systolic/diastolic hypertension have been detailed in the executive summary. The importance of treating isolated systolic hypertension in the elderly in terms of stroke prevention cannot be over-emphasized. Initial treatment of isolated systolic hypertension in the elderly should be with a thiazide diuretic at a low-dose (**Class I Level A**) or a long-acting di-hydropyridine calcium channel blocker (**Class I Level A**). Beta-adrenergic blocking drugs should not be used as first line treatment for hypertension in the elderly due to their lack of any vascular protection (**Level III Grade A**) and were removed from first line indication as far back as the 1999 revision of the CHS recommendations. Further details of the CHS recommendations may be obtained from their website at www.chs.md. (See Table 4 Major Hypertension Cardiovascular Prevention Trials: Event Reduction).

The 2002 recommendations await review of the recently published ALLHAT Trial (57). This landmark trial enrolled 33357 participants age 55 and older with hypertension and at least on other CHD (coronary heart disease) risk factor. Participants were randomized to receive chlorthalidone 12.5-25 mg/d (n=15255, 8784 ≥65), amlodipine 2.5-10 mg/d (n=9048, 5204 ≥65) or lisinopril 10-40 mg/d (n=9054, 5185 ≥65). Patients were followed for a mean of 4.9 years. The doxazosin arm of the study had previously been terminated due to a 25% increase in the major secondary endpoint of combined cardiovascular disease (CVD) outcome driven by a 50% increase in CHF. The primary outcome of the trial was fatal coronary heart disease(CHD) events or non-fatal myocardial infarction combined. There was no difference between the three remaining treatment groups in primary outcome or all cause mortality. Secondary outcomes showed increased heart failure with amlodipine vs chlorthalidone and increased combined CVD, stroke and heart failure for lisinopril vs chlorthalidone. This impact of ALLHAT is to validate low dose diuretic therapy as the gold standard initial anti-hypertensive of choice. Selection of second line, add on therapy will be contingent on co-morbidity.

Hyperlipidemia - Pharmacological Lipid Lowering:

The clinical benefit of lipid lowering was examined in a meta-analysis of 8 double blind placebo controlled secondary prevention trials up to an including HPS (27) in 54,381 subjects treated with simvastatin, pravastatin, lovastatin or fluvastatin (29) Compared to placebo a mean 20% cholesterol reduction was associated with a 30% reduction in CHD events and a 17% reduction in all cause mortality. The principal secondary prevention trials ,4S (24), CARE (25), and LIPID (26) enrolled patients to a maximum age of 75 years. Patients > 65 years old had similar benefits as compared to younger patients.

The Heart Protection Study (HPS) enrolled patients 40-80 years old, with vascular disease and or diabetes and a total cholesterol > 3.5 mmol/L in whom there was uncertainty whether cholesterol lowering was indicated. Patients were randomized to treatment with simvastatin 40 mg daily or placebo and followed for five years. Simvastatin reduced cardiovascular mortality by 17%, all cause mortality by 13%, major coronary events by 27%, stroke by 25% and need for revascularization by 24%. No evidence was observed to suggest a threshold below which lowering LDL cholesterol would not reduce risk. The benefits were similar for patients < 65, 65-70, and > 70 years old. The 1263 patients age 75-80 at entry and hence age 80-85 at the end of the study derived an equivalent reduction in major vascular events of about 25% RRR: 9.2% ARR (142 vs 209, p=0.002).

HPS suggests that all patients with a history of coronary disease, other occlusive arterial disease, or diabetes benefit from statin therapy with simvastatin 40 mg regardless of age, gender or baseline lipid parameters.

Persistent liver function abnormalities were rare 0.09% simvastatin vs 0.04% placebo (p=0.3). Similarly muscle pain symptoms and myopathy were not statistically different on statin or placebo. This suggests that monitoring of liver and muscle enzymes may not be indicated and that full dose statin therapy with simvastatin 40 mg is generally safe across the study population.

The HPS (27) did evaluate cognitive function utilizing a modified Telephone Interview for Cognitive Status (TICS-m) questionnaire. The results of this analysis were negative possibly due to the insensitivity of the measurement instrument. Whether more formal neuro-psychological testing will reveal benefits of statins in prevention of dementia awaits further study. The benefit of therapy with simvastatin 40 mg on the development of recurrent vascular events in the HPS population remains to be reported.

The PROSPER trial (28) was designed to examine the hypothesis that pravastatin would reduce cardiovascular and cerebrovascular events in elderly subjects with existing vascular disease or at high risk of developing the condition. 5,804 elderly men (n=2804) and women (n=3,000) 70-82 years of age, with total plasma cholesterol of 4.0 - 9.0 mmol/l, triglycerides less than 6 mmol/L and good cognitive function were recruited by community screening in the environs of Glasgow, Leiden and Cork. Participants were randomized to receive pravastatin 40 mg/day or matching placebo, with an average follow-up of 3.2 years. The primary outcome measure was the combined endpoint of coronary heart disease (CHD) death (definite plus suspect), nonfatal myocardial infarction (definite plus suspect) and fatal plus nonfatal stroke was reduced by 15% (hazard ratio 0.85, 95% CI 0.74 – 0.97, p=0.014). Coronary heart disease death and non-fatal myocardial infarction risk was also reduced (0.81, 0.69 – 0.94, p=0.006). Stroke risk was unaffected (1.03, 0.81–1.31, p=0.8), but the hazard ratio for transient ischaemic attack was 0.75 (0.55–1.00, p=0.051). New cancer diagnoses were more frequent on pravastatin than on placebo (1.25, 1.04–1.51, p=0.020). However, incorporation of this finding in a meta-analysis of all pravastatin and all statin trials showed no overall increase in risk. Mortality from coronary disease fell by 24% (p=0.043) in the pravastatin group. Pravastatin had no significant effect on cognitive function or disability.

The ALLHAT-LLT(29), a subset of ALLHAT, randomized 10,355 persons age 55 years or older with low density lipoprotein (LDL) cholesterol 120-189 mg/dl (3-4.725 mmol/L) or 100-129 mg/dl (2.5-3.25 mmol/L) if known CHD and triglycerides < 350 mg/dl (3.9 mmol/L) were randomized to Pravastatin 40 mg/d (n=5170) or usual care (n=5185). Mean age was 66 years and mean follow-up was 4.8 years. There was no significant difference in the primary outcome of all-cause mortality or the secondary outcomes of non-fatal MI or fatal CHD events, cause specific mortality including CHD and stroke, or cancer. Total cholesterol (TC) levels were reduced 17% with Pravastatin and 8% with usual care. During the trial 32% of the usual care participants and 29% without CHD started taking lipid lowering drugs. The modest TC reductions between the study groups and the high use of non-study statin in the usual care group likely accounts for the negative results of the trial.

A growing body of clinical trials evidence supports the use of statins for lipid lowering in elderly patients to age 80-85 years, with either clinical vascular disease (coronary, cerebrovascular, or peripheral arterial) or with diabetes. In the light of the HPS, statin therapy should be considered in these higher risk patients regardless of their LDL cholesterol level provided the patients do not have significant co-morbidities that would be expected to limit their lifespan to less than the expected window of benefit. (See Table 5-Major Dyslipidemia and Cardiovascular Prevention Trials: Event Reduction)

Prevention of Vascular Complications of Diabetes

Diabetes confers a significant risk for cardiovascular disease and the prevalence of diabetes rises in the elderly. In a 7-year follow-up of 2432 patients Haffner et al highlighted the high risk that type 2 diabetes imparts for the development of fatal or non-fatal MI, fatal or non-fatal stroke or death from cardiovascular causes. Patients with prior coronary disease and diabetes were at the highest risk. This study consisted of patients aged 45 to 64, hence with follow-up to age 71.

The major cause of morbidity and mortality amongst diabetics is macro-vascular disease: coronary heart disease, cerebrovascular disease and peripheral vascular disease. Prevention of macro-vascular complications requires aggressive control of risk factors, particularly hypertension and dyslipidemia. The evidence for benefit in the elderly is well supported but beyond the scope of this discussion:

Micro-vascular complications such as nephropathy, retinopathy and neuropathy benefit not only from blood pressure control but also from tight glucose control. The evidence for benefit in the elderly beyond age 75 is limited. The hazards of hypoglycemia in the elderly merit a cautious approach to tight control in patients with advanced diabetes, life-limiting co-morbid illness and cognitive or functional impairment or limited life span. (64).

Stroke Prevention

Stroke is important as a principle determinant of frailty. Measures to reduce CHD risk have the ancillary benefit of preventing stroke and dementia. These measures include aspirin (or clopidogrel), coumadin in atrial fibrillation, blood pressure control, and lipid lowering. Excellent guidelines for primary and secondary prevention of ischaemic stroke have been published. (65, 66) and the National Stroke Association (67) has provided a tabular summary of stroke prevention interventions. Broader discussion is beyond the scope of this chapter.

HRT

The role of hormone replacement therapy in the primary and secondary prevention of cardiovascular disease has been the subject of recent notoriety and controversy. The Women's Health Initiative (WHI) (67) recruited 16608 healthy women aged 50 to 79 (3576 age 70-79) with an intact uterus to a randomization of estrogen plus progestin vs placebo. The study was terminated early after a mean follow-up of 5.2 years (planned follow-up 8.2 years). Results included an increase in the primary outcome of coronary heart disease (non-fatal MI and CHD death) with a hazard ratio (HR) of 1.29 (95% CI 1.02-1.63) and in the primary adverse outcome of invasive breast cancer HR 1.26 (95% CI 1.00-1.59). The results of the Heart and Estrogen/progestin Replacement Study (HERS) (68) showed no overall effect of HRT on CHD events in 2763 women younger than age 80 (mean age 66.7 years) with prior CHD an intact uterus. There was, as well, a statistically significant time trend, with more CHD events in the hormone therapy group than in the placebo group in year 1 and fewer in years 4 and 5. More women in the hormone therapy group than in the placebo group experienced venous thromboembolic events (34 vs 12; HR 2.89; 95% CI, 1.50-5.58) and gallbladder disease (84 vs 62; HR 1.38; 95% CI, 1.00-1.92).

