

Chapter 17: Obstetrics

1 Complications in pregnancy

1.1 Learning objectives

By the end of this lesson you will be able to:

- Briefly explain the following conditions, including how you can assist the clinician:
 - Ectopic pregnancy
 - Ante-partum haemorrhage
 - Miscarriage
 - Pre-eclampsia.

1.2 Ectopic pregnancy

Normal fertilisation and implantation

Once a sperm has penetrated an ovarian egg, the egg is considered fertilised, and makes its way along the fallopian tube to the uterus (womb). Around six days after fertilisation, it loosely attaches itself to the endometrium (the inner lining of the uterus), usually at the fundus of the uterus. As the egg (now called a blastocyst) invades the uterine wall, it divides into two distinct types of cells that form the placenta: One set of cells invades through the endometrial layer of the uterus until they reach the maternal arterioles. The cells constrict the flow through these vessels, digest the vessel wall and form blood-filled cavities called lacunae. Since the lacunae are still connected to the maternal circulation, blood passes through the maternal arterioles and the lacunae before returning via the maternal venules. The second set of cells from the blastocyst form into finger-like projections called chorionic villi. These project into the lacunae and allow diffusion of nutrients and gases to occur between the maternal and fetal circulations [Tortora, 2008].

Maternal blood flow through the placenta is mostly pressure-dependent and so is sensitive to reductions in maternal blood pressure and increases in venous pressure (for example, caval occlusion if a pregnant woman is laid supine). The placenta affects fetal circulation by altering resistance to blood flow. Increases in placental

resistance, due to pre-eclampsia for example, can have a negative impact on umbilical artery blood flow [Vause, 2005].

In an ectopic pregnancy, the egg implants itself somewhere other than the uterus. This occurs in 1–2% of all pregnancies. Risk factors increasing the chance of an ectopic pregnancy include [ALSG, 2010]:

- Pelvic inflammatory disease
- Intrauterine contraceptive device
- Previous ectopic pregnancy
- Sterilisation or reversal of sterilisation
- Endometriosis.

Signs and symptoms of an ectopic pregnancy typically present when the patient is 6–8 weeks pregnant, so the mother will usually have missed only one menstrual period. Signs and symptoms include [AACE, 2013]:

- Acute lower abdominal pain
- Small amounts of bleeding externally or a brownish vaginal discharge
- Signs of blood loss inside the abdomen (signs of shock)
- Unexplained fainting
- Shoulder-tip pain.

1.2.1 Management

The management of a ruptured ectopic pregnancy includes [AACE, 2013; ALSG, 2010]:

- Oxygen administration to maintain an SpO₂ of 94–98%
- Intravenous access and fluids if the mother is hypotensive
- Pain relief
- Reassurance
- Prompt (blue light) transport to an appropriate receiving hospital
- Keep the patient nil by mouth.

You will be able to assist the clinician with many of these, although in time-critical situations, most interventions are likely to be performed en route to the hospital.

1.3 Ante-partum haemorrhage

Maternal physiology

There are a number of maternal changes that occur in pregnancy including [AACE, 2013; ALSG, 2010]:

- Cardiac output at the end of pregnancy increases by 50%
- Average maternal heart rate increases by 10–15 beats per minute
- Systolic and diastolic blood pressures drop by 10–15 mmHg, although by the end of pregnancy, these values usually approach the normal range
- Work of breathing increases, as does respiratory rate, while vital capacity reduces
- Circulating blood volume increases by 50% (although there is a relative anaemia)
- The increase in blood volume results in the pregnant patient tolerating greater blood or plasma loss before showing signs of hypovolaemia. In fact, tachycardia may not develop until blood loss exceeds 1000 ml and blood pressure is usually maintained well beyond this level of loss [Bose, 2006]. However, in order to maintain maternal blood pressure in hypovolaemic states, blood is shunted away from the uterus and placenta, compromising the fetus.

Ante-partum haemorrhage

Ante-partum haemorrhage (APH) is defined as bleeding from the genital tract after the 24th week of pregnancy and is primarily related to three conditions: placental abruption, placenta praevia and uterine rupture [Magill-Cuerden, 2011].

Placental abruption

This occurs when a normally sited placenta separates from the uterine wall, resulting in bleeding from the maternal sinuses (Figure 1.1). The exact cause (aetiology) of abruption is unclear, but there are a number of identified risk factors [Mukherjee, 2008; Walfish, 2009]:

- Trauma to the abdomen
- Multiparity (multiple births previously)
- Substance abuse
- Smoking
- Prior abruption

- Hypertension (high blood pressure)
- Pre-eclampsia
- Preterm pre-labour rupture of membranes.

Placental abruption often causes severe abdominal pain. If the patient is not already in labour then she is likely to start with contractions. The uterus will be tense, feeling hard and woody, and the abdomen, tender. The volume of visible blood loss is not likely to be an accurate indicator of actual blood loss. Any revealed blood loss is typically dark in colour. Suspect concealed haemorrhage if there is a good history and signs of altered mental status or increasing tachycardia, even if the systolic blood pressure is normal [ALSG, 2010].

Placenta praevia

This term refers to a placenta that is partially or completely sited in the lower part of the uterus (Figure 1.2), in some cases over the cervix, making a normal vaginal delivery impossible. There are a number of risk factors including [Walfish, 2009]:

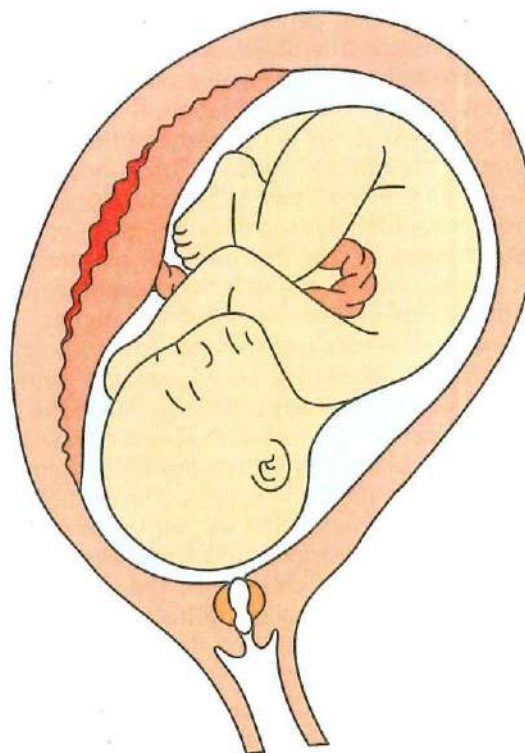


Figure 1.1 Placental abruption

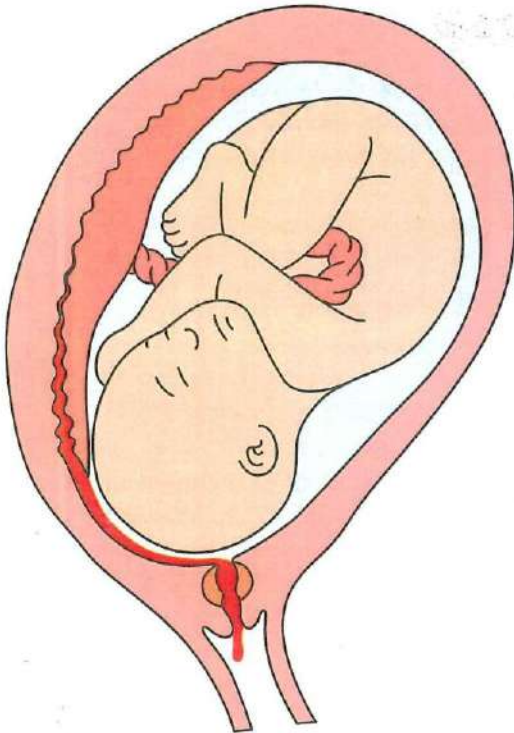


Figure 1.2 Placenta praevia

- Multiparity
- Advanced maternal age
- Previous caesarean section or other uterine surgery
- Previous placenta praevia.

