Care of the newborn at birth and emergencies in the first month of life

Care of the Newborn Infant at Birth

Minimum standards

- Two clean dry towels
- Firm work surface
- Self inflating bag/valve/mask
- Stethoscope
- Laryngoscope, with straight blades size 0 and 1 , spare bulbs
- Set of ET tubes (2.5mm, 3.0mm, 3.5 and 4 mm) with adaptors to fit the inflation system
- Umbilical catheter with fixating equipment
- Adrenaline 1:10,000
- Sodium bicarbonate 8.4%
- Naloxone
- Dextrose 10%
- Ringer-Lactate or Hartmann's
- Soft suction device
- Warming device
- Food grade plastic wrapping

The baby at risk of developing problems at birth

Those born preterm

Preventative Strategies:

Minimising the risk of surfactant deficiency:

- can be halved if mother is given:

Dexamethasone 12 mg IM 2 doses 12 hours apart
or
Dexamethasone 6 mg IM 4 doses 12 hours apart,

Stopping premature uterine contractions:

- give a 10 mg nifedipine capsule orally. Up to three further doses can be given at 15 minute intervals if uterine contractions persist
- if this stops labour, give between 20 mg and 50mg of a slow release nifedipine tablet three times a day for the next three days

Problems associated with preterm birth:

- surfactant deficiency
- increased risk of infection and hypothermia
- nutritional problems: maturity is more important than weight. Babies born before 36 weeks of gestation nearly always need some help with feeding. Breast milk is ideal, and everything possible should be done to help the mother sustain her lactation until the baby is ready to feed reliably from the breast. A limited ability to suck and swallow usually appears from 32 weeks of gestation but it remains unpredictable, unreliable and uncoordinated until

36 weeks gestation. In the event that breastfeeding cannot be initiated immediately after birth, mothers should be encouraged to start expressing breast milk, to be given by nasogastric tube or cup and spoon. Partial breast feeding can also help the mother to sustain her lactation but in any event the mother should regularly express milk.

Those at risk of dangerous infection

When to consider antibiotics for the mother before birth:

- symptomatic ascending infection in-utero in the mother (fever and signs of systemic illness) needs urgent treatment with IV antibiotics (penicillin/amoxicillin and gentamicin). If this is overlooked both the mother and the baby's life will be in danger
- asymptomatic infection (no fever and no systemic signs of illness) is however a much commoner problem. This occasionally progresses so rapidly once labour starts that, unless treatment is started urgently, the baby and possibly the mother will die even if the most appropriate antibiotic is given immediately after birth. Because such infection by definition is silent, it is important that antibiotic treatment therefore be given in any mother going into active spontaneous labour before 35 weeks gestation. If the membranes are definitely **not** ruptured give oral amoxicillin or penicillin (erythromycin if allergic) and if the membranes are ruptured see next bullet point.
- membrane rupture can be both a sign of, and a risk factor for ascending bacterial infection. What most people mean by premature rupture of membranes (PROM) is really preterm pre-labour rupture of membranes (PPROM) where the membranes rupture before there is any overt sign of uterine activity or any detectable uterine contractions. When this happens in the preterm baby, it is often a sign of an ascending infectious process. IV antibiotics (penicillin/amoxicillin plus gentamicin) must be given to the mother.
- treatment with the above IV antibiotics should also be given at any gestation if the mother's membranes have ruptured more than 18 hours before delivery. If premature rupture of membranes occurs before the onset of premature labour contractions then infection is more likely
- maternal fever (>38C) in labour is also a strong indication for initiating the same IV antibiotics for the mother. Similarly foul-smelling or purulent liquor requires intravenous antibiotic treatment of the newborn from birth without waiting for any signs of infection.

Antibiotic treatment of the newborn to prevent perinatal infection

WHO recommends that a neonate with risk factors for infection (i.e. membranes ruptured > 18 hours before delivery, maternal fever > 38 °C before delivery or during labour, or foul smelling or purulent amniotic discharge should be treated with prophylactic antibiotics (IM or IV) ampicillin and gentamicin for at least 2 days. *(Ampicillin 50-100 mg/kg IV 12 hourly and Gentamicin 5mg/Kg every 24 hours IV if more than 32 weeks gestation and 3mg/Kg if less than 32 weeks).* After 2 days, the neonate should be reassessed and treatment continued only if there are signs of sepsis (or a positive blood culture).

Hypothermia

Hypothermia seriously increases the risk of surfactant deficiency

Equipment for resuscitation of the newborn

- Two or more clean dry towels
- A firm working surface
- Heat source
- Sterile Gloves
- Sterile scissors
- Sterile cord clamps
- Food grade plastic wrapping (cling-film)
- Clock
- Soft well-fitting face masks (size 0/1 and 00)
- Self inflatable bag
- Source of oxygen
- A stethoscope
- Laryngoscope, with straight blades size 0 and 1 , spare bulbs
- Set of ET tubes (2.5mm, 3.0mm, 3.5 and 4 mm) with adaptors to fit the inflation system
- Endotracheal stylet
- Umbilical venous catheter (or use sterile feeding tube)
- Pulse oximeter (ideal)
- Roll of zinc oxide tape for name-band
- 1ml, 5ml and 10ml syringes
- Emergency drugs: 1 in 10,000 adrenaline or 1 in 1000 plus sterile water for dilution
- Ringer-Lactate or Hartmann's
- 10% glucose
- Naloxone if opiates used during labour or maternal opioid dependence

About 5% of infants do not breathe well at birth but respond to lung inflation with an immediate and easily detectable rise in heart rate. Only around 1% need advanced resuscitation. It is difficult to convincingly identify the baby's pulse rate by palpation at any site, so the best way to determine the heart rate is to listen over the chest with a standard or Pinard stethoscope.

Self-inflating bag, valve and masks
A soft close fitting face mask is essential. Access to a range of sizes of mask makes it possible to manage babies weighing as little as 500g or as much as 5000g at birth. It provides a near air tight seal between mask and face in a way that mimics the effectiveness and efficiency of an endotracheal tube. Hence it is possible with a self-inflating bag to administer slow inflating pressures up to a maximum inspiratory pressure of 35 cm H_2O to the fluid-filled lung of a baby who is not breathing or who is making poor respiratory efforts at birth.

S**imple suction devices**, with a soft wide bore tube (10 or 12) either mechanically or electrically operated are available. Suction is rarely needed and should not be performed routinely.

An **umbilical vein catheter** may be used to administer drugs, but it is important to note that babies who require drugs during resuscitation have poorer outcomes and are at increased risk of death and long term neurological sequelae. Ringer-Lactate or Hartmann's, plasma expander or blood in the case of hypovolemia due to fetal bleeding (see below) may occasionally be required.

A **clock** will help you document the duration of resuscitation and timings for interventions done.

A **heat source** is important plus **food grade plastic wrapping** for infants <32 weeks of gestation.

A **pulse oximeter** can be of help in picking out the occasional baby with hypoxaemia requiring further intervention or evaluation for cardiac or pulmonary disease.

Management at Delivery of a Baby not needing Resuscitation

Summary of management of the healthy baby at birth
1. Deliver the baby onto a warm surface or place on the mother's abdomen
2. Clamp cord when pulsation has stopped
3. Prevent hypothermia (skin to skin contact started in the first hour of life)
4. Early breast feeding
5. Minimise risk of infection
6. Injection Vitamin K

Keep newborns without complications in **skin-to-skin contact with their mothers** during the first hour after birth to prevent hypothermia and **promote breastfeeding.** Colostrum, the initial milk with a clear, yellowish and thick appearance is an extremely nutritious and concentrated feed rich in immunoglobulins. Mothers should be informed of its benefits and that it is ideal for their baby to feed on this as soon after birth as possible and as frequently as possible.

Preventing heat loss after birth:

- once the initial resuscitation process has finished and the baby becomes pink, and starts to breathe without distress, he/she can be given to the mother for skin to skin contact and their first feed at the breast. This practice, amongst other benefits, not only prevents hypothermia but also helps in better uterine contraction following delivery
- the practice of using water or oil to clean the skin within a few hours of birth before body temperature has stabilised can make the baby dangerously hypothermic. .A simple drying of the skin with a warm towel or sheet is all that is required
- nothing is a more effective source of warmth than the mother's own body as long as the baby is first well dried to minimise evaporative heat loss. A larger sheet or blanket can then be used to protect both mother and baby from the convective heat loss caused by draughts
- babies have relatively big heads. Covering the head with a shawl or blanket or woollen cap can significantly reduce heat loss
- heat and water loss through the skin can be a particular problem in babies born before 32 weeks of gestation. This can be limited initially by wrapping all but the face in a clean plastic wrapping like cling-film or a food grade plastic bag with a hole cut in the end of the bag for the baby's head to protrude, for a few hours after birth. *Remember, however, that plastic over the face can cause death from suffocation.* If plastic bags/ cling film is not available, the pre-term baby must be wrapped well in a clean towel/blanket.
- heat supplementation can be provided by locally built and maintained incubators, overhead heating systems and by skin-to-skin (kangaroo) care.
- the first bath should be delayed for at least twenty-four hours.

Managing the placenta, cord and umbilical stump

After a vaginal delivery wait for 1-2 minutes before cutting the cord to maximise the baby's haemoglobin, unless there is a need to start resuscitating the baby or the mother.

The cord must be cut cleanly, and the cut stump secured to minimise the risk of late hemorrhage. Remember, prevention rather than treatment is the key. The umbilical stump will shrink as it dries out. Plastic clamps that shut down further as the cord starts to shrink are very effective. A stump

that is left too long provides a reservoir where bacteria can breed and therefore should not be permitted. A length of 2 to 4cm is ideal. The stump does not need to be covered except to keep it from snagging on clothes and blankets. The application of chlorhexidine solution 4% once immediately after birth may prevent omphalitis. Other possible antiseptics include surgical spirit or iodine.

A little 'stickiness' of the cord is of no concern. If a red skin flare develops suggesting early spreading staphylococcal cellulitis these babies must be given an anti-staphylococcal antibiotic (oral cloxacillin or flucloxacillin (25mg/kg three times a day). If the skin around the stump becomes oedematous with increasing redness (omphalitis) intravenous cloxacillin/flucloxacillin plus gentamicin for 7 days is needed (see later). Babies who are systemically unwell need urgent broad-spectrum antibiotic treatment, IV or IM, for septicaemia.
The risk of neonatal tetanus can be eliminated by ensuring that all mothers are immunised against tetanus with at least two injections of tetanus toxoid 1 month apart during pregnancy.

The risk of cross-infection during or after birth
Puerperal infection ('child-bed fever') is an illness that killed thousands of recently delivered women for more than two centuries. The fact that this could be eliminated if birth attendants washed their hands thoroughly ***every*** time they moved from one woman to the next was shown many years before it was ever realised that this lethal illness was caused by group A streptococcal infection. The coming of antibiotic treatment has reduced the risk of death, but it has not lessened the need for meticulous hand washing before vaginal examination or delivery. Failure to observe this simple but important precaution also puts the baby at risk of cross-infection, especially if the baby is being cared for in a hospital setting.

WHO estimates that infection is responsible for a third of all neonatal death (over 3000 deaths a day). Kangaroo care has significantly reduced neonatal deaths from infection by colonising babies with mother's rather than the hospital's bacteria.

SECTION 11 Quiz 1

1) With regard to newborn babies which of the following statements are true?

a) birthweight matters more than maturity as a risk factor for developing problems at birth
b) premature babies are more vulnerable to hypoglycaemia
c) antibiotics should not be given to newborn babies unless there is proven infection in them
d) most newborns need drying and keeping warm – only a few will need resuscitation
e) waiting to clamp the cord until it stops pulsating may reduce the risk of anaemia in the baby when 4 – 6 months old

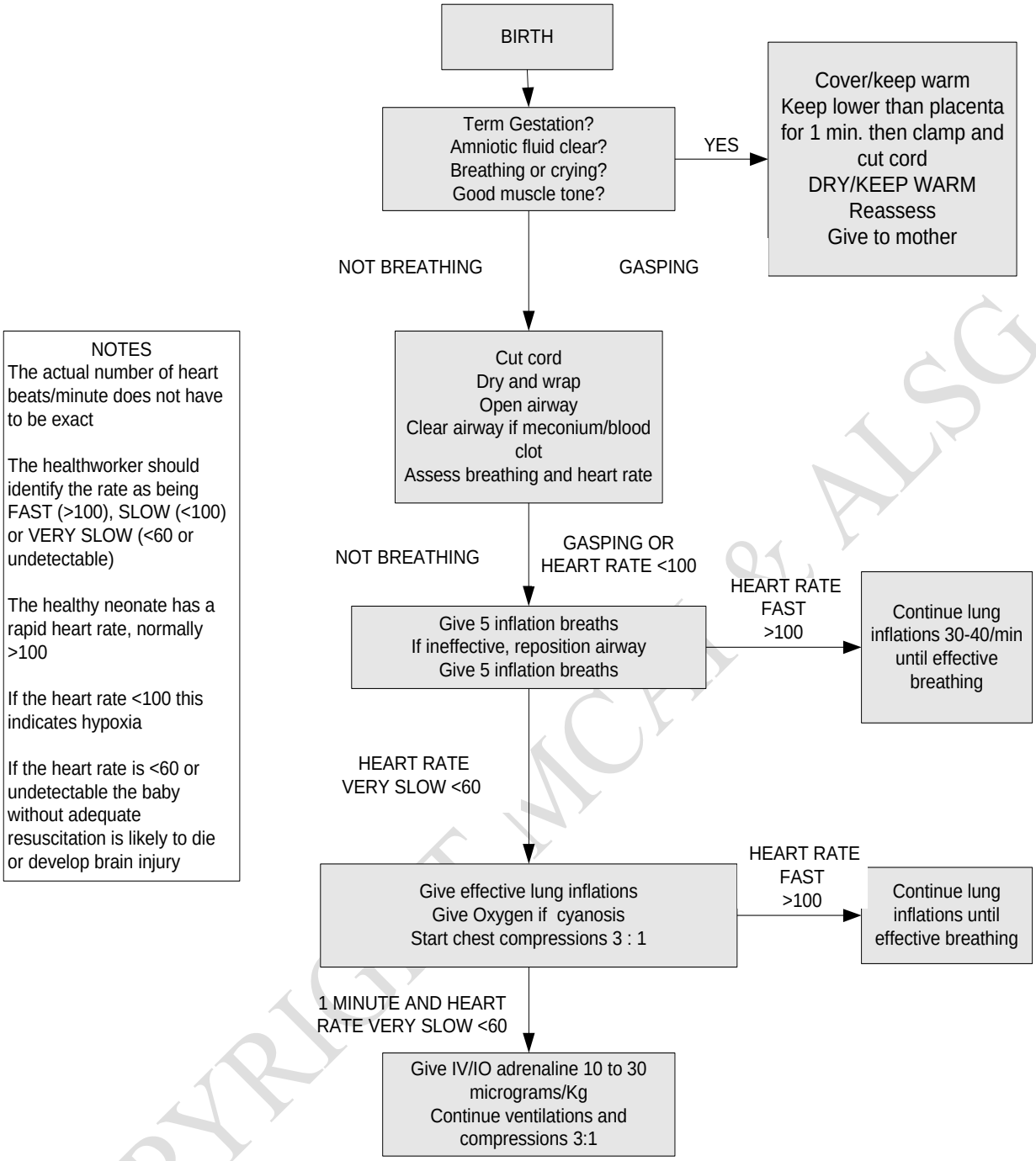
ANSWERS: 1) b,d,e

Resuscitation at Birth

Sequence of actions during resuscitation of the newly born

FIRST CALL FOR HELP
Start the clock or note the time. Keep the baby warm and assess the baby's breathing, tone and heart rate**:**

- babies are born small and wet. They get cold very easily, especially if they remain wet and in a draught. Whatever the problem, **dry the baby well**. Remove the wet towels, and **wrap the baby in dry towels**.
- there is good evidence that for significantly preterm babies (30 weeks and below), placing the baby under a radiant heater after drying and immediately covering the body, with clean plastic wrapping, is effective in keeping these very small babies warm during resuscitation.
- **drying the baby** will provide significant stimulation and will allow time to **assess, tone, breathing, and heart rate**.
- it is important to **reassess** these observations regularly (particularly the heart rate) approximately every 1 minute throughout the resuscitation process. The first sign of any improvement in the bradycardic baby will be an increase in heart rate.
- a healthy baby will be born blue but will have good tone, will cry within a few seconds of delivery, will have a good heart rate (the heart rate of a healthy newborn baby is about 120-150 beats per minute) and will rapidly become pink during the first 90 seconds or so. An ill baby will be born pale and floppy, not breathing and with a slow or very slow heart rate.
- The heart rate of a baby is best judged by listening with a stethoscope. It can also sometimes be felt by palpating the umbilical cord but a slow rate at the cord is not always indicative of a truly slow heart rate and is a difficult skill which can divert the health worker from applying lung inflations as soon as possible. In addition, if the baby is not breathing, feeling for peripheral pulses is not helpful. If a stethoscope is not available, you can listen to the heart by placing your ear on the baby's chest or using a Pinard stethoscope.



Airway (A) Keep the airway open

- before the baby can breathe effectively the airway must be open.
- the best way to achieve this is to place the baby on his/her back with the head in the **neutral position** (that is with the neck neither flexed nor extended). Most newborn babies will have a relatively prominent occiput, which will tend to flex the neck if the baby is placed on his/her back on a flat surface. This can be avoided by placing some support using a folded nappy or cloth under the shoulders of the baby, but be careful not to overextend the neck.
- if the baby is floppy it may also be necessary to apply chin lift or jaw thrust.

