Symptoms that may be present | Clinical signs that may be present | Diagnosis
--- | --- | ---
Collapse | Shock | Amniotic fluid embolus
Dyspnoea | Apnoea
Cardiac arrest
Cyanosis
Coagulopathy |
Severe tachycardia or signs of heart failure point to an arrhythmia or a cardiomyopathy. A history of polyuria, sighing respiration and a very high blood glucose level points to diabetes (see Section 2.7.D on diabetic ketoacidosis). A history of drug ingestion points to poisoning.

**Phase 1 (compensated) shock**

<table>
<thead>
<tr>
<th>Physiology</th>
<th>Clinical effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sympathetic reflexes maintain cardiac output by:</td>
<td>Normal systolic blood pressure (diastolic blood pressure may be increased due to vasoconstriction)</td>
</tr>
<tr>
<td>• increased systemic arterial resistance</td>
<td>Tachycardia</td>
</tr>
<tr>
<td>• decreased blood flow to non-essential organs</td>
<td>Cool skin and increased capillary refill time</td>
</tr>
<tr>
<td>• increased heart rate</td>
<td>Decreased urine output (&lt; 0.5 mL/kg/hour, or &lt; 30 mL/hour in the mother)</td>
</tr>
<tr>
<td>• constriction of the venous reservoir</td>
<td>Confusion/agitation</td>
</tr>
<tr>
<td>• angiotensin and renin release leading to renal preservation of salt and water and reabsorption of intestinal fluid</td>
<td></td>
</tr>
</tbody>
</table>

**Phase 2 (uncompensated) shock**

<table>
<thead>
<tr>
<th>Physiology</th>
<th>Clinical effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure of compensatory mechanisms with decreased tissue perfusion leading to:</td>
<td>Hypotension</td>
</tr>
<tr>
<td>• increased anaerobic metabolism, leading to lactic acidosis</td>
<td>Cold peripheries and markedly increased capillary refill time</td>
</tr>
<tr>
<td>• acidosis impairs cardiac function and cellular homeostasis, leading to a further decline in cellular metabolic functions</td>
<td>Acidotic breathing</td>
</tr>
<tr>
<td>• inflammatory mediators are released which further impair cell function and vital systems such as the coagulation cascade and platelet function</td>
<td>Absent urine output</td>
</tr>
<tr>
<td></td>
<td>Impaired cerebral function</td>
</tr>
</tbody>
</table>

**Phase 3 (irreversible) shock**

The diagnosis of irreversible shock is a retrospective one. Severe damage to vital organs leads to inevitable death due to diminished energy stores which cannot be replenished even if circulatory function is restored. Therefore early recognition and effective treatment of shock are vital.

**Physiology of septic shock**

Tissue perfusion is decreased through the action of bacterial toxins and host inflammatory mediators. This results in the following:

- abnormal distribution of blood in the microcirculation, sometimes with peripheral vasodilatation
- loss of intravascular fluid into the extravascular space due to capillary leakage
- depressed myocardial contractility due to toxins and acidosis
- although cardiac output may be normal or raised from baseline, it may still be too low to deliver sufficient oxygen and nutrients to the tissues, because in septic shock the cells do not use oxygen properly. There appears to be a block at the mitochondrial level in the mechanism of oxygen uptake. This progressive deterioration in cell oxygen consumption can lead to multiple organ failure.

**Early (compensated) septic shock**

This is characterised by the following:

- raised cardiac output with tachycardia

All of these signs may be minimal. Mental confusion in particular needs to be looked for carefully, if septic shock is not to be overlooked at this stage. In the group with increased systemic resistance, decreased capillary return is a useful sign in these circumstances.

A pregnant patient may lose 1200–1500 mL of blood before showing obvious signs of shock (20% of circulating blood volume, 6–7 litres). Maternal signs of hypovolaemia are late.

Fetal distress may be the first sign of shock in pregnancy.

**Graphs to indicate the progression of shock in relation to clinical signs**

**Stage 1**

At first, with less than 1000 mL of blood loss, there are very few signs and symptoms. The patient may be slightly anxious, and the pulse and respiratory rate are slightly elevated but still within the normal range. Therefore, if this is the first recording taken, you may think it is normal for this particular patient, but it may in fact be abnormal for her (see Figure 2.5.A.1).
Note that in the anaemic mother the signs may be worse and the risks may be greater earlier than this.

Stage 2
After further blood loss, the perfusion to organs is maintained by the body’s stress response. This increases the diastolic pressure, with a resultant reduction in the pulse pressure, and the pulse rate continues to rise, reaching over 100 beats/minute (see Figure 2.5.A.2).

Meanwhile, urine is not being produced and the mother’s respiratory rate starts to increase.

Note that in the anaemic mother the signs may be worse and the risks may be greater earlier than this.

Stage 3
When 2000 mL of blood have been lost, a drop in blood pressure is observed, along with other signs and symptoms of hypovolaemia. It must be emphasised that hypotension, which is commonly used as an indicator of the severity of blood loss, is in fact a very late sign.

Generally, the pulse rate should be lower than the systolic blood pressure. If the pulse rate is higher than the systolic pressure, the patient is in grave danger (see Figure 2.5.A.3).

Note that in the anaemic mother the signs may be worse and the risks may be greater earlier than this.

Stage 4
If more than 2000 mL of blood are lost, this is an uncompensated very late stage of hypovolaemia, which could very rapidly result in death if emergency measures are not initiated immediately (see Figure 2.5.A.4).

Note that in the anaemic mother the signs may be worse and the risks may be greater earlier than this.

In late (uncompensated) septic shock:
- hypotension occurs as a result of decreased vascular resistance, and even with a normal or raised cardiac output, shock develops
- the cardiac output may fall gradually over several hours, or precipitously within minutes
- as tissue hypoxia develops, plasma lactic acid levels increase
- survival depends on the maintenance of a hyperdynamic state.

Choice of fluid for volume replacement
Crystalloid or colloid fluids are appropriate for volume replacement in shock (see Section 2.8.B).

However, dextrose/glucose infusions (particularly hypotonic ones such as 5% glucose or 0.18% saline in 5% glucose) do not constitute appropriate fluid resuscitation, and can be dangerous because they lower serum sodium levels, which can result in seizures and brain swelling.

Compared with colloids, crystalloid fluids:
- diffuse more readily into the interstitial space
may be associated with more peripheral oedema
where capillary leak exists, allow more water to enter the interstitial space, because of the lower osmotic pressure
need two to three times the volume of colloids to expand the vascular space
have been reported to be associated with lower mortality.
Nevertheless, the use of both crystalloids and colloids is appropriate, although crystalloids (e.g. Ringer-lactate or Hartmann’s solution or normal saline) are more likely to be available. Choice of crystalloid
The fluid that was traditionally infused into the circulation for the management of shock was normal saline (0.9% sodium chloride). This fluid has increasingly been shown to be dangerous, especially in the sick patient. An infusion of normal saline causes a hyperchloraemic acidosis (a high chloride concentration leading to an acidosis) which, in the shocked patient, who is already acidic, causes a deterioration in the health of cells in vital organs, even though perfusion of the cells has been improved by the increased circulating volume. There are sodium-containing alternatives to normal saline that are safer as they approximate more closely to human serum/plasma in content (see Table 1.6.1), although they are slightly more expensive. We recommend the use of either of these alternatives – Ringer-lactate and Hartmann’s solution, which are widely available – for all fluid replacement. Hospitals are advised to change their standard crystalloid from 0.9% (“normal”) saline to Ringer-lactate or Hartmann’s solutions as soon as possible. As not all hospitals will have access to these solutions immediately, there may sometimes be no alternative but to start fluid replacement with normal saline. However, if more than 20 mL/kg needs to be given, then one of the safer alternatives should be used in very sick patients if at all possible.

**Blood**

If there is significant blood loss or pre-existing severe anaemia in the face of any blood loss, blood will be needed. Full cross-matching takes about 1 hour to prepare. For urgent need, type-specific non-cross-matched blood (which is ABO- and rhesus-compatible, but has a higher incidence of transfusion reactions) takes about 15 minutes to prepare. In dire emergencies, O-negative blood must be given.

Fluids should be warmed, especially if they are needed in large volumes. In the absence of heaters, bags of fluid or blood can be warmed by placing them under the clothes next to the skin of a relative. Even this takes time, and another method is to pass the tubing of an IV set through a bowl containing warm water.

**Primary assessment and resuscitation**

**Suspect or anticipate shock** if at least one of the following is present:
- bleeding in early pregnancy (e.g. miscarriage, induced abortion, ectopic pregnancy or molar pregnancy)
- bleeding in late pregnancy or labour (e.g. placenta praevia, abruptio placenta, ruptured uterus)
- bleeding after childbirth (e.g. ruptured uterus, uterine atony, tears of genital tract, retained placenta or placental fragments)
- infection (e.g. induced or septic miscarriage/abortion, chorioamnionitis, endometritis, pyelonephritis)
- trauma (e.g. injury to the uterus or bowel during induced abortion, ruptured uterus, tears of the genital tract).

**Primary assessment indicating shock**
- Fast, weak pulse (> 100–110 beats/minute).
- Palor (especially of the inner eyelids, palms or around the mouth).
- Sweating or cold clammy skin.
- Rapid breathing (> 30 breaths/minute).
- Anxiety, reduced conscious level, confusion or unconsciousness.
- Low blood pressure (systolic pressure less than 90 mmHg is a late sign).
- Reduced urine output (< 30 mL/hour).

**Resuscitation**

If heavy bleeding is the suspected cause of shock, take simultaneous steps to stop the bleeding. These consist of uterotonic drugs such as oxytocin or misoprostol, uterine massage, bimanual compression, aortic compression and condom catheter, and anti-shock garment in postpartum haemorrhage. Urgent surgical intervention may be required (e.g. for ruptured ectopic pregnancy).

**Airway**

Try at the same time to stop bleeding by surgical or specific medical treatments as urgently as possible.
- Use an opening manoeuvre if the airway is not open or is partially obstructed. Keep the airway open. If there is improvement but the airway closes without active opening support, consider airway adjuncts to maintain the airway if the patient is unconscious (P or U on the AVPU scale).
- Suction if necessary.
- The airway may need to be maintained and protected by intubation, using experienced senior help (if available).
Breathing
- Provide a high concentration of oxygen through a face mask with a reservoir bag if there is adequate spontaneous respiration.
- For patients with inadequate ventilation, respiration should be supported with oxygen via a bag-mask, and experienced senior help should be summoned (if available).

Circulation
- Gain IV access.
  - Use a short, wide-bore (16- to 18-gauge) IV cannula if possible for IV access.
  - Access via the internal or external jugular veins is a good option if peripheral access is impossible. Long saphenous vein cut-down may also be considered, and the new intraosseous drill can be used if all else fails (see Section 8.4.B).
  - Applying pressure on the site of the bleeding can be valuable in many circumstances, including postpartum haemorrhage (see Section 2.5.D.iv) and external haemorrhage from major trauma.
  - Try to obtain two vascular access sites to give large volumes quickly, and in case one line is lost.
  - A blood pressure cuff can be used to speed up infusions in emergency situations. Wrap the cuff around the blood/fluid bag and place it inside a non-compressible bag. (see Figure 2.5.A.5).
- Use the left lateral tilt position or recovery position to minimise aortic and vena caval compression, and to reduce the risk of aspiration in patients after 20 weeks' gestation.
- Elevate the legs by raising the foot of the bed.
- Consider using a non-pneumatic anti-shock garment (NASG).
- Give an initial rapid bolus of 500 mL to 1 L of Ringer-lactate or Hartmann’s solution or blood if the patient is haemorrhaging. A colloid at the same dose can also be given, if available. It is essential that the bolus is given as rapidly as possible. In the absence of syringe pumps, it should be manually pushed in using a 20- to 50-mL syringe (using a three-way tap and link to an IV giving set).
- Further boluses of 500–1000 mL will usually be required in the first hour. Once more than 2 litres have been given IV, complications such as pulmonary or cerebral oedema may occur. Expert help, including CVP monitoring, is very valuable if it is available.

The concept of ‘targeted crystalloid fluid-resuscitation’ is important and requires urgent research into shock due to obstetric haemorrhage. Here the initial boluses of IV crystalloids required to treat shock would only be given to keep the vital organs (especially the brain, heart and kidneys) perfused before blood becomes available and, of most importance, surgery and specific medical treatments to stop the bleeding have started to take effect. The administration of too large a volume of IV crystalloids fluids may increase the blood pressure, damage clotting and disrupt early clot formation.

If this approach is used when giving boluses of crystalloid in shock due to bleeding (before blood is available and before procedures undertaken to stop haemorrhage are effective), only the amount necessary to keep the blood pressure at a level sufficient to perfuse the vital organs is given. There is no clear evidence to indicate the precise blood pressure that should be achieved in a woman in shock due to haemorrhage. However, adequate perfusion of vital organs may best be indicated by a radial pulse which can be palpated and an alert conscious level.

During pregnancy, the adequacy of the fetal heart rate may also be helpful.

Our personal practice, especially in low resource settings, is to start with IV boluses of 500 mL of crystalloid and reassess after each bolus, always aiming to stop haemorrhage and obtain blood for transfusion as soon as possible. In situations where there is brisk active blood loss and delay in obtaining blood or effective intervention to halt the bleeding, several boluses of crystalloids may be required. The importance of undertaking measures to halt the bleeding and obtaining blood for transfusion rapidly cannot be overstated.

Tranexamic acid
If bleeding is the cause of shock, this inexpensive and safe drug can be helpful. The drug should be started as soon as possible after the onset of major haemorrhage, in order to be effective.

The loading dose is 1 gram over 10 minutes followed by an IV infusion of a further 1 gram over a period of 8 hours. The slow IV bolus dose is given by injecting 1 gram of tranexamic acid into a 100-mL bag of 0.9% saline and letting it run through over a period of about 10–20 minutes (the exact timing is not crucial). The 8-hour infusion is given by injecting 1 gram of tranexamic acid into a 500-mL bag of 0.9% saline and giving it over a period of 8 hours (approximately 60 mL/hour).

Keep the patient warm but do not overheat.

**FIGURE 2.5.A.5** Pressure bag over the bag of Ringer-lactate or Hartmann’s solution to increase infusion rate.

Transfuse blood as soon as possible to replace blood loss.
Determine the cause of bleeding

- If bleeding occurs before the first 24–28 weeks of pregnancy, suspect miscarriage, induced abortion, ectopic pregnancy or molar pregnancy.
- If bleeding occurs after the first 24–28 weeks or during labour, but before delivery, suspect placenta praevia, abruptio placenta or ruptured uterus.
- If bleeding occurs soon after childbirth, suspect atomic uterus, retained placental fragments, ruptured uterus, tears of the genital tract or occasionally an inverted uterus.
- In all cases consider the possibility of a primary or secondary blood clotting disorder.

Cases where infection is the suspected cause of shock

- Collect appropriate samples (blood cultures, urine, pus, swabs) for microbial culture before starting antibiotics, if facilities are available but do not delay giving antibiotics because of specimen collection.
- Give a combination of antibiotics to cover aerobic and anaerobic infections, and continue until the patient has been fever-free for 48 hours:
  - benzyl penicillin 2.4 grams initially, then 1.2 grams IV 6-hourly or ampicillin 2 grams initially, then 1 g IV/IM every 6 hours plus gentamicin 80mg IV/IM 8-hourly or 5 mg/kg body weight IV/IM once every 24 hours plus metronidazole 500mg IV every 8 hours
  - or ceftriaxone 2–4 grams IV once daily or cefotaxime 2 grams 12-hourly IV plus metronidazole 500mg IV every 8 hours.
- If the patient is in shock, do not give antibiotics by mouth or IM, as they will not be absorbed.
- Reassess the patient’s condition for signs of improvement.

Cases where haemorrhage due to trauma is the cause of shock

- Try and stop haemorrhage and if appropriate prepare for surgical intervention.
- Give 500 mL IV crystalloid fluid resuscitation boluses and reassess circulation after each bolus until blood is available (see above).

General issues

Avoid giving IV boluses of 5% dextrose or dextrose saline (4%/0.18%), as they cause hyponatraemia, and may result in cerebral oedema and death.

An antibiotic such as cefotaxime or ceftriaxone should always be given IV when a diagnosis of septicemia is made obvious by the presence of a purpuric rash (suspect meningococcal infection).

Take blood for the following investigations (if available):
- full blood count (FBC), renal and liver function tests, blood culture, cross-matching, blood clotting, glucose stick test and glucose laboratory test.
- Catheterise and monitor urine output.
- If peritonitis is possible, add metronidazole IV.

Cases where a blood clotting disorder is present and fractionated blood products are not available

- Use fresh whole blood (straight from the donor if possible). In general, in obstetric emergencies, volume overload is not a problem.
- If volume overload is a concern, allow the unit of fresh whole blood to stand for 30 minutes. The red blood cells will drop to the bottom, and the fluid/plasma above them containing clotting factors can be drawn off with a syringe and needle, and plasma alone can be given.

Central venous access

This can be valuable provided that the healthcare workers present have the skills needed to do this safely as it is potentially hazardous. The catheter should be inserted in the intra-thoracic inferior vena cava or superior vena cava via the femoral, internal jugular or subclavian vein routes. However, it is essential that resuscitation is not delayed by trying to insert a central venous catheter. If there is a clotting disorder, never use the subclavian route.

A normal central venous pressure (CVP) is 4–10 cmH₂O, and optimising the CVP can improve cardiac output with less risk of inducing heart failure. Take great care if the CVP is > 12 cmH₂O, as cardiac failure may be induced by excessive IV fluids, especially if severe anaemia, malnutrition or a primary cardiac disorder is present.

Reassess ABC on a regular basis.

Reassess the response to fluids to determine whether the woman’s condition is improving. Signs of improvement include the following:
- decreasing pulse rate (a rate of ≤ 100–110 beats/minute)
- increasing blood pressure (systolic pressure ≥ 90–100 mmHg)
- improving mental status (less confusion or anxiety)
- increasing urine output (≥ 30 mL/hour).

Continue monitoring to ensure that the pulse rate and blood pressure do not deteriorate after improvement, indicating the return of shock.

If the mother’s condition improves, adjust IV fluids to 1 litre over 6 hours, and continue management for the underlying cause of shock.

If more than 3 litres have been given IV in a mother, and if shock is still present, call for anaesthetic assistance.

Correct any hypoglycaemia.

Inotropes

An IV infusion of dobutamine and/or dopamine at 5–20 micrograms/kg/minute should be considered, especially if a third bolus of fluid is required. Sometimes adrenaline by IV infusion at 0.05–2 micrograms/kg/minute may be required.

These infusions can initially be given carefully through a peripheral vein until central venous access is obtained. Patients who require ventilation and inotropic support should be cared for in a high-dependency or intensive-care unit with invasive monitoring (if available). Seek early advice.

---

**Box 2.5.A.1 Whole blood clotting time**

If laboratory clotting tests are not available:

- Transfer 2mL of venous blood into a small dry clean plain glass test tube (approximately 10mm × 75mm).
- Hold the tube in your closed fist to keep it warm (+ 37°C).
- After 4 minutes, tip the tube slowly to see if a clot is forming. Then tip it again every minute until the blood clots and the tube can be turned upside down.
- Failure of a clot to form after 7 minutes, or formation of a soft clot that breaks down easily, suggests a blood clotting disorder.
2.5.B Severe anaemia, including sickle-cell disease

**BOX 2.5.B.1 Minimum standards**
- Oral and parenteral iron.
- Folic acid.
- Blood transfusion.
- Antimalarial drugs.
- Antihelmintic drugs.
- Haemoglobin measurements at healthcare facilities in the community.

Introduction

In normal pregnancy there is an increased total blood volume and a marked increase in plasma volume, so the haemoglobin concentration falls. Pathological anaemia is mainly due to iron deficiency, associated with depleted iron stores before pregnancy and poor diet. Malaria is another major cause of anaemia in pregnancy. Anaemic women cope poorly with blood loss at delivery. Where amoebiasis and other hookworms are endemic, these may worsen the anaemia.

**Prevention of anaemia**

Oral iron supplementation is advised during all pregnancies. It is particularly important in the mother who is anaemic before pregnancy or who has a poor diet. The WHO recommends an iron supplement of 60 mg/day for mothers with adequate iron stores, and 120 mg/day for those women without adequate iron stores. Give ferrous...
sulphate or ferrous fumarate 200mg by mouth plus folic acid 400 micrograms by mouth once daily throughout pregnancy. Continue for 3 months postpartum. The mother may take the tablets after meals rather than in the morning if she prefers to do so.

In an endemic area, look for hookworm ova in the stools, and treat them if you find them. If a laboratory is not available to identify them, assume that they are present. Wait until around 16 weeks of pregnancy and then treat with mebendazole ("Vermox") 500mg as a single treatment.

If the mother has a large spleen and is anaemic, this is probably caused by malaria, which should be treated.

In areas where malaria is endemic, institute intermittent preventive treatment (IPT) with antimalarial drugs (see Section 2.8.D).

Severe anaemia is present if haemoglobin levels are less than 5.0 g/dL or if there are signs of heart failure and haemoglobin levels are less than 7.5 g/dL. This condition is very dangerous for both mother and baby.

Haemoglobin can be measured using either small drops of capillary blood or a venous sample. A portable battery-operated haemacue (www.biomedcentral.com/content/pdf/1472-6890-11-5.pdf) or a paper chart method can be used in rural areas where clinics are held.

**FIGURE 2.5.B.1** WHO test strip with colour scale for measuring haemoglobin in a rural area.

**Presentation of severe anaemia**

- The patient will be weak, with near white palms, soles and tongue, and signs of heart failure if the anaemia is severe (see below).
- In haemolysis, the urine may be dark brown in colour and there may be signs of jaundice.

**Treatment of severe anaemia**

If heart failure is not present, give ferrous sulphate 200mg orally three times a day, vitamin C 1000mg daily (this can increase haemoglobin levels by 1 gram/litre per week) and folic acid 5mg once daily. If vitamin C is not available, iron tablets may be taken with orange juice to aid absorption.

**Parenteral iron:** parenteral administration produces a larger and more rapid rise in haemoglobin levels, and is more effective in replenishing ferritin levels, so might be necessary for patients who cannot tolerate oral preparations or who are non-compliant, or if the anaemia is diagnosed late and rapid correction is required.

Parenteral iron is best given IV. Intramuscular injections are painful and may stain the skin. Do not give parenteral iron during the first trimester.

**IV preparations:** the side effects of intravenous iron preparations are less common with iron sucrose than with iron dextran. Side effects of iron dextran include arthralgia, myalgia, pyrexia, flushing and hypotension. Serious hypersensitivity is observed in approximately 1 in 200 patients

**Iron sucrose (Venofer®):** 200mg (elemental iron). For IV infusion, dilute 10mL of iron sucrose (200mg) in 100mL of 0.9% saline and infuse immediately after dilution. The first 10mL (20mg) should be given slowly over 10 minutes and the remainder over 1 hour. No test dose is required for iron sucrose, as anaphylaxis is rare with this preparation. However, adrenaline must be available. A fall in blood pressure is possible if the iron infusion is given too quickly.

IV infusions can be repeated weekly if the required rise in haemoglobin levels is not achieved, up to a maximum total dose of 1000mg.

Do not overdose with iron, as this can affect the absorption of other essential elements from the diet and increase the oxidative stress of pregnancy.

Treat for malaria, give prophylaxis (see Section 2.8.D), and prevent future inoculations with impregnated bed nets. Treat any chronic parasitaemia (e.g. hookworm, schistosomiasis).

Where hookworm is endemic (prevalence of 20% or more), give one of the following anthelmintic treatments:

- albendazole 400mg by mouth once; this must not be given in the first trimester because it causes fetal anomalies
- or mebendazole 500mg by mouth once or 100mg twice a day for 3 days
- or levamisole 2.5mg/kg body weight by mouth once daily for 3 days
- or pyrantel 10mg/kg body weight by mouth once daily for 3 days.

Where hookworm is highly endemic (prevalence of 50% or more), repeat the anthelmintic treatment 12 weeks after the first dose.

**Treatment of severe anaemia where there is heart failure**

Give a high concentration of oxygen, bed rest and sit the patient upright (with lateral tilt as well if she is more than 20 weeks pregnant).

- Consider transfusion with packed cells if the haemoglobin concentration is less than 5.0 g/dL (with IV furosemide of 40mg for each unit of packed cells). If blood cannot be centrifuged, let the bag hang until the cells have settled. Infuse the cells slowly and dispose of the remaining serum (see Section 1.7 on blood transfusion).
- Partial exchange transfusion may be helpful. Use a cannula in a large vein in the antecubital fossa, withdraw 20mL of the patient’s anaemic blood and infuse 40mL of new blood (ideally packed red blood cells) over 5 minutes and repeat 5–10 times.
Ideally, women with sickle-cell disease (SCD) should be taken. The patient's pre-pregnant weight, height, and risk of placenta praevia. Curettage should be obtained because of the increased risk of induction of labour and Caesarean section.

The mother is in great danger for at least 48 hours after delivery. Prescribe iron and folate during the puerperium.

Sickle-cell anaemia in pregnancy

Sickle-cell anaemia is a disease in which the patient’s red cells form sharp points when they lack sufficient oxygen. These pointed red cells are destroyed by the body, and as a result the patient becomes anaemic. Sickle-cell anaemia is harmful to pregnant mothers. It causes miscarriage and perinatal deaths. It also causes painful crises, which may be life-threatening. Infections, especially urinary and chest infections, are also more common.

If labour occurs when the patient is severely anaemic:
- Deliver with the patient sitting up.
- Cross-match blood and have it available in case of postpartum haemorrhage (PPH).
- Avoid a prolonged second stage as this increases the risk of PPH.
- If there are signs of heart failure or maternal exhaustion shorten the second stage with a ventouse if possible.
- Manage the third stage actively (give oxytocin), and suture any tears without delay.
- The mother is in great danger for at least 48 hours after delivery. Prescribe iron and folate during the puerperium.

Tests for chronic disease complications and other relevant issues

These include:
- Echocardiogram: used to screen for pulmonary hypertension that is associated with increased mortality. A tricuspid regurgitant jet velocity of more than 2.5 m/second is associated with a high risk of pulmonary hypertension.
- Blood pressure and urinalysis: identifies women with hypertension and/or proteinuria.
- Full blood count with a reticulocyte index.
- Haemoglobin electrophoresis.
- Serum iron, total iron binding capacity (TIBC) and ferritin levels.
- Renal and liver function tests: performed annually to identify sickle nephropathy and/or deranged hepatic function.
- Red cell antibodies: may detect an increased risk of haemolytic disease of the newborn.
- Measurement of antibodies to hepatitis A, B and C, and HIV.
- Rubella antibody titre.
- Tuberculin skin test.
- Pap smear, cervical smear, and gonococcus culture and screening for other sexually transmitted diseases; bacterial vaginosis testing should also be performed.
- Retinal screening (if an ophthalmologist is available); proliferative retinopathy is common in patients with SCD.
- T2-star (T2*) cardiac magnetic resonance imaging: this screens for iron overload in the multiply transfused who have a high ferritin level; aggressive iron chelation before conception is advisable in iron-loaded women.

Medication and vaccination

- Penicillin (or erythromycin) prophylaxis: there is limited evidence of its effectiveness in pregnant women with SCD, although some authorities recommend it.
- Folic acid (5mg daily) is useful both before and throughout pregnancy.
- Hydroxyurea is helpful in severe SCD, but it is teratogenic in animals. Women on this medication should use contraception and stop hydroxyurea 3 months before attempting to conceive. If they become pregnant, the medication should be stopped and an ultrasound scan performed to look for structural abnormality. Termination is not indicated just.

BOX 2.5.B.2 Minimum standards

- A multidisciplinary team that includes an obstetrician, a midwife and a haematologist.
- Blood pressure and urinalysis monitoring.
- A facility for haemoglobin estimation and electrophoresis, and other laboratory tests.
- Analgesia, including paracetamol, NSAIDs and morphine.
- Blood transfusion.
- Oxygen.
- Penicillin prophylaxis.
- Pneumococcal (PCV and Pneumovax), hepatitis B and Haemophilus influenzae vaccines.
- Ultrasound scanning.
because of exposure to hydroxyurea, as it is still possible to deliver an unaffected baby.

