Failure to breathe at birth and resuscitation

Objectives

When you have completed this unit you should be able to:

- Define failure to breathe well at birth.
- Appreciate the importance of poor breathing at birth.
- List which infants are likely to need resuscitation at birth.
- Prepare for resuscitation.
- Resuscitate an infant.

Assessing the infant at birth

1-1 Do all newborn infants breathe well at birth?

No. Most newborn infants start to breathe well without assistance and often cry immediately after birth. By 1 minute after delivery most infants are breathing well or crying. If an infant fails to establish adequate, sustained respiration after delivery (gasps only or does not breathe at all) the infant is said to have failed to breathe well at birth. About 10% of all newborn infants fail to breathe well and require some assistance to start breathing well after birth.

Infants should cry or breathe well after delivery.

Failure to breathe well will result in hypoxia if the infant is not rapidly resuscitated. Therefore failure to breathe well is an important cause of neonatal death if not managed correctly.

NOTE

> The word 'asphyxia' causes an enormous amount of confusion as it is used by paediatricians to indicate that the infant does not breathe well after delivery (i.e. 'neonatal asphyxia'). However it is also used by obstetricians to indicate fetal hypoxia (i.e. 'intrapartum or birth asphyxia'). Therefore the word asphyxia should be avoided as it is of very little help and is difficult to define. It is best to simply state the nature of the problem (i.e. fetal hypoxia or failure to breathe well at birth) so that everyone understands.

1-2 What is hypoxia?

Hypoxia is defined as *too little oxygen in the cells of the body.* Hypoxia may occur in the fetus or the newborn infant. If the placenta fails to provide the fetus with enough oxygen, hypoxia will result and cause fetal distress. Similarly, with failure to breathe well after delivery the infant will develop hypoxia if not correctly managed. As a result of hypoxia, before or after delivery, the heart rate falls, central cyanosis develops and the infant becomes hypotonic (floppy) and unresponsive. Most fetal hypoxia occurs during labour (i.e. intrapartum hypoxia).

Hypoxia is defined as too little oxygen in the cells of the body.

NOTE

> The definitions of failure to breathe well and hypoxia are not the same. However, fetal hypoxia may result in poor breathing at birth while poor breathing will result in hypoxia if the infant is not rapidly resuscitated. Many infants with fetal hypoxia during labour still manage to cry well at birth and, therefore, do not have poor breathing. Hypoxaemia means too little oxygen in the blood. It is sometimes used instead of hypoxia.

1-3 What is the Apgar score?
The Apgar score is a method of assessing an infant's clinical condition after delivery. The Apgar score is based on 5 vital signs:

1. Heart rate
2. Respiratory effort
3. Presence or absence of central and peripheral cyanosis
4. Muscle tone
5. Response to stimulation

Each vital sign is given a score of 0 or 1 or 2. A vital sign score of 2 is normal, a score of 1 is mildly abnormal and a score of 0 is severely abnormal. The individual vital sign scores are then totalled to give the Apgar score out of 10. The best possible Apgar score is 10 and the worst 0. An infant with a score of 0 shows no sign of life.

Normally the Apgar score is from 7 to 10. Infants with a score between 4 and 6 have moderate depression of their vital signs while infants with a score of 0 to 3 have severely depressed vital signs and are at great risk of dying unless actively resuscitated.

Due to the presence of peripheral cyanosis in most infants at delivery, it is unusual for a normal infant to score 10 at 1 minute. By 5 minutes most infants will have a score of 10. If the Apgar score is guessed, and not correctly assessed, too high a score is usually given. This is a common error in Apgar scoring.

A normal Apgar score is 7 or higher.

NOTE

The Apgar score is named after the late Dr Virginia Apgar, an anaesthetist from the USA, who described the scoring method in 1953. A way to remember the steps in the Apgar score is Appearance (colour), Pulse (heart rate), Grimace (response to stimulation), Activity (tone) and Respiration.

1-4 When should you determine the Apgar score?
The Apgar score should be performed on all infants at 1 minute after complete delivery to record the infant's clinical condition after birth. If the 1 minute Apgar score is below 7, then the Apgar score should be repeated at 5 minutes to document the success or failure of the resuscitation efforts. If the 5 minute Apgar score is still low, it should be repeated every 5 minutes until a normal Apgar score of 7 or more is achieved. In many hospitals, the Apgar score is often routinely repeated at 5 minutes even if the 1 minute score was normal. This is not necessary and the infant should rather be handed to the mother. Apgar scoring is an important way to document the infant's clinical condition and the response to resuscitation in the hospital or clinical records.

