

CME

Follow the link from the online version of this article to obtain certified continuing medical education credits

bmj.com Cardiology updates from BMJ Group are at bmj.com/specialties/cardiovascular-medicine

Postpartum management of hypertension

Kate Bramham,¹ Catherine Nelson-Piercy,² Morris J Brown,³ Lucy C Chappell⁴

¹Maternal Medicine/Nephrology, Women's Health Academic Centre, King's College, London, UK

²Guy's and St Thomas' NHS Foundation Trust, London, UK

³Clinical Pharmacology Unit, University of Cambridge, Cambridge, UK

⁴Women's Health Academic Centre, King's College, St Thomas' Hospital, London SE1 7EH, UK

Correspondence to: L C Chappell lucy.chappell@kcl.ac.uk

Cite this as: *BMJ* 2013;346:f894
doi: 10.1136/bmj.f894

Hypertension in the postpartum period affects several groups of women, including those with previous chronic hypertension, gestational hypertension, pre-eclampsia, and eclampsia. In addition, pre-eclampsia may present for the first time in the postnatal period. Although the underlying causes and clinical presentation of these types of hypertension vary, patients can be investigated and treated in a similar manner. This review covers management of postpartum hypertension and its future consequences. Hypertension affects 6-10% of pregnancies,¹ but few studies have reported the incidence of postpartum hypertension. This review is relevant to general practitioners, obstetricians, and specialists in secondary care who may see women with postpartum hypertension.

What are the normal blood pressure changes during pregnancy and postpartum?

Generalised systemic vasodilation occurs during pregnancy; despite a 40-50% increase in cardiac output, mean arterial pressure drops by about 10 mm Hg to reach its lowest value by mid-pregnancy.² During the last trimester, blood pressure gradually increases to prepregnancy values. Blood pressure usually falls immediately after delivery, then tends to rise, reaching a peak three to six days post partum in both normotensive women and those with hypertension during pregnancy.³⁻⁵ Transient hypertension may occur post partum after uncomplicated pregnancies.⁶ This may be secondary to pain, drugs, excess fluid administration, salt and water accumulated during pregnancy moving into the intravascular compartment, or restoration of non-pregnant vascular tone.³ It is important to recognise normal postpartum fluctuations in blood pressure so that unnecessary treatment is avoided.

How should blood pressure be measured?

Korotkoff phase 5 measurements should be used to identify the diastolic pressure, except in rare cases when sounds continue to be heard through to 0 mm Hg (then use Korotkoff phase 4).⁷ Multiple readings are more reliable, at least 30 seconds apart, and an average is recommended. Although some automated devices have been validated in pregnancy, many underestimate blood pressure, so readings obtained by automated devices should be confirmed

with sphygmomanometry.⁸ For practical purposes 24 hour blood pressure monitoring is not necessary to diagnose hypertension in the early postpartum period but is recommended if hypertension persists after six weeks.⁹

What causes and known associations should be included when assessing early postpartum hypertension?

The most common cause of postpartum hypertension in the first six weeks is persistence of hypertension that had been present during pregnancy—gestational (pregnancy induced) hypertension, pre-eclampsia, or pre-existing chronic hypertension. Pain, anxiety, and drugs may also transiently raise blood pressure (box). Hypertension may occur for the first time post partum and lead to the development of pre-eclampsia, eclampsia, or HELLP (haemolysis, elevated liver enzymes, low platelets) syndrome.^{10 11}

How quickly should pregnancy associated hypertension resolve?

Several studies, mainly retrospective, report that raised blood pressure should normalise within days of delivery (29-57% by three days; 50-85% by seven days) in most women,^{16 17} with the speed of resolution and prevalence of persistent hypertension depending on the underlying or pre-existing diagnosis.^{5 18} The proportion of women remaining hypertensive at six to 12 weeks post partum depends on the population. Women with previous chronic hypertension, long duration of antihypertensive treatment in pregnancy, higher maximum systolic and diastolic blood pressures,¹⁹ higher body mass index,²⁰ or occurrence of preterm pre-eclampsia²¹ are more likely to have sustained hypertension. About one in five women with hypertension in pregnancy will have persistently raised blood pressure (chronic hypertension) and will need antihypertensive drugs at two years.^{10 11}

How should new onset postpartum hypertension be identified?