Global Cardiovascular Risk Reduction:

A comprehensive integrated strategy to reduce cardiovascular risk and CHD events is essential to avert the rising tide of cardiovascular, cerebrovascular and CHD events in the expanding elderly population. The failure to apply the evidence in these patient populations represents a huge lost opportunity to prevent cardiovascular disease and compress attendant morbidity. Consistent implementation of geriatric cardiovascular prevention provides the opportunity to recapture a large proportion of this lost benefit. This is an opportunity we cannot afford to lose.

Yusuf has highlighted the cumulative benefit of cardiovascular secondary risk intervention in a recent editorial (see Table 1) (2). This table is a useful compliance tool in clinical practice.

Table 1 Potential cumulative impact of four simple secondary-prevention treatments

	Relative-risk reduction	2-year event rate
None	~	8%
Aspirin	25%	6%
β-blockers	25%	4·5%
Lipid lowering (by 1·5 mmol)	30%	3·0%
ACE inhibitors	25%	2·3%

Cumulative relative risk reduction if all four drugs are used is about 75%

Events=cardiovascular death, myocardial infarction, or strokes. To calculate cumulative risk-reduction, multiplicative scale was used--e.g. two interventions each reducing the risk of event by 30% would be expected to have about 50% relative risk-reduction $[1-(0.70 \times 0.70)]$. No interactions in treatment effects are observed in trials suggesting that proportionate risk-reduction of specific drug in presence or absence of other effective interventions would be expected to be similar. Smoking cessation lowers risk of recurrent myocardial infarction by about one-half after about 2 years. So, in smoker with vascular disease, quitting smoking and use of four simple preventive strategies could theoretically have large potential benefit (say around 80% relative-risk reduction).

Yusuf, S. Two decades of progress in preventing vascular disease. *Lancet* 2002; 360: 2-3.

Prevention of Cardiovascular Events in an Older Population - Executive Summary and Recommendations:

Advancing age is one of the strongest risk factors for cardiovascular events in our population. Elderly patients with established vascular disease or longstanding type II diabetes are likely to derive the greatest benefit from interventions that aim to reduce the global cardiovascular risk. However many risk factors associated with cardiovascular disease decline in importance with advancing age. Until recently, clinical trials have not addressed risk factor control in the elderly either with or without established vascular disease. Evidence is now increasing to indicate that global vascular risk reduction is beneficial in the older population.

Recommendations:

Diet and obesity reduction

- A reasonable diet is low in saturated fats and refined carbohydrates (e.g. refined grains, sugar and potatoes) supplemented by poly-unsaturated fats, fruits and vegetables (**Class II Level C**)
- Simple dietary instruction sheets should be made available for dissemination by physicians to patients (**Class II Level C**)
- Weight reduction should be encouraged for overweight patients of all ages

Exercise:

- Physical activity enhances well being and is recommended both for primary and secondary prevention of cardiovascular disease. (See section 8 “Cardiac Rehabilitation and Secondary Prevention”)

Smoking cessation

- Smoking cessation is to be encouraged in elderly patients with or without vascular disease. (**Class I Level A**)
- Both nicotine replacement therapy and other pharmacological agents are safe in elderly patients with cardiovascular disease. (**Class II Level C**)

Hypertension management

Recommendations of the Canadian Hypertension Society for the management of hypertension in the elderly include:

- Anti-hypertensive therapy should be strongly considered if diastolic blood pressure readings average 90 mmHg or more in the presence of hypertensive target organ damage or other independent cardiovascular risk factors. **(Class I Level A)**
- Anti-hypertensive therapy should be prescribed for average diastolic blood pressures of 100 mmHg or more (grade A) or average systolic blood pressures of 160 mmHg or more (grade A) in patients without hypertensive target organ damage or other cardiovascular risk factors. **(Class I Level A)**
- Initial treatment of isolated systolic hypertension in the elderly should be with a thiazide diuretic at a low-dose **(Class I Level A)** or a long-acting di-hydropyridine calcium channel blocker **(Class I Level A)**.
- Beta adrenergic blocking drugs should not be used as first line treatment for hypertension in the elderly due to their lack of any vascular protection **Level III Grade A**
- Blood pressure treatment targets in the elderly are < 140/90 for systolic + diastolic hypertension and < 140 mmHg for isolated systolic hypertension. **(Class I Level A)**

Hyperlipidemia

Treatment algorithms and targets for lipid management of elderly patients should be based on recommendations of the Working Group on Hypercholesterolemia and other Dyslipidemias.

- Intensive LDL lowering therapy is recommended for the elderly patient up to age 85 in the presence of cardiovascular, cerebrovascular or peripheral vascular disease or type II diabetes. **(Level I, Grade A)**
- Therapy with lipid lowering agent that has been shown to be safe and effective in the elderly population in large-scale clinical trials is recommended **(Level II, Grade A)**

Aside from dietary, lifestyle, exercise smoking cessation and other hygienic measures, specific pharmacological lipid lowering therapy is not recommended for the elderly patient in the absence of clinical cardiovascular, cerebrovascular, peripheral vascular disease, type II diabetes or multiple risk factors. **(Level II, Grade C)**

Prevention of Vascular Complications in Diabetes

- Hypertension should be controlled aggressively to appropriate targets **(Level I, Grade A)**
- Aggressive LDL control is indicated to reduce cardiovascular and cerebrovascular outcomes **(Level I, Grade A)**
- Tight glucose control must be weighed against risks of hypoglycemia in elderly patient **(Level II, Grade C)**

Prevention of diabetes

- Lifestyle measures such as weight reduction / control and exercise should be encouraged in all age groups.
- Blockade of the renin-angiotensin system in patients with cardiovascular disease or high risk hypertensive patients may reduce the incidence of diabetes **(Level II, Grade A)**

Stroke prevention

- Stroke is important as a principle determinant of frailty. Measures to reduce CHD risk have the ancillary benefit of preventing stroke and dementia. These measures include aspirin (or clopidogrel), coumadin in atrial fibrillation, blood pressure control, lipid lowering and ACE inhibition in high-risk populations.

HRT:

- HRT is not recommended in any formulation for the sole purpose of preventing ischemic heart disease (IHD) in healthy women or women with multiple risk factors for IHD **(Level III, Grade A)**
- The initiation of conjugated estrogen with or without MPA in women with established IHD is not recommended for the prevention of future cardiac events or to slow the progression of coronary disease **(Level III, Grade A), Grade A)**

Tables:

Table 2: Aspects of the care gap

GAP	Lost benefit
Failure to anti-coagulate high risk and elderly patients with atrial fibrillation (6,7,8)	CVA, peripheral emboli, dementia?
Under use of ASA (92)	CVA, CAD
Failure to control systolic HTN (10,11)	CVA, CAD, CHF, renal failure, dementia?
Failure to control HT in diabetics (12)	Macro-vascular complications
Failure to control BS in diabetics (13,14)	Micro-vascular complications
Under use of hypolipidemic therapy (9,15)	CVA, MI, CAD progression, revascularization, dementia?
Under use of Beta blockers post MI (16,17)	Recurrent MI, sudden death
Under use of Beta blockers in CHF (18)	Recurrent CHF, re-admission, mortality
Under use of ACE inhibitors in post MI & CHF (19,20)	Recurrent CHF, re-admission, mortality
Under use of ACE inhibitors in HOPE Trial population (21)	CVA, MI, CHF, revascularization, mortality, development of diabetes?

Table 3 Major Cardiovascular Clinical Trials: Age Ranges and Applicability to the Elderly

Trial	Enrolment Age	Follow-up Years	Maximum Age
Dyslipidemia Trials			
WOSCOP (22)	45-65 M	4.9	70
AF-CAPS/Tex CAPS (23)	45-73 M	5.2	78
	55-73 W		
4S (24)	35-70	5.4	75
CARE (25)	21-75	5	80
LIPID (26)	31-75	6	81
HPS (27)	40-80 (1263 pts 75-80)	5	85
PROSPER (28)	70-82	3.2	85
ALLHAT (29)	≥55, mean 66 (age range not given)	4.8	71
Ace inhibitor CHF Trials			
SOLVD treatment (30)	21-80	4.6	84.6
SOLVD prevention (31)	21-80	5.2	85.2
V-HeFT II (32)	18-75	5.7	80.7
Atlas (33)	65 mean	4.8	70
Ace inhibitor Post MI Trials			
SAVE (34)	21-80	5	85
AIRE (35)	65 SD 10	Ave 15 mo.	