Most blood loss is likely to be revealed and can be significant, particularly if the patient is in labour. Blood loss tends to be bright red. If the patient is not in labour, then the uterus will be relaxed, the abdomen non-tender and the patient may be pain free. However, bleeding can cause uterine irritation, which will result in contractions and associated discomfort. Placenta praevia is usually identified during ante-natal scans and patients deemed at risk booked in for an elective caesarean section. Recurrent bleeding is common.

Uterine rupture

This is a tear in the uterus and most commonly associated with previous caesarean section, but can occur in a first pregnancy (primigravida). It is rare and tends to occur during labour, but is very serious and can result in serious consequences, including death for mother and baby.

Uterine rupture can cause severe localised abdominal pain and rapid onset of maternal hypovolaemic shock. In labour, rupture may present with a sudden cessation of contractions and retraction of any presenting parts [Walfish, 2009].

1.3.1 Management

The management of APH includes [AACE, 2013; ALSG, 2010]:

- Oxygen administration to maintain an SpO₂ of 94–98%
- Positioning the mother in a full left-lateral tilt (Figure 1.3)
- Intravenous access and fluids if the mother is hypotensive
- Pain relief
- Reassurance
- Prompt (blue light) transport to an appropriate receiving hospital with obstetric theatres, blood transfusion, intensive care and anaesthetic services immediately available
- Making a pre-alert call to the receiving hospital
- Keep the patient nil by mouth.

You will be able to assist the clinician with many of these, although in time-critical situations most interventions are likely to be performed en route to the hospital.



Figure 1.3 A woman who is more than 20 weeks pregnant in the left-lateral position on an ambulance stretcher

1.4 Miscarriage

A miscarriage (previously called a spontaneous abortion) is defined as the loss of a pregnancy before 24 weeks' gestation. It is more common, however, in the first 12 weeks [ALSG, 2010].

If products of conception are not completely passed through the cervix, they can become trapped and lead to cervical shock. This is a life-threatening emergency.

Risk factors for miscarriage include [AACE, 2013]:

- Previous miscarriages
- Smoker
- Obesity.

Signs and symptoms

- Bleeding can be light or heavy and there may be clots or jelly-like tissue present
- The patient is likely to have pain, which is typically located in the suprapubic region of the abdomen or the lower back. It may radiate down the back of the patient's legs
- The patient may note that the signs of pregnancy (morning sickness or breast tenderness) have been improving.

1.4.1 Management

The management of a miscarriage includes [AACE, 2013; ALSG, 2010]:

- Oxygen administration to maintain an SpO₂ of 94–98%
- Positioning the mother in a full left-lateral tilt, if over 20 weeks
- Intravenous access and fluids if the mother is hypotensive
- Pain relief
- Reassurance
- Prompt (blue light) transport to an appropriate receiving hospital
- Making a pre-alert call to the receiving hospital
- Keeping the patient nil by mouth.

1.5 Pre-eclampsia

Pre-eclampsia is defined as new hypertension presenting after 20 weeks of pregnancy with significant proteinuria (protein in the urine). It can be classified into mild, moderate and severe based on the mother's blood pressure [NICE, 2011]:

- Mild: Systolic blood pressure 140–149 mmHg and diastolic blood pressure 90–99 mmHg
- Moderate: Systolic blood pressure 150–159 mmHg and diastolic blood pressure 100–109 mmHg
- Severe: Systolic blood pressure 160 mmHg or greater and diastolic blood pressure 110 mmHg or greater.

Pre-eclampsia and eclampsia (generalised convulsions in the pre-eclamptic patient) are the second most common cause of maternal death after sepsis [Cantwell, 2011].

Risk factors for pre-eclampsia include [ALSG, 2010]:

- Primiparity, or first baby with new partner
- Previous severe pre-eclampsia
- Pre-pregnancy hypertension
- Diabetes
- Obesity
- Twins or higher multiple pregnancies
- Kidney disease
- Mother over 40 or under 16 years of age.

Mild and moderate pre-eclampsia is unlikely to require intervention from the ambulance service, but you may be called to a patient with severe pre-eclampsia. In addition to a raised blood pressure, they may also have signs and symptoms of [AACE, 2013]:

- Headache: Severe and frontal
- Visual disturbances
- Epigastric and/or right-sided upper abdominal pain
- Muscle twitches or tremor
- Nausea and vomiting
- Confusion
- Rapidly progressing oedema.

1.5.1 Management

The management of severe pre-eclampsia includes [AACE, 2013; ALSG, 2010]:

- Oxygen administration to maintain an SpO₂ of 94–98%
- Intravenous access, but NO fluids
- Reassurance
- Preparing for eclampsia (convulsions)
- Prompt transport to an appropriate receiving hospital with a consultant-led obstetric unit, although note that strobe lights and loud sirens can lead to eclampsia.

You will be able to assist the clinician with many of these, although in time-critical situations, most interventions are likely to be performed en route to the hospital. Ask specifically about the use of lights and sirens en route to hospital.

2 Normal childbirth

2.1 Learning objectives

By the end of this lesson you will be able to:

- Outline the stages of labour
- Identify the equipment required for delivering a baby
- Outline ways to support the clinician during childbirth
- Describe how to support a woman in labour
- State the components of the APGAR assessment for newborn babies.

2.2 Stages of labour

Normal labour follows a sequence of progressively painful contractions of the uterus that cause the cervix to shorten and dilate, which enables the descent of the fetus through the maternal pelvis, leading to spontaneous vaginal birth of the baby. Afterwards, the placenta and membranes are expelled. Typical time frames are shown in Table 2.1 [Magill-Cuerden, 2011].

First stage

This stage commences with the onset of regular contractions, which cause cervical dilation from 0 to 10 cm. Established labour is signified by regular contractions (about 3–4 in 10 minutes) lasting around 1 minute each. By 8 cm dilated women typically become vocal, requesting epidurals and demanding that the baby is delivered, for example [ALSG, 2010].

Second stage

This stage starts once the cervix is fully dilated and ends with delivery of the baby. Women may have a strong urge to push, which can feel similar to the sensation of wanting to open their bowels ... which might also happen, so be prepared!

Third stage

After delivery of the baby, the third stage commences, ending with the delivery of the

placenta. If this stage lasts more than 30 minutes, the placenta is classed as being retained. In addition, if the placenta partially separates, life-threatening haemorrhage can ensue (post-partum haemorrhage) [ALSG, 2010].

2.3 Assisting in labour and childbirth

Although the clinician will assume clinical responsibility for the health and well-being of the mother and baby, you have an important part to play supporting them both. You can do this by [AACE, 2013]:

- Providing reassurance: Labour and childbirth can be frightening for women
- Ensuring that pain relief is to hand: Entonox is safe to use in labour (Figure 2.1)
- Supporting the mother to adopt whichever position she finds comfortable, although make sure she does not lie on her back. In this position, a pregnant uterus can compress the inferior vena cava, reducing cardiac output and making the mother's blood pressure drop.
- Cutting the cord: If you are asked to do this, ensure that the cord has stopped pulsating (unless the newborn requires urgent resuscitation), apply two clamps about 3 cm and 15 cm from the umbilicus (where the cord attaches to the baby) and keep the baby's fingers and genitals well away!
- Keeping an eye out for blood loss: Women in late pregnancy typically have a circulating blood volume of around 6–7 litres (compared with the normal 5 litres) to allow for blood loss during delivery. However, while some women can tolerate losses up to 1 litre with no apparent effect on their circulation, others will become symptomatic with much smaller volumes. Alert the clinician to all blood loss you identify [PROMPT, 2012].

