Abdominal Aortic Aneurysm From Puncture to Stent: Step by Step Technical Point Lessons from EVAR

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Preparation

- Understand anatomy of aorta and iliac access vessels well
  - Very important in not only device selection but also access decisions
    - Which side will be the main body?
    - Can percutaneous access be performed?
    - Will a surgical conduit be required?

Anesthesia selection

- General:
  - For open access, conduit placement, difficult patient
- Standby:
  - For percutaneous access
  - Conscious sedation ***after*** initial imaging so patient can cooperate with breathhold for DSA

Percutaneous access

- Very important that access point is optimized and in CFA
- Perc needle access under fluoroscopy to avoid calcium, and angiogram through needle to assess location in CFA
- Alternatives include US guided access of CFA
- Place 5F sheaths on both sides

Percutaneous access

- Place two Proglide closure devices in each vessel
  - Angle them 45 degrees off the centerline, so that their axes are 90 degrees apart

or

- Place a single Prostar in each vessel

Regardless of which you choose, make sure to follow wires and device tips on fluoroscopy as you work so that AAA is not disturbed

Percutaneous access

- Place Amplatz wire into the last closure device and place 10F sheath in each CFA
- Make sure to organize the sutures appropriately and clip out of the way with mosquitoes on the drapes for later use

Angiography

- Only 3 pieces of information are required on angiography:
  - Distance from lowest renal to bifurcation, taking into account any tortuousity
  - Distance from lowest renal to main body iliac bifurcation/hypogastric origin
  - Distance from the aortic bifurcation to both iliacs
- These are confirmatory as the CTA provides much of this info
  - For patients with renal failure, much of this can be done with US

Angiography

- Place marker pigtail or Omniflush catheter at the level of the renal arteries, and perform DSA
- Make sure to use the non-main body CFA for the initial angiogram so the catheter can be left in place for device deployment
- Alternatively, in patients with renal failure, a 6F IM renal guide can be placed in the lowest renal, and secured with a BMW wire, and used to locate the renal during deployment

Device deployment

- In cases where access if limited or difficult, dilate with a 14F dilator of sheath prior to introducing >18F EVAR device

- Line up contralateral gate on flouroscopy outside the body
  - The placement of the gate will be done to:
    - Optimize gate access after main body deployment
    - Stabilize device

- Carefully advance device under flouroscopic guidance through the iliacs, minimize rotation

Device deployment

- Line up proximal markers at the renal artery
  - Usually some cranial angulation is required in order to remove parallax
  - Take as much of the infrarenal neck as possible
- Small (5-10 cc) injections of contrast will identify renal arteries
- Make sure sheath is pulled back to appropriate position to allow full deployment
- Carefully deploy graft till contralateral gate is out

Contralateral gate access

- Place a J-wire into the pigtail and carefully remove the trapped catheter from behind the graft, but ***do not lose position within the aneurysm below the gate***
  - Reacessing the aneurysm sac after equipment is in can be difficult

- Using an angled Glidewire and angled catheter or Omniflush, and multiple fluoroscopic views, access the contralateral gate
  - Once in, place a pigtail or Omniflush into graft neck and spin to assure intragraft position

Contralateral limb

- Place an Amplatz wire into the marker pigtail you used to spin in the graft, but don't remove the catheter
- Instead line up the markers at the bottom of the gate and make sure markers extend well into the iliac
- Angle flouroscope to contralateral caudal 20-20 position
- Inject only enough contrast through the contralateral sheath to identify the hypogastric so distance can be measured

Contralateral limb

- Choose a limb long enough to take as much of the iliac as possible and deploy carefully in gate

Ipsilateral extension?

- Now remove the main body delivery device

- Using the marker catheter and same fluoroscope and injection method, assess the remaining distance to the ipsilateral hypogastric
  - If greater than ~2 cm, place an extension device

Balloons and stents

- Using a Coda or Reliant balloon, dilate:
  - The proximal infra-renal attachment site
  - All graft overlap sites
  - Distal iliac attachment sites
- Stent limbs only for persistent external compression or twisting

Closure

- Close the access sites:
  - Over a soft J-wire
  - Have another Proglide available in case of failure and place straight up
  - Remove wire once it appears hemostasis will be secured (but before cinching knot!)
  - If hemostasis fails, place 14-16F sheath and have surgical repair

Thank you

Patient JH: 72 y.o. male

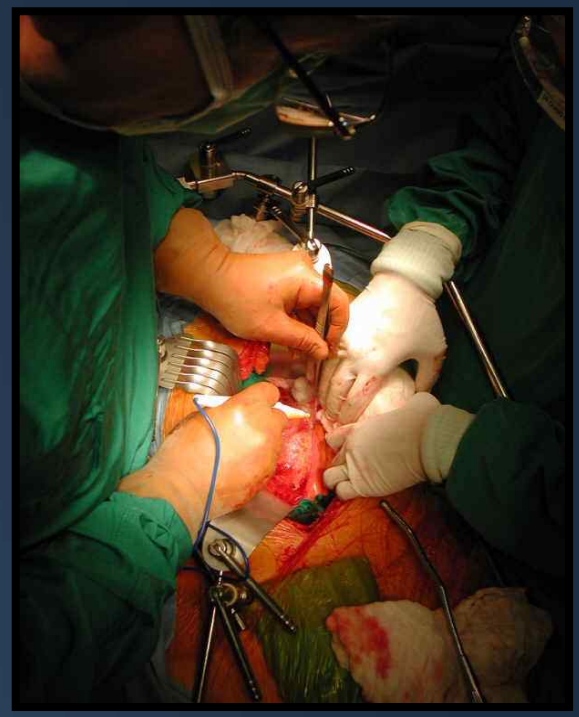
- Admitted 7/18/09-8/17/09
- Initial complaint seizure and hypertension
  - PMHx:
    - HTN
    - Mild dementia
    - COPD
    - CKD

