NEWBORN RESUSCITATION

FACT FILE 3D

This unit will introduce you to the principles of neonatal resuscitation. However, it is essential that you update your knowledge and practice of neonatal resuscitation while you continue to practice as a health professional caring for neonates in the newborn period and beyond. The Guidelines from the UK Resuscitation Council (2010) are applicable to any health professional looking after neonates in any situation, beit within the hospital, community or home setting.
http://www.resus.org.uk/pages/nls.pdf

Equipment: Prior to addressing the rationale behind resuscitation practice, it is important to consider the equipment one requires in line with adequate preparation. Within delivery suite and hospital settings, you should be familiar with your own Resuscitaire (pictured below- left) or trolley / box / other, along with your own procedure for checking equipment. Models and makes of Resuscitaire vary but they all provide a flat surface, a radiant heat source, timer, light, pressurised gas supply, T piece ventilator tubing and connector, suction, pressure gauge and self-inflating (bag- mask – valve- also pictured below- right); i.e. all necessary equipment for airway management and ventilation. The draw will contain all other equipment that may also be required after the fundamental consideration of airway and breathing; i.e. drugs, endotracheal tubes, tapes, scissors.

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Outside the hospital setting; for example a planned home delivery or transport situation, the equipment will comprise essential airway equipment appropriate to the setting. For unexpected arrival of a newborn baby outside the hospital, principles of *basic* life support (without equipment) are relevant (keeping the baby warm with anything available, using mouth over baby's mouth and nose to ventilate them) and help must be sought straight away to get mother and baby to a hospital. Whatever the setting and available equipment, the guidelines that are now explained should follow the same principles, order and assessment criteria.

Physiology of hypoxia

In order to decide on the appropriate level of resuscitation, it is necessary to understand what happens to newborn babies at birth. Most of us are accustomed to adult resuscitation where it is usually the heart that fails. This then leads to respiratory failure so that both the respiratory and cardiac functions have to be supported during resuscitation attempts. In fetuses /newborn babies, however, the heart usually continues to function even when there are very low levels of oxygen. This means that it is usually only necessary to provide respiratory support initially. If cardiac function is depressed because of prolonged asphyxia, then cardiac massage is much easier to carry out in neonates because of the cartilaginous rib cage.

Most of the information we have on perinatal hypoxia is derived from animal studies because of the difficulties in carrying out experiments on human fetuses /neonates. However, the following knowledge on this area has been extrapolated from these classic experiments. This is described now in relation to the fetus prior to birth but the physiology could also apply to the newborn baby who suffers hypoxia.

If there is a severe acute lack of oxygen during labour, the fetus may try to make deep rapid breathing movements. In the absence of oxygen, their arterial oxygen levels will fall. As the centres responsible for regulation of the breathing are affected by the lack of oxygen, breathing will cease. This is known as primary apnoea. The fetus will try to maintain blood flow to the heart and brain and the systemic blood pressure rises because of the secretion of catecholamines, vasopressin and angiotensin.

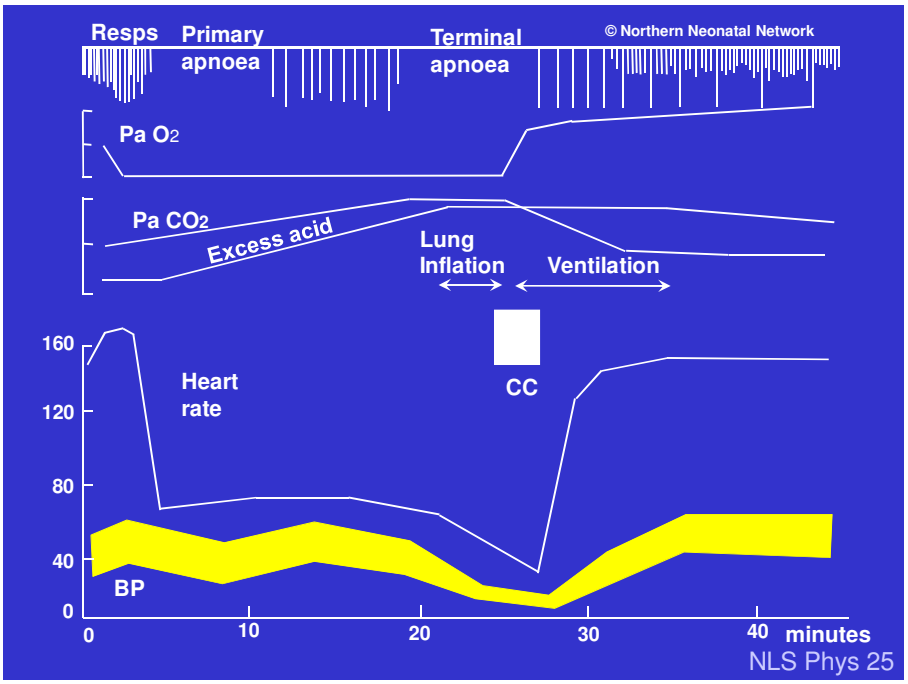
At this stage the body will try to reduce blood flow to other organs.