Notes:

The best way to stabilise a baby's condition at birth is to ensure that the upper airway remains unobstructed. The child will then have little difficulty in drawing air into its lung for itself when it takes its first spontaneous gasp or cry. Unfortunately, books often talk of the need to keep the airway 'clear', giving the false impression that the baby is going to find it difficult to breathe unless all the fluid and mucus is first sucked out of the way. There is no evidence that this is ever necessary unless the infant is meconium stained and does not breathe well. **Moreover, blind deep suction of the nose or mouth can stimulate the vagus nerve leading to bradycardia and laryngospasm.**

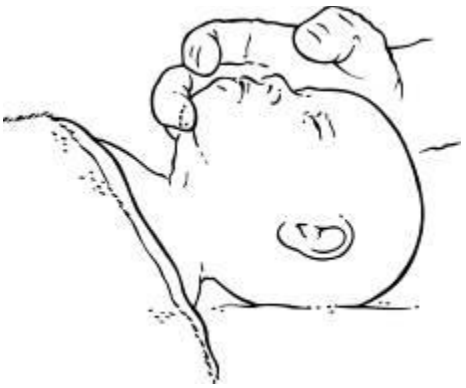
However, the upper airway of any baby who is born limp and hypotonic certainly needs to be opened and maintained in just the same way as the airway of any other unconscious patient. In an unconscious patient, pharyngeal tone decreases even more than it does during sleep causing the upper airway to narrow or close. When such patients are laid on their back the tongue also falls back, further obstructing the airway. The three key ways to counter this are to:

1. Hold the head in the neutral position and
2. Support the chin or
3. Push the jaw forward.

Because of molding, most babies have quite a prominent occiput at birth. Lying supine (on their back) on a flat surface, the neck becomes flexed, and the airway becomes obstructed. Exactly the same thing can happen if the neck is over-extended. The aim is to ensure that the head is in a 'neutral' position – a posture most easily achieved by placing a small (2cm) pad under the baby's shoulders.

Neutral position

If tone is poor it may also be necessary to support the chin. It is important to support the bony part of the chin. Pressure anywhere else may merely push the base of the tongue backwards, making matters worse.



CHIN LIFT

If tone is very poor it may be necessary to use one or two fingers under each side of the lower jaw, at its angle, in order to push the jaw forwards and outwards ('jaw thrust') but this will require a second person to give the inflation and ventilation breaths with the bag/valve/mask.

JAW THRUST

Although it is rare for debris to totally block the trachea such a problem should be suspected if a baby tries to breathe but remains cyanosed and bradycardic, with laboured breathing and marked inter-costal and/or sub-costal recession. This is one of the few situations where tracheal intubation can be life saving at birth.

Meconium

It is estimated that about 15% of infants have meconium stained liquor at birth. Meconium aspiration syndrome (MAS) can occur in about 1 in 10 such babies. The development of MAS is not entirely dependent on suctioning at birth. It is possible for babies to aspirate meconium in-utero if there is hypoxia and gasping. However some babies may aspirate meconium **during** delivery and these are the ones in whom the risk of **MAS can be reduced by suctioning when the baby's head is on the perineum.**

Studies based on experience from Africa and India have shown that suctioning the mouth of infants with meconium stained liquor during birth when the head is at the perineum has dramatically reduced the incidence of Meconium Aspiration Syndrome (MAS) and death. There is subsequently, no need for further suctioning after birth if the baby breathes well.

What if the trachea seems blocked?

If babies are born through meconium and are unresponsive (or 'not vigorous') at birth, the oropharynx should be inspected and cleared of meconium. If intubation skills are available, the larynx and trachea should also be cleared. If, despite this, meconium has entered the trachea, resuscitation here is only possible if the accumulated debris can be immediately removed. The easiest way to do that is to pass an endotracheal tube and then remove the debris by direct suction. Sometimes the meconium debris is so big that it cannot be sucked through the tube but suction will nearly always serve to draw the debris into the tube. The tube can then be removed and the debris blown clear, followed by re-intubation to clear the remaining obstructive material. Suction may also make it easier to see the larynx during intubation.

Breathing (B)

If the baby is not breathing adequately **give 5 inflation breaths as soon as possible.** Until now the baby's lungs will have been filled with fluid. Aeration of the lungs in these circumstances is best with slow inflations at pressures of about 30 cm of water with the bag and mask; these are called 'inflation breaths'. These initial ventilation breaths should last 2-3 seconds each. The aim is to mimic the initial breaths taken by a normal baby to open the airways, remove lung fluid and achieve its functional residual capacity.

- if the heart rate was below 100 beats per minute initially then it should rapidly increase as oxygenated blood reaches the heart. If the heart rate does increase then you can assume that you

have successfully aerated the lungs. If the heart rate increases but the baby does not start breathing, then continue to provide regular ventilation breaths at a rate of about 30-40 per minute until the baby starts to breathe.

- the chest may not move during the first 1 or 2 breaths as fluid is displaced. Adequate ventilation is usually indicated by either a rapidly increasing heart rate or a heart rate that is maintained at more than 100 beats per minute. Therefore, reassess the heart rate after delivery of the first 5 breaths. It is safe to assume the chest has been inflated successfully if the heart rate responds. Once the chest is aerated and the heart rate has increased or the chest has been seen to move, ventilation should be continued at a rate of 30–40 per minute. Continue ventilatory support until regular breathing is established.
- if the heart rate does not increase following inflation breaths, then either you have not aerated the lungs or the baby needs more than lung aeration alone. By far the most likely possibility is that you have failed to aerate the lungs effectively. If the heart rate does not increase, and the chest does not passively move with each inflation breath, then you have not aerated the lungs.

Under these circumstances consider:

- is the baby's head and neck in the neutral position?
- do you need jaw thrust?
- do you need a second person's help with the airway or to squeeze the bag? A relative or ward orderly can be shown immediately how to effectively squeeze the self inflating bag while you ensure that the mask is held firmly and in the best position on the face over the mouth and nose with the airway open.
- is there an obstruction in the oropharynx (laryngoscope and suction under direct vision)?

Bag and Mask inflation of the lung

Having positioned the baby correctly it is then usually quite easy to use a self inflating bag and mask to provide inflations.

Remember that the baby cannot breathe through the bag valve mask system and so do not leave the mask sealed to the face and expect the baby to breathe from the bag. The valve between the bag and mask prevents this. When the baby is breathing, remove the mask and watch closely to ensure adequate breathing continues.

Most babies will respond to any inflationary maneuver of this type by gasping and then starting to breathe on their own without further support. If this does not happen, it is still easy to confirm that lung aeration has been achieved, because the heart rate will rise reliably and consistently above 100 beats per minute. If lung aeration has been achieved and the baby does not quickly start to breathe proceed to circulation C

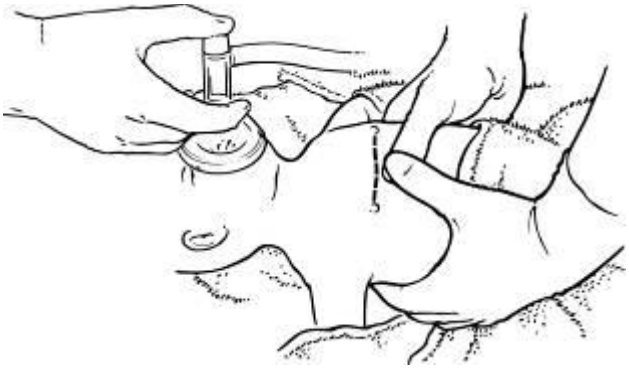
There is good evidence that most babies can be resuscitated using mask resuscitation and chest compression without any need for tracheal intubation.

Circulation (C) Chest compressions:

- most babies needing help at birth will respond to successful lung inflation with an increase in heart rate followed quickly by normal breathing. Chest compression should be started only when you are sure that the lungs are being aerated successfully.
- if the heart rate remains slow (less than 60 beats/minute) or absent following 5 inflation breaths (or alternatively one minute of ventilation at a rate of around 30 breaths per minute), despite good chest movements in response to your inflation efforts, start chest compression.

- in babies, the most efficient method of delivering chest compression is to grip the chest in both hands in such a way that the two thumbs can press on the lower third of the sternum, just below an imaginary line joining the nipples, with the fingers over the spine at the back.
- compress the chest quickly and firmly, reducing the antero-posterior diameter of the chest by about one third.
- because oxygenation is such an important part of neonatal resuscitation **the ratio of compressions to inflations in newborn resuscitation is recommended as around 3:1**
- chest compressions move oxygenated blood from the lungs back to the heart and out into the ascending aorta. From there the two coronary arteries will then quickly deliver oxygen to the failing anoxic heart muscle. It is important to allow enough time during the relaxation phase of each compression cycle for the heart to refill with blood at the same time ensuring that the chest is inflating with each breath.

- It is not possible to compress the chest effectively more than about 60 times a minute because sluggish venous return delays atrial filling.



Drugs (D)

Rarely inflation of the lungs and effective chest compression will not be sufficient to produce adequate circulation and perfusion in babies. In these circumstances drugs may be helpful however drugs are needed only if there is no significant cardiac output despite effective lung inflation and chest compression.

- **Adrenaline:** The recommended dose for adrenaline is 10 microgram per kg body weight (0.1 ml /Kg body weight of 1:10,000 solution). If this is not effective, a dose of up to 30 microgram/ Kg (0.3 ml/Kg body weight of 1:10,000 solution) may be tried. It is ideal to have ready made and well labeled 1 in 10,000 adrenaline solutions on all emergency trolleys. In situations where this is not available in a ready made state this could be prepared by adding 1 ml of 1 in 1000 solution to 9 mls of normal saline. **However, it is potentially dangerous to leave inadequately labeled and made up doses of adrenaline around as giving the same number of mls of 1 in 10,000 as 1 in 1000 could cause cardiac arrest.** Do not use a higher dose by these routes (intravenous) as it is harmful.
- **Glucose**: The recommended dose of glucose is 200 mg/Kg (2 ml/Kg of 10% dextrose). Hypoglycaemia **(less than 2.5 mmol/litre (45mg/dl)** is a potential problem for stressed or hypoxic neonates, so 10% dextrose should be considered in cardiac arrest, as the heart will not recover in the presence of hypoglycaemia. This should be followed by an infusion of 5ml/kg/hour of 10% glucose if there is confirmation of hypoglycemia by a blood test. This should be continued until feeding is well established.
- **Naloxone** can be used to reverse profound opiate induced respiratory depression. Give 200 microgram 'depot' dose IM irrespective of body weight.

No other drug has ever shown itself to be of any use.

Acute blood loss as a cause of circulatory arrest (circulatory volume support)

- Sudden acute blood loss is rare, but an often unrecognised, cause of acute circulatory collapse. Bleeding from an aberrant placental blood vessel (vasa praevia) can rapidly lead to hypovolaemic death. Circulatory collapse probably does not occur until the baby has lost between 30 and 40 ml/kg of blood, but **Ringer-Lactate or Hartmann's,** will usually reverse the immediate critical hypovolaemia rapidly. The initial intravenous fluid bolus should be **10 ml/kg** of **Ringer-Lactate or Hartmann's, or blood of group O Rh negative blood (if immediately available). This can be repeated ONCE** if there is no or only minimal response. A similar response can be achieved with plasma, albumin, or some artificial plasma expanding agent (such as gelatin). A packed red cell transfusion using group specific or group O Rh-negative duly cross matched blood can be given later to correct the associated anaemia.
- Other, less well recognised, causes of hypovolaemic collapse include acute feto-maternal blood loss, sudden twin-to-twin transfusion, and accidental incision of the placenta during Caesarean delivery and cord ligature that has come off and not been detected.

Aside from these specific indications fluid should not be used during neonatal resuscitation.

Environment
This is always at risk of being overlooked and must receive attention in all babies, before and at birth.

- A CLEAN and WARM environment is the objective in all cases. It only takes a few seconds to dry the baby and provide a clean dry blanket for warmth. The room in which delivery occurs should also be clean, warm and free of draughts.
- small babies, in particular, rapidly become cold especially if left wet, which can be lethal. Enclosing the trunk and the limbs in a clear plastic drape or bag (plus a woollen cap if available) can greatly reduce evaporative heat loss. Indeed, babies born more than 10 weeks early have skin that is so thin that it is not really 'waterproof'. This will cause excessive evaporative heat loss to persist for several days after birth.

Should one use air or 100% oxygen for resuscitation of the newborn?

Air is safer for initial resuscitation. However, additional oxygen should be available if there is not a rapid improvement in the infant's condition. Avoid hyperoxia, especially in the preterm infant.

When to cut and clamp the cord in a baby who needs resuscitation at birth?
Immediately as resuscitation takes priority.

Additional issues

- few babies need support with their breathing once their lungs have been aerated. Most will gasp, cry, or breathe just as soon as an attempt is made to get air into the lung and then continue breathing adequately.
  - a few may, however, benefit from further support if they do not start to breathe regularly, or only gasp occasionally. Some may be limp and hypotonic, and a few may be drowsy because of drugs given to the mother during labour. Check that the heart rate remains normal (above 100 beats per minute) and that there is no central cyanosis (best judged by looking at the colour of the tongue).
  - try to assess whether there is hypoxemia (cyanosis or SaO2 less than 90% with a pulse oximeter), if the baby's breathing remains laboured and irregular or if the child's colour remains blue. Hyaline membrane disease meconium aspiration syndrome and transient tachypnoea of the newborn are most likely.

Other possibilities include:

- intrapartum pneumonia

  - diaphragmatic hernia
  - pneumothorax
  - pulmonary hypoplasia (possibly associated with a skeletal or renal abnormality).
  - cyanotic congenital heart disease (although this usually takes a little time to appear).
  - persistent fetal circulation.
- if breathing requires continuous support it is important to try and reduce mask inflation pressures to little more than half of what was needed to aerate the lung in the first place. It is easy to over-ventilate a baby with healthy lungs and to wash out so much of the carbon dioxide that normally provides the main stimulus to breathing that all such activity stops for a while. There is also increasing evidence that sustained over-ventilation can seriously reduce cerebral blood flow.

Endotracheal intubation

As discussed earlier, most babies needing resuscitation can be managed with bag/valve/mask intubation. However, occasionally endotracheal intubation is required but this must be done by someone skilled and practiced in the technique. It is most likely to be required for prolonged resuscitation, in meconium aspiration and in significantly pre-term babies whose breathing, once resuscitated is likely to remain insecure. A straight bladed laryngoscope is preferred and tube sizes are around 3.5 mm for a term baby and 2.5 for a pre-term infant. Sizes larger and smaller should be available.

Preterm babies:

- babies with surfactant deficiency may have difficulty in expanding their lungs, and in developing a normal 'cushion' of trapped lung gas (functional residual capacity, or FRC), at birth.
- the preterm lung is, however, quite a delicate structure with relatively little elastic support, and any use of undue pressure or excessive ventilation during resuscitation can damage the lungs.

While an inspiratory pressure of 30 cm H_2O may well be necessary to aerate the lung at birth, such pressure is best not applied too abruptly, and should be reduced as rapidly as possible after that. The key aim must be to conserve such surfactant as already exists by sustaining the lung's functional residual capacity (an objective best achieved by providing at least 5 cm H_2O of positive end expiratory pressure (PEEP). Aim to achieve this consistently throughout transfer to the nursery. This can be achieved using nasal prongs or a nasal mask (nasal PEEP) thus avoiding tracheal intubation altogether.

Summary of poor response to resuscitation

If the baby either fails to respond or makes a poor response to resuscitation, the most likely problem is inadequate oxygenation. The following steps should be considered.

- Check the airway and ventilation
- Check for technical faults if using equipment

☐ Is the oxygen attached?
☐ Is the airway blocked?
☐ Is the endotracheal tube in the correct place?

- Re-examine the chest to see if a pneumothorax has developed – this is not uncommon, but seldom causes a problem. Drain a tension pneumothorax with a small cannula over needle (21 gauge) in the second intercostal space in the mid-clavicular line. This should be followed by the insertion of a chest drain .
- Consider the possibility of a congenital heart lesion if the baby remains cyanosed, despite breathing and a good heart rate
- Consider the possibility of maternal opiates or anti-hypertensive sedation such as diazepam or phenobarbitone if the baby is pink, well perfused, but requires assisted ventilation
- Shock, caused by acute blood loss, should respond to a rapid bolus of 10 to 20ml/kg of O-ve blood.
- Consider hypoglycaemia

Stopping resuscitation

The prognosis is poor if the baby has been without a cardiac output after 20 minutes of resuscitation.

Vitamin K prophylaxis against haemorrhagic disease of the new-born
All new-born infants should receive Injection Vitamin K 1mg, intramuscularly. Vitamin K is given to prevent haemorrhagic disease of the new-born (HDN) which may cause significant bleeding and even death. The intramuscular route is preferred as it provides a depot over many weeks.

Neonates who have needed resuscitation, are requiring surgery, those with birth trauma, preterm infants and those exposed in utero to maternal medication that is known to interfere with vitamin K are at especially high risk of bleeding and must be given vitamin K 1mg IM.