The incidence of new onset postpartum hypertension is unknown but it is estimated to occur in 0.3-28% of women.²² Most studies report only women who are readmitted for pre-eclampsia, eclampsia, or complications of hypertension because others are generally managed as outpatients.^{5 23-25}

bmj.com

Previous articles in this series

- ▶ Diagnosis and management of pulmonary embolism (*BMJ* 2013;346:f757)
- ▶ Anaphylaxis: the acute episode and beyond (*BMJ* 2013;346:f602)
- ▶ Ulcerative colitis (*BMJ* 2013;346:f432)
- ▶ Prostate cancer screening and the management of clinically localized disease (*BMJ* 2013;346:f325)
- ▶ Bed bug infestation (*BMJ* 2013;346:f138)
- ▶ Developmental assessment of children (*BMJ* 2013;346:e8687)

SUMMARY POINTS

The most common cause of postpartum hypertension is high blood pressure (from gestational hypertension or pre-eclampsia) that persists after delivery

Suggested first line antihypertensive drugs that are safe in breastfeeding mothers include labetalol, nifedipine, and enalapril

Refer women with persistent hypertension or proteinuria six weeks after delivery to a specialist

Inform women with recent hypertensive disorders of pregnancy of the risk of recurrence in a future pregnancy

Women with pre-eclampsia have a 3.7-fold increased risk of future hypertension, 2.2-fold risk of ischaemic heart disease, and 1.8-fold risk of stroke

SOURCES AND SELECTION CRITERIA

We searched PubMed (June 2012) for relevant articles on postpartum management of hypertension, pre-eclampsia, and eclampsia. The MeSH terms for the search included "postpartum", "hypertension", "pre-eclampsia", and "eclampsia", in addition to keyword variations. We obtained information from prospective randomised clinical trials, cohort studies, case series, systematic reviews, and meta-analyses. We also searched national and international guidelines for those including advice on postpartum management of hypertension and kidney disease.

Causes of postpartum hypertension^{1 9 12}**Early postnatal period (<6 weeks post partum)**

Unresolved antenatal hypertension: Pre-eclampsia, gestational hypertension, or chronic hypertension during pregnancy

Drugs: Use of non-steroidal analgesia, ergot derivatives (such as ergometrine for postpartum haemorrhage), or ephedrine

Hypervolaemia: Use of large volume of fluids—for example, after regional anaesthesia

Pain: Inadequate analgesia

Anxiety: May improve with repeat testing

New onset postpartum pre-eclampsia: Symptoms include headaches, epigastric pain, visual changes, seizures

Normal physiological rise in blood pressure: Mild hypertension only, usually on days 3-6; caused by intravascular shift of pregnancy associated extravascular volume; resolves spontaneously

Persistent or chronic hypertension (>6 weeks post partum)

Diagnosis or presence of hypertension before 20 weeks' gestation; long duration of antihypertensive treatment during pregnancy¹³; high maximum systolic and diastolic blood pressure¹³; high body mass index¹⁴; preterm pre-eclampsia¹⁵

Primary hypertension: Essential hypertension is associated with a family history of hypertension, raised body mass index, >35 years of age, black ethnicity, maternal low birth weight, pre-eclampsia or hypertension; secondary causes must be excluded to make a diagnosis

Secondary to renal disease

Chronic kidney disease: Family history of renal disease; clinical features of autoimmune disease (such as rash, arthritis, mouth ulcers); history of:

- Recurrent urinary tract infections in childhood or primary enuresis (reflux nephropathy)
- Micturition difficulties including incomplete bladder emptying
- Renal calculi
- Episodes of haematuria (IgA nephropathy)

Renal artery stenosis: Possible audible renal bruit

Renin producing tumours

Drug induced or drug related: History of taking oral contraceptives, glucocorticoids, liquorice (mimics primary aldosteronism), cocaine, other illicit drugs, or nephrotoxic agents (including non-prescribed over the counter drugs such as non-steroidal anti-inflammatory drugs and calcineurin inhibitors)

Secondary to endocrine disorders

Primary aldosteronism (Conn's syndrome) and other mineralocorticoid excess states: History of myalgia, weakness, headaches, hypokalaemia

Cushing's syndrome and other glucocorticoid excess states including chronic steroid treatment: History of steroid use or rapid weight gain; polyuria or polydipsia; skin changes including acne, skin thinning, telangiectasia

Phaeochromocytoma: History of episodic headache, tachycardia, and sweating

Thyroid or parathyroid disease: Clinical features of hyperthyroidism, hypothyroidism, or hyperparathyroidism (hypercalcaemia)