Hospital course

- Renal Duplex non-diagnostic
- MRA: 7/22/09
  - moderate right renal artery stenosis
  - Renal consulted
  - Stent placed in IR 7/23/09
- Carotid Doppler: 7/22/09
  - difficult study, both left bifurcation and probable distal disease
  - Vascular surgery consulted
  - Carotid angiogram 7/28/09

Elective Open Repair AAA

- Major surgical procedure
  - Mortality 2% to 5%
- Complications
  - Pseudoaneurysms
  - Erectile dysfunction
  - Aortoenteric fistula
  - Graft thrombosis
  - Graft infection
- Recovery period 6 weeks to 4 months



Functional Outcomes Following Open AAA Repair

- 154 consecutive elective AAA repairs
  - 1990-1997
- Operative mortality 4%
- Mean hospital stay: 10.7 days
- Mean ICU stay: 4.57 days
- 11% of pts transferred to skilled nursing facility
  - Mean stay: 3.66 months

Oregon Health Sciences Center

J Vasc Surg 2001;33:913-20

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Functional Outcomes Following Open AAA Repair

- Only 64% of patients experienced complete recovery
  - Mean time 3.9 months
- 33% were not fully recovered at mean f/u of 34 months
- 18% said they would not undergo AAA repair again knowing recovery process

Oregon Health Sciences Center

J Vasc Surg 2001;33:913-20

Endovascular AAA Repair

- Minimally invasive
- Reduced morbidity
- Reduced hospital stay
- Early return to function
  - Typically 2 to 4 weeks for full recovery

Currently Available Devices (U.S.)

Medtronic AneuRx

US Trial Implants 1193

Gore Excluder

US Trial Implants 235

Cook Zenith

US Trial Implants 352

Endologix Powerlink

US Trial Implants 192

Device profiles

company	device	neck diameter	outer diameter	fixation location	graft material
cook	zenith	22,24,26, 28,30,32	20F,23F	**suprarenal**	woven polyester
endologix	power-link	25,28	21F,22F	**infrarenal**	ePTFE
gore and associates	excluder	23,26, 28.5	18F	**infrarenal**	ePTFE
medtronic	aneuRx	20,22,24, 26,28	21F	**infrarenal**	woven polyester

Patient Inclusions*

- AAA > 5 cm
- AAA 4 to 5 cm with increase in size of > 5mm past 6 months
- AAA size twice the size of infrarenal neck
- Saccular

** AneuRx U.S. Clinical Trial n=1192*

J Vasc Surg 2001;33:S135-45

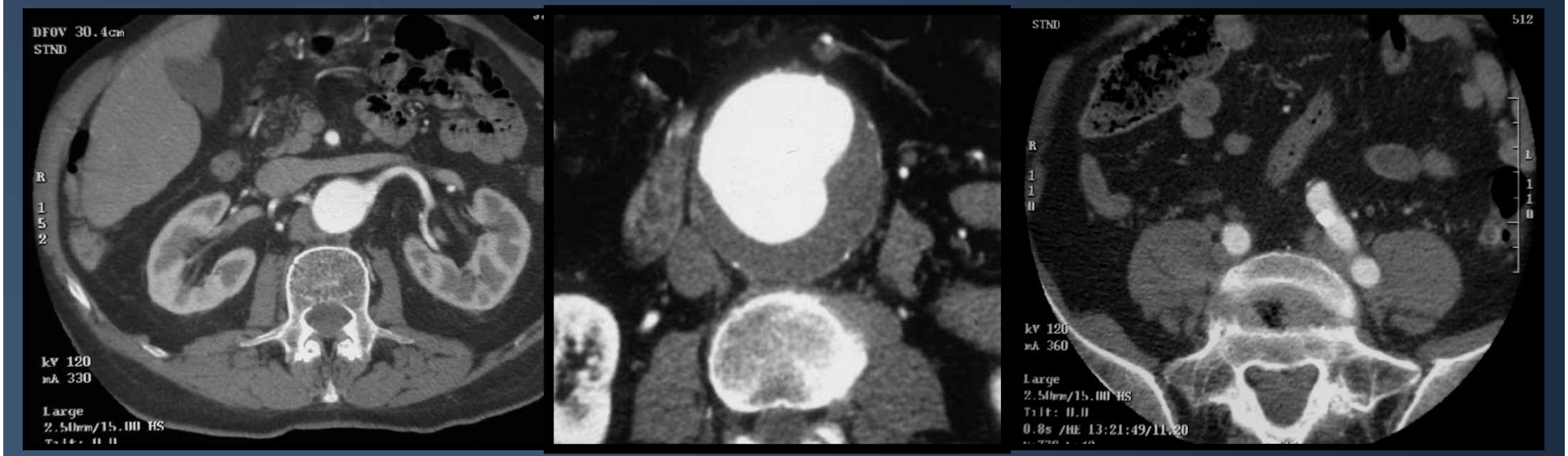
Anatomic Considerations

Endovascular Stent Grafts

- Proximal aortic neck
  - Diameter of device oversized 10-20%
  - Length ≥ 1.5cm for all FDA approved devices
- Angulation/tortuosity
  - Short angulated necks, short wide necks, & severe AAA tortuosity can lead to suboptimal outcomes
- Iliac access
  - Large enough to accommodate 18F-24F delivery systems (7-8mm for bifurcated devices)