SECTION 11 Quiz 2

1) Regarding resuscitation of the newborn which of the following statements are true?

a) the primary problem is usually of cardiac origin
b) most newborn babies need supplemental oxygen for the first few minutes of life
c) the principles of resuscitation differ depending on the cause of the problem
d) drugs are rarely needed
e) an airway containing mucus often causes a problem in the newborn unless cleared by suction

2) Put the following in the order 1 – 5 which you would resuscitate a newborn

a) give drugs
b) breathing
c) airway
d) dry and assess
e) circulation

3) If the newborn is not breathing on initial assessment which of the following statements are true?

a) the head should be placed in the neutral position
b) if airway opening manoeuvres have been ineffective, an oropharyngeal airway may help open the baby's airway
c) initial breathing support should include 5 inflation breaths each sustained for 2 – 3 seconds duration
d) inflation breaths can be assumed to be effective if the heart rate increases
e) chest compressions should be started at a rate of 5 chest compressions to 1 breath if the heart rate is less than 60 bpm

ANSWERS: 1) d 2) 1 =d, 2= c, 3 = b, 4 = e, 5 = a 3) a,b,c,d (e should be 3compressions to 1 breath)

Common emergency problems requiring hospital care in the first month of life

Many emergencies can be prevented by attention to good feeding practices, adequate warmth and infection prevention**.**

1. prematurity and low birth weight
2. birth injuries
3. feeding difficulties
4. poor temperature control, especially hypothermia
5. infection - prevention and early recognition and safe management
6. respiratory distress and apnoeic attacks
7. bleeding or anaemia
8. jaundice
9. reduced conscious level and seizures including hypoglycaemia
10. surgical disorders
11. other miscellaneous problems

1. Prematurity and low birth weight

- **A low birth weight baby** is one weighing less than 2.5 kg at birth. Low birth weight may be attributable to preterm delivery or intrauterine growth restriction.
- **A preterm baby** is one born before 37 completed weeks have elapsed since the first day of the last menstrual period (259 days). Most preterm babies are born after 32 weeks of gestation.
- **A small for gestational age (SGA) baby** is one whose birth weight falls below the 10th percentile on a birth weight centile chart.

Low birth weight

Babies with birth weight between 2.25 and 2.5 kg

- These babies are normally strong enough to start feeding themselves. They need to be kept warm and closely observed for infection but otherwise no special care is required.

Babies with birth weight between 1.75 and 2.25 kg

- These babies sometimes need extra care but can normally stay with their mothers to provide feeding and warmth, especially if skin-to skin contact can be maintained. Close monitoring by healthcare provider is required.
- Feeds can be started within 1 hour of delivery. Many of these babies will be able to suck and can be breastfed. Those who cannot breastfeed should be given expressed breast milk with a cup. When the baby is sucking well from the breast and gaining weight on a daily basis, cup feeds can be weaned off.
- These babies should be reviewed at least twice a day to assess feeding ability, fluid intake and presence of any DANGER SIGNS for infection. Such problems will necessitate close monitoring in a neonatal nursery (if available) in a similar way to very low birth weight The risk of keeping the child in hospital (including hospital acquired infections) should be considered.

Babies with birth weight below 1.75 kg

These babies are at risk of hypothermia, apnoea, hypoxemia, sepsis, feed intolerance and necrotizing enterocolitis. The risks increase the smaller the baby. All babies with a birth weight below 1.75 kg should be admitted to a Special Care or Neonatal Intensive Care Unit (if available).

- Oxygen should be administered by nasal prongs or head box if there are signs of respiratory distress, such as moderate to severe recession (pre-term babies may show mild recession with normal breathing) and definitely in the presence of cyanosis. **Pulse oximetry to measure**

oxygen saturation is a vital part of oxygen usage in the pre-term infant. Retinopathy of prematurity (ROP, previously known as retrolental fibroplasia), which leads to lifelong blindness in many cases, is caused by high blood levels of oxygen in the pre-term infant. For a baby born at or before 32 weeks gestation or weighing less than 1,500 Gm should have a target oxygen saturation of 90-94%, which is higher that the saturation to which the fetus is exposed in utero.

- To prevent hypothermia, nurse the baby skin-to-skin between the mother's breasts or clothed in a warm room, or in an incubator. A hot water bottle wrapped in a towel can be useful for keeping the baby warm if no power for heating is available but take care not to burn the baby. Aim for an axillary temperature of 36–37 ° C with the feet warm and pink. When the mother is asleep or if she is ill, a clean incubator can be used. Incubators should be washed with disinfectant between infants.
- It is best to give fluids enterally, however if the baby is not well enough, give IV fluids (*see* under Fluid Management). Initially, consider giving approximately 2–4 ml of expressed breast milk every 2 hours through a nasogastric tube. This can be adjusted depending on the weight and the amount of IV fluids the baby is receiving. With increasing age / weight gradually increase volume and timing of each feed (maximum time interval between feeds should not exceed 4 hours). Total fluid intake of enteral feeds plus IV fluids per 24 hours should follow the fluid management guidelines (i.e.70ml/Kg on day 1, 90ml/Kg on day 2, 120ml/Kg on day 3 and 150ml/Kg to 180ml/kg thereafter). Some babies can be fed with a cup or spoon. Use only expressed breast milk if possible. If 2–4 mls per feed is tolerated (i.e. no vomiting, abdominal distension, or gastric aspirates of more than half the feed) the volume can be increased by 1–2 ml per feed each day. Ideally, aim to have feeding established in the first 5–7 days so that the IV fluids can be tapered off. Reduce or withhold feeds if signs of poor tolerance occur. As the baby grows, recalculate the feed volume based on the higher weight. Feeds may be increased over the first 2 weeks of life to 150–180 ml/kg/day based on a 3-4 hourly feeding pattern.
- Check blood glucose every 6 hours until enteral feeds are established and immediately if there are any danger signs for infection.
- Give enteral feeds only if there is no abdominal distension or tenderness, bowel sounds are present, meconium has been passed, no apnoea, low aspirates, no vomiting and adequate stool output.
- Observe carefully and constantly for infection.
- Monitor for apnoea ideally with a pulse oximeter supplemented by close visual monitoring of the baby by the mother or close relative.

Danger Signs associated with infection in the neonate

- Child feeding less than well than before
- Child lying quiet and making few spontaneous movements
- Fever > 38ºC
- Capillary refill time > 3 seconds
- Respiratory rate 60 or more breaths a minute
- Indrawing of the lower chest wall when breathing, *or* grunting
- Cyanosis
- History of a convulsion

<u>Less common but important signs include:</u>

- Low respiratory rate < 20/minute or apnoea
- Jaundice
- Abdominal distension

2. Potentially dangerous birth injuries

A **sub-galeal haemorrhage** (bleeding between the skull periosteum and the scalp aponeurosis) is the least common but most dangerous scalp swelling. Onset and progression is often insidious with progressive pallor due to significant haemorrhage. The boggy swelling of the head, extending from above the eyes to the occiput may only be noticed after the baby has developed hypovolemic shock. The baby may develop bruising behind the ears and around the eyes. This must be recognized early as they often need urgent transfusion. Injection Vitamin K must be administered to these babies.

3. Feeding difficulties

Babies born after 34 weeks are generally mature enough to suck and swallow but may be less demanding of feeds than term babies. Attention to the following can help a preterm baby to establish breastfeeding:

- encourage early and prolonged skin contact
- encourage small, frequent feeds by waking the baby every two to three hours and putting to the breast
- in case of infants who will not latch on and suck, mothers can be encouraged to express breast milk and offer it to the baby by gavage (orogastric/nasogastric tube) or simple cup and spoon
- for otherwise well infants on breast milk feeds who are experiencing inadequate growth, an inadequate milk supply may be the problem. There are several causes for this, which can usually be identified by listening to the mother and then watching the baby feed. A relaxed mother will have a good "let-down" reflex which gives the baby the more calorie rich hind milk as well as the fore milk. The mother can tell when she has "let-down" by a tingling feeling in her breasts and the baby starts to swallow rapidly. The baby must latch on properly for feeding to be successful and this may need some assistance from the midwife. The best way to increase the milk supply for a hungry baby who is not thriving is to increase feed frequency. Breast milk works on a demand and supply system, the more the baby demands, the more the breast supplies. If the baby is not feeding vigorously enough to increase the milk supply, then the mother should express milk after feed and give it to the baby as above.
- avoid giving formula or breast milk by bottle. A small feeding cup (about the size of a medicine measuring cup with a smooth rim) or a spoon can be used to feed the baby.
- give expressed breast milk via nasogastric tube if too unwell to suck or drink from a cup.
- as the baby becomes stronger encourage a transition to demand breastfeeding.

The use of gastric feeding tubes - Tube feeding is the best option for babies who have not yet developed a coordinated suck and swallow reflex. Nasogastric tubes are popular, easier to secure and less easily pushed out by the baby's tongue but they can almost completely block one nostril significantly increasing the work of breathing. Therefore orogastric tubes may be better, especially if respiratory distress is present.

Type of milk

Breast milk will supply the nutrient requirements of almost all babies. However for preterm babies the following supplements may be needed:

- **Multivitamin** preparation (preferably containing adequate Vitamin D) may be commenced from 3 weeks of age.

- **Iron supplements** are usually commenced from about 6 weeks of age. The daily dietary iron supplementation is 2 to 4 mg/kg of elemental iron, up to a maximum of 16 mg/day.

- **Phosphorus supplements** may be needed in case of very small babies who can become hypo-phosphataemic (plasma phosphorus < 1.5 mmol/litre). If untreated this may result in metabolic bone disease. Adding 0.05 ml/kg of a 4 mmol/ml phosphorus solution to each of eight feeds per day will give 50 mg/kg/day supplemental dietary phosphorus.

  Vitamin D supplementation: Supplementing mothers with vitamin D (4000 IU/day) during lactation or by supplementing the infant (400 IU/day).

- **Vitamin A supplementation:** Oral supplementation of 4000 IU/kg/day for (VLBW < 1500 Gm at birth) infants from establishment of full enteral feeding until discharge. Supplementing term newborn infants with vitamin A (100,000 IU as a single dose) within 48 hours of birth reduces infant mortality by almost a quarter, with the greatest benefit to those of low birth weight.
- **Vitamin K:** Give <u>all</u> neonates vitamin K 1mg IM within one hour of birth. Those requiring surgery, those with birth trauma, those who are preterm and those exposed before birth to maternal medication (that can interfere with vitamin K) are at high risk of bleeding and must be given vitamin K . If the need for surgery only becomes apparent sometime after birth we suggest a repeat dose before surgery.

Fluid and electrolyte management for the neonate in hospital

When giving fluid or blood intravenously, best practice is to use an in line infusion chamber/burette to avoid fluid overload.

Fluid requirements

Giving large volumes of fluid in the first few days may make a baby oedematous and worsen any respiratory disease. **Start** an ill newborn baby who cannot take enteral fluids (breast milk) on 60 ml/kg/day IV as 10% dextrose solution, increasing in daily steps of 20-30 ml/kg/day to a maximum of 140-180 ml/kg/day. However in a small-for-gestational age baby it may be necessary to begin with 70-90 ml/kg/day in order to meet glucose requirements.

Ideally use a 100 ml paediatric intravenous burette where 60 drops = 1 ml and therefore 1 drop per minute = 1 ml per hour. So for a 1.8kg baby on day 1: 1.8 x 60 =108mls, in each hour the fluid will be 108 ÷ 24 = 4.5mls which will be 9 drops every 2 minutes.

Insensible water loss (mainly through the skin) is high in some circumstances, particularly in babies under 29 weeks gestation or when an overhead heater (radiant warmer) rather than an incubator is used. Helpful measures to reduce insensible water loss in such cases are:

- Place the infant below the neck in a clean plastic bag to maintain humidity.
- Clothing the baby, or wrapping the body below the head with bubble wrap or aluminium kitchen foil (shiny side inwards next to baby).

In the first week of life, high insensible water loss will be reflected by high weight loss (greater than 10% of birth weight) and often an increase in the plasma sodium concentration to 150 mmol/litre or higher. If either occurs, the infant is dehydrated and fluid intake should be increased by 30 ml/kg/day. *Such babies are much better nursed in closed incubators*.

In very low birth weight infants, enteral feeds should be advanced slowly with 20-30 ml/kg/day increments. Babies who are being enterally fed but are unable to breast feed can be given expressed breast milk by oro-gastric tube or spoon and cup. A general plan for fluid treatment can be:

- Day 1 60ml/kg/day
- Day 2 80-90ml/kg/day
- Day 3 100-120ml/kg/day
- Day 4 120-150ml/kg/day

- Day 5 140-180ml/kg/day

Monitor the fluid intake by weighing the baby daily and recording frequency of urine output... Urine output can be monitored by measuring the difference between wet nappies (diapers) and a dry one using kitchen scales. Generally expect at least 8 wet nappies in a 24 hour period. Look out for signs of fluid overload (oedema) or dehydration.

Electrolyte requirements

Sodium requirements: Babies over 2 days of age need some sodium supplementation in a dose of 2–3 mmol/kg/day. This can most easily be given by adding 20 ml/kg of normal saline (0.9%) to the daily requirement of 10% glucose to make up the total daily fluid volume needed. This gives approximately 3 mmol of sodium per kg.

Potassium supplements: 1-2 mmol/kg/day will meet requirements and can be provided by adding small amounts of potassium chloride to feeds. IV potassium is unsafe. **Do not add KCl until urine output is established.**

Glucose requirements: Infusing glucose at the following rates will match the normal hepatic glucose output and therefore maintain blood glucose concentration at an acceptable level:

- Term infant 3-5 mg/kg/min
- Preterm, appropriate weight for gestation 4-6 mg/kg/min
- Small-for-gestational age 6-8 mg/kg/min

10% glucose at 60ml/kg/day will give 4 mg (0.22 mmol) glucose/kg/minute.

Always use 10% glucose for peripheral IV infusions.

Drug use in the newborn baby

The IV rather than IM route should be used especially if the baby is already being given IV fluids.

4. Temperature control and hypothermia prevention and treatment

Hypothermia can be due to a cold environment but **remember;** malnutrition/starvation or serious infection can present as hypothermia.
Normal temperatures for newborn infants are 36.5 – 37.4 axillary if measured over 5 minutes and lower (probably 36.0 -37.0) if measured over a shorter period (around at least 1 minute).

Use a low-reading digital not mercury thermometer. If **axillary** temperature is less than 32°C then hypothermia is severe; between 32 and 35.9°C is moderate. If temperature does not register on normal thermometer, assume hypothermia.
Hypothermia can be prevented by:

- drying the baby immediately after birth and placing the baby in skin to skin contact with the mother. This is especially important in low birth weight babies who do not have other complications. For those with medical problems, warm the infant by thermostatically controlled heated mattress (37-38°C) or air heated incubator 35-36°C or skin-to-skin care
- "Kangaroo care": skin-to-skin contact with the mother between her breasts and covered with a blanket is most effective especially for low birth weight babies.
- a cot heated **with a hot-water bottle which is removed before the infant is placed in it** can be as effective.
- ordinary domestic radiant heaters or electrical blower type heaters can also be effective.

- cover the head with a warm woollen hat and dress the baby in warm DRY clothes. Keeping the nappy dry is also helpful.
- Take care when examining the infant not to allow the temperature to fall (ideally room temperature should be > 25°C).
- monitoring axillary temperatures 4-6 hourly.
- feeding 2-3 hourly and continue 4 hourly feeds during the night.
- avoiding washing baby before 24 hours age and be wary of draughts.
- baby should always sleep next to or with the mother during the night.

Table Incubator temperatures to keep infant's axillary temperature 36-36.5°C

Weight	Day 1	Day 2	Day 3	Day 4
<1200g	35°C	34°C	34°C	33.5°C
1200-1500 g	34°C	34°C	33.5°C	33.5°C
1500-2500 g	33.5°C	33°C	32°C	32°C
>2500g	33°C	32.5°C	31°C	30.5°C

Do not use anti-pyretic drugs to control fever in a newborn infant. Instead control the environment (e.g. remove some clothes, adjust incubator temperature) and always consider serious infection. If either hyperthermia or hypothermia is present.

5. Neonatal infection: prevention, early recognition and safe management

Preventing infection

A neonate with risk factors for infection (i.e. membranes ruptured > 18 hours before delivery, mother with fever > 38 °C before delivery or during labour, or foul smelling / purulent amniotic fluid) should be treated with prophylactic antibiotics (ampicillin and gentamicin IM or IV) for at least 2 days. After 2 days, reassess and treatment continued only if signs of sepsis (or a positive blood culture).

Simple measures to prevent infection include:

- ensuring a **clean delivery environment** for the mother and baby (including disinfectant cream for all maternal vaginal examinations e.g. hibitane cream).
- **good cord care** which should be kept clean and dry. It should not be covered. An antiseptic solution or cream such as chlorhexidine 4% may reduce omphalitis. A study has shown that one application immediately after birth is effective.
- **exclusive breastfeeding**.
- **hand washing** for all staff and for families before and after handling babies.
- **not using water for humidification** in incubators.
- using **incubators which have been cleaned first with an antiseptic** (if kangaroo mother care is not possible).
- strict **asepsis for all invasive procedures**
- **removing intravenous cannulae** when they are no longer necessary.
- keeping invasive procedures (like blood sampling, unnecessary IV cannulation etc.) to the minimum.