β-Blocker CHF Trials			
CIBIS II (36)	18-80	1.3	81.3
US Carvedilol HF Trials (37)	18-85	0.5	86
Merit-HF (38)	44-80	1 mild HF Mean 1 year	81
Other major trials			
DIG Trial (39)	Mean age 63.4 (2417 > 70)	3.1	42% > ³ 80
RALES (40)	65 ± 12	3	80
HOPE (41)	55(55% > 65)	3.75	66 ± 7
Hypertension Trials			
EWPHE (42)	≥ 60 (mean 72)	4.7	76.7
SHEP (43)	> 65 (mean 72)	5 years	77
STOP-H (444)	70-84	Mean 25(6-65) mo	89
Syst-Eur (45)	> 60 (mean age 70.2)	Median 2 years	72.2
HOT (46)	61.5 (50-80)	3.7	83.7
CAPPP (47)	52.6 (25-66)	6.1	72.1
STOP-2 (48)	70-84	4.5	88.5
NORDIL (49)	60.5 (55-80)	4.5	84.5
INSIGHT (50)	55-80 (76.8% > 60)	3-5 years	85
PROGRESS (51,52)	Mean 63-65	3.9	69.9
LIFE (53)	55-80	4.8	84.8
SCOPE (54,55)	70-89 (21%>80)	5 years	85+
HYVET (56)	> 80	In progress	
ALLHAT (57)	33,357 55-64 19173 ≥ 65	4.9 year follow-up	Mean age 67

Table 4 Major Hypertension Cardiovascular Prevention Trials: Event Reduction

Trial	Patient number	Percentage Change in Trial Endpoint of Treatment Groups. All events (fatal and non fatal)			Intervention vs placebo unless otherwise specified
Hypertension Trials					
		CVA	Cardiac	All CV	
SHEP (43)	4736	-36	-20	-24	HCT/triamterene ± methyl dopa
MRC (58)	4396	-25	-2	-34	Chlorthalidone & Atenolol
STOP-H (44)	1627	-47	-19	-17	HCT, Amiloride & Atenolol
Syst-Eur (45)	4695	-42	-13	-17	HCT, Amiloride
CAPP (47)	10985	+25	(MI)		Atenolol, Metoprolol, Pindolol
STOP-2 (48)	6614	ND	-26	-31	Nitrendipine, Enalapril & HCT
NORDIL (49)	≈11,000	-20	-23	ND	Captopril vs β-blocker or diuretic
INSIGHT (50)	6321	ND	ND	ND	β-blocker or HCT vs ACE-i vs DHP-CCB
PROGRESS (51)	6105	-28	ND	-26	Diltiazem vs β-blocker ± HCT
LIFE (53)	9193	-25	ND	-13	Nifedipine vs HCT/amiloride
SCOPE (54,55)	4964	-24	ND	ND	Perindopril alone (42%) ± indapamide (58%)
		Outcomes driven by combination therapy			
		Outcomes driven by non-fatal stroke			
ALLHAT (57)	33357	Doxazosin arm dropped - 25% increase major secondary endpoint, combined CVD outcome driven by 50% increase in CHF Significant increase in CHF: LDD vs -ACE 19% & CCB 38% (p<.001) 15% increase ACE/LDD p=0.002 (blacks)			Chlorthalidone (LDD))vs Lisinopril (ACE), Amlodipine (CCB)& Doxazosin LDD vs ACE vs CCB 10% increase ACE/LDD P=0.001 (blacks)

Table 5 Major Dyslipidemia and Cardiovascular Prevention Trials: Event Reduction

Trial	Patient number	Percentage Change in Trial Endpoint of Treatment Groups. All events (fatal and non fatal)			Intervention vs placebo unless otherwise specified
		Dyslipidemia Trials			
		CVA	Cardiac	All CV	
WOSCOP (22)	6595	-11	-31	-32	Placebo vs Pravastatin 40 mg
AF/Tex CAPS (23)	6605		-25	-25	Lovastatin 20-40 mg
4S (24)	4444	-30	-34	-35	Simvastatin 10-40mg
CARE (25)	4159	-31	-25		Pravastatin 40 mg
LIPID (26)	9014	-19 p NS	-29	-24	Pravastatin 40 mg
HPS (27)	20536	-25	-27	-24	Simvastatin 40mg
PROSPER (28)	5804	-15	-19	+3 p NS	Pravastatin 40 mg
ALLHAT (29)	10,355 5707 ≥ 65	No significant difference in any endpoint vs usual care (which included @ 30% use of lipid-lowering therapy)			Usual care vs Pravastatin 40 mg

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Cardiac Rehabilitation and Secondary Prevention for the Older Patient

Terry Kavanagh¹, Jean A. Caprio Triscott², William Dafoe³, Neil McCartney⁴

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¹University of Toronto, ²University of Alberta, ³University of Ottawa,

⁴McMaster University

Correspondence:

Dr Terence Kavanagh
Department of Medicine
University of Toronto
5385 Yonge St
Toronto, ON M2N 5R7

Email: terence.kavanagh@utoronto.ca

Definition of Cardiac Rehabilitation:

The Canadian Guidelines for Cardiac Rehabilitation and Cardiovascular Disease Prevention defines cardiac rehabilitation as “the enhancement and maintenance of cardiovascular health through individualized programs designed to optimize physical, psychological, social, vocational and emotional status”.¹ In recent years cardiac rehabilitation services have been expanded to include secondary prevention, defined as “the sum total of all interventions, both physiological and behavioral, designed to favorably modify an individual’s lifestyle, and enhance adherence and compliance with long-term behaviors compatible with minimizing disease progression”.¹ The major components of a cardiac rehabilitation are medical assessment, prescribed exercise, cardiac risk factor modification, as well as education, counseling and behavioral interventions.²

Historically, cardiac rehabilitation has its origin in the care of myocardial infarction survivors, and these still constitute a significant proportion of referrals. However, the spectrum of potential candidates has now broadened to include patients with stable angina, coronary artery bypass graft surgery, coronary angioplasty, cardiac transplantation, valve surgery, and more recently those with compensated chronic heart failure.

Background

Loss of physical function is an inevitable accompaniment of aging and health professionals need to be aware of the profound effect this may have on the medical management of the older patient. The rate of physical deterioration varies widely in this population but from a practical viewpoint the elderly can be categorized into five levels; the physically elite, the physically fit, the physically independent, the physically frail and the physically dependent. The physically frail live precariously close to losing their dependence. Although they are capable of performing most of the basic activities of daily living, they sometimes require help with the more onerous tasks such as shopping or heavy housework. It may only require a minor medical setback to render them totally dependent. By the same token, the likelihood that those who are currently independent joining the ranks of the physically frail is high because of the ever-present threat of chronic disease, and particularly cardiovascular disease. In fact, adults over the age of 65 account for more than 50% of all myocardial infarctions and revascularization procedures in Canada. Furthermore 20% of this age group report that they are suffering from symptoms of coronary heart disease,^{3,4} are more highly disabled than their younger counterparts and are prone to recurrent events.⁵ They also have a greater prevalence of co-morbid conditions, with 40% reporting that they suffer from rheumatism or arthritis, 35% from hypertension, 12% from diabetes, and 5% from emphysema or asthma. As a consequence over one-third are markedly limited in carrying out activities of daily living in the home or elsewhere.⁴ This, then, is a population which is in need of cardiac rehabilitation, and would stand to gain the most from its multi-faceted services. Traditionally, however, attention has been directed to younger patients, and only in recent years has there been increasing interest in the value of cardiac rehabilitation in those aged 65 years and older. This shift in emphasis is well timed, since the oldest-old (those over aged 80 years) is the fastest growing portion of the elderly population, accounting for 19.7% of those aged over 65 years in 2001, and projected to increase to 34.8% in the year 2016.^{6,7}

Referral Patterns

Overall, the reported referral rate of patients considered suitable for cardiac rehabilitation in the United States varies from 15% to 30%,⁸ with one Canadian study reporting 24% of patients recovering from myocardial infarction, coronary artery bypass graft surgery or coronary angioplasty.⁹ Those most likely to be referred include younger patients, those who are physically active with a good functional capacity, speak English, and live in a city. In contrast, patients more than 70 years of age, those with a history of emphysema or asthma, and neurological or cognitive impairment, are less likely to be considered for cardiac rehabilitation.^{9,10} Despite similar clinical profiles, older women are less likely to be referred than older men, possibly due to the referring physician’s perception that cardiac rehabilitation is less efficacious in women, or that women are more averse to exercise.¹¹

A number of studies have examined the factors that influence the referred patient’s decision to enroll in and attend a cardiac rehabilitation program. The enthusiasm of the referring physician has been shown to be the

most powerful motivator,^{11,12} whereas low functional status, poor spousal or family support, and a lower socio-economic status or education predict non-attendance.¹³

There appears to be heightened awareness of patients and their physicians of the value of cardiac rehabilitation services in the elderly. In a US report from a single centre, the number of patients older than 65 years attending and completing cardiac rehabilitation increased from 28.3% in 1986 to 52.1% in 1996.¹⁴ The study population reflected the demographics of patients with clinical coronary artery disease: men outnumbered women and, on average, female subjects were older than the males. There was a statistically significant increase in medical co-morbidities over the course of the study.

It is also encouraging to note for stroke patients in need of cardiac rehabilitation, significant medical and cognitive deficits do not significantly interfere with progress and should not be considered a contraindication for rehabilitation services.¹⁵

Recommendations:

Physicians should recognize that the older patient might have a high level of physical and psychological disability following a coronary event, as well as greater co-morbidity. Such older patients stand to gain the most, and therefore should be strongly considered for rehabilitation services. (Level of Evidence B, 1)

Elderly patients should be strongly encouraged to participate in a rehabilitation program, as the most powerful predictor of adherence to a rehabilitation program is the strength of the referring physician's recommendation. (Level of Evidence B, 1)

Benefits of Cardiac Rehabilitation

The Younger Patient

Exercise Training Benefits

Aerobic-type exercise training was introduced in the 1950s to counter the deconditioning effects of prolonged immobilization in patients recovering from a myocardial infarction. It has remained a major component of cardiac rehabilitation because of its many benefits.^{16,17} which include:

- An increase in maximal work capacity as well as a greater tolerance for prolonged sub maximal physical tasks, due in part to an increase in peripheral oxygen extraction and in part to an increase in resting and exercise stroke volume.
- A decrease in the rate pressure product (heart rate x systolic blood pressure) and thus myocardial oxygen demand at rest and at the same sub maximal levels of effort. The net effect is to increase the threshold for angina an/or ST-segment depression.
- A reduction of abdominal (visceral) adiposity, with enhanced sensitivity to insulin, improved glucose tolerance and consequent reduction in the risk of Type II diabetes.
- A reduction in triglycerides and an increase in HDL cholesterol levels.
- A lowering of systolic and diastolic blood pressure, particularly in hypertensive subjects.
- An increase in fibrinolytic activity, a reduction in fibrinogen levels and platelet activity.
- A decrease in resting and exercise plasma catecholamine levels and sympathetic tone with a consequent lessening of the threshold for lethal ventricular arrhythmias.
- Improvement in endothelial function.