If the fetus continues to be asphyxiated then the centres which regulate gasping activity are activated. The fetus may make several deep gasping efforts every 10 - 20 seconds. The increasing acidosis and hypoxia affects the circulation and the blood pressure starts to fall. The effort of anaerobic respiration (in the absence of oxygen) means that the glycogen stores in the heart are used up and the heart rate and cardiac output will fall. This stage is known as terminal apnoea.

Generally newborn babies born in primary apnoea will be cyanosed but may still have good muscle tone. They tend to respond rapidly to the administration of oxygen and make a rapid recovery. Those born in terminal apnoea will usually be limp and pale because of the shutdown of the peripheral circulation. They will require oxygen and circulatory support in order overcome the effects of hypoxia. Once circulation is restored, the newborn baby in terminal apnoea will usually gasp before starting to breathe normally.

SUMMARY OF COMPROMISE:

RAPID BREATHING – PRIMARY APNOEA – GASPING – TERMINAL APNOEA



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A newborn baby who is born not breathing could therefore be in primary or terminal apnoea or they could be in the gasping stage (between gasps). As we do not know immediately which stage the newborn is in, it is vital that we carry out the same resuscitation procedure for any newborn in compromise. The speed of their response and clinical signs later will then tell us what stage of compromise the newborn baby was born at.

Assessment

The initial phase of the NLS algorithm (Resuscitation Council, 2010) comprises drying the baby, essential to prevent transepidermal heat loss and also enables you to assess what their response to stimulation is. The wet towel should be discarded and the newborn baby wrapped in a dry towel. A lowering of the body temperature in a newborn baby can cause cold stress leading to metabolic acidosis.

Initial assessment should also be undertaken during drying which should include respiratory effort, heart rate, colour, and tone. Recent guidelines now recommend the use of pulse oximetry to assess oxygenation. In addition, as soon as the baby is born, make a note of the exact time and start the clock, if there is one available.

If the newborn baby is well perfused and is breathing spontaneously with a heart rate of more than 100 beats per minutes, no resuscitation is required. They should be dried, wrapped and given to mum / dad for skin to skin contact after the cord has been cut (after one minute). Even if there is a slight delay in the initial breath, if the airway is open, gentle stimulation is likely to be sufficient to enable the baby to start breathing on their own.

If the baby is making little or no respiratory effort, is cyanosed but has a heart rate of more than 100 beats per minute then action will be needed to stimulate them to breathe.

If the baby is not breathing and has a heart rate of less than 100 or is pale and floppy, then immediate steps will need to be taken to resuscitate the baby.

Figure 1- NEWBORN RESUSCITATION ALGORITHM

Following assessment, the pneumonic **a-b-c-(d**) should always be remembered and followed in that order (airway, breathing, circulation, drugs).