Recognizing and treating neonatal infection Bacterial sepsis (sometimes severe enough to cause septicaemia) in the neonate may present with any number of subtle, non-specific changes in activity or physical findings. A change in feeding pattern, vomiting, irritability, pallor, diminished tone, and/or decreased skin perfusion could be suggestive of neonatal infection. Other presenting physical findings may include lethargy, apnoea, tachypnoea, cyanosis, petechiae or early jaundice. There may be fever but this is not common, especially with bacterial infections occurring in the first week. However temperature instability with hypothermia may be seen. Abnormal glucose homeostasis (hypoglycaemia or hyperglycaemia) and/or metabolic acidosis are commonly associated findings. Babies are very prone to infection and can become ill very rapidly once infection takes hold. Antibiotic treatment is only likely to work if started early, but the recognition of early infection is not easy. A WHO study showed that more than a third of all deaths in the first month of life in most resource-poor countries were caused by infection. It also found that more than 80% of these babies had one or more of the following eight signs or symptoms when first seen.

Danger Signs associated with infection in the neonate

☐ Child feeding less than well than before
☐ Child lying quiet and making few spontaneous movements
☐ Fever > 38ºC
☐ Capillary refill time > 3 seconds
☐ Respiratory rate 60 or more breaths a minute
☐ Indrawing of the lower chest wall when breathing, or grunting
☐ Cyanosis
☐ History of a convulsion

Less common but important signs include:

☐ Low respiratory rate < 20/minute or apnoea
☐ Jaundice
☐ Abdominal distension
☐ Skin infections

All neonates with signs of sepsis must be treated with IV antibiotics for at least 10 days after blood and other appropriate cultures taken.

Ampicillin (or penicillin) plus gentamicin are the first line drugs to be used. Consider adding cloxacillin or flucloxacillin if there are signs suggesting *staphylococcus aureus* as a cause (e.g. skin pustules, an abscess or omphalitis). Blood cultures are ideal though not always possible before starting antibiotics. If the infant does not respond within 48 hours, consider changing the antibiotic. If there is a possibility of meningitis, risk of resistance or gram negative organisms, a third generation cephalosporin such as cefotaxime should also be added.

Early-onset sepsis (first 72 hours)

Early-onset sepsis usually occurs as a result of bacteria acquired by vertical transmission from mother to infant during labour and delivery.

Maternal risk factors for early onset sepsis include:

- maternal fever before delivery or during labour (especially 38°C or greater)
- pre-labour rupture of membranes
- prolonged rupture of membranes (18 hours or greater)
- preterm labour
- maternal bacteruria during pregnancy (including *E.Coli* and *group B Beta-haemolytic Streptococcus*
- infected infant (*group B Beta-haemolytic Streptococcus*) in a previous pregnancy

These neonates mostly present with respiratory distress and have bacteraemia or pneumonia.

Late-onset sepsis

The most common infections are focal infections such as omphalitis, skin infections and meningitis. A circumcision wound can also be the site of serious infection.

Treat suspect bacterial septicemia with or without early meningitis as follows:

- open the **airway** and keep it open
- ensure the baby is **breathing** adequately and if apnoeic, gasping or having very low respiratory rate consider ventilation using bag and mask until breathing adequately
- give **oxygen** until pink or normal oxygen saturation in air
- insert an **IV cannula**, using full sterile precautions. Umbilical vein catherisation may be the easiest way to gain vascular access quickly in a shocked baby less than a week old
- otherwise it might be necessary to site an **intra-osseous** line or cannulate a **scalp or external jugular vein**.
- take samples for full blood count, blood culture, lumbar puncture, blood glucose and other tests (urine analysis and culture, CXR, biochemical) if needed and available. Failure to sterilise the skin rigorously can render blood culture results un-interpretable. Chlorhexidine, 0.5% aqueous solution is a very effective antiseptic for this purpose.
- if possible, check blood glucose but if facilities do not allow this, give 2 ml/kg of 10% glucose IV over 2–3 minutes as initial bolus, followed by 5ml/kg of 10% glucose per hour for the next few days whilst enteral feeds are established. A baby who becomes alert and active immediately following the initial bolus is suggestive of hypoglycemia (hypoglycemia is a blood glucose level below 2.5 mmol/l (36mg/dl) and may be part of the problem) If an intravenous line cannot be inserted and hypoglycemia is suspected give expressed breast milk or 10% glucose by nasogastric tube or sublingual sucrose. Further intermittent monitoring of the blood glucose level should be done and the infusion continued till oral feeding is possible.
- give the first dose of ampicillin and gentamicin (with or without cefotaxime) intravenously using the dose regimen outlined below. Use the high meningitic dose if meningitis is suspected and continued if confirmed for the duration of therapy. If IV access is not immediately possible give the initial antibiotic dose IM. Never wait for the results of cultures before starting antibiotics.
- start an IV infusion of 60mls/kg/24 hours of 10% dextrose
- if the baby is shocked, give an IV bolus of 10ml/kg of **Ringer-Lactate or Hartmann's,**. This can be repeated twice (total of 30mls/kg) if baby remains shocked. The use of inotropes (Dopamine / Dobutamine) or colloids (fresh frozen plasma) can be considered. Consider a blood transfusion.
- if the child has any respiratory symptoms take a portable chest x-ray if facilities allow. Do not take a sick baby to an X-ray department for this as the resulting information is not worth the risks of moving a sick infant. Look regularly to see if cyanosis is developing or use a pulse oximeter if available and give supplemental oxygen using nasal prongs. Do not give anything by mouth to a baby who is breathless, especially if oxygen dependent.

Points to consider:

- undertake the ABC approach. Oxygen may be needed .If the conscious level is impaired the airway may be at risk.
- Watch for seizures and treat as appropriate. **Always consider meningitis as a possible cause.** If there are any features suggestive of meningitis do a lumbar puncture at same time as blood cultures or within 2 hours of starting antibiotic treatment because the blood culture is sterile in 15% of babies with early meningitis. **Do not delay antibiotic therapy pending the undertaking of a lumbar puncture.** Treat seizures with phenobarbitone 20 mg/Kg by IM or slow IV

injection. If needed continue with phenobarbitone at a maintenance dose of 3-5 mg/kg/day. Diazepam or midazolam can also sometimes be used to control seizures. **However always have a bag and mask available if diazepam or midazolam is given to stop fitting as these drugs cause temporary apnea in some patients which can easily be managed with bag and mask ventilation for a few minutes.**

- microscopic examination of the CSF (meningitis = 25 or more WBCs/mm^3), low glucose and high protein with or without gram stain can provide early confirmation of meningitis
- surface swabs and gastric aspirate cultures have no diagnostic significance.
- urinary tract infection can occasionally be the primary focus of a Gram negative septicemic illness. Simple microscopy on a clean catch or supra-pubic urine specimen may be used to rule out a urinary tract infection. Identification of a urine infection may suggest ultrasound imaging of the renal tract and long-term prophylactic antibiotics.
- watch for, prevent and correct any sign of hypothermia.
- antibiotics can be stopped after 48 hours if the blood cultures are negative **and** the baby has improved. If available, a normal CRP at 48 hours can help exclude sepsis. If blood cultures are not available, continue the antibiotics for the full course appropriate for the site of infection (meningitis 14-21 days).
- Think of herpes infection, congenital TORCH infection (newborn intrauterine acquired infections such as rubella) or neonatal malaria (rare) in a malaria endemic region

Specific neonatal infections

Meningitis

Survival and later prognosis depends on early diagnosis and rapid treatment. Confirmatory diagnosis from a lumbar puncture may take several hours. Hence it is urgent and appropriate to start antibiotic treatment empirically as soon as the diagnosis is suspected.

The presenting features of meningitis include lethargy, reduced or unwillingness to take feeds, irritability, high-pitched cry, apnoeic episodes, lowered conscious level or even coma, hypotonia, convulsions, generalised signs of accompanying sepsis and a bulging or tense anterior fontanel. **Always measure and record the head circumference.**

Empiric antibiotic therapy includes antibiotics used for neonatal sepsis (i.e. a beta-lactam antibiotic plus an aminoglycoside) and a third-generation cephalosporin (e.g. cefotaxime or ceftazidime) with excellent CSF penetration and bactericidal effect for sensitive gram-negative bacteria. The duration of treatment is at least 14 days for uncomplicated Gram-positive bacteria and 21 days for Gram-negative bacteria.

Ampicillin and gentamicin is the most frequently used initial combination. Benzyl penicillin may be preferable for known or suspected group B streptococcal infection. Cefotaxime is the drug of choice for most Gram negative organisms and ceftazidime is used for *Pseudomonas* infection.

Investigations for meningitis

- Lumbar puncture is essential if meningitis is suspected and should be undertaken in all newborn infants with non-localising features of sepsis. Only attempt lumbar puncture once stabilised, and ideally within 2 hours of initiating antibiotic treatment.
- Cerebrospinal fluid (CSF) cell counts, chemistry and Gram stain would often point towards meningitis. An elevated CSF leucocyte count (>25 WBC's/cubic millimetre) with pleocytosis is characteristic of neonatal meningitis. The CSF protein in meningitis may be high (> 2.0 g/litre in a term baby) and the CSF glucose is typically low (<30% of blood glucose value).
- Sometimes the CSF picture in preterm babies who have sustained an intra-ventricular haemorrhage can show a mild reactive pleocytosis in the first few weeks of life which can be

quite misleading. If there is clinical suspicion this should be treated as bacterial meningitis until cultures are known to be negative.
- If a "bloody tap" is obtained it is best to treat the baby as meningitis and repeat the lumbar puncture after 24-48 hours.

Diarrhoea in the newborn
- If dehydrated give low osmolarity oral rehydration solution (ORS) in addition to breast milk.
- In sick babies or in babies unable to feed orally consider IV fluids.
- If bloody diarrhoea assume dysentery and initiate antibiotic therapy. Avoid use of cotrimoxazole.
- In the septic and unwell infant, give IV antibiotics
- Beware of intussusception, although it is rare under 1 month of age

Sometimes what is described as diarrhoea by mothers is actually the loose breastfed stools of some babies in the first few days of life.

Skin, eye and mucous membrane infections

Conjunctivitis
Most conjunctivitis presents as "sticky eyes", but this may not always be of bacterial origin, especially if it occurs in the first few days. A bacterial process must however be considered in all cases. Infants with a crusting serous discharge without significant conjunctival inflammation may simply have blocked naso-lacrimal tear ducts. This usually responds to gentle pressure / massage applied in a downward motion along the nose immediately adjacent to the eyes. The discharge may be cleaned from the eye with sterile 0.9% saline drops. Show parent how to irrigate the eyes with sterile normal saline. The eyes should be wiped from the inside to outside edge using a clean cotton wool swab for each eye. Hands should always be washed before and after the procedure.

If the condition worsens or if there is conjunctival inflammation (i.e. **conjunctivitis)** or a purulent discharge**,** use of topical therapy should be considered. Erythromycin, tetracycline, neomycin or chloramphenicol ophthalmic ointments or drops after obtaining a swab culture. Apply the ointment 2-4 times a day for 5 days after washing away any pus with sterile normal saline as described above. Treat this level of infection as an outpatient but review every 48 hours.

Gonococcal conjunctivitis
A severe rapidly progressive purulent conjunctivitis occurring within the first few days must always be assumed to be due to *Neisseria gonorrhoea* which must be promptly treated in hospital with parenteral antibiotics and irrigation. Intravenous penicillin for 7 days has been used successfully, but because of increased worldwide resistance (penicillinase-producing *gonococcus*), a third-generation cephalosporin is often selected as the first-line therapy (cefotaxime 25 mg/kg (max 125 mg) IM, as a single dose OR cefixime 20 mg/kg orally, as a single dose.

Repeatedly clean the eye, or irrigate with saline until pus formation stops. It is vital to prevent corneal rupture and subsequent blindness.

In the case of a presumed or diagnosed gonococcal or chlamydial infection, the mother and partner should also be treated.

In countries with a low rate of sexually transmitted diseases, staphylococcal and Gram-negative organisms are more likely. Staphylococcal infections can be treated with Cloxacillin or flucloxacillin 30 mg/kg PO or IV every 6-8 hours for 5 days.

Chlamydial conjunctivitis
Chlamydia trachomatis is a common cause of infectious conjunctivitis in the neonate. It typically presents between 5 and 14 days. The presentation can vary from mild to moderate conjunctival erythema and from scant mucoid discharge to copious purulent discharge. Eyelid oedema, chemosis, or pseudomembrane formation may also be present. Corneal involvement is unusual initially, although untreated chlamydia conjunctivitis can result in varying degrees of conjunctival scarring and corneal infiltrates.
Treat with erythromycin 10 mg/kg orally, 6-hourly for 14 days. Topical antibiotics are ineffective. Ensure the mother is referred for treatment.

Skin pustules

Most commonly caused by *Staphylococcus aureus*. Oral therapy with a penicillinase-resistant penicillin (e.g. flucloxacillin), or first-generation cephalosporin (e.g. cephalexin 12.5 mg/kg 6 hourly for 7 days) is required. If septicaemia is suspected then blood cultures and IV antibiotics after hospitalization are needed. Sometimes staphylococcal pustules can be difficult to distinguish from **erythema toxicum** (a benign, non-infectious newborn rash).

Umbilical infection
A clinically relevant infection presents as redness extending from the umbilicus. This should be distinguished from the ooze resulting from an umbilical granuloma. If there is a redness extending from the umbilicus, oral anti staphylococcal antibiotics should be used. In addition, clean the area with soap and warm water and remove/drain pus and crusts. Dry and paint the area with antiseptic such as gentian violet or use a alcohol swab to clean the area at the time of every nappy change.

Cellulitis
This is most commonly caused by streptococci, but *Staphylococcus aureus*, Gram-negative *enterococcus* and anaerobes should also be considered when infection occurs at sites where there have been breaks in the skin. IV antibiotic therapy with flucloxacillin or penicillin should be given.

Omphalitis is characterised by peri-umbilical erythema and induration, often with a purulent discharge from the umbilical stump. Treatment with IV antibiotics (for example penicillinase-resistant penicillin and aminoglycoside) must be given for both Gram-negative and Gram-positive bacteria. Omphalitis may become rapidly progressive with spread to deeper tissues or along umbilical blood vessels. Infection with *Clostridia* is common in the setting of poor maternal immunity or poor umbilical cord care. Hence cover with metronidazole is usually also given.

Scalded skin syndrome
This is a rare dangerous infection due to toxin producing staphylococcal organisms leading to an allergic reaction producing the effect of both serious infection as well as burns. Give high dose IV cloxacillin or cefotaxime.

Superficial candidiasis ("thrush" and "monilial" rash)
Superficial candidiasis of the oral mucosa ("thrush") commonly manifests as white patches which do not easily scrape with a spatula. The nappy area may be affected as well ("monilial" rash). Unlike irritant dermatitis the erythema extends into skin folds and there may be small raised erythematous lesions. Treat with oral nystatin suspension, 1 ml after feeds (divide it between each cheek with a small syringe). Topical nystatin ointment may be used to treat the skin rash but only in combination with oral nystatin. Keep the nappy area dry.

Congenital syphilis

Congenital syphilis may be acquired from an infected mother either via trans-placental transmission of *T. Pallidum* at any time during pregnancy or possibly at birth from contact with maternal lesions.

Clinical signs in babies may include:

- low birth weight with a heavy placenta
- palms and soles may show a red rash, grey patches, blisters or skin peeling
- abdominal distension due to big liver and spleen
- jaundice
- anaemia
- some low birth weight babies with syphilis have signs of severe sepsis with lethargy, respiratory distress, skin petechiae or other signs of bleeding.
- some sequelae of congenital infection such as interstitial keratitis, eighth cranial nerve deafness, Hutchinson teeth (peg-shaped, notched central incisors), anterior bowing of the shins, frontal bossing, mulberry molars, saddle nose, rhagades, and Clutton joints (symmetric, painless swelling of the knees) may not become apparent until many years after birth. The first 3 manifestations are referred to as the Hutchinson triad.

Late manifestations can be prevented by treatment of early infection.

Investigation

No newborn infant should be discharged from the hospital without determination of the mother's serologic status for syphilis at least once during pregnancy and also at delivery in communities and populations in which the risk for congenital syphilis is high. If you suspect syphilis, do a VDRL test

Treatment

Infants should be treated for congenital syphilis if they have proven or probable disease demonstrated by one or more of the following:

1. Physical, laboratory, or radiographic evidence of active disease;
2. Positive placenta or umbilical cord test results for treponeme using direct fluorescent antibody-T pallidum staining or dark field test;
3. A reactive result on VDRL testing of CSF
4. A serum quantitative non-treponemal titer that is at least fourfold higher than the mother's titer using the same test and preferably the same laboratory.

Parenteral IV penicillin G remains the preferred drug for treatment of syphilis at any stage. Recommendations for penicillin G use and duration of therapy vary depending on the stage of disease and clinical manifestations.

Asymptomatic neonates born to VDRL or RPR-positive women should receive 37.5mg/Kg (50,000 units/kg) of benzathine benzyl penicillin as a single intramuscular dose into the anterolateral thigh. Ensure that the needle is not in a vein when this drug is given by drawing back and ensuring no blood is in the needle as it can cause cardiac arrest and severe CNS damage if given IV.

Symptomatic infants require treatment with:

- Procaine benzyl penicillin 50mg/kg as a single dose by deep IM injection daily for 10 days.

Caution: *Accidental intravascular administration may result in cardiac arrest and/or neurological damage*

OR

- Benzyl penicillin (aqueous crystalline penicillin G) 30 mg/kg or 50,000 U/kg IV, 12-hourly for 7 days and thereafter 8-hourly for 3 days

OR

- Procaine penicillin 30 mg/kg or 50,000 U/kg IM, daily for 10 days

Treat the **mother and partner** for syphilis and check for other sexually transmitted infections.