- Stabilization or reversal of atherosclerotic process.
- In addition to the exercise component, a comprehensive rehabilitation program today includes dietary counseling, risk factor education, and behavioral modification. This results in greater success in improving blood lipid levels, weight control, reduction in cigarette smoking, as well as improvement in psychosocial well being and reduction of stress.^{1,2}

Mortality

In the 1980s O'Connor and co-workers performed a meta analysis of 22 randomized controlled trials of cardiac rehabilitation following a myocardial infarction and demonstrated a 20% reduction in mortality after a three year follow-up.¹⁸ This benefit has been confirmed in a more recent meta analysis involving 7000 patients.¹⁹ However, only two of O'Connor's 22 studies included subjects over the age of 65 years and none included those over 70 years.

The Older Patient

Although evidence favors the beneficial effects of cardiac rehabilitation in the younger patient, data on the elderly is less robust. There is a paucity of randomized control trials, and sample sizes are smaller. Nevertheless, the current literature provides sufficient information to permit conclusions to be drawn regarding outcomes.

Accordingly, we have reviewed 21 studies of cardiac rehabilitation in the elderly. Of these, exercise was the only, or the prime component in 12 (one randomized controlled trial,²⁰ two non-randomized controlled trials^{21,22} and nine observational studies.^{11,23,24,25,26,27,28,29,30} The remaining eight reports (all observational in design) described comprehensive programs.^{31,32,33,34,35,36,37,38,39} The methodologies employed compared outcomes in (i) elderly vs. younger patients and (ii) subgroups of elderly patients (men vs. women, rehabilitated vs. usual care). In all, some 4,600 patients have been studied, of whom 2,000 were elderly (mean 71.3±3.0years). Patients studied included those recovering from a myocardial infarction, coronary artery bypass graft surgery and angioplasty, as well as those with stable angina pectoris.

Mortality and Morbidity

None of the current studies were designed to determine the effect of cardiac rehabilitation on mortality. However, Bondestian and coworkers, in a controlled study, demonstrated a significantly lower incidence of re-hospitalization and visits to the emergency department at three and 12 months in older patients who attended a four-month rehabilitation program.³¹

Aerobic Training Benefits

Many of beneficial results of training demonstrated in younger patients have not been investigated in their older counterparts. However, it is reasonable to infer that these benefits would be observed in an older population. Peak oxygen intake (VO₂peak) is the best measure of exercise capacity, and is assessed by a maximal or symptom-limited treadmill or cycle ergometer exercise test. VO₂peak decreases progressively with age, at a rate of 8% to 10% per decade (or 4 mL.kg.min⁻¹). Inability to reach 17.5 mL.kg.min⁻¹ (5 METs) without signs or symptoms is a criterion of disability used by the U.S. Social Security Administration.¹⁷ Others have identified 15 mL.kg.min⁻¹ as the threshold below which independent living becomes difficult.^{40,41} Elderly patients frequently enter a rehabilitation program with VO₂peak values which range from 15 to 19 mL.kg.min⁻¹, suggesting that they already have difficulties living independently. Thus, even a modest improvement in fitness will delay the onset of dependency. In fact, studies show that elderly patients can increase their peak VO₂ by as much as 16% - 29% following exercise training; an improvement similar to, or in some cases greater than their younger counterparts. Older patients have also exhibited a training-induced reduction in rate pressure product, allowing them to achieve sub maximal workloads at reduced ventilation, blood lactate levels, and perception of fatigue.^{23,25,26,29} Activities such as climbing stairs, completing heavy household chores or

carrying out physical leisure-time activities are completed without angina or shortness of breath. None of the 21 elderly-related studies reported any exercise-related mishap.

Recommendation:

Older patients of both sexes with a history of coronary artery disease should be considered prime candidates for aerobic exercise training, since this has been shown to result in significant gains in sub maximal and maximal effort tolerance, improvement in symptoms, a loss of body fat and an increase in lean body mass: all benefits are achieved without any increased risk of complications or adverse events (Level of Evidence B, 1)

Benefits of Resistance Training

There is limited information on the responses of the older cardiac patient to resistance training. Nevertheless, there are numerous randomized trials of resistance training in the older patient without CAD which demonstrate an unequivocal benefit.⁴² Such benefits are observed even among the oldest (90+ years) and frail elderly residing in nursing homes.⁴³ These studies, in addition to the those on younger patients with CAD and CHF, provide sufficient information to allow conclusions to be drawn about outcomes in the older CAD population.

The specific benefits of resistance training are:

- Increases in maximum muscle strength and lifting endurance of 50% or more.^{42,44}
- Improvements, or retarded losses, of bone mineral content and bone mineral density.⁴⁵
- Increases in peak exercise capacity, sub maximal endurance, and ratings of perceived exertion during heavy sub maximal exercise.^{44,46}
- Reduced arterial pressure during lifting with the trained muscles.⁴⁷
- Improvements in tasks demanding significant arm or leg strength.⁴⁸
- Improvements in quality of life parameters such as total mood disturbance, depression/dejection, fatigue/inertia, and emotional health domain scores.⁴⁹

Recommendation:

Resistance training should be considered for low-risk older coronary patients, since it has the potential to reverse the loss of lean tissue associated with aging, increase muscle mass and strength, improve balance, and allow activities of daily living to be carried out with greater ease and safety. (Level of Evidence C,1)

Risk Factor Modification

Comprehensive rehabilitation regimens that include education, dietary counseling and behavioral modification as well as exercise, can achieve an improvement in body dimension and lipid profile. However, lipid lowering when required is more readily achieved with medication. Observational studies in the elderly have reported significant reductions in body mass, percent body fat, and body mass index, as well as improvements in total cholesterol, triglycerides, HDL-cholesterol and HDL/LDL ratio.^{25,33,34}

Improvement in Mood, Quality of Life

Older coronary patients, in addition to exhibiting high levels of physical disability, also may suffer from somatization, are prone to moderate to severe depressive/anxiety states, and score poorly on quality of life measures.³⁷ Depression in cardiac patients is associated with serious implications. Not only does depression have an adverse influence on well-being and social function, but it is also associated with an increase in one year mortality after myocardial infarction.⁵⁰ Depression often is unrecognized by the physician, probably because its manifestations are masked by the symptoms of the older patient's many co-morbidities.³⁷ A number of studies have reported significant improvement in mood state and total quality of life following a 12-week comprehensive cardiac rehabilitation program.^{28,32,34,35,36,37} Scores for depression, anxiety, hostility, and somatization dropped on average 42%, 41%, 36% and 37% respectively and total quality of life scores increased by 22%. Patients aged over 75 years appeared to have an especially large benefit with substantial improvements in mood (56%, 66%, 65%, 42%).³⁴

The one randomized controlled trial in the elderly which evaluated quality of life after exercise training reported that a three-month intervention group experienced a marked improvement in chest pain and shortness of breath at sub maximal leisure-time activities as well as improved alertness, physical ability, daily activity, and fitness. However, apart from chest pain and shortness of breath, some of the gains were lost at the 12-month follow-up.⁵¹ The authors concluded that continued formal rehabilitation sessions are necessary to maintain the benefits gained.

Recommendation:

A comprehensive cardiac rehabilitation program should be considered for older cardiac patients. Such a program not only improves body dimensions and blood lipids, but also has been shown to improve quality of life, enhance mood state, and alleviate depression. (Level of Evidence B, 1)

Program Delivery

Shorter hospital stays following a coronary event have all but eliminated in-patient rehabilitation programs. In the traditional out-patient model the patient is referred to a rehabilitation facility, is assessed by a multidisciplinary team, prescribed an individualized exercise and risk reduction program, and attends an onsite exercise education class two or three times weekly for as short as eight weeks, or as long as one year. An alternative is the home-based model where the patient reports at regular intervals by mail or telephone to a nurse case manager. The latter functions as a link between the patient, the family physician, and the rehabilitation team, which may include a lipidologist, a cardiologist, a psychologist, or exercise specialist, depending on the patient's needs. This approach has the advantage of promoting self-reliance as well as being effective and low cost. However, the lack of surveillance and emergency care during exercise sessions makes it unsuitable for high-risk patients. Furthermore, there is less opportunity for in-depth education and counseling.

For the physically independent patient, the attraction of the home-based program is clear. Even where a cardiac rehabilitation facility is available, a combined program is often the preferred choice. The initial stages of the program begin with attendance at an outpatient centre and are followed by transition to a home regimen. Facilities for exercise may exist in local community centres or in covered shopping malls, and are becoming increasingly available to early-morning seniors' walking clubs. With a local case manager, follow-up can be carried out in combination with the family physician or cardiovascular specialist.

Although a high proportion of the old and the oldest-old are still physically independent and will benefit from a combined program, many members of this group are living close to the lower limit. A coronary event may be all that is needed to tip the scales in the direction of frailty or dependency. These individuals, in addition to cardiovascular testing, require careful evaluation of their functional level and exercise capacity. Various batteries of tests can be used to measure not only activities of daily living but also muscular strength and endurance, agility, neuromuscular coordination, balance and flexibility. The results will aid in the planning of a program appropriate to the patient's needs in terms of location, content and realistic outcomes. For some then, an in-patient regimen is required, which at least initially, emphasizes general and/or geriatric rehabilitation techniques.