If an infant does not breathe well after being dried, it is important to start resuscitation immediately and not wait for the 1 minute Apgar score.

All infants should receive an Apgar score at 1 minute to document the infant's clinical condition after delivery.

1-2 What causes a low Apgar score?

There are many causes of a low Apgar score. These include:

1. Fetal distress due to hypoxia before delivery (especially during labour)
2. Maternal general anaesthesia or recent analgesia (e.g. morphine)
3. Preterm infant
4. Difficult or traumatic delivery
5. Excessive suctioning of the pharynx after delivery
6. Severe respiratory distress

Fetal distress due to hypoxia during labour is only one of the many causes of failure to breathe well at birth.

It is important to always try and find the cause of a low 1 minute Apgar score. If the Apgar score remains low at 5 minutes, despite good resuscitation efforts, the infant probably had fetal hypoxia before birth.

Intrapartum hypoxia is the most important cause of failure to breathe well at birth.

NOTE

A base deficit of 10 or more in a sample of umbilical artery blood strongly suggests that the infant has had significant hypoxia before delivery. This is very useful information in any delivery following a diagnosis of fetal distress. It is also very useful in infants who need resuscitation after delivery.

Neonatal resuscitation

2.1 What is neonatal resuscitation?

Resuscitation is a series of actions taken to establish normal breathing, heart rate, colour, tone and activity in a newborn infant with depressed vital signs (i.e. a low Apgar score).

2.2 Which infants need resuscitation?

All infants who do not breathe well after delivery need immediate resuscitation. Therefore, it is important to formally asses an infant's breathing after delivery. Any infant who stops breathing or has depressed vital signs at any time after delivery or in the nursery also requires resuscitation.

All infants who do not breathe well at birth must be resuscitated.

2.3 Can you anticipate who will need resuscitation at birth?

The following clinical situations often lead to the delivery of an infant who does not breathe well:

1. Signs of fetal distress during labour (baseline bradycardia or late decelerations)
2. Delivery before 37 weeks of gestation
3. Abnormal presentation of the fetus (e.g. breech)
4. Difficult or traumatic delivery (e.g. forceps delivery)
5. General anaesthesia or recent analgesia (pethidine or morphine within the last 4 hours)

Remember that any infant can be born with failure to breathe well without prior warning. It is essential, therefore, to be prepared to resuscitate any newborn infant. Everyone who delivers an infant must be able to perform resuscitation.

Any infant can fail to breathe well without warning signs during labour.

2.4 What equipment do you need for basic infant resuscitation?

It is essential that you have all the equipment needed for basic infant resuscitation. The equipment must be in good working order and immediately available. The equipment must be checked daily.

A warm, well-lit corner of the delivery room should be available for resuscitation. A heat source, such as an overhead radiant warmer, is needed to keep the infant warm. Avoid draughts. A good light, such as an angle poise lamp, is required so that the infant can be closely observed during resuscitation. A firm, level working area is needed. A thin foam mattress with a plastic covering can be easily cleaned.

The following essential equipment must be available in all hospitals and clinics where infants are delivered:

1. **Suction apparatus**: An electric or wall vacuum suction apparatus is ideal but the vacuum pressure should not exceed 200 cm water (i.e. 20 kPa or 200 mbar). Soft F10 end hole suction catheters are needed. Smaller catheters (F5 and F6) with side holes are of limited use as they block easily. They can be used for an orogastric tube or for umbilical vein catheterisation. A suction bulb can also be used to remove secretions from the infant's mouth and nose.
2. **Oxygen**: Whenever possible a cylinder or wall source of 100% oxygen or an oxygen concentrator should be available. However, most infants can be resuscitated in room air only without oxygen. A flow meter is needed and an air-oxygen blender is very useful. A pulse oximeter (saturation monitor) is very helpful to identify infants who are hypoxic.
3. **Ventilation bag and mask**: A neonatal self-inflating ventilation bag and mask (e.g. Laerdal) must be available to provide ventilation. A reservoir attached to the ventilation bag is needed if high concentrations of oxygen are required. Correct size face masks with a cushioned rim are important. A resuscitation apparatus such as the T-piece infant resuscitator may also be used.
4. **Endotracheal tubes**: 2.5 mm, 3.0 mm and 3.5 mm straight tubes must be available. Introducers are also needed. Cuffed endotracheal or shouldered tubes must not be used in newborn infants.
5. **Laryngoscope**: A laryngoscope with a small, straight blade (size 0 and 1 blades). Spare batteries and bulbs must be kept with the laryngoscope. This is the only expensive piece of equipment that is essential for all hospitals and clinics where deliveries are done.
6. **Naloxone**: Ampoules of naloxone (Narcan). Syringes and needles will be needed to administer the drug.
7. **Adrenaline** 1:1000 ampoules.
8. **Normal saline ampoules**
9. **Wall clock or wrist watch**: Needed to note the time at birth and time the Apgar scoring.
10. **Disposable gloves**. Always wear gloves when delivering or resuscitating an infant.
11. **Stethoscope**.

While a pulse oximeter is not essential it is very useful to monitor the infant's heart rate and oxygen saturation response to resuscitation. Place the probe on the infant's right hand.

All resuscitation equipment must be available and checked every day.

NOTE

Equipment to start an intravenous infusion is useful for advanced resuscitation.

2.5 How should you stimulate respiration immediately after birth?

Immediately after birth all infants must be thoroughly dried with a warm towel and then placed in a second warm, dry towel before they are clinically assessed. This prevents rapid heat loss due to evaporation, even in a warm room. Dry the infant's head, body, arms and legs and wipe any blood or maternal faeces off the face,Handling and rubbing the newborn infant with a dry towel is usually all that is needed to stimulate the onset of breathing. Most infants can be dried on the mother's abdomen. There is no need to smack newborn infants to get them to breathe. Never shake an infant. If the infant does not cry or breathe well in response to drying and stimulation, the umbilical cord must be cut and clamped immediately and the infant must be moved to the resuscitation area.

Dry to stimulate breathing in all infants immediately after delivery.

Infants who are active and breathe well can stay with their mother. It is best to delay clamping their umbilical cord for 2 to 3 minutes if the infant does not need resuscitation. Then the infant should be placed in the kangaroo mother care position to keep warm. Infants who breathe well should *not* be routinely suctioned as this is not necessary and suctioning sometimes causes apnoea. Infants born by Caesarean section also need not be routinely suctioned. However, the infant's mouth can be wiped with a clean towel if there are excessive secretions.

It is not necessary to routinely suction the mouth and nose of infants after delivery.

2.6 How do you resuscitate an infant?

If the infant fails to respond to the stimulation of drying, then the infant must be actively resuscitated. The most experienced person, irrespective of rank, should resuscitate the infant. However, all staff who conduct deliveries must be able to resuscitate infants. It is very helpful to have an assistant during resuscitation. Stand at the head of the infant where it is easier to carry out the steps needed in resuscitation.

There are 4 main steps in the basic resuscitation of a newborn infant. They can be easily remembered by thinking of the first 4 letters of the alphabet, i.e. 'ABCD': Airway – Breathing – Circulation – Drugs. Therefore the steps in neonatal resuscitation are:

1. **Airway**: Open the airway.
2. **Breathing**: Start the infant breathing by providing adequate ventilation.
3. **Circulation**: Obtain a good heart rate and circulation with chest compressions.
4. **Drugs**: Give adrenaline to stimulate the heart and naloxone to reverse pethidine and morphine.

2.7 How should you open the airway?

1. **Position the head correctly** by placing the infant on his back and then putting the infant's head in the neutral position with the neck slightly extended. Do not flex or overextend the neck. It is important to position the head correctly to open the airway before starting mask ventilation.
2. **Gently clear the throat**. The infant may be unable to breathe because the airway is blocked by meconium or blood. Therefore, gently suction the back of the mouth and throat with a soft end-hole F10 catheter. Excessive suctioning, especially if too deep in the region of the vocal cords, may result in apnoea and bradycardia by stimulating the vagal nerve. This can be prevented by holding the catheter 5 cm from the tip when suctioning the infant's throat. Do not suction the nose before suctioning the mouth or throat as this often causes the infant to gasp and inhale mucus and blood. Never hold an infant upside down to clear secretions. Suctioning clear liquor from the airways is probably not needed. Remember to keep the infant warm. Opening the airway will often allow the infant to start breathing. Gently rubbing the infant's back may help stimulate breathing.