Antibiotics for severe infection in the neonate

- **Ampicillin (or amoxicillin)** Give 100 mg/kg per dose IM where meningitis is a possibility. Give 50 mg/kg per dose in other situations. Give one dose every 12 hours in the first week of life, every 8 hours in a baby 1–3 weeks old, and every 6 hours in a baby older than that. Oral dosing can sometimes be used to complete a course of treatment.
- **Benzyl penicillin** Give 60 mg/kg if meningitis **or** tetanus is a possibility. Give 30 mg/kg per dose in all other situations, including syphilis. Time the interval between each dose as for ampicillin. Oral dosing (with phenoxy methylpenicillin) can sometimes be used to complete a course of treatment.
- **Cefotaxime** Give 50 mg/kg per dose IV or IM. Time the interval between each dose as for ampicillin except in meningitis where doses are given 6 hourly.
- **Chloramphenicol** This remains a useful antibiotic, although there is a serious risk of death from liver failure if the dose suggested here is exceeded. Give a 25 mg/kg loading dose IM followed by 12.5 mg/kg once every 12 hours to babies less than 1 week old. Give this dose every 8 hours in babies 1–4 weeks old unless there is evidence of liver damage or renal failure. Babies older than this can be given (12.5mg/kg) once every (6) hours from the outset. Oral dosing can be used to complete any course of treatment. (can double dose in those over 1 month with severe infection). Be very careful if the intravenous dose has to be diluted to get the correct dosage.
- **Cloxacillin (or flucloxacillin)** Give 100 mg/kg per dose IM or IV if serious infection is present. Give 50 mg/kg per dose in other situations. Time the interval between each dose as for ampicillin. Oral treatment can often be given to complete a course of treatment (25mg/kg standard, 50mg/kg severe, 100mg/kg in infections such as osteomyelitis).
- **Erythromycin** Give 12.5 mg/kg per dose by mouth once every 6 hours. There is no satisfactory IM Preparation.
- **Eye drops (and ointments)** Prophylactic 1% silver nitrate drops have been used to minimise the risk of gonococcal infection (IM ceftriaxone being used for overt infection). The use of 2.5% polyvidone-iodine solution may be equally effective. 1% tetracycline ointment should be used (with oral erythromycin) to treat chlamydia conjunctivitis - a condition that is not prevented by silver nitrate use. *Pseudomonas* infection requires treatment with systemic antibiotics and topical (gentamicin 0.3% eye drops).
- **Gentamicin** Give 5 mg/kg IM or IV once every 24 hours. If baby weighs less than 2Kg give 4mg/Kg per dose. Leave 36 or 48 hours between each dose if there is renal failure.
  - **If less than 32 weeks gestation -4-5 mg/kg 36 hourly, If more than 32 weeks 4-5mg/kg 24hrly).**
- **Metronidazole:** Give a 15 mg/kg loading dose and 7.5 mg/kg per dose once every 12 hours in babies less than 4 weeks old and every 8 hours in children older than that. Treatment can be given IV or my mouth, but solubility makes IM use unsatisfactory. If used IV start maintenance 24 hours after loading, if oral then give first dose 12 hours after loading.
- **Miconazole:** This controls infection with Candida ('thrush') better than topical nystatin. Use the oral gel at least four times a day and the skin cream twice a day for at least 7 days. Topical treatment with 0.5% aqueous gentian violet for not more than 4 days may be equally effective. Oral nystatin drops (1 ml four times a day) can be used to reduce heavy intestinal tract carriage.
- **Procaine penicillin:** Give asymptomatic babies born to mothers with evidence of untreated syphilis a single 100 mg/kg **IM** injection. **Never give this drug IV.** Babies thought to be

infected at birth are often given 100 mg/kg once a day for 10 days, but rarely repeated IM injections can cause a sterile abscess with subsequent muscle fibrosis and atrophy, or IM or IV benzylpenicillin for 10 days (as specified above) is just as effective. Babies born to mothers fully treated for syphilis (1.8 grams (2.4 mega units) of benzathine benzylpenicillin at least 4 weeks before birth need no further treatment after birth.

6. Respiratory disorders

Features of respiratory distress in the newborn include

Tachypnoea (rate > 60 /min)
Recession of the chest wall and sternum
Expiratory grunting
Nasal flaring
Prolonged apnoea (lasting greater than 20 seconds) or intermittent apnoea with cyanosis or severe falls in oxygen concentration (<90%)
Gasping
Tachycardia
SaO_2 < 94 % in air
Cyanosis is a relatively late presentation of a respiratory or cardiac cause

The three cardinal signs characterising respiratory distress:

Tachypnoea: respiratory rate >60 per minute.
Retractions (recessions): tugging of the soft tissues between the ribs or at the edges of the rib cage.
Grunting: a prolonged expiratory effort usually with an audible noise.

Two of these signs are sufficient to make the diagnosis. Cyanosis is not a necessary diagnostic feature but is often present if oxygenation is compromised by an underlying lung or cardiac condition.
If pulse oximetry is available, the SaO_2 in infants with respiratory impairment will usually be less than 92% in air (often less than 90% in more severe cases).

Causes of early respiratory distress
"Early" respiratory distress (presenting in the first 12 hours of life) may result from a number of causes:

- **"Transient tachypnoea of newborn"** associated with a delay in clearing of fetal lung fluid
- **Pneumonia or sepsis (such as *group B streptococcus* sepsis)**
- **Surfactant deficiency (**hyaline membrane disease or respiratory distress syndrome)
- **Pneumothorax**
- **Meconium aspiration**
- **Congenital abnormalities** of the lung or airways (including diaphragmatic hernia)

Maternal fever during labour and prolonged rupture of the fetal membranes (more than18 hours) particularly point to pneumonia or sepsis. Pneumonia may also be due to congenital syphilis. Pneumothorax should be considered if the baby has been resuscitated using positive-pressure ventilation (although it has been described as occurring spontaneously in about 1% of normal term babies). Transient tachypnoea is more common among babies delivered by elective caesarean section (in the absence of spontaneous labour). Surfactant deficiency and infection are the most likely causes in preterm babies.

Congenital heart disease does not usually cause early respiratory distress. Cyanosis/severe hypoxemia is the more likely presentation. Respiratory distress associated with heart failure normally occurs after the first week of life in association with tachycardia, pallor, sweating, hepatomegaly and excessive weight gain.

Causes of respiratory distress in the newborn

Common

- Lack of surfactant causing respiratory distress syndrome in the preterm baby
- Infection acquired before or during delivery
- Transient tachypnoea of the newborn (wet lung)

Less common

- Meconium aspiration
- Persistent pulmonary hypertension of the newborn
- Pneumothorax

Rare

- Pulmonary hypoplasia
- Congenital abnormalities e.g. diaphragmatic hernia, choanal atresia, tracheo-oesophageal fistula
- Pulmonary haemorrhage
- Metabolic causes (inborn error of metabolism)

Non-respiratory

- Congenital heart disease
- Hypothermia
- Severe anaemia

Principles of treatment of neonatal respiratory failure

- Ensure the **Airway** is open and remains open. Thick secretions from the throat may be cleared by intermittent suction using direct observation
- Ensure the baby is **Breathing.** If the baby is apneic, gasping or has a very slow respiratory rate use chest inflations with a bag valve mask to re-establish breathing.
- Babies should be offered enough supplemental oxygen to treat any degree of central cyanosis and ideally to keep SaO_2 in normal range (94% to 96%) in the term infant but never hyperoxic (above 96% in a newborn infant receiving additional inspired oxygen). An oxygen supply must be available at all times in areas where newborn infants are treated. **Nasal prongs optimize the efficient use of the available supply.**
- Babies should ideally have their actual oxygen needs monitored and adjusted at regular intervals; titrating the oxygen flow to maintain saturation on the pulse oximeter between 94-96% for term babies and lower for pre-term babies as described earlier (90-94%).
- Babies with serious respiratory distress should not be offered feeds until their condition has stabilised. Support expression of milk by the mother so that she is ready when her baby has recovered to provide breast milk. In such situations, intravenous infusion of 10% glucose (60 ml/kg/day) is safest. If there are no facilities for intravenous infusion, breast milk or 10% glucose may be given in limited quantities (up to 60 ml/kg/day) by orogastric tube. ***Nasogastric tubes may contribute to upper airway resistance so an orogastric tube is preferred in infants with respiratory distress although it is more difficult to keep in place and so sometimes compromise over this may be necessary.***
- Babies less than 2 days should be started on an IV infusion of 10% dextrose at 60-90mls/kg/24 hours. For babies more than 3 days old 10 % dextrose with added sodium chloride can be used at the age appropriate giving rates (see fluid management section). It is recommended that in neonates it is best to use a pediatric burette (chamber) where 1ml = 60 micro-drops (1 drop per minute = 1 ml per hour). ***Caution:*** *A standard infusion set gives 20 drops/ml and can lead to dangerous fluid overload if not carefully controlled.*
- Give IV or IM (IV route is preferable) antibiotics at least for the first 48 hours in all infants with respiratory distress as bacterial infection is a likely reason for the baby's respiratory problems. Take blood for culture first wherever possible. Antibiotics can be stopped if blood culture results are negative and baby is well after 72 hours.
- A portable chest x-ray where facilities allow can be useful.
- Take steps to prevent hospital acquired cross infection.

Management issues in specific respiratory conditions

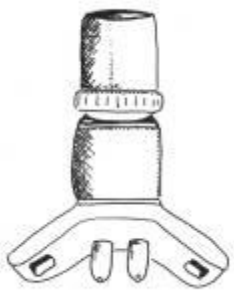
Primary surfactant deficiency ('Idiopathic Respiratory Distress Syndrome', IRDS)

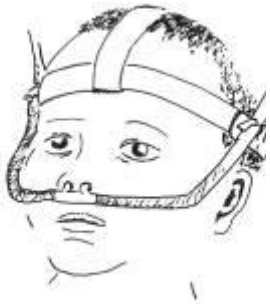
Principles of treating IRDS are
1. Minimal handling of the baby
2. Supplementary oxygen
3. IV fluids
4. No oral feeding
5. Increased end expiratory pressure (nasal CPAP)
6. Avoid hypothermia
7. Always give IV antibiotics in case the cause is pneumonia

- Surfactant deficiency is by far the commonest cause of respiratory distress in a preterm baby in the first three days of life. It is a self-limiting condition, because birth always triggers a gradual increase in surfactant production. The challenge therefore is to support the baby for the first 2-3 days (72 hours) of life without doing further damage to the lung until such time as the deficiency resolves itself.
- The key features of IRDS (cyanosis, an expiratory 'grunt', tachypnea, and intercostal and/or subcostal recession) become clinically obvious within four hours of birth. Supplemental oxygen, minimal handling and IV fluid, keeping the baby 'nil by mouth' are main forms of treatment.
- Always give IV antibiotics in case the cause is pneumonia
- Most babies will manage well for themselves as long as they are offered help in preventing the lung from closing down and becoming airless for the 72 hour period it takes for surfactant production to 'switch on'. The expiratory grunt which is a characteristic feature of this condition is the baby's own method of sustaining positive end expiratory pressure (PEEP), and holding the alveoli open. Making the baby breathe against a constant positive airway pressure (CPAP) gradient achieves the same result. By applying this pressure at the nose (nasal CPAP), the complications associated with tracheal intubation can be avoided. CPAP given via paired short prongs or specially made nasal mask is probably best as it minimises airway resistance.

Fig.

nCPAP





Transient tachypnea of the newborn

1. This is almost indistinguishable from IRDS at birth. However unlike IRDS the signs do not progress with time in the hours after birth. Most of these babies are born at or near term. All are tachypneic, and a few are obviously cyanosed for 6-12 hours after birth. The condition

seems to be caused by a delay in clearing lung fluid after birth. All these babies will recover on their own as long as handling is kept to a minimum and as long as they are not fed until their respiratory signs have subsided. Some need supplemental oxygen, but few need it for more than 72 hours. It appears to be more common after Caesarean section. Always give IV antibiotics in case the cause is pneumonia but stop after 72 hours if the baby is no longer having any respiratory distress.

Aspiration pneumonia

Aspiration of particulate matter can occasionally almost block the trachea. More commonly it can also cause a chemical pneumonitis. Meconium can be particularly irritant in this regard, making the term baby very oxygen dependent for the best part of a week.

Contrary to some studies originating from well-resourced centers in the developed world, suctioning meconium stained infants during deliveries in India and South Africa has made a dramatic difference in reducing the risk of Meconium Aspiration Syndrome.

Nevertheless with minimal handling, IV fluid and supplemental oxygen, most of these babies can be expected to make a complete recovery as long as there has been no associated hypoxic cerebral damage.. Antibiotics should probably be given until it is clear there is no associated bacterial infection.

Aspiration after birth can also cause a similar picture. Milk can block the trachea but it seldom causes much of an inflammatory reaction. Gastric acid however can be much more damaging. Recurrent minor un-recognized reflux and aspiration is probably commoner than a single massive episode of aspiration and it can certainly, over time render the baby quite oxygen dependent. Babies who are hypotonic, have a poor cough reflex or repeated apnea are probably at particular risk in this regard.

Bacterial pneumonia

This should be managed as outlined in the section on suspected infection, remembering that there may be septicemia as well as pneumonia.

Persistent fetal circulation

- This is relatively common in under resourced countries and is a potentially life threatening condition leading to poor lung perfusion after birth. It may complicate fetal hypoxia, meconium aspiration, early bacterial pneumonia, diaphragmatic hernia, RDS or (very occasionally) be a primary disorder.
- The treatment in the first instance is oxygenation, minimal handling, IV fluids and avoidance of oral feeds. Metabolic acidosis should be vigorously and rapidly corrected or even over-corrected.

Pneumothorax

This may occur spontaneously in up to 1-2% of babies. It is often asymptomatic, and may be associated with meconium aspiration, too high inflation pressures used during mechanical ventilation or resuscitation and respiratory distress syndrome. It does not automatically need to be treated, unless there is progressive respiratory distress when confirmation by chest x-ray (if available) is often too time consuming specially in case of a rapidly developing tension pneumothorax. *A hyper-resonant chest with mediastinal shift (trachea deviated away from the side of the suspected pneumothorax) and rapidly deteriorating clinical condition with severe hypoxemia and/or cardiovascular compromise (bradycardia, hypotension), strongly suggests a tension pneumothorax requiring an immediate needle thoracocentesis followed (if this results in immediate*

improvement in respiratory and cardiovascular function) by the insertion of a chest drain into the 4th or 5th intercostal space in the mid to anterior axillary line. In an emergency situation with a rapidly deteriorating cardiac and respiratory function this must be done without prior X-ray confirmation. Transillumination can be useful if a "cold light" (fiber-optic light source) is available (the affected side may glow brightly).

A pneumothorax that does not result in severe respiratory distress and is not under tension, may spontaneously resolve without mechanical removal of the pleural air but oxygen and careful monitoring is required.

Lung hypoplasia due to oligohydramnios
Chronic loss of liquor before birth can impede lung growth enough to threaten survival, but what looks like a serious problem at delivery can occasionally resolve quite rapidly after 1-2 days. However where the oligohydramnios is due to bilateral renal agenesis or dysplasia the prognosis for survival is very poor. The stiffness of the small malformed lungs in these cases causes marked intercostal and subcostal recession with un-relievable hypoxaemia.

Congenital malformations
The commonest congenital defect causing respiratory distress soon after birth is **diaphragmatic hernia.** This occurs in 1:4000 births and more commonly affects the left side. Clinical examination reveals respiratory distress, reduced air entry on the affected side with a displaced apex beat and scaphoid abdomen. The chest x-ray is diagnostic. It used to be thought that early surgery improved the chance of survival, but this is now known to be untrue. Hence immediate transfer does not have to be considered until the child's initial respiratory problems have stabilised. In the interim period an IV line and open nasogastric tube should be in place to keep the gut empty of gas and feeding withheld. Restricted lung growth means that only about half these babies have any chance of survival.

Management of diaphragmatic hernia
- Oxygen supplements
- Minimal handling
- IV fluids and withholding of oral feeds
- NGT to keep the stomach empty
- Stabilisation of respiration with mechanical ventilation or nasal CPAP can be helpful if availible.
- Transfer to surgical care if baby responds to treatment

Congenital heart disease occasionally can cause overt cyanosis from birth, but there are seldom any associated signs of respiratory distress.

Apneic/hypoxemic episodes Apnea is a cessation of respiration or a hypoxemic event associated with signs of cardio-respiratory decompensation (bradycardia, cyanosis, pallor). Apneic episodes are common in preterm babies <32-weeks' gestation ("apnea of prematurity"). In term babies, apnea usually signifies an underlying pathologic condition.

Apnea of prematurity

Caffeine is effective. It has a long half-life (daily dosing) and serum levels do not have to be monitored. Continuous positive airway pressure (CPAP) or rarely mechanical ventilation may become necessary to control recurrent apnoea.
The diagnosis of "apnea of prematurity" is one of exclusion as various other processes may cause or exacerbate apnea. In the case of a preterm baby these include:

- respiratory distress (surfactant deficiency, pneumonia, pulmonary edema due to a persistent ductus arteriosus)
- intraventricular hemorrhage
- hypoglycemia
- over-heating or hypothermia
- sepsis
- severe anemia may also contribute to apnea

Airway obstruction This may result from simple malpositioning of the head (for example hyper-flexion or hyper-extension of the neck), especially in preterm infants. Congenital airway anomalies like tracheo-oesophageal fistula or aberrant thoracic blood vessel compressing the trachea (vascular sling) may also present as apnea. Maintaining proper head positioning or surgical correction of the underlying anomaly should be provided.