Acromegaly: Carpal tunnel syndrome; sweating; enlarged feet, hands, jaw, tongue; muscle weakness

Carcinoid tumours: Diarrhoea, flushing, wheezing, weight loss

Secondary to neurological disorders

Sleep apnoea: History of snoring and episodic apnoea; high body mass index

Increased intracranial pressure: Symptoms or signs of intracerebral tumours

Spinal cord injury: Quadriplegia, paraplegia, Guillain-Barré syndrome

Coarctation of the aorta: Radio-radial or radio-femoral pulse delay; differential blood pressure in arms

The National Institute for Health and Clinical Excellence (NICE) guidelines on routine postpartum care, based on expert opinion, recommend checking blood pressure within six hours of delivery in all normotensive women without complications of pregnancy. They also recommend checking blood pressure on the fifth day post partum to identify women with a late presentation of pre-eclampsia.²⁶ Measurement of proteinuria immediately post partum is not recommended because of the presence of lochia.

NICE guidelines for the management of hypertension disorders in pregnancy recommend informing all women

of the possible occurrence of hypertension, pre-eclampsia, or eclampsia and giving information on relevant symptoms before discharge. Symptoms include severe headache (increasing in frequency and unrelieved by regular analgesia); visual disturbance such as blurred vision, flashing lights, double vision, or floating spots; nausea and vomiting; malaise, breathlessness caused by pulmonary oedema; sudden swelling of the face, hands, or feet; or seizure up to four weeks post partum.²⁷ Prospective cohort studies have not identified a clear pattern of risk factors for postpartum pre-eclampsia, and some of the symptoms described may overlap with normal postpartum problems.

Why should postpartum hypertension be identified?

The most important immediate clinical concern is to identify women with severe hypertension or postpartum pre-eclampsia (or both), who are at risk of life threatening complications, such as intracranial haemorrhage, eclampsia, or reversible cerebral vasoconstriction syndrome. The triennial Confidential Enquiry into Maternal Deaths continues to identify substandard care in the management of women with hypertension in pregnancy, particularly inadequate treatment of systolic hypertension.²⁸ A multicentre study from the United States of women with postpartum pre-eclampsia reported that women may present up to four weeks after delivery, with most (66%) being readmitted with this diagnosis after initial discharge from the hospital.²⁵ Three well conducted large prospective cohort studies in the United Kingdom found that 32-44% of eclampsia cases occur after delivery.²⁹⁻³¹ It is promising that the overall incidence of eclampsia has fallen in the UK,³⁰ possibly because of the introduction of prophylactic magnesium sulphate in women at risk.

How should women with early postpartum hypertension be managed?

The most recent Cochrane review (2005) on management of postpartum hypertension found insufficient data of high quality on which to base guidance.³² However recommendations and expert opinion based on limited data have been published, including recent NICE guidelines for the management of hypertension in pregnancy.²⁷ Figures 1 (below) and 2 (on bmj.com) outline a management strategy, including frequency of blood pressure monitoring, investigations, and treatment. Informing the family doctor and community midwife of a woman's discharge will enable appropriate follow-up. Avoid non-steroidal anti-inflammatory drugs in women with marked hypertension in pregnancy and in those with pre-eclampsia because of concerns about associated increases in blood pressure, antagonism of some antihypertensive drugs,^{33 34} and exacerbation or development of renal impairment.³⁵

Investigate the small proportion of women who present with hypertension in association with new or severe headache (or both), visual disturbance, or neurological deficits for intracerebral pathology. Risk factors for postpartum stroke and cerebral venous thrombosis include advanced maternal age, hypertension, caesarean section, and fluid and electrolyte disturbances.^{36 37} Reversible cerebral vasoconstriction syndrome is a cerebrovascular disorder associated with multifocal arterial constriction and dila-