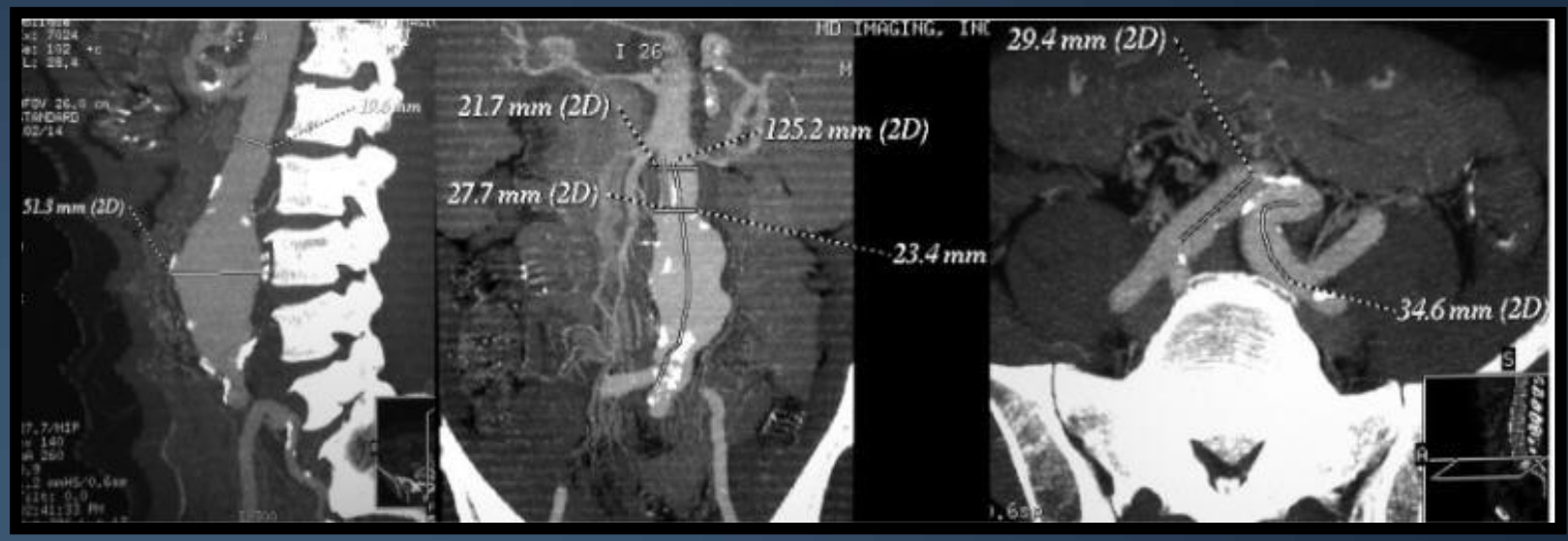
Preoperative Imaging

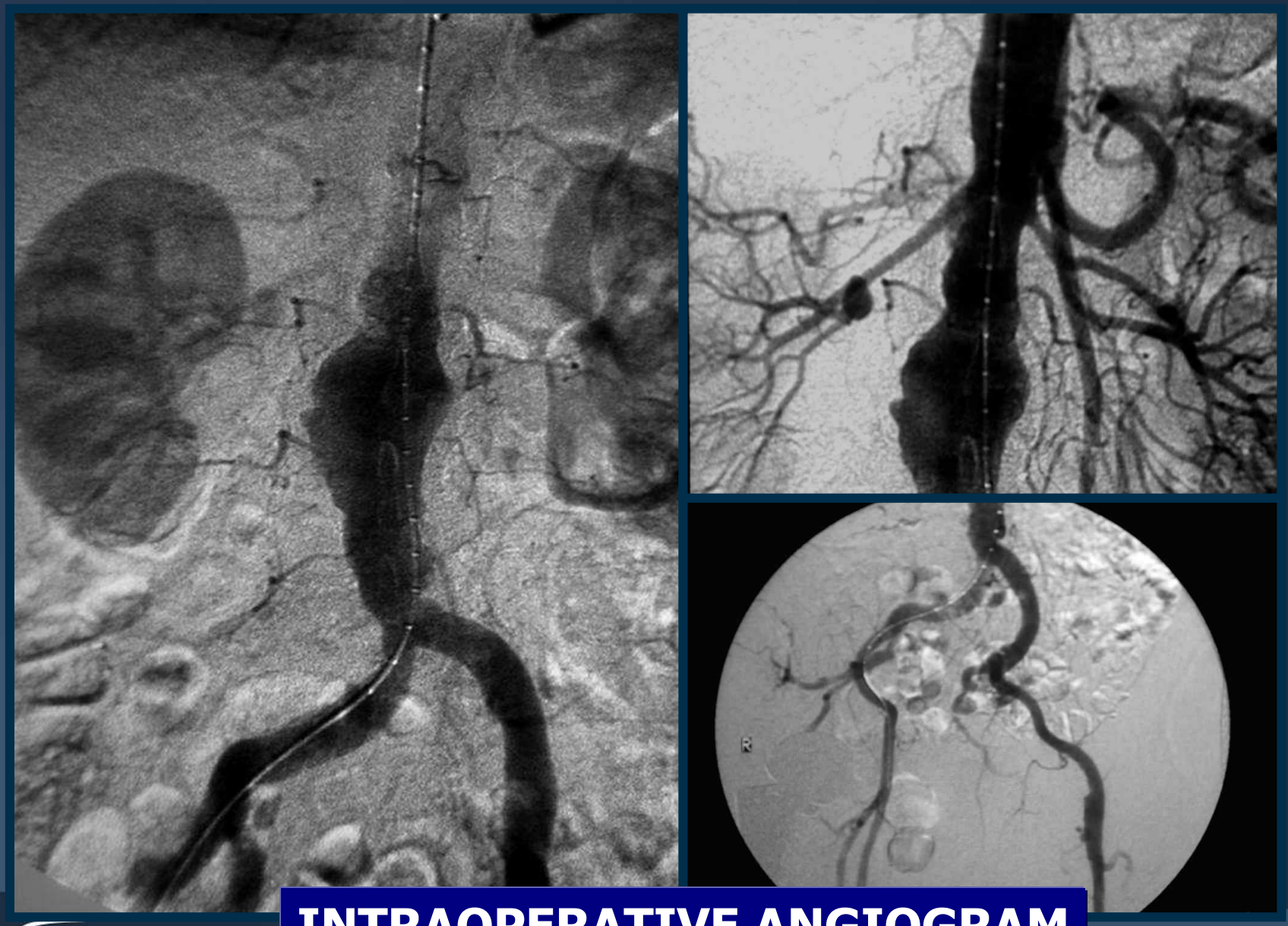
CTA (3mm cuts)