Infection must always be excluded and antibiotics administered until infection has been ruled out by subsequent clinical findings and laboratory results (complete blood counts, chest X-ray, blood cultures etc.).

Epileptic fits **(**see below) Fits may present primarily as apnea. Epileptic fits in the first one to three postnatal days with a history of an operative vaginal delivery (for example forceps) or other birth trauma may indicate the possibility of an intracranial hemorrhage .

Maternal medication is common cause of apnea in the newborn. It can be intra-partum maternal narcotic administration for maternal pain/sedation during the last 4 hours before delivery. The effects can be reversed by the administration of naloxone hydrochloride (100 micro-grams/kg, usually given IM). Naloxone should not be administered if there is a history of chronic narcotic use in pregnancy since acute neonatal narcotic withdrawal may be precipitated.

Exposure to high magnesium sulphate levels have also been associated with apnea in the immediate postnatal period. This is usually a self-limiting.

Continuous monitoring, preferably with a pulse oximeter, is needed especially if the baby becomes bradycardic or cyanosed with the apnoea.

Treatment of apnoea:

- gentle stimulation is usually all that is required to start the baby breathing again.
- bag and mask resuscitation can occasionally be called for and there should always be equipment immediately available and ready (not locked away in a cupboard)
- oral caffeine may reduce the number of episodes in a preterm baby. Caffeine seldom causes the tachycardia and the other side effects associated with theophylline. It is advisable to continue caffeine for 4–5 days after cessation of apnea. Recurrent apnea not responding to caffeine occasionally requires a period of nasal CPAP or mechanical ventilation.

Table Caffeine use in apnoea of prematurity

Drug and Preparations	Each dose	Dose frequency	Administration notes
Caffeine citrate	20 mg/kg	Loading dose	If oral dose too large, divide into two
	5-8 mg/kg maintenance	once daily	and give 1 hour apart
Caffeine base	10 mg/kg	Loading dose	Give IV loading dose over 30-60
	2.5-4 mg/kg maintenance	once daily	minutes diluted as much as possible

7. Bleeding or anaemia

Causes Peri-partum haemorrhage of relatively small amounts of blood can result in hypovolemic shock in the newborn. Common causes may include a slipped ligature on the umbilical cord, intra-uterine feto-maternal haemorrhage (diagnosed by Kleihauer-Betke test) or subgaleal hemorrhage. Vasa praevia or an accidental incision of the placenta during Caesarean section are other causes.

Later bleeding in the first week of life is uncommon but may signify haemorrhagic disease of the newborn or clotting factor deficiency.

Presenting features The baby will look pale and shocked with weak peripheral pulses, tachypnea and a tachycardia that may exceed 200 beats/minute. Blood pressure may be low or undetectable even in a term baby. **The haematocrit and haemoglobin concentration may be normal in an infant with acute hypovolemic shock and is an unreliable early indicator of the amount of blood lost**. DO NOT WASTE TIME CHECKING THIS. Revealed blood loss rarely results in hypovolemic shock. Common sites of blood loss include the umbilical stump and gastrointestinal tract. In the latter case there may be doubt as to whether blood is of maternal (blood swallowed at delivery or from a bleeding nipple) or infant origin.

Treatment:

- in an emergency in a shocked baby give O Rh-negative blood (20 ml/kg) at a rate depending on the degree of shock (usually the first 10 ml/kg can be safely given over 5 minutes), monitoring the response and reducing the rate of infusion as improvement occurs. Sometimes a further 10-20 ml/kg may be necessary.
- if no O-ve blood for transfusion is available, take blood from the mother's vein and infuse it immediately with no delay to avoid infusing clots into the baby as a bolus (10ml/Kg in the first instance)
- if blood is not immediately available use 10-20 ml/kg of 4.5% albumin or **Ringer-Lactate or Hartmann's,**.
- if there is overt bleeding take a blood sample for blood group and cross match, haemoglobin, platelet count, film and clotting studies. Then give 1 mg vitamin K (phytomenadione or phytonadione) intravenously.

8. Jaundice

The serum bilirubin level usually noticeably rises after the first 24 hours of life and peaks at between 100 and 300 µmol/l by 3–5 days after birth.

Causes of Physiological Jaundice in the Neonatal Period:

- increased breakdown of red blood cells in the first few days of life
- reduced life span of red cells (70 days compared with 120 in the adult)
- less efficient metabolism of bilirubin by the immature liver

"Physiological jaundice" is common, affecting at least a third of normal term babies. Jaundice can be considered physiological and does not require treatment or investigation if the following criteria are met:

- jaundice is not present in the first 24 hours of life.
- the baby is well, free of signs of infection without enlargement of liver or spleen.
- the bilirubin concentration does not exceed 300 µmol/l (approximately 17 mg/dl) at any stage (term babies only). A much lower acceptable level is set for preterm babies.
- the bilirubin concentration reaches a peak on the fourth or fifth day of life.
- the jaundice has fully resolved by the end of the second week of life.

The risk of jaundice can be reduced by encouraging early, unrestricted demand breastfeeding.

Bilirubin encephalopathy (kernicterus) in the absence of overt haemolysis is excessively uncommon in the **term** baby unless the serum bilirubin level exceeds 425 µmol/l.

(Note *:* *µmol/l divided by 17.1 =* ***mg/dl*** *AND mg/dl multiplied by 17.1 =* ***µmol/l***)

Prolonged jaundice >14 days

Here it is important not just to know the total bilirubin but **the proportion of conjugated bilirubin**. Conjugated bilirubin is not neurotoxic but its presence signifies presence of biliary obstruction attributable to potentially serious conditions such as neonatal hepatitis or biliary atresia.

The history can be informative if laboratory investigation is not available. Presence of pale un-pigmented stools or dark urine would be suggestive of biliary obstruction. Urine can also be tested with a reagent strip for bilirubin (if positive for bilirubin the diagnosis of biliary obstruction is supported, provided baby is not receiving phototherapy when unconjugated bilirubin appears in the urine).

It is important to identify biliary atresia promptly because operative intervention is more likely to be successful if undertaken within eight weeks of birth. Even mild jaundice merits review if the stool becomes grey or putty coloured rather than yellow or green.

Similarly in the absence of a neonatal screening programme (as is prevalent in the majority of under resourced countries) it is important that congenital hypothyroidism and G6PD be identified. This can be done by simple tests including T4, TSH, G6PD assay, bilirubin (total and direct), complete blood picture and reticulocyte count

Breast Milk Jaundice Ten per cent of breast fed babies are still slightly jaundiced a month after birth. Laboratory investigations seldom reveal anything needing treatment and the baby is otherwise well. This scenario may be suggestive of breast milk jaundice however it is important that other common causes including congenital biliary atresia, hypothyroidism and Glucose 6-Phosphate Dehydrogenase Deficiency (G6PD) be ruled out. Remember breast milk jaundice is a diagnosis of exclusion.

Ill babies with continuing jaundice should be given a prophylactic 1 mg IM injection of vitamin K if it is not clear that they received such an injection at birth to minimize the risk of potentially fatal late vitamin K deficiency bleeding.

Pathological jaundice
There is an increasing risk that high levels of serum bilirubin will breach the blood/brain barrier causing critical damage. This becomes more likely if in the presence of haemolysis.

Causes

- Haemolytic disease
- Neonatal sepsis
- Starvation
- Hypothyroidism
- Congenital infection
    - Syphilis
    - Toxoplasmosis
    - Cytomegalovirus
    - Rubella
    - Hepatitis

In the first week of life, the following factors may lead to jaundice sufficiently severe to require treatment:

- **preterm delivery**. Even moderate prematurity significantly increases the risk of early or severe jaundice and the risk of associated sequelae. Consequently the bilirubin treatment charts give lower treatment thresholds for babies 31-34 weeks gestation. At less than 31 weeks, treatment is started at even lower bilirubin levels.
- **haemolytic disease**. This may be iso-immune (for example Rh or ABO incompatibility) or due to red cell disorders, for example hereditary spherocytosis or G6PD.
- **infection**. Haemolysis and impaired elimination of bilirubin may be associated with septicaemia. Congenital infection (for example syphilis) may also be associated with jaundice, but other features such as rash, hepatosplenomegaly, thrombocytopenia will be present, and there is usually a significant conjugated bilirubin level.
- **rarer causes**. These include inborn errors of metabolism (galactosaemia), congenital hypothyroidism, other intra-uterine infections and neonatal malaria.
- **obstructive jaundice**. Rarely presents in the first week of life but is important in the differential diagnosis of prolonged jaundice.

Haemolysis
Clinically noticeable jaundice within 24 hours of birth, more so if the mother is blood group O and the baby is group A or group B, or the mother is Rhesus negative and the baby is Rhesus positive should suggest the possibility of a hemolytic disease.

Term babies with physiological jaundice seldom need treatment with phototherapy unless there is an unusually high rate of red cell breakdown. However, phototherapy should be started just as soon as jaundice becomes apparent if there is evidence of haemolytic disease. The trend in the bilirubin level should then be checked twice a day (the level cannot be judged from skin color once phototherapy has commenced)

Investigation
A good principle to remember is to measure bilirubin and investigate if jaundice in any baby appears on day 1, in any preterm baby if jaundice appears on day 2, any sick neonate and in all babies at any age if the palms or soles of the feet are yellow.

In a baby who develops jaundice in the first 24 hours the most likely causes are **infections** or **haemolytic disease**. History and examination may be helpful. It may be helpful to determine if the mother has previously had affected babies or if she is known to have a hereditary haemolytic disorder or if risk factors for infection or clinical signs of sepsis exist. Hepato-splenomegaly could be suggestive of congenital infection.

The following should suggest a high risk for hemolysis:

- red cell antibodies in the mother's blood.
- a positive Coombs or direct anti-globulin test in blood from the umbilical cord.
- a family history of G6PD deficiency or congenital spherocytosis.
- a history that previous children were seriously jaundiced in the first week of life.
- otherwise unexplained neonatal anaemia at birth (a haemoglobin level <140 g/l or a haematocrit < 40%).

Useful laboratory tests are:

- mother and baby's ABO and Rh blood groups. Save serum to cross-match if exchange transfusion needed
- direct Coombs test (if positive indicates an iso-immune haemolytic anaemia)
- complete blood count and reticulocyte count (anaemia and reticulocytosis indicating haemolysis and/or abnormal white blood cells indicating possible infection)
- peripheral blood smear (abnormal red cell morphology and/or fragmented red cell forms suggesting a specific red cell disorder and/or haemolysis)
- G6PD screen
- syphilis serology
- thyroid function tests (T4, TSH)
- urine test for non-glucose reducing substance (for possible galactosaemia)
- liver ultrasound

Treatment

In general, the smaller the baby and the sicker the baby, the greater the urgency to intervene.

The specific bilirubin levels for which phototherapy and exchange transfusions need to be considered in infants under 31 weeks gestation are less certain. A frequently used guideline is to initiate phototherapy when the bilirubin level approaches 85 µmol/l per kg birth-weight (which equals approximately 5 mg/dl per kg birth weight), and to consider an exchange transfusion for levels above 170 µmol/l per kg birth weight (which equals approximately 10 mg/dl per kg birth weight).

Table Recommendations from WHO 2012

	PHOTOTHERAPY		EXCHANGE TRANSFUSION	
AGE	HEALTHY NEWBORNS ≥35 WEEKS GESTATION	NEWBORNS <35 WEEKS GESTATION OR ANY RISK FACTORS	HEALTHY NEWBORNS ≥35 WEEKS GESTATION	NEWBORNS <35 WEEKS GESTATION OR ANY RISK FACTORS
Day 1	Any visible jaundice		260 mmol/l (15 mg/dL)	220 mmol/l (10 mg/dL)
Day 2	260 mmol/l (15 mg/dL)	170 mmol/l (10 mg/dL)	425 mmol/l (25 mg/dL)	260 mmol/l (15 mg/dL)
Day ≥3	310 mmol/l (18 mg/dL)	250 mmol/l (15 mg/dL)	425 mmol/l (25 mg/dL)	340 mmol/l (20 mg/dL)

Phototherapy

While under phototherapy, it is important to monitor body temperature and to protect the baby from draught. It is also standard practice to mask the eyes to protect against bright lights. The baby should be nursed naked in an incubator, under a radiant heater or in a cot allowing maximum skin exposure. Feeding, especially breast feeding should continue without interruption as more frequent breast feeding is helpful not only in eliminating meconium from the bowel and also enhancing bilirubin clearance via the stool and urine. During phototherapy baby can be removed for breastfeeds as necessary (intermittent treatment has been shown to be as effective as continuous). Extra fluid (e.g. breast milk substitute, water, sugar water etc.) should **not** be given. The total daily fluid intake may need to be increased about 10 percent, especially in preterm babies, to minimise additional water losses from evaporation and convection.

Phototherapy can be stopped when serum bilirubin is 50mmol/l (3mg/dl) below the phototherapy threshold.

Exchange transfusion.

Bilirubin levels rising above certain threshold values place an infant at risk for developing bilirubin encephalopathy (kernicterus). In such cases, the bilirubin level needs to be immediately lowered with a double volume exchange transfusion. A volume of the infant's blood equal to the bodyweight in kg x 2 x 80 ml/kg is exchanged in small aliquots with O Rh-negative blood, or blood cross-matched against maternal antibodies.

Exchange Transfusion

1. Calculate the baby's circulating volume = 85 ml/kg. Twice this amount of blood will be required. Do not exceed this (usually 1 bag of whole blood = 450ml). Do not use blood more than 4 days old.
2. Check that the blood has either the same ABO group as the baby or is blood group O Rh-negative AND is compatible with the mother's serum.
3. Ensure the baby is closely monitored throughout the procedure.
4. This is a sterile procedure, so gloves and gowns must be used and universal precautions applied.
5. Secure umbilical vein access.
6. Ideally, use a blood warmer (especially for low birth weight infants) otherwise warm by placing under mother's dress next to skin
7. Set up a closed circuit with either a 4-way tap, or two 3-way taps. The four links are
   a. The baby
   b. The syringe for removing and replacing blood
   c. The blood to be transfused
   d. The route for discarding the baby's blood
8. Make sure that the total blood in and out is recorded. Plan to spend 1.5 to 2 hours on the procedure.
9. Withdraw 6 mls of blood from the baby and discard it.
10. Withdraw 6 mls of blood from the blood bag or bottle and transfuse into the baby.
11. Steps 9 and 10 should in total take about 3 minutes to avoid abrupt changes in BP.
12. Repeat steps 9 and 10 until the correct volume of blood has been exchanged.
13. Symptomatic hypocalcaemia may occur as the citrate in donor blood binds calcium. This responds best to halting the procedure for 15 minutes. Giving calcium gluconate is of little benefit and may be hazardous, so is best avoided.

Exchange transfusion should only be undertaken once all the attendant risks have been considered. Even in experienced hands 1% of babies may suffer a sudden cardiac arrest during or shortly after the procedure. This should respond to prompt intervention using the approach adopted when dealing with cardiac arrest at birth, but the baby needs to be monitored closely, and staff need to be ready

for such a possibility if this is not to prove fatal. Air embolism can kill within minutes and faulty technique can cause sudden hypo- or hypervolemia, or introduce later sepsis. The use of donor blood more than five days old can cause serious hyperkalemia and an arrhythmia. Blood straight from the fridge at 4ºC can impose a major cold stress. It is also critical to avoid causing hepatitis B or HIV infection. In addition there is a definite but poorly understood risk that the procedure will trigger serious necrotizing enterocolitis.

9. Fits, spasms or reduced conscious level

Seizures (fits, convulsions) have been reported to affect about 0.1% of term babies and 10% of those <1500g at birth.

Presenting features
Seizures may be subtle (apnoea, staring, lip smacking/grimacing, deviation of the eyes, cycling movements of limbs) or more obvious (tonic extensor posturing or clonic movements). Involvement of a limb or one side of the body does not necessarily imply a focal cause in the neonate. A bulging anterior fontanel may suggest intracranial haemorrhage or infection. It is important to **always measure and note the head circumference.** Sometimes involuntary movements (for example extreme jitteriness) or benign myoclonic jerks can be hard to distinguish from seizures. The presence of associated autonomic instability and/or lateral eye deviations may signal seizure activity whereas the absence of these findings or elimination of these movements when the limbs are restrained, indicate a non-seizure event.