Table 2.1: Typical time frame in labour

Stage of labour	First pregnancy	Subsequent pregnancies
First	12–14 hours	6–10 hours
Second	60 minutes	Up to 30 minutes
Third	20–30 minutes	20–30 minutes



Figure 2.1 Entonox is safe in pregnancy

2.4 Equipment for childbirth

When assisting a clinician with a birth, either in the community or in the back of an ambulance, an important task is preparing the area for delivery and having the correct equipment to hand.

Delivery area

- Drape either the ambulance stretcher or the bed/sofa etc. with incontinence pads as childbirth is messy!
- Open the maternity pack and lay out the contents so they are easily to hand
- Towels: These should be warm and dry. You'll need at least two
- Blankets: To cover the mother to keep her warm and protect her modesty
- Heat: The delivery area should be around 25°C, which is generally uncomfortably hot for you and your colleagues, but is essential to avoid the newborn becoming hypothermic.

Maternity packs

The contents of maternity packs vary so make sure you are familiar with the contents of your service's packs. Typical equipment found in maternity packs as shown in Figure 2.2 consists of:

- Baby wrap: These often have an insert so that it can be placed over the baby's head. If you have plenty of warm towels, you may not need this
- Clinical waste bag
- Umbilical cord clamps: These are used to prevent blood loss from either the baby or the mother via the placenta following birth

- Maternity pad: Multiple uses, but helpful for applying direct pressure during excessive blood loss following childbirth
- Clear polythene bag: Babies who are premature (born at under 28 weeks) should be placed up to their neck in a food-grade clear plastic wrap or bag immediately after birth without drying [Nolan, 2010]
- Scissors: To cut the cord
- Shallow dish: Usually used to catch or place the placenta in. It is important that a midwife checks the placenta to ensure it is complete and no parts have been retained inside the mother
- Suction catheter: Not usually required, but useful for removing excessive secretions from the baby's mouth and nose.

Resuscitation equipment

Most childbirths end with a screaming baby and a happy mother, but ensure you have the following equipment to hand in case there is a need to resuscitate the newborn or support the mother in the event of large blood loss:

- Oxygen
- Paediatric bag-valve-mask
- Suction unit
- Cannulation equipment (adult)
- Intravenous fluids (usually sodium chloride).

2.5 APGAR

Once a baby has been born, he or she requires assessment to identify the need for intervention, up to and including newborn life support. A commonly used tool is the APGAR score, which was devised by Virginia Apgar in 1953 [Apgar,



Figure 2.2 A maternity pack

1953]. APGAR is a mnemonic consisting of 5 elements which are helpful in assessing the newborn baby [AACE, 2013]:

- **A**pppearance (skin colour)
- **P**ulse rate
- **G**rimace (response to stimulation)
- **A**ctivity or muscle tone (whether moving spontaneously, or floppy)
- **R**espiratory rate.

APGAR scores are recorded at 1 and 5 minutes following birth and each element awarded a score of 0–2 (Table 2.2) [AAP, 2006; AACE, 2013].

An APGAR score of 8 or more generally means that the newborn baby is in good condition [Magill-Cuerden, 2011].

3 Childbirth complications

3.1 Learning objectives

By the end of this lesson you will be able to:

- Briefly explain the following complications, including how you can assist the clinician:
 - Cord prolapse
 - Shoulder dystocia
 - Breech presentation
 - Post-partum haemorrhage
 - Multiple births
 - Pre-term labour.

3.2 Cord prolapse

If the umbilical cord descends below the presenting part, it is said to be prolapsed. However, the presenting part does not actually

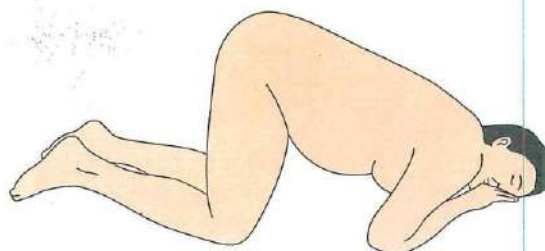


Figure 3.1 Knees to chest position

have to be visible from the entrance to the vagina (introitus). If the cord prolapses, it can become occluded by pressure from the presenting part, resulting in serious fetal morbidity or death. In the absence of a midwife, the only way to know that the cord has prolapsed is if someone checks the introitus, which is why it is vital to perform a visual check to see if the mother's waters have broken (i.e. the membranes have ruptured) [ALSG, 2010].

3.2.1 Management

This is a time-critical emergency. If the woman has been on the phone to a midwife, she may have been advised to adopt a knees to chest position (Figure 3.1), but this is not a practical position to transport the mother in an ambulance.

Assuming delivery is not imminent, get the mother onto the ambulance trolley as quickly as possible. If you can get the trolley alongside, that is great; otherwise walk her to the ambulance. Do not use a carry chair as this can compress the cord.

Table 2.2: APGAR score [AACE, 2013]

Score	0	1	2
Appearance	Blue or pale all over	Blue extremities, body pink	Body and extremities pink
Pulse rate	Absent	<100	≥100
Grimace or response to stimulation	No response to stimulation	Grimace/feeble cry when stimulated	Cry or pulls away when stimulated
Activity or muscle tone	None	Some flexing of arms and legs	Flexed arms and legs that resist extension
Respiration	Absent	Weak, irregular, gasping	Strong cry

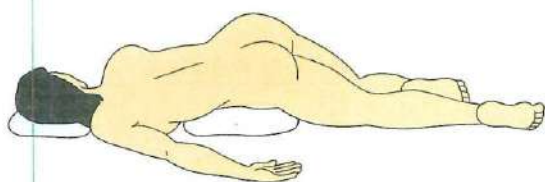


Figure 3.2 Left lateral position with hips raised

Once on the trolley (in or out of the ambulance), place the mother in the left lateral position with hips raised, either with blankets under her hips (Figure 3.2), or by placing the trolley in the Trendelenburg position (i.e. feet end of the trolley raised and head lowered) [ALSG, 2010].

The clinician should make one attempt to replace small loops into the vagina using two fingers. Once this has been completed, cover the vagina with dry pads to prevent further prolapse [AACE, 2013].

The patient should be rapidly conveyed (blue light) to the nearest consultant-led obstetric unit. Make sure a pre-alert call, including notification of a cord prolapse, is made.

3.3 Shoulder dystocia

Shoulder dystocia is a vaginal, head-first delivery that requires additional obstetric manoeuvres after the head has delivered, and a head-body delivery delay of more than 60 seconds [RCOG, 2012]. Shoulder dystocia is difficult to predict prior to birth, with around 50% of cases having no risk factors and in babies of normal birth weight [ALSG, 2010].

In the late second stage of labour, a clue that shoulder dystocia is a possibility is head bobbing, where the fetal head is visible during contractions, but retracts in between. At the time of delivery, you may see the 'turtle neck sign', where the fetal chin retracts tightly onto the mother's perineum and the fetal neck is not visible at all [RCOG, 2012].

3.3.1 Management

The senior clinician will attempt to deliver the anterior shoulder by applying gentle downwards traction. If this is not successful after two contractions, place the mother flat on her back with a pillow under her head and ask her to bring her knees towards her chest (the McRobert's position, Figure 3.3). Due to the size of the mother's uterus, this will cause flexion and

abduction of her hips, increasing the anterior-posterior diameter of the pelvis [RCOG, 2012]. In 60–70% of cases, this position alone will result in successful delivery with gentle downwards and outwards traction while the mother is encouraged to push.

If after another two contractions the baby has still not delivered, you will be asked to apply suprapubic pressure to aid delivery. The procedure is as follows [AACE, 2013]:

- The clinician will identify the fetal back (usually the opposite side to the way the fetus is facing)
- You will be asked to stand on the same side as the fetal back and adopt a CPR-style hand technique with your hands positioned two-finger's breadth above the symphysis pubis, behind the fetal shoulder
- Do not push on the fundus (the superior portion of the uterus) as this could rupture the uterus
- You will be instructed to press down and away to dislodge and rotate the shoulder
- While this is being done, the clinician will apply gentle downward traction on the head.

