ANZCOR Guideline 13.1 – Introduction to Resuscitation of the Newborn Infant

Summary

Guidelines 13.1-13.10 and the Newborn Life Support algorithm are provided to assist in the resuscitation of newborn infants. Differences from the adult and paediatric guidelines reflect differences in the causes of cardiorespiratory arrest in, and anatomy and physiology of newborns, older infants, children and adults. These guidelines draw from the consensus on resuscitation and treatment recommendations issued by the International Liaison Committee on Resuscitation (ILCOR), which included representation from ARC and NZRC. The 2015 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (Neonatal), the European Resuscitation Council Guidelines for Resuscitation 2015 and local practices have also been taken into account.

To whom do these guidelines apply?

The term “newborn” refers to the infant in the first minutes to hours following birth. In contrast, the neonatal period is defined as the first 28 days of life. Infancy includes the neonatal period and extends through the first 12 months of life.

Guidelines 13.1-13.10 and the Newborn Life Support algorithm are specifically for the care of infants during the neonatal period, and particularly for newborn infants. The exact age at which paediatric techniques and in particular, compression-ventilation ratios, should replace neonatal methods is unknown, especially for very small premature infants. For term neonates beyond the newborn period, and particularly in those with known or suspected cardiac aetiology of their arrest, paediatric techniques may be used (see Paediatric Advanced Life Support Guidelines 12.1-12.7).

Who is this audience for these guidelines?

Guidelines 13.1-13.10 and the Newborn Life Support algorithm are for health professionals and those who provide healthcare in environments where equipment and drugs are available (such as a hospital). When parents are taught CPR for their infants who are being discharged from birth hospitals, the information in Basic Life Support Guidelines (Guidelines 1-8) is appropriate.
Recommendations

The Australian and New Zealand Resuscitation Committee on Resuscitation (ANZCOR) recommends that:

1. Newborn infants be assessed for the need for basic and advanced life support and receive care using the Newborn Life Support algorithm and according to these guidelines.
2. Healthcare providers implement policies and protocols that utilise this algorithm and these guidelines.

Guideline

1 Need for Neonatal Resuscitation

Approximately 85 percent of babies born at term will initiate spontaneous respirations within 10 to 30 seconds of birth. An additional 10 percent will respond during drying and stimulation, approximately three percent will initiate respirations following positive pressure ventilation, two percent will be intubated to support respiratory function and 0.1 percent will require chest compressions and/or adrenaline (epinephrine) to achieve this transition. Resuscitation is defined as the preservation or restoration of life by the establishment and/or maintenance of airway, breathing and circulation, and related emergency care. (ANZCOR Guideline 1.1). For most newborns, resuscitation manoeuvres are administered as part of a graded strategy to support their own physiological efforts to adapt after birth. Only a very few appear lifeless and require the full range of neonatal resuscitation interventions described in these guidelines.

Term infants who have had low or no risk factors for needing resuscitation, who are breathing or crying and who have good tone must be dried and kept warm. These actions can be provided on the mother’s chest (skin to skin) and should not require separation of mother and baby.

Although the need for resuscitation of the newborn infant can often be anticipated, and the need for resuscitation in low risk births may be 1% or less, there remain many occasions when it is unexpected. Therefore, a suitable place, equipment and personnel trained to resuscitate a newborn infant must be available at all times, and in all places, where infants are born.

2 Unique Physiology of Newborn Infants

The transition from fetal to extraterine life is characterised by a series of unique physiological events. Among these, the lungs change from liquid-filled to air-filled, pulmonary blood flow increases dramatically, and intracardiac and extracardiac shunts cease.

During the normal onset of breathing, newborns exert negative pressure on the lung with each breath. For the first few breaths, these pressures are greater than those needed for subsequent breaths, due to the need to clear liquid from the airways and begin lung aeration. If the baby does not achieve this initial lung aeration and positive pressure ventilation needs to be used, higher peak inspiratory pressures may be needed for the first inflations than subsequently.
The level of pressure will vary from baby to baby, depending on the maturity of the lungs and any lung disease that is present. (For this reason, the suggested starting pressures provided in Guideline 13.4 are only a guide, and pressures need to be individually adjusted according to the baby’s response).