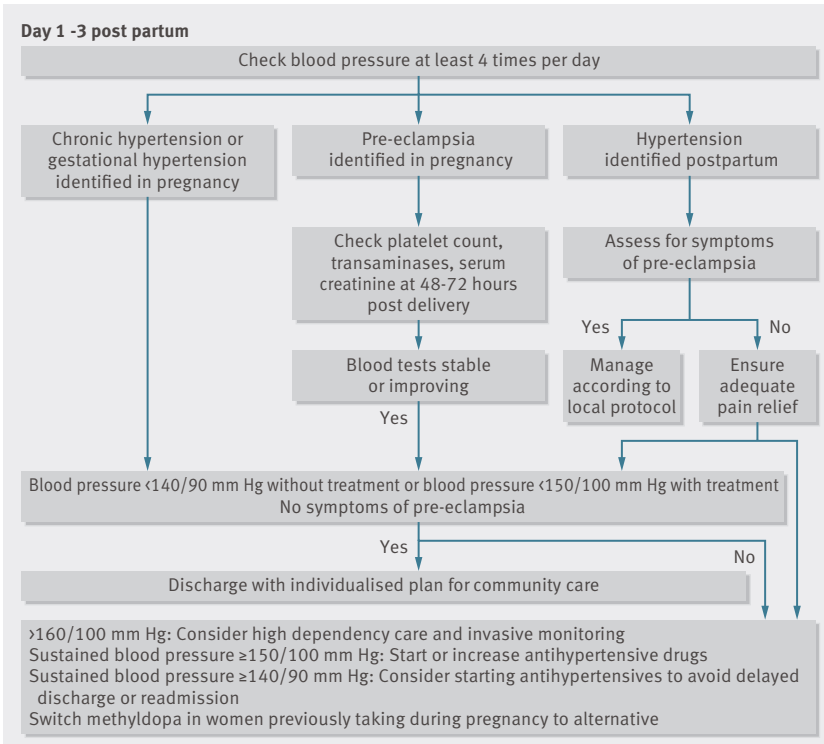


Fig 1 | Inpatient management of postpartum hypertension.

Drugs and dosages for breastfeeding mothers ^{27,40}		
Drug*	Dose	Comments
Recommended by NICE and widely used in UK		
<i>α/β</i> blockers:		
Labetalol	100-600 mg 2-3 times daily	Only small quantities detected in breast milk
Atenolol	25-100 mg once daily	Second line use for women who require once daily formulation
Calcium channel antagonists:		
Nifedipine SR	10-20 mg twice daily	Amount in breast milk too small to be harmful; manufacturer suggests avoid but widely used without reports of neonatal side effects
Amlodipine	5-10 mg once daily	Second line use for women who require once daily formulation; amount in breast milk too small to be harmful; manufacturer suggests these drugs should be avoided but used in clinical practice without report of harm
Nifedipine MR	30-60 mg once daily	
Angiotensin converting enzyme (ACE) inhibitors:		
Enalapril	5-20 mg twice daily	Can be used in women who were previously taking an ACE inhibitor when other first choice agents cannot be used or cardiac/renal protection is needed; excreted into breast milk in low concentrations but amount probably too small to be harmful
Contraindicated		
Other ACE inhibitors and angiotensin receptor blockers	Not recommended	Minimal data on use during lactation; manufacturers suggest that it should be avoided
Diuretics	Not recommended	Produce excessive thirst in breastfeeding women; large doses may suppress lactation
*None of these drugs is licensed for use in breast feeding. NICE=National Institute for Health and Clinical Excellence.		

tion that usually occurs three to 14 days post partum and is commonly associated with thunderclap headaches.³⁸

Imaging may be normal initially but show segmental cerebral vasoconstriction later on.³⁹

How should women with postpartum hypertension be managed after discharge?

After discharge from hospital, national guidelines recommend that blood pressure is checked every other day in

women with postpartum hypertension until targets are achieved.²⁷ After this, check weekly or fortnightly depending on blood pressure levels (fig 2) to allow appropriate reduction and cessation of antihypertensives when possible.

Which antihypertensives should be used?

Data on antihypertensive drugs for postpartum use are extremely limited; the choices have been informed largely by expert working groups and are based on common usage rather than good quality evidence. Although preparations requiring once daily administration are preferable to improve adherence, particularly in the postnatal period, this should be balanced against possible accumulation in the infant with a long acting once daily formulation.²⁷ The NICE Guideline Development Group reviewed studies on safety of antihypertensive agents in breast feeding²⁷; the table summarises the drugs commonly used. The group’s advice is based on a consensus view and takes into account absence of reported paediatric concerns together with information, where available, on transfer of antihypertensive drugs in breast milk. No antihypertensive drugs are licensed in the UK for use in breast feeding. Agents with high protein binding and low lipid solubility are less likely to be transferred in breast milk.⁴¹ If a mother or healthcare professional raises concerns about the health of the baby (such as not feeding well, apnoea), consider antihypertensive drugs as a possible cause. Breastfeeding mothers of babies born preterm should be treated by specialists in liaison with neonatologists.