Well but jittery baby	Baby with clonic seizures
No abnormal eye movements	Abnormal eye movements
No apnoea	Apnoea
No colour changes	Pallor or cyanosis
No heart rate changes	Tachycardia
Easily triggered by handling and stopped by gentle passive flexion of the affected limb	Independent of handling
Rhythmical movements	Jerky with fast and slow components that are not equal

Causes of seizures

- Hypoxia
- Hypoglycaemia
- Meningitis
- Drug related seizures
- Sepsis
- Tetanus
- Hypocalcaemia
- Hyper or hyponatraemia
- Metabolic abnormalities

- **Hypoxic ischaemic encephalopathy** This is the most common cause of seizures in a term baby. Onset is usually within the first 24 hours and almost never commences after the third day.
- **Intracranial haemorrhage**, **subarachnoid haemorrhage** or **cerebral infarctions** are also common causes. With subarachnoid haemorrhage, seizures may or may not be focal however unilateral tonic-clonic seizures are often observed with cerebral infarction. Although **intraventricular haemorrhage** occurs most frequently in low-birth weight infants or at gestational ages under 32 weeks, very rarely it may manifest in term or near-term infants with neonatal seizures. Always give 1 mg IV vitamin K.
- **Infection.** Although meningitis is not the commonest cause of neonatal convulsion it must always be excluded by lumbar puncture and antibiotics commenced pending results of culture.
- **Metabolic causes** of seizures include:
  - **Hypoglycaemia: always** check blood glucose.
  - **Hypocalcaemia:** check plasma calcium
  - **Hyponatremia/hypernatremia:** Seizures are uncommon unless plasma sodium is < 120 mmol/litre or > 160 mmol/litre. Seizures in infants with hypernatremia may result in cavernous sinus thrombosis. A rapid fall or rise in serum sodium as may occur with too rapid therapeutic correction may be more injurious than the absolute value of serum sodium. A slow correction is essential such situations.
- **Bilirubin encephalopathy** (see jaundice, above).
- Rare **inborn errors of metabolism**
- **Maternal substance abuse**, particularly opiate withdrawal.
  - **Tetanus** in some countries.

If the baby is alert and well between episodes of seizure activity, seems normal on examination, and is feeding normally; sometimes it may be perfectly appropriate to do nothing.

Investigations

- Lumbar puncture and blood culture.
- Blood glucose, calcium, urea and electrolytes.

Treatment

- Airway and Breathing
- Circulatory access
- Give glucose IV or NG (2ml/Kg of 10% glucose)
- Give antibiotics IV or IM if possibility of meningitis or sepsis
- Stop seizure with anticonvulsant:
  - Phenobarbitone OR Phentoin OR Paraldehyde

- Stop feeds and place an intravenous line.
- Start antibiotic therapy (see Infections above)

- Treat hypoglycaemia if present.
- Monitor heart and respiratory rate, oxygenation (ideally with pulse oximetry). Treat low SaO2 or cyanosis with oxygen.
  - Consider anticonvulsant therapy: the earlier the fits appear, the more frequent they are (more than two or three per hour), and the longer they last (more than 3 minutes) the more likely it is that anticonvulsants are needed. Fits which interfere with respiration need to be treated urgently and may require respiratory support.

Emergency treatment of hypoglycaemia

Hypoglycaemia is a common cause of seizures in babies. It is ideal to do a rapid bed-side test for low blood sugar and act accordingly but if the test is not available then a test dose of 2mls/kg of

10% glucose should be given IV or, if venous access is not available, then sublingual sucrose 1-2gms can be tried.

Anticonvulsant treatment

Phenobarbital is the first line drug for neonatal seizures. Give a 20 mg/kg loading dose slowly followed by 3-5 mg/kg once every 24 hours. Treatment can be given IV, IM or PO. Seizure control may be achieved more quickly if the first dose is given IV, but this loading dose must be given slowly, over at least 5 minutes to minimise the risk of shock, hypotension or laryngospasm. An additional 10 mg/kg may be required if seizures persist or recur (70% response rate).

Phenytoin (*second line***):** Initial seizure control with this drug requires the presence of a saline filled IV line (because the drug crystallises out in dextrose/glucose solutions). The same problem also makes the IM route prohibited. Give a 20 mg/kg loading dose (diluted in 10-15mls of normal saline) IV slowly over 10-20 minutes (monitor for hypotension and cardiac arrhythmia making sure the drug does not leak into the tissues) and then 2 mg/kg IV or by mouth once every 8 hours.

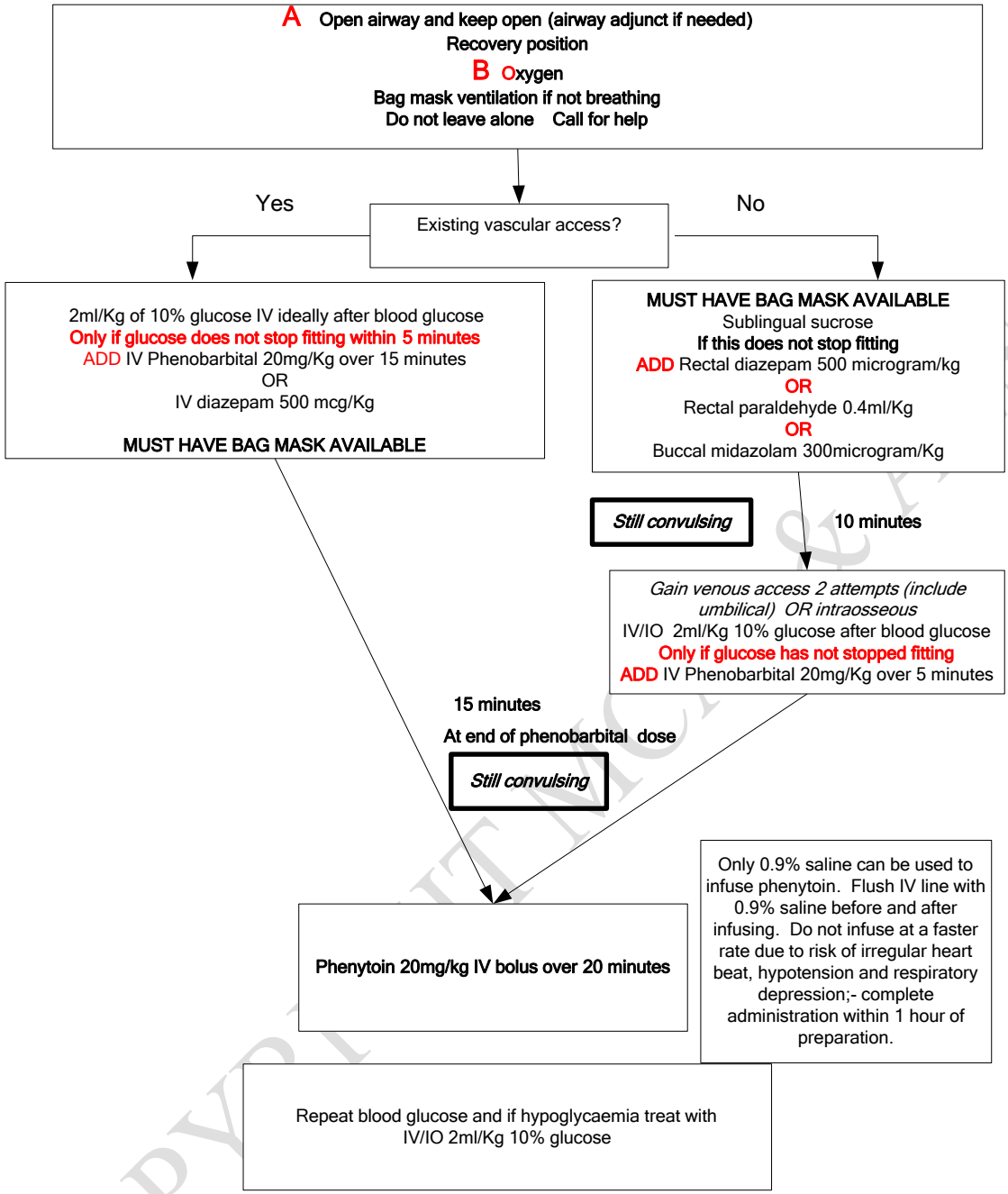
Paraldehyde (*third line***):** Give a single 0.4 ml/kg dose mixed with an equal volume of mineral oil by rectal route. The rectal route offers excellent bioavailability of the drug. This dose can be repeated once if seizures persist. Give within 10 minutes of preparation when using a plastic syringe (because paraldehyde interacts with many plastics). . Paraldehyde can also be given by IM route however problems with muscle necrosis make it a less desirable route.

Midazolam: This has an immediate effect but a short duration of action. Like diazepam it can cause respiratory depression hence bag and mask must be available when it is used and the baby monitored closely.

Note: Anticonvulsants may precipitate a need for respiratory support. Therefore always have a bag-valve-mask available.

Once seizures are controlled, maintenance therapy (which is rarely needed) with a single agent is often possible (usually phenobarbitone).

Figure Pathway of Care Prolonged Seizure in Neonates



NOTES

A. Indications: Still fitting when seen if just arrived at hospital OR If already in hospital where onset of fit is seen and generalised convulsion lasting > 10-15 minutes or repeated convulsions without return of consciousness between fits.
B. Hypoglycaemia is blood glucose <2.5 mmol/l (45mg/dl).
C. **If blood glucose cannot be measured treat as hypoglycaemia.**
D. If hypoglycaemia has been present give feed (milk or sugar water) orally or NG when conscious. To make an oral or NG sugar solution dissolve 4 level teaspoons of sugar (20 gram) in 200ml of clean water.
E. If IV/IO glucose does stop fitting, repeat blood glucose 10 minutes later and give an infusion of 10% dextrose .

It is essential to consider in detail the four main treatable causes of convulsions **(1.hypoglycaemia, 2. hypocalcaemia, 3. meningitis and 4. tetanus)** since any delay in diagnosis could be harmful.

1. Hypoglycaemia (less than 2.5 mmol/litre (45mg/dl)

Hypoglycaemia is a common problem; it can occur in babies who appear well and also in babies who are sick. It is important to identify an infant at risk and take preventative and curative measures as early as possible. **Untreated symptomatic hypoglycaemia can result in brain damage.**

Infants at risk for hypoglycaemia:

- infants of diabetic mothers
- preterm babies
- small-for-gestational age or wasted babies
- large-for-gestational age babies
- post-term babies
- sick babies with infections and respiratory failure
- fasted babies

Causes of neonatal hypoglycaemia

Increased utilisation of glucose / hyperinsulinism:

- infants of diabetic mothers
- respiratory distress
- abrupt interruption of high glucose infusion
- polycythaemia

Decreased production/stores

- prematurity
- small-for-gestational age or wasting
- inadequate nutrition

Increased utilisation and/or decreased production or other causes

- perinatal stress (hypoxia, sepsis, shock, hypothermia)

Diagnosis of hypoglycaemia

- Fits due to hypoglycaemia typically start in a previously well baby on or after the second day of life.
- Indications for measuring the blood glucose concentration of a term baby include lethargy, poor feeding, temperature instability, respiratory distress, new-onset apnoea/bradycardia, jitteriness, pronounced hypotonia, diminished consciousness and seizures. Association between such signs and low blood glucose concentration is described as "symptomatic hypoglycaemia".
- Beware of blaming these signs on "hypoglycaemia" alone. *Remember a baby who seems drowsy may be infected and low blood glucose concentration may merely be an associated finding.* It is important to try and establish the root cause of the problem.
  - Although laboratory estimates of blood glucose are ideal for diagnosing and managing this condition, reagent strips can be helpful.
  - Blood glucose concentration in the first 6 hours of life is very often low (1.5-2.0 mmol/litre). There is no evidence this is harmful for otherwise healthy term babies who adapt by mobilising other fuels. Consequently early testing (<6 hours of age) is pointless - unless neurological signs are present or if there are other conditions so necessitating.

When to test

- **Symptomatic infants** (lethargy, poor feeding, temperature instability, respiratory distress, new-onset apnoea/bradycardia, jitteriness, and seizures) should be tested immediately.
- **Infants at risk** should be tested soon after birth (i.e. within 6 hours) and then 3 hourly until stable at 2.5 mmol/litre (45 mg/dl) or higher. Continue to monitor until feeds are well established.

- In **infants with hypoglycaemia**, check blood glucose every 20-30 min from beginning of treatment, then hourly until stable at 2.5 mmol/litre (45 mg/dl) or higher. Continue to monitor frequently (every 4-8 hours) during treatment and while decreasing supplemental intravenous glucose infusions.

Management of hypoglycaemia

Infants at risk for hypoglycaemia, appearing to be well

- Initiate early feeding within 1 hour after birth with breast milk or formula (only if breast milk is not available) and repeat every 2-3 hours.
- Feeding with 5% glucose is not recommended in infants because milk provides more energy.
- Infants of diabetic mothers are unlikely to develop hypoglycaemia on the second day of life if tests in the first 24 hours are satisfactory.

Infants with symptomatic hypoglycaemia who are unable to feed or who failed correction of glucose levels with enteral feeding

- Establish an IV line using sterile precautions and take a sample for blood culture and other biochemical tests (if available). Give intravenous glucose bolus 200 mg/kg over 5 min (2 ml/kg of 10% glucose). If the baby almost immediately becomes more alert and active *'on the end of your needle'* you have made the diagnosis, even before the laboratory report comes back. **In such situations it is then important to keep the blood sugar level stable by starting a sustained infusion of 10% dextrose at 5 ml/kg per hour (or 5-8 mg/kg/min) for the next 2-4 days while gradually building up oral feeds.**
- If further episodes of symptomatic hypoglycaemia occur, the bolus should be repeated and the infusion rate increased by 10-15%.
- A baby who seems drowsy may be infected and a low blood glucose may be an associated finding not the main cause of the problem. It is important to exclude infection and initiate antibiotics if indicated.
- When administering boluses, never use high concentrations of glucose (>10%) because of risk of intra-ventricular haemorrhage and/or cerebral oedema.
- Most babies will correct hypoglycaemia with infusion of 5-8 mg/kg/min; it is not infrequent though that babies with severe intrauterine growth restriction or wasting and those with hyper-insulinism may require infusion rates up to 12-15 mg/kg/min.
- When normal blood glucose levels have been stable for 12-24 hours and the baby is tolerating enteral feeding, decrease the intravenous glucose infusion by 10-20% each time levels are greater than 2.5mmol/L (45mg/dl).
- Always decrease intravenous infusion gradually because of the risk of precipitating hypoglycaemia.
- If unable to gain intravenous access, Hypostop gel an oral glucose mixture containing 500 micrograms of glucose per ml can be helpful. Apply 1-2 ml to the oral mucosa.
- If hypoglycaemia persists beyond the first week of life and requires large infusions of glucose (greater than 8 mg/ kg/min), evaluation for endocrine or metabolic disorders should be undertaken.

2. Hypocalcaemia

Fits due to hypocalcaemia (a serum total calcium of < 1.7 mmol/l), with or without hypomagnesaemia are generally benign and occur unexpectedly in an otherwise well but hyper-reflexic child more than 2-3 days old. As with hypoglycaemia signs may settle *'on the end of needle'* if the baby is given 1-2 ml/kg of 10% calcium gluconate in equal dilution as a *slow* IV infusion. Such seizures usually respond perfectly to oral supplementation. It is appropriate to investigate the mother for an unrecognised endocrine abnormality if facilities allow. **Do not allow calcium infusions to go outside the vein as it will cause serious tissue damage.**

3. Meningitis

See earlier

4. Tetanus

Do not forget this.

Clinical presentation

A previously well neonate, presents at 3-20 days with irritability, decreased sucking, trismus, muscle spasms or convulsions. This becomes more relevant if there is any doubt about the way the umbilical cord was managed at birth or if there is no proof that the mother was ever immunised with tetanus toxoid vaccine

The clinical presentation depends upon the distance the injury is from the spinal cord. The incubation period varies from 3-21 days. The shorter the incubation period and the time from onset of symptoms to the first spasm, the worse the outcome.

More than 90% of patients develop trismus ("locked jaw") due to the short pathway of the fifth cranial nerve. As the disease progresses, spasm of muscle groups supplied by other cranial nerves occurs including the seventh cranial nerve resulting in facial muscle rigidity and risus sardonicus Spasm of the pharyngeal muscles may result in dysphagia and spasm of the laryngeal muscles may result in asphyxia. The generalised muscle **spasms are extremely painful,** may be prolonged, giving rise to opisthotonus. The sympathetic system can be affected causing lability of temperature, blood pressure and cardiac function.

Early signs will be helpful in making the diagnosis. The mother may complain of an abnormal cry ('baby cannot cry well') because she has noticed that trismus prevents the mouth from opening. This happens before suckling is affected. If one is uncertain, a slight touch stimulus may initiate spasm or rigidity. History of the birth (usually at home) and of how the cord was cut, is informative, though not particularly discriminating. Contamination at birth, for example being born onto the floor plus/minus cord cutting with an unsterile instrument, is more likely to result in tetanus than for example following a circumcision but either could be responsible.

Management of established tetanus

The approach to treatment given here is appropriate for both neonatal and childhood tetanus.
Management is targeted at:

- Neutralising existing toxin and preventing its further production
- Control of spasms
- Prevention of complications.
- Providing adequate nutrition

On admission

- Secure and maintain the airway, ensure adequacy of ventilation.
- Insert an intravenous line. IV infusions, even slow IV administration of drugs, may not be possible, because of lack of suitable IV giving set (even as simple as burette type) equipment or skilled time. However, an IV cannula should be left in situ for drug and antibiotic administration.
- **IM injections must be avoided at all costs, since they will provoke spasms.**
- If the baby/child is in **acute spasm,** this should be terminated by giving **diazepam by bolus IV infusion over 15 minutes (dose 200 micrograms/kg) or rectally (400 micrograms/kg).** Ensure that for intravenous infusion, diazepam is diluted to 100 micrograms/ml and that extravasation does not occur (very irritant).
- Also give an IV loading dose of 25-40mg/Kg of magnesium sulphate over 20-30 minutes (maximum loading dose = 2 gram)
- **ALWAYS HAVE A BAG MASK AVAILABLE IN CASE THE PATIENT STOPS BREATHING AS A RESULT OF THE DIAZEPAM PLUS MAGNESIUM.**
- When stable, a nasogastric tube, ideally passed by an anaesthetist, will allow fluids, food and drugs to be given with minimal disturbance. Feeds need to be given frequently (ideally hourly)

and in small amounts due to reduced gut motility. **In the neonate regular breast milk feeds via a nasogastric tube are essential.**

- Any obvious wound should be debrided and cleansed especially if extensive necrosis is present and previous sutures should be removed In neonatal tetanus, wide excision of the umbilical stump should **not** be done.
- The disease itself does not induce immunity, so after recovery tetanus vaccine must be given for future prevention.