If the baby has not been delivered after a further two contractions:

- The mother should be encouraged to empty her bladder
- You will be asked to continue applying pressure on the symphysis pubis but, in addition, gently rock backwards and forwards on the symphysis pubis.

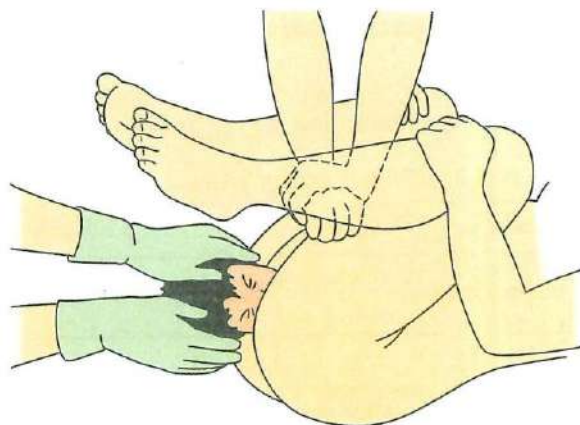


Figure 3.3 The McRobert's position with an assistant applying suprapubic pressure

If the baby has not been delivered after a further two contractions:

- Assist the mother onto all fours (hands and knees). The clinician will apply gentle downward traction to deliver the posterior shoulder (i.e. the shoulder nearer the mother's back).

If the baby has not been delivered after a further two contractions:

- It is time to go!
- The mother should be rapidly transported to the nearest consultant-led obstetric unit. If you cannot get the ambulance stretcher next to the patient, it is acceptable to allow the mother to walk a short distance, but get ready to deliver the baby
- Place the mother in the left lateral position with hips raised
- Provide high-flow supplemental oxygen
- Pre-alert the unit and make sure you tell them it's a shoulder dystocia.

3.4 Breech presentation

In a breech presentation, the fetus enters the birth canal with buttocks or feet first, rather than the more usual head first. The most common presentations are shown in Table 3.1 [Magill-Cuerden, 2011]. Breech presentations are similar to normal labour except that you may see buttocks, feet or the soles of the feet during your assessment of the introitus. In addition, the genitals may look bruised and swollen, and meconium may be present (looking a bit like black toothpaste) [ALSG, 2010].

3.4.1 Management

If delivery is not in progress and the clinician is confident that you can get the mother to hospital, transport the mother to the booked obstetric unit, but continually reassess en route.

If birth is imminent, call for a second ambulance and community midwife and adopt the following principles [AACE, 2013]:

- The golden rule is that breech births should be as hands-off as possible
- Ask the mother to adopt a semi-recumbent position; if she is sitting on a chair or sofa, get her to shift to the edge and support her splayed legs

- The body should deliver spontaneously without intervention, and should rotate so that the baby's back faces the mother. If this does not happen, the clinician should gently rotate the baby, holding onto the pelvis (not the legs or abdomen)
- If asked to clamp or cut the cord, **do not** do this until the head has been delivered
- Once the body has delivered, the clinician will lift the baby by its feet to assist in delivering the head
- Once the baby has been delivered, the childbirth is managed as for a normal childbirth, but breech babies are more likely to be covered in meconium and require newborn life support.

3.5 Post-partum haemorrhage

Primary post-partum haemorrhage (PPH) is defined as a blood loss greater than 500 ml within 24 hours of birth [WHO, 2012]. It affects around 18% of vaginal births, although only 1.3% involve major PPH, which is a blood loss of over 1000 ml [PROMPT, 2012]. Massive PPH is defined as loss of 50% of the mother's circulating blood volume within three hours of delivery [AACE, 2013].

Risk factors

As with many aspects of obstetrics, there is no definitive list as to who will suffer a PPH and who will not, but there are a number of risk factors that make a PPH more likely [ALSG, 2010]:

- Multiparity greater than 5
- Advancing maternal age
- Previous PPH or ante-partum haemorrhage (APH)
- Long labour
- Obesity
- Anything that increases the size of the uterus (multiple pregnancy, large baby, excess amniotic fluid)
- Uterine fibroids
- Partial separation of the placenta.

3.5.1 Management

The management of the PPH depends on the cause of the bleeding, so it is important to determine this early in your assessment. There are

four main causes of PPH, known as the four Ts [AAFP, 2012]:

- Tone
- Tissue
- Trauma
- Thrombin.

Tone

Uterine atony (poor tone of the uterus) is the cause of 70–90% of PPHs [AAFP, 2012]. Usually the uterus contracts after birth, occluding the

spiral arteries that have provided the blood supply to the placenta during pregnancy.

In order to control the blood loss from an atonic uterus, the upper portion of the uterus (called the fundus) must be massaged to encourage the uterine fibres to contract. If you are asked to perform fundal massage, start at the umbilicus and apply firm pressure backwards towards the aorta and then downwards towards the uterus in a circular cupping motion. This will encourage the contraction of the uterus (Figure 3.4). As this

Table 3.1: Common breech presentation

Presentation	Incidence	Explanation	
Frank	65%	Bottom first with legs flexed at the hip and extended at the knees.	
Complete	25%	Hips and knees are flexed resulting in the fetus sitting cross-legged, with feet beside the bottom.	
Footling	10%	One or both feet come first, with bottom higher up. Rare presentation at term, but common in premature births	

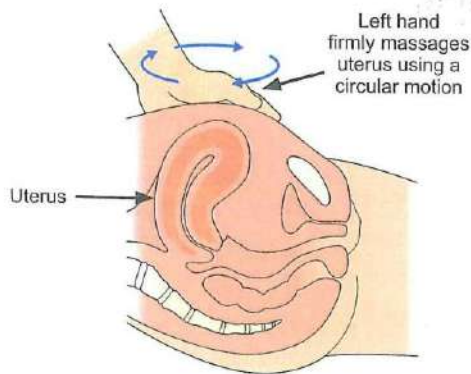


Figure 3.4 Fundal massage

is an uncomfortable procedure, it is important to remember to inform the patient of what you are about to perform and why, gain consent and ensure appropriate analgesia is used. The clinician may elect to use oxytocic drugs such as syntometrine or misoprostol [AACE, 2013].

Tissue

If there are any tissues left behind after the birth, such as the placenta or membranes, the uterus will continue bleeding in order to remove them. This mechanism is responsible for around 10% of PPHs [AAFP, 2012]. These patients should not receive fundal massage as this might cause partial separation of the placenta, causing further bleeding [AACE, 2013]. The completeness of the placenta and membranes is important, so keep the placenta with the mother so that it can be checked to ensure it is complete.

Trauma

Trauma to the genital tract during childbirth occurs in approximately 85% of births [Smith, 2013]. These are wide ranging in terms of severity, from small tears that only involve the skin of the perineum, to deeper tears that affect the muscle layers. Due to an abundant vascular supply, 20% of PPHs are caused by tears [AAFP, 2012]. The bleeding can originate from the tear or from ruptured vessels within the tissue. Definitive management is suturing of the perineum, but direct external pressure with a maternity pad or gauze and the administration of oxytocic drugs such as syntometrine and

misoprostol is the mainstay of pre-hospital treatment.

Thrombin

Clotting problems are rare, being responsible for only 1% of PPHs. These can lead to life-threatening clotting disorders which require urgent hospital management.

3.6 Multiple births

Multiple births (twins or greater) occur in about 1.6% of births in England and Wales each year [ONS, 2013a]. It is uncommon for women with multiple pregnancies to give birth outside of hospital, but premature delivery (before 37 weeks) is more common, increasing the risk of parents being caught out [AACE, 2013].