- Angiotensin-converting enzyme inhibitors or angiotensin-receptor blockers are used in patients with SCD with significant proteinuria (a protein:creatinine ratio of more than 50 mg/mmol), but they are not safe in pregnancy and should be discontinued prior to conception.
- Chelation therapy (e.g. desferrioxamine) should be stopped prior to conception.
- Vaccination against the following is recommended before pregnancy (if not previously given): Haemophilus influenzae type b, conjugated meningococcal C, and pneumococcus, hepatitis B and influenza.

Antenatal care

Antenatal care should ideally be delivered by a multidisciplinary team that includes an obstetrician and a midwife with experience of high-risk antenatal care, and a haematologist with an interest in SCD.

Discussion about pregnancy, SCD and vaccination should cover the points listed under ‘Before pregnancy’ above. Providing information and education about SCD, improving the mother’s nutritional status, malaria prevention and early detection of bacterial infection have a positive impact on SCD-related morbidity and mortality in Africa.

SCD may increase the risk of pre-eclampsia, so it is advisable to give low-dose aspirin (75 mg daily) from 12 weeks’ gestation (unless there is an allergy). Because of the effects on fetal development, non-steroidal anti-inflammatory drugs (NSAIDs) should only be given between 12 and 28 weeks’ gestation.

Iron supplements should only be given if there is laboratory evidence of deficiency (haemoglobin level less than 11 g/dL). Live attenuated vaccines should not be given until after delivery.

The woman’s partner should be offered testing for haemoglobinopathy. If the partner is a sickle-carrier or has SCD, the risks of delivering an infant with SCD should be discussed. This should ideally occur within 10 weeks of conception, so that prenatal diagnosis and discussion about termination can be offered. Factors to be considered include coping skills for caring for a child with a serious illness, personal and cultural values with regard to childbearing, religious beliefs, the need and desire to have children, feelings and attitudes about abortion, and beliefs about self-determination versus fate as determinants of adverse events.

Pregnant women with SCD are likely to have an increased risk of venous thromboembolism, and their management should be tailored. Graduated compression stockings are an option. For hospital admissions, low-molecular-weight heparin is recommended (see Section 2.5.H).

Blood pressure and proteinuria assessment should occur at each visit because of the increased risk of pregnancy-induced hypertension in SCD. Any pre-existing proteinuria or renal impairment should be monitored more frequently. Women should be observed closely if their blood pressure rises above 125/75 mmHg, if their systolic blood pressure increases by 30 mmHg, or if their diastolic blood pressure increases by 15 mmHg, in association with oedema and proteinuria in the second trimester.

Urinalysis for protein should be performed at each antenatal visit, and midstream urine sent for culture and sensitivity if symptoms of urinary tract infection are present and routinely if resources allow microscopy.

Ultrasound scanning should ideally occur as follows:
- Women should be offered a viability scan at 7–9 weeks’ gestation.
- They should be offered the routine first-trimester scan (at 11–14 weeks’ gestation) and a detailed anomaly scan at 20 weeks’ gestation. In addition, they should be offered serial fetal biometry scans (growth scans) every 4 weeks from 24 weeks’ gestation.

Transfusion in women with SCD who are pregnant

- Routine transfusions are not required.
- Red cell units should ideally be matched for Rhesus (C, c, D, E, e) and Kell type.
- Ideally, cytomegalovirus seronegative units should be used.
- Decisions about transfusion should be made by an experienced haematologist (if available) and an obstetrician. One approach is to consider initiation of transfusions for women who have complications such as pre-eclampsia, severe anaemia, or increasing frequency of pain episodes.
- Each woman should have an individualised care plan that takes into account her previous sickle-cell and pregnancy history.
- Treatment of acute painful crisis is the same as that for non-pregnant patients, with hydration, oxygen and analgesics, although doses of the latter may be higher. Reassurance should be given that morphine use during pregnancy does not jeopardise the baby’s health. However, if large doses of morphine are needed in late pregnancy, the newborn may require opioid weaning.

Intrapartum care

No randomised controlled trials are available to guide the timing of delivery. If there is a normally growing fetus, offer elective birth through induction of labour, or by elective Caesarean section if indicated for other reasons, between 38 and 40 weeks’ gestation. In low resource settings the risks of induction and the uncertainty about due date must be balanced against the potential increased risk of late pregnancy complications such as abortion and pre-eclampsia in SCD. SCD is not a contraindication to attempting vaginal delivery, or vaginal birth after previous Caesarean section. A ‘group and save’ for possible transfusion is acceptable for delivery unless there are atypical antibodies, when a cross-match should be requested (to reduce delays).

In women who have hip replacements it is important to discuss suitable positions for delivery.

During labour the following measures are recommended:
- Inform the multidisciplinary team (the senior midwife in charge, senior obstetrician, anaesthetist and haematologist) when labour is confirmed.
- Maintain warmth and hydration.
- Maintain continuous intrapartum electronic fetal heart rate monitoring if available, as there is an increased risk of fetal distress which may necessitate operative delivery. There is also an increased rate of stillbirth, placental abruption and compromised placental reserve.
- Intravenous fluids should be administered if oral hydration is inadequate. A fluid balance chart should be kept.
Changes during the intrapartum period:
- There is an increased frequency of sickle-cell crises and ACS.
- Cardiac function can be compromised because of chronic hypoxaemia and anaemia.
- There is an increased risk of painful crises with protracted labour (more than 12 hours). If the woman is well hydrated and labour is progressing, the labour should be carefully supervised. Caesarean section should be considered if labour is not progressing well and delivery is not imminent.
- There is an increased oxygen demand. Use of pulse oximetry to detect hypoxia is appropriate. If the oxygen saturation is 94% or less, oxygen should be given by nasal cannula.
- Routine antibiotic prophylaxis in labour is not supported by evidence, but hourly observations of vital signs should be performed. A raised temperature (> 37.5°C) requires investigation. The clinician should have a low threshold for commencing broad-spectrum antibiotics.
- Women should be offered anaesthetic assessment in the third trimester of pregnancy, as general anaesthesia should be avoided where possible. Regional (epidural) anaesthesia during labour where available may reduce the need for both general anaesthesia for delivery and high doses of morphine with lower body sickle pain. Regional analgesia (spinal) is recommended for Caesarean section.
- Avoid pethidine because of the risk of seizures. Morphine is the most appropriate drug.

Postpartum care
- If the baby is at high risk of SCD (based on parental haemoglobinopathy results), early testing for SCD should be offered.
- Maintain maternal oxygen saturation above 94% and adequate hydration based on fluid balance until discharge.
- Low-molecular-weight heparin (or unfractionated heparin if former not available) should be administered while the woman is in hospital and for 7 days post-discharge following vaginal delivery, or for a period of 6 weeks following Caesarean section.
- Anti-thrombotic stockings are recommended in the puerperium.
- The risk of sickle-cell crisis is increased. Hydration and oxygenation should be maintained and early mobilisation encouraged. Crises should be managed as for non-pregnant women. NSAIDs can be given in the postpartum period and during breastfeeding. Breastfeeding should be encouraged.
- Postpartum contraceptive advice should be given. Progestogen-containing contraceptives, injectable contraceptives and the levonorgestrel intrauterine system are safe and effective in SCD. Oestrogen-containing contraceptives should be used as second-line agents.
- Barrier methods are as safe and effective in women with SCD as in the general population.

Further reading

2.5.C Septic abortion or miscarriage

Introduction
Septic abortion is defined as abortion complicated by infection. Sepsis may result from infection if organisms rise from the lower genital tract following either spontaneous miscarriage or induced abortion. Sepsis is more likely to occur if there are retained products of conception and evacuation has been delayed. Sepsis is a frequent complication of unsafe abortion involving instrumentation.

Diagnosis
Consider the possibility of septic abortion in any woman or girl with a history of termination of pregnancy or attempted termination. Presentation is typically with some of the following symptoms and signs: lower abdominal pain, prolonged vaginal bleeding, tender uterus, foul-smelling vaginal discharge, purulent cervical discharge, fever and malaise.

Treatment
If septic shock is present, this will be shown by some of the following signs and symptoms:
- fast, weak pulse (≥ 100–110 beats/minute)
- pallor (especially of the inner eyelid, palms or around the mouth)
- sweatiness with cold or warm (vasodilated) skin
- rapid breathing (> 30 breaths/minute)
- anxiety, confusion or unconsciousness
- low blood pressure (systolic pressure < 90 mmHg is a late sign)
- reduced urine output (< 30 mL/hour).
Resuscitation then proceeds as described below.

**Airway**
- Use an opening manoeuvre if the airway is not open or is partially obstructed. Keep the airway open. If there is improvement but the airway closes without active opening support, consider airway adjuncts to maintain the airway if the patient is unconscious (P or U on the AVPU scale).
- Suction if necessary.
- The airway may need to be maintained and protected by intubation, using experienced senior help if available.

**Breathing**
- Provide a high concentration of oxygen through a face mask with a reservoir bag if there is adequate spontaneous respiration.
- For patients with inadequate ventilation, respiration should be supported with oxygen via a bag-mask, and experienced senior help summoned (if available).

**Circulation**
- Gain IV access.
  - Use a short, wide-bore (16- to 18-gauge) IV cannula if possible for IV access.
  - The internal jugular and external jugular veins are good options for access if peripheral access is impossible. Long saphenous vein cut-down may also be considered.
  - Try to obtain two vascular access sites to give large volumes quickly, and in case one line is lost.
- Elevate the legs by raising the foot of the bed.
- Give an initial rapid IV/IO bolus of 500 mL to 1 litre of Ringer-lactate or Hartmann’s solution. It is essential that the bolus is given as rapidly as possible.
- Further boluses of 500–1000 mL will usually be required during the first hour. Once more than 2 litres have been given IV, complications such as pulmonary or cerebral oedema may occur. If available, expert help, an anaesthetist, and the use of inotropes, sodium bicarbonate, and intermittent positive pressure ventilation (IPPV) with positive end-expiratory pressure (PEEP) are all potentially valuable.
- A fresh blood transfusion may also be important.

**Antibiotics after taking specimens for culture if facilities are available (blood cultures, high vaginal swab and urine)**
All patients, whether shocked or not, must be given the following antibiotics without delay:
- ampicillin 2 grams IV every 6 hours
- plus gentamicin 80 mg IV/IM 8-hourly or 5 mg/kg body weight IV/IM every 24 hours
- plus metronidazole 500 mg IV every 8 hours.

All of these should be continued until the woman has been fever-free for 48 hours.

Patients who do not appear to be shocked on first examination must still be frequently observed for the early signs of shock during the first 6–12 hours. The frequency of observations can then be reduced.

Start antibiotics as soon as possible and ideally before attempting manual vacuum aspiration (MVA).

The woman or girl may also need the following:
- MVA to remove infected products of conception. This is preferable to curettage, because perforation may already have occurred, or could easily do so because of the friable nature of the uterine wall
- Hysterectomy after stabilisation if the infection cannot be controlled.

**Further reading**
Surviving Sepsis Campaign: www.survivingsepsis.org/GUIDELINES/Pages/default.aspx

## 2.5.D Obstetric haemorrhage

### 2.5.D.i Ruptured ectopic pregnancy

**Introduction**
An ectopic pregnancy is defined as the implantation of the fertilised ovum outside the uterus, usually within the Fallopian tube.

When it is a few weeks old it ruptures the tube, resulting in bleeding into the peritoneal cavity.

If the fetus is expelled (“tubal abortion”) it leaves from the fimbrial end of the Fallopian tube with blood collecting as a haematoma, usually at about 8 week’s gestation.

If the Fallopian tube ruptures, there is generally severe abdominal pain, with or without shock, depending on the amount of bleeding. Rupture usually occurs from 8 weeks’ gestation onwards, but the timing can vary depending on the exact site of the pregnancy and the rate of growth of the pregnancy tissue. As a result rupture is possible before 8 weeks and beyond 12 weeks’ gestation.

**Cause of ectopic pregnancy**
This is not known, but associated factors include the following:
- pelvic inflammatory disease leading to salpingitis (especially as a result of gonococcus, chlamydia or TB infection)
- if pregnancy occurs with an intrauterine contraceptive device in place (a rare occurrence)
- previous tubal surgery resulting in tubal ligation or tubal re-anastomosis
- previous ectopic pregnancy
- previous intra-abdominal infection (peritonitis).

**Sites of implantation**
Implantation in the Fallopian tube is most common (over 90% of cases), usually at the ampulla. Less common but
more dangerous is implantation at the interstitial end. The fetus can also rarely implant on the bowel, pelvic peritoneum, cervix or ovary.

Clinical presentation: symptoms and signs

- Abdominal pain that is lower abdominal (which tends to be unilateral), cramping or stabbing, due to distension of the tube and peritoneal irritation from blood in the abdominal cavity. Rupture results in generalized abdominal pain, often associated with distension, guarding and rebound tenderness (peritonism).
- Shoulder tip pain, caused by blood irritating the diaphragm.
- Rectal pain or perineal discomfort caused by the presence of blood in the pouch of Douglas.
- Diarrhoea is an atypical symptom and can rarely be the main presenting complaint.
- Hypovolaemic shock occurs as soon as sufficient blood has been lost. Often there will be fainting or a feeling of faintness that requires the patient to lie down.
- A fast weak pulse (heart rate ≥ 100 beats/minute).
- Hypotension (a late sign after much blood has been lost: systolic pressure < 90 mmHg).
- Vaginal bleeding, which can mimic a normal menses (75%):
  - usually dark, and not heavy
  - may be irregular.
- Signs and symptoms of early pregnancy are unusual. They include tiredness, nausea and/or vomiting (especially in the early morning), breast swelling and urinary frequency.
- Anaemia if there is chronic slower bleeding.

In all women and girls of reproductive age with diarrhoea and/or dizziness or fainting, do a pregnancy test and consider the possibility of ectopic pregnancy.

Abdominal examination reveals muscle guarding and rebound tenderness and probably fever. The differential diagnosis is appendicitis. There may be abdominal distension with shifting dullness if there is free blood in the abdomen.

Pelvic examination: caution must be exercised when performing a bimanual vaginal examination if an ectopic pregnancy is possible, because of the risk of rupture during and due to the examination. Vaginal examination may show general pelvic tenderness, sometimes with a mass in the fornix, or increased tenderness on one side. There may be cervical excitation, bluish discoloration of the vagina and fornix, or increased tenderness on one side. There may be general pelvic tenderness, sometimes with a mass in the abdomen.

Diagnosis

Consider this diagnosis in particular if any anaemia, shock or abdominal pain is greater than expected for the amount of vaginal bleeding. Check whether the woman or girl has any risk factors for an ectopic pregnancy.

Differential diagnosis: threatened miscarriage, acute or chronic pelvic inflammatory disease (PID), torsion or rupture of an ovarian cyst, acute appendicitis or peritonitis.

Tip test: Tilt the head down. If there is blood in the peritoneal cavity it will irritate the diaphragm; this is manifested as shoulder tip pain. This test is useful if it gives a positive result, but a negative result does not exclude haemorrhage.

Do a pregnancy test in all potentially fertile women and girls with abdominal pain, fainting or shock. If they are unable to provide a urine specimen, consider using a urinary catheter to obtain one.

Ultrasound examination

If there is a positive pregnancy test but no intrauterine pregnancy is seen on the ultrasound scan, an ectopic pregnancy is likely. The likelihood of ectopic pregnancy increases if free fluid and/or an echogenic mass is seen.

Culdocentesis is not recommended, as it may delay surgery and introduce infection.

Primary assessment and resuscitation of shocked patients

Call for help. A surgeon and anaesthetist must be urgently requested, and the operating theatre must be prepared.

Airway

- Use an opening manoeuvre if the airway is not open or is partially obstructed. If there is an improvement, use airway adjuncts to support the airway or ask an assistant to hold it open.
- Suction if necessary.
- The airway may need to be maintained and protected by intubation using experienced senior help (if available).

Breathing

- Provide a high concentration of oxygen through a face mask with reservoir bag for patients with adequate spontaneous respiration.
- For patients with inadequate ventilation or depressed conscious level (P or U on the AVPU scale), respiration should be supported with oxygen by bag-valve-mask inflations and experienced senior help obtained, including an anaesthetist.

Circulation

- Elevate the legs and consider using a non-pneumatic anti-shock garment.
- Gain IV access.
- Use a short wide-bore IV cannula if possible (14- to 16-G).
- External jugular vein access is a good option if peripheral access is impossible. Long saphenous vein cut-down may also be considered, and, if the operator is adequately trained, central venous access ideally via the internal jugular vein can be extremely helpful, or the intravenous route if this is not possible (see Section 8.4.B).
- Try to obtain two vascular access sites in order to give large volumes quickly, and in case one line is lost.
- Take blood for cross-matching of 4-6 units, full blood count, renal function tests (if available) and blood clotting.
- Give 500mL to 1 litre of Ringer-lactate or Hartmann’s solution by rapid bolus while awaiting blood for transfusion.
- Remember that young healthy women and girls can lose a lot of blood before they become shocked, especially if it is a slow leakage rather than a sudden large loss of blood.
The concept of **targeted crystalloid fluid resuscitation** is important in management. Here the initial boluses of IV crystalloids required to treat shock would only be given to keep the vital organs (especially the brain, heart and kidneys) perfused before blood and, most important of all, surgery have become available.

The administration of too large a volume of IV crystalloid fluids by increasing blood pressure and damaging the coagulation system could increase bleeding by disrupting early clot formation.

If this approach is adopted when giving boluses of crystalloid to patients who are in shock due to bleeding, before blood becomes available and here, of most importance, surgical intervention, only the amount needed to keep the blood pressure at a level sufficient to perfuse the vital organs would be given. There is no clear evidence to indicate the precise blood pressure that should be achieved in a woman in shock due to a ruptured and bleeding ectopic pregnancy. However, adequate perfusion of vital organs may best be indicated by a radial pulse that can be palpated and an alert conscious level.

**Disability**

Conscious level on AVPU scale.

**Central venous access**

This is valuable if skilled staff are available to undertake it. Ideally it should be achieved using a multi-lumen catheter coated with heparin, if available, with the catheter placed in the intra-thoracic inferior vena cava (IVC) or superior vena cava (SVC).

A normal central venous pressure (CVP) (see Section 2.7.A for details of measurement) is +4 to +10 cmH₂O, and optimising the CVP can improve cardiac output with less risk of inducing heart failure. Take great care if the CVP is greater than 12 cmH₂O, as cardiac failure may be induced by excessive IV fluids, especially if severe anaemia, malnutrition or primary cardiac disorders are present.

**Emergency treatment**

If the diagnosis is ruptured ectopic pregnancy with shock, order blood for transfusion and immediately prepare the operating theatre. Obtain a surgeon urgently, and proceed to urgent laparotomy while resuscitation is under way. Do not wait for blood.

At laparotomy, perform salpingectomy. Repair of the tube carries a major risk of future ectopic pregnancy, and should not be undertaken in resource-limited settings.

**Autotransfusion**

If blood is unquestionably fresh and free from infection, it can be collected after the abdomen has been opened and transfused.

When the woman is on the operating table prior to surgery and the abdomen is distended with blood, it is sometimes possible to insert a needle through the abdominal wall and collect the blood in a donor set.

Alternatively, open the abdomen and proceed as follows:

- Scoop the blood into a basin and strain it through gauze to remove all clots.
- Clean the top portion of a blood donor bag (containing anticoagulant) with antiseptic solution and open it with a sterile blade.
- Pour the mother’s blood into the bag and infuse it through a filtered set in the usual way.
- If a donor bag with anticoagulant is not available, add 10 mL of 0.3 molar sodium citrate to each 90 mL of blood.

**Advice post salpingectomy for ruptured ectopic pregnancy**

- If the other tube was macroscopically normal there is good chance of further successful pregnancy.
- The risk of a recurrent ectopic is 10% or more; that is 10 times the background risk therefore an early ultrasound scan is recommended (if available) as soon as a new pregnancy is suspected.
- Offer family planning advice.
- Consider treatment of pelvic inflammatory disease for the patient and her partner if there was intra-operative evidence of pelvic infection and no clear history of previous treatment.

2.5.D. ii Miscarriage

**Types of miscarriage**

Consider miscarriage or induced abortion in any woman or girl of reproductive age if more than 1 month has elapsed since her last menstrual period, and one or more of the following is present: bleeding, lower abdominal pain, partial expulsion of products of conception, dilated cervix, or smaller uterus than expected for gestation.

**Spontaneous miscarriage**

This is the loss of a pregnancy before fetal viability (28 weeks’ gestation in low-resource settings). It occurs in at least 15% of pregnancies.

The stages of spontaneous miscarriage may include the following:

- **threatened miscarriage**: pregnancy may continue.
- **incomplete miscarriage**: products of conception are partially expelled.
- **complete miscarriage**: products of conception are completely expelled.
- **missed miscarriage**: is not associated with symptoms but found incidentally on routine ultrasound scan or when ultrasound is performed to investigate a pregnancy that is not growing as anticipated. The time from fetal demise to expulsion from the uterus varies widely and it is not uncommon for a miscarriage to remain **in situ** for many weeks.

Miscarriages can be complicated by infection (see Section 2.5.C).
Threatened miscarriage
Here there is light vaginal bleeding and sometimes cramping lower abdominal pain. On examination there is a soft uterus corresponding in size to the date of the last menstrual period, and the cervix is closed.

Ideally in the presence of bleeding the viability of the pregnancy should be assessed by sonicaid/Pinnard stethoscope (if gestation permits) or by ultrasound. However, if the bleeding is light and self-limiting and ultrasound is not easily available then a conservative approach can initially be followed. Advise the woman to avoid strenuous exercise and sexual intercourse but bed rest is not necessary. Follow her up in the antenatal clinic. If the bleeding continues, assess for fetal viability and if the equipment is available perform an ultrasound scan. There is no medication that can prevent progression to a complete miscarriage.

Inevitable miscarriage
This can be diagnosed clinically by the findings of an open internal cervical os and/or the passage of products of conception per vagina. If in doubt the diagnosis should be confirmed by ultrasound.

Incomplete miscarriage
Here there is a history of significant bleeding (greater than menstruation), often with passage of clots and fetal tissue and varying degrees of lower abdominal pain secondary to uterine contraction. Bleeding can vary in severity and the cervix may be open or closed. Often the bleeding has reduced and almost stopped in which case, a complete miscarriage is an important differential diagnosis.

Diagnose by visualisation or palpation of products of conception in or through the cervical os, or by visualisation of retained products of conception on ultrasound.

Management of miscarriage
There are three broad methods for managing miscarriage:
1 Expectant: No medical or surgical intervention is made but the patient is monitored for spontaneous resolution. This relies on ready access to emergency treatment and careful follow-up, and is therefore not commonly used in resource poor settings.
2 Medical: Medication is used to expedite or induce expulsion of the retained products of conception. In resource poor settings this is generally used only for later mid-trimester miscarriages (below).
3 Surgical: The uterus is surgically evacuated of the products of conception.

Surgical Management
If pregnancy is less than 16 weeks this is the preferred management method where access to care and follow-up are restricted.

If the pregnancy is 12 to 16 weeks gestation with an unfavourable cervix that is likely to be difficult to dilate, then consideration should be given to:
1 ‘ripening’ the cervix with misoprostol 200 to 600 micrograms around 3 to 24 hours prior to the procedure
2 Using medical induction as for gestations of 16 weeks and over (below).
3 Expectant management – especially if the patient appears to be contracting and is otherwise stable
4 Performing the surgery under optimal conditions: in an operating theatre with local anaesthetic, and with an experienced practitioner available.

If the cervix is open and/or some products have already been expelled a sponge forceps can be used to remove products of conception if they are visibly protruding through the cervix. A manual evacuation of the uterus can then be performed to ensure evacuation is complete.

- Manual vacuum aspiration (MVA) (see Figures 2.5.D.ii.1, 2.5.D.ii.2 and 2.5.D.ii.3) is the preferred method of evacuation. Evacuation by curettage should only be used if MVA is not available.
- If evacuation is not immediately possible and there is significant bleeding, give ergometrine 200–500 micrograms IM or misoprostol 200 micrograms orally, sublingually or rectally.
- Proceed to evacuation as soon as possible.

If the pregnancy is more than 16 weeks; a late miscarriage:
A detailed account of how this can be managed is given on pages 182–3.
In summary management, as above, can be divided into Expectant, Medical and Surgical approaches.
Expectant management is most appropriate when the miscarriage is progressing on its own.
Medical management includes oxytocin, misoprostol and misoprostol.
Surgical management for retained placental tissue either by Manual Vacuum Aspiration/curettage or, after 24 weeks, manual removal of the placenta is sometimes required. It is very important that this complication, which can cause chronic vaginal bleeding, is recognised.

Safe evacuation of retained products
1 Explain the procedure and the reasons for undertaking it, and obtain consent.
2 This must be a surgically aseptic procedure, with the use of sterile gloves and gown. Apply antiseptic solution (such as 0.5% chlorhexidine) to the vagina and cervix (especially the os) by first inserting a high-level disinfected or sterile speculum into the vagina and then using a sterile or high-level disinfected sponge forceps with a cotton or gauze swab and giving three applications of antiseptic.
3 Where possible perform the procedure in the operating theatre. This is especially indicated if there is a risk of heavy bleeding (e.g. molar pregnancy, suspected coagulation disorder), if the procedure is poorly tolerated by the patient or if the cervical os is difficult to dilate or difficult to access.
4 Even when bleeding is not heavy, give oxytocin 10 units IM or ergometrine 200 micrograms IM before MVA to make the uterus firmer and reduce the risk of perforation.
5 Prepare the MVA syringe by closing the pinch valve and pulling back on the plunger until its arms lock. In the case of large amounts of retained products (e.g. molar pregnancy), prepare two or three syringes.
6 Manually examine the uterus to assess whether it is anteverted or retroverted prior to instrumentation and to access its size.
7 Provide an oral analgesic, paracetamol 1 gram, and if the cervix is not dilated sufficiently to pass the MVA...
catheter, prepare 20 mL of 0.5% lignocaine (without adrenaline) with a 3.5 cm long 22- or 25-gauge needle to perform a paracervical nerve block.

8 Using a Cusco’s or Sims’ speculum or vaginal retractor, visualise the cervix. You will need an adequate light source.

9 Inject 1 mL of 0.5% lignocaine into the anterior or posterior lip of the cervix, whichever has been exposed, if a tenaculum is to be used.

10 Apply either a tenaculum or sponge (ring) forceps (the latter do not require administration of local anaesthetic, and are less likely to tear the cervix in incomplete miscarriage) to the lip of the cervix.

11 If the cervix is insufficiently dilated for the MVA catheter to be passed, perform a paracervical nerve block following slight traction applied to the cervical lip to identify the junction between the cervix and the vaginal wall where injections of lignocaine are to be made. Inject 2 mL of lignocaine just under the epithelium (no deeper than 3 mm) at 3, 5, 7 and 9 o’clock positions. Ensure that the needle is not in a vein with each injection by drawing back the needle before injection, as IV injection of lignocaine is dangerous and can cause convulsions and cardiac arrest. Wait 2 minutes and check that the cervix is anaesthetised by pinching it gently with forceps. If the pinch is felt, wait for another 2 minutes.

12 Grasp the lip of the cervix with the sponge forceps and apply gentle traction. Cervical dilatation with Hegar dilators is only needed where the cervical os is not dilated and is firm. Slowly introduce the dilators (the smallest one first) into the cavity, checking carefully whether the uterus is anteverted or retroverted, until the resistance felt on passage through the closed internal os is released and the dilator is felt to pass through it into the uterine cavity. Usually a dilatation of 10–12 mm is sufficient. Ensure that the cervix is not torn or a false passage created by the dilators.

13 Pass the MVA cannula gently with a rotating movement through the cervix into the uterine cavity just beyond the internal os. Slowly push the cannula into the uterus until it touches the fundus. Measure the depth by dots visible on the cannula and then withdraw the cannula by about 0.5 cm. Note the depth of the cavity and do not pass instruments beyond this. The risk of uterine perforation is higher in cases complicated by sepsis, or in a postpartum uterus with retained products of conception (see Section 2.5.D.iv). Also be aware that as it is evacuated the uterus generally contracts and thus the cavity will be smaller by the end of the procedure. Attach the prepared MVA syringe to the cannula and release the pinch valves, allowing the vacuum to transfer to the cannula and the inside of the uterus.