FIGURE 1: NEWBORN LIFE SUPPORT (NLS) ALGORITHM
(Resuscitation Council, 2010)

Dry the baby
(*exception preterm – place in plastic bag)
Remove wet towel and cover / keep warm
Start clock / note time / CALL FOR HELP
↓
Assess colour, tone, breathing and heart rate
↓
If not breathing
Open the airway (neutral position- See Figure 2)
↓
If still not breathing
Give 5 inflation breaths using air initially
(Add oxygen according to pulse oximetry readings – See Figure 3)
(2-3 seconds each at pressure 30 cm / H20 for term OR
* max. 25 cm / H20 for preterm)
Look for a response
If no increase in heart rate, look for chest movement / CALL FOR HELP
↓
If no response
Recheck head position
Apply jaw thrust
Repeat inflation breaths
Look for a response
If no increase in heart rate, look for chest movement
↓
If still no response
Try alternative airway opening manoeuvres (See Figure 4) / **CALL FOR HELP**
Repeat inflation breaths
Look for a response
If no increase in heart rate, look for chest movement
↓
Continue repeating inflation breaths UNTIL THERE IS A RESPONSE
↓
When the chest is moving
Give ventilation breaths at 30/minute and check the heart rate
↓
If the heart rate is not detectable OR slow (<60/min) and not increasing
CALL FOR HELP / Start chest compressions immediately at ratio 3:1
Reassess every 30 seconds
Consider venous access and drugs (See Figure 5) if no increase in heart rate
↓
If heart rate increases, stop compressions and continue ventilation breaths at 30 / minute

*** Exceptions to the standard NLS algorithm**

- Preterm neonates less than 28 weeks – place in plastic bag at delivery and dry head only, use less maximum peak pressure on inflation
- Presence of thick meconium in a neonate that is not breathing and unresponsive at delivery, suction may be necessary *earlier* under direct vision; that is, as part of A, prior to B and C

Figure 2: The Neutral position

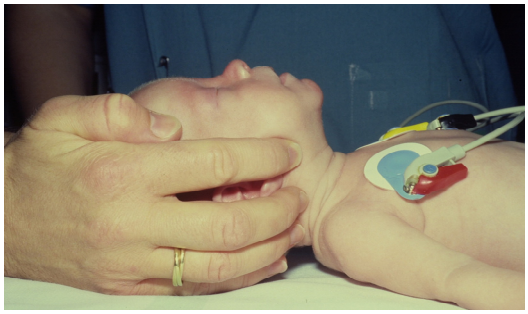

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Figure 3: Normal Oxygen saturation readings at birth

Acceptable pre-ductal SpO_2

2 min 60%
3 min 70%
4 min 80%
5 min 85%
10 min 90%

Figure 4: – Alternative airway opening manoeuvres

Getting help from a second person (2 person jaw thrust, one to apply jaw thrust and the other to ventilate)
Inspection of the oropharynx under direct vision and suction if necessary
Insertion of an oropharyngeal airway under direct vision.

Figure 5 – Resuscitation Drug dosages

Adrenaline – Use 1:10,000 strength only; 10 mcg / kg (or 0.1mls / kg), subsequent dosages if necessary 30 mcg / kg (0.3. mls / kg)-Via intravenous route. If endotracheal route is used, give 50-100 mcg kg (0.5 – 1 ml / kg)

Sodium Bicarbonate - 1-2 mmols / kg (2-4 mls) 4.2% strength (if using 8.4%, draw up 1mmol/kg and dilute with same volume prior to administering)

10% Dextrose; 2 - 2.5 mls / kg **Volume** (Normal Saline) 10mls / kg

READ THE FULL GUIDELINES FROM http://www.resus.org.uk/pages/nls.pdf **AND CONSIDER THE NEWBORN LIFE SUPPORT (NLS) ALGORITHM CAREFULLY (FIGURE 1). THEN consider the following important points…….**

- Most newborns require A and B only, due to the primary reason for resuscitation. Only a few require C and D.

- The order of the algorithm is very important; there is no point attempting to ventilate the neonate unless the airway is open. Similarly, attempting cardiac compressions will be pointless unless the chest is moving.

- **CALL FOR HELP –** This has been added to Figure 1 throughout the algorithm to indicate there is no set time to call for assistance. As soon as a problem is noted, help should be called and then again as appropriate depending on the course of events, response to resuscitation and necessary interventions

- Drying and wrapping is an essential part of the initial procedure (except in preterm babies < 28 weeks who should be put into a plastic bag).

- Airway – neutral position (**SEE FIGURE 2**). Suction is not required initially (unless thick meconium is seen – see later). Jaw Thrust should be applied to stabilise the airway by bringing up the lower jaw.