Complications during a multiple pregnancy are also more likely and include [ALSG, 2010]:

- Pregnancy-induced hypertension, including pre-eclampsia
- Placental abruption
- Placenta praevia
- Post-partum haemorrhage.

Risk factors for multiple pregnancy include [ALSG, 2010]:

- Fertility treatment
- Previous history of twins
- Family history of multiple pregnancies
- Multiparity (having previously given birth twice or more).

3.6.1 Management

If delivery is not imminent, then the mother will be transported rapidly to the nearest consultant-led obstetric unit [AACE, 2013].

If delivery is in progress, however, follow local guidelines to request a community midwife and assist the clinician in delivering the first baby.

Once the first baby has been born, mother and baby need to be transported rapidly to the nearest obstetric-led unit **if** the second baby is not due to be imminently delivered. If the second baby is coming, remain on scene and contact the emergency operations centre (EOC) for an additional ambulance. Remember to make a pre-alert call and ensure the unit knows that it is a multiple pregnancy [AACE, 2013].

3.3 Pre-term labour

Pre-term labour is defined as labour occurring before 37 weeks' gestation. It is a significant cause of neonatal morbidity and death, with babies born before 24 weeks unlikely (although not impossible) to survive [ALSG, 2010].

Risk factors for pre-term labour include [ALSG, 2010]:

- Previous pre-term labour
- Multiple pregnancies (twins or more)
- Maternal smoking
- Lower socioeconomic groups
- Spontaneous rupture of membranes in the current pregnancy.

3.3.1 Management

The destination depends on the gestation (how many weeks pregnant the mother is). If the woman is less than 22 weeks pregnant, then she should be taken to the nearest gynaecology unit. After 22 weeks, the mother should ideally be transported to an obstetrician-led unit [AACE, 2013].

These babies are best born in hospital and the clinician will try to achieve this by asking you to promptly transport the patient. Confirm the destination hospital.

If it is clear that childbirth is imminent, either at scene or en route to hospital, contact the emergency operations centre (EOC) and request a midwife and additional ambulance to your current location.

Once the baby has been born, it should be transported by the second crew immediately. Remember that babies born under 27 weeks should be placed up to their neck in a food-grade clear plastic wrap or bag immediately after birth without drying [Nolan, 2010].

The mother should be transported in your ambulance to the same hospital as the infant.

4 Newborn life support

4.1 Learning objectives

By the end of this lesson you will be able to:

- Demonstrate the resuscitation of the newborn in line with current national guidelines.

4.2 Introduction

The resuscitation of babies at birth is different from that of infants and children, because of the transformation, usually within seconds, from being a fetus with fluid-filled lungs, with all respiratory work undertaken by the mother's placenta, to a baby with air-filled lungs who is capable of ventilating themselves. Childbirth is a hypoxic process for the fetus, but it is resilient and usually will not require intervention.

However, if the normal physiological processes fail, then you will need to intervene [Maconochie, 2012].

4.2.1 Management

Normally, your clinician will undertake the following steps, but will still require your assistance as some manoeuvres (such as maintaining a patent airway) are better with two people. In some circumstances (such as post-partum haemorrhage) you may be asked to start resuscitation of a newborn until the mother can be stabilised or further help arrives.

There are 5 stages that the resuscitation moves through systematically (Figure 4.1):

1. Drying and covering the baby
2. Assessing the need for intervention
3. Airway
4. Breathing (aerating the lungs and positive pressure ventilation)
5. Chest compressions.

When a baby is born, unless the clinician feels there is a need for immediate resuscitation, wait until the umbilical cord stops pulsating. Keep the baby warm during this period and then [Maconochie, 2012]:

- Dry the baby quickly. Discard the towel used to dry the baby and wrap it in another, warm and dry towel
- Assess the baby:
 - Respiration: Most babies will spontaneously breathe effectively, such that the heart rate rises above 100 beats/min and leads to 'pinking up' of the torso within 3 minutes of the birth. If the baby is not breathing, or only making occasional gasps, then further intervention is required

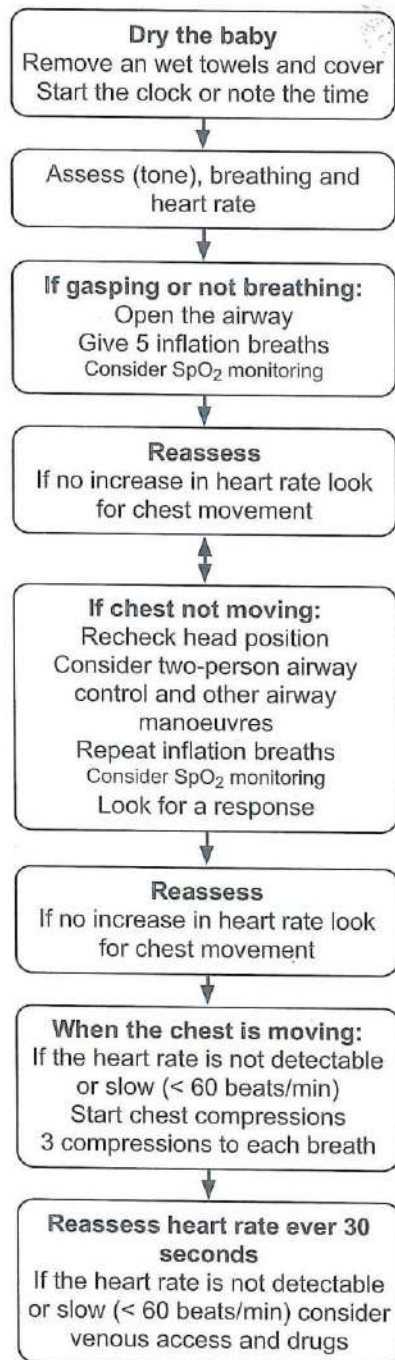


Figure 4.1 Newborn life support algorithm
Reproduced with the kind permission of the Resuscitation Council (UK)

- **Heart rate:** This is best undertaken by auscultating over the cardiac apex (near the baby's left nipple). The exact rate is not necessary, just note whether it is very slow (less than 60 beats/min), slow (60–100 beats/min) or fast (over 100 beats/min). Anything under 100 beats/min is abnormal and will require intervention
- **Colour:** This is not a reliable sign, but improvements in colour are encouraging
- **Muscle tone:** Babies should be moving spontaneously and should resist gentle attempts to move their limbs. A floppy baby is not a good sign
- **Airway:** A newborn baby's head is disproportionately large compared to its body, which leads to flexion of the neck and occlusion of the airway. Worse, overextension of the head can also lead to obstruction. Place the newborn on a folded towel (to about a thickness of 2 cm) to support the shoulders (Figure 4.2). A jaw thrust may be required to open the airway
- **Breathing:** The first 5 breaths are known as inflation breaths. These are prolonged (2–3 seconds in duration) and are best performed with a 500 ml paediatric bag-valve-mask (BVM) with a blow-off valve set at 30–40 cmH₂O to prevent excessive airway pressures being generated. Note that the chest may not move for the first to third ventilations as fluid in the lungs has to be displaced. Successful ventilation can be gauged by either a rapidly increasing heart rate after the first 5 breaths, or a heart



Figure 4.2 Resuscitation of the newborn. Note the use of a towel to help with positioning, the neutral position of the newborn's head, and the use of the encircling technique to provide chest compressions

rate >100 beats/min. Note that you should ventilate with air, NOT oxygen initially

- Chest compressions: If the heart rate remains very slow (<60 beats/min) despite 30 seconds of ventilating the baby and seeing a visible chest rise with each inflation, you will need to start chest compressions. The best way to

perform compressions on a neonate is to use the two-thumb encircling technique (Figure 4.2). Compress the chest quickly and firmly by one-third of its depth with a compression-to-ventilation ratio of 3:1. Once the heart rate rises above 60 beats/min, compressions can be discontinued.