If opening the airway fails to start breathing, the infant needs ventilation. Do not waste time by giving oxygen, without also applying ventilation, if the infant does not breathe.

If an infant fails to breathe well after birth, ventilation should be started as soon as possible but preferably within one minute ('The golden minute'). The Apgar score should be determined at 1 min to assess the infant's clinical condition.

Infants needing ventilation include:

1. Any infant who is not breathing at all, is breathing poorly or gasping
2. Any infant who has central cyanosis
3. Any infant who has a heart rate below 100 per minute

Ventilation is indicated if the infant does not breathe well.

Most infants who breathe well will have a good heart rate and soon become centrally pink. Free-flow mask oxygen alone, without ventilation, is only indicated in the few infants who breathe well with a good heart rate but remain centrally cyanosed. Even in infants who are warm and breathe well, peripheral cyanosis may take up to 10 minutes to resolve.

2.8 How can you start the infant breathing by providing adequate ventilation?

1. Keep the infant warm: Under a radiant heater if available. Good lighting is important. Infants under 28 weeks can be placed in a clean plastic bag to prevent hypothermia.
2. **Mask ventilation**: If the infant fails to breathe adequately despite opening the airway, some form of artificial ventilation (breathing) is required. Almost all infants (90%) who do not breathe on their own can be adequately ventilated with a bag and mask. The mask must be held firmly over the infant's nose and mouth but not over the eyes. Make sure the head is in the correct position and the airway is open. **It is very important to position and hold the mask correctly. Do not simply press the mask onto the face.**
3. Even if breathing is not started, most infants can be kept alive with face mask ventilation until help arrives. Intubation and ventilation are only needed if adequate chest movement cannot be achieved with correct mask ventilation. Good bag and mask ventilation is the most important step in resuscitation of an infant. Ventilate the infant at about 40 breaths per minute. If mask ventilation is needed for more than a few minutes, it is useful to pass a F8 orogastric tube to prevent abdominal distension.
4. **Intubation and ventilation**: An alternate method of ventilation is via an endotracheal tube. Although it is usually not needed, all staff who frequently deliver infants should learn this simple technique. Infants who fail to respond to mask ventilation must be intubated. Ventilate the infant at a rate of about 40 breaths a minute. Make sure that the infant's chest moves well with each breath and that good air entry is heard over both sides of the chest. Abdominal distension or air entry heard over the abdomen suggests that the oesophagus has been intubated in error. Mouth-to-mouth ventilation and direct mouth suction should be avoided unless it is an emergency, as the infant's mother may be HIV positive.

Most infants can be adequately ventilated with a bag and mask in room air.

Ventilation is usually given with room air. However sometimes it may be necessary to give supplementary oxygen until good breathing efforts and heart rate are established. Set the flow meter at 5 litres per minute. Added oxygen can usually be stopped once the infant is centrally pink and the heart rate normal. It is very useful to have a blender and pulse oximeter so that the amount of oxygen can be monitored and controlled.

Remember that a self-inflating bag and mask will not deliver oxygen unless the bag is squeezed. A reservoir is needed to provide an infant with 100% oxygen.

A T-piece infant resuscitator is a very efficient method of ventilating a newborn infant by face mask or endotracheal tube.

Oxygen: If possibly infants should be resuscitated in room air only without additional oxygen. Only if the heart rate does not increase to 100 beats per minute or if central cyanosis remains despite adequate ventilation should oxygen be given. Oxygen should be reduced then stopped as soon as possible.

Adequate ventilation is the most important step in newborn resuscitation.

Once adequate ventilation has been given for one minute, the infant's breathing, colour and heart rate must be assessed. Stop ventilation once the infant is pink and breathing well with a heart rate above 100 beats per second. If the heart rate remains below 60 beats per minute in spite of effective ventilation for one minute seconds, chest compressions are needed. A good heart rate is the best indicator of adequate ventilation.

A good heart rate is the best indicator of adequate ventilation.

NOTE

> Using oxygen rather than room air in neonatal resuscitation may increase the risk of neonatal encephalopathy. Many experts agree that room air should be used unless good ventilation does not correct the bradycardia and central cyanosis.