Evacuate the uterine contents by gently rotating the syringe from 10 to 12 o’clock and moving the cannula back and forth within the uterus. Do not allow the cannula at this stage to be withdrawn past the cervical os into the vagina, as the vacuum will be lost. If the vacuum is lost or the syringe is more than half full, empty it and then re-establish the vacuum. Do not hold the syringe by the plunger arms while the vacuum is present, as they may become unlocked and the plunger will then slip back into the syringe, pushing materials back into the uterus.

14 To ensure that all products of conception have been removed, check that red or pink foam but no tissue is seen in the cannula. The uterus will have a ‘gritty’ feel when the cavity is empty, and haemostasis should be achieved. The uterus may contract around the cannula. Always examine the syringe contents after the procedure. An absence of products of conception in a patient with signs of pregnancy or a positive pregnancy test and continued bleeding suggests three possibilities. Either the miscarriage was complete before evacuation, or the products are still in the uterus (in which case evacuation needs to be repeated), or there is an ectopic pregnancy. Be very careful about the third possibility.

15 If MVA is not available and a curette is used, undertake the procedure up to Step 11 above. Apply the curette with firm but controlled movements in all four quadrants of the uterus (anterior wall, left lateral, posterior wall and right lateral). The uterus will have a ‘gritty’ feel when the cavity is empty, and haemostasis should be achieved. If there is ongoing bleeding ensure that the cavity is empty with additional gentle curettage.

16 IV antibiotics should be given as a single dose unless...
there are signs of sepsis, in which case a full course of antibiotics should be given (see Section 2.5.C). All patients should be treated prophylactically for *Chlamydia trachomatis* with either azithromycin 1 g orally stat or doxycycline 100 mg orally twice daily for 7 days.

17 Anti-D immunoglobulin prophylaxis, if available and affordable, should be given to women with a Rhesus-negative blood group. In well-resourced countries, a dose of 250 IU of anti-D immunoglobulin is given before 20 weeks’ gestation, and 500 IU after 20 weeks’ gestation.

18 Give paracetamol, 500 mg to 1 gram orally, if needed for pain.

19 If an unsafe induced abortion is suspected, examine the woman for signs of infection and uterine, vaginal, bladder or bowel injury, and thoroughly irrigate the vagina with sterile Ringer-lactate or Hartmann's solution to remove any herbs, local medications or caustic substances before MVA is undertaken (see Section 2.5.C).

**Follow-up and management after a miscarriage, especially where evacuation has occurred**

Uncomplicated evacuations may not require follow-up. The patient should be encouraged to eat and drink and be mobile. She should be aware of the potential complications of miscarriage that include: retained tissue (sometimes requiring repeat evacuation), infection and haemorrhage. She should be advised to seek help if there are any symptoms suggestive of these complications, such as ongoing bleeding beyond 2 weeks, very heavy bleeding at any time, severe abdominal pain, offensive-smelling vaginal secretions, fever or malaise. Rigors or fainting potentially indicate severe complications, and the woman must return immediately to the hospital if these symptoms occur. Family planning must be discussed, and the woman advised to avoid pregnancy for at least 3 months.

In the case of mid-trimester miscarriages (>12 weeks’ gestation), consideration should be given to the cause of the miscarriage as it is less common at this time and more likely to be secondary to a treatable factor. As a minimum, malaria (where endemic), syphilis and urinary tract infection should be excluded or treated.

**Uterine perforation**

Uterine perforation may occur following evacuation of the uterus in either a medical or non-clinical setting. The risk of complications, such as infection, perforation, and damage to visceral organs such as bladder and bowel, is high where procedures are performed in non-clinical settings, and in such cases a laparotomy will be required along with high-dose intravenous antibiotics (see Section 2.5.C).

In most perforations where only the uterus has been damaged, the hole will heal spontaneously. Keep the woman under close observation for at least 48 hours.

**Symptoms and signs of perforation when it has occurred in a non-medical setting**

These include severe abdominal pain, vaginal bleeding, weakness, and dizziness or fainting. On examination of the abdomen there will be guarding, rebound tenderness or a rigid abdominal wall. Frequently there will be signs of septic shock (see Section 2.5.A).

**Complete miscarriage**

Evacuation of the uterus is not needed. Observe closely for evidence of bleeding, and follow the woman in the clinic.

**Miscarriage beyond 16 weeks’ gestation**

Spontaneous miscarriage will generally result in expulsion of the complete fetus (this is also usually the case between 12 and 16 weeks’ gestation) and placenta. These may be expelled together within the gestational sac or separately after rupture of the fetal membranes.

The patient may present with bleeding, pain, loss of liquor or a history of having already expelled the fetus before arrival. The examination may reveal an effacing and/or dilated cervix, bulging membranes, or fetal parts. The cervix may also be closed and the patient relatively asymptomatic despite a finding of fetal death on ultrasound. Ultrasound may reveal fetal cardiac activity despite evidence of an inevitable miscarriage.

Management of late miscarriage can be divided into Expectant and Medical management with Surgical management reserved for retained placental tissue after fetal expulsion and the rare cases where life-threatening haemorrhage occurs and delivery is not rapidly achievable by any other means.

If there are no signs of labour and especially if the cervix is unfavourable then the use of mifepristone is beneficial, but not essential if unavailable.

**Expectant management**

This is best reserved for patients where the delivery/miscarriage process is clearly ongoing and is likely to occur spontaneously without medical intervention. If the delivery is urgent due to the maternal condition, the patient must be monitored closely to ensure the labour is progressing so that it can be medically augmented promptly if required.

**Medical management**

If spontaneous delivery is not expected or delayed then delivery can be expedited medically. If chorioamnionitis is suspected then delivery is urgent and induction should be started without delay and the patient treated appropriately with antibiotics and other measures as indicated during the process.

The patient needs to be assessed for evidence of infection, bleeding or other associated disorders and treated accordingly.

The following investigations should be performed as a minimum: blood group and cross match, HB, malaria RDT +/- malaria smear, urine analysis for possible infection.

If there are no signs of labour and especially if the cervix is unfavourable, then the use of mifepristone is beneficial if available but can be omitted. If the delivery is urgent then either the interval between mifepristone and misoprostol treatment can be reduced or they can be administered together.

1. Give mifepristone 200 micrograms orally.
2. Observe the patient in hospital for a period of 36 to 48 hours.
3. Obtain intravenous access and give misoprostol 100 micrograms vaginally or orally every 3 hours up to a total of 5 doses. Oral administration is advised following initial vaginal installation of the first dose of misoprostol and assessment, especially, in the presence of ruptured
membranes, to reduce the risk of ascending infection. A sterile technique must be followed whenever vaginal assessments are performed.

4. Review by a doctor if delivery has not occurred within 3 hours of the final dose.

Note: The dose of misoprostol should be reduced to 100 microgram beyond 27 weeks’ gestation and to 50 microgram in women at higher risk of perforation e.g. grand-multiparae and after previous Caesarean section.

If mifepristone or misoprostol are not available, infuse oxytocin, 40 units in 1 litre of IV fluid (Ringer-lactate or Hartmann’s solution) over 4 hours until expulsion of the products of conception occurs.

Following delivery, oxytocin 10IU intramuscular should be given and the patient monitored for bleeding.

If the placenta is not expelled with or immediately following the fetus, retained tissue is likely even if the placenta is eventually expelled. Have a low threshold for exploration and evacuation.

Where gestation is around 24 weeks it may be safer to remove the placenta manually as after a term pregnancy. If not possible then MVA/curettage can be used.

Abortion
This is the deliberate termination of pregnancy before the fetus is viable.

- **Unsafe abortion** is a procedure performed by individuals who lack the necessary skills and/or in an environment that does not meet minimal medical standards. It may be attempted by ‘medically’ inducing the abortion or by ‘surgically’ expelling or removing products. The terms medical and surgical are used loosely here as ‘medicines’ used include highly toxic herbs as well as over-the-counter medicines taken in overdose.

Likewise ‘surgical’ is used to describe anything from unskilled use of routine surgical instruments to self-insertion of sticks or other objects into the uterus to disturb the pregnancy. Unsurprisingly, complications following unsafe abortion are common and unsafe abortion is a major contributor to maternal mortality.

- **Septic abortion** is abortion complicated by infection. Sepsis may result from ascending infection from the lower genital tract, and is more likely to occur if there are retained products of conception and evacuation has been delayed. It is a frequent complication of unsafe abortion involving instrumentation.

Molar pregnancy/gestational trophoblastic disease
This is relatively uncommon. Gestational trophoblastic disease refers to molar pregnancy (complete and partial moles), choriocarcinoma and placental site trophoblastic tumour.

Complete and partial molar pregnancies are distinguished by the presence of a fetus in the partial group. Complete moles usually result from duplication of a single sperm following fertilisation of an empty ovum. There is no evidence of fetal tissue. Partial moles usually result from dispermic fertilisation of an ovum. There is generally evidence of a fetus or fetal red cells. Only complete molar pregnancy is likely to progress to choriocarcinoma.

Signs of pregnancy are exaggerated. The uterus increases in size more rapidly than normal, vomiting is often but not always severe and constant, there may be pre-eclampsia in the early part of the second trimester, and HCG levels are very high. The symptoms and signs that are typically present include heavy bleeding, a dilated cervix, uterus larger than dates and softer than normal, and partial expulsion of products of conception that resemble grapes. MVA is required to evacuate the uterus (with anti-D prophylaxis in Rhesus-negative women if available and affordable). Diagnosis in low-resource settings is very difficult, and requires good-quality ultrasound and ability to monitor blood HCG levels before dilatation and curettage. The products of conception should be examined visually and ideally histologically.

**Management of molar pregnancy**
This is difficult and requires referral to hospital, ideally with expert facilities if these are available.

MVA will usually be required. There is a higher risk of bleeding, and therefore it is essential to cross-match blood prior to MVA.

Follow-up HCG measurements, regular ultrasound and possibly chemotherapy will be needed (see below).

Chest X-ray and ideally liver function tests will also be required.

The woman should be strongly advised not to become pregnant within the next year, and family planning advice is particularly important.

**Choriocarcinoma**, a malignant condition, is the most serious form of mole. It may follow a normal pregnancy and be manifested as continuing vaginal bleeding. Metastasis may occur to the lungs and other organs, and specialist care will be required, including chemotherapy.

**Further reading**
<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Clinical signs</th>
<th>Diagnosis</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe constant abdominal pain</td>
<td>Shock</td>
<td>Placental abruption</td>
<td>Call for surgical and anaesthetic help</td>
</tr>
<tr>
<td>Light or heavy vaginal bleeding (or non-visible bleeding in concealed abruption)</td>
<td>Tense and tender uterus on abdominal examination</td>
<td></td>
<td>Oxygen</td>
</tr>
<tr>
<td>Reduced or absent fetal movements</td>
<td>Fetal distress or absent fetal heart rate</td>
<td></td>
<td>Left lateral tilt or recovery position</td>
</tr>
<tr>
<td>Dizziness</td>
<td></td>
<td></td>
<td>IV fluid boluses for shock + blood</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td></td>
<td></td>
<td>Cross-match 4 units of blood and freeze-dried plasma if available, transfuse prior to delivery if possible, to try to correct any clotting abnormality</td>
</tr>
<tr>
<td>Confusion</td>
<td></td>
<td></td>
<td>Deliver the fetus as soon as possible if it is viable, either by inducing labour or by Caesarean section</td>
</tr>
<tr>
<td>Vaginal bleeding that may be light or very heavy</td>
<td>Soft uterus</td>
<td>Placenta praevia</td>
<td>Call for surgical and anaesthetic help</td>
</tr>
<tr>
<td>Bleeding can be precipitated by intercourse or vaginal examination</td>
<td>Presenting part may be higher than expected. Malpresentation is more common</td>
<td></td>
<td>Treat shock if present, including the lateral tilt or recovery position (see above)</td>
</tr>
<tr>
<td>No pain</td>
<td>Fetus may be distressed, non-viable or uncompromised with normal movements and normal fetal heart rate pattern</td>
<td></td>
<td>Do not undertake digital vaginal examination, as this can puncture the placenta and precipitate massive bleeding which may be fatal</td>
</tr>
<tr>
<td>Ultrasound will show placenta praevia</td>
<td>Ultrasound will show placenta praevia</td>
<td></td>
<td>If preterm and not bleeding too heavily, give steroids, admit for bed rest and only go for Caesarean section if there is a further bleed</td>
</tr>
<tr>
<td>Do not undertake digital vaginal examination, as this can puncture the placenta and precipitate massive bleeding which may be fatal</td>
<td></td>
<td>Cross-match ideally 4 units of blood</td>
<td></td>
</tr>
<tr>
<td>Continuous abdominal pain</td>
<td>Shock (especially an increasing heart rate)</td>
<td>Ruptured uterus</td>
<td>Call for surgical and anaesthetic help</td>
</tr>
<tr>
<td>Vaginal bleeding that may be light or heavy</td>
<td>Tense, distended and tender abdomen</td>
<td></td>
<td>Treat shock if present</td>
</tr>
<tr>
<td>History of a previous Caesarean section or other surgery on the uterus</td>
<td>Easily palpable fetal parts</td>
<td></td>
<td>Cross-match ideally 4 units of blood</td>
</tr>
<tr>
<td>Absent fetal movements and heart sounds</td>
<td>Signs of cephalo-pelvic disproportion</td>
<td></td>
<td>Prepare operating theatre for laparotomy while resuscitating patient</td>
</tr>
<tr>
<td>Malpresentation – transverse lie</td>
<td>Scar from previous surgery</td>
<td></td>
<td>Stop oxytocin infusion if in situ</td>
</tr>
<tr>
<td>Haematuria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy vaginal and other bleeding</td>
<td>Bleeding from sites in addition to the vagina</td>
<td>Coagulation failure</td>
<td>Fresh blood transfusion</td>
</tr>
<tr>
<td>Signs of other conditions that may be responsible, such as:</td>
<td></td>
<td></td>
<td>Blood products such as platelets, fresh-frozen plasma and cryoprecipitate if available</td>
</tr>
<tr>
<td>● placental abruption</td>
<td></td>
<td></td>
<td>Antibiotics if appropriate</td>
</tr>
<tr>
<td>● pre-eclampsia or eclampsia (high blood pressure and proteinuria)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● retained dead fetus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● septicemia, including intrauterine sepsis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● incompatible blood transfusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● amniotic fluid embolism</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaginal bleeding that is light</td>
<td>Fetal distress or death</td>
<td>Vasa praevia (placental blood vessels lying in the membranes and in front of the baby’s head)</td>
<td>If diagnosed by ultrasound before labour, plan for Caesarean section</td>
</tr>
<tr>
<td>Bleeding can be precipitated by intercourse or artificial rupture of membranes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No pain</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
of bleeding, as well as to aid evaluation of the severity of bleeding.

Bleeding from the vagina or vulva may result from local trauma or infection. Vulval bleeding may be due to vulval varices, and may be heavy.

**Diagnosis**

Important points in history taking include the following:

- Is the bleeding provoked or unprovoked?
  - Bleeding due to placenta praevia is likely to be unprovoked. However, bleeding may be precipitated by intercourse or vaginal examination.
  - Abruptio placentae is more likely after abdominal trauma.
  - Intercourse may cause bleeding from cervical or vaginal lesions.
- Is the bleeding painful or painless?
  - Bleeding due to placenta praevia is usually painless.
  - Bleeding due to abruptio placentae is initially painless, but as it continues contractions will occur and eventually become tonic with constant severe pain and a woody feel to the uterus.
- Is it fresh or old blood?
- Is the bleeding light or heavy?

**Management of APH**

This can be summarised as follows:

- ABC.
- Monitor vital signs.
- Gain IV access and give fluid resuscitation.
- Send blood for urgent haemoglobin, group and cross-matching, as well as Kleihauer test (if available).
- Catheterise the patient.
- Perform an abdominal examination: assess uterine tone, tenderness, presence of contractions, auscultation of the fetal heart.
- Do a speculum examination: assess for vaginal and cervical lesions, and severity of bleeding. If the placental site is unknown ideally an ultrasound scan should be performed first. If not possible, caution must be taken as bleeding from a placenta praevia may be exacerbated by vaginal assessment.
- Listen to the fetal heart.

Insert a venous cannula if any of the following are present: active bleeding, contractions, tenderness or increased tone of the uterus. If the patient is shocked, proceed to assessment and resuscitation (see below).

**Investigations:** haemoglobin, platelet count, clotting tests, urea and electrolytes, liver function tests. Cross-match 4 units if there is major (> 500 mL) or massive (> 1500 mL) haemorrhage or if the bleeding is rapid; group and save if there is loss of < 500 mL and the bleeding is not ongoing. Perform a Kleihauer test, if available, if the woman is Rh negative or if there is major abdominal trauma.

**Management of the different causes of APH**

**Placenta praevia**

Placenta praevia is an abnormally situated placenta in the lower uterine segment. It presents with painless bleeding, often with no precipitating factor. Bleeding may be heavy and is bright red.

**FIGURE 2.5.D.III.1 Increasing levels of low implanted placentas.**

**Prevention and protection**

- Early detection of placenta praevia is very important to prevent serious bleeding.
- Any bleeding during pregnancy must be investigated by an ultrasound scan.
- Mothers with placenta praevia should have immediate access to an obstetric unit with facilities for Caesarean section.
- Mothers over 28 weeks pregnant with a placenta praevia and bleeding should stay in hospital until delivery by Caesarean section, or live very near to an obstetric unit that can perform Caesarean section.

Never allow a digital vaginal examination to be undertaken on a patient with known or suspected placenta praevia, as it can precipitate massive vaginal bleeding.

Careful speculum examination can help to exclude bleeding from the cervix or vagina but if placenta praevia is known to be present then undertake with extreme caution, ideally in the operating theatre.

**Placental abruption**

- Placental abruption refers to the premature separation of a normally situated placenta. The bleeding may be concealed or revealed, or mixed. It may be partial or complete (if complete, the fetus will be dead).
- The characteristic initial symptom is painless bleeding, which can be concealed or be associated with vaginal bleeding. As abruption becomes worse, contractions will occur and eventually become tonic with constant severe pain and a woody feel to the uterus. At this stage there will usually be shock, severe abdominal pain, and tenderness over the uterus. In early bleeding the uterus may still be soft to touch, but as the bleeding progresses it has a hard ‘woody’ feel due to uterine contraction. It may be difficult to palpate the fetal parts, the uterus may be large for dates and there may be signs of fetal distress or intrauterine fetal death. It is possible for large bleeds to be asymptomatic and even small bleeds can occasionally result in fetal death.
- Disseminated intravascular coagulation (DIC) is a common complication. A large placental abruption can occur without any visible vaginal blood loss (concealed haemorrhage).
- Remember that blood loss is invariably underestimated. Young healthy women will compensate and maintain their blood pressure until they lose around 20% of their circulating volume.
Symptoms and signs

- Characteristically there is pain and tenderness over the uterus, with blood loss vaginally and cessation of contractions.
- Uterine rupture usually presents with shock, which is partly due to blood loss and partly due to increased vagal nerve stimulation (so there may be a slow pulse rather than a fast one). The baby is usually dead or has severe fetal distress.
- There may be a change in the nature of the pain in labour, from severe intermittent pain to a constant pain.
- Vaginal bleeding may or may not be present. Bleeding from a ruptured uterus can fail to drain vaginally due to an impacted fetal head, and usually the majority of bleeding is intra-abdominal in this situation.
- Maternal shock can be made worse by dehydration, exhaustion and acidosis if prolonged obstructed labour has preceded the rupture.
- The abdomen is tender to palpation, and the fetal parts can be too easily palpable.
- On vaginal examination, the presenting part may be high or impacted; the fetal head may have retreated into the uterus.
- There may be a marked maternal bradycardia (< 60 beats/minute) due to increased vagal tone.
- The main differential diagnosis is placental abruption.

Ruptured uterus

Uterine rupture is full-thickness separation of the uterine muscle and the overlying visceral peritoneum, sometimes associated with extrusion of the fetus, placenta or both into the abdominal cavity.

- Bleeding from a ruptured uterus can occur either before (rare) or after the onset of labour, although the vast majority occur during labour itself.
- Risk factors for rupture include, obstructed labour due to cephalo-pelvic disproportion, multiparity (especially grand-multiparity), previous uterine surgery (including myomectomy and Caesarean section), and use of uterotonicics (including misoprostol and oxytocin).
- A previous Caesarean section scar may rupture during labour. However, obstructed labour even without a uterine scar, particularly in a woman of high parity, may also cause uterine rupture.
- Excessive doses of oxytocin during labour can precipitate uterine rupture and oxytocin should be used with particular caution in multiparous women, especially if it is being used to augment rather than induce labour. Any mother who is receiving this drug during labour should be assessed closely for contraindications before its administration, and should not be left alone.
- Extra careful consideration must be given to the administration of oxytocin in labour to a woman with a uterine scar, because of the increased risk of uterine rupture. This applies to women with previous myomectomy as well as to those with a previous Caesarean section.
- In any setting, including resource limited settings, women with uterine scars should only receive oxytocin before delivery when a high level of supervision is available.
- Ideally, always use a burette in-line giving set to administer IV oxytocin, to avoid over-dosage.
- Rupture of the uterus can also occur following violence or major trauma.

Management

1. Suspect uterine rupture in any patient with risk factors such as previous Caesarean section.
2. Primary assessment, resuscitation and emergency treatment for shock (see below).
3. Call the obstetrician and anaesthetist.
4. Obtain consent and prepare the operating theatre.
5. Perform urgent laparotomy.
6. Give prophylactic IV antibiotics (ampicillin, gentamicin and metronidazole).

For a discussion of the dangers of oxytocin during labour, and its management and contraindications, see above (and see Section 2.5.F).

Vasa praevia

- This is an uncommon but life-threatening condition for the fetus or neonate. In vasa praevia, fetal blood vessels run over or close to the cervix beneath the presenting part, unprotected by Wharton's jelly or placental tissue. These vessels are vulnerable to laceration and compression, most commonly at the time of delivery.
- Fetal or neonatal death can occur due to exsanguination or asphyxiation.
- Antenatal diagnosis can be made only by skilled ultrasound examination. Caesarean section is then needed to reduce the high mortality rate.

Failure of blood clotting

This may be due to a pre-existing coagulation problem, or to complications of the pregnancy causing excessive bleeding and disseminated intravascular coagulation (DIC) (consumption of the clotting factors).

Obstetric causes include the following:
- placental abruption
- pre-eclampsia or eclampsia
- retained dead fetus
- septicaemia, including intrauterine sepsis
- incompatible blood transfusion
- amniotic fluid embolism.

Primary assessment and resuscitation and secondary assessment and emergency treatment for bleeding in pregnancy

In any patient with vaginal bleeding and known or possible placenta praevia, a vaginal assessment should be avoided and performed with extreme caution if deemed to be essential. Ideally an ultrasound should be used to confirm the placental site.

The aims are as follows:
- to prevent shock and disseminated intravascular coagulation
- to achieve intact fetal survival if viability is possible in the circumstances.
Call for experienced obstetric and anaesthetic assistance (if available) and ensure that the operating theatre is ready

**Airway**
- Open the airway using chin lift or jaw thrust techniques if it is closed or partially obstructed. If there is an improvement, keep the airway open using either an assistant or an oropharyngeal airway if the patient is unconscious and this is tolerated without gagging.
- Suction if necessary.
- The airway may need to be secured by intubation using experienced senior help (if available).

**Breathing**
- Normal respiratory rates in a pregnant mother at rest are 15–20 breaths/minute. Tachypnoea can be due to acidosis.
- Provide high-flow oxygen by face mask with reservoir bag for adequate spontaneous respiration regardless of SaO₂. This increases fetal oxygen delivery as well as improving maternal tissue oxygenation.
- If ventilation is inadequate, especially when there is a depressed conscious level (P or U on the AVPU scale), airway and breathing should be supported by bag-valve-mask inflations with high-flow oxygen, and experienced senior help should be called, including an anaesthetist if available.

**Circulation**
- Normal heart rates in a pregnant mother at rest are 60–90 beats/minute.
- Normal blood pressure in a pregnant mother at rest is 95/60–135/85 mmHg.
- Remember to put the patient in the left lateral tilt position and elevate the legs.
- Monitor the heart rate and blood pressure, and reassess regularly. Aim to keep the heart rate at ≤ 110 beats/minute and the systolic blood pressure at ≥ 100 mmHg.

Recognise the signs of hypovolaemia. These include the following:
- tachycardia
- tachypnoea
- cold, pale, sweaty and possibly cyanosed skin
- alteration of mental state: confusion or unconsciousness
- fall in urine output to less than 30 mL/hour
- narrowed pulse pressure
- alteration of consciousness

Healthy women and girls who are pregnant can maintain a normal blood pressure when large volumes of blood are lost. Most, but not all, will demonstrate tachycardia if they are bleeding significantly, but bradycardia may also be observed.

Remember that young healthy women can lose a lot of blood before they become shocked, especially if it is a slow trickle rather than a sudden large loss.

**Restore circulating volume**
- Put the mother in the left lateral tilt or recovery position to minimise the effects of compression of the inferior vena cava or aorta. Lateral tilt can be achieved by using a pillow, blanket or rolled up towel. A wedge may be used during obstetric procedures. Assistants can also manually displace the uterus.

**FIGURE 2.5.D.III.2 Manual displacement of uterus and left lateral tilt.**
- Gain IV access and take blood for full blood count, cross-matching and blood cloting measurement. If IV access is not possible, consider intra-osseous needle insertion (see Section 8.4.B).
  - Use a short wide-bore IV cannula if possible, either 14G (usually orange) or 16G (usually grey).
  - External jugular vein access is a good option if peripheral access is impossible. Long saphenous vein cut-down may also be considered. If adequately trained personnel are available, central venous access, ideally via the internal jugular vein, can be extremely helpful. If access is not possible, consider intra-osseous needle insertion (see Section 8.4.B).
  - Try to obtain two vascular access sites to give large volumes quickly, and in case one line is lost. Do not waste time, and as soon as the first IV cannula is in place, give an IV fluid bolus.
  - Take blood for cross-matching (ideally 4–6 units), full blood count, renal function tests (if available), and blood cloting.

- Elevate the legs.
- Give an initial IV bolus of 500 mL to 1 litre of Ringer-lactate or Hartmann’s solution as fast as possible using a three-way tap and 20- to 50-mL syringes to push in as rapidly as possible. If reassessment of the circulation shows little or no improvement, then a further 500 mL should be given and followed by blood transfusion as soon as this is available. (A normal adult has a circulatory blood volume of 5 litres, and during pregnancy this increases by 40% to 7 litres.)

- Apply an anti-shock garment (if available) to help maintain adequate central circulation.

Tranexamic acid can be of benefit in patients with continued bleeding. The loading dose is 1 gram over 10 minutes followed by an IV infusion of a further 1 gram over 8 hours. The slow IV bolus dose is given by injecting 1 gram of tranexamic acid into a 100-mL bag of 0.9% saline and letting it run through over about 10–20 minutes (the exact timing is not crucial). The 8-hour infusion is given by injecting 1 gram of tranexamic acid into a 500-mL bag of 0.9% saline and giving it over 8 hours (approximately 60 mL/hour).

- Ensure adequate transfusion; the best way to resuscitate the fetus is to resuscitate the mother. Inadequate
transfusion is common, especially in cases of placental abruption.

- A central venous pressure (CVP) line can aid the decision as to whether more fluid is needed. However, insertion should not delay initial resuscitation, and must be undertaken by a competent person. If peripheral access is inadequate, this route may be used for volume replacement. If DIC is established, CVP insertion is more hazardous and the subclavian vein should be avoided, because it is not externally compressible.
- If shock is accompanied by a bradycardia of less than 60 beats/minute (e.g., in a patient with a ruptured uterus), give atropine 500–600 micrograms as an IV injection.

**Blood products**

- Fresh whole blood is preferable for managing obstetric haemorrhage.
- Use cross-matched blood where available except in an immediately life-threatening emergency, when group-specific blood should be used, as cross-matching may take up to an hour.
- The patient’s blood group should be established during pregnancy, to facilitate the provision of blood when it is needed.
- All large-volume infusions should be warmed. In particular, do not infuse cold fluid through a CVP line. The patient should also be kept warm, as hypothermia will exacerbate poor peripheral perfusion, acidosis and coagulation abnormalities. Any benefits of blood filters may be outweighed by their deleterious effect on the speed of transfusion. A good way of warming blood is to place the cold bag under the clothes of a relative next to their skin until the blood is warmed.
- Hand-inflated pressure bags are effective for giving blood and other fluids quickly (see Figure 2.5.A.5 on p. 170).