Chapter 18: Children and Infants

1 Why paediatric patients are different

1.1 Learning objectives

By the end of this lesson you will be able to:

- Explain how paediatric patients are anatomically, physiologically and developmentally different from adults.

1.2 Introduction

Paediatrics is a speciality of medicine that looks after people from birth to age 18 years. Children are generally divided into 5 main groups [Lissauer, 2007]:

- Infants: From birth to 12 months of age. In the first four weeks after birth, infants may also be called neonates
- Toddler: Approximately 1–2 years of age
- Pre-school: This is a young child aged 2–5 years
- School-age: Generally 5–12 years (or the onset of puberty)
- Teenager: Also called adolescents. Generally from onset of puberty to 18 years, when, in the UK, they become an adult. Some guidance (such as for resuscitation or the administration of some drugs) treats this group the same as adults).

Note that for the purposes of resuscitation, an infant is a patient under 12 months of age and a child is a patient who is 1 year to the onset of puberty (around 12 years) [Maconochie, 2012].

1.3 Anatomy and physiology

As children get older, their bodies change anatomically and physiologically. This is important to remember when undertaking your assessment as you may need to modify your plan for their management.

1.3.1 Airway

Most of the changes in the infant and child airway have been covered in the section on CHOKING IN THE PAEDIATRIC PATIENT (chapter 9).

However, some extra points to consider are provided here.

Face and mouth

Infants' faces are small. This makes sizing of a face mask for resuscitation important if a good seal is to be achieved. It is important that pressure on the eyes is avoided as this can result in damage and a reflex bradycardia. The floor of the mouth is also easy to compress, so care must be taken not to apply pressure to the soft tissues under the mandible during airway opening and positive pressure ventilations (Figure 1.1) [Maconochie, 2012].

Nose and pharynx

In the first 6 months, infants breathe through their nose, meaning that any nasal obstruction can result in increased work of breathing and respiratory compromise [AAP, 2013].

1.3.2 Breathing

Infants and small children have relatively small resting lung volumes, which means they have less oxygen capacity in reserve than adults and have a higher oxygen consumption. In cases of respiratory compromise therefore, the blood oxygen levels in these infants and small children will rapidly decline, making the prompt administration of supplemental oxygen crucial [Maconochie, 2012].

The ribs of infants are cartilaginous and so are very pliable. In addition, they have weak



Figure 1.1 Infant positive pressure ventilation

intercostal muscles, which means that the diaphragm is their main muscle of respiration. If the diaphragm is impeded in any way, such as by gastric distension, for example, their ventilation may become ineffective [AAP, 2013].

As children get older, their intercostal muscles become more developed, contributing more to mechanical ventilation. Their ribs ossify, hardening and acting as an anchor for the developing intercostal muscles, making them less likely to collapse during periods of respiratory distress. As a result, intercostal recession in any child over the age of 5 years should be seen as an ominous sign of severe respiratory distress [Maconochie, 2012].

Infants have a relatively high metabolic rate, oxygen consumption and carbon dioxide production, requiring a higher respiratory rate than older children. This can be further increased by pain, fever and anxiety, resulting in changing 'normal' respiratory rates for infants and children (Table 1.1) [Maconochie, 2012].

Table 1.1: Respiratory rate ranges in infants and children

Age (years)	Respiratory rate (breaths/min)
< 1	30–40
1–2	26–34
2–5	24–30
5–12	20–24
> 12	12–20

1.3.3 Circulation

The circulating blood volume in an infant is about 80 ml/kg, which means that in a newborn baby weighing 3 kg, their blood volume is only 240 ml, making small blood losses significant.

Another important point to note is that oxygen delivery to the tissues is dependent on the arterial blood oxygen content multiplied by the cardiac output. In respiratory failure, a reduction in arterial blood oxygen can be compensated by increasing cardiac output. However, in circulatory failure, it is not possible to increase arterial blood

oxygen content so tissue oxygen delivery falls immediately [Fuchs, 2012].

The stroke volume at birth is small, only 1.5 ml/kg, so increasing cardiac output is mainly achieved by increasing heart rate. Thus heart rates in infants and small children are higher than in older children (Table 1.2). In addition, systemic vascular resistance increases as children get older, a change reflected by increased 'normal' blood pressures (Table 1.3) [Maconochie, 2012].

Table 1.2: Paediatric heart rate ranges

Age	Awake (beats/min)	Deep sleep (beats/min)
0–3 months	85–205	80–140
3 months to 2 years	100–180	75–160
2–10 years	60–140	60–90
> 10 years	60–100	50–90

Table 1.3: Paediatric blood pressure ranges

Age	Systolic blood pressure (mmHg)
0–1 month	> 60
1–12 months	80
1–10 years	$90 + (2 \times \text{age in years})$
> 10 years	120

1.4 Cognitive development

Children are also challenging because their brain develops as they age. This means that during your assessment of a child, you will expect different levels of interaction and abilities in a 1-year-old compared to a 12-year-old child [Lissauer, 2007; AAP, 2013; Fuchs, 2012].

1.4.1 Infants

Under 2 months

Infants in this age group will spend the majority of their time feeding and sleeping. They are unable to tell the difference between their parents/carers and others, so do not display

stranger anxiety. They will exhibit primitive reflexes such as grasping objects placed in the palm of their hand, or turning their head towards a gentle stimulation of the side of their mouth (rooting).

2–6 months

Infants become more active during this period, making assessment a little easier. They begin to make eye contact, will smile and follow the light of your pen torch or a toy with their eyes. They will also turn their head in response to a loud noise or the voice of their parent/carer. Their motor skills develop and they will start to roll over and reach for objects. They will vocalise with coos and laughs when spoken to.

6–12 months

Infants are much more socially interactive at this age. They may be able to say single words such as "mama" or "dada", but will also develop stranger anxiety in the latter stages (typically after 9 months), so keep the infant with their parent/carer if possible. They will be able to feed themselves, sit unsupported, reach for objects and pass them between hands.

1.4.2 Toddlers

There is a rapid change in growth and cognitive development at this age. By 18 months, children will have a vocabulary of around 6–10 words, and will know the name of, and be able to point to, several parts of their body. They should be able to walk steadily and feed themselves with a spoon.

As they reach 2 years of age, children may be able to combine several words together to make a simple phrase. They will start to engage in symbolic play, feeding their teddy for example. Stranger anxiety may be extreme and they are typically illogical thinkers, learning by trial and error, but have no sense of danger. They are self-centred and will be able to label objects as "mine". Toilet training may lead to children being dry during the day.

1.4.3 Pre-school

These children are creative and illogical thinkers, often confusing fantasy and reality. They are likely to have misconceptions about illness, injury and bodily functions. In addition, they may fear the dark, being left alone and the presence of

monsters under the bed. They have good language skills and can participate in parallel play, taking it in turns with others, but their attention span is short.

1.4.4 School-age

Children at this age understand cause and effect and are capable of abstract thought. They can tell you about the progress of their current illness or injury but their ability to understand the seriousness of the situation is limited. They can be involved with their care if explanations are kept simple and clear. Peer-group support becomes important at this age, but they will still have separation anxiety from their parents/carers when ill, and fear pain and loss of control.

1.4.5 Teenagers

Teenagers (adolescents) are sometimes compared to toddlers: highly mobile but lacking common sense! However, they are able to rationalise and express themselves and their feelings in words. This is also a period of experimentation and risk-taking. Children at this age will typically transition from relying on their parents/carers for psychological support and development to their friends and peers. This typically leads to feelings of anxiety if they are 'different' from their peers. In addition, they may struggle with anxiety of independence, body image, sexuality and peer pressure.