The fetal lung liquid moves from the airways to the lung tissue, and then reabsorbs more slowly (over several hours) into the circulation. In babies who are preterm or who have difficulty breathing, lung liquid can move back from the lung tissue into the airways, whereupon it needs to be cleared again, perhaps repeatedly. Continuous positive end expiratory pressure can help prevent this.

Aeration of the lungs triggers a fall in pulmonary vascular resistance and increase in pulmonary blood flow, which rises 5 to 6 fold after birth. In healthy newborn infants, oxygen levels rise over several minutes, typically taking 5-10 minutes for oxygen saturation of haemoglobin to reach 90%. Uncompromised babies born at sea level have oxygen saturation levels of about 60% during labour. The 25th centile for oxygen saturation is approximately 80% at 5 minutes. Normal newborn infants have a heart rate within 3-4 minutes after birth varying between 110 and 160/min.

Adaptation to extrauterine life depends on many coordinated and interdependent physiological events, failure of any of which can impair successful transition. Inadequate lung aeration can cause respiratory failure and prevent the normal increase in pulmonary blood flow. If pulmonary vascular resistance does not fall, the consequence is persistent pulmonary hypertension, with inadequate blood flow through the lungs and hypoxaemia. Haemorrhage from the fetus before birth can cause neonatal hypovolaemia and hypotension. Acidosis and hypoxia before or during birth can depress respiratory drive and cardiac function.

In preterm infants there are additional considerations. Surfactant deficiency reduces lung compliance. Preterm infants also typically have weaker respiratory muscles, immature airway protective reflexes, and a chest wall that deforms easily. Very premature infants and infants born by caesarean section, without the effect of labour, may not clear fetal lung liquid and therefore, may not aerate their lungs as easily as term babies born by vaginal delivery.

In advanced gestation, passage of meconium into the amniotic fluid becomes more common and in some cases, it is associated with fetal compromise. If meconium is passed into the amniotic fluid it may be inhaled before or during delivery and lead to inflammation of the lungs and airway obstruction. Complications of meconium aspiration are more likely in infants who are small for their gestation, and those born after term or with significant perinatal compromise.

Perinatal infections and congenital anomalies are among other potential causes of impaired adaptation at birth.

### 3 Anticipating the Need for Resuscitation

#### 3.1 Personnel

All personnel who attend births should be trained in neonatal resuscitation skills which include: basic measures to maintain an open airway, ventilation via a facemask / laryngeal mask and chest compressions. At least one person should be responsible for the care of each infant.
A person trained in advanced neonatal resuscitation (all of the above skills plus endotracheal intubation and ventilation, vascular cannulation and the use of drugs and fluids) may be needed even for low-risk births and should be in attendance for all births considered at high risk for needing neonatal resuscitation.

Guideline 13.2 lists examples of maternal, fetal, and intrapartum circumstances that place the newborn infant at increased risk of needing resuscitation. If it is anticipated that the infant is at high risk of requiring advanced resuscitation more than one experienced person should be present.

### 3.2 Training

Organised programs to develop and maintain standards, skills and teamwork are required for newborn resuscitation and are essential for health care providers and institutions caring for mothers and infants at the time of birth.\(^{20}\)

### 3.3 Equipment

The need for resuscitation at birth cannot always be anticipated.\(^{21}\) Therefore, a complete set of resuscitation equipment and drugs should always be available for all births. This equipment should be regularly checked to ensure it is complete and operational. A list of suggested resuscitation equipment and drugs is provided at the end of this guideline.

### 3.4 Communication

Preparation for a high-risk birth requires communication between the people caring for the mother and those responsible for the infant. This should include any factors that may affect the resuscitation and management of the infant including:

- maternal conditions
- antenatal diagnoses
- assessments of fetal wellbeing.