Preoperative Imaging

3D Reconstructions





INTRAOPERATIVE ANGIOGRAM

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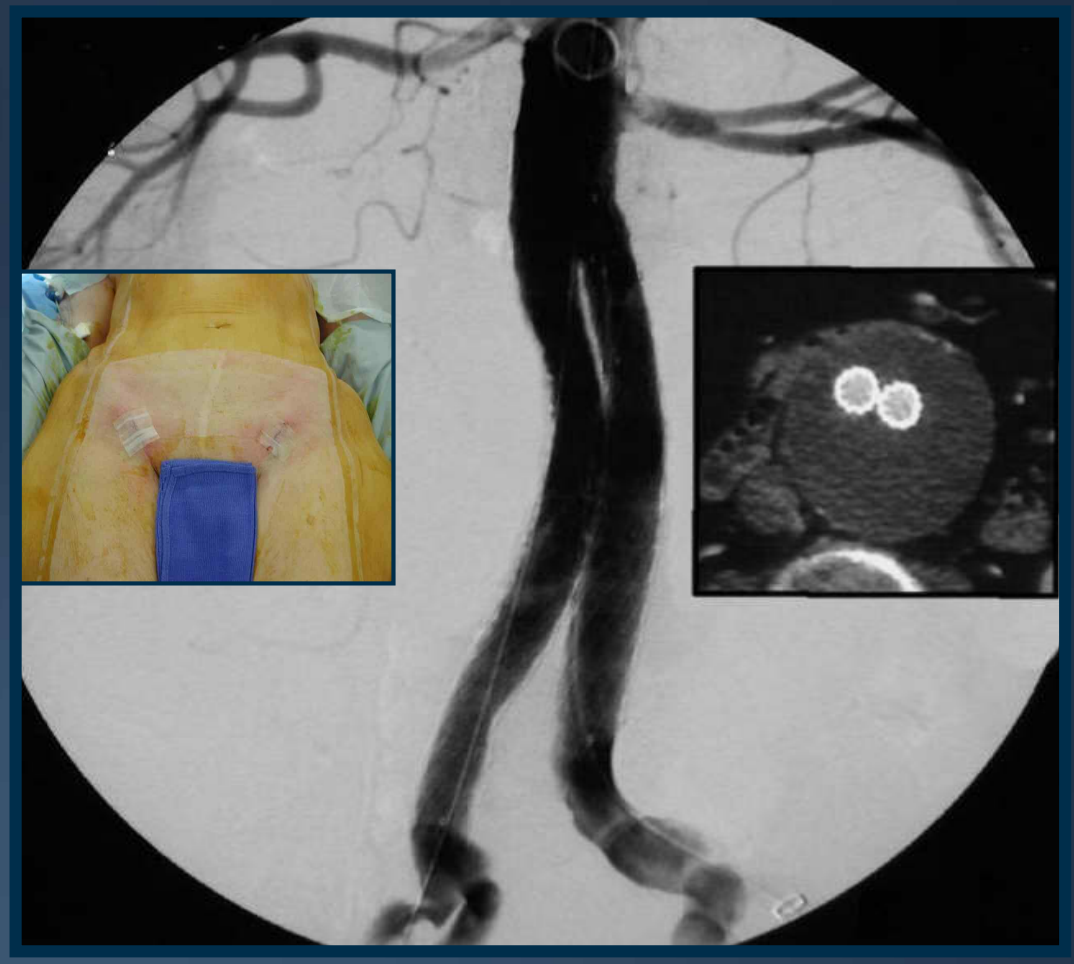


- Completion angiogram shows aneurysm exclusion
- Groins repaired
- Follow-up CTA reveals thrombosis of AAA sac

Keys to success

- Appropriate patient selection
- Precise device placement with focus on good fixation and seal in proximal aortic neck and distal iliac landing zones
- Appropriate and timely patient follow-up