NICE recommends that methyldopa is changed to an alternative agent because of associated sedation, postural hypertension, and depression; although the Medicines and Healthcare Products Regulatory Agency (MHRA) considers it to be the drug of choice during breast feeding,⁴² many clinicians choose an alternative to avoid the side effects. For black women of African or Caribbean origin, in whom plasma renin may be low even at a young age,⁴³ calcium channel blockers such as nifedipine are the drugs of choice (with an angiotensin converting enzyme inhibitor as second choice) because β blockers are of less benefit in such women. This links to advice given for treatment of non-pregnant adults, in whom first line treatment is determined by ethnicity to reflect likely renin status.⁹ Although angiotensin converting enzyme inhibitors and angiotensin receptor blockers are contraindicated in pregnancy, enalapril may be safely used in lactating women.⁴⁴

Who should be investigated for secondary hypertension?

In women who were normotensive before pregnancy, international guidelines suggest that hypertension and proteinuria (>2+ on urinalysis) should have resolved between six weeks (NICE) and 12 weeks (National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy) post partum.^{1 27} All women with hypertension in pregnancy should have blood pressure and urine checked by a doctor at six weeks and persistent hypertension confirmed by ambulatory monitoring.¹ Because the underlying cause may be treatable, NICE guidelines for the management of hypertension in pregnancy and those for the management of primary hypertension in adults recommend that all women under

QUESTIONS FOR FUTURE RESEARCH

What are the optimum blood pressure targets and antihypertensive agents for women post partum?

What is the safety profile of antihypertensive drugs for breastfeeding women?

What proportion of women with persistent postpartum hypertension has secondary hypertension?

What proportion of women with postpartum hypertension develops cardiovascular disease in the future?

Which predictive models of cardiovascular risk are most accurate in women who have had hypertension in pregnancy?

What interventions might reduce the long term incidence of cardiovascular disease in women with previous hypertension in pregnancy?

ADDITIONAL EDUCATIONAL RESOURCES

Resources for healthcare professionals

National Institute for Health and Clinical Excellence guidelines for the management of hypertension in pregnancy. www.nice.org.uk/nicemedia/live/13098/50418/50418.pdf

Confidential Enquiry into Maternal Deaths. <http://onlinelibrary.wiley.com/doi/10.1111/j.1471-0528.2010.02847.x/pdf>

Guidelines from the Royal College of Obstetricians and Gynaecologists. www.rcog.org.uk/womens-health

Seventh Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure. www.nhlbi.nih.gov/guidelines/hypertension/jnc7full.pdf

Committee Opinions from the American Congress of Obstetricians and Gynecologists. www.acog.org/Resources_And_Publications/Committee_Opinions_List

UK Renal Association guidelines for the management of chronic kidney disease. www.renal.org/whatwedo/InformationResources/CKDeGUIDE/Stage1-2CKD.aspx

Cardiovascular risk assessments. <http://qrisk.org/>; <http://assign-score.com/>

Resources for patients

Action on Pre-eclampsia (APEC) (<http://www.apec.org.uk/>)—Useful information for patients including a downloadable leaflet “Post-Natal Recovery from Pre-eclampsia” (http://apec.org.uk/pdf/Post_Natal-Recovery-From_Pre-eclampsia.pdf)

Pre-eclampsia Foundation (<http://www.preeclampsia.org/>)—Information for patients and their families about pre-eclampsia

the age of 40 years with stage 1 (>140/90 mm Hg) hypertension should be assessed for a secondary cause (table).²⁷ Advice is reinforced by the recent discovery that a common subgroup of Conn’s syndrome is caused by a specific somatic mutation that occurs most often in young women; hypokalaemia may be masked by pregnancy but may be present post partum.^{45 46} Specialist review should be with a cardiologist, nephrologist, clinical pharmacologist, or endocrinologist depending on local expertise and the suspected underlying cause. The proportion of women of reproductive age with secondary hypertension is unknown but has been estimated to be from 0.2% to 10%.^{13 22}

When should persistent proteinuria be investigated?