### 4 Environment

#### 4.1 Temperature

Newborns are at risk from hypothermia or hyperthermia so prevention of both heat loss and overheating is important. Hypothermia can increase oxygen consumption and impede effective resuscitation.\(^{22,23}\) The infant should be cared for in a warm, draft-free area. For term and near term infants, drying the infant and removing the wet linen reduce heat loss [Class A, expert consensus opinion]. When resuscitation is not required the mother’s body can keep the infant warm, using her as a heat source by placing the infant skin-to-skin on the her chest or abdomen in a position that maintains airway patency and covering both with a warm blanket or towel. If resuscitation is necessary, place the infant under a preheated radiant warmer or if unavailable, an alternative heat source.

Non asphyxiated babies of all gestations, should be maintained with a temperature of between 36.5 and 37.5\(^\circ\) C. [CoSTR 2015, strong recommendation, very low quality of evidence]
Admission temperatures to newborn units are predictors of outcome and should be recorded as a quality of care measure. [CoSTR 2015, strong recommendation, moderate quality of evidence] Hypothermia is associated with an increased risk of mortality. There is evidence of a dose effect with mortality increasing by 28% for each degree below 36.5°C at admission. 

Hypothermia on admission is also associated with worse respiratory outcomes and greater likelihood of hypoglycaemia, late onset sepsis and intraventricular haemorrhage.1

For special considerations for preterm infants see Guideline 13.8.

4.2 Hyperthermia

No studies have examined the effects of hyperthermia after resuscitation of newborn infants. However, babies born to febrile mothers (temperature >38°C) have an increased risk of death, perinatal respiratory depression, neonatal seizures and cerebral palsy.24-25

4.3 Induced Hypothermia for Hypoxic Ischaemic Encephalopathy

Inducing hypothermia in infants of 35 weeks gestation and above with evolving moderate to severe hypoxic ischaemic encephalopathy will reduce the degree of brain injury in some (see guideline 13.9).26-30 The target during resuscitation and stabilisation should be to maintain normothermia (with care to avoid hyperthermia), until a decision has been made that the baby has signs of encephalopathy and meets criteria for induced hypothermia. Any infant who is considered a possible candidate for therapeutic hypothermia should be discussed as soon as possible after initial resuscitation with a neonatal intensive care specialist, and plans should be made for prompt admission to a neonatal intensive care unit. If indicated, whole body cooling can be initiated without specialised equipment.31 Local guidelines should be in place to ensure that infants that meet criteria for induced hypothermia are promptly recognised and referred. [Class A, expert consensus opinion]

5 Recommended Equipment and Drugs for Resuscitation of the Newborn Infant

Resuscitation equipment and drugs should be readily available in the areas of hospitals where infants are born or receive neonatal care. Equipment should be checked regularly according to local policy and before any resuscitation to ensure it is complete and operational. A clear record documenting the checking procedure should be maintained for each set of resuscitation equipment and drugs.20

Prior preparation of standardized kits containing the equipment needed for procedures such as umbilical catheterization can save considerable time in emergencies [Class B, expert consensus opinion].20

5.1 Recommended equipment and drugs

General

- Firm, horizontal, padded resuscitation surface
- Overhead warmer
- Light for the area
- Clock with timer in seconds
- Warmed towels or similar covering
- Polyethylene bag or sheet, big enough for a baby less than 1500g birth weight
- Stethoscope, neonatal size preferred
- Pulse oximeter plus neonatal probe

**Equipment for airway management**

- Suction apparatus and suction catheters (6F, 8F, and either 10F or 12F)
- Oropharyngeal airways (sizes 0 and 00)
- Intubation equipment:
  - Laryngoscopes with infant blades (00, 0, 1)
  - Spare bulbs, and batteries
  - Endotracheal tubes (sizes 2.5, 3, 3.5, and 4 mm ID, uncuffed, no eye)
  - Endotracheal stylet or introducer
  - Supplies for fixing endotracheal tubes (e.g. scissors, tape)
- End-tidal carbon dioxide detector (to confirm intubation)
- Meconium suction device (to apply suction directly to endotracheal tube)
- Magill forceps, neonatal size (optional)
- Laryngeal Mask airway, size 1