Follow-Up Imaging

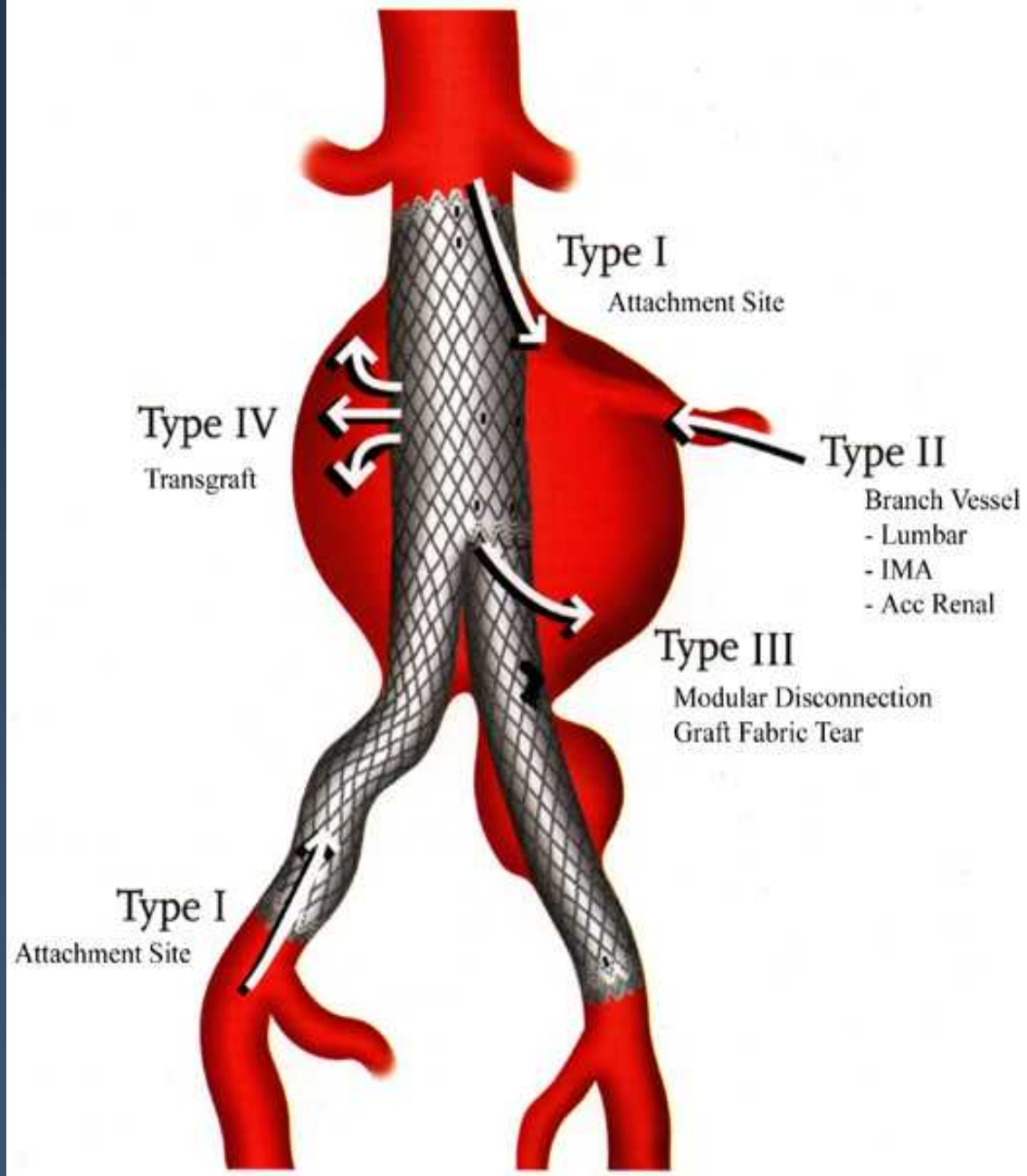
CT and Abdominal X-Rays (KUB)

- 1 month
- 6 months
- 12 months
- Annually

Alternatives to CT scanning

- Ultrasound with or without contrast agent
- Cardiomems device to assess endotension
  - May be more sensitive than other methods
  - Allows for direct measurement of pressure within the excluded sac
  - Need data to support endotension as a predictor of delayed rupture
  - Requires specialized monitoring equipment

Endoleak Classifications



How does endovascular repair compare to standard open surgery?

- EVAR trials surgical control groups inadequate
  - Patients only followed 1 year
  - No randomization
- The common assumption that there are no long term ruptures, graft complications or AAA related deaths following open repair is inaccurate

