



## Newborn Life Support

### Introduction

Passage through the birth canal is a hypoxic experience for the fetus, since significant respiratory exchange at the placenta is prevented for the 50-75 sec duration of the average contraction. Though most babies tolerate this well, the few that do not may require help to establish normal breathing at delivery. Newborn life support (NLS) is intended to provide this help and comprises the following elements:

- drying and covering the newborn baby to conserve heat;
- assessing the need for any intervention;
- opening the airway;
- lung aeration;
- rescue breathing;
- chest compression;
- administration of drugs (rarely).

### Physiology

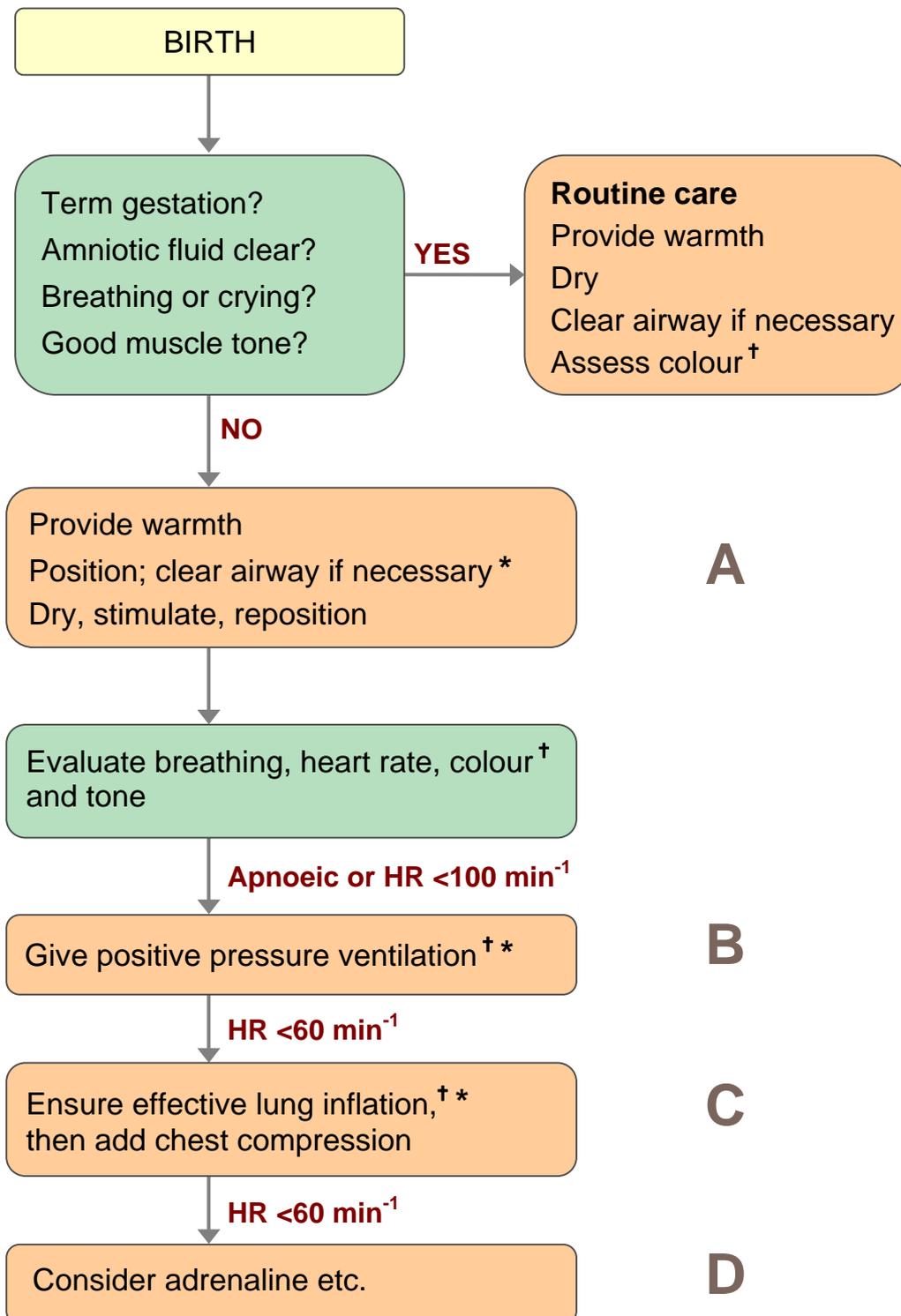
If subjected to continuing hypoxia in utero, the fetus will eventually lose consciousness and stop trying to 'breathe', as the neural centres controlling breathing cease to function due to lack of oxygen. The fetus then enters a period known as 'primary' apnoea.

Up to this point, the heart rate remains unchanged, but soon decreases to about half the normal rate as the myocardium reverts to anaerobic metabolism - a less fuel-efficient mechanism. The circulation to non-vital organs is reduced in an attempt to preserve perfusion of vital organs. The release of lactic acid, a by-product of anaerobic metabolism, causes deterioration of the biochemical milieu.