- Breathing – 5 inflation breaths 2-3 seconds each – i.e. long, slow inflations (30 cm H20 for term / 25 for preterm babies). Start ventilation in AIR and assess the need for supplemental oxygen by using pulse oximetry to see the oxygen saturation levels (**SEE FIGURE 3**). Add oxygen using an air-oxygen blender preferably, according to oximetry readings. These are known to be more accurate as a means of assessing oxygenation than colour.

- You cannot move on from breathing until either (1) the heart rate has increased and the chest is moving OR (2) the chest is moving but the heart rate remains slow. if the chest does not move, then alternate airway manouvres are carried out (**SEE FIGURE 4**) until visible chest rise is seen

- Re-assessment after each stage or intervention is essential in order to move on through the algorithm. The 2 most important questions to ask when re-assessing are; has the heart rate increased? Is the chest moving?

- Circulation / chest compressions –Can only be commenced when the chest is moving in the presence of a slow heart rate (< 60 or doping). Thumbs should circle the chest just below an imaginary line across the nipples, placed middle of sternum. A third of the depth of the chest is pressed at a ratio of 3 compressions to 1 breath

- Drugs- (**SEE FIGURE 5).** Again, should only be started if the chest is moving and when chest compressions are not effective in bringing the heart rate up

Exceptions to the main algorithm

Although the principles of neonatal resuscitation can be applied universally, there are times when the approach needs to be modified. Most units will have guidelines to deal with these situations. It is important that you are aware of them as emergencies cannot always be anticipated and you need to know the correct procedure so that you can provide effective support.

The preterm baby

Preterm babies will generally require more help with establishing respiration than term because of their relative immaturity. The principle of *stabilisation* applies to this group of neonates. A lower inflation pressure is recommended (25 cm water). It is often necessary to intubate very preterm infants (< 28-30 weeks) electively and administer surfactant replacement therapy in the delivery room. However, in line with protective lung strategies, it is also essential not to intubate and give positive pressure ventilation unless absolutely necessary. The use of positive end expiratory pressure (PEEP) and / or continuous positive airway pressure (CPAP) is advocated as being an intervention to increase the functional residual capacity of the preterm lung and so assist in gaseous exchange.

It is essential not to allow preterm babies to become cold or acidotic as lowering of the pH or hypothermia can hinder the production of surfactant. It is recommended that preterm babies less than 28 weeks gestation are not dried but placed into a plastic bag to prevent trans epidermal heat loss via their immature skin.

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Babies of 24 weeks gestation or less present special problems as survival is more limited and those who do survive may experience considerable mortality. It is essential that an experienced paediatrician attends the delivery and discusses the care options with the parents.

Meconium aspiration

It is possible for the baby to aspirate meconium before or during birth if they have suffered hypoxia, passed meconium and then undergone gasping so potentially taking meconium into their lungs. If meconium is present but the baby is vigorous and breathing, then it is unnecessary to suction. If meconium aspiration is suspected, once the baby is delivered and is shown not to be breathing, suction of the mouth can be done under direct vision using a laryngoscope to act as a tongue depressor and light source. If a laryngoscope is not available, a tongue depressor and pen torch can be used. It is essential that this is done gently as vigorous suctioning can cause a bradycardia by vagal stimulation. If there is meconium below the cords, then it will be necessary to intubate the baby and suction directly to the tracheal tube, if an appropriate person is available to undergo this. Once as much meconium as possible has been removed, then resuscitation should continue as normal.

The Resuscitation Council summarises the guidelines for the presence of meconium as

'Attempts to aspirate meconium from the nose and mouth of the unborn baby, while the head is still on the perineum, are not recommended. If presented with a floppy, apnoeic baby born through meconium it is reasonable to inspect the oropharynx rapidly to remove potential obstructions. If appropriate expertise is available, tracheal intubation and suction may be useful. However, if attempted intubation is prolonged or unsuccessful, start mask ventilation, particularly if there is persistent bradycardia.'