EVAR vs. Open repair of AAA

Level 1 evidence confirms early benefit of EVAR vs. OPEN

EVAR-1

DREAM

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EVAR-1

	EVAR	OPEN
30 – Day Mortality	1.7 %	4.7 %
Secondary Interventions	9.8 %	5.8 %

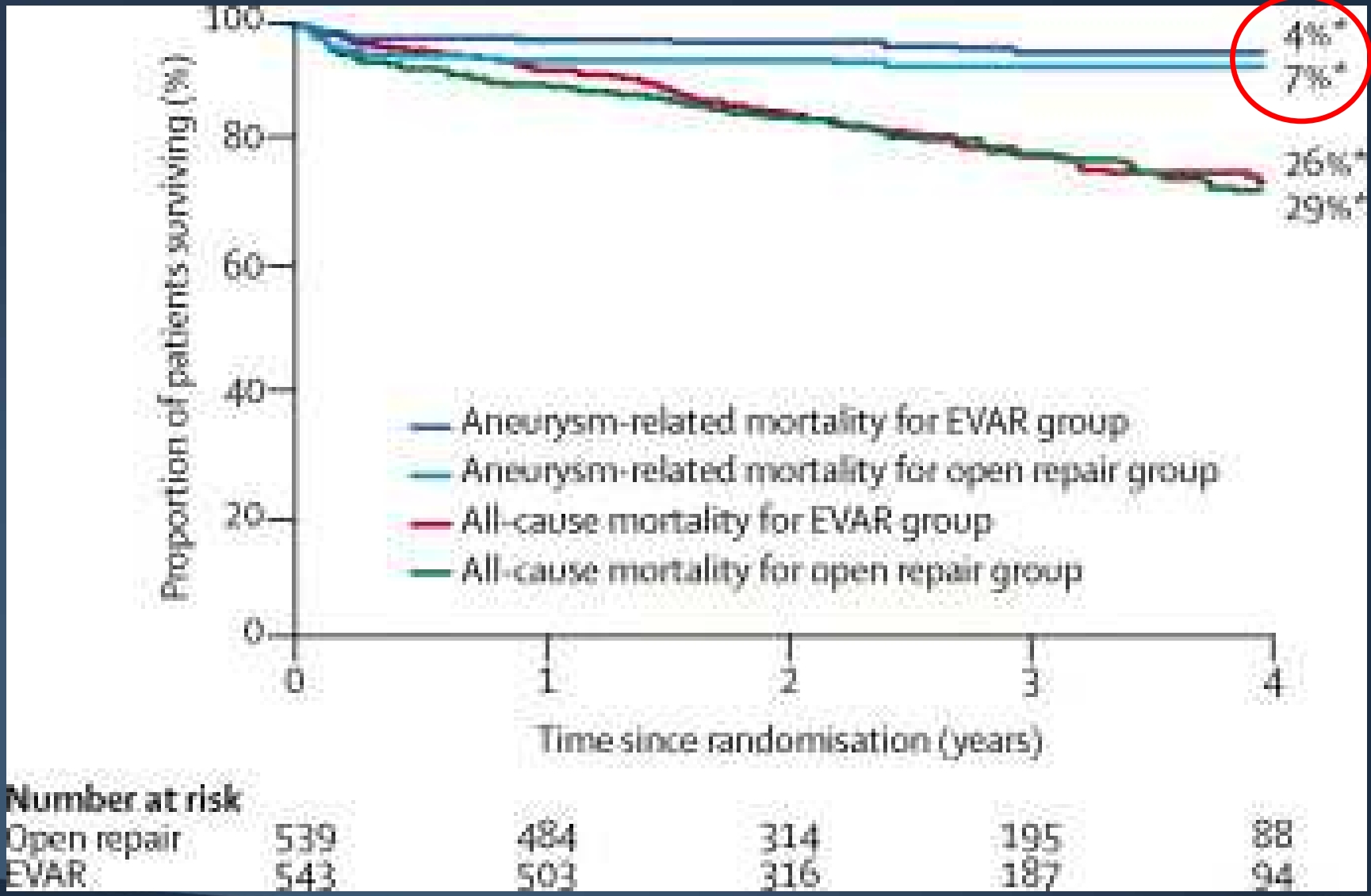
Lancet. 2004 Sep 4;364(9437):843-8

DREAM

	EVAR	OPEN
30 – Day Mortality	1.2 %	4.6 %
Combined Op Mortality & Complications	4.7 %	9.8 %

N Engl J Med 2004;351:1607-1618,1677-1679

Benefits of EVAR Sustained



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Recently released 5 year data

- Medtronic data
  - Device has the longest experience since FDA approval (1999)
  - Of the more than 600 patients in the trial at five years of follow-up, 96.0 percent were free from an aneurysm-related death at five years.

	EVAR (n=543)	Open repair (n=539)
Age at randomisation (years)	74·2 (6·0)	74·0 (6·1)
Men	494 (91%)	489 (91%)
Body-mass index (kg/m²)	26·4 (4·6)	26·4 (4·4)
AAA diameter (cm)	6·5 (0·9)	6·5 (1·0)
Diabetes	49 (9%)	62 (12%)
Current smokers	115 (21%)	117 (22%)
Past smokers	367 (68%)	380 (70%)
Never smoked	61 (11%)	41 (8%)
Previous history of cardiac disease*	234 (44%)	229 (43%)
Aspirin use	292 (54%)	280 (52%)
Statin use	177 (33%)	181 (34%)
Systolic blood pressure (mm Hg)	148 (22)	147 (22)
Diastolic blood pressure (mm Hg)	82 (12)	82 (13)
Ankle-brachial pressure index (mean of both legs)	1·01 (0·18)	1·03 (0·18)
FEV_1 (L)	2·1 (0·7)	2·1 (0·7)
Serum creatinine (μmol/L)†	102 (91–118)	102 (90–119)
Serum cholesterol (mmol/L)	5·1 (1·2)	5·1 (1·1)

Data are mean (SD) or number of patients (%), unless otherwise indicated. Numbers do not always add up to totals in group because of occasional missing values. *Cardiac disease classified as history of any of the following: myocardial infarction, cardiac revascularisation, angina, cardiac valve disease, significant arrhythmia, and uncontrolled congestive cardiac failure. †Creatinine was positively skewed and data are presented as median (IQR).