Unfortunately, despite its proven benefits, cardiac rehabilitation in Canada suffers from inadequate funding, lack of consensus on program content and duration, poor regional distribution of services, and limited patient accessibility for both young and old.⁵²

Recommendation:

It is recommended that, when dealing with older patients, home-based as well as center-based cardiac rehabilitation programs be considered. It is important that cardiac rehabilitation personnel ensure good communication with the primary physician, the cardiologist, and when indicated, with geriatric services. (Level of Evidence C,1)

Recommendation:

Cardiac Rehabilitation Services are unevenly distributed across the country, vary considerably in the methods by which they are funded, and are virtually non-existent in some provinces. It is recommended that provincial health networks consider their respective cardiac rehabilitation needs, and implement a plan to provide an effective delivery infrastructure, based where possible, on health service funding. (Level of Evidence C,1)

The Exercise Program

Aerobic Training

Although many older patients have a low fitness level, others have enjoyed an active physical life and aspire to regain their prior functional capacity through exercise rehabilitation. Thus, although it is prudent to start exercising training at a low intensity and to progress cautiously in those who are poorly conditioned, one should allow for individual differences and prescribe accordingly.

As with younger patients, the exercise prescription is customarily based on the results of an exercise test with, where possible, analysis of expired air for determination of peak oxygen intake or VO_{2peak} . The preferred protocol is one in which the initial work rate is low and the subsequent increments small, e.g., a modified Bruce or Naughton test.¹⁷ When patient balance is poor, exercise on a cycle ergometer is an alternative to the treadmill. For the very frail elderly, other testing options are ECG telemetry during a sub-maximal tests such as the six-minute walk,⁵³ the 10-metre shuttle walk test,⁵⁴ or simulated activities of daily living.^{55,56} It should also be borne in mind that exercise-induced supraventricular and ventricular arrhythmias increase with age, and that dyspnea may be a more frequent manifestation of myocardial ischemia than angina. Contraindications to testing and training are similar to those in younger patients.^{57,17}

The general principles of exercise prescription are also similar for both young and old patients.^{1,17} However some modifications may be required to allow for age-related changes, which may affect the responses to exercise. These include:

- Elevated systolic blood pressure due to an increase in arterial wall stiffness and peripheral resistance.
- Lower maximal heart rates (rate reduction of 1 $bt \cdot min^{-1}$ per year), due in part to a decreased sensitivity to catecholamines.
- Decreased maximal arterial venous oxygen difference, reflecting a poorer perfusion and reduced oxygen extraction by skeletal muscle.
- Decreased peak stroke volume and peak cardiac output.
- Decreased maximal oxygen intake: the decline occurring at a rate of about 4-5 $mL \cdot kg \cdot min^{-1}$ per decade from age 30 years. A slower increase in oxygen intake and heart rate are observed in the early stages of exercise and a slower decrease during recovery.
- Impaired heat tolerance as a result of a reduced peak cardiac output, a slower onset of sweating, and poorer heat loss due to an increase in subcutaneous fat.
- Greater risk of post-exertional venous pooling and hypotension because of impaired baroreceptor reflexes.
- Severe deconditioning, with loss of muscle strength, joint flexibility, neuro-muscular co-ordination, and bone density.
- Adverse drug reactions are often atypical, particularly in the frail elderly, and may interfere with activity programs, e.g., orthostatic hypertension due to ACE-inhibitors, diuretics, beta-blockers, etc.

Special Considerations When Prescribing Exercise

It is important to individualize the exercise prescription based on clinical status, symptoms and co-morbidity.

Mode: By definition aerobic exercise must be continuous and rhythmic. High-impact exercise such as jogging should probably be avoided because of the increased likelihood of musculoskeletal injuries in the older patient. Preferred activities include walking, stationary cycling, low-impact or water aerobics, arm ergometry, etc.

Intensity: This is crucial to the safety and efficacy of the exercise program. Commonly, it is based on a percentage of VO_2 peak, a percentage of maximal heart rate (HRmax), or on the patient's perceived exertion. **VO_2 peak:** Training intensities range from 40% - 85%, depending on fitness. Older patients, at least initially, will obtain a training effect at the lower intensities, i.e., 40% - 60%.

HRmax: There is a linear relationship between heart rate and VO_2 during aerobic exercise. This allows heart rate to be substituted for VO_2 when calculating the exercise prescription. However, the heart rate reaches a maximum value before the oxygen intake, and thus the preferred training range of VO_2 peak 50% - 60% is equivalent to HRmax 55% - 70%. Note that HRmax varies considerably in older individuals, and where possible it should be measured rather than age-predicted. On occasion, meaningful gains in cardiovascular fitness can be obtained at training heart rates <100 bts.min⁻¹ or, where indicated, 10 beats below the heart rate safely achieved at exercise testing.

Perceived Exertion: In practice, the Borg numerical scale is the most common (range 6-20).^{57,58} A rating of 12 is "light" and is equivalent to VO_2 peak 40%, whereas a rating of 13 is "somewhat hard" and is equivalent to VO_2 peak 60%.

Additional time should be allowed for a longer warm-up and cool-down (e.g., 15 minutes), which can be spent at light activities and stretching exercises.

Duration: Twenty minutes progressing to 45 minutes.

Where the physical limitations are such that the duration is limited to less than 15 minutes, then one should aim for 2-3 sessions daily.

Frequency: Three to five times weekly.

Recommendation:

When prescribing aerobic exercise for older cardiac patients, the initial training intensity should be low and progression gradual, with longer warm-up and cool-down and avoidance of high heat and humidity. Walking is the training mode of choice. (Level of Evidence C, 1)

Resistance Training

Inclusion and Exclusion Criteria

Contraindications to resistance training are: unstable angina, uncontrolled hypertension (systolic pressure >160 mm Hg and/or diastolic pressure >100 mm Hg), uncontrolled dysrhythmias, a recent history of congestive heart failure that has not been evaluated and effectively treated, severe stenotic or regurgitant valvular disease, and hypertrophic cardiomyopathy.¹⁷ Preferred inclusion criteria are moderate to good left ventricular function and an exercise capacity of >5 METs.

For patients who meet these criteria, the principles of prescription for resistance training are similar to those in younger individuals, with some modifications.

Exercise Prescription for Resistance Training

Patients should take part in 2-4 weeks of aerobic training prior to doing resistance training. Pre-training instruction should emphasize correct lifting and breathing techniques. Resistance training should be carried out twice weekly and include one set of 10-15 repetitions of 8-10 exercises designed to train all major muscle groups.

If 1 RM (the most weight one can lift in one repetition) is determined, patients should begin training with loads equivalent to 30-40% of the 1 RM for upper body exercises and 50-60% of the 1 RM for lower body exercises. Older, and frailer individuals may start training at lower intensities and progress more slowly.

Determination of the 1 RM is not strictly necessary. Patients can begin using light weights, which result in moderate levels of fatigue by the end of a set of lifting. Once patients can complete their final lift with ease, the weights can be increased. Added loads of 2-5 pounds/week for the arms and 5-10 pounds/week for the legs are adequate in most cases. Slower progression may be necessary in the older patient.

Equipment can include springs, elastic bands, free weights and an assortment of machines. The likelihood of dropping a weight is greater in older patients and therefore, machine weights may be preferable. If they are used they can be double pinned in order to restrict joint range thus reducing risk of injury while still allowing the patient to obtain a significant training effect.

For patients with poor ROM or joint pain, weight machines can be double pinned to restrict the ROM. This avoids discomfort and risk of injury while still allowing the patient to attain a significant training effect. Variable resistance machines may also be useful for such a patient.

Monitoring of Patients

Blood pressure can be monitored in a non-engaged limb. However pressures measured immediately after lifting do not reflect the increase during lifting, and may even be below resting values. Artefact from muscle contractions limits the value of electrocardiographic telemetry.

Recommendation:

Low risk older patients with good ventricular function can commence supervised resistance training 4 to 6 weeks after starting aerobic exercise. Sessions should be carried out twice weekly, utilizing light weights (30% to 50% of 1 RM) with one set of 10-15 repetitions for major muscle groups. Blood pressure can be monitored in the non-exercising limb. (Level of Evidence C,1)

Chronic Heart Failure

Recent evidence indicates that medically prescribed and supervised exercise rehabilitation in non-edematous chronic heart failure can improve symptoms and enhance quality of life without compromising cardiac function.^{59,60,61,62} Training-induced changes include improvement in muscle metabolism, increased peripheral blood flow, improved autonomic nervous system activity and ventilatory control. While the precise exercise training protocol should be individualized, most programs have utilized continuous aerobic activity such as walking or stationary cycling. There is some evidence, however, that interval-type training can be effective and that resistance training is safe and also efficacious.^{63,64} There is a marked lack of studies on exercise training in older patients with chronic heart failure, with only one report involving patients in their 80s.⁶⁵

Recommendation:

It is recommended that the effects of exercise training in chronic heart failure be further evaluated in the older patient. (Level of Evidence is C,1)

Recommendations for Additional Research

There is need for research in:

- Evaluation of the effects of cardiac rehabilitation in older patients, particularly women, and those of different ethnic groups.
- Evaluation of the efficacy of strength training in the older patient population.
- Determination of the optimal length of a cardiac rehabilitation program, its cost-effectiveness and cost outcomes.
- Evaluation of the most effective modes of program delivery for the older patient, e.g., home based versus centre, supervised versus non-supervised exercise.