**Identify and treat any blood clotting disorders.**

- Assess bedside clotting: coagulopathy is defined as failure of a clot to form after 7 minutes, or formation of a soft clot that breaks easily (see Section 7.5 for details of whole blood clotting time measurement). Suspect and aggressively treat blood clotting disorders using warmed fresh blood, platelets (if the platelet count is < 50,000 × 10⁹), fresh-frozen plasma (15 mL/kg) and cryoprecipitate as appropriate and if available.
- Freeze-dried plasma is being used in the military in adverse conditions, as it is shelf stable for 2 years and easily reconstituted with sterile water within minutes. It would be a very useful addition to the emergency stores.

---

**FIGURE 2.5.D.III.3** Pathway of care for massive antepartum haemorrhage (APH). FBC, full blood count; CVP, central venous pressure; DIC, disseminated intravascular coagulation; PPH, postpartum haemorrhage.
in resource-limited countries where the use of fresh or frozen plasma presents major storage problems.

- Urinary catheterisation is needed for measurement of hourly urine output. Aim for a rate of more than 30mL/hour.

When the patient is stable, move her to a place where there is adequate space, light and equipment to continue resuscitation and treatment.

**Fetal assessment**

- When the patient is stable, move her to a place where there is adequate space, light and equipment to continue resuscitation and treatment.

**Anaesthetic issues**

Cardiovascular instability is a relative contraindication to spinal anaesthesia.

- Rapid sequence induction agents with minimal peripheral vasodilator action, such as ketamine 1–2mg/kg, should be considered.
- Adrenaline and atropine should be readily available in case cardiovascular collapse occurs on induction. Ventilation with high oxygen concentrations may be needed until the bleeding is controlled.
- volatile agents have been associated with increased blood loss due to their relaxant effects on uterine muscle. Anaesthesia should be maintained with IV agents (usually ketamine) if uterine atony is a problem.
- If spinal anaesthesia is used, compensatory lower limb vasoconstriction is abolished, so profound hypotension may occur.

**2.5.D.iv Postpartum haemorrhage**

**Introduction**

The definition of a postpartum haemorrhage (PPH) is blood loss of more than 500mL from a vaginal birth and more than 1 litre after a Caesarean section. It is common, occurring in 1–3% of all pregnancies. Globally it causes 25–50% of maternal deaths, and is the leading cause of death in low-resource settings.

Estimates of blood loss are inaccurate and tend to be low, often around half the actual loss. Blood is mixed with amniotic fluid and sometimes with urine. It is also dispersed on sponges, towels and linen, in buckets and on the floor.

The importance of any given volume of blood loss varies depending on the mother’s haemoglobin level. A mother with a normal haemoglobin level will tolerate blood loss that would be fatal for an anaemic woman. This is why it is essential to ensure that every woman who reaches labour has an adequate haemoglobin level.

Even healthy non-anaemic women can have catastrophic blood loss.

Bleeding may occur at a slow rate over several hours, in which case the condition may not be recognised until the mother is shocked. Previously healthy women can compensate for substantial blood loss until a relatively late stage.

**Delivery options**

- Diagnose and treat the source of bleeding.
- Perform Caesarean section for major abruption or placenta praevia.
- Induce labour if the fetus is dead, there is no placenta praevia, the mother is stable and there is no significant ongoing blood loss.
  - Urine output should be monitored hourly and Caesarean section considered if labour does not become established fairly quickly. The longer the dead fetus remains in utero, the greater the likelihood of development of DIC.
  - Expect and be prepared for massive postpartum haemorrhage, whether the baby is delivered vaginally or by Caesarean section. In cases of severe APH that require surgery, discuss the possibility of hysterectomy.

It is often APH that weakens and PPH that kills, because APH uses up the clotting factors and platelets, leaving the woman in danger if PPH follows soon afterwards.

If no safe operating theatre facilities for Caesarean section are present, give oxygen, transfuse fresh blood and transfer the patient as soon as she is safe and stable. Ensure that IV fluids are in place, catheterise the patient, and ensure that she is nil by mouth.

**Monitoring**

Essential monitoring should include pulse rate and volume, blood pressure, respiratory rate, oxygenation (SaO₂ if available), temperature and fluid balance (with a urinary catheter). Regular checks of the haematocrit, clotting studies and blood gases will help to guide resuscitation.

Monitor blood glucose levels and treat any hypoglycaemia.

Risk assessment in the antenatal period does not necessarily predict women who will have PPH. However, identification and treatment of anaemia antenatally will allow women to better withstand life-threatening PPH.

**Prevention of PPH**

**Active management of the third stage of labour**

This is essential for prevention of PPH, and it consists of four possible interventions:

1. a prophylactic uterotonic drug after delivery, after checking that there is not a second twin present.
2. early cord clamping and cutting
3. controlled cord traction
4. uterine massage after delivery of the placenta.

**Prophylactic uterotonic drug after delivery**

This is the most important intervention. Oxytocin 10IU IM or, especially if the mother is shocked, 5IU by slow (over 1–2 minutes) IV injection is the first choice because it causes uterine contractions to prevent atony rapidly and with minimal adverse effects. Atony is the most common cause of PPH (around 80% of cases). Where oxytocin is
unavailable or does not work, other uterotonic drugs should be used, including:

- ergometrine 200 or 500 micrograms IM or misoprostol 600 micrograms sublingually or orally if the mother is fully conscious
- misoprostol 800 micrograms rectally if the mother is drowsy or unconscious.

All uterotonic drugs should be given within 1 minute of the complete birth of the fetus, to aid separation of the placenta by enhancing uterine contractions and reducing the risk of bleeding from an atonic (relaxed) uterus. It is essential that, before giving such drugs, you are certain there is not another fetus in the uterus.

Ensure that both oxytocin and ergometrine are protected from heat damage by paying close attention to the cold chain and their storage, otherwise they may not be effective. Ideally oxytocin should be stored in a fridge, but it can be kept at 15–30°C for 3 months. Oxytocin must never be frozen. Ergometrine should always be stored in a fridge at 2–8°C. Misoprostol can be stored at ambient temperature.

Remember that ergometrine is contraindicated in heart disease, hypertension, pre-eclampsia and eclampsia, as it raises the blood pressure by vasoconstriction, which increases the risk of cerebrovascular accidents.

**Early cord clamping and cutting**

This is not an essential part of the active management of the third stage of labour, and it is no longer recommended unless the infant needs resuscitation.

**Controlled cord traction**

This is optional where delivery is undertaken by a skilled birth attendant, but contraindicated if a skilled attendant is not available. Details are given in Section 2.3.

**Strong uterine massage**

This should always be undertaken immediately after delivery of the placenta until the uterus is contracted and remains so. Check the state of contraction of the uterus every 15 minutes for 2 hours, and repeat the massage if at any time the uterus becomes soft and relaxed.

In order to prevent PPH during or after Caesarean section, the use of oxytocin plus cord traction is recommended in preference to manual removal of the placenta.

**How to manage the third stage of labour if uterotonic drugs are not available**

Unfortunately it is not uncommon for hospitals to run out of uterotonic drugs. In this avoidable and dangerous situation, expectant and/or physiological management should be undertaken.

1. Place the baby on the mother’s breast.
2. Leave the cord alone.
3. Observe for the following signs of placental separation:  
   - a small gush of blood  
   - a lengthening of the cord at the introitus  
   - the mother feeling uncomfortable, feeling a contraction and wanting to “bear down”.

Most placentas separate within 1 hour of birth. If this does not happen, seek help.

4. Deliver the placenta.
   - Sit the mother upright.
   - Encourage her to bear down with a contraction (only after placental separation).
   - Catch the placenta. If membranes are dragging behind it, gently twist a few turns and with slight traction and an up-and-down movement deliver the placenta plus membranes.

Controlled cord traction should not be undertaken prior to...
the separation of the placenta in the absence of uterotonic drugs.

**Monitoring after the placenta has been delivered by active or expectant management**
1. Monitor the blood pressure, pulse and state of the uterus (i.e. whether it is contracted) every 15 minutes for 2 hours after delivery of the placenta.
2. Examine the placenta for completeness.

**Causes of PPH**

**Primary PPH**
This occurs within 24 hours of birth, and in around 80% of cases is due to uterine atony.

- **Remember the 4 T's: Tone, Tissue, Trauma, Thrombin.**
  - **Tone:** atonic uterus – failure to contract after birth.
  - **Tissue:** retained placenta or placental fragments.
  - **Trauma:** ruptured uterus, or trauma to the cervix, vagina or perineum.
  - **Thrombin:** clotting defects, notably disseminated intravascular coagulation (DIC).

Remember also the following:
- **Haemorrhage may be concealed within the uterus or within the abdominal cavity.**
- **A ruptured uterus** can cause concealed bleeding, as can bleeding following Caesarean section.
- **An inverted uterus is associated with PPH.**
- **Any degree of PPH is dangerous if there has been severe anaemia before delivery.**

**Secondary PPH**
Secondary PPH (occurring from 24 hours or more after delivery up to 6 weeks after birth) is commonly associated with retained products of conception that undergo necrosis, become infected and prevent involution (sustained contraction) of the uterus. A fever suggests an infective component.

See p. 198 for details of the management of this problem.

**Factors that predispose to PPH**
These include the following:
- previous APH
- retained products of conception
- trauma to the uterus or birth canal (e.g. from instrumental delivery)
- uterine over-distension (e.g. due to multiple pregnancy or polyhydramnios)
- grand multiparity
- prolonged labour.

**Management of PPH**
First call for help (this must include a surgeon and an anaesthetist), palpate the uterus and massage it strongly and immediately, as it is most likely that an atonic uterus is the cause (see Figure 2.5.D.iv.1 and below).

**Airway and breathing**
- Ensure that the airway is open and remains so.
- Provide high-flow oxygen through a face mask with reservoir bag if there is adequate spontaneous respiration.
Give 100% oxygen (using a mask with reservoir and high flow rate).
- For patients with inadequate ventilation or depressed conscious level (P or U on the AVPU scale), respiration should be supported with oxygen via a bag-valve-mask, and experienced senior help should be summoned (if available).

Circulation

**Primary assessment denoting shock**
- Fast, weak pulse (≥ 100–110 beats/minute). Normal heart rates in a pregnant mother at rest are 60–90 beats/minute. Tachycardia is an early sign of shock.
- Low-volume (weak) pulse.
- Palor (especially of the inner eyelid, palms or around the mouth).
- Sweetness or cold clammy skin.
- Prolonged capillary refill time (> 3 seconds).
- Rapid breathing (> 30 breaths/minute). Normal respiratory rates at rest are 15–20 breaths/minute; tachypnoea can be due to acidosis.
- Low blood pressure (systolic pressure < 90 mmHg) is a very late sign. Healthy women and girls can maintain a normal or even high blood pressure while losing large volumes of blood.
- Nausea with or without vomiting.
- Anxiety, confusion or unconsciousness.
- Reduced urine output (< 30 mL/hour). Urinary catheterisation is needed for measurement of hourly urine output if the patient is shocked (normal output is > 30 mL/hour).

**Procedures for stopping haemorrhage must be started immediately and then undertaken in parallel with IV fluid resuscitation.**

**Measures to stop further haemorrhage due to uterine atony**

**Rubbing up a contraction**
Poor contraction of the uterus after delivery is the commonest cause of PPH. Rub up a contraction of the uterus (do not just pinch the skin).

As the muscle fibres are stimulated to contract, they compress the blood vessels running between the muscle fibres and help to stop bleeding.

**Abdominal massage of the uterus**
If the uterus is atonic, a contraction may be rubbed up by abdominal massage.
- Massage the fundus in a circular motion with the cupped palm of your hand until it is contracted.
- When it is well contracted, place your fingers behind the fundus and push down in one swift action to expel clots.

**Uterotonic drugs**
These drugs make the uterus contract.
- Give 10 IU of oxytocin IM or 5 IU IV slowly, especially if the patient is already shocked, and repeat after 5 minutes if they are still bleeding and/or the uterus is not contracted. This is the drug of first choice.
- Oxytocin starts to work 2–3 minutes after IV injection, but has a relatively short duration of action, and an infusion will be needed to maintain a contracted uterus. Following an oxytocin bolus, give an IV infusion of oxytocin 40 IU in 500 mL (60 drops/minute with a standard IV giving set where 20 drops = 1 mL) or 1 litre (120 drops/minute) of Ringer-lactate or Hartmann’s solution over 4 hours.

Side effects include hypotension (due to vasodilatation when given as a rapid IV bolus) and fluid retention.

If the mother does not have eclampsia, pre-eclampsia or hypertension, **ergometrine** 200 to 500 micrograms IM in addition may help uterine contraction. If the first dose of oxytocin does not stop bleeding within a few minutes, give **misoprostol** (which, unlike oxytocin and ergometrine, does not need to be kept in a refrigerator). It is given rectally as 4 × 200 microgram tablets or pessaries (800 micrograms in total) or, if the patient is conscious, orally as 3 × 200 microgram tablets or 2 × 200 micrograms of powder sublingually.

Ergometrine, either as part of Syntometrine (oxytocin 5 IU and ergometrine 500 micrograms IM) or alone, is contraindicated in pre-eclampsia, as its hypertensive action increases the risk of convulsions and cerebrovascular accidents.

**Urinary catheterisation**
This may help the uterus to contract.

**Bimanual uterine compression**
If heavy PPH continues despite uterine massage, and with the placenta already delivered, this procedure can be very effective. If the placenta is still in place priority should be given to removing it as soon as possible.
- You must wear sterile or disinfected gloves (ideally long versions up to the elbow).
- Introduce your right hand into the vagina, clench your fist with the back of your hand positioned posteriorly and your knuckles in the anterior fornix.
- Place your other hand on the abdomen behind the uterus and squeeze the uterus firmly between both hands.
- Continue compression until the bleeding stops (i.e. there is no bleeding when compression is released), and the uterus is contracted.

Although this procedure is painful, it is highly effective and can significantly reduce or even successfully treat uterine
haemorrhage. Therefore, if the bleeding is profuse, and the
number of staff attending the patient allows, it is a good
idea for one member of the team to commence bimanual
compression while uterotonic drugs are prepared and given,
and initial fluid resuscitation commenced.

**FIGURE 2.5.D.IV.5 Bimanual compression.**

**Aortic compression**

If bleeding still persists, apply aortic compression.

- Apply downward pressure with a closed fist (with your
  thumb outside the fist) over the abdominal aorta directly
  through the abdominal wall.

- The point of compression is just above the umbilicus
  and slightly to the left.

- Aortic pulsations can be felt through the anterior abdomi-
  nal wall in the immediate postpartum period. Press the
  aorta down on to the vertebral column.

- With your other hand, palpate the femoral pulse with four
  fingers parallel to and just below the inguinal ligament
  to check the adequacy of compression.

- If the pulse is palpable during compression, the
  pressure exerted by the fist is inadequate.

- If the femoral pulse is not palpable, the pressure
  exerted is adequate.

**FIGURE 2.5.D.IV.6 Aortic compression.**

Continue until the bleeding stops. If it does not stop,
continue to exert pressure while transferring the mother to
a facility where expert help is available.

**Uterine tamponade**

Uterine packing with a hydrostatic balloon such as a Rusch
balloon or condom over a simple in–out urinary catheter can
help to control haemorrhage from an atonic uterus that does
not respond to the above measures. The uterus may also be
packed with a sterile pack or gauze, although it is important
to ensure any gauze used is tied together, counted carefully,
and extended into the vagina to facilitate removal.

A condom catheter, which is inserted into the uterus
as a sterile procedure and filled with 250–500 mL of sterile
Ringer-lactate or Hartmann’s solution or 0.9% saline to
create a uterine wall tamponade, is an effective way of
stopping uterine bleeding that is continuing despite the use
of uterotonic drugs and procedures (see Figure 2.5.D.iv.7).

It is important to check that the balloon is fully inside
the uterus as it is inflated, and to take measures to
ensure that it does not become displaced into the
vagina. This can be done by packing the vagina with a
pack or gauze swab.

**FIGURE 2.5.D.IV.7 Condom catheter inflated with sterile IV fluid.**

Leave the balloon in position until the bleeding has
stopped for up to 24 hours (the exact time needed is
unclear). Before removing it, ensure that at least 1 unit of
cross-matched blood for possible transfusion is available,
with the possibility of making more available if required.
Theatre staff and an anaesthetist should be warned in
case bleeding occurs when the catheter is removed. One
approach is to remove 50 mL every 30 minutes until it is
fully emptied. Observe the patient closely for 4 hours after
removal of the catheter, looking at vaginal blood loss and
vital signs. IV antibiotics should be given when the catheter
is put in place, and should be continued for 48 hours.

An alternative new approach (the EgAr device from The
Gambia) useful in low resource settings involves inflating a
condom with air rather than IV fluids (see Figure 2.5.D.iv.8).
It includes the following components:

- a firm type of urinary catheter (used for temporary inser-
  tion and drainage of urine) rather than an indwelling Foley
catheter, which is easily constricted

- a latex male condom from a sterile and unbroken pack

- the inflator (with its tube) of an aneroid blood pressure
  machine

- a surgical suture (preferably black silk) for tying the
  condom to the catheter

- a piece of sterile thread for tying the end of the condom
  after inflation to stop the escape of air

June 2015 © 2014 Maternal and Child Health Advocacy International MCAI
sterile gauze to pack the vagina and maintain the inflated condom in the uterine cavity.

Using a sterile procedure throughout, the catheter is inserted into the condom, with the end part of the condom touching the tip of the catheter. The lower part of the condom is tied to the catheter using suture thread and inserted into the uterine cavity. The condom is then inflated with air until the bleeding is either arrested or greatly reduced. Pneumatic pressure is rapidly achieved after a few inflations. The uterus gradually increases in size (this can be seen abdominally) as the condom is being inflated, and the woman should experience no more than slight discomfort. Excessive inflation of the condom must be avoided, and pain indicates that too much air is being forced into the condom. If this happens, the volume of air can be easily reduced by loosening the valve of the inflator.

Compared with inflating the condom with fluid (assuming that IV fluid is available, which is not always the case), this technique is much faster and easier, and good control is achieved by using the valve on the inflator.

Fluid resuscitation
The aim of fluid resuscitation is to maintain perfusion of vital organs (the brain, heart and kidneys) during the manoeuvres described above.

1. Elevate the patient’s legs (raise the foot of the bed).
2. Try to obtain two vascular access sites in order to give large volumes quickly, and in case one line is lost. Insert a wide-bore IV cannula (ideally two) (14- to 16G) and send blood for a full blood count, cross-matching (4–6 units) and clotting. If peripheral veins are difficult to access, the external jugular vein or long saphenous vein cut-down are good alternatives. If a skilled person is available, an internal jugular vein central line can be helpful, especially if the central venous pressure can be measured.
3. If venous access is not possible, consider inserting an intra-osseous line using the newly available drill system (see Section 8.4.B).
4. Give 500 mL of O-negative blood if it is immediately available. If not, standard practice is to give an initial rapid IV bolus of 1 litre of Ringer-lactate or Hartmann’s solution (or of 0.9% saline if the former are not available) while waiting for blood for transfusion. It is essential that the IV bolus is given as rapidly as possible, with the aid of pressure bags or manual pressure. A blood pressure cuff that is wrapped around the fluid bag and inflated can be used to speed up infusions (see Figure 2.5.D.iv.9). An alternative is to push the boluses in using a 20- to 50-mL syringe (with a three-way tap linked to the IV giving set).
5. As soon as it is available give 1 unit of blood (500 mL) as rapidly as possible, and repeat as required. Fresh blood is particularly useful for combating the coagulopathy that occurs in major blood loss if specific coagulation components such as platelets are unavailable. Remember that blood loss is usually underestimated.
6. Further 500- to 1000-mL boluses of IV crystalloid or blood, if available, will usually be required in the first hour. Once more than 2 litres have been given IV, complications such as pulmonary oedema may sometimes occur, so be alert for circulatory overload.

The concept of targeted crystalloid fluid resuscitation may be relevant here and requires urgent research. If this approach is adopted the initial boluses of IV crystalloids required to treat shock would only be given to keep the vital organs (especially the brain, heart and kidneys) perfused before blood becomes available and, most important of all, before specific treatments to stop the bleeding have started to take effect. Giving too much IV crystalloid fluid may theoretically increase bleeding by disrupting early clot formation and damaging the coagulation system. There is no clear evidence to indicate the precise blood pressure or clinical signs that should be achieved in a woman in shock due to PPH.

Adequate perfusion of vital organs may be indicated by a radial pulse that can be palpated and a fully alert conscious level.

Until bleeding has been stopped and blood is available for transfusion, our personal practice, especially in low resource settings, is therefore to start with IV boluses of 500 mL of crystalloid and reassess after each bolus.
7. Keep the patient warm but do not overheat them, as this will cause peripheral vasodilatation and reduce the
Further IV fluid administration should be guided by the response of the pulse rate, blood pressure and capillary refill time, and later by the hourly urine output. Aim for a pulse rate of ≤ 100–110 beats/minute and a systolic blood pressure that is ≥ 90–100 mmHg and stable.

**Blood products**

Fresh whole blood is the ideal choice if it is available. Full cross-matching of blood may take up to an hour and is often unavailable in resource poor settings. In an emergency, group-specific blood should be used. The patient’s blood group should have been established during pregnancy, as this facilitates the provision of blood when it is needed. O-Rhesus-negative blood can be transfused in acute emergencies.

All large-volume infusions of blood should be warmed. A good way of warming blood is to place each bag of blood or fluid under a relative’s clothes next to their skin. Do not infuse cold fluid directly through a central venous line.

**New potentially valuable treatments for PPH**

**Tranexamic acid**

If there is continuing bleeding, especially if it has been caused by genital tract trauma, this inexpensive and safe drug can be helpful. Recent evidence has shown that tranexamic acid can reduce mortality from major haemorrhage in major trauma in adults. The drug should be started as soon as possible, and within the first 3 hours after the onset of major haemorrhage, in order to be effective.

The loading dose is 1 gram over 10 minutes followed by an IV infusion of a further 1 gram over 8 hours.

The slow IV bolus dose is given by injecting 1 gram of tranexamic acid into a 100-mL bag of 0.9% saline and letting it run through over a period of about 10–20 minutes (the exact timing is not crucial).

The 8-hour infusion is given by injecting 1 gram of tranexamic acid into a 500-mL bag of 0.9% saline and giving it over a period of 8 hours (i.e. approximately 60 mL/hour). If there is a gap between the initial bolus and the subsequent infusion this probably does not matter too much, but ideally one should follow the other.

**The non-pneumatic anti-shock garment (NASG)**

This compression garment is made from neoprene, a stretchable material that recoils and applies pressure through the skin. It feels like a tight diving wet-suit to wear, and consists of five segments that compress the legs (segments 1, 2 and 3), the pelvis (segment 4) and the abdomen (segment 5) (see Figures 2.5.D.IV.10 and 2.5.D.IV.11). The abdominal segment includes a foam compression ball that presses on the area of the uterus. The segments are held in place by Velcro. It is a very promising, potentially life-saving technique for low-resource settings.

Preliminary pre- and post-intervention trials have shown that the NASG significantly reduces shock, blood loss, the need for emergency hysterectomy, and maternal mortality and severe morbidity associated with PPH and other causes of obstetric haemorrhage. Randomised controlled trials by the World Health Organization and others are currently under way in Zambia and Zimbabwe.

The NASG is reported to reduce shock by compressing blood vessels in the lower parts of the body, thereby diverting up to 30% of total blood volume to the heart, lungs, brain and possibly the kidneys. There is evidence that, through the applied pressures of 25–50 mmHg, it decreases blood flow in the pelvis and, in PPH, blood loss from the atomic uterus.

It is particularly promising in settings where there can be delays in transfer to facilities where comprehensive emergency obstetric care is available, and where blood transfusion and surgery can be undertaken. In such settings, even in hospitals, blood transfusion is frequently delayed for between 1 and 3 hours, with O-negative blood rarely available and supplies of stored blood precarious. The NASG, by stabilising the patient, gives time for blood transfusion to become established and other treatments to be given, as well as very probably reducing the amount of blood that subsequently needs to be transfused.


‘may’ for ‘will’, as sometimes the bleeding, particularly in PPH, may be reduced during the application of the NASG, and advanced treatments such as surgery may not then be required.

The NASG is applied in sequence from the lower legs up to the abdominal compression segment (segment 5). With experience it can be applied by one person in 2 minutes, although it takes from 5 to 10 minutes if the healthcare worker is alone and unused to applying it. Help from others present, such as porters or relatives, can be valuable. In PPH due to uterine atony, it is particularly important that someone is massaging the uterus and giving the other treatments outlined above when the NASG is being applied. After the garment is in place the legs no longer need to be elevated and the uterus can still be externally massaged by placing one hand underneath the pelvic segment of the NASG. Vaginal examinations and repair of cervical or vaginal tears can be performed while the NASG is in place. The pelvic and abdominal segments can be opened for surgery such as emergency hysterectomy or B-Lynch sutures.

The NASG can be applied in addition to all the other measures for PPH described above when signs of shock first appear (see Section 2.5.A). The only contraindication to its use is known heart disease. The aim with all treatments is for a pulse rate of ≤ 100–110 beats/minute and a systolic blood pressure that is ≥ 90–100 mmHg and stable in a woman who is fully alert and has a urine output of ≥ 30 mL/hour.

The NASG is removed segment by segment when bleeding has been reduced to safe levels and the patient’s cardiovascular stability has been maintained for at least 2 hours (systolic blood pressure ≥ 90–100 mmHg, heart rate ≤ 100–110 beats/minute and haemoglobin concentration of ≥ 7 g/dL). Removal begins at the ankles with 15-minute gaps between each segment that is opened, and clinical measurements being made before each segment is removed. If the systolic blood pressure drops by ≥ 20 mmHg and/or the heart rate increases by ≥ 20 beats/minute, reapply that segment of the NASG and consider additional treatments such as further blood transfusion.

Between patients, the NASG can be laundered in the same way as for bloodstained sheets. First soak the garment in 0.5% chloride solution for 15 minutes. Then wash and scrub it with a soft brush in soapy water. Finally rinse it in clean water and leave it to air-dry. Fold and store the garment when it is completely dry.

Each NASG can be used 50–100 times, and at present costs US$150–200.

**Stopping bleeding due to trauma to the perineum, cervix or vagina**

If the bleeding continues despite all of the measures described above, examine the perineum, vagina and cervix with a sterile speculum. Postpartum bleeding with a contracted uterus is usually due to a cervical or vaginal tear. Trauma to the lower genital tract is the second most frequent cause of PPH, and may coexist with an atonic uterus.

Examine the mother carefully and repair any tears. Bleeding from trauma can be substantial and may be fatal, especially if there is pre-existing severe anaemia. Suture packs, a torch, a Sims’ speculum and sutures must always be immediately available on the PPH emergency trolley.

Initially stop the bleeding with sterile packing until a surgeon is able to repair the wounds.

**Repairing a perineal tear**

Get a good light, and start at the top of the tear. If difficult ask for help if available.

1. Anything except very minor tears should be repaired in the lithotomy or similar position as it provides a better view and is more comfortable for the surgeon/midwife.
2. Use a cutting needle on the skin and a round-bodied needle on other tissues.
3. Put the first stitch in above the highest point of the tear (apex). This is usually within the vagina.
4. When you get to the junction between the vaginal mucosa and the skin, put a needle through the loop and tie a knot.
5. Continue by applying stitches into the muscle and fascia to close any dead space (gaping of the vaginal skin) and again tie a knot once done.
6. Next close the skin by placing the needle in through the skin on one side, and then in through the sub-cutaneous tissues and out through the skin on the other side. If using interrupted sutures, the stitches are usually inserted ~ ½ cm from the skin edges and ~ 1 cm apart from each other. Tie a knot after each stitch to oppose the skin.

**Repairing a bleeding cervical tear**

Place the patient in the lithotomy position and explain the procedure to the patient.