Babies with severe congenital abnormalities

Most congenital abnormalities can be detected antenatally. This allows care to planned in advance. In some cases it may be decided that the baby will not be resuscitated, while in other cases the baby may need specialised care at birth. Certain conditions will require adjuncts such as the picture below of a newborn baby with a small jaw and chin who has a nasopharyngeal airway in situ due to difficulty in achieving mask ventilation. However, not all congenital abnormalities are anticipated and sometimes a baby will be born with an unexpected abnormality. It can be very difficult to judge the severity of the abnormality at delivery as some appear to be more serious at first glance than they actually are. In these cases, it is probably best to initiate resuscitation and then assess the baby in the neonatal unit.

Stabilisation following resuscitation

Following the resuscitation, the newborn baby will require a degree of stabilisation depending on the extent of interventions needed at birth. If resuscitation actions improve the condition early and promptly, then the newborn will recover quickly and may need a period of close observation for a given period. If extensive resuscitation is required, then they will be transferred to a neonatal unit where further assistance with respiratory support may be required along with stabilisation of cardiovascular status, temperature, blood sugar and fluid management.

Stopping resuscitation

We also unfortunately have to consider times when resuscitation for various reasons may not be successful or the newborn baby has become so compromised that nothing can be done to resuscitate them. The decision to stop resuscitating a baby should be made by an experienced member of staff. If the baby has a good heart rate but is not making spontaneous respiratory efforts, then ventilatory support should be continued while the baby is transferred to the neonatal unit for further investigation and assessment. However, outcome is poor if there is no cardiac output after 10 minutes of good quality resuscitation which will influence decision making around when to stop. If there is a doubt whether to stop, the baby should be transferred to the neonatal unit until a further opinion is gained. Parents of course also need to be included and consulted and so exact timing around this difficult area is dependent on many factors and complexities all which need to be considered.

Outcome

The outcome and long term prognosis following resuscitation will depend on the gestation of the baby and the type / extent of hypoxia to which the baby has been exposed. Therapeutic hypothermia is now recommended for term or near term neonates who have suffered moderate to severe Hypoxic Ischaemic Encephalopathy (HIE) and who fit specific criteria due to evidence that has shown an improvement in outcomes for these neonates.

Record keeping

It is essential that accurate and contemporaneous records are made of the resuscitation. The following aspects should be included:

- time to first gasp,
- onset of regular respirations,
- time of achievement of a regular heart rate
- mode of resuscitation and the response
- duration of ventilation
- umbilical cord pH, blood gases
- names of people present at resuscitation
- Drugs given and dosages
- Information given to the parents.

- If there were any delays in commencing resuscitation then this should be documented.
- The entry should be dated, timed and legibly signed.

Communication

It is essential that the parents are given accurate and timely information. All discussions with parents should be documented in the notes to avoid conflicting advice and information as this is a source of anxiety to the parents. It is also essential to keep the midwifery staff caring for the mother informed of the baby's progress and the outcome.

Conclusion

All health professionals caring for newborn babies should be trained and updated when necessary according to the Resuscitation Council Newborn Life Support (NLS) guidelines (www.resus.org.uk).

These Guidelines refer to Newborn Resuscitation which applies to the time immediately after birth and usually while the baby remains on the postnatal ward until discharge home. After discharge, Paediatric Guidelines apply. In the neonatal unit, the policy may be to continue the *NLS* Guidelines while the neonate remains on the unit or the Paediatric Guidelines may be adhered to after a certain period.

Participating in neonatal resuscitation is a stressful event as the actions or omissions of neonatal staff are likely to have a direct influence on the outcome. Everyone involved in neonatal resuscitation should have access to regular training sessions. Clinical practice audit should be carried out to ensure that practice is consistent with guidelines and the guidelines themselves should be reviewed to ensure that they are up dated regularly to take account of new developments and research.

All the information and points in this Fact Sheet can be considered by also reading the full guidelines from the UK Resuscitation Council which gives further detail and explanation http://www.resus.org.uk/pages/nls.pdf

KEY READING

RESUSCITATION COUNCIL NLS Guidelines 2010
http://www.resus.org.uk/pages/nls.pdf

MECONIUM ARTICLE
http://www.neonatal-nursing.co.uk/journal_article.html?RecordNumber=5651&number=15
http://www.neonatal-nursing.co.uk/pdf/inf_015_mec.pdf

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