

Resuscitation of the newborn

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Abstract

Most newborns are born vigorous and do not require resuscitation. However, the World Health Organisation has estimated that 10% of all newborn infants need some intervention at birth and approximately 0.5% will require cardiopulmonary resuscitation. Frequently, the need for resuscitation may be anticipated based on maternal and obstetric history, but this is not always the case and therefore anyone involved in delivery of newborn infants should be trained in resuscitation.

Keywords infant; neonatal; newborn; resuscitation; review

Introduction

Resuscitation is one of the most frequently performed procedures in the neonatal period. It is therefore important that procedures are evidence based, and frequently updated. In 2015, the Resuscitation Council (UK) issued new guidelines on newborn resuscitation, accredited by the National Institute for Health and Care Excellence. The changes in approach in the 2015 guidelines are outlined in [Table 1](#).

Physiology

The primary reason for resuscitation in the newborn infant differs from that in adults. Whilst most adults requiring resuscitation will have a cardiac event, the newborn infant's heart is healthy and it will usually be a respiratory (hypoxic) event that will have compromised the newborn. Particular attention to management of the **Airway** and **Breathing** is therefore imperative.

The fetal lung is filled with fluid (approximately 30 ml/kg which equates to about 100 ml in an average term baby). This is absorbed rapidly soon after birth due to various adaptive processes, the lung becomes aerated and a functional residual capacity (FRC) established. In compromised hypoxic infants this

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Expansions on 2010 neonatal resuscitation recommended in NLS current guidance (2015)

Cord clamping	Delay cord clamping in infants not needing resuscitation Cord clamping should be delayed for at least 1 minute from delivery of baby. Stripping or milking of the cord is not recommended
Temperature	The temperature of newly born infants is actively maintained between 36.5 °C and 37.5 °C after birth unless a decision has been taken to start therapeutic hypothermia.
Monitoring	Pulse-oximetry should be used for patient assessment during neonatal resuscitation.
Oxygen or air	It is best to start resuscitation of term infants in air and subsequently guided by pulse-oximetry. For preterm infants, a low concentration of oxygen (21–30%) should be used initially for resuscitation at birth.
Cardio-pulmonary resuscitation	Recommended chest compression: ventilation ratio is 3:1. There should be 30 seconds of adequate ventilation breaths prior to starting compressions. Recommended dose of adrenaline is 10–30 mcg/kg IV.
Capnography	Detection of exhaled carbon dioxide is recommended to confirm ET placement but may not helpful in circulatory arrest.
Meconium	Routine suction in active infants is not recommended. There should be no unnecessary delay in commencing inflation breaths.
Resuscitation of preterm infants	Preterm babies less than 28 weeks' gestation should be covered up to neck with food grade plastic bag/wrap without drying, and stabilised under a radiant header. Early Use of nasal CPAP should also be considered in those spontaneously breathing preterm infants.
Hypoxic ischaemic encephalopathy	For birth asphyxia in term or near term infants, to treat with therapeutic hypothermia (33.5–34.5 °C) within 6 hours after birth

Table 1

may not occur and the onset of breathing may be delayed. These babies need intervention.

Physiological studies, performed more than 50 years ago, evaluated the fetal responses to hypoxia-ischaemia. During

labour uterine contractions lead to compromise in placental gas exchange and so the fetus is exposed to hypoxia. The first response of the fetus to hypoxia is to breathe more deeply and rapidly; after a few minutes, regular breathing ceases due to lack of oxygen (primary apnoea). If the hypoxic insult continues, primitive spinal centres produce whole body gasps at a rate of about 12/minute. Soon after this, the fetus enters a further phase known as terminal apnoea. Without further intervention at this point, the baby would die.

A baby who is not breathing at birth could be in primary apnoea, about to gasp, or in terminal apnoea. It is not possible to distinguish this at the time and therefore any baby not breathing at birth should have resuscitation initiated.

Practical considerations

Anticipation of resuscitation

Anticipation and adequate preparation are critical for successful neonatal resuscitation. At every delivery there should be at least one person trained in neonatal resuscitation, whose primary responsibility is the newborn. Preparation for early management of a newborn infant should include a review of obstetric notes and handover from colleagues regarding any possible complications at delivery.