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Elderly Patients With Cardiac Disease
Quality of Life, End of Life, and Ethics

Paddy Rodney PhD¹, Jonathan Howlett MD²

¹University of Victoria, ²Dalhousie University

Correspondence

P. Rodney,
University of Victoria School of Nursing Lower Mainland Campus
c/o Langara College, 5th Floor, Library Building,
100 West 49th Avenue
Vancouver BC V5Y 2Z6
Tel: 604-323-5923
Fax: 604-323-5929
Cell: 604-338-7655

E-mail: prodney@uvic.ca

Executive Summary

- ◆ In order to move forward to meet the needs of elderly cardiac patients we need to better understand their quality of life and the issues that they face at the end of life.
- ◆ There is no established method for determination of quality of life in patients with cardiovascular disease, regardless of age.
- ◆ Elderly patients with cardiovascular disease represent the single largest group at high risk of death, yet a subject such as of end of life in this group of patients is seldom brought up until an emergency situation occurs.
- ◆ There is a near total lack of scientific data relating to end of life issues in the cardiovascular genre despite the large number of deaths that occur in medical wards and intensive care units.
- ◆ The application of ethical decision making models can be of significant assistance for patients, families, and health care providers facing complex questions at the end of life.
- ◆ Evaluation for withholding or withdrawing treatment needs to include the patient's physiological status, personal wishes, cultural and spiritual beliefs, and overall quality of life and should be done with input from the patient's family and other health care team members.
- ◆ Communication about withholding or withdrawing treatment needs to start *early*, needs to include the team and family, and needs to always include attention to pain and symptom management.
- ◆ Age should not be used as the primary criterion for withholding or withdrawing treatment.
- ◆ Futility determinations are difficult to apply in many cases because of individual variation and because there is not sufficient outcome data with which to determine the potential physiological effect.
- ◆ Advance directives can assist with determinations of appropriate end of life treatment and care, even if they are not legally binding in all Canadian jurisdictions.
- ◆ Advance directives are best when they include both instructional and proxy directives.
- ◆ Elderly patients with cardiac disease and their families will benefit from the education of physicians on the art of *how* to talk about the end of life.

Patients and their families too often approach the long term and final stages of cardiac and other chronic illnesses poorly prepared. Research tells us that the fallout for Western health care includes violations of informed consent, overtreatment with biotechnology, and family and interdisciplinary team conflicts (Brody, 1995; Burgess et al., 1999; Callahan, 1995; Cook, 1997; Cook et al., 1995; De Ville & Kaplan, 1998; Fins et al., 1999; Health Canada, 2002; Hiltunen et al., 1999; Jezewski, 1994; Lo, 1995; Manias, 1998; Marik & Zaloga, 2001; Moscovitz & Nelson, 1995; Resnick, Cowart, & Kubrin, 1998; Rodney, 1994; 1997; Ruark et al. 1997; Solomon et al., 1993; Solomon, 1995; Starzomski, 1998; Subcommittee to Update "Of Life and Death" of the Standing Senate Committee on Social Affairs, Science and Technology, 2000; Thorne, 1993; Tilden et al., 1999; Ventres et al., 1997; Walter et al., 1998; Weiss & Elite, 2000). Across Canada, this fallout has been exacerbated by the past decade or more of cost constraint. Physicians, nurses, and other health care providers now face escalating workloads, staff shortages, and shrinking resources (Aiken, Clarke & Sloane, 2000; Armstrong & Armstrong, 1996; Barry-Walker, 2000; Brown, 1996; Burgess, 1996; Rachlis et al., 2000; Rodney & Varcoe, 2001; Woodward et al., 1999). Patients and their families face increasing difficulty accessing appropriate programs of treatment and care, including end of life and palliative care¹ (Blue et al., 1999; Dossetor & MacDonald, 1994; Health Canada, 2002; Stajduhar, 2002; Subcommittee to Update "Of Life and Death" of the Standing Senate Committee on Social Affairs, Science and Technology, 2000).

The consequences for elderly patients with cardiac disease—who may face concomitant problems such as other chronic illnesses, limited mobility, social isolation, poverty, and so forth—are only beginning to be examined. Indeed, this CCS Consensus Document is a benchmark for the kind of inquiry that needs to be done to plan and deliver appropriate treatment and care for this special population. In order to move forward to meet the needs of elderly cardiac patients we need to better understand their *quality of life* and *the issues that they face at the end*

¹ *Quality end of life care* includes “adequate pain and symptom control, appropriate use of life-sustaining treatments, and support for patients and their families” (Health Canada, 2002, p. 80). *Palliative care* is a special kind of healthcare for individuals and their families who are living with a life-threatening illness that is usually at an advanced stage. The goal of palliative care is comfort and dignity for the person living with the illness as well as the best quality of life for both this person and his or her family (Health Canada, 2002, p. 79).

For the purposes of this paper, we shall consider quality end of life care to be the overall goal, with palliative care as a specialized set of interventions that may be utilized to meet that goal.

of life. Such an understanding is prerequisite to promoting value-based ethical decision making during their illness trajectory

Quality of Life [references still to be integrated in text]

Quality of life is an imprecise parameter and is difficult to measure in patient populations. While no recognized gold standard exists for measurement of quality of life (QOL), it may be described in general or disease-specific terms, (for those with specific health conditions). The basis for measurement typically includes administration of a validated questionnaire. Measurement of QOL may be complicated by modifying factors, such as age, gender, socioeconomic status, language, and patient or family expectations. Results may vary depending on the method of administration. For instance, a questionnaire administered by telephone will provide a different score in the same individual than an interview or a self-administered test. As a result, careful consideration of the clinical situation coupled with cautious interpretation of results is required. For these reasons, QOL interpretation is essentially semi-quantitative and must be performed in view of age and sex standardization.

General Quality of Life

Several tools for measurement of QOL exist for both healthy and ill populations. The most widely used tool, the Short Form 36 (SF36), examines 36 elements in 8 different areas of interest including physical, social, functional, emotional and spiritual domains. The self-answering questionnaire is based upon selection of responses in a Likert scoring system, adding each response for a domain and total score. The scores are standardized from 1- 100. Generally, the higher score indicates poorer quality of life. Published values for exist in several populations. Normal age and sex standardized data has recently been published for Canadian adults. Other tolls for measurement of general QOL exist, each with advantages and disadvantages, but the SF36 is most widely used.

Patients over age 75 years comprise an under-represented group, however a few comments may be made. Generally, quality of life decreases with increasing age; females score lower than comparably aged males in areas related to physical functioning and energy or vitality. At all ages, QOL scores are lower for those with

cardiovascular conditions than healthy individuals, with the most marked differences tending toward (but not limited to) physical function. Elderly patients with cardiovascular disease are most affected and report the poorest quality of life. Elderly patients are also at increased risk of financial stress and social isolation. Many

are widowed or institutionalized or may suffer from multiple co-morbidities. Given these difficulties, there is no established method for determination of quality of life in patients with cardiovascular disease, regardless of age.

Quality of life in elderly patients may also vary according to type of cardiovascular disease. Elderly patients with hypertension report mild reduction in SF36 scores, while those with ischemic heart disease and acute myocardial infarction report worse scores. Surprisingly, atrial fibrillation, once thought benign in terms of

quality of life, was associated with a marked impairment of SF36 score. The poorest scores occur in association with congestive heart failure, which also has the worst prognosis.

Disease Specific Quality of Life

Questionnaires designed to mirror the effects of a specific disease on quality of life are referred to as disease-specific instruments. Commonly used instruments include the Minnesota Living with Heart Failure (for CHF) and Seattle Angina Questionnaires (for ischemic heart disease). Similar principles for scoring are employed as with the general instruments which are prone to the same difficulties mentioned above. There is a relative paucity of data for elderly patients with cardiovascular disease.

Quality of life is difficult to measure but has a great impact upon patient decision making and medical care.

Many patients with severe cardiac disease prefer to trade off life expectancy for improved symptoms and quality of life. Over time and as QOL changes, these decisions may also change. Thus, QOL assessment, while imprecise, carries importance in the management of the elderly with cardiovascular disease.

Lower quality of life scores have been used to predict morbidity and mortality in elderly patients with cardiovascular disease. Depressive mood and symptoms have recently been shown to play a very important part in the clinical course of cardiac disease. Clinical and sub-clinical depression occurs in at least 20-30% of patients with cardiac disease and predicts worse outcomes in the post myocardial infarction setting, and in those

with CHF. Elderly patients develop this at least as frequently as younger patients. Depression may also present atypically in this population, magnifying an already under recognized diagnosis. Poor quality of life scores are associated with clustering of 'social risk factors', including poverty, social isolation, medical comorbidity and adherence to medical therapy. The following socioeconomic factors have a strong impact upon hospital readmission in elderly patients with cardiac disease:

History of depression or anxiety (Bennett et al., 1997; Marcantonio et al., 1999; Naylor et al., 1999)

History of noncompliance (Naylor et al., 1999)

Inadequate support system; living alone (Chin & Goldman, 1997; Krumholz et al., 1998; Naylor et al., 1999; Struthers et al., 2000)

Cognitive impairment (Bennett et al., 1997; Smith et al., 2000)

The effects of multidisciplinary programs targeting elderly patients with cardiovascular disease have been performed, with mixed results. Post myocardial infarction rehabilitation interventions have shown mixed but generally positive on quality of life. Interventions have included home telephone interviews, home visits,

patient counseling and education sessions, and exercise, both with and without a full scale exercise rehabilitation program. Studies have employed varying methods and length of follow up. Two interventions have repeatedly shown improvements in quality of life- these include supervised exercise for those with CHF following myocardial infarction, and a disease-management program directed toward management of CHF.

Even for these two interventions, long term data (>1 year) are not available. Routine measurement of quality of life by *any* tool has not to date been shown to improve clinical endpoints. Long term assessment and collection of detailed socioeconomic data is required.

Recommendations

1. There is no gold standard measurement tool for quality of life though several disease specific and general tools exist. Using these semi-qualitative or qualitative techniques, attempts should be made in elderly patients to

evaluate their quality of life with the intent of identifying important problems or issues that require assessment.

These may include social or physical isolation, financial hardship, loss of independence or other problems.

2. Depression in the elderly may present in an atypical fashion and is common in those with cardiovascular disease and should be sought and treated aggressively.

3. Multidisciplinary approaches are favoured in the assessment and treatment of the elderly patient with poor quality of life. The participation of social workers, occupational therapists, nurses, psychologists, dieticians, pharmacists, home workers and other health care providers can greatly improve identification and redress of patient and environmental factors, thereby improving care.

End of Life Issues

Introduction [references still to be integrated in text]

Perhaps no issue of health care evokes such an emotional response in patients and their families as the subject of end of life. End of life issues are difficult and time consuming, they nevertheless are of critical importance if the terminal aspect of patient care is to be optimal. Elderly patients with cardiovascular disease represent the single largest group at high risk of death. Age is the most important predictor of outcome for patients with cardiovascular disease. As such, a prominent part of care in this group should be the preparation for death. Unfortunately, end of life issues in this group of patients is seldom brought up until an emergency situation occurs. Several factors contribute to the avoidance of this subject including anxiety of health professionals, patients, their families/caregivers, patients' lack of knowledge of the conditions prognosis, ineffective communication between health professional and patients, unrealistic patient expectations, and cultural or religious beliefs. Elderly patients are also at risk of cognitive impairments, making learning and knowledge retention problematic. Although heart disease is the leading cause of death in the elderly, end of life care of patients with heart disease has been negligible. Symptom control and psychological care must be available to all patients with heart failure at end of life. While heart failure is a chronic disease it is frequently a terminal illness. This may dictate care objectives in certain cases.

Palliative care in cancer and heart failure are likely very different. Cancer treatments such as chemotherapy and radiation usually cause significant side effects while treatment for heart failure frequently improves symptoms. This simple fact underscores the fundamental differences in end of life issues between heart disease and malignancy. As such, new research into end of life care in elderly patients with heart disease is urgently needed, since applicable findings from the cancer literature may not translate effectively to the elderly cardiac patient.

The Regional Study of Care for the Dying was a population-based survey of family members or others who knew about the last year of life of people who died in 1990 in England [reference]. Of the 600 people for whom heart disease was the underlying cause of death, the majority (54%) died in a hospital, and 36% were reported to have died alone. Of the total, 58% of the patients preferred treatment in a hospital. Patients generally wished aggressive treatment. Some of these choices may have been made through an incomplete understanding of the potential benefits of palliative care. While many patients with other terminal conditions refuse aggressive life prolonging treatments, patients with advanced heart failure usually prefer to receive maximal medical therapy until death. Below are shown the most frequently reported symptoms in the RSCD:

Common Symptoms in Regional Study of Care for the Dying [reference]

<u>Symptom</u>	<u>Occurrence in Last Year</u>	<u>“Very Distressing”</u>
Pain	78%	50%
Dyspnea	61%	43%
Low mood	59%	50%
Sleeplessness	45%	
Loss of appetite	43%	
Confusion	27% of < 55 years 42% of > 84 years	43% of < 75 years 33% of > 75years
Constipation	37%	43%
Nausea/vomiting	32%	42%
Anxiety	30%	55%
Urinary incontinence	29%	
Fecal incontinence	29%	64%

An additional problem is the inherent uncertainty of prediction for mortality in cardiovascular patients. For instance, over one third of patients die suddenly as the initial symptom of acute myocardial infarction.

Similarly, between one and two thirds of patients with congestive heart failure die suddenly as opposed to progressive pump failure. This contrasts with nearly all published end of life cancer literature where the

overwhelming majority of deaths due to malignancy can be predicted within weeks or days. Data from SUPPORT (an end of life study) related resuscitation preferences of patients with CHF. Of the 936 patients in the sample, 69% definitely did want to be resuscitated in the case of a cardiac arrest, 23% explicitly stated that

they did not want to be resuscitated, and 8% were unsure. The physician's perception of the patient's preference was not accurate in 24% of the cases. Two months later, 19% of patients had changed their preferences- 14% of those who initially wanted resuscitation and 40% of those who initially did not, indicating as disease course changes, preferences for active care may increase rather than the opposite.

In summary, there is a near total lack of scientific data relating to end of life issues in the cardiovascular genre despite the large number of deaths that occur in Medicine wards and intensive care units. Existing principles can

be gleaned from the cancer literature. These principles include the fundamental importance of patient/ caregiver knowledge of their disease and its prognosis. Decision-making rests upon this requirement. Patients have been

most comfortable discussing these difficult issues with someone whom they trust and have a prior relationship with. This person may or may not be the physician member of the treatment team, though physician

involvement is very important. Patients and their families must not be rushed during discussion of end of life, and may take several visits to resolve the matter. Many patients wish to have their caregiver or loved ones involved in the decision-making. Patients may also change their mind regarding such treatment.

It is important to underscore that elderly patients with cardiovascular disease are at especially high risk of death and other complications. They are less likely to understand their illness and its complications and prognosis and have less social support. Many elderly patients do not understand the complexities of medical care and require careful explanation. In view of the lack of evidence in this area, research of the end of life issue in elderly patients with cardiovascular disease is urgently needed.

Recommendations

D 1. There is no established ‘best’ approach to end of life issues in the elderly cardiac patient. This includes the setting of appropriate endpoints- the endpoint of ‘successful no codes’ achieved is not satisfactory.

R 2. All elderly patients with cardiovascular disease need to clearly understand their illness and prognosis (including uncertainty). Patient expectations regarding outcomes of medical care should be ascertained, and corrected if necessary. Every effort should be made to communicate this information effectively.

3. When appropriate, family members or loved ones should be part of the decision making process.

A 4. Patient desires and discussion of end of life issues should be clearly documented on the medical record. Physician opinions regarding treatments should also be clearly documented.

5. Patient desires and attitudes regarding end of life issues should be periodically reviewed and updated on the medical record.

F 6. End of life issues should be reviewed whenever there is an important change in the patient’s clinical status.

7. Research in the quality of life and end of life issues in the elderly patient with cardiac disease is urgently needed.

Ethical Decision Making

T Given the complexity of the quality of life and end of life issues that elderly patients with cardiac disease face, and the challenges we face in today’s era of cost constraint, it is crucial that we look at the values that underpin treatment and care decisions for this special population. A growing number of health care providers and ethicists are calling for more careful approaches to ethical decision making--especially at the at the end of life--for all patients (Burgess et al., 1999; Canadian Healthcare Association et al., 1995; Kuhl, 1994; 1997; Murphy, 1996; Roy, 1994; Roy, Williams, & Dickens, 1994).

Ethical decision making can be thought of as a structured form of moral deliberation that occurs when physicians and other health care team members confront an ethical problem and ask the question “What ought I

to do?" (Beyerstein, 1993, p. 422). *Contextual* approaches to ethical decision making encourage us to

D undertake a careful assessment of the patient's physiological status, personal wishes, cultural and spiritual beliefs, and overall quality of life. They also encourage us to understand the patient in the context of his/her

family and social environment (Bowman & Singer, 2001; De Renzo & Strauss, 1997; Hoffmaster, 2001;

Kaufman, 2001; Kuhl & Wilensky, 1999; Jonsen, Sieglar, & Winslade, 1992; McDonald, 2002; Rodney, 1997; Sherwin, 1998; Winkler, 1993). **R** All of these contextual features are especially important for elderly patients

with heart disease.

The fundamental concepts we have available for ethical decision making include the traditional principles of autonomy, beneficence/nonmaleficence and justice as well as more relational concepts such as fidelity and care.

For instance, in helping an elderly patient with cardiac disease make decisions about treatment and care,

autonomy would remind us to respect the individual as a unique individual with a unique life story (eg. spiritual

beliefs), *beneficence/nonmaleficence* would remind us to pay attention to the possible harms as well as the

benefits of treatment (eg. coronary artery bypass), *justice* would remind us to **E** consider the circumstances of the

patient's life and put appropriate resources in place (eg. home care), *fidelity* would remind us to foster trust in

patient-family-team relationships (eg. through regular meetings), and *care* would remind us to pay attention to

the well-being of family and health care team relationships (eg. through grief counseling for family members

T facing the impending death of the patient).

The application of ethical decision making models can be of significant assistance for patients, families, and health care providers facing complex questions at the end of life with cardiac disease. However, physicians and other health care providers also require education in ethical theory, the application of ethical decision making models, and related ethical issues. The latter include contemporary thinking about withholding and withdrawing treatment, controversies about the concept of futility, and the use of advance directives.

Withholding and Withdrawing Treatment

The appropriate application of an ethical decision making model to the treatment of elderly patients with heart disease requires some knowledge of contemporary legal and ethical issues in withholding and withdrawing

treatment. Withholding and withdrawing treatment entail reasoned clinical judgements identifying what

treatments are or are not in the patient's best interest. That best interest can be determined on the basis of an assessment using an ethical decision making process. For example, once an elderly patient who comes into the

emergency department in severe left sided heart failure has been stabilized with oxygen, ventilation, morphine, diuretics and so on, it is not inappropriate to withdraw acute treatment and institute a palliative care plan after a

full evaluation is complete. While treatment withdrawal may be psychologically difficult for family, physicians, and other health care providers, it is much more defensible than slow or partial institution of resuscitative

measures because of fears that "once we put the tubes in we can never get them out".

Withholding and withdrawing treatment for elderly patients with heart disease requires an evaluation of the patient's physiological status, personal wishes, cultural and spiritual beliefs, and overall quality of life, as we

have described earlier in this paper. The evaluation should be done with input from the patient's family and other health care team members—especially the family physician, who is often in a good position to provide

much of the necessary background information. Age should not be used as the primary criterion (Hamel et al., 1999; Richter & Eisemann, 2000). Furthermore, the formal use of an ethical decision making model, as well as

the assistance of an ethics consultants and/or an ethics committee, can assist in the determination of a value-based course of action for complex cases.

One particular question in withholding and withdrawing treatment that comes up frequently--especially for elderly patients with heart disease--is *whether or not to resuscitate the patient*, and how to communicate that decision. Research from a variety of practice contexts throughout Western health care has consistently warned

² For an example of a useful contextual ethical decision making model, see Michael McDonald's "An Ethical Decision Making Framework", found at the University of British Columbia Centre for Applied Ethics Website: <http://www.ethics.ubc.ca>

that resuscitation decisions tend to be poorly made and poorly communicated (Calam & Andrew, 2000;

Casarett, & Siegler, 1999; Jezewski, 1994; Marik & Zaloga, 2001; Mello & Jenkinson, 1998; van Walraven et al., 2001). "Do Not Resuscitate" (DNR and other variations of the acronym) policies can protect patients from

the loss of dignity occasioned by prolongation of life and can protect health care professionals from potential

legal liability should they determine that further treatment by resuscitation would be medically useless (Storch, Rodney, & Starzomski, 2002). While DNR policies vary from organization to organization, a good DNR policy

(or protocol or guideline) should include the following:

Instructions to foster *early* discussions of end of life issues with patients, families and team members before full-blown crises emerge;

Clear directions for *documentation* of the DNR order and documentation of the communication processes that have led to the DNR decision, including who was involved and when;

Mechanisms to *review* previous or current DNR orders, including how to rescind a DNR order and how to re-assess and honour DNR orders from other admissions or other agencies;

Directions for how to *temporarily suspend* a DNR order during special procedures (eg. surgery, cardiac catheterization);

Differentiation of the DNR decision from *other decisions for treatment and care*. DNR does not necessarily mean no treatment—there may be levels of associated treatment and care ranging from full critical care to full palliative care; and

Communication guidelines that promote healthy interdisciplinary team decision making with patient and family involvement and that suggest how to resolve conflict (Bradley et al., 2001; Calam, Far, & Andrew, 2000;

Canadian Healthcare Association et al., 1995; 1999; Carlsen et al. 1998; Elwell & Fainsinger, 2000; Kerridge et al., 1998; Löfmark & Nilstun, 2001; Manias, 1998; Molloy et al., 2000; Murphy & Webster, 2000; Resnick et al., 1998; Rodney et al., 2002; St. Paul's Hospital, 1998; Webster et al., 1991).

Futility vs Trust

DAs we have identified earlier in this paper, elderly patients with cardiac disease face an uncertain prognosis and an uncertain quality of life. It may therefore be tempting for physicians and other health care providers to assert that acute treatment is futile. However, futility is a loaded term and should be used with care (if at all).

RTo say that treatment is futile is to say that it is impossible or unlikely to achieve its therapeutic goal, or that there is something problematic about the goal (Browne, 2000, p.2; Schneiderman, Jecker, & Jonsen, 1990).

There are a number of concerns about the ways in which the concept of futility can be employed as a seemingly

"objective" tool to limit patient autonomy. A diagnosis of 'medical futility' can be used to limit the ability of patients and families to request treatment that the physician feels is inappropriate. Yet futility determinations are

difficult to apply in many cases because of individual variation and because there is not sufficient outcome data with which to determine the potential physiological effect (Browne, 2000; Council on Ethical and Judicial Affairs, American Medical Association, 1999; Dunphy, 2000; Keyserlingk, 2000; Starzomski, 1994; Storch, Rodney, & Starzomski, 2002; Weijer, 1998). Furthermore, saying 'no' to patients and/or families' request for

treatment is not necessarily implemented in an equitable manner. Some patients and family members have difficulty in discussions about futility because of conflicts of values with physicians and other health care

professionals, particularly if they are of a sociocultural background different from the professionals' (Burgess et al., 1999; Keyserlingk, 2000; Rodney, 1997; Storch, Rodney, & Starzomski, 2002; Taylor, 1995; Weijer, 1998;

Wolf, 1994). There is a particular risk that the label of futility will be (inappropriately) used as a justification to ration treatment (Council on Ethical and Judicial Affairs, American Medical Association, 1999). Elderly

patients with heart disease may be particularly at risk here, especially if they do not speak English (or French in Francophone communities), are impoverished, and so on.

What this means is that end of life decision making for elderly patients with cardiac disease, or any other patients, must occur in a supportive and caring environment where patients, families and health care providers work together in a collaborative manner, and where there is transparency and trust (Keyserlingk, 2000; Kuhl &

Wilenski, 1999; Murphy & Webster, 2000; Rodney, 1994; 1997; Roy, 1994; Roy, Williams, & Dickens, 1994; Solomon et al., 1990; Starzomski, 1994; 1998; Taylor, 1995; Weijer, 1998). The practice recommendations we have articulated throughout this paper are aimed toward this goal.

Advanced Directives and Anticipatory Guidance

The trajectory of illness for elderly patients with cardiac disease often brings them to a point where they can no longer speak for themselves about choices for treatment and care. Fortunately, one means we have to listen when they no longer are able to speak is the use of advance directives. An advance directive is "a written document containing a person's wishes about life-sustaining treatment" that "extend[s] the autonomy of competent patients to future situations in which the patient is incompetent" (Singer, 1994, p. 111; see also Dossetor & Cain, 1997; Downie, 1995; Gordon, 2000; Storch, Rodney, & Starzomski, 2002; Wilson et al., 1996). One form of an advanced directive is an *instructional directive*, where the individual articulates "what or how healthcare decisions are to be made in the event that he or she becomes incompetent" (Health Canada, 2002, p. 84). The second form is a *proxy directive* (also known as a durable power of attorney for healthcare decisions), where the individual articulates "who is to make healthcare decisions in the event that he or she becomes incompetent" (Health Canada, 2002, p. 84). Advance directives are best when they include both. The appointment of a proxy decision-maker who knows the patient and can represent his/her best interest is an important means of ensuring that someone speaks on behalf of the individual's prior decisions (Dossetor & Cain 1997; Singer, 1994). Provincial and territorial legislation on informational and proxy directives varies from province to province, and so it is important for physicians and other health care providers to become familiar with their own province's or territory's legislation (or lack thereof)³.

Advance directives are meant to assist with decisions about the withholding and withdrawal of treatment

³ Proxy decision makers are often called *substitute* decision makers. It is important to note that across Canada there are a number of legislative initiatives moving towards *assisted (supported)* decision making (Gordon, 2000). Assisted decision making is not as absolute as substitute decision making, and "reflects new efforts to provide better ways of recognizing and meeting the needs of adults who have difficulty with certain areas of decision-making but who could make their own decisions with a little friendly help" (Gordon, p. 71).

including, but certainly not limited to, resuscitation (Storch, Rodney, & Starzomski, 2002). No instructional directive can anticipate the complexity and ambiguity of many of the decisions about treatment and care that will be faced for patients at the end of their life. This is especially true for elderly patients with heart disease,

who often have an uncertain and prolonged illness trajectory. Nonetheless, the instructional directive, particularly if accompanied by a proxy directive, can be of great assistance in the commencement of an ethical decision making process. The instructional directive can help us to better understand who the patient is as a person and what he/she would want. The proxy directive can ameliorate team-family conflict, and can enhance family participation in decision making for the benefit of the patient.

Perhaps the most important benefit of advanced directives is that they encourage patients, families, physicians, and other health care providers to consider end of life decision making before they find themselves in full blown crises (Sawchuk & Ross-Kerr, 2000). Encouraging patients and their families to consider advance directives early in the course of the patient's illness is important. Such discussions--and the teaching associated with them--can occur in the family physician's office as part of regular visits, and/or with specialists prior to

considering new interventions (eg. coronary bypass surgery). Documentation of the patient's instructions and choice of proxy should be made available to acute care, long term care, and community facilities when they are involved with the patient in the future (Bradley et al., 2001; Ghushn et al., 1998; Molloy et al., 2000). Even in jurisdictions where the process is not legislated, the advanced discussion and documentation helps to facilitate ethical decision-making. While physicians may feel that it is difficult to talk to their patients about dying,

physicians also report that education and role modeling by their colleagues make it easier (Calam & Andrew, 2000; Calam, Far, & Andrew, 2000). Elderly patients with cardiac disease and their families will benefit from the education of physicians on the art of *how* to talk about the end of life, just as they will benefit from ongoing education of physicians about the science of cardiac medicine (Bowman & Singer, 2001; Calam & Andrew, 2000; Calam, Far, & Andrew, 2000; Carlsen et al., 1998; Fins et al., 1999; Kaufman, 2001; Kuhl, 1999; Pellegrino & Thomasma, 1993; Potkins et al., 2000; Quill, 2000; Resnick et al., 1998; Solomon, 1995).

Recommendations

1. Education in ethical theory and models of ethical decision making should continue to be promoted for physicians and interdisciplinary teams involved in the care of elderly patients with heart disease. Such learning could occur at entry- and continuing- education levels.

2. Evaluation for treatment withdrawal needs to include the patient's physiological status, personal wishes, cultural and spiritual beliefs, and overall quality of life. The evaluation should be done with input from the patient's family and other health care team members.

3. The formal use of an ethical decision making model, as well as the assistance of an ethics consultants and/or an ethics committee, can assist in the determination of a value-based course of action for complex cases.

4. Up to date and comprehensive levels of care and DNR policies (or protocols or guidelines) ought to be available in acute care, long term care, and community health care agencies.

5. Exercise caution in using the term "futility" in discussions with patients, families, and health care providers. Be aware that seemingly unreasonable requests by patients and/or families for treatment usually arise from unresolved grief and loss of trust in the health care team.

6. Physicians and other health care providers ought to become familiar with their own province's or territory's legislation (or lack thereof) on advanced directives. Where appropriate and legally binding, advanced directives (including living wills) should be respected.

7. Discussions with patients and families about advance directives should occur in the family physician's office as part of regular visits, and/or with specialists prior to considering new interventions (eg. heart surgery).

8. Documentation of the patient's instructions and choice of proxy should be made available to acute care, long term care, and community facilities when they are involved in the patient's care.

9. Physicians report that they would benefit from education about and support in *how* to have anticipatory discussions about dying with their patients and families. Preparatory and continuing medical education programs in cardiac care ought to include content about communication at the end of life.

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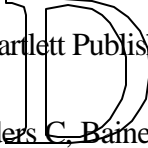
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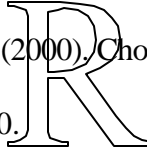
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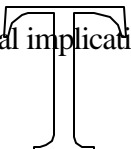
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