Antibiotics

Oral (or intravenous) metronidazole (30 mg/kg per day, given at 6-hour intervals; maximum, 4 g/day) is effective in decreasing the number of vegetative forms of C tetani and is the antimicrobial agent of choice. Parenteral penicillin G (100 000 U/kg per day, given at 4- to 6-hour intervals; maximum 12 million U/day) is an alternative treatment. Therapy for 10 to 14 days is recommended. Oral therapy can be given after the initial period.

Associated septicaemia is not uncommon in the neonate and additional broader spectrum antibiotics will often be required (see above for treatment of neonatal sepsis).

Hospital acquired infections are also common, especially pneumonia, and should be appropriately treated.

Neutralisation of toxin

Antitetanus human immunoglobulin (HTIG) is the preparation of choice for neutralising unbound tetanospasmin. It is given by intravenous infusion over 30 minutes at a dose of **5000-10,000 units immediately on admission.** Adverse reactions are rare. **Local instillation is of no benefit.**

For neutralisation of the toxin, HTIG is not available in most countries where it is needed. An equine immunoglobulin may be available and is used, 500-1000 units/kg IM (maximum dose 20,000 units). There is a risk of anaphylaxis **Adrenaline must be immediately available**.

Immune Globulin Intravenous (IGIV) contains antibodies to tetanus and can be considered for treatment in a dose of 200 to 400 mg/kg if HTIG is not available.

Management of spasms and hypertonicity

- Spasms can usually be controlled by slow IV injection of diazepam 200 micrograms/kg followed by IV 25-40mg/Kg of magnesium sulphate over 20-30 minutes (maximum loading dose = 2 gram).
- Subsequently give IV diazepam 200 micrograms/Kg every 4-6 hours and magnesium sulphate 10-20mg/Kg 2-4 hourly IV.
- Stop diazepam if magnesium alone controls the spasms.
- Reduce the dose of diazepam if apnoeic episodes occur.
- **ALWAYS HAVE A BAG MASK AVAILABLE IN CASE THE PATIENT STOPS BREATHING AS A RESULT OF THE DIAZEPAM.**
- Paracetamol 25 mg/kg 6 hourly for pain (20 mg/kg in the neonate). If this is insufficient the WHO pain ladder approach should be adopted. Oral or IV morphine may be needed.

Alternative antispasmodic or sedative drugs

- Phenobarbitone (15 mg/kg in one or two divided doses) as loading dose then 5 mg/kg/day can be used for breakthrough spasms

Tracheostomy, assisted ventilation and prevention of complications

Hospitals in regions with a high prevalence of neonatal tetanus may not have appropriate facilities for ventilation, or even for emergency intubation of neonates; bag and mask ventilation, when apnoeic attacks occur, may be the only alternative.

Many patients have major problems with pharyngeal spasms/upper airway obstruction and are best managed with a tracheostomy and pharmacological control of the spasms (sometimes the tracheostomy may need to be undertaken as an emergency procedure). Up to a third of those needing a tracheostomy do not require ventilation.

- Intubation can be very difficult because of pharyngeal/laryngeal spasm and often a mini-tracheostomy without prior intubation may be appropriate, provided experts for the procedure and anaesthesia are present.
- Infusions of morphine are essential to minimise suffering due to severe pain. (Under no circumstances should paralysis be given to children who are intubated and ventilated without infusions of morphine).
- **Good nursing and frequent monitoring with particular attention to suction of secretions from the airway, maintenance of adequate hydration, temperature, mouth hygiene, turning of the patient to avoid orthostatic pneumonia and bed sores, will reduce complications.**
- The infant should be nursed in a quiet environment with low level lighting. Sudden loud noises should be avoided.
- It will be helpful to involve the mother in management, either to call staff if the baby goes into spasm or stops breathing. She can also be taught to feed the baby by tube, including checking position by suction before each feed) and taught minimal handling techniques. She could also count minor spasms, though may not be able to chart them.
- Invasive procedures should be kept to a minimum and preceded by appropriate analgesia. There must be **continuous** observation by experienced personnel.
- In a high dependency care unit, cardiac function should ideally be monitored by ECG to detect toxin-induced arrhythmias and autonomic instability.
- High dependency care of severe cases of tetanus may be necessary for up to 3-4 weeks.

It is important to realise that the baby has unimpaired consciousness and is often aware of what is taking place. Prescribe appropriate (regular and frequent) analgesia, as antispasmodics alone do not prevent the suffering resulting from painful spasms or painful procedures. The spasms are also very frightening and distressing for the parents.

Monitoring

Only absolutely essential blood tests should be done to avoid precipitating spasms

- Glucose, urea and electrolytes
- A chart of the occurrence of spasms can be helpful
- Cardiac monitoring
- Pulse oximetry
- Fluid input/output
- Nutritional intake

Biochemical causes of convulsions

Remember biochemical disturbance may not be the main underlying problem. In many babies with evidence of hypoglycaemia or hypocalcaemia or any other biochemical disturbance these abnormalities may be a sign of another more serious underlying illness. Of these by far the most important treatable condition is meningitis. Unless the baby is otherwise entirely well it is important not to miss this possibility.

- Other important diagnostic possibilities include hypocalcaemia (see above), hyponatremia and hypernatremia. Often a history and clinical features will help in the recognition of these biochemical abnormalities and a serum level will clinch the diagnosis. Any existing problem will be made worse if hypernatremia is corrected too rapidly.

Inborn errors of metabolism

Other more complex biochemical disturbances are usually associated with metabolic acidosis and progressively deepening coma in a child who was initially well for 1–2 days after birth.

Hypoxic ischaemic encephalopathy

This is an abnormal neurological state of babies who have suffered significant lack of oxygen and/or circulation to vital organs before, during, or immediately after birth and signified by:

- Signs of fetal distress in labour low Apgar score (three or less at 5 minutes) despite appropriate resuscitation measures.
- Neonatal neurological abnormalities
- Evidence of multi-organ dysfunction such as oliguria, haematuria (signifying acute tubular necrosis), increased liver transaminase levels (hepatic necrosis) or myocardial dysfunction

Hypoxic ischaemic encephalopathy related problems in the days after birth

- **Reduced consciousness and/or convulsions**: treat with phenobarbital and check glucose to rule out hypoglycaemia.
- **Apnoea:** is common after severe perinatal asphyxia and is sometimes associated with convulsions. Manage with oxygen by nasal prongs and resuscitation with bag and mask.
- **Inability to suck:** feed with expressed breast milk via a gastric tube. Beware of delayed emptying of the stomach which may lead to regurgitation of feeds.
- **Poor motor tone**. May be floppy or have limb stiffening (spasticity).

Treatment

- Supportive with close attention to monitoring of oxygenation and fluid balance. Avoid hyponatremia which may result from inappropriate antidiuretic hormone secretion and excessive intravenous hypotonic solutions. Acute renal failure is often present; if so restrict fluids to measured urine output and gut losses plus 15 ml/kg/ 24 hours for full term and 24 ml/kg/24 hours for preterm infants (to reflect insensible losses) and avoid giving potassium supplements.
- Seizures are treated as described above.
- Keep axillary temperature at 35.5 to 36 degrees. Avoid overheating.

Once bacterial meningitis has been excluded, intra-partum hypoxia or birth trauma will turn out to be the underlying problem in most babies presenting with fits in the first 2–3 days of life. The outlook is poor for babies who have not recovered and started to feed normally within a week of birth.

Drug related seizures Accidental infiltration of the fetal scalp during the injection of lidocaine into the maternal perineum can cause fits simulating intrapartum hypoxia. With supportive treatment there is every prospect of complete recovery.

Some babies born to **drug-dependent mothers** show signs of drug withdrawal, starting 1–2 days after delivery. A small minority may have seizures. Minimal handling in a quiet, dark room with small frequent feeds and a more gradual withdrawal from the drug to which they have been exposed (that is gradually reducing doses of enteral morphine) is the only treatment usually necessary.

Congenital brain abnormalities

Up to 10% of otherwise unexplained neonatal seizures are associated with the existence of some underlying cerebral problem (often cortical dysgenesis). Some of these babies will benefit from continuing anticonvulsant treatment.

10. Surgical disorders

Diaphragmatic hernia
See under resopiratory disorders above

Oesophageal atresia - should always be considered if there is a history of polyhydramnios or excessive frothy salivation following delivery. Surgery is much more likely to be successful if this can be performed before aspiration pneumonia develops. Pass a large bore catheter as far down the oesophagus as possible. If a chest x-ray shows that this has stopped at the level of the heart and has not entered the stomach the diagnosis is made. Such a baby needs referral for surgery with steps taken to suck the blind upper oesophageal pouch clear of all accumulating secretions at least once an hour before and during transfer. Site an IV line and ensure the baby does not become hypoglycaemic.

Volvulus, pyloric stenosis or intussusception Serious vomiting, often associated with abdominal distension, in the first few days of life suggests the existence of a problem requiring urgent referral for surgical review. This is particularly true if the vomit is green (bile stained) as this is suggestive of duodenal atresia or bowel obstruction requiring urgent surgical intervention. If serious vomiting develops in a baby who has passed a stool, the diagnosis of volvulus, pyloric stenosis or intussusception must be considered.

Necrotizing enterocolitis (NEC)
This is a very serious condition with mortality of approximately 20-40%. Preterm or small for dates babies are at increased risk of developing this condition.

Suspect the condition in a baby who had started accepting oral feeds and then develops an ileus or becomes lethargic and starts passing a bloody stool. The problem is caused by the sudden focal invasion of bacteria into an area of ischemic gut, and an abdominal x-ray will often show gas accumulating within the gut wall.

Common signs of NEC are:

- abdominal distension or tenderness
- intolerance of feeding
- bile-stained vomit or bile-stained fluid up the nasogastric tube
- blood in the stools

Features of multisystem failure such as coagulopathy, petechial hemorrhage, oliguria and hematuria may be present.
Investigations
A plain abdominal X-ray may show an abnormal gas pattern in the form of:

- *free intra-peritoneal air* - best seen with a left side down (lateral decubitus X ray) where free air may be easily seen overlying the dense hepatic tissue.
- *intramural gas (pneumatosis intestinalis)* or *gas in the portal tracts of the liver*.

Treatment

- Stop all enteral feeds for at least 5 days and provide intravenous fluids, typically at 120 ml/kg/day of 10% glucose with added electrolytes. Adjust fluids as indicated based on weight change, urine output and serum electrolyte determinations.
- If available place an oro-gastric tube open with intermittent gastric aspiration (every 4 hours). The goal here is to keep the intestines decompressed. The quantity of gastric fluid aspirated is usually of relatively small volume so replacement fluid is seldom required.

- Start parenteral broad spectrum antibiotics (usually ampicillin and gentamicin). Because of the probable association of gram negative anaerobes give metronidazole, especially if pneumatosis, perforation or evidence of peritonitis are present. Broader spectrum antibiotics may be considered in the presence of extensive disease, poor response or based on culture results.
- Treat shock with Ringer-Lactate or Hartmann's, or colloid such as 4.5% albumin, 10 ml/kg over 15 minutes. Repeat if necessary.
- Measure hemoglobin daily and transfuse if it falls below 10g/dl.
- If bleeding give 1 mg vitamin K IV and fresh frozen plasma 10 ml/kg (if available).
- The principal goal of therapy is bowel rest and antibiotic treatment of any contributing or evolving bacterial infection. The length of this therapy is usually 10-21 days depending on the severity of the process. Enteral feeds (breast milk) are re-introduced slowly at the end of antibiotic therapy (20-30 ml/kg/day) with careful monitoring for abdominal distension or other signs of obstruction**.**

Hirschsprung's disease

An absence of ganglion cells in the affected intestine. The incidence is about 1 in 4400-7000 live births; the male to female ratio is about 4:1 and in long segment disease it approaches 1:1. The longer the segment of aganglionosis, the higher the familial incidence.

Associated conditions

The associated conditions include Down's syndrome (4-16%), Waardenburg syndrome, multiple endocrine neoplasia 2A, congenital central hypoventilation syndrome and Von Recklinghausen's disease.

Presentation

The usual presentation is with a delayed passage of meconium beyond 48 hours after birth; 95% of full-term infants pass meconium within 24 hours after birth and the remainder within 48 hours. The child then has episodes of constipation, abdominal distension, vomiting and poor feeding and fails to thrive. He/she may also present with a history of constipation with explosive diarrhoea, the latter indicating the development of enterocolitis.

Differential diagnosis

Hirschsprung's disease should be considered in the differential diagnosis of any child who has constipation dating back to the newborn period. However childhood constipation related to dietary and habitual problems needs to be carefully ruled out to avoid unnecessary xrays and biopsies.

Examination

On examination the child has a distended abdomen and after a rectal examination there is often the explosive passage of flatus and faeces.

- A plain *X* ray of the abdomen may show dilated bowel loops with paucity of air in the location of the rectum. Barium enema may show the characteristic coning, although a simple colonic dilatation can occur in any chronic constipation.
- Rectal biopsy remains the gold standard for diagnosis. It should be performed at least 2 cm above the anal valves as the normal anus has a paucity/absence of ganglion cells at the level of the internal sphincter. Though suction rectal biopsy with acetylcholinesterase staining has become the accepted standard for diagnosis in most centres, a full-thickness rectal biopsy under general anaesthesia is equally useful where such facilities are not available.

SECTION 11 Quiz 3

1) Which of the following are features of sepsis in the first month of life?

a) poor feeding
b) skin capillary refill time less than 2 seconds
c) indrawing of lower chest wall when breathing
d) respiratory rate 60/minute or more
e) hypoglycaemia

2) Management of suspected sepsis in the first month of life includes which of the following procedures?

a) lumbar puncture
b) urine culture
c) antibiotics only if definite bacteriological evidence of infection

ANSWERS: 1) a,c,d,e 2) a, b

SECTION 11 Quiz 4

1) When considering management of breathing problems of babies in the first month of life which of the following statements are true?

a) it is recommended to feed babies by mouth if they have serious respiratory distress
b) an IV infusion of 10% dextrose is recommended in babies during the first 48 hours of life
c) enough supplemental oxygen to ensure oxygen saturations of 94% or more should be given
d) frequent handling is helpful

2) Which of the following are features of primary surfactant deficiency (RDS)?

a) a self limiting condition causing respiratory distress in the pre-term baby during the first 3 days of life
b) cyanosis
c) tachypnoea
d) grunting

3) Which of the following statements are true about recurrent apnoea in the first month of life?

a) is common in the pre-term baby
b) may be related to recurrent seizures
c) should be monitored with pulse oximetry if causing cyanosis and bradycardia
d) may be an indication of early sepsis in a previously well baby

ANSWERS: **1) b,c (frequent handling is dangerous) 2) a,b,c,d 3) a ,b,c,d**

SECTION 11 Quiz 5

2) Concerning jaundice in the first few days of life in the full term infant which of the following statements are true?

a) it may be normal
b) it can cause severe brain injury if the unconjugated bilirubin rises above 350 mmol/L
c) during phototherapy the eyes should be masked
d) gastric feeding should be continued throughout phototherapy even when the bilirubin level is falling
e) pre-term infants are more likely to need treatment than term infants

ANSWERS: **1) a, b, c, d, e**

SECTION 11 Quiz 5

1) **Concerning jaundice in the first few days of life in the full term infant which of the following statements are true?**
   a) it may be normal
   b) it can cause severe brain injury if the unconjugated bilirubin rises above 425 mmol/L at 2-3 days in a full term infant
   c) during phototherapy the eyes should be masked
   d) gastric feeding should be continued throughout phototherapy even when the bilirubin level is falling
   e) pre-term infants are more likely to need treatment than fullterm infants

SECTION 11 Quiz 6

1) **To help prevent neonatal tetanus which of the following statements are correct?**
   a) the stump should be cut at 2-4cm long
   b) the stump should be kept covered for the first 5 days after birth
   c) prophylactic antiseptic lotion to the cord is helpful
   d) all mothers should be immunised against tetanus before delivery

ANSWERS: 1) a,c,d

SECTION 11 Quiz 7

1) **Causes of fits in babies which need treatment include which of the following conditions?**
   (a) hypoglycaemia reversed by giving 2 ml/kg of 10% glucose
   (b) hypocalcaemia which always needs treatment with intravenous calcium
   (c) meningitis

ANSWERS: 1) a,b,c

SECTION 11 Quiz 8

1) **Concerning feeding in the newborn which of the following statements are correct?**
   a) preterm babies (< 36 weeks gestation) are likely to need some tube feeds
   b) if tube feeds are needed, the orogastric route will significantly increase the work of breathing
   c) sudden reluctance to feed may be an early sign of sepsis

2) **Which of the following statements are true concerning necrotising enterocolitis?**
   a) It should be suspected if there is sudden intestinal ileus
   b) It can be confirmed by abdominal x-ray if gas is seen within the gut wall
   c) It has a high mortality
   d) It should always be treated surgically

ANSWERS: 1) a, c 2) a,b,c