Get a good light and if at all possible an assistant. Search all round the patient’s cervix, if the cervix is not easily visible grasp it with a sponge holding forceps (or similar) and pull it into view. In order to visualise the entire cervix it is often necessary to follow the cervix round from anterior to posterior by pulling each segment down with the sponge holding forceps. Ideally two forceps are used and the next segment picked up with one set of forceps while traction is maintained with the other (‘walking the cervix’).
Once the cervical tear is identified start suturing it at its highest point (the apex).
If you cannot insert sutures, control the bleeding with a vaginal pack and transfer the patient.

**Stopping bleeding due to retained placenta or retained products of conception**

Examine the placenta and ensure that it is complete.

**Retained placenta**

A retained placenta is defined as occurring:

1. after active management of the third stage of labour (see Section 2.3), if the placenta is not delivered within 30 minutes of the birth
2. after expectant management of the third stage of labour, if the placenta is not delivered within 60 minutes of the birth.

Risk factors include a full bladder, a previous retained placenta, high parity, uterine fibroids, a history of previous uterine surgery and placenta praevia. The placenta may become trapped in the cervix or lower uterus. There may be no bleeding with a retained placenta, especially if there is abnormal adherence (placenta accreta).

A retained placenta occurs in around 2% of deliveries.

**Management of retained placenta**

If there is a clinically significant PPH, the placenta must be removed urgently. Call for help (including an anaesthetist and an obstetrician), insert a venous cannula, take blood for haemoglobin and cross-matching as for PPH, and ensure that the operating theatre is ready.

Massage the uterus, and if there is atony it should be managed as described for PPH above. However, although oxytocin should be used as necessary, do **not** give ergometrine because it causes tonic uterine contraction, which may delay expulsion.

**Cause 1: The placenta is separated but trapped in the lower part of the uterus or cervix**

If the placenta is undelivered after 30 minutes of oxytocin stimulation, and the uterus is contracted and the placenta separated (usually indicated by the gushing of blood and rising of the uterus into the abdomen as a firm, more movable structure as with a normal placental separation and delivery), attempt controlled cord traction. During this procedure, and at all times, keep one hand on the abdomen to support the uterus and prevent its inversion.

Avoid forceful cord traction and fundal pressure, as they may cause uterine inversion.

This situation usually responds to firm and persistent traction on the cord with the other hand countering this on the uterus to prevent inversion. Ensure that the bladder is empty. Ask the mother to empty her bladder, otherwise catheterise the bladder if necessary. If you can see the placenta, ask the mother to push it out; an upright position may help. Undertake a sterile vaginal examination and if you can feel the placenta in the vagina or cervix, remove it.

**Cause 2: The placenta has failed to separate from the uterus**

If controlled cord traction plus uterotonic drugs are unsuccessful, manual removal of the placenta is likely to be required (see below).

**Cause 3: The placenta is morbidly attached to the uterus**

Very adherent tissue may be placenta accreta, a situation that is more likely to occur after a previous Caesarean section. Efforts to extract a placenta that does not separate easily may result in heavy bleeding or uterine perforation, which usually requires hysterectomy.

Therefore, if there is any suspicion of a morbidly adherent placenta the patient should ideally be referred to a hospital with operating facilities and a surgical team (if available). See pages below for more details on management.

Where there is significant haemorrhage, uterine and vaginal packing with gauze or balloon tamponade/condom catheter can halt the bleeding and eventually allow residual placenta to disintegrate and resorb/expel on its own. Hysterectomy will be needed if bleeding cannot be stopped by the measures described above.

If bleeding continues, assess clotting status using a bedside clotting test. Failure of a clot to form after 7 minutes, or formation of a soft clot that breaks down easily, suggests coagulopathy.

If there are signs of infection (fever with foul-smelling vaginal discharge), give antibiotics as for endometritis.

**Manual removal of the placenta**

This is a painful procedure associated with a high risk of infection unless it is undertaken using full sterile procedures. In many low-resource settings, manual removal of the placenta is undertaken without analgesia or anaesthesia, and often not even in the operating theatre.

Unless it is performed as an emergency for major PPH, we consider that manual removal of the placenta should be undertaken in an operating theatre with preceding morphine or ketamine in the presence of an anaesthetist. Elbow-length sterile gloves should be used. Provided that active PPH is not occurring, the mother should first be adequately resuscitated with IV fluids/blood and oxygen. The pulse rate, blood pressure, oxygen saturation and urine output should be closely monitored. Ideally, facilities for blood transfusion and, if necessary, emergency hysterectomy should be available.

After the placenta has been removed, massage the uterus to encourage tonic uterine contraction. An IV infusion of oxytocin 40 units in 500 mL or 1 litre of Ringer-lactate or...
Hartmann's solution should be administered over 4 hours to ensure continued uterine contraction. A single dose of prophylactic antibiotics should be given just before all manual removals (2 grams of ampicillin IV or IM plus 80 mg of gentamicin IM/IV).

Treatment of PPH that continues despite all of the above interventions

Reassess the patient and determine whether bleeding is continuing and whether there is a clotting disorder. Assess the clotting status using a bedside clotting test. Failure of a clot to form after 7 minutes, or formation of a soft clot that breaks down easily, suggests coagulopathy.

If bleeding continues, re-examine the patient and ensure that the oxytocin IV infusion is running correctly (40 units of oxytocin in 500 mL of Ringer-lactate or Hartmann’s solution over 4 hours).

Exclude the following:
- Inverted uterus
- Retained products of conception
- Damage to the genital tract: check for bleeding from the cervix, vaginal walls and perineum.

If the above measures fail to control PPH, do not wait too long.

The following operative interventions are available:
- B-Lynch sutures
- Hysterectomy, which may be life-saving, and should be considered early in order to reduce the risk of life-threatening coagulopathy.

Check the haemoglobin levels or haematocrit after resuscitation and when the patient is stable. Consider administering oral iron if the patient is anaemic.

Treatment of secondary PPH

This is particularly dangerous in low-resource settings. Severe and life-threatening anaemia can develop rapidly, and frequently the woman is admitted in shock and urgently requiring blood transfusion. Severe life-threatening septic shock can also develop.

Assess vital signs and temperature, and if the patient is shocked proceed as described above for massive PPH.

Assess the uterine size, and perform a speculum and vaginal examination and note the degree of bleeding, whether the blood is offensive, whether the cervix is still open, and whether there is cervical and uterine tenderness. Take a high vaginal swab for bacteriology (if available) before antibiotics are given.

Insert an IV line and take blood for haemoglobin, blood cultures, cross-matching and blood clotting (or clotting/bleeding time if unavailable) (as DIC may occur).

Urgently start 7 days of treatment with IV antibiotics, as the bleeding is often secondary to infection. This is especially likely if there is foul-smelling lochia, a fever, or there has been prolonged rupture of membranes prior to delivery.

- Give IV ampicillin 2 grams IV every 6 hours
  - plus gentamicin 80 mg IV or IM every 8 hours or 5 mg/kg body weight IV/IM once every 24 hours
  - plus metronidazole 500 mg IV every 8 hours.
- Alternatively, give ceftriaxone 2 grams IV or IM once daily plus metronidazole 500 mg IV every 8 hours.

Provide blood transfusion (ideally fresh blood) if the haemoglobin level is < 5 g/dL, or if it is < 7.5 g/dL with symptoms suggesting early cardiac failure or shock or if there is brisk ongoing blood loss.

Examine for suspected retained placental fragments, but beware of the high risk of uterine perforation. Feel inside the uterus using elbow-length sterile gloves, and try to remove any retained products manually or using ovum forceps. Be very careful not to perforate the uterus. Placental tissue that sticks to the uterus may be placenta accreta, which may result in heavy bleeding (see below for management). If the cervical os has already started to close, this approach might not be possible. If a curette is used, it should be blunt, and great care should be taken as the uterus will be soft and easy to perforate. A vacuum aspirator (as used for treating miscarriage) or digital curettage may be safer options. Laparotomy is occasionally needed to deal with the continued bleeding from an infected or ruptured uterine incision or infected placental bed.

FIGURE 2.5.D.IV.14 Supporting the fundus while detaching the placenta. Reach the placenta from the implantation site by keeping the fingers tightly together and using the edge of the hand to gradually make a space between the placenta and the uterine wall

FIGURE 2.5.D.IV.15 Withdrawing the hand plus the placenta from the uterus.

FIGURE 2.5.D.IV.16 Evacuating the uterus.
Section 2.5

**Call for help and initiate resuscitation**
Immediately massage the uterus

**Airway**
Breathing: high-flow oxygen and bag-mask if patient stops breathing

**Circulation**
Stop bleeding by continuous massage and giving uterotonic drugs:
- Oxytocin 10 IU IM or 5 IU IV slowly if shocked, and maintain contraction with oxytocin 40 IU in 500 mL Ringer-lactate or Hartmann’s over 4 hours
- Place two IV lines (14–16G cannula)

If shocked:
- Give 500-mL boluses of Ringer-lactate or Hartmann’s as rapidly as possible while awaiting blood
- Elevate legs

If placenta is in place: remove urgently
If still bleeding and shocked: try ergometrine* 200 micrograms IV over 2–3 minutes
If still bleeding: add misoprostol (3 x 200 micrograms orally or sublingually or 4 x 200 micrograms rectally if drowsy)
Consider tranexamic acid and NASG

Examine cervix and vagina for lacerations: if present, pack and take to theatre for repair
If no lacerations and still bleeding from uterus, apply bimanual compression and/or aortic compression while assembling hydrostatic balloon (condom catheter) into uterus inflated with 250–500 mL sterile crystalloid or air

If still bleeding
Laparotomy and possible hysterectomy
Do not leave it too late

Continually reassess ABC
Urinary catheter
Regularly monitor pulse volume and rate, blood pressure, temperature and SaO₂
Place baby on breast as soon as well enough
Treat coagulation problem with fresh blood and if possible platelets and clotting factors

* Do not give ergometrine if patient has pre-eclampsia

**FIGURE 2.5.D.IV.17** Pathway of care for massive postpartum haemorrhage (PPH). Aim for a contracted and empty uterus. FBC, full blood count; NASG, non-pneumatic anti-shock garment; ABC, airway, breathing and circulation.

**Management of placenta accreta**
This serious complication is caused by the placenta being morbidly adherent to deeper layers in the uterine muscle or even external to the uterus. It is more common after a previous Caesarean section and in the presence of a placenta praevia. After Caesarean section an attempt should be made to assess the site of the placenta with ultrasound to determine whether it is likely to overlie the previous scar.

If the patient undergoes a new Caesarean section, or has a retained placenta, the procedure should be carried out by the most experienced practitioner possible and preparations made for major haemorrhage, i.e. experienced anaesthetic assistance, good intravenous access, cross matched blood and availability of the non-pneumatic anti-shock garment.

An option is to allow the placenta to be left in situ where it may separate and expel itself over time. This risks haemorrhage, infection and DIC and in these cases the mother must be made aware of these risks. She must be observed carefully for signs of infection, given prophylactic antibiotics (single dose of ampicillin 2 g IV/IM plus gentamicin 5 mg/kg body weight IV/IM) and warned about what to expect when the placenta is eventually expelled. She must have rapid access to emergency care and be monitored as an inpatient.

Alternatively, an attempt to remove the placenta can be made. Haemorrhage, as discussed, should be anticipated and the procedure performed in theatre with adequate intravenous access, monitoring, cross-matched blood available and the most experienced anaesthetic and surgical personnel possible.

An alternative option is an immediate hysterectomy in order to prevent later complications and the necessity for very close post-partum monitoring. The decision will need to be based on the patient’s wishes, the resources available and the doctor’s abilities. If there is no facility for emergency hysterectomy, the patient should be transferred to a facility where this is available.

**Bleeding due to inverted uterus**
See Section 2.6.H.

**Anaesthetic issues when managing PPH**
Cardiovascular instability is a relative contraindication to regional blockade.

Rapid sequence induction agents with minimal
peripheral vasodilator action, such as ketamine, should be considered (see Section 1.24). Adrenaline and atropine should be readily available in case cardiovascular collapse occurs on induction. Ventilation with high concentrations of oxygen may be needed until the bleeding is controlled.

Volatile agents have been associated with increased blood loss due to their relaxant effects on uterine muscle. Anaesthesia should be maintained with IV agents (ketamine or etomidate) if uterine atony is contributing to haemorrhage.

Disseminated intravascular coagulation (DIC)
Suspect and aggressively treat coagulopathy using warmed fresh blood, platelets, fresh-frozen plasma and cryoprecipitate as appropriate and available. DIC is more likely to occur if there has been a previous antepartum haemorrhage.

Sheehan’s syndrome
Very rarely, massive PPH can cause pituitary infarction (also called Sheehan’s syndrome). This presents initially as failure of breastfeeding, and later as no return of menstrual bleeding, as well as fatigue, low blood pressure and loss of pubic and axillary hair. Treatment is with replacement hormones, including oestrogen, progesterone, thyroid and adrenal hormones. Specialist endocrinological advice is necessary.

Monitoring
Once the bleeding has been controlled, frequent observations of respiratory rate, pulse rate, blood pressure, urinary output and oxygen saturation (if available) are vital both to detect problems and to monitor the response to treatment. At least 48 hours of close observations are required.

Further reading
Videos on techniques used to treat PPH: www.glowm.com

2.5.E Hypertension, pre-eclampsia and eclampsia

**BOX 2.5.E.1 Minimum standards**
- Blood pressure machine
- Urine protein testing sticks
- Magnesium sulphate
- Antihypertensive drugs (labetalol, hydralazine, methyl-dopa and nifedipine)
- Bag-valve-masks, oxygen and oropharyngeal airway
- Suction
- Patella hammer
- Pulse oximeter

**Introduction**
Hypertension in pregnancy occurs when the systolic blood pressure is ≥ 140 mmHg and/or the diastolic blood pressure is ≥ 90 mmHg. If the blood pressure is elevated, confirm this by making repeated measurements (see below).

Severe hypertension (systolic pressure ≥ 170 mmHg and/or diastolic blood pressure ≥ 110 mmHg) must be treated, because a systolic or diastolic blood pressure at or above these levels is associated with a risk of cerebral haemorrhage, hypertensive encephalopathy and placental abruption.

**Measuring blood pressure and looking for hypertension**
When you measure the blood pressure of a woman, she should be rested and seated at a 45-degree angle with the machine on the bed beside her. Do not prop it up on her abdomen. Also do not lie her down, as this causes compression of the central veins. Open the cuff out flat, and make sure that you place the centre of the inner bladder on the artery. A falsely high reading will be obtained if the cuff’s bladder does not encircle at least 80% of the circumference of the arm.

If the blood pressure is consistently higher in one arm, this arm should be used for all subsequent measurements. Some automated blood pressure machines under-measure systolic blood pressure.

The systolic pressure is the onset of the first sound (Korotkov 1). The diastolic pressure is the complete disappearance of sounds (Korotkov 5). The normal systolic blood pressure in pregnancy is in the range 95–135 mmHg. The normal diastolic blood pressure is in the range 60–85 mmHg. Diastolic blood pressure measures peripheral resistance and does not vary with the woman’s emotional state to the same degree that systolic pressure does. The blood pressure normally falls during the second trimester of pregnancy, reaching its lowest value by the end of the
second trimester, and returning to pre-pregnancy levels at term.

If the systolic pressure is ≥ 140 mmHg and/or the diastolic blood pressure is ≥ 90 mmHg on two consecutive readings taken ≥ 4 hours apart, hypertension should be diagnosed.

In addition to a blood pressure of ≥ 140/90 mmHg, any increase in systolic pressure of ≥ 30 mmHg or in diastolic pressure of ≥ 15 mmHg over recent previous measurements requires close monitoring, even if the pressures do not reach 140 mmHg systolic or 90 mmHg diastolic.

The categories of hypertension in pregnancy
These can be classified as follows.

Pre-eclampsia
This is hypertension (blood pressure of ≥ 140/90 mmHg) that develops after 20 weeks’ gestation, always in association with proteinuria (≥ 0.3 grams in a 24-hour specimen). This level correlates with ≥ 1+ on dipstick testing.

Pre-eclampsia is a multi-system disorder. Other conditions cause proteinuria, and false-positive results are possible (e.g. due to contamination with normal vaginal discharge or amniotic fluid). Urinary infection may also produce proteinuria, but rarely ≥ 2+ on dipstick testing. Blood in the urine due to catheter trauma, schistosomiasis or contamination with vaginal blood may also give false-positive results.

Random urine sampling, such as the dipstick test for protein, is a useful screening tool. A change from negative to positive during pregnancy is a warning sign. If dipsticks are not available, a sample of urine can be heated to boiling point in a clean test tube. Add a drop of 2% acetic acid to check for persistent precipitates that can be quantified as a percentage of protein in the sample. Only clean-catch midstream specimens should be used. Catheterisation for this purpose is not justified, due to the risk of urinary tract infection.

HELLP is a syndrome that consists of Haemolysis, Elevated Liver enzymes and Low Platelets. It may complicate pre-eclampsia, sometimes with only mild or borderline hypertension and marginally abnormal proteinuria. Pre-eclampsia and eclampsia are still one of the main causes of maternal mortality and morbidity in low-resource countries. In one study it was reported that 38% of eclamptic fits occur antenatally, 18% occur in the intrapartum period, and the remaining 44% occur postpartum, usually in the first 48 hours after delivery. Sometimes the first fit occurs postnatally.

Oedema occurs with the same frequency in women with and without pre-eclampsia. However, if oedema develops suddenly and is widespread, always screen for pre-eclampsia. Test for oedema by pressing with your finger for 1 minute over the bony part of the mother’s tibia. If there is a dent when you take your finger away, oedema is present. If the mother has been lying down, look for oedema over the sacrum. Oedema can also make a finger ring tight. Oedema of the face is more likely to represent a sign accompanying pre-eclampsia.

Gestational hypertension
This is hypertension that develops only after 20 weeks’ gestation but with no other features of pre-eclampsia, and which resolves within 3 months after birth. Patients who present early in pregnancy (after 20 weeks) and with severe hypertension are more likely to develop pre-eclampsia.

Chronic hypertension
1. Essential hypertension (also called primary hypertension) occurs before 20 weeks’ gestation, without cause (see below).
2. Hypertension may also be secondary to other medical conditions such as chronic renal disease, endocrine disorders or diabetes mellitus.
It is important to control the hypertension in these cases, keeping the blood pressure below 150/100 mmHg, but not permitting the diastolic pressure to go below 80 mmHg.

**Pre-eclampsia in a woman with chronic hypertension and gestational hypertension**

Women with hypertension in pregnancy are at increased risk of developing superimposed pre-eclampsia and should be monitored more frequently for the presence of proteinuria and systemic features of pre-eclampsia from 20 weeks' gestation onwards but especially in the third trimester.

**Pre-eclampsia**

**Risk factors**

These include the following:
- first pregnancy
- multiple pregnancy
- family history of pre-eclampsia
- chronic hypertension (see above)
- renal disease
- hypertension/pre-eclampsia during a previous pregnancy
- diabetes mellitus
- molar pregnancy.

For those at high risk of recurrence, a systematic review of 59 trials involving 37,560 women found that low doses of aspirin reduced the risk of pre-eclampsia by about a sixth (17%), with a similar lowering of the risk of the baby dying (14%), and a small lowering of the risk of the baby being born too early (8%). Doses up to 75 mg appear to be safe and high risk women are advised to start taking them from 12 weeks' gestation and to continue until delivery of the baby.

**Investigations**

These include the following:
- urine dipstick test for protein and microscopy to exclude infection
- haemoglobin levels and platelet count
- urea and electrolytes, and creatinine
- liver function tests
- lactate dehydrogenase (LDH) and uric acid
- blood film
- electrocardiogram (ECG)
- ultrasound scan of the uterus.

If there are signs of DIC, clotting studies should be undertaken (whole blood clotting time in low-resource settings; see below). If there is severe hypertension in early pregnancy, investigations (if available) for the rarer causes such as molar pregnancy, autoimmune disorders, phaeochromocytoma, etc. may be indicated.

**Management of pre-eclampsia and gestational hypertension**

Pre-eclampsia progresses during pregnancy, and the only definitive treatment is delivery. If the patient is at term (i.e. after 36 weeks) then, after stabilisation of the mother, the baby should be delivered as soon as possible.

There is no evidence that bed rest improves the outcome for the mother or the fetus. Heavy physical labour is clearly inappropriate. However, women in low-income settings are commonly seen working in this way despite being in advanced pregnancy.

Mild cases can be cared for without hospital admission, but there need to be regular (at least weekly) checks on blood pressure and urine, and the family must be made aware of the warning signs of severe pre-eclampsia or eclampsia (see below).

If there is severe pre-eclampsia or eclampsia, if the blood pressure cannot be adequately controlled, or if there is pulmonary oedema, deteriorating renal or liver function, placental abruption or evidence of falling platelet counts or DIC, delivery is urgent but must always take place after stabilisation. In cases before 36 weeks’ gestation, an injection of dexamethasone or betamethasone 12 mg IM, two doses 12 hours apart or 6 mg IM, four doses 12 hours apart, improves the likelihood of avoiding neonatal respiratory failure (see Section 3.1).

Stabilisation involves correction of severe hypertension, control of fluid intake and output, correction of blood clotting disorders (in low-resource settings with fresh blood transfusion) and prevention or control of eclampsia (see below).

**Antihypertensive drugs for pre-eclampsia**

Mild pre-eclampsia does not require antihypertensive drugs.

If the systolic blood pressure is 150–160 mmHg and/or the diastolic blood pressure is 95–105 mmHg, treatment with oral antihypertensive drugs should be started.

Systolic pressure of ≥170 mmHg and/or diastolic pressure of ≥110 mmHg must be urgently treated with antihypertensive drugs. However, it is essential that the blood pressure is not lowered too rapidly, as this can seriously affect the woman's cerebral circulation and the circulation to the placenta and fetus. Aim for a systolic blood pressure of 150 mmHg.

**Oral antihypertensive drug treatment**

**Methyldopa**

This drug acts directly on the central nervous system and takes 24 hours to work. The dose is 250 mg three times a day initially, increasing every 2 days up to 750 mg three times a day. Side effects include dry mouth, postural hypotension, sedation and depression. Methyldopa is contraindicated in patients with depression or liver disease.

The simultaneous administration of oral iron and oral methyldopa can lead to a drug interaction that can result in clinically significant increases in blood pressure (>15 mmHg increase in systolic pressure and >10 mmHg increase in diastolic pressure).

**Labetalol**

This is a beta-blocker with mild alpha-blocking effects. The dose is 100–400 mg three times a day. Side effects include bradycardia, bronchospasm, weakness, scalp tingling (only for 24–48 hours), nausea and headache. Labetalol is contraindicated in patients with asthma.

**Hydralazine**

This is a vasodilator. The dose is initially 25 mg twice a day, increasing gradually to 50 mg three times a day. Side effects include uncontrolled hypotension, flushing, tachycardia, palpitations, headache and (uncommonly) a lupus syndrome.
Treatment of severe hypertension

It is vital that severe hypertension is controlled at any gestation, both before and after delivery.

Antihypertensive drugs should be given urgently to all patients with a systolic blood pressure of ≥ 170 mmHg and/or a diastolic blood pressure of ≥ 110 mmHg.

Without urgent treatment there is a risk of cerebral haemorrhage, eclampsia and pulmonary oedema.

The aim should be a gradual and sustained reduction in blood pressure with one or more of the drugs described below.

Blood pressure should not be allowed to fall below 140/80 mmHg before delivery.

Hydralazine

This is the most widely available antihypertensive drug in low-resource settings. Give 5 mg IV slowly over a period of 5 minutes (it acts within 5 minutes). Repeat the BP after every 15 minutes and treat with further doses of 5 mg until the diastolic blood pressure is 90–100 mmHg and the systolic BP is 140–160. Repeat the hydralazine hourly as needed, or give hydralazine 12.5 mg IM every 2 hours as needed.

Alternatively, give hydralazine IV infusion, 20 mg in 200 mL of 5% dextrose at 0.5 mL (10 drops) per minute (20 drops = 1 mL for a standard giving set), and stop the drip when the diastolic blood pressure is ≤ 90 mmHg. Hydralazine may cause an increase in the maternal heart rate.

Side effects include uncontrolled hypotension, flushing, tachycardia, palpitations, headache and (uncommonly) a lupus syndrome.

Labetalol

Intravenous labetalol is preferable to hydralazine if the maternal pulse rate exceeds 120 beats/minute.

The labetalol dosage is 10 mg IV. If the response is inadequate (i.e., if diastolic blood pressure remains above 110 mmHg) after 10 minutes, give a further dose of labetalol 20 mg IV. Increase the dose to 40 mg and then 80 mg if a satisfactory response is not obtained after 10 minutes of each dose.

Alternatively, use an IV infusion of 200 mg in 200 mL of Ringer-lactate solution at 40 mg/hour, increasing the dose at 30-minute intervals as required to a maximum of 160 mg/hour.

Side effects include bradycardia, bronchospasm, weakness, scalp tingling (only for 24–48 hours), nausea and headache. Labetalol is contraindicated in patients with asthma, as it may cause severe bronchospasm.

Nifedipine

The slow release/modified action version of the tablets must always be used in this situation. Nifedipine is a calcium antagonist that can be administered as an initial 10 mg oral dose (onset of action within 10–20 minutes), with a repeat dose of 10 mg if there is an inadequate response after 30 minutes. Subsequent oral doses are 20 mg twice a day. Side effects include severe headaches associated with flushing and tachycardia. Oedema, weakness and constipation may also occur. Nifedipine is contraindicated in patients with aortic stenosis. It may inhibit labour.

Give prophylactic magnesium sulphate if hypertension is accompanied by proteinuria and/or if protein testing is not available by symptoms which suggest that eclampsia may occur (see below).

Eclampsia or severe pre-eclampsia

Although pre-eclampsia and eclampsia are most common in the primigravida, they can occur in multiparous patients.

Symptoms and signs of impending eclampsia

These include the following:

- headache, visual disturbances, epigastric pain and vomiting
- rapidly developing generalised (especially facial) oedema
- pulmonary oedema
- right upper quadrant tenderness
- recently developed hypertension ≥ 170/110 mmHg with proteinuria > 1 gram/24 hours or a rapid rise in blood pressure
- clonus and increased tendon reflexes
- HELLP syndrome.

Any headache or epigastric pain occurring in the second half of pregnancy should be investigated for pre-eclampsia (measure the blood pressure and test the urine for protein).

Differential diagnosis (see Table 2.5.E.1)

- A seizure:
  - in a patient with known epilepsy (see Section 5.16.E)
  - in severe malaria (see Section 2.8.D)
  - in head injury (see Section 2.7.E)
  - in meningitis/encephalitis (see Section 2.7.E).
- Intoxication (local anaesthetic overdose).
- Amniotic fluid embolus (see Section 2.5.I).

Maintain a high index of suspicion of pre-eclampsia or eclampsia even in those with malaria, migraine or epilepsy, as the conditions may coexist.

A small proportion of mothers with eclampsia have a normal blood pressure. Treat all convulsions as eclampsia until another diagnosis is confirmed.

Convulsions with signs of pre-eclampsia indicate eclampsia.

Convulsions due to eclampsia:

- can occur regardless of the severity of hypertension
- are difficult to predict, but rarely occur without increased tendon reflexes, headache or visual changes
- are tonic–clonic and resemble grand mal convulsions of epilepsy
- may recur frequently, as in status epilepticus, and may be fatal
- will not be observed if the woman is alone
- may be followed by coma that lasts for minutes or hours depending on the frequency of convulsions
- occur after childbirth in about 44% of cases, usually but not always within the first 24 hours after birth. The longer the gap between delivery and a fit, the more likely the diagnosis is to be a condition other than eclampsia (e.g. cerebral venous thrombosis).

The first eclamptic fit is usually self-limiting.