**Equipment for supporting breathing**

- Face masks (range of sizes suitable for premature and term infants)
- Positive-pressure ventilation device, either:
  - T-piece device, or;
  - Flow-inflating bag with a pressure safety valve and manometer;
    and
  - Self-inflating bag (approximately 240 ml) with a removable oxygen reservoir
- Medical gases:
  - Source of medical oxygen (reticulated and/or cylinder, allowing flow rate of up to 10 L/min) with flow meter and tubing
  - Source of medical air plus air/oxygen blender
- Feeding tubes for gastric decompression (e.g. size 6 & 8F)

**Equipment for supporting the circulation**

- Umbilical venous catheter (UVC) kit (including UVC size 5F)
- Peripheral IV cannulation kit
- Skin preparation solution suitable for newborn skin
- Tapes/devices to secure UVC/IV cannula
- Syringes and needles (assorted sizes)
- Intravenous needles

**Drugs and fluids**

- Adrenaline (epinephrine): 1:10 000 concentration (0.1 mg/mL)
- Volume expanders
- Normal saline
- Blood suitable for emergency neonatal transfusion needs to be readily available for a profoundly anaemic baby

**Documentation**

- Resuscitation record sheet
6 Cord Clamping

In both animal and human studies, deferring cord clamping for 30-60 seconds, when compared with immediate cord clamping is associated with increased placental transfusion, increased cardiac output, and higher and more stable neonatal blood pressure. There is good evidence from animal studies that among the benefits, placental transfusion can fill the expanding pulmonary vascular bed, obviating the need for it to fill by “left to right” flow from the aorta across the ductus arteriosus. However, there remains controversy about how long it is appropriate to delay clamping if the baby is perceived to require resuscitation.

For the uncomplicated term birth, a meta-analysis of studies comparing delaying cord clamping after birth for a time ranging from 30 seconds until the cord stops pulsating with immediate cord clamping (usually within 15 seconds) showed higher neonatal haemoglobin levels and improved iron status through early infancy, but a greater likelihood of needing phototherapy for jaundice.

For the uncomplicated preterm birth, delaying cord clamping for a minimum time of 30 seconds increases the infant’s blood pressure during stabilization and at 4 hours after birth, reduces risk of periventricular leukomalacia and intraventricular haemorrhage (although there is insufficient evidence to determine whether there is an effect on severe IVH), lowers the incidence of necrotising enterocolitis, increases blood volume and lowers the chance of needing a blood transfusion. Although this evidence is from randomised trials, it is very low quality, having been downgraded for imprecision and very high risk of bias. In preterm infants, there is also low quality evidence that delayed cord clamping increases peak bilirubin levels but without increasing the likelihood of needing phototherapy.

We suggest delayed umbilical cord clamping for preterm infants not requiring immediate resuscitation after birth. (CoSTR 2015, weak recommendation, very low quality of evidence)

Although on theoretical grounds, the depressed infant might receive greater benefit from deferred cord clamping, constriction of uterine arteries normally occurs immediately after birth. Therefore it is unclear whether the placenta can be relied upon to provide compensatory gas exchange in the infant who does not begin breathing soon after birth. Furthermore, a depressed newborn may have experienced impaired placental gas exchange even before birth. Small and sick infants who received immediate resuscitation were generally excluded from the randomised trials conducted to date. Therefore, there is insufficient evidence to recommend the optimal timing of cord clamping in the compromised newborn. The more severely compromised the infant, the more likely it is that resuscitation measures need to take priority over delayed cord clamping. It stands to reason that cardiac compressions will not improve the systemic and coronary perfusion if the cord remains unclamped and the low resistance placenta is still connected.

6.1 Cord Milking

Milking of the umbilical cord from the placental side to the newborn has been studied as an alternative method to increase the newborn’s intravascular blood volume.

We suggest against the routine use of cord milking because there is insufficient published human evidence of benefit. (CoSTR 2015, weak recommendation, very low quality of evidence).
7 Checking Resuscitation Equipment

ANZCOR is aware of cases where equipment failure (e.g. oxygen pipes being incorrectly connected resulting in hypoxic gases being administered, and resuscitation bag valve devices incorrectly assembled) that have led to adverse outcomes. The checking and maintenance of hospital and resuscitation equipment is covered by National Standards and local policies.

Practitioners involved in resuscitation should always be alert to