Equipment and environment

It is important to prepare the environment and the equipment before delivery of the baby. Resuscitation should take place in a warm, well-lit, draught-free area with a flat resuscitation surface below a radiant heater.

Apart from air and oxygen sources, the recommended minimum set of equipment includes air-oxygen blender, face masks, T-pieces/self-inflating bags, suction apparatus and tubing, laryngoscope with different sizes of straight blades, tracheal tubes, laryngeal airways and drugs. A stethoscope, pulse oximetry and carbon dioxide detection are used for monitoring.

Initial steps and evaluation

Cord clamping

Clamping of the umbilical cord before the first breath is associated with reduced cardiac filling and may induce bradycardia. By delaying clamping, studies have shown that cardiovascular output is maintained and there is a smoother transition between fetal and neonatal circulation. Delayed cord clamping is associated with better haematological indices in term babies. In preterm infants delayed cord clamping reduces the risk of intraventricular haemorrhage, need for blood transfusion and risk of necrotising enterocolitis. It is therefore recommended to delay clamping of cord for 1 minute in all babies not requiring resuscitation. However, if resuscitation is required then this should take priority.

Temperature management

Newborn babies are covered in fluid, and have a large surface area. They can suffer significant heat loss leading to hypothermia. Exposure of the newborn to cold stress will lower arterial oxygen tension and increase metabolic acidosis. Hence, an essential early step in neonatal resuscitation is the prevention of hypothermia.

Term babies should be dried immediately and covered with dry towels. If the baby needs resuscitation then place the baby on a warm surface under a preheated radiant heater.

In preterm babies, hypothermia is associated with increased morbidity and mortality. Hence babies less than 28 weeks of gestation should be immediately placed into a plastic bag, ensuring that they are completely covered up to the neck without drying. A hat should be applied and the infant placed on a warm surface under preheated radiant heater. They should remain wrapped in the plastic bag until their temperature has been checked in NICU and the incubator is sufficiently heated. The delivery room temperature should be maintained at 26 °C, at the very least.

The effect of postnatal hyperthermia has not been studied extensively but maternal fever has been shown to be associated with neonatal respiratory distress, encephalopathy and increased mortality. It is unclear whether these morbidities are secondary to hyperthermia or an underlying disease process. Also in babies with newborn encephalopathy and hypoxic brain injury, hyperthermia is associated with adverse outcome. For this reason it is advised to avoid neonatal hyperthermia during resuscitation.

Initial infant assessment

As soon as baby is born, a clock should be started or the time noted. The baby should be dried and wrapped; this will not only provide stimulation but will also allow time to assess tone, breathing and respiration. It is important to reassess these observations regularly at 30 second intervals throughout the resuscitation.

On the basis of the initial assessment, the baby can be placed into three groups:

- **Vigorous breathing or crying, good tone, heart rate >100/minute**

This baby does not require any intervention other than drying and wrapping.

- **Breathing inadequately/apnoeic, normal or reduced tone, heart rate <100/minute**

Dry and wrap. This baby may improve with mask inflation, but may need further interventions if it does not respond.

- **Breathing inadequately/apnoeic, floppy, low or undetectable heart rate and pale (suggesting poor perfusion).**

Dry and wrap. This baby may need full resuscitation including lung inflation and ventilation, and following lung inflation may need chest compressions with, or without drugs if there is no improvement.

The heart rate of baby is best judged by listening with a stethoscope or using a pulse oximeter, as a slow heart rate measured by palpating the umbilical cord may not be indicative of the true heart rate.

Neonatal resuscitation should be commenced if assessment shows that the baby has failed to establish adequate regular normal breathing or has a heart rate of <100/minute. Opening the airway and successfully inflating the lungs is usually all that is necessary. Further interventions will be futile unless these two first steps have been successfully completed.

Approach to resuscitation

The systematic approach to newborn resuscitation is demonstrated in [Figure 1](#). It uses the Airway, Breathing, Circulation, Drugs (A,B,C,D) approach.

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