Table 1: **Baseline characteristics**

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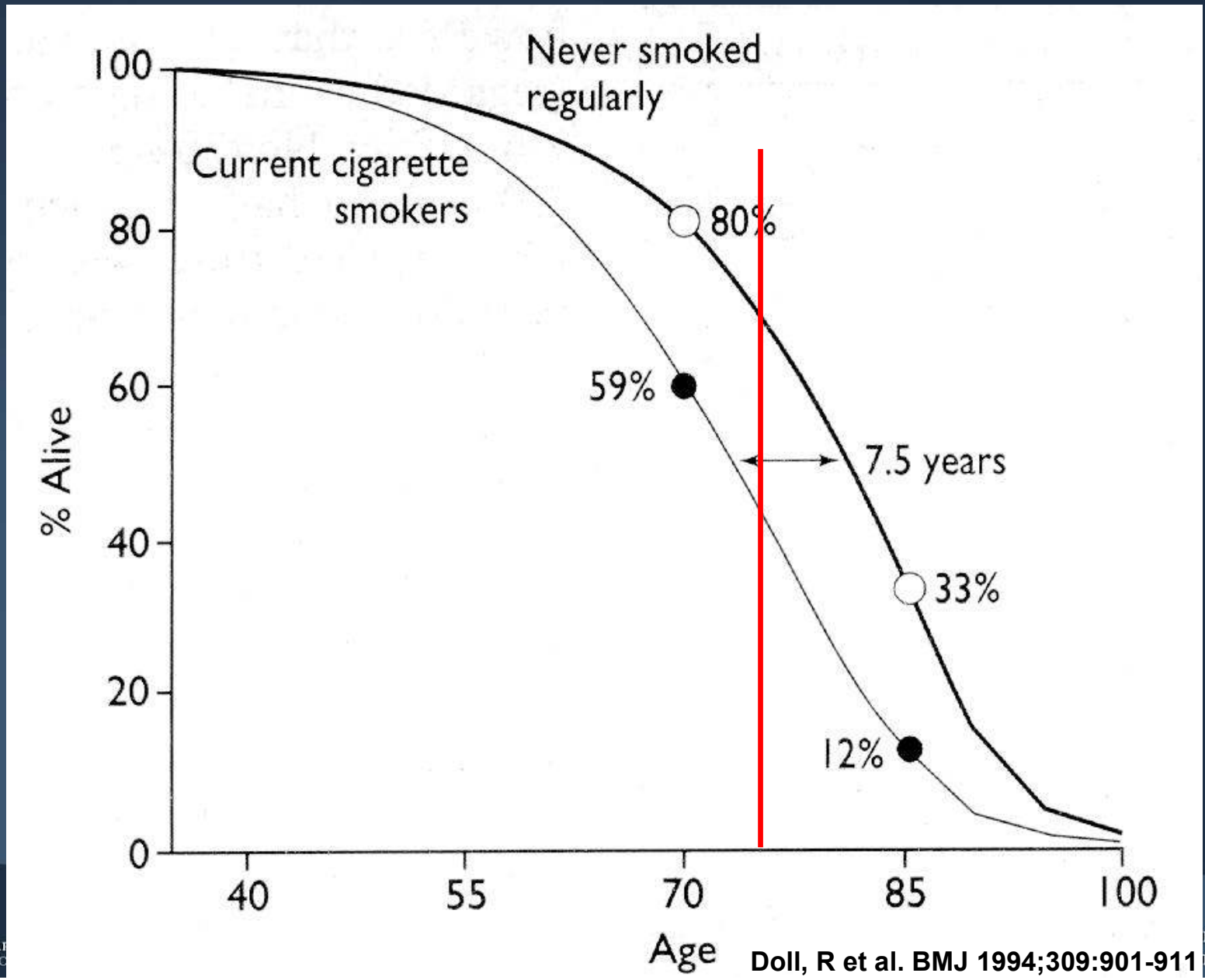
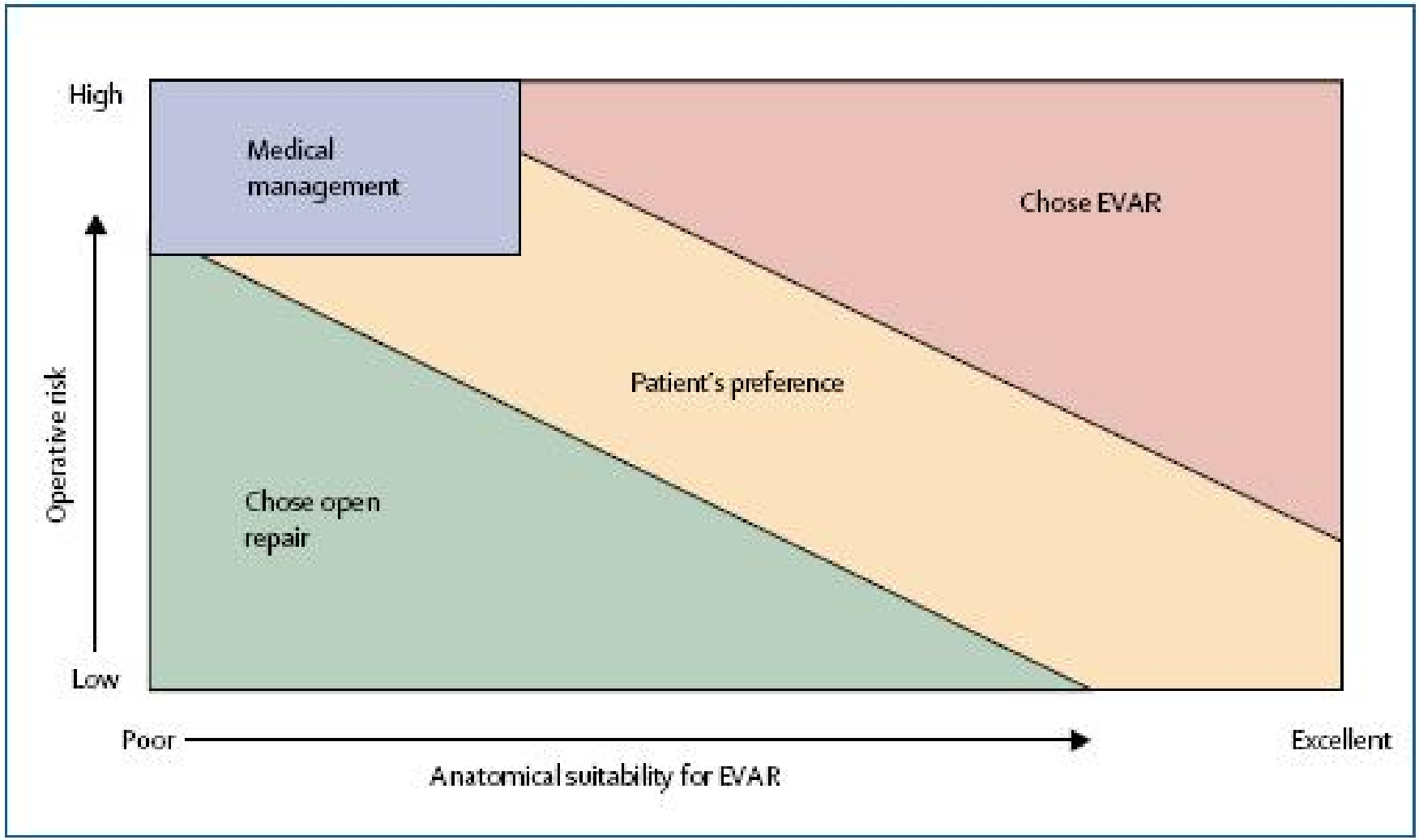
Overall survival after age 35 among smokers and non-smokers