If the insult continues, shuddering, whole-body gasps at a rate of about 12 min<sup>-1</sup> are initiated by primitive spinal centres. If these gasps fail to aerate the lungs they fade and the fetus enters a period known as 'secondary', or 'terminal', apnoea. Up until now, the circulation has been maintained but, as terminal apnoea progresses, the rapidly-deteriorating biochemical milieu begins to impair cardiac function. The heart eventually fails and, without effective intervention, the baby dies. The whole process probably takes almost twenty minutes in the term newborn human baby.

Thus, in the face of asphyxia, the baby can maintain an effective circulation throughout the period of primary apnoea, through the gasping phase, and even for a while after the onset of terminal apnoea. Thus, the most urgent requirement of any asphyxiated baby at birth is that the lungs be effectively aerated. Provided the baby's circulation is sufficiently intact, oxygenated blood will be conveyed from the aerated lungs to the heart. The heart rate will increase and the brain will

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\* Tracheal intubation may be considered at several steps

† Consider supplemental oxygen at any stage if cyanosis persists

be perfused with oxygenated blood. Following this, the neural centres responsible for normal breathing will, in many instances, function once again and the baby will recover.

Merely aerating the lungs is sufficient in the vast majority of cases. However, though lung aeration is still vital, in a few cases cardiac function will have deteriorated to such an extent that the circulation is inadequate and cannot convey oxygenated blood from the aerated lungs to the heart. In this case, a brief period of chest compression may be needed. In a very few cases, lung aeration and chest compression will not be sufficient, and drugs may be required to restore the circulation. The outlook in this last group of infants is poor.

## Guideline changes

The following are the main changes that have been made to the NLS guidelines:

- The use of food-grade plastic wrapping is recommended to maintain body temperature in significantly preterm babies.
- Attempts to aspirate meconium from the nose and mouth of the unborn baby, while the head is still on the perineum, is no longer recommended.
- Ventilatory resuscitation may be started with air. However, where possible, additional oxygen should be available if there is not a rapid improvement in the infant's condition.
- Adrenaline (epinephrine) should be given by the intravenous or intraosseous route, as standard doses are likely to be ineffective if given via a tracheal tube.
- If there are no signs of life after ten minutes of continuous and adequate resuscitation efforts, then discontinuation of resuscitation may be justified.

## Sequence of actions

### 1 Keep the baby warm and assess

Babies are born small and wet. They get cold very easily, especially if they remain wet and in a draught.

- Whatever the problem, first make sure the cord is securely clamped and then dry the baby, remove the wet towels, and cover the baby with dry towels.
- For significantly preterm babies (30 weeks and below), there is now good evidence that placing the baby under a radiant heater and, without drying the baby beforehand, immediately covering the head and body, apart from the face, with food-grade plastic wrapping, is the most effective way of keeping these very small babies warm during resuscitation or stabilisation at birth.
- Drying the baby will provide significant stimulation and will allow time to assess colour, tone, breathing, and heart rate.

Reassess these observations regularly (particularly the heart rate) every 30 sec or so throughout the resuscitation process. The first sign of any improvement in the baby will be an increase in heart rate. Consider the need for help; if needed, ask for help immediately.

- 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  $\text{min}^{-1}$ ), and will rapidly become pink during the first 90 sec or so. A less healthy baby will be blue at birth, will have less good tone, may have a slow heart rate (less than 100 beats  $\text{min}^{-1}$ ), and may not establish adequate breathing by 90-120 sec. 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 be felt by gently palpating the umbilical cord but a slow rate at the cord is not always indicative of a truly slow heart rate - feeling for peripheral pulses is not helpful.

## 2 Airway

Before the baby can breathe effectively the airway must be open.

- The best way to achieve this is to place the baby on his back with the head in the neutral position, i.e. 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 back on a flat surface. This can be avoided by placing some support under the shoulders of the baby, but be careful not to overextend the neck.
- If the baby is very floppy it may also be necessary to apply chin lift or jaw thrust.

## 3 Breathing

- If the baby is not breathing adequately by about 90 seconds **give 5 inflation breaths**. Until now the baby's lungs will have been filled with fluid. Aeration of the lungs in these circumstances is likely to require sustained application of pressures of about 30 cm of water for 2-3 sec – these are 'inflation breaths'.
- If the heart rate was below 100 beats  $\text{min}^{-1}$  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 for himself, then continue to provide regular breaths at a rate of about 30-40  $\text{min}^{-1}$  until the baby starts to breathe on his own.
- 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 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.

- Consider:
  - Is the baby's head in the neutral position?
  - Do you need jaw thrust?
  - Do you need a longer inflation time?
  - Do you need a second person's help with the airway?
  - Is there an obstruction in the oropharynx (laryngoscope and suction)?
  - What about an oropharyngeal (Guedel) airway?
- Check that the baby's head and neck are in the neutral position, that your inflation breaths are at the correct pressure (30 cm of water) and applied for the correct time (2-3 sec inspiration), and that the chest moves with each breath. If the chest still does not move, ask for help in maintaining the airway and consider an obstruction in the oropharynx, which may be removable by suction under direct vision. An oropharyngeal (Guedel) airway may be helpful.
- If the heart rate remains slow (less than  $60 \text{ min}^{-1}$ ) or absent following 5 inflation breaths, despite good passive chest movement in response to your inflation efforts, start chest compression.