2 Initial assessment and management of the paediatric patient

2.1 Learning objectives

By the end of this lesson you will be able to:

- Conduct an initial assessment of the paediatric patient
- Identify problems with a paediatric patient's airway, breathing, circulation and neurological status
- Describe the principles that underpin the support of a seriously ill paediatric patient
- Demonstrate the procedures to support a clinician to manage a seriously ill paediatric patient.

2.2 Introduction

The assessment of the paediatric patient is much the same as for adults, and you will follow the standard procedure you learnt about in the PATIENT ASSESSMENT PROCESS lesson (chapter 8). As before, the primary survey is a chance to identify and correct life-threatening problems. In infants and children, prompt recognition and intervention when there are signs of respiratory and/or circulatory failure can prevent the majority of paediatric cardiorespiratory arrests [Maconochie, 2012].

2.3 Developmental approach to the paediatric patient

As you found out in the lesson on WHY PAEDIATRIC PATIENTS ARE DIFFERENT, a child's cognitive development changes as they age, which requires modification to your method of assessment. In this section, you will be provided with some suggestions about how to conduct an assessment of the paediatric patient. Don't forget that you will also need to manage and reassure an often anxious and distressed parent/carer.

2.3.1 Infants

Conduct your assessment by taking account of the following principles [AAP, 2013]:

- Keep the environment comfortable, in terms of temperature and security for the infant. Familiar toys and blankets can help
- Use the name of the patient while conducting your assessment
- Where possible, assess an infant in the arms of a parent/carer
- Approach the infant slowly and calmly. Loud voices and fast movements may scare them
- Do not stand over an infant, but sit or kneel at their eye level
- Look, listen and feel, in that order, to minimise infant distress
- Warm your hands, and tools such as stethoscopes
- Be flexible in your assessment. If the infant is calm, count the respiratory rate and listen to the chest first. This is not possible to do accurately when the infant is crying
- Observe the interaction between parent/carer and the infant. Consider if child abuse is a possibility

- Toys can be used to distract the infant
- Older infants may display stranger anxiety, so if you need to expose the infant, ask the parent/carer to do this. Don't let the infant get cold, though
- Save painful procedures (such as blood sugar measurement) until last.

2.3.2 Toddlers

Conduct your assessment taking account of the following principles [AAP, 2013]:

- Use the name of the patient while conducting your assessment
- Approach slowly and don't touch them until they are familiar with you
- Communicate using a firm, but friendly, tone of voice
- Do not stand over a toddler, but sit or kneel at their eye level
- Where possible, place the toddler on the lap of a parent/carer
- Use play and distraction to help you conduct your assessment
- If you need to use equipment, such as a stethoscope, let them hold it and become familiar and comfortable with it
- Communicate directly with the toddler. Admire their clothes or ask about pets. Remember they are self-centred at this age
- Provide limited choices. For example "Do you want me to listen to your belly or chest first?"
- Avoid questions that can be answered with a "NO"
- Examine a toddler from toe-to-head
- Involve the parent/carer. For example, place the pulse oximeter probe on their finger first, and ask them to remove the toddler's clothes or hold an oxygen mask near the toddler
- Do not expect toddlers to sit still and cooperate. Be patient and opportunistic.

2.3.3 Pre-school

Conduct your assessment taking account of the following principles [AAP, 2013]:

- Use the name of the patient while conducting your assessment
- Use simple terms to explain what you are going to do

- Choose your words carefully. Use age-appropriate language and avoid scaring the child
- Teddy or dolls can be helpful to explain what you are going to do
- Set limits on behaviour, if required. For example, "You can cry or scream, but not kick or bite". Praise good behaviour
- Use games and toys to provide distraction. Ambulance bandages can be useful for this
- Focus on one thing at a time and minimise the time between explaining a procedure, especially a painful one, and carrying it out.
- Speak directly to the teenager and ask them first for information. If they do not know the answer, for example the name of their GP, check with them if it is okay to ask their parent/carer
- Respect their modesty and privacy. Be confidential unless you have a duty to report or pass on their disclosures
- Be honest and non-judgemental. Provide accurate information and allay fears, particularly concerns over body image or being 'different' as a result of their current illness or injury
- Do not mistake the size of the teenager as a measure of their maturity
- Avoid becoming frustrated or angry if the teenager does not want to communicate or is uncooperative
- Enlist the help of their friends to assist when the teenager is being uncooperative, although keep in mind the teenager's right to confidentiality.

2.3.4 School-age

Conduct your assessment taking account of the following principles [AAP, 2013]:

- Use the name of the patient while conducting your assessment
- Privacy becomes important in this age group. Make sure the environment is appropriate, and if you need to expose the child to examine them, cover them up afterwards
- Speak directly to the child first, then include the parent/carer. Ask older children if they would like their parent/carer present
- Involve the child in their care if they want this. Feeling out of control can distress children in this age group. However, do not negotiate unless the child really does have a choice
- Anticipate the fears that the child has and address them straight away. Assure them that becoming ill or injured is not a punishment
- Explain in simple terms what is wrong and what is going to be done
- Explain procedures just prior to undertaking them. Don't lie to the child, for example telling them a procedure won't hurt, when it will
- Praise the child for being cooperative, but do not chastise them if they are not
- Physical assessments in this age group can usually be conducted head-to-toe.

2.3.5 Teenagers

Conduct your assessment taking account of the following principles [AAP, 2013]:

- Use the name of the patient while conducting your assessment

2.4 Primary survey

The primary survey in the infant and child is the same as for adults, except for the general impression component, which should include use of the paediatric assessment triangle (PAT). The PAT is advantageous in children because it can be undertaken without actually touching the child and can be performed 'across the room' to avoid increasing a child's anxiety, by getting too close initially [AAP, 2013].

2.4.1 General impression

It is important to gain a general impression of the health of an infant or child from 'across the room', before your presence has an adverse effect on their level of anxiety or distress. To help you achieve this, use the paediatric assessment triangle (PAT) [Dieckmann, 2010]. As the name suggests, it consists of three key components:

- Appearance
- Work of breathing
- Circulation to skin.

Appearance

The child's general appearance is probably the most significant aspect of the PAT as it provides information about the perfusion of the brain. The

parts of this component can be remembered using the mnemonic TICLS [AAP, 2013]:

- **Tone:** Is the infant/child moving spontaneously or are they floppy and listless?
- **Interactiveness:** Does the infant/child respond to people, objects and sounds or are they uninterested in their surroundings?
- **Consolability:** Can the infant/child be consoled by their parent/carer?
- **Look/Gaze:** Does the infant/child look at you or do they have a 'glass-eyed' stare into the distance?
- **Speech/Cry:** Is their speech or cry strong or weak, muffled or hoarse?

Work of breathing

In children, it is their work of breathing that provides a better indication as to the adequacy of oxygenation and ventilation, rather than the more traditional respiratory rate and/or auscultation in adults [AAP, 2013]. Look for signs of increased work of breathing as well as listening for abnormal airway sounds:

- **Abnormal airway sounds:** These include snoring, muffled or hoarse speech, stridor, grunting and wheezing
- **Abnormal positioning:** Children who can sit up may adopt a 'sniffing the morning air' position, tripod position and/or refuse to lie down
- **Recession:** Recession of the chest muscles provides an indication of increased work of breathing, as does head bobbing in infants. Beware the child over 5 who has signs of recession, as this is a sign of serious respiratory compromise [Maconochie, 2012]
- **Flaring:** Look for nasal flaring, an exaggerated opening of the nostrils during laboured inspiration.