Control of blood pressure is essential in the management of severe pre-eclampsia or eclampsia where high blood pressure may cause a cerebrovascular accident (stroke). Magnesium sulphate is essential for preventing eclampsia and, if eclampsia occurs, for preventing further fits.
<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Signs</th>
<th>Results of investigations</th>
<th>Diagnosis</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>None unless very severe</td>
<td>Blood pressure ≥ 140/90 mmHg before 20 weeks’ gestation</td>
<td>Urine for protein negative Renal function tests normal</td>
<td>Essential hypertension</td>
<td>Consider antihypertensive drugs</td>
</tr>
<tr>
<td>None unless very severe</td>
<td>Blood pressure ≥ 140/90 mmHg before 20 weeks’ gestation</td>
<td>Proteinuria ≥ 2+</td>
<td>Hypertension secondary to other disease such as renal impairment, or autoimmune disease</td>
<td>Treat hypertension with drugs if severe, and treat the underlying condition</td>
</tr>
<tr>
<td>None unless very severe</td>
<td>Blood pressure ≥ 140/90 mmHg after 20 weeks’ gestation</td>
<td>No proteinuria</td>
<td>Pregnancy-induced hypertension</td>
<td>Treat hypertension with drugs if severe</td>
</tr>
<tr>
<td>None unless very severe</td>
<td>Blood pressure ≥ 140/90 mmHg before 20 weeks’ gestation</td>
<td>Proteinuria ≥ 2+</td>
<td>Mild to moderate pre-eclampsia</td>
<td>Avoid work involving heavy labour</td>
</tr>
<tr>
<td>Headaches increasing in frequency and unrelieved by paracetamol Visual disturbance Upper abdominal pain Shortness of breath Passing small amounts of urine Oedema</td>
<td>Blood pressure ≥ 140/90 mmHg before 20 weeks’ gestation Hyper-reflexia Passing less than 400 mL of urine in 24 hours Pulmonary oedema Facial and rapidly developing oedema</td>
<td>Proteinuria ≥ 2+</td>
<td>Severe pre-eclampsia</td>
<td>Urgent admission to hospital Magnesium sulphate</td>
</tr>
<tr>
<td>May be history of the above Generalised convulsions Unconscious</td>
<td>Generalised fitting Coma Blood pressure ≥ 140/90 mmHg after 20 weeks’ gestation Facial and rapidly developing oedema</td>
<td>Proteinuria ≥ 2+</td>
<td>Eclampsia</td>
<td>ABC Magnesium sulphate</td>
</tr>
<tr>
<td>Difficulty opening mouth and swallowing</td>
<td>Spasms of the face, neck and trunk Arched back Board-like abdomen</td>
<td></td>
<td>Tetanus</td>
<td>ABC, Penicillin, anti-tetanus immunoglobulin Muscle relaxants (magnesium and/or diazepam) Nasogastric feeding</td>
</tr>
<tr>
<td>Past history of convulsions</td>
<td>Convulsions Coma Normal blood pressure EEG abnormal</td>
<td></td>
<td>Epilepsy</td>
<td>ABC, blood glucose Anticonvulsant drugs</td>
</tr>
<tr>
<td>Chills/rigors Headache Muscle/joint pain</td>
<td>Fever Convulsions Coma Severe anaemia Jaundice</td>
<td>Blood smear for malarial parasites</td>
<td>Severe malaria</td>
<td>ABC, blood glucose Antimalarial drugs</td>
</tr>
<tr>
<td>Headache Stiff neck Photophobia Vomiting</td>
<td>Fever Stiff neck Reduced conscious level or coma Convulsions</td>
<td>Full blood count Blood culture Lumbar puncture (unless there is evidence of raised intracranial pressure)</td>
<td>Meningitis or encephalitis</td>
<td>ABC Antibacterial or antiviral drugs</td>
</tr>
<tr>
<td>Headache Blurred vision Photophobia History of migraine</td>
<td>Normal blood pressure</td>
<td>No proteinuria</td>
<td>Migraine</td>
<td>Paracetamol Bed rest in dark room</td>
</tr>
</tbody>
</table>
Maternal complications of severe pre-eclampsia

These include the following:
- eclampsia
- cerebrovascular accident (stroke)
- renal failure
- HELLP syndrome, possible leading to rupture of the liver capsule
- pulmonary oedema
- placental abruption, possibly leading to DIC
- intrauterine growth restriction, fetal death.

Primary assessment, resuscitation and emergency treatment of convulsions in eclampsia

Call for help
- Never leave the patient alone.
- Prevent maternal injury during the convulsion.

Airway
- If the airway is not open, use an airway-opening manoeuvre and keep it open. Consider an airway adjunct such as an oropharyngeal airway or intubation. Do not attempt to insert an oropharyngeal airway while the patient is convulsing.

- The oropharynx may need gentle suctioning under direct vision, being careful to avoid inducing laryngospasm.
- The recovery position should be adopted to minimise the risk of aspiration of vomit.

Breathing
- If there is spontaneous breathing, give a high concentration of oxygen via a face mask plus reservoir. Give 100% oxygen (mask with reservoir and a flow rate of at least 5 litres/minute) regardless of the mother’s oxygen saturation (this increases fetal oxygen delivery as well as improving maternal tissue oxygenation).

- Treat hypertension if systolic BP ≥ 170 mmHg or diastolic BP ≥ 110 mmHg
  - Aim to reduce BP to around 140/90–140/100 mmHg
  - Beware treatment-related maternal hypotension

- Hydralazine: 5 mg IV slowly
  - Repeated doses of 5 mg IV 15 minutes apart may be given if necessary. If heart rate > 120 beats/minute do not give hydralazine, but use labetolol

- Labetolol: 10 mg IV slowly and repeat after 10–20 minutes or start IV infusion 20 mg/hour increasing dose at 30-minute intervals up to maximum of 160 mg/hour
  - If IV access is not available give 100 mg orally and transfer

- Magnesium sulphate
  - In poorly resourced settings
    - Loading dose: MgSO4 5 g in 10 mL by deep intramuscular injection in each buttock. Thus total dose given = 10 grams in hospital also add 4 g IV over 20 minutes
    - Maintenance dose: MgSO4 5 g IM 4-hourly using alternate buttocks

  - In well-resourced settings
    - Loading dose: MgSO4 4 g IV over 20 minutes
    - Maintenance dose: MgSO4 1 g per hour infusion

  - If seizures continue or recur MgSO4 2 g IV over 5–10 minutes or IM
  - If this fails: diazepam 2 mg IV every 2 minutes to maximum total of 10 mg IV

  - Stop MgSO4 if:
    - respiratory rate < 16 breaths/minute
    - OR if SaO2 < 90%
    - OR if urine output < 100 mL in 4 hours
    - Antidote: 10% calcium gluconate 10 mL IV over 10 minutes

  - If seizures continue or recur MgSO4 2 g IV over 5–10 minutes or IM
  - If this fails: diazepam 2 mg IV every 2 minutes to maximum total of 10 mg IV

- **FIGURE 2.5.E.4** Pathway of care for eclampsia when the mother is having convulsions.

- **FIGURE 2.5.E.5** The recovery position.
Circulation

- Look for signs of life (breathing, movement, gagging/coughing) or for a pulse at the carotid. If these are absent or you are not sure, initiate CPR (see Sections 1.12 and 1.13).
- If the mother is over 20 weeks’ gestation, put her in the left lateral tilt position and/or manually displace the uterus to reduce vena caval compression, or put her in the recovery position.
- Secure IV or intra-osseous access.
- Monitor the blood pressure.
- Attach a pulse oximeter.
- Insert a urinary catheter with strict fluid input/output chart.
- Insert a 14G or 16G IV cannula and take 20 mL of blood for full blood count, blood group, cross-matching (4 units = 2 litres) and clotting. Do a 20-minute whole blood clotting time (WBCT20) test if laboratory analyses are not available (see Section 7.5).

A central venous pressure (CVP) line may be a helpful monitor to avoid fluid overload, but the benefits must be weighed against the risks. If disseminated intravascular coagulation (DIC) is established, CVP insertion is more hazardous (you must avoid subclavian vein access).

Emergency drug treatment of eclampsia

Stopping the convulsion and preventing further convulsions

The majority of seizures are self-limiting.

Commence magnesium sulphate to prevent further fits.

Magnesium sulphate \( (\text{MgSO}_4) \) treatment

Magnesium sulphate is the anticonvulsant of choice. If the mother is conscious, warn her that there will be a feeling of warmth passing through her body when magnesium sulphate is infused, and that this is not harmful. Failure to do so may result in the mother pulling out her IV cannula, and other potentially dangerous reactions.

Loading dose in well-resourced settings

Give 4 grams of MgSO\(_4\) as 20 mL of a 20% solution of magnesium sulphate IV added to 80 mL of 5% dextrose solution slowly over 20 minutes (total volume 100 mL). (To make 20 mL of a 20% solution, add 8 mL of 50% MgSO\(_4\) solution to 12 mL of sterile water.)

If convulsions recur after completion of the loading regime, give 2 grams of MgSO\(_4\) IV slowly over 10 minutes (10 mL of 20% solution is added to 90 mL of Ringer-lactate or Hartmann’s solution).

Do not use the same IV line to inject other drugs if MgSO\(_4\) is being given by IV infusion.

Loading dose in resource-limited settings

Give 5 grams of MgSO\(_4\) (10 mL of 50% solution) by deep intramuscular injection in each buttock. Thus the total dose given is 10 grams. (Sometimes 0.5 mL of 2% or 1 mL of 1% lignocaine is given in the same syringe for each injection of 5 grams, to reduce the pain of the injections.) An aseptic technique is essential.

Maintenance dosage

- Well-resourced countries: Provided that there is close monitoring (ideally with a burette in giving set), give 1 gram of MgSO\(_4\)/hour IV for 24 hours (i.e. 25 mL/hour of the loading dose solution of 4 grams in 100 mL described above).
- Resource-limited countries: give 5 grams of MgSO\(_4\) IM 4-hourly (plus 1 mL of 1% lignocaine, or 0.5 mL of 2%, in the same syringe) using alternate buttocks.

Alternative regime

This regime is recommended in Asia where pregnant women are smaller than those in Africa and there are more resources.

Loading dose: Give 4 grams of MgSO\(_4\) as 20 mL of a 20% solution added to 80 mL of 5% dextrose solution slowly IV over 20 minutes (total 100 mL). (To make 20 mL of a 20% solution, add 8 mL of 50% MgSO\(_4\) solution to 12 mL of sterile water).

Then immediately give 3 grams (6 mL of 50% solution) by deep intramuscular injection in each buttock. (Sometimes 1 mL of 1% or 0.5 mL of 2% lignocaine is given in the same syringe, to reduce the pain of the injections.)

Maintenance dose

Give 2.5 grams of MgSO\(_4\) IM every 4 hours using alternate buttocks.

Treatment if seizures continue or recur

Give 2 grams of MgSO\(_4\) if body weight is less than 70 kg, or 4 grams if body weight is over 70 kg, as an extra loading dose IV over 5–10 minutes or IM in low-resource settings.

Alternative regime

This regime is undertaken in some West African countries, and was recommended by the World Health Organization in 2003.

Loading dose: 4 grams IV of MgSO\(_4\) over 20 minutes: add 8 mL 50% to 92 mL Ringer-lactate or Hartmann’s solution. This is followed by 10 grams 50% MgSO\(_4\) solution IM (6 grams in each buttock: deep IM injections with lidocaine as above in the same syringe). Ensure that the needle is not in a vein.

Maintenance dose: This is 5 grams MgSO\(_4\) 50% solution with lidocaine every 4 hours into alternate buttocks.

If eclampsia recurs, and only after 15 minutes, give 2 grams of MgSO\(_4\) over 5 minutes IV: add 4 mL of 50% to 16 mL of Ringer-lactate or Hartmann’s solution.

Continued treatment with magnesium sulphate

Continue MgSO\(_4\) for 24 hours after delivery or the last convulsion, provided that:

- respiratory rate is > 12–16 breaths/minute
- urine output is > 30 mL/hour (WHO figure is > 100 mL over 4 hours)
- tendon reflexes are present.

Discontinue magnesium sulphate when:
respiratory arrest. can cause severe hypotension, cardiac arrhythmias or

Twice a day can be given. IV injection if given too rapidly

Slow IV injection. Subsequently a dose of 100 mg orally

15 mg/kg (maximum dose 2 grams) over 20 minutes by

Gravins, magnesium sulphate is contraindicated and, if

Normal respiration and reflexes have returned.

The magnesium sulphate infusion may be recommenced

If respiratory depression develops, give 100% oxygen by

Face mask with reservoir, and give calcium gluconate 1 gram

(= 10 mL of 10% solution) IV slowly over 1–2 minutes. Too rapid administration can result in loss of consciousness, cardiac arrhythmias and cardiac arrest.

If respiratory arrest occurs:

Give chest inflations with bag-valve-mask ventilation with 100% oxygen

Inject calcium gluconate 1 gram (10 mL of 10%) IV slowly over 5 minutes.

The magnesium sulphate infusion may be recommenced at a reduced dose, if this is considered necessary, once normal respiration and reflexes have returned.

Note for anaesthetists: there is an increased sensitivity to muscle relaxants (particularly non-depolarising agents) in patients on magnesium.

In patients with known renal disease or myasthenia gravis, magnesium sulphate is contraindicated and, if available, phenytoin should be used. The loading dose is 15 mg/kg (maximum dose 2 grams) over 20 minutes by slow IV injection. Subsequently a dose of 100 mg orally twice a day can be given. IV injection if given too rapidly can cause severe hypotension, cardiac arrhythmias or respiratory arrest.

Other indications for magnesium sulphate treatment where eclampsia has not yet occurred include the following:

Persistent hypertension despite adequate antihypertensive drugs and good fluid management

Evidence of thrombocytopenia or liver dysfunction if these can be measured.

The same regimen of magnesium sulphate (or diazepam if magnesium sulphate is not available) is used for prophylaxis as described above for the treatment of eclampsia. A loading dose alone may be sufficient.

Diazepam

A bag-valve-mask must be immediately available in case the patient stops breathing.

Loading dose: diazepam 2 mg increments IV every 2 minutes up to 10 mg.

If convulsions recur, repeat the loading dose.

Maintenance dose: diazepam 40 mg in 500 mL of Ringer-lactate or Hartmann’s solution, titrated to keep the mother sedated but able to be woken and without hypoventilation.

Maternal respiratory depression may occur when the dose exceeds 30 mg in 1 hour. Assist ventilation (e.g. bag-valve-mask, anaesthesia apparatus, intubation) if necessary, and do not give more than 100 mg in 24 hours.

Rectal administration: give diazepam rectally when IV access is not possible. The loading dose is 20 mg in a 10-mL syringe. Remove the needle, lubricate the barrel and insert the syringe into the rectum to half its length. Discharge the contents and leave the syringe in place, holding the buttocks together for 10 minutes to prevent expulsion of the drug. Alternatively, the drug may be instilled in the rectum through a catheter.

If convulsions are not controlled within 10 minutes, administer an additional 10 mg per hour or more, depending on the size of the woman and her clinical response.

Be prepared for neonatal resuscitation when diazepam has been administered, especially if it was used in large doses.

Severe pre-eclampsia

Stage 1: Prevention of fitting

If there are significantly increased tendon reflexes, often also with ankle clonus, before delivery or afterwards, and the patient shows other signs of impending eclampsia (e.g. confusion, jittersness, severe headache), prophylactic “anti-convulsant” therapy (magnesium sulphate where possible) should be commenced.

Other indications for magnesium sulphate treatment where eclampsia has not yet occurred include the following:

Persistent hypertension despite adequate antihypertensive drugs and good fluid management

Evidence of thrombocytopenia or liver dysfunction if these can be measured.

The same regimen of magnesium sulphate (or diazepam if magnesium sulphate is not available) is used for prophylaxis as described above for the treatment of eclampsia. A loading dose alone may be sufficient.
Stage 2: Reduction of blood pressure and expansion of intravascular volume
Hypertension should be treated if the blood pressure is ≥ 170/110 mmHg as described above. Careful fetal monitoring during the commencement of treatment is vital, as a rapid fall in maternal blood pressure may cause fetal heart rate abnormalities, especially in a growth-restricted or compromised fetus.

If the gestation is less than 36 weeks, dexamethasone or betamethasone 12 mg IM in two doses 24 hours apart should be given to improve fetal lung maturity and decrease the risk of neonatal respiratory failure, if time allows.

Antihypertensive drugs

Volume expansion during antihypertensive treatment
Antihypertensive agents such as nifedipine and hydralazine act as vasodilators. In pre-eclampsia where intravascular volume is reduced, a small volume load should be given immediately prior to IV antihypertensive treatment (300 mL of Ringer-lactate or Hartmann’s solution IV over 20 minutes). Colloid or starch, such as Haemaccel (500 mL), which remains for longer in the intravascular compartment, may be helpful. Clinical examination for signs of cardiac failure (see Section 2.7.A) should be sought before and after such treatment.

Stage 3: Anticipate and/or manage complications
Airway and breathing
- Keep the airway clear.
- The respiratory rate should be recorded regularly (ideally it should be 15–40 breaths/minute).
- Beware of over-sedation, aspiration, pulmonary oedema and laryngeal oedema (which presents with stridor).
- If the respiratory rate is less than 12–15 breaths/minute, particularly if the mother is receiving magnesium sulphate or opiates for pain control, action should be taken and other signs of toxicity sought (see above).
  - If an opiate is being used, naloxone may be required.
  - If magnesium sulphate is being given, stop this and give calcium gluconate (see above).
- Oxygen can be given using nasal cannulae (ideally with 
  \( \text{SaO}_2 \) monitoring): if 
  \( \text{SaO}_2 \) is less than 94%. Keep 
  \( \text{SaO}_2 \) in the range 94–98%.
- Arrange for a chest X-ray if aspiration is suspected.
- An increased respiratory rate is an early sign of pulmonary oedema.

Circulation
Consider fluid balance/fluid overload
(uria in catheterisation is important).
Usually there is net fluid overload in pre-eclampsia, but the fluid has leaked out of the intravascular compartment due to low oncotic pressure (partly due to hypoalbuminaemia) and increased capillary permeability.

Complications of excessive fluid in the wrong compartment include cerebral oedema, pulmonary oedema and laryngeal oedema (stridor).
Renal failure may develop secondary to the hypertension or to intravascular hypovolaemia (or as a primary injury in severe pre-eclampsia).

Keep IV fluids at a rate of less than 100 mL/hour or less than 1 mL/kg per hour (the World Health Organization suggests a rate of less than 1 litre in 6–8 hours). Fluid restriction should be maintained until there is postpartum diuresis, which is easy to recognise as there is usually oliguria in severe pre-eclampsia. If there is APH or PPH, fluid restriction will probably not be appropriate.

- Insert an indwelling urinary catheter, and keep a strict intake–output chart with hourly running totals. The total maintenance fluid intake should not exceed 1.5–2 litres over 24 hours. If the average urine output is less than 30 mL/hour over a period of 4 hours this is usually due to the decreased intravascular volume, and will respond to a bolus of 200 mL of IV Ringer-lactate or Hartmann’s solution, which can be repeated if necessary.
- In the presence of over-hydration, particularly with heart failure or renal impairment, furosemide 20–40 mg IV should be given. Mannitol is not advisable because of the fluid load that results from its administration, and because of its rebound effects.
- Beware of cardiac arrhythmias. Ideally monitor potassium levels regularly and ECG continuously.
- Magnesium sulphate is renally excreted, so careful observation for magnesium toxicity is required if there is oliguria.
- Fluid infusion equal to the same quantity as the urinary output in the preceding hour plus 30 mL is a useful guide to IV fluid administration.
- Central venous pressure (CVP) monitoring may be useful to guide management, especially if urine output is low. (Keep the CVP at up to + 6 cmH2O in a spontaneously breathing patient.)

Additional organ involvement
Neurological complications
These include cerebrovascular accidents and cerebral oedema.

Undertake regular (2-hourly) neurological examination (including pupillary and tendon reflexes) and record the AVPU and/or Glasgow Coma Scale (GCS) scores. All patients should be able to open their eyes to stimulus, obey commands and respond to questions about their name and age. If not, they are over-sedated or may be developing cerebral complications.

The GCS Scale has three components, with a maximum possible score of 15:

<table>
<thead>
<tr>
<th>E</th>
<th>Eye-opening response (E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Spontaneous</td>
</tr>
<tr>
<td>3</td>
<td>To speech</td>
</tr>
<tr>
<td>2</td>
<td>To pain</td>
</tr>
<tr>
<td>1</td>
<td>None</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>M</th>
<th>Best motor response (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Obeys command</td>
</tr>
<tr>
<td>5</td>
<td>Localises to pain stimulus</td>
</tr>
<tr>
<td>4</td>
<td>Withdraws</td>
</tr>
<tr>
<td>3</td>
<td>Abnormal flexion/decorticate posture</td>
</tr>
<tr>
<td>2</td>
<td>Extensor response/decerebrate posture</td>
</tr>
<tr>
<td>1</td>
<td>No movement</td>
</tr>
</tbody>
</table>

*Note: The GCS Scale has three components, with a maximum possible score of 15.*
Sulphate with or without other anticonvulsants may require magnesium sulphate can help to prevent this. Mannitol is not indicated. Recurrent convulsions despite magnesium sulphate occurs in the parietal cortical areas, and is a result of cerebral vasospasm.

Meninges are not protected by pharyngeal and/or laryngeal reflexes. The HELLP syndrome (Haemolysis, Elevated Liver enzymes, Low Platelet counts) syndrome is a dangerous form of severe pre-eclampsia.

### Haematological complications

These include disseminated intravascular coagulation (DIC).

- Group and save and cross-match fresh blood.
- Check the full blood count (including a platelet count if possible).
- Do a whole blood clotting test as well as APTT (if available) (see Section 7.5). Failure of a clot to form after 7 minutes, or formation of a soft clot that breaks down easily, suggests coagulopathy.
- If the platelet count is > 100 000 × 10⁹, a major coagulation problem is unlikely. Spontaneous haemorrhage may occur with counts below 10 000 × 10⁹.
- In frank DIC, give whole fresh blood if there is bleeding.

### Hepatic complications

These include jaundice, bleeding tendency, hepatic failure, hepatic sub-capular oedema or hepatic rupture (the last two cause right upper quadrant or epigastric pain). Delivery of the baby is urgent.

### Fetal problems

These include intrauterine growth retardation, fetal distress in labour, preterm delivery as a result of obstetric intervention, fetal death due to placental abruption or fetal asphyxia in labour.

### General nursing care

- Airway and breathing management should be undertaken as appropriate. This includes ensuring that SaO₂ remains normal at ≥ 94%.
- Maintain the patient in the lateral tilt or recovery position at all times before delivery.
- Indwelling aseptically placed urinary catheter and hourly urine output measurement.
- Care of eyes and oral hygiene.

### The HELLP syndrome (Haemolysis, Elevated Liver enzymes, Low Platelet counts) syndrome is a dangerous form of severe pre-eclampsia.

- If the platelet count is < 50 000 × 10⁹ there is a high risk of bleeding, and if bleeding occurs in the absence of platelet transfusions, fresh blood may be helpful.
- Liver dysfunction may cause upper abdominal pain, and lowering of the blood pressure may be helpful.
- Delivery is urgent.

### Stage 4: Delivery of the baby

The need for in-utero transfer should be considered, particularly if there are maternal complications that are likely to require a Caesarean section or high-dependency care. The need for delivery is dependent on the maternal and fetal conditions. Either Caesarean section or induction of labour may be appropriate, depending on the clinical findings. Although delivery will resolve the disease, it is inappropriate to deliver an unstable mother, even if there is fetal distress. Once eclamptic seizures have been controlled, severe hypertension has been treated and any hypoxaemia corrected, delivery can be expedited.

In severe pre-eclampsia, aim to deliver within 24 hours of the onset of symptoms. In eclampsia, aim to deliver within 12 hours of the onset of convulsions.

It is important to stabilise the mother’s condition first. Then decide about the mode of delivery.

In selected patients, labour may be induced if the following conditions apply:

- the cervix is favourable
- the maternal condition is stable (i.e. eclampsia and blood pressure are controlled), there is no fetal distress and there is a cephalic presentation.

### Assessment of the cervix

- If the cervix is favourable (i.e. soft, thin and partly dilated), rupture the membranes with an amniotic hook or a Kocher’s forceps, and induce labour using an oxytocin infusion (see Section 2.3) or oral misoprostol (see Section 2.3 and below).

- If vaginal delivery is not anticipated within 12 hours (for eclampsia) or within 24 hours (for severe pre-eclampsia), deliver by Caesarean section.

- If there are fetal heart rate abnormalities (< 110 beats/minute or > 160 beats/minute), consider Caesarean section if this is safe for the mother.

- If the cervix is unfavourable (i.e. firm, thick and closed) and the fetus is alive, deliver by Caesarean section if the mother is adequately resuscitated.

- If there are no facilities for Caesarean section or if the fetus is dead or too premature for survival, deliver vaginally.

### Aiming for vaginal delivery

If the cervix is unfavourable (i.e. firm, thick and closed) and the fetus is alive, Caesarean section should be performed. If the fetus is dead, consideration should be given to induction of labour using misoprostol (unless there has been a previous Caesarean section, in which case misoprostol is contraindicated).

There are many possible misoprostol regimens for induction of labour (vaginal misoprostol tablet, oral misoprostol solution or oral misoprostol tablet). Each has been widely used. The latest evidence is that oral misoprostol solution is the most appropriate treatment (Cochrane reviews).

### Oral misoprostol solution

A single misoprostol tablet is dissolved in drinking water (a 200-microgram tablet in 200 mL of water or a 100-microgram tablet in 100 mL of water), and 20–25 mL of misoprostol solution (20–25 micrograms) are then given every 2 hours. The solution is stable for up to 24 hours at room temperature, but should then be discarded.

### Oral misoprostol tablets

Oral misoprostol tablets: 100-microgram misoprostol tablets are cut to 25 micrograms size and administered orally every 2 hours up to a maximum of six doses. However,
this may not be very accurate, so there is a danger of giving an incorrect dosage. The solution described above is much safer.

Caesarean section

If Caesarean section is performed, ensure that coagulopathy has been treated. Ensure that fresh blood for transfusion is available.

Spinal anaesthesia is usually safer than general anaesthesia for Caesarean section, unless there is a contraindication (e.g. maternal refusal, coagulopathy, thrombocytopenia, decreased conscious level, ongoing seizures). There does not appear to be an exaggerated decrease in blood pressure after spinal anaesthesia, and vasopressors (e.g. ephedrine) should be used cautiously in order to avoid a hypertensive response. An IV bolus of 500 mL of Ringer-lactate or Hartmann's solution may occasionally be required if the blood pressure does fall.

The use of general anaesthesia in severe pre-eclampsia or eclampsia is very hazardous. There may be laryngeal oedema, which makes airway management difficult, and increases in blood pressure during intubation and extubation, with an increased risk of intracranial haemorrhage. Drugs to weaken the vasopressor response to intubation should be used.

Local anaesthesia or ketamine in women with pre-eclampsia or eclampsia are contraindicated unless facilities and/or expertise dictate that these are the safest options in a given situation.