#### 4 Chest compression

Almost all babies needing help at birth will respond to successful lung inflation with an increase in heart rate followed quickly by normal breathing. However, in some cases chest compression is necessary.

- Chest compression should be started only when you are sure that the lungs have been aerated successfully.
- 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.
- **The ratio of compressions to inflations in newborn resuscitation is 3:1.**
- Chest compressions move oxygenated blood from the lungs back to the heart. Allow enough time during the relaxation phase of each compression cycle for the heart to refill with blood. Ensure that the chest is inflating with each breath.

In a very few babies inflation of the lungs and effective chest compression will not be sufficient to produce an effective circulation. In these circumstances drugs may be helpful.

## 5 Drugs

Drugs are needed only if there is no significant cardiac output despite effective lung inflation and chest compression.

- The drugs used are adrenaline (1:10,000), sodium bicarbonate (ideally 4.2%), and dextrose (10%). They are best delivered close to the heart, usually via an umbilical venous catheter.
- The recommended dose for adrenaline is 10 microgram  $\text{kg}^{-1}$  (0.1 ml  $\text{kg}^{-1}$  of 1:10,000 solution). If this is not effective a dose of up to 30 microgram  $\text{kg}^{-1}$  (0.3 ml  $\text{kg}^{-1}$  of 1:10,000 solution) may be tried.
- The dose for sodium bicarbonate is between 1 and 2 mmol of bicarbonate  $\text{kg}^{-1}$  (2 to 4 ml  $\text{kg}^{-1}$  of 4.2% bicarbonate solution).
- The dose of dextrose recommended is 250 mg  $\text{kg}^{-1}$  (2.5 ml  $\text{kg}^{-1}$  of 10% dextrose).
- Very rarely, the heart rate cannot increase because the baby has lost significant blood volume. If this is the case, there is often a clear history of blood loss from the baby, but not always. Use of isotonic crystalloid rather than albumin is preferred for emergency volume replacement. A bolus of 10 ml  $\text{kg}^{-1}$  of 0.9% saline or similar given over 10 - 20 sec will often produce a rapid response and can be safely repeated if needed.

## Explanatory Notes

### Meconium

A large multicentre, randomised, controlled study<sup>1</sup> has shown that attempts to aspirate meconium from the nose and mouth of the unborn baby while the head is still on the perineum (so-called intrapartum suctioning) does not prevent meconium aspiration syndrome and this practice is no longer recommended. Another large multicentre, randomised, controlled study<sup>2</sup> has shown that attempts to remove meconium from the airways of vigorous babies after birth also fail to prevent this complication.

However, if babies are born through thick 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. It is acknowledged that no proof of the efficacy of this practice exists.

### Air or 100% oxygen

Concern about possible injurious effects of excess oxygen, particularly in preterm infants, and the apparent effectiveness of air in some limited, randomised, controlled, human studies of resuscitation at birth, has resulted in a minor change in the guidelines.

There is no evidence to suggest that any one concentration of oxygen is better than another when starting resuscitation. Some clinicians may wish to start with

air. However, where possible, it is recommended that additional oxygen should be available for use if there is not a rapid improvement in the infant's condition. Equally, hyperoxia should be avoided, especially in the preterm infant.

### Route and dose of adrenaline

Adrenaline should be used in a concentration of 1:10,000 (100 microgram ml<sup>-1</sup>). It is best given intravenously or by the intraosseous route. The standard recommended dose by these routes is 10 – 30 microgram kg<sup>-1</sup> (0.1 – 0.3 ml kg<sup>-1</sup> of 1:10,000). Do not use a higher dose by these routes as it is harmful.

Guidelines 2000 endorsed the use of adrenaline via the tracheal tube until an intravenous route had been established. Data now suggest that standard doses given via the tracheal tube are likely to be ineffective.

### Induced hypothermia

Induced hypothermia may reduce the neurological damage associated with moderate post-asphyxial encephalopathy. However, as yet there are insufficient data to recommend routine use of modest systemic or selective cerebral hypothermia following resuscitation of infants with suspected asphyxia. Further randomised clinical trials are needed to determine which infants benefit most and which method of cooling is most effective.

### References

1. Vain NE, Szyld EG, Prudent LM, et al. Oropharyngeal and nasopharyngeal suctioning of meconium-stained neonates before delivery of their shoulders: multicentre, randomised controlled trial. *Lancet* 2004; 364: 597-602.
2. Wiswell TE, Gannon CM, Jacob J, et al. Delivery room management of the apparently vigorous meconium-stained neonate: results of the multicenter international collaborative trial. *Pediatr* 2000; 105: 1-7.