Circulation to skin

When cardiac output is not sufficient to meet the body's metabolic demands, the circulation to non-essential organs, such as the skin, reduces. This can manifest in children as [AAP, 2013]:

- **Pallor:** White or pale skin indicating a reflex shunting of blood away from the skin. This may be the only sign of compensated shock
- **Cyanosis:** This is blue discolouration of the skin caused by inadequate oxygenation. Note that blue hands and feet in newborns and infants

under the age of 2 months (acrocyanosis) is a normal finding

- **Mottling:** This is caused by abnormal blood vessel tone in the capillary beds of the skin. There are patchy areas of pallor and cyanosis. This can be normal when the child is exposed to a cold environment.

24.2 Airway

Assessment

Obstruction of the airway is common in seriously ill children, causing hypoxia, which can lead to unconsciousness and cardiorespiratory arrest (such as in cases of choking) [Maconochie, 2012]. The lesson ON CHOKING IN THE PAEDIATRIC PATIENT (chapter 9) covered the former, so will not be revisited here.

Look for apparent difficulty in breathing or increased work of breathing. In conscious children, they may be in visible distress. Listen for additional noises, such as stridor, a high-pitched (usually) inspiratory sound [Maconochie, 2012].

Management

Children who are conscious should be allowed to adopt a position of comfort, ideally one that they themselves adopt to maximise the efficiency of their airway, and supplemental high-flow oxygen via a non-rebreathe mask should be administered.

For unconscious children, their head needs positioning appropriately to open the airway and prevent the tongue from falling backwards and occluding the airway. This can be achieved in children using a head tilt–chin lift, or jaw thrust manoeuvre as described in the MANAGING THE AIRWAY lesson (chapter 9). Remember that in infants, their head should be placed in the neutral position, with padding under the shoulders to account for their proportionally larger head (Figure 2.1). Care must be taken not to compress the soft tissues under a child's jaw as this can also occlude the airway [Maconochie, 2012].

Suction is useful in children, as in adults, but in infants, suction pressures should not exceed 120 mmHg.

Oropharyngeal airways (OPAs) can be used in children as for adults. For small children and infants, it is generally recommended that the



Figure 2.1 An infant, with their airway in neutral alignment

OPA is introduced the 'right way round' and not rotated 180°. This is likely to require a tongue depressor or, if that is not available, a laryngoscope [Gregory, 2010b].

2.4.3 Breathing

Assessment

The most effective way of determining whether the airway is obstructed is to look, listen and feel [Biarent, 2010]:

- Look for chest (and abdominal) movements
- Listen at the child's mouth and nose for breath (plus added) sounds
- Feel for air movement on your cheek.

Note that the chest may move in children, even with an obstruction, making it important to listen and feel.

As part of gaining a general impression, you will already have considered the patient's work of breathing, which includes [AAP, 2013]:

- Abnormal airway sounds
- Abnormal positioning
- Recession
- Flaring.

Other signs of increased work of breathing include elevated respiratory rates and accessory muscle use.

Abnormal airway sounds

Stridor is a high-pitched inspiratory sound, which indicates an upper airway obstruction. This may be an object, or swelling due to infection. In severe cases, it can also occur on expiration. A wheeze, on the other hand, is usually an expiratory sound and is a sign of lower airway

obstruction. You may be able to hear it with just your ears, but often it will only be heard on auscultation [AAP, 2013].

Grunting is usually heard in neonates and small infants, although it can occur in small children. It occurs when the infant exhales against a partially closed glottis. This generates a small amount of end-expiratory pressure, keeping the small airways from collapsing at the end of expiration. It is an indication of severe respiratory compromise [Maconochie, 2012].

Abnormal positioning

Children in respiratory distress typically adopt a position that maximises their respiratory efficiency. In upper airway obstruction, this will be a 'sniffing the morning air' position. In lower respiratory problems they may adopt a 'tripod' position, sitting forward with their arms outstretched and resting on their knees [Maconochie, 2012].

Recession

Recession can be sternal, subcostal and/or intercostal. Note that significant recession can be seen in infants and young children, even in mild respiratory distress, due to their compliant chest wall (Figure 2.2). However, as previously mentioned, it is a serious sign in children over 5 years of age [AAP, 2013].

Respiratory rate

An increased respiratory rate (tachypnoea) is often the first sign of respiratory problems,



Figure 2.2 A newborn with intercostal recession
By Bobigalindo (Own work) [CC-BY-SA-3.0-2.5-2.0-1.0], via Wikimedia Commons

although it can be difficult to assess in the crying infant/child (Table 2.1) [Maconochie, 2012].

Table 2.1: Respiratory rate ranges in infants and children

Age (years)	Respiratory rate (breath/min)
< 1	30–40
1–2	26–34
2–5	24–30
5–12	20–24
> 12	12–20

Accessory muscle use

Additional muscles are often recruited when the work of breathing increases. One group is the sternocleidomastoid muscles in the neck. These cause 'head bobbing' in infants, who will nod their head up and down with each breath. However, this is not an efficient method of breathing [Maconochie, 2012].

Pulse oximetry

This can be unreliable when a child has poor peripheral circulation, but if obtainable, a reading of less than 90% on air, or 95% on high-flow oxygen, is a sign of respiratory failure and urgent intervention is required [Biarent, 2010].

Management

All seriously ill children should receive high-flow oxygen via a non-rebreather mask, unless their ventilation is insufficient. In this case, assistance should be provided with bag-valve-mask ventilation. For children who are conscious, placing a mask over the child may be distressing. In this case, attempt administration using the least-threatening method, for example by asking the parent/carer to hold an oxygen mask close to the patient's mouth and nose [AACE, 2013].

2.4.4 Circulation

Assessment

When assessing circulation, look for signs of blood and other fluid losses, which are causing shock. Children can compensate very well, maintaining their blood pressure until they have

significant fluid losses. However, you can spot the child in compensated circulatory failure by examining the following [Maconochie, 2012]:

- Heart rate
- Pulse volume
- Capillary refill time.

Heart rate

Tachycardia is common in children and has a number of causes including pain, anxiety and fever. Bradycardia, however, is a serious sign and you should make your senior clinician aware if you discover an infant's heart rate less than 80 beats/min or a child's heart rate less than 60 beats/min [Maconochie, 2012].

Pulse volume

When a child develops shock, peripheral pulses will become weak and thready. If central pulses (such as a carotid pulse) become weak and thready, the child is in cardiorespiratory failure and arrest is imminent [Maconochie, 2012].

As children become peripherally vasoconstricted in response to shock, their extremities will become cool. Sometimes there is a clear demarcation line between cool skin and warm skin, that will either move towards the torso if shock progresses, or move distally if perfusion and circulation improve [AACE, 2013].

Capillary refill time

Capillary refill time can be a useful indicator of circulatory status, as was covered in the ASSESSMENT OF CIRCULATION lesson (chapter 11).

Management

The principal method of maintaining circulation is to ensure that airway and breathing are adequately addressed and any life-threatening conditions, such as tension pneumothorax, are identified and treated. However, for seriously fluid-depleted children, intravenous access will be required and fluid replacement in 20 ml/kg boluses of normal saline will be required [AACE, 2013].

2.4.5 Disability

Assessment

Often, you will already have an idea about the patient's level of consciousness (LOC) from the general impression. Use the AVPU mnemonic to quickly gauge the child's LOC:

- A : Alert
- V: Responds to voice
- P: Responds to pain
- U: Unresponsive.

Pupils should be checked for dilation, equality and reactivity. Seriously ill children are typically hypotonic and floppy, but in cases of serious brain dysfunction, posturing (particularly in response to pain) such as abnormal flexion and extension may be seen [Maconochie, 2012].

Management

Ensure that airway, breathing and circulation are managed adequately. Don't forget to check

blood glucose, and during the history determine whether there is a risk of poisoning or meningococcal septicaemia [AACE, 2013].

2.4.6 Exposure/Environment

In order to complete the primary survey it may be necessary to remove some of the child's clothing, but be mindful that children lose heat rapidly, particularly infants. Use this time to thoroughly examine infants and children who are ill, for rashes [Pilbery, 2013].