Stage 5: Management after delivery

- If the patient is post-eclampsia or at high risk of convulsions, continue to administer parenteral anticonvulsants (i.e. magnesium sulphate, or diazepam if magnesium sulphate is not available) for 24 hours after the birth. Continue for as long as the patient has increased ten-don reflexes.
- Do not give ergometrine to women with pre-eclampsia, eclampsia or high blood pressure, because it increases the risk of convulsions and cerebrovascular accidents.
- Monitor the mother closely.
- Use antihypertensive agents if the diastolic blood pressure is > 105–110 mmHg or the systolic blood pressure is > 160 mmHg.
- Continue oxytocin infusion to keep the uterus contracted.
- Syntometrine (which contains ergometrine, and can cause or worsen hypertension) is contraindicated. Give oxytocin alone or with misoprostol, and avoid the possible hypertensive effects of ergometrine. If postpartum haemorrhage occurs, this should be managed as described in Section 2.5.D.iv.
- Keep the mother in the delivery unit or close observation area for at least 24 hours after the last fit.
- Review the need for further anticonvulsants and anti-hypertensive drugs.
- Regular monitoring is essential.
- It is not uncommon for the blood pressure to drop transiently following delivery only to rise again after 24 to 48 hours. Patients with severe pre-eclampsia and eclampsia should be monitored as in-patients for 72 hours after delivery so that dangerous post-partum rises in BP can be detected and treated.
- Women and their families should also be warned about the use of the left lateral tilt position prior to delivery, the use of the recovery position after convulsions, the risk of aspiration of food, and care of the IV site.
- Before the mother goes home, the family and attendants should be warned about the risk of postnatal depression, especially if the outcome has been poor. The woman or girl should be followed up closely in the community.
- In women with severe pre-eclampsia/eclampsia a plan should be made to monitor the BP in the post-partum period, even in women who are not discharged on antihypertensive medication. This is because the BP is commonly labile during this period. One or ideally two checks (or more if the BP is poorly controlled) should be advised over the first 2 weeks following delivery. This may be done at a clinic local to the patient’s residence, but may require that the patient stay in or near the hospital if no facilities exist close to her home.
- Charts for vital signs and fluid balance

### BOX 2.5.E.2 Emergency box for eclampsia

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drugs</td>
<td></td>
</tr>
<tr>
<td>Magnesium sulphate 50%, 5 g in 10-mL ampoule</td>
<td>× 10 ampoules</td>
</tr>
<tr>
<td>Calcium gluconate 10%, 10-mL ampoule</td>
<td>× 2 ampoules</td>
</tr>
<tr>
<td>Hydralazine, 20 mg in 1-mL ampoule</td>
<td>× 2 ampoules</td>
</tr>
<tr>
<td>Labetalol, 200 mg in 20-mL ampoule</td>
<td>× 1 ampoule</td>
</tr>
<tr>
<td>0.9% Sodium chloride, 10-mL ampoule</td>
<td>× 10 ampoules</td>
</tr>
<tr>
<td>Diazepam, 5 mg/mL ampoules</td>
<td>× 20</td>
</tr>
<tr>
<td>Intravenous fluids</td>
<td></td>
</tr>
<tr>
<td>Hartmann’s solution</td>
<td>× 1</td>
</tr>
<tr>
<td>Giving set</td>
<td>× 1</td>
</tr>
<tr>
<td>IV blood giving set</td>
<td>× 1</td>
</tr>
<tr>
<td>Venous access</td>
<td></td>
</tr>
<tr>
<td>20-gauge cannula (pink)</td>
<td>× 2</td>
</tr>
<tr>
<td>18-gauge cannula (green)</td>
<td>× 2</td>
</tr>
<tr>
<td>16-gauge cannula (grey)</td>
<td>× 2</td>
</tr>
<tr>
<td>Tourniquet</td>
<td>× 1</td>
</tr>
<tr>
<td>Fixation tape</td>
<td>× 1 roll</td>
</tr>
<tr>
<td>Airway equipment</td>
<td></td>
</tr>
<tr>
<td>Guedel airways: sizes 4, 3 and 2</td>
<td></td>
</tr>
<tr>
<td>Self-inflating bag-mask-valve</td>
<td></td>
</tr>
<tr>
<td>Green oxygen tubing (2 metres) and high and medium concentration (MC) facemasks for oxygen delivery</td>
<td></td>
</tr>
<tr>
<td>Yankauer sucker</td>
<td></td>
</tr>
<tr>
<td>Other equipment</td>
<td></td>
</tr>
<tr>
<td>50-mL syringe</td>
<td>× 2</td>
</tr>
<tr>
<td>20-mL syringe</td>
<td>× 2</td>
</tr>
<tr>
<td>10-mL syringe</td>
<td>× 2</td>
</tr>
<tr>
<td>Green needles</td>
<td>× 2</td>
</tr>
<tr>
<td>Patella hammer</td>
<td>× 1</td>
</tr>
<tr>
<td>Urinary catheter</td>
<td></td>
</tr>
<tr>
<td>Charts for vital signs and fluid balance</td>
<td></td>
</tr>
</tbody>
</table>
the symptoms of severe pre-eclampsia and advised that although delivery does usually resolve the disease, it can still worsen suddenly in the first 2 weeks following delivery (rarely up to 6 weeks).

- Antenatal care provided by the hospital during a future pregnancy is important. There is an increased risk of pre-eclampsia and hypertension if these problems have been present before.
- All patients are at risk of deep vein thrombosis (DVT), so close observation and appropriate treatment if DVT is identified are important (see Section 2.5.H). Anti-embolism stockings and low-molecular-weight heparin (or unfractionated heparin if the former is not available) prophylaxis should be considered early on.

Hypertension may take from many days to up to 3 months to resolve. Resolution will occur if the diagnosis is pre-eclampsia, unless there is an underlying medical cause.

### Monitoring and preparation for emergencies
- Measure pulse rate and volume, blood pressure, respiratory rate and oxygen saturation regularly. A minimum of hourly if receiving MgSO₄ and more often if unstable.
- Monitor fluid intake and urinary output hourly.
- Monitor AVPU and GCS scores, reflexes and pupil responses hourly.
- Monitor the mother for confusion and visual disturbance.
- Monitor the fetus regularly.
- Record all drugs used.

Each maternity unit should have an emergency box to ensure that appropriate equipment and drugs are readily available.

## 2.5.F Prolonged and obstructed labour, uterine rupture and shoulder dystocia

### Prolonged and obstructed labour

It helps to reduce prolongation of labour if mothers in labour are allowed to sit upright, or in a lateral or semi-upright position, *never flat on their backs*. They should be encouraged to stand, and be mobile in the first stage of labour for as long as is comfortably possible. The benefits of this include the assistance of gravity in the descent of the baby, the avoidance of pressure on the inferior vena cava (IVC), with all of the effects of compression on the circulatory dynamics, and possibly a reduction in the pain of contractions.

### Recognition of prolonged or obstructed labour and early referral

Remember the three P’s: Power (too little), Passenger (too big) and Passage (too small).

### Prevention of prolonged labour

- Good antenatal care is essential, so that the presentation of the fetus is known (and ideally confirmed by ultrasound examination) before the onset of labour. If the presentation is abnormal, the mother must be transferred to hospital as soon as she goes into labour.
- Use of the modified WHO partograph.
- Optimal nutritional state in the mother.
- Absence of anaemia in the mother.
- Adequate fluids and glucose during labour.
- Ensuring adequate bladder emptying.
- Emotional support.

### Risks associated with slow progress in labour

**For the mother these include the following:**

- Infection
- Uterine rupture
- Fistulae
- Death.

**For the baby they include the following:**

- Infection
- Insufficient oxygen supply to the brain and traumatic injury
- Stillbirth
- Neonatal death
- Permanent brain damage.

---

![Figure 2.5.F.1](image1)
**Figure 2.5.F.1** Cervical dilatation over time.

![Figure 2.5.F.2](image2)
**Figure 2.5.F.2** Obstruction of the fetal head’s descent.
Main causes of slow progress in labour

These include the following:
1. Poor-quality uterine contractions
2. Malpresentations and malpositions
3. Disproportion between the size of the baby and the size of the pelvis; it is important to exclude causes (1) and (2) before diagnosing this.

All three of these causes require urgent transfer to hospital.

Bandl’s ring

The presence of a Bandl’s ring may be one sign that is seen in obstructed labour. It is often a late sign.

A Bandl’s ring is a depression between the thickened upper segment and the thinned lower segment. A distended bladder sometimes forms a third swelling.

Moulding of the fetal head

Moulding refers to the overriding of the fetal skull bones that may occur during labour. Moulding should be assessed at the sagittal suture (not the lambdoid). During descent of the fetal head, the fetal skull bones move closer together. Moulding is described in three stages. The first stage (+) occurs when the bones touch, the second stage (2+) occurs when the bones overlap but are reducible, and the third stage (3+) is irreversible overlapping of the bones. Moulding, especially 3+, may suggest cephalo-pelvic disproportion, and should be looked at in conjunction with other clinical signs of obstructed labour.

Partogram in obstructed labour

Figure 2.5.F.4 shows the partogram for Mrs H, a mother who was admitted in active labour at 10 am.

- The fetal head is 3/5 palpable.
- The cervix is dilated to 4 cm.
- Three contractions occur in 10 minutes, each lasting for 20–40 seconds.
- Clear amniotic fluid is draining.
- There is fetal head moulding.

At 2 pm:
- The fetal head is still 3/5 palpable.
- The cervix is dilated to 6 cm and to the right of the alert line.
- There is a slight improvement in contractions (three in 10 minutes, each lasting for 40 seconds).
- There is second-degree moulding.

At 5 pm:
- The fetal head is still 3/5 palpable.
- The cervix is still dilated to 6 cm.
- There is third-degree moulding.
- The fetal heart rate 92 beats/minute.

Caesarean section was performed at 5.30 pm.

Note: The partogram for Mrs H is characteristic of obstructed labour. There is arrest of cervical dilatation in the active phase of labour, with no descent of the fetal head.

The presence of meconium and a falling fetal heart rate suggest fetal distress. All of these features, plus moulding of the fetal skull bones, point to cephalo-pelvic disproportion.

Oxytocin was rightly withheld, as Mrs H was multiparous, and this drug would therefore have increased the risk of uterine rupture in this patient.
Diagnostic issues in obstructed labour

The mother
- The patient may be dehydrated, tachycardic, ketogenic (urine positive for ketone bodies, breath smells of ketones), febrile and exhausted, and there may be infected vaginal secretions.
- The bladder may be distended with retained urine, or it may be oedematous.
- Abdominal examination may reveal haemoperitoneum from a ruptured uterus. Blood may not appear vaginally, due to the impacted fetal head, which should be dislodged upwards to allow full assessment. If a ruptured uterus is suspected, a laparotomy should be performed (see below).
- Abdominal examination may reveal distended bowel from sepsis and ileus.

The fetus
- The lie and relationship of the fetus to the pelvis must be assessed.
- Despite visible caput at the introitus, 60% of the fetal head may still be palpable abdominally.

### TABLE 2.5.F.1 Diagnosis of unsatisfactory progress of labour

<table>
<thead>
<tr>
<th>False labour</th>
<th>Cervix not dilated</th>
</tr>
</thead>
<tbody>
<tr>
<td>No palpable contractions/infrequent contractions</td>
<td>Cervical dilatation to the right of the alert line on the partogram</td>
</tr>
<tr>
<td>Prolonged latent phase</td>
<td>Secondary arrest of cervical dilatation and descent of the presenting part in the presence of good contractions</td>
</tr>
<tr>
<td>Prolonged active phase</td>
<td>Secondary arrest of cervical dilatation and descent of the presenting part with large caput, third-degree moulding, cervix poorly applied to the presenting part, oedematous cervix, ballooning of the lower uterine segment, formation of a retraction band, and maternal and fetal distress</td>
</tr>
<tr>
<td>Cephalo-pelvic disproportion</td>
<td>Less than 3–4 contractions in 10 minutes, each lasting from less than 40 seconds to 1 minute, with 1 minute of relaxation between contractions</td>
</tr>
<tr>
<td>Inadequate uterine activity</td>
<td>Presentation other than vertex with occipito-anterior</td>
</tr>
<tr>
<td>Malpresentation</td>
<td>Cervix fully dilated and the woman has the urge to push, but there is no descent</td>
</tr>
<tr>
<td>Prolonged expulsive (second stage) phase</td>
<td></td>
</tr>
</tbody>
</table>
The cervix in the primigravida whose partogram is shown in
Figure 2.5.F.5 was 4 cm dilated on admission. Her contrac-
tions were ineffective at two in 10 minutes, decreasing to
one contraction in 10 minutes. Her membranes ruptured
3.5 hours later, but her cervix dilated only a further 2 cm in
4 hours, with no further dilatation in the subsequent 3 hours.
Fetal distress developed, with meconium and a falling fetal
heart rate. Caesarean section was performed. It would have
been advisable to start an oxytocin infusion at 13.30 hours,
or at least by 15.30 hours.

The primigravida whose partogram is shown in
Figure 2.5.F.6 started an oxytocin infusion at the time of
membrane rupture, which increased the effi  cacy of contrac-
tions. She progressed to a spontaneous vaginal delivery.
The fetal heart rate was satisfactory throughout.

Emergency treatment for obstructed
labour
Assess ABC and resuscitate if required.
- Place a wide-bore IV cannula (14- to 16G).
- Place the mother in the left lateral tilt or recovery position.
- Send blood for haemoglobin, grouping and cross-
matching, and electrolytes if possible.
- Give 1 litre IV of Ringer-lactate or Hartmann’s solution
containing 5% or 10% glucose over 1 hour as an infu-
sion, or as rapidly as possible if the patient is shocked.
Then reassess.
- Catheterise the patient to decompress the bladder,
measure urine output and look for haematuria.
- The presence of haematuria may suggest uterine
rupture.
- If there is concern about the viability of the vaginal
and bladder wall, the catheter may be kept in situ for
up to 6 weeks to prevent or minimise the formation
of a vesico-vaginal fistula.
- Give IV ampicillin (2 grams 6-hourly), gentamicin (80 mg
IV/IM 8-hourly or 5 mg/kg body weight IV/IM once
every 24 hours) and metronidazole (500 mg 8-hourly).
Cefuroxime (1.5 grams 8-hourly, if available) can be given
instead of ampicillin plus gentamicin.
- Measure the pulse rate, capillary refill time (CRT), blood
pressure, temperature and urine output frequently.
- If there has been recent food intake, or abdominal disten-
sion is present, the stomach should be emptied using a
nasogastric tube, and then 10 mL of magnesium trisilicate
oral suspension should be given to reduce the acidity of
the gastric contents.

Overcoming slow progress in labour
- If the cervix is fully dilated and there is cephalic presenta-
tion and no signs of obstruction, instrumental delivery
(ventouse or forceps) can avoid the need for Caesarean
section. However, if the cervix is fully dilated and there is
obstruction, instrumental delivery can make Caesarean
section very difficult by causing further impaction of the
fetal head.
- If the cervix is not fully dilated, in the primigravida with
cephalic presentation, give an oxytocin infusion.
- If the cervix is not fully dilated, with abnormal presenta-
tion, perform a Caesarean section.
- If there is a ruptured uterus, a laparotomy and Caesarean
hysterectomy must be performed.
Urgent referral is required if the above measures are not possible. Stabilise the mother’s ABC before transfer if necessary.

Reasons for fetal death in obstructed labour
- Strong contractions with inadequate relaxation between contractions (sometimes made worse by inappropriate use of oxytocin) interfere with placental exchange.
- Excessive moulding of the head, in cephalic presentation, leads to intracranial haemorrhage. In breech presentation, the head may be trapped by an incompletely dilated cervix, or may not enter the pelvis because of disproportion.
- Ascending infection, amnionitis and severe intrauterine infection caused by prolonged ruptured membranes and labour, and/or unsterile vaginal examinations.
- Ruptured uterus.

Risks of Caesarean section in obstructed labour
These include the following:
- intra-operative haemorrhage
- post-operative shock
- generalised peritonitis
- the hazards of general or regional anaesthesia
- rupture of the uterine scar in subsequent pregnancies

The management of uterine rupture in this setting depends on its site and extent. With a straightforward anterior rupture without extension, uterine repair (plus bilateral tubal ligation) may be most appropriate and safe.

If infection is present before a Caesarean section is performed, dangerous complications can follow. In one series of 107 Caesarean sections, performed in 156 patients with intrapartum infection, the following complications occurred:
- post-operative shock: 18 patients (17%)
- generalised peritonitis: 70 patients (65%)
- mortality: 13 patients (12%).

Rupture of the uterus
Complete rupture of the uterus is life-threatening to both mother and baby.

Causes
A previous Caesarean section scar may rupture during labour. However, obstructed labour, even without a uterine scar, particularly in a woman of high parity, may cause uterine rupture. It may be caused by inappropriate use of oxytocic drugs, especially in multiparous women, or in the presence of cephalo-pelvic disproportion. No woman who is receiving an oxytocin infusion should be left alone.

Ideally, always use a burette giving set to administer IV oxytocin to avoid dangerous over-dosage. In the absence of a burette, refer to the progressive oxytocin dosage, and use as described in Section 2.3, making sure to slow or stop once labour is well established.

Uterine rupture may be caused by violence or trauma during pregnancy, sometimes as a result of domestic violence (see Section 2.11).

Risk factors for uterine rupture
These include the following:
- malpresentation and malposition
- previous Caesarean section, especially if oxytocic agents

FIGURE 2.5.F8 Mechanism and anatomy of vaginal fistulae. The arrows show where this mother’s cervix, rectum and bladder are being pinched between the baby’s head and the mother’s spine and pubis. (a) The baby’s head can press the mother’s vagina and bladder against the symphysis pubis or the sacrum. This can make the tissues necrose (die) and cause a fistula. (b) The fistula can be in various places: 1, between the bladder and the vagina; 2, between the urethra and the vagina; 3, between the bladder and the cervix; 4, between the rectum and the vagina (recto-vaginal fistula); 5, between the vagina and the small gut. (c) A vesico-vaginal fistula. (d) A catheter has been placed in a recto-vaginal fistula.

FIGURE 2.5.F9 Bandl’s ring in obstructed labour. Uterine rupture may be imminent.
are used, or if a classical Caesarean section scar is present
- previous uterine surgery (e.g. myomectomy), or uterine perforation at the time of dilation and curettage (D&C) or manual removal of the placenta; this is often unrecognised
- the multiparous woman who has delivered normally before and has a significantly larger baby or a malposition in the current pregnancy, and is allowed a prolonged second stage.

**Symptoms and signs**

Uterine rupture usually presents with hypovolaemic shock, but vaginal bleeding can be concealed. The baby is usually dead.

Around 50% of ruptures occur at or near full dilatation.
- There is a change in the nature of the pain, from severe intermittent pain to a constant dull ache.
- Vaginal bleeding may or may not be present.
- There is maternal shock due to blood loss with or without vagal stimulation, as well as dehydration, exhaustion, and ketoacidosis in cases of prolonged obstructed labour.
- Abdominal distension occurs that is tender to palpation, and there is absence of a fetal heart rate.
- On vaginal examination, the presenting part may be high or impacted.
- Uterine rupture may be preceded by the appearance of Bandl’s ring (see Figure 2.5.F.9).

Suspect rupture in a patient with any of these risk factors.

**Primary assessment and resuscitation**

**Call for help, especially for a surgeon and an anaesthetist, as urgent laparotomy will be required.**

**Airway**

- If the airway is not open, use an airway-opening manoeuvre and keep it open. Consider an airway adjunct such as an oropharyngeal airway or intubation.
- The oropharynx may need gentle suctioning under direct vision, but be careful to avoid inducing laryngospasm.
- The recovery position should be adopted to minimise the risk of aspiration of vomit (see Figure 2.5.F.10).

**Breathing**

- If there is spontaneous breathing, give a high concentration of oxygen via a face mask with reservoir. Give 100% oxygen (mask with reservoir and flow rate of at least 6 litres/minute) regardless of the mother’s oxygen saturation. This increases fetal oxygen delivery as well as improving maternal tissue oxygenation.
- If the patient is apnoeic or hypoventilating, provide chest inflations with bag-valve-mask-reservoir ventilation and high-flow oxygen.

**Circulation**

**Evaluate the pulse rate and volume, peripheral circulation (capillary refill time) and blood pressure.**

- If signs of life are absent, initiate CPR.
- Perform the left lateral tilt or manual displacement of the uterus.
- If the patient shows signs of shock, support the circulation as described below:
  - Insert a 14- to 16G IV cannula and take 20 mL of blood for a full blood count, cross-matching (4 units = 2 litres) and clotting. Do a whole blood clotting time (WBCT) test if laboratory analyses are not available.
  - Give 500 mL to 1 litre of Ringer-lactate or Hartmann’s solution by rapid IV bolus.
  - Reassess, and if shock is still present, give blood (if available) (500 mL as rapidly as possible after warming) or another 500 mL to 1 litre of Ringer-lactate or Hartmann’s solution.
  - If the patient is ketotic from prolonged obstructed labour, add 50 mL of 50% glucose to the second litre of Ringer-lactate or Hartmann’s solution.
  - Central venous access may be needed for volume replacement if peripheral access is not possible.

**Emergency treatment**

1. Obtain consent for laparotomy and hysterectomy.
2. Try to place a second IV cannula.
3. Perform urgent laparotomy under general anaesthesia.
4. The type of operation will depend upon the size and site of rupture, and the degree of haemorrhage.
5. Give IV prophylactic antibiotics (ampicillin 2 grams or cefuroxime 1.5 grams plus metronidazole 500 mg).

The rupture may extend anteriorly towards the back of the bladder, laterally towards the uterine arteries, or into the broad ligament plexus of veins, leading to massive haemorrhage.

Posterior rupture may occur, and is usually associated with intrauterine malformations, but has occurred in patients who have had a previous Caesarean section or uterine trauma, or after rotational forceps. Fundal rupture has been documented, and a detailed history usually elicits previous dilatation and curettage (D&C) or manual removal of the placenta.

Continuing haemorrhage is an indication for performing a total or subtotal hysterectomy. Subtotal hysterectomy is a simpler procedure than total hysterectomy, and has a reduced risk of ureteric or bladder damage.

The choice of uterine repair depends on the site of the injury. In one series of 23 cases of ruptured uterus, hysterectomy was undertaken in 15 cases (65%) and repair in the other 8 cases. Five successful further pregnancies were reported without repeat rupture (all delivered by Caesarean section). In another Middle Eastern series of 11 cases of uterine rupture, 8 cases had uterine repair, and all became pregnant again and were delivered by Caesarean section.
Shoulder dystocia (see video for download on www.mcai.org.uk)

Shoulder dystocia is caused by impaction of the shoulders against the bony pelvis. Special manoeuvres are required to deliver the shoulders. The reported incidence is between 0.15% and 2% of all vaginal deliveries. Shoulder dystocia carries a significant risk to the baby due to hypoxia, fractures of the clavicle and humerus, and injuries to the brachial plexus.

The problem lies at the pelvic brim where the anterior shoulder gets caught, while the posterior shoulder has usually entered the pelvis. Treatment therefore aims to encourage the anterior shoulder into the pelvis, or if this fails, either rotating the posterior shoulder round into the anterior position or delivering the posterior arm first. Traction on the head when the anterior shoulder is caught above the pelvic brim will not work and is dangerous.

Delivery should occur within 5 minutes of the delivery of the head. The longer the delay, the greater the risk of hypoxic injury to the baby.

Postpartum haemorrhage is common after shoulder dystocia, and there is a risk of serious vaginal and perineal lacerations.

Risk factors for shoulder dystocia

Antepartum risk factors include the following:
- Fetal macrosomia
- Maternal obesity
- Diabetes
- Prolonged pregnancy
- Advanced maternal age
- Male gender
- Excessive weight gain
- Previous shoulder dystocia
- Previous big baby.

Intrapartum risk factors include the following:
- Prolonged first stage
- Prolonged second stage
- Oxytocin augmentation of labour
- Assisted delivery.

These risk factors often do not help in the prediction of individual cases of shoulder dystocia. Therefore the practice of emergency drills is essential for good management of the unexpected case.

Slow progress in labour, particularly in the multiparous patient or in the woman with a past history of a big baby or difficulty delivering the shoulders, should alert one to the possibility of shoulder dystocia.

During delivery, signs include the following:
- Difficulty delivering the face and chin
- Head retractions between contractions
- Head bobbing
- The delivered head becomes tightly pulled back against the perineum (turtle sign).

As soon as the situation is suspected, a plan of action should be initiated.

Management of shoulder dystocia

If risk factors are present, try if possible to have an experienced obstetrician present in the second stage of labour. However, 50% of cases are unexpected.

Be prepared for the problem, including postpartum haemorrhage, which may follow.

Try each manoeuvre for 30–60 seconds only: if it does not work, move on. Try to recognise it early on and before applying any traction to the head, which can delay helpful procedures and cause Erb’s paralysis.

The following acronym suggested by Advanced Life Support in Obstetrics (ALSO) is helpful (see www.also.org.uk):

HELPERR: H = Help
E = Evaluate/Episiotomy
L = Legs (McRoberts)
P = Pressure (suprapubic)
E = Enter (posterior arm and Wood’s screw)
R = Rotate (on to all fours)
R = Repeat

1 Call for help. This condition needs the most experienced team and extra helpers.
2 McRoberts manoeuvre (legs) (see Figures 2.5.F.11 and 2.5.F.12). Both thighs are sharply flexed, abducted and rotated outwards, ideally by two assistants. Each assistant holds the leg in the region of the thigh and flexes the leg until the thigh lies parallel to the anterior abdominal wall. This will reduce the angle between the sacrum and the lumbar vertebrae to help to free the impacted shoulder. If two assistants are not available, the mother may be placed in the all fours position (see below).

FIGURE 2.5.F.11 McRoberts manoeuvre, showing how important it is to fully flex both legs on to the mother’s abdomen so that the thighs lie parallel to the anterior abdominal wall.

FIGURE 2.5.F.12 In McRoberts manoeuvre, with only one assistant the left leg is held flexed against the abdomen by a nurse, and the mother holds her right leg in this position.
3 **Suprapubic pressure with moderate traction (not fundal pressure).** Suprapubic pressure is applied to reduce the diameter between the shoulders and push the anterior shoulder underneath the symphysis pubis. It is important to know where the fetal back lies, so that pressure is applied in the right direction (i.e., from the fetal back forwards towards the fetal chest). If you are unsure of the position of the back, confirm it by vaginal examination. Pressure should be applied to the back of the shoulder with the heel of the hand, and sometimes a rocking movement may be helpful. Strong traction and fundal pressure should be avoided.

![Suprapubic pressure](image)

**FIGURE 2.5.F.13 Suprapubic pressure.**

4 **Apply moderate traction (harder pulling can make impaction worse and cause Erb’s paralysis).** Once both McRoberts manoeuvre and suprapubic pressure are in place, moderate traction can be applied while discouraging maternal efforts (which can increase the impaction of the shoulders).

5 **Consider an episiotomy.** A medio-lateral episiotomy is recommended to allow more space for manoeuvres such as delivering the posterior shoulder, allowing the operator to use the sacral hollow, and reducing vaginal trauma.

6 **Deliver the posterior arm and shoulder.** Insert a hand up to the fetal axilla and hook the posterior shoulder down. Traction on the posterior axilla then brings the posterior arm within reach. Run your index finger or middle finger, or both, along the back of the fetal humerus, then flex the elbow at the antecubital fossa, which will disengage the arm, which can then be brought down (hold the hand and sweep it across the chest). Sometimes it comes out directly lying alongside the head, and sometimes it comes out with an element of rotation anteriorly.

7 **Internal rotational manoeuvres (Rubin’s and Wood’s screw manoeuvres).** These measures are rarely required.

   **Rubin’s manoeuvre.** The operator inserts the fingers of one hand vaginally, positioning the fingertips behind the anterior shoulder. The shoulder is then pushed towards the fetal chest.

   **Wood’s screw manoeuvre.** If Rubin’s manoeuvre is unsuccessful, the fingers of the opposite hand may be inserted vaginally to approach the posterior shoulder from the front of the fetus. The combination of these two movements may allow rotation of the shoulders and aid delivery. If delivery of the posterior shoulder or arm is not successful, try to rotate the posterior shoulder 180-degrees in a corkscrew fashion (clockwise or anticlockwise) to bring it to an anterior position, from which the delivery can continue as normal (this rotation releases the impacted anterior shoulder that ends up in the posterior pelvis). It is important not to twist the fetal head or neck during this manoeuvre.

8 **All fours position.** This is another procedure that can be useful if no help is available. The mother quickly positions herself evenly on hands and knees (Gaskin’s manoeuvre). In many cases this alone relieves the dystocia. In addition, it can assist with the delivery of the posterior arm. The other manoeuvres described above can also be performed with the mother in this position. Early on try to deliver the posterior shoulder from this position. Sometimes pushing one leg forward into the
Section 2.5

2.5.G Severe infection in the puerperal period

Diagnosis of infection after childbirth

TABLE 2.5.G.1 Symptoms and signs of infection, with diagnosis and treatment

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Signs</th>
<th>Investigations</th>
<th>Diagnosis</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigors/chills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower abdominal and/or</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pelvic pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foul-smelling liquor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent light vaginal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bleeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of incomplete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>placenta delivered</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of prolonged</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rupture of membranes,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frequent unsterile vaginal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>examinations in labour</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigors/chills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower abdominal and/or</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pelvic pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foul-smelling liquor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent light vaginal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bleeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of incomplete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>placenta delivered</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of prolonged</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rupture of membranes,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frequent unsterile vaginal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>examinations in labour</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigors, chills and/or</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>malaise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigors/chills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower abdominal and/or</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pelvic pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foul-smelling liquor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent light vaginal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bleeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of incomplete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>placenta delivered</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of prolonged</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rupture of membranes,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frequent unsterile vaginal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>examinations in labour</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigors, chills and/or</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>malaise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigors/chills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower abdominal and/or</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pelvic pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foul-smelling liquor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent light vaginal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bleeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of incomplete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>placenta delivered</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of prolonged</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rupture of membranes,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frequent unsterile vaginal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>examinations in labour</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigors/chills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower abdominal and/or</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pelvic pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foul-smelling liquor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persistent light vaginal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bleeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of incomplete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>placenta delivered</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of prolonged</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rupture of membranes,</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frequent unsterile vaginal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>examinations in labour</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rigors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mastitis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If bacterial infection is</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>suspected, give anti-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>staphylococcal antibiotics:</td>
<td>fl  ucloxacin or cephalexin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast abscess</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical drainage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the patient is systemically</td>
<td>fl  ucloxacin or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>very unwell, give anti-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>staphylococcal antibiotics:</td>
<td>cefotaxime or ceftriaxone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

‘starting of a race’ position can open up the pelvis from this position.

9 Symphysiotomy. If the baby is still undelivered, symphysiotomy should be considered.

10 Check the vagina and perineum for trauma, and repair accordingly.

11 Prepare for postpartum haemorrhage.
### Symptoms

- History of Caesarean section
- Rigors, chills and/or malaise
- Severe abdominal pain
- Vomiting

### Signs

- High, swinging fever
- Swelling and redness around incision
- High fever
- Abdominal distension
- Rigid abdomen
- Absent bowel sounds
- Shock (see above for signs)

### Investigations

- Full blood count, including white blood cell count
- Blood culture
- Nasogastric tube
- Ultrasound
- Microscopic examination of urine
- Chest X-ray

### Diagnosis

- Wound abscess
- Peritonitis
- Pelvic abscess
- Pyelonephritis
- Pneumonia
- Malaria

### Treatment

- Surgical drainage
- Treat shock
- Give IV antibiotics
- Nasogastric tube
- Immediate laparotomy in operating theatre
- Give IV antibiotics:
  - Ampicillin 2 grams IV/IM every 6 hours
  - Gentamicin 80 mg IV/IM every 8 hours or 5 mg/kg body weight IV/IM once every 24 hours
  - Metronidazole 500 mg IV every 8 hours
  - Surgical drainage
- IV antibiotics (see Section 2.8.F)
- If the patient is in shock, initiate immediate treatment
- IV antibiotics (see Section 2.8.A)
- Antimalarial drugs (see Section 2.8.D)

---

### Endometritis

This is the most serious and common cause of puerperal sepsis. It accounts for up to 15% of maternal deaths in resource-limited countries.

Infection of retained products of conception is the most common cause (suspect this if there is excessive vaginal bleeding or poor involution of the uterus). This can lead to long-term health problems, including infertility, chronic pelvic inflammatory disease and ectopic pregnancies.

Endometritis is defined as infection of the genital tract at any time between the onset of rupture of the membranes or labour and the 42nd day following delivery or abortion, in which two or more of the following are present:

- Abdominal and/or pelvic pain
- Fever of ≥ 37.5°C (can be masked by paracetamol or other antipyretic drugs)
- Abnormal quantity of vaginal discharge
- Foul-smelling discharge
- Delay in the rate of involution of the uterus.

Puerperal sepsis can present with few symptoms (the woman feels unwell and usually has a fever). It can also progress rapidly to become life-threatening within hours.

### Pathogens that cause sepsis

The pathogens most commonly responsible are group A beta-haemolytic streptococcus (often of community origin) and endotoxin-producing enterobacteria (e.g. *E. coli*). Less commonly involved are *Clostridium*, *Bacteroides*, *Chlamydia* and *Mycoplasma*. Bacterial infections are often mixed.

### Risk factors

These include the following:

- Prolonged rupture of membranes (> 48 hours before delivery)
- Contact with others, especially children, with a bacterial throat infection (Streptococcus)
- Frequent (particularly unsterile) vaginal examinations
- Prolonged and obstructed labour
- Instrumentation (e.g. forceps delivery)
- Caesarean section (especially in an emergency)
Pathogenesis

- Endotoxins are released from the cell wall of Gram-negative bacteria.
- Endotoxins can cause shock.
- Extensive tissue necrosis, even gangrene, may occur, especially in the uterus.

Complications

These include the following:

- Wound infection and wound dehiscence (burst abdomen)
- Peritonitis
- Ileus
- Septicaemia, possibly accompanied by shock
- Abscess formation in cul-de-sac and sub-diaphragmatic space
- Adnexal infections
- Ovarian abscess
- Pelvic abscess
- Breast infection or abscess
- Deep vein thrombosis
- Pulmonary embolus

Investigations

These include the following:

- High vaginal swab if bacteriology facilities are available
- Midstream samples of urine (MSSU) and microscopy of urine.

Treatment

Treat as an emergency, including IV fluid boluses if shock is present (see Section 2.5A), if there is persistent tachycardia (> 100 beats/minute), hypotension (systolic blood pressure < 90 mmHg), increased respiratory rate (> 25 breaths/minute), confusion or disorientation, oliguria (< 30 mL/hour), rash or bradycardia (< 50 beats/minute).

Give antibiotics until the patient has been fever-free for 48 hours or 7–10 days:

- Amoxicillin 2 grams IV every 6 hours
- Gentamicin 80 mg IV/IM every 8 hours or 5 mg/kg body weight IV/IM once every 24 hours
- Metronidazole 500 mg IV every 8 hours

If fever is still present 72 hours after initiating antibiotics, re-evaluate the patient and consider revising the diagnosis.

Often a 1 to 2 week antibiotic course is completed orally once the patient has been fever free for 48 hours.

If retained placental fragments are suspected, perform a digital exploration of the uterus to remove clots and large pieces. Use ovum forceps or a large curette if necessary, but be very careful not to penetrate the uterine wall, which is very soft at this stage. Where general anaesthesia is not available, agents such as ketamine may be considered for this procedure.

If there is no improvement with conservative measures, and there are symptoms and signs of general peritonitis (abdominal pain, fever, and abdominal tenderness with rebound tenderness), perform a laparotomy to drain the pus, and if the uterus is the source do not leave it too late to perform a hysterectomy.

Wound infections

Wound infections may be superficial or deep. Superficial infections involve the skin and subcutaneous tissues, but not the rectus sheath (fascia). They may present with cellulitis or abscess formation. Cellulitis should be treated with antibiotics; this may prevent the development of a wound abscess.

Clear or purulent fluid exuding from the wound should raise concern that the infection is deep to the sheath. Where there is abscess formation, the wound should be opened by removing sutures to the skin and subcutaneous tissues, to allow drainage of pus. Antibiotics are not always required if an abscess is drained and the surrounding tissues appear healthy.

The wound may require debridement if tissue necrosis is suspected. If the sheath looks healthy and intact, the fascial sutures should be left in situ. The wound should be packed with a damp dressing, which must be changed every 24 hours.

If the sheath appears necrotic or infected, it should be opened and the peritoneal cavity inspected for collections of pus. If pus is present, it should be evacuated, and a broad corrugated drain left in situ in the peritoneal cavity to facilitate drainage post-operatively.

Necrotising fasciitis is a relatively uncommon but potentially life-threatening variant of wound infection, which presents with rapidly spreading cellulitis, with severe pain and tenderness. Urgent wide debridement of necrotic tissue is required, with antibiotics as for deep wound infection (see below). Secondary closure should be undertaken 2–4 weeks later, provided that the infection has resolved.

Antibiotic regimes for wound infections

Where possible, swabs should be taken for culture and sensitivity before starting antibiotics.

Superficial infections

Give ampicillin 500 mg by mouth, four times a day for 5 days, plus metronidazole 500 mg by mouth, three times a day for 5 days.

Deep infections

Give benzyl penicillin, 2 million units (1200 mg) IV every 6 hours, plus gentamicin 80 mg IV/IM every 8 hours or 5 mg/kg body weight IV/IM once every 24 hours, plus metronidazole 500 mg IV every 8 hours.

IV antibiotics should be continued until at least 48 hours after the pyrexia has settled.

The patient may then be switched to oral antibiotics, as described above.
**Peritonitis**
Treat shock, if present. Then:
- provide nasogastric suction
- infuse IV fluids for maintenance and replacement
- give antibiotics IV until the patient has been fever-free for 48 hours:
  - ampicillin/amoxicillin 2 grams IV/IM every 6 hours
  - plus gentamicin 80 mg IV/IM every 8 hours or 5 mg/kg body weight IV/IM once every 24 hours
  - plus metronidazole 500 mg IV every 8 hours.
- if necessary, perform a laparotomy to repair diseased or injured bowel.

**Pelvic abscess**
Give antibiotics before draining the abscess, and continue until the patient has been fever-free for 48 hours:
- ampicillin/amoxicillin 2 grams IV every 6 hours
- plus gentamicin 80 mg IV/IM every 8 hours or 5 mg/kg body weight IV/IM once every 24 hours
- plus metronidazole 500 mg IV every 8 hours.

If the abscess is fluctuant in the cul-de-sac, drain the pus through the cul-de-sac (culdocentesis) (see below). If the spiking fever continues, perform a laparotomy.
Bowel may be secondarily involved in the inflammatory process, and care must be taken to avoid bowel perforation.
Peritonitis may develop in association with a pelvic abscess. Prompt nasogastric suction and administration of intravenous fluids are important, as well as IV antibiotic therapy as described above.

**Culdocentesis and colpotomy**

**Culdocentesis for the detection of pus**
- Apply antiseptic solution to the vagina, especially the posterior fornix.
- Infiltrate with 1% lignocaine.
- Gently grasp the posterior lip of the cervix with a tenaculum and gently pull to elevate the cervix and expose the posterior vagina.
- Place a long needle (e.g. spinal needle) on a syringe and insert it through the posterior vagina, just below the posterior lip of the cervix (see Figure 2.5.G.1).
- Pull back on the syringe to aspirate the cul-de-sac (the space behind the uterus).
- If pus is obtained, keep the needle in place and proceed to colpotomy (see below).

**Colpotomy for a pelvic abscess**
If pus is obtained on culdocentesis, keep the needle in place and make a stab incision at the site of the puncture.
Remove the needle and insert blunt forceps or a finger through the incision to break the loculi in the abscess cavity (see Figure 2.5.G.2).
- Allow the pus to drain.
- Insert a disinfected soft rubber corrugated drain through the incision. (If a surgical drain is not available, a make-shift drain can be prepared by cutting off the fingertips of a disinfected rubber glove.)
- If required, use a stitch through the drain to anchor it in the vagina.
- Remove the drain when there is no more drainage of pus.
- If no pus is obtained, the abscess may be higher than the pouch of Douglas. A laparotomy will be required for peritoneal lavage (wash-out).

**Mastitis**
Mastitis may be infective or non-infective, ranging in severity from mild local erythema and tenderness through to abscess and sepsicaemia.
- Non-infective mastitis may be due to a blocked lactiferous duct, or to difficulties with breastfeeding technique. It may lead to infective mastitis.
- Infective mastitis is common in lactating women. It is usually caused by the bacterium Staphylococcus, which generally responds to a 7- to 10-day oral course of flucloxacillin or a cephalosporin, both of which are safe to take while breastfeeding.

Mastitis usually presents with a hot red swollen section of one breast. It may be associated with flu-like symptoms, namely pyrexia of 38°C or above, chills and myalgia.

**Treatment**
Continue breastfeeding. Although the symptoms of mastitis may discourage breastfeeding, it is important to try to continue. Regular breastfeeding will help to:
- remove any blocked breast milk from the breast
- resolve the symptoms of mastitis more quickly
- prevent mastitis from becoming more serious.

The milk from the affected breast may be a little saltier than normal, but is safe for the baby to drink. Any bacteria that are present in the milk will be harmlessly absorbed by the baby’s digestive system and cause no problems.

Breastfeed frequently on the affected side, in order to empty the breast of retained milk. The baby can empty...
the breast more efficiently than a breast pump. However, if the baby is not feeding well, a breast pump or hand expression will be needed to get the milk out. It may be less painful if the affected breast is given to the baby second, after the let-down reflex has occurred.

Mastitis can usually be successfully treated by resting, drinking plenty of fluids and varying the baby’s position at the breast. It is important to ensure that the baby is properly attached to the nipple, and that the breast is empty after the feed. It may be necessary to feed more frequently, and to express the remaining milk after a feed. Paracetamol is useful for pain control. Massaging the areas of tenderness may be beneficial.

**Prevention of mastitis**
The following advice should be given to any mother who has experienced mastitis:

- Relieve engorgement promptly. Milk that does not flow gets thicker and clogs the ducts.
- Breastfeed frequently. Do not restrict the length of feedings.
- If the mother feels her breasts getting full, she should encourage the baby to feed without waiting for the baby to initiate this.

**Repeated mastitis**
This is usually the result of irregular breastfeeding patterns, such as missing feeds and giving bottles in place of breastfeeding. Recurrent mastitis may also result from tiredness and stress.

With regard to antibiotic treatment, the bacterium involved in mastitis is usually *Staphylococcus*, and the two most effective antibiotics are cloxacinil and cephalosporins, which are safe to take while breastfeeding. A 10-day oral course is recommended.

### 2.5.H Pulmonary embolism

**BOX 2.5.H.1 Minimum standards**
- Oxygen.
- IV unfractionated heparin.
- Low molecular weight heparin.
- Subcutaneous heparin.
- Blood clotting measurements.
- Anti-embolism stockings.

**Introduction**
If left untreated, as many as 24% of patients with deep vein thrombosis (DVT) will have a pulmonary embolism. However, when DVT is treated with anticoagulants (if that is possible), pulmonary embolism occurs in only 4.5% of cases, and the mortality rate is less than 1%.

Deaths are equally common antenatally and postnatally. Pregnancy is a thrombogenic state associated with a five- or sixfold increase in the risk of pulmonary embolism. The majority of DVTs in pregnancy are ileo-femoral, and these are more likely to embolise.

Anti-embolism stockings and early mobility after Caesarean section and after childbirth are the main ways of preventing this.

**Additional risk factors**
- **Operative delivery:** Caesarean section increases the risk of pulmonary embolism by two- to eightfold; the risk is greater after an emergency procedure than after an elective one.
- **Age:** The mortality from pulmonary embolism is 100 times higher in pregnant women over 40 years of age than in those aged 20–25 years.
- **Obesity.**
- **Congenital and acquired thrombophilia:** Patients with antithrombin III deficiency, protein C and S deficiency, activated protein C resistance, and lupus anticoagulant and antiphospholipid antibody are at increased risk of pulmonary embolism.

- Surgical procedures during pregnancy or the puerperium (especially Caesarean section).
- **Other risk factors:** Restricted activity, pre-eclampsia, dehydration, excessive blood loss and homocystinuria.

**Clinical presentation**
- Dyspnoea, tachypnoea, pleuritic chest pain, cough, haemoptysis and leg pain.
- Massive pulmonary embolism may be associated with cyanosis, circulatory collapse with hypotension, syncope or convulsions and central chest pain.
- Occasionally, patients present with unexplained tachycardia.

**TABLE 2.5.H.1 Signs and symptoms of pulmonary embolism**

<table>
<thead>
<tr>
<th>Findings</th>
<th>Patients with proven pulmonary embolism (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tachypnoea</td>
<td>89</td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>81</td>
</tr>
<tr>
<td>Pleuritic pain</td>
<td>72</td>
</tr>
<tr>
<td>Apprehension</td>
<td>59</td>
</tr>
<tr>
<td>Cough</td>
<td>54</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>43</td>
</tr>
<tr>
<td>Haemoptysis</td>
<td>34</td>
</tr>
<tr>
<td>Temperature &gt; 37°C</td>
<td>34</td>
</tr>
</tbody>
</table>

Tachycardia and a few localised crepitations may be the only findings on physical examination.

Massive pulmonary embolism may produce right-sided heart failure with jugular venous distension, an enlarged liver, a left parasternal heave, and fixed splitting of the second heart sound.

Clinical evidence of DVT may not be found in patients with pulmonary embolism. Symptoms and physical findings must be interpreted with caution during pregnancy, because
dyspnoea, tachypnoea and leg discomfort are common findings as pregnancy progresses.

**Investigations**

Request a full blood count, urine and electrolytes, oxygen saturation, and (when available) clotting studies and arterial blood gases.

- Request an ECG and chest X-ray (if available). These investigations do not confirm or refute the diagnosis of pulmonary embolism.
- **ECG** is non-specific for the diagnosis of pulmonary embolism. The changes in electrical axis that occur in normal pregnancy make the ECG findings in pulmonary embolism even less specific. Sinus tachycardia is the most common abnormality. Right axis deviation and right ventricular strain pattern may be present with a large pulmonary embolism. The S1Q3T3 pattern is very rare.
- **Chest X-ray** helps to exclude pneumothorax and pneumonia. The non-specific radiological changes in pulmonary embolism include segmental collapse, a raised hemidiaphragm, consolidation and unilateral pleural effusion. A wedge-shaped infarction is a rare finding.

**Primary assessment and resuscitation for possible pulmonary embolism (ABC approach)**

**Call for help.**

**Airway**

- Use an opening manoeuvre if the airway is not open or is partially obstructed. If there is an improvement, use airway adjuncts to maintain the airway.
  - An oropharyngeal airway is usually appropriate only if the patient is unconscious.
- **Suction** if necessary.
- The airway may need to be maintained and protected by intubation using experienced senior help (if available).

**Breathing**

- Provide a high concentration of oxygen through a face mask with reservoir bag, if there is adequate spontaneous respiration.
- For patients with inadequate ventilation or depressed conscious level, respiration should be supported with oxygen via a bag-valve-mask and experienced senior help summoned (if available).

Give 100% oxygen (mask with reservoir and flow rate of at least 6 litres/minute) regardless of SaO2, as it increases fetal oxygen delivery as well as improving maternal tissue oxygenation.

**Circulation**

- Place a wide-bore IV cannula (16- to 18G).
- Place the woman in a lateral tilt or recovery position if undelivered and more than 20 weeks’ gestation.
- If possible, locally treat clinically suspected pulmonary embolism while awaiting confirmation from objective tests (if available) to prevent further thromboembolic complications and extension of the existing thrombus.
  - IV unfractionated heparin is the mainstay of treatment.
  - Initiate treatment with an IV bolus of 5000 IU of heparin given over 5 minutes.

**Note:** there are serious potential risks of anticoagulation, in particular the risk of life-threatening haemorrhage in the 24 hours after delivery, especially after Caesarean section.

- Empirical anticoagulation should be undertaken only when the diagnosis is clear clinically.
- **Additional treatment options for shocked patients** (if available) include thrombolytic therapy using streptokinase, pulmonary embolectomy and transvenous catheter fragmentation of the clot (available only in well-resourced units). Expert advice should be sought (if available).

**Secondary assessment and emergency treatment**

Involve the senior obstetrician, the anaesthetist and the medical team (if available).

- Transfer the patient to the high-dependency area (if available) and commence close monitoring of heart rate, blood pressure, central oxygenation (SaO2, if possible), ECG (if available) and urine output.

**Anticoagulation**

Heparin is the anticoagulant of choice in pregnancy, as it does not cross the placenta. Rapid and prolonged anticoagulation prevents extension of the thrombus and its recurrence.

When available, acute therapy is with an IV bolus of unfractionated heparin, 5000IU over 5 minutes, followed by an IV infusion of 1000–2000 IU/hour for 5–10 days. The dose is adjusted to maintain the activated partial thromboplastin time (APTT) at 1.5–2.5 times the control. Repeat the APTT every 6 hours during the first 24 hours of therapy, and thereafter monitor it daily.

Treatment may then be continued with subcutaneous heparin at a dose of 10 000IU twice daily. Maintaining the APTT in the therapeutic range (1.5–2.5 times the control) following subcutaneous heparin may be problematic, and can lead to under- or over-anticoagulation. Low-molecular-weight heparin (LMWH) is ideal if available.

- Before giving heparin, measure the platelet count (if available).

Rare complications of heparin treatment are allergy and thrombocytopenia. The platelet count should be monitored at the onset of treatment and monthly thereafter.

**Warfarin** crosses the placenta and is associated with characteristic damage to the fetus in the first trimester. Major fetal CNS abnormalities such as microcephaly and optic atrophy are also seen with warfarin use in the second and third trimesters. In addition, there is a higher risk of intracerebral bleed from the trauma of delivery, and a higher risk of bleeding complications during labour and delivery.

For all these reasons, warfarin is not recommended in the antenatal period. However, warfarin can be initiated in the postpartum period and overlapped with heparin until the INR is maintained at 2.0–3.0.

**Can a patient be anticoagulated with heparin if APTT is not available?**

This is difficult. You will need to weigh the risks of not treating against the risks of treating. The only good thing about this situation is that the half-life of heparin is short (a few hours).

- If the diagnosis is uncertain and/or the risk to the patient is low, do not give heparin.
Section 2.5

2.5.1 Amniotic fluid embolism

Introduction

Amniotic fluid embolism occurs when a bolus of amniotic fluid is released into the maternal circulation during uterine contractions. It becomes trapped in the maternal pulmonary circulation and causes cardiorespiratory collapse and clotting problems with disseminated intravascular coagulation (DIC). It is very rare, and extremely difficult if not impossible to treat without high-level resources.

Clinical presentation

Amniotic fluid embolism usually presents late in the first stage of labour. It has also been reported during first-trimester surgical termination of pregnancy, second-trimester termination, after abdominal trauma and after amniocentesis.

The diagnosis is essentially clinical and by exclusion and treatment of other possible causes. Amniotic fluid embolism may occur during labour (70%), during Caesarean section (19%) or immediately postpartum (11%).

The major signs include the following:

- acute hypotension or cardiac arrest
- acute hypoxaemia (dyspnoea, cyanosis or respiratory arrest)
- coagulopathy (laboratory evidence of DIC or fibrinolysis or severe clinical haemorrhage) if the patient survives long enough for DIC to become established (more than 30 minutes)
- the absence of other causes or symptoms.

Differential diagnosis

- Pulmonary embolus: infrequent during labour, often

Anticoagulant treatment of deep vein thrombosis and/or pulmonary embolism

Following IV unfractionated heparin given as resuscitation (as described above), provide a heparin infusion of 1000–2000 IU/hour, and adjust the dose to maintain the APTT at 1.5–2.5 times the patient’s control. Repeat the APTT every 6 hours during the first 24 hours of therapy. Thereafter monitor the APTT daily unless it falls outside the therapeutic range.

Another option is to treat with an LMWH such as enoxaparin given subcutaneously. The drug is available in syringes of 40, 60, 80 and 100 mg. The dose should be based on the patient’s pre-pregnancy weight and should be given 12-hourly. The dose will vary depending on the drug used, but for enoxaparin is 1 mg/kg 12 hourly (note this is a greater total dose than the non-pregnancy dose of 1.5 mg/kg/24 hours). If coagulation tests are available, the aim is to achieve an APTT of 1.5–2.5 times the pre-treatment level. If these tests are not available, careful monitoring for signs of overdose, which can cause haemorrhage, should be undertaken and the mother should be warned of the symptoms to be alert for.

The mother can then be discharged home when she has been taught how to administer the injections and dispose safely of the needles.

Anticoagulation following pulmonary embolism or DVT should be continued throughout pregnancy and for at least 3 months postpartum.

LMWH should be continued for the duration of the pregnancy, and for at least 3 months after delivery. An expert should be consulted about the use of prophylactic heparin during any further pregnancy.

On entering labour, the mother should not be given any further doses of LMWH. If an elective Caesarean section is planned, the mother should have the usual dose of LMWH on the night before surgery, but the morning dose should be omitted. After delivery, as long as there are no concerns about bleeding, enoxaparin should be restarted 4 hours after a vaginal delivery and 8 hours after a Caesarean section. A once daily regimen may be used, especially after 3 days when concerns about haemorrhage are much reduced.

Shocked patients with a pulmonary embolus should ideally be managed on an intensive-care or high-dependency unit (if available). These patients will ideally have arterial blood pressure and central venous pressure (CVP) monitoring. They will also receive haemodynamic support with adequate fluid management and inotropes, in order to ensure maximal right heart filling.

All women at high risk of DVT or pulmonary embolism (e.g. those who have suffered these conditions before, in this or a previous pregnancy) should use anti-embolism stockings and receive subcutaneous heparin until they are fully mobile.

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25

25
accompanied by chest pain, without development of coagulopathy.

- **Air embolism:** may follow ruptured uterus, pressurised IV infusion or Caesarean section. The distinguishing feature in air embolism is pre-cardial water-wheel murmur. There is no coagulopathy.
- **Septic shock:** unlikely in the absence of evidence of preceding infection and pyrexia.
- **Anaphylactic shock:** there is no coagulopathy.
- **Eclampsia:** usually preceded or accompanied by hypertension and proteinuria.
- **Toxic reaction to anaesthetic or local anaesthetic agents:** there is no coagulopathy.
- **Acute left heart failure:** usually more insidious onset. There is no coagulopathy.
- **Cerebral haemorrhage:** no cyanosis or hypotension. There is no coagulopathy.
- **Massive obstetric haemorrhage:** the history may help. Beware concealed abruption. Uterine atony may be a feature of both. Hypoxaemia in massive obstetric haemorrhage is less pronounced than in amniotic fluid embolism.
- **Aspiration of gastric contents:** usually occurs in an unconscious patient, or during induction of or emergence from general anaesthesia. There is no coagulopathy.

**Management**

Management is supportive, and aims to correct hypoxaemia, shock and coagulopathy and its consequences.

- Give 100% inspired oxygen by face mask and reservoir.
- If the patient is unconscious (P or U on the AVPU scale), intubation and assisted ventilation (if available) are needed.
- High positive end-expiratory pressure (PEEP) should be avoided.
- Two large-bore cannulae (16G) IV should be sited.
- Urgently cross-match blood, ideally at least 6 units of group-specific blood with retrospective cross-matching (if available) should be ordered. Check clotting factors (or clotting time) and platelets. Blood needs to be sent for a full blood count, clotting, fibrinogen and fibrinogen degradation product (FDP) levels (if available) immediately, and frequent repeated estimations of haematological parameters are required (if available).
- Cardiac arrest is managed according to protocols (see Section 1.13).
- If the woman is in labour, immediate delivery is required, by Caesarean section (under general anaesthetic) if vaginal delivery is not imminent. In cardiac arrest, if a cardiac output cannot be restored immediately, cardiac massage and ventilation should continue and Caesarean section should be performed.
- Circulatory support depends on the causes of decreased cardiac output. The available haemodynamic data indicate that high left heart filling pressures, reflecting a failing left ventricle, are a feature of the condition. In patients who survive the initial haemodynamic collapse, there is a high risk of secondary pulmonary oedema (70%). Inotropic support, ideally guided by monitoring of the central venous pressure (CVP), may be life-saving.
- If massive obstetric haemorrhage occurs, large volumes of fresh blood and blood products may be required.
- Monitoring of cardiac filling pressures may help to prevent fluid overload and pulmonary oedema.
- Place an arterial line if possible.
- Correct coagulopathy with fresh blood, platelets, fresh-frozen plasma and cryoprecipitate (rich in fibrinogen) if available.
- Massive haemorrhage may be due not only to coagulopathy, but also to coexisting uterine atony. Oxytocic drugs will be needed. Uterine tamponade may reduce blood loss while the coagulopathy is corrected.
- Patients who survive are at high risk for heart failure, ARDS and DIC. If the patient is sustaining a cardiac arrest, there is a high risk of neurological injury. As in other cardiac arrests associated with pregnancy, delivery may improve the success of resuscitation.

**Outcome**

The outcome is poor, even when optimum treatment and monitoring is available, so it is important to exclude other possible and treatable causes of collapse, including anaphylaxis, pulmonary embolism, haemorrhage, sepsis, myocardial infarction, eclampsia, intracranial haemorrhage, hypoglycaemia and drug toxicity (e.g. magnesium, local anaesthetics).

The outcome depends on the facilities for cardiorespiratory support and the ability to manage the DIC with blood and blood products.

---

2.6 Complications that require hospital care

### 2.6.A Ovarian cysts in pregnancy

Ovarian cysts in pregnancy may cause abdominal pain due to torsion or rupture. Laparotomy is required if torsion of an ovarian cyst is suspected. If the findings at laparotomy are suggestive of malignancy (i.e. solid areas in the tumour, growth extending outside the cyst wall), the specimen should be sent for immediate histological examination if June 2015 © 2014 Maternal and Child Health Advocacy International MCAI