Renal impairment with the presence of proteinuria is a common feature of pre-eclampsia, but post partum it may be difficult to distinguish between underlying renal disease and resolving glomerular involvement caused by pre-eclampsia. Small cohort studies have reported that proteinuria resolves in 86–88% of women who had pre-eclampsia by six weeks post partum, with proteinuria persisting in fewer than 5% beyond three months.^{37 47} Varying rates of previously undiagnosed renal disease have been described in women with pre-eclampsia, but data are limited to case reports or biopsy series with inherent selection bias.⁴⁸ Several studies suggest that women with early

onset pre-eclampsia are more likely to have underlying renal disease.^{49 50} NICE guidelines recommend referring women with persistent dipstick proteinuria greater than 2+ at six weeks post partum to a specialist for further investigation.²⁷ In practice, proteinuria may not have fully resolved by six weeks, especially in women in whom it was heavy during pregnancy, and specialists may continue monitoring for further reductions before investigating for chronic kidney disease. A large prospective epidemiological study in the US suggested that 3% of people aged 20–39 years have chronic kidney disease stages 1 and 2 (reduced estimated glomerular filtration rate or albuminuria)⁵¹; antenatal urinary dipstick and appropriate postpartum follow-up may provide an opportunity to identify early chronic kidney disease.⁵²

What are the implications of hypertension in pregnancy for future pregnancies?

Women with hypertension in pregnancy are at greater risk of complications (including pre-eclampsia, small for gestational age infants, and preterm delivery) in a subsequent pregnancy, particularly those who required delivery before 34 weeks’ gestation and those with other comorbidities (such as chronic hypertension, renal disease, obesity, and diabetes).²⁷ Screen women with early onset pre-eclampsia (delivered <34 weeks’ gestation) for antiphospholipid syndrome.²⁷ NICE guidelines recommend counselling all women about the risk of recurrence. Women with gestational hypertension have a 16–47% risk of recurrent gestational hypertension and a 2–7% risk of pre-eclampsia. Women with pre-eclampsia have a 13–53% risk of gestational hypertension in the subsequent pregnancy and a 16% risk of pre-eclampsia. This rises to 25% if pre-eclampsia was complicated by severe pre-eclampsia, HELLP syndrome, or eclampsia and led to birth before 34 weeks; it rises to 55% if delivery occurred before 28 weeks’ gestation.²⁷ Discussion about future pregnancies may influence decisions around ongoing treatment. If a woman requires drug treatment beyond the first three months post partum and wishes to have further pregnancies in the near future, aim to achieve good blood control using drugs that are safe at the time of conception.

How should long term health risk be assessed and managed?

Cardiovascular disease is the leading cause of death in women internationally,¹⁴ and several population based retrospective cohort studies suggest that gestational hypertension and pre-eclampsia are associated with significant long term risk of cardiovascular disease and death from cardiovascular causes.^{53–55} A meta-analysis of long term outcomes of women with pre-eclampsia found increased risks of several vascular complications compared with women with pregnancies not complicated by pre-eclampsia. These included chronic hypertension after 14.1 years weighted mean follow-up (relative risk 3.70, 95% confidence interval 2.70 to 5.05), cardiovascular disease after 11.7 years weighted mean follow-up (2.16, 1.86 to 2.52), cerebrovascular disease after 10.4 years weighted mean follow-up (1.81, 1.45 to 2.27), and thromboembolism after 4.7 years weighted mean follow-up (1.79, 1.37 to 2.33).¹⁵

It is currently unclear whether underlying metabolic abnormalities that predated pregnancy predispose women to both atherosclerosis and hypertension, or whether placental disease itself increases cardiovascular risk. However persistence of insulin resistance,^{56 57} raised fasting lipids,⁵⁸⁻⁶⁰ and abnormalities of coagulation have been identified in women with previous pre-eclampsia compared with controls with uncomplicated pregnancies.⁶¹ Predictors of subsequent development of hypertension in women with resolution of postpartum hypertension include obesity, high-normal blood pressure, family history of hypertension, recurrence of a hypertensive disorder in a subsequent pregnancy, and markers of the metabolic syndrome including dyslipidaemia and hyperinsulinaemia.^{62 63}

Ten year cardiovascular risk assessments can underestimate the lifetime risk of cardiovascular events in younger people,⁶⁴ and the risk scores to predict individualised risk after hypertension in pregnancy are being evaluated.⁶⁵ With this caveat, consider using the ASSIGN (<http://assign-score.com>) or QRISK2 (<http://qrisk.org>) assessments in women

over 30 years old who had hypertension during pregnancy, even if hypertension and proteinuria resolved after birth. Women seem to be motivated to adjust their lifestyle after complicated pregnancies.⁶⁶ Smoking cessation, avoidance of weight gain (or weight loss if body mass index >30), low salt diet, and regular exercise interventions can be offered to all postpartum women,⁹ but it is unclear whether preventive interventions in women with hypertension in pregnancy reduce long term vascular complications.