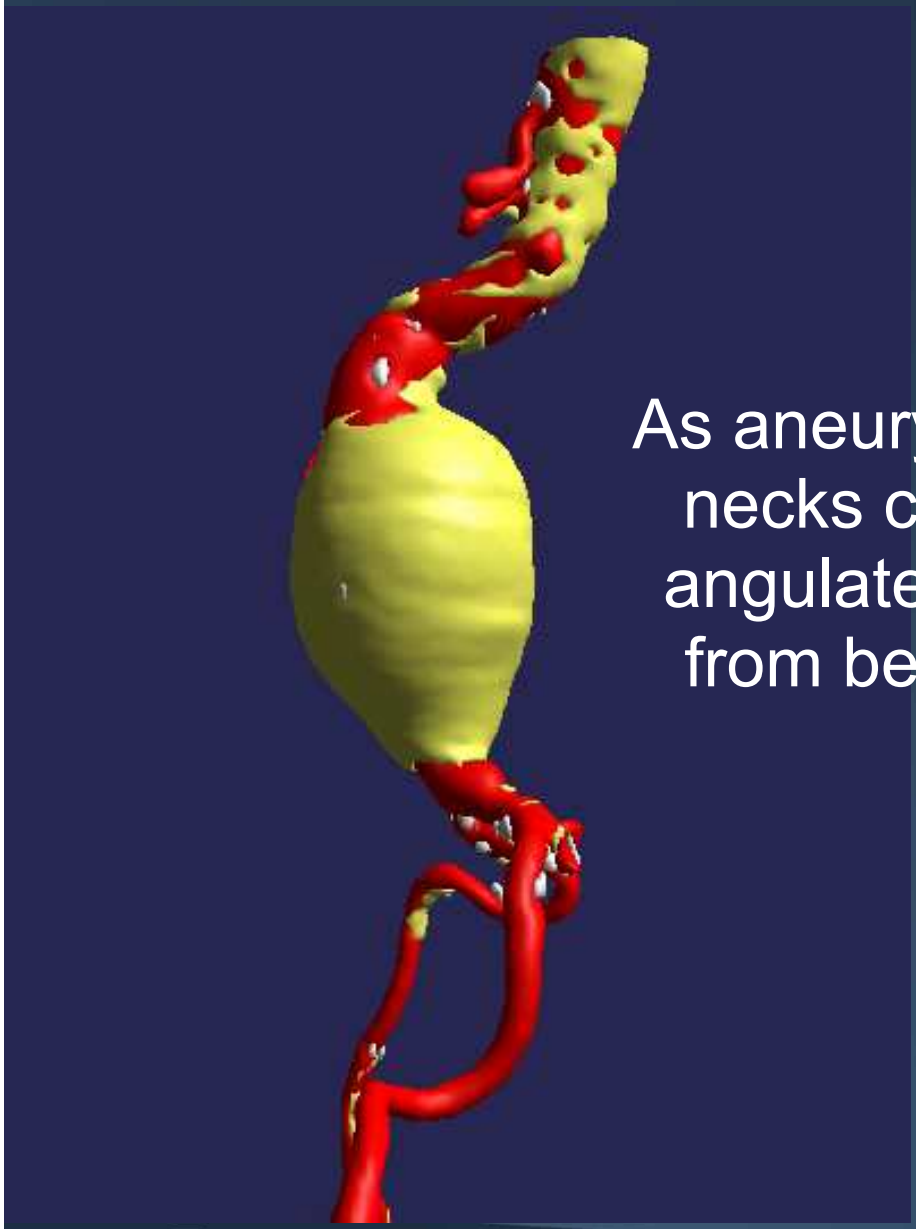


Doll, R et al. BMJ 1994;309:901-911

EVAR vs Open surgery: strategy has evolved



Jack L Cronenwett, Lancet Vol 365 June 25, 2005



As aneurysms grow in size, proximal necks can become shorter and more angulated which may preclude patient from being good anatomic candidate for stent graft

Small vs. Large AAA

Clinical Outcomes following EVAR

	Small < 5.5 cm	Large > 5.5 cm
Type 1 Endoleak	1.4 %	6.4 %
Migration	4.4 %	13 %
Conversion	1.4 %	8.2 %
Aneurysm Related Death	1.5 %	6.1 %
Survival @ 24 months	86 %	71 %

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Ouriel et al
J Vasc Surg 2003;37:1206-12

Conclusions Regarding EVAR for Small vs. Large AAA

- Outcomes of EVAR influenced by AAA size
- Differences important in choosing observation or repair
- It is important to balance risk for rupture with size dependant outcome

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J Vasc Surg 2003;37:1206-12

PIVOTAL Trial

- Positive Impact of EndoVascular Options for Treating Aneurysms
- Randomization of close to 1700 patients with 4-5cm AAA's to EVAR or continued follow up
- AAA's must exceed double the diameter of the reference aorta and meet inclusion criteria for the AneuRX device
- Patients who become symptomatic, exceed 5.0 cms or experience rapid growth will be offered repair

EVAR
2007

- Patient selection and implant technique have improved
- Devices are better and easier to use
- Results are continuously improving
- Early detection and treatment of smaller aneurysms may lead to fewer aneurysm related deaths and better long term results