The authors acknowledge the work of the PRECOG III (pre-eclampsia community guideline) working group, formed under the auspices of APEX to look at postpartum management of pre-eclampsia and hypertension. Members of the group were Catherine Nelson-Piercy, Stephen Robson, James Walker, Chris Redman, Andrew Shennan, Jason Waugh, Carol Cooper, Mervi Jokinen, Jill Blincowe, and Fiona Milne.

Contributors: KB performed the literature search and wrote the initial draft. LCC revised this and further drafts. MJB and CN-P provided further contributions and revised subsequent drafts. All authors approved the final version. LCC is guarantor.

Competing interests: None declared

Provenance and peer review: Commissioned; externally peer reviewed.

Patient consent obtained.

References are in the version on bmj.com.

ANSWERS TO ENDGAMES, p 40

ANATOMY QUIZ 1

Coronal computed tomography of the upper cervical spine

- A: Condyle of the occipital bone (left)
- B: Lateral mass of C1 (atlas) vertebra (left)
- C: Odontoid peg (dens)
- D: C2 (axis) vertebral body
- E: C3 vertebral body

ANATOMY QUIZ 2

Magnetic resonance cholangiopancreatography of the biliary tree and adjacent structures

- A: Right hepatic duct
- B: Left hepatic duct
- C: Common hepatic duct
- D: Common bile duct
- E: Pancreatic duct
- F: Second part of duodenum
- G: Gallbladder
- H: Cystic duct

STATISTICAL QUESTION

Case-control studies: measures of risk

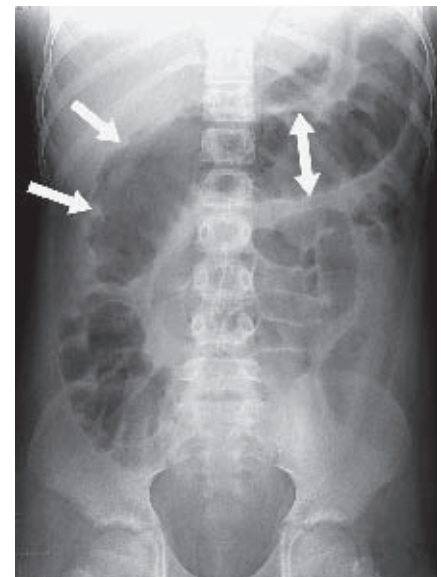
The odds ratio (*b*) of gastroschisis for the risk factor of genitourinary infections can be calculated for the above case-control study, whereas the hazard ratio (*a*), relative hazard (*c*), and relative risk (*d*) cannot.

For long answers go to the Education channel on bmj.com

PICTURE QUIZ

Acute abdominal pain in a child with inflammatory bowel disease

- 1 The radiograph shows abnormal colonic dilation, particularly in the transverse colon, with loss of normal haustration and thumbprinting, indicative of mucosal oedema (figure). Mild central dilation of the small bowel is also present, but no evidence of perforation. The diagnosis is toxic megacolon complicating a case of acute severe colitis. A colonic diameter of greater than 56 mm, together with systemic toxicity, is diagnostic in children over the age of 10.
- 2 Intravenous corticosteroids, broad spectrum intravenous antibiotics, and prompt surgical review, with close monitoring of clinical and blood parameters.
- 3 Potential predisposing factors for toxic megacolon include hypokalaemia and use of opioids, loperamide, anticholinergics, psyllium seeds, and antidepressants. The cessation or rapid reduction of corticosteroids, sulfasalazine, or mesalazine may also contribute. *Clostridium difficile* infection is another possible risk factor to exclude. It is increasingly common in adults and children and can be easily treated.
- 4 In one study, 70% of children with toxic megacolon needed colectomy compared with 30% of controls with acute severe colitis without toxic megacolon.



Plain abdominal radiograph showing abnormal colonic dilation (double headed white arrow), loss of normal haustration, and thumbprinting indicating mucosal oedema within the colon (two single headed white arrows) in a child with inflammatory bowel disease and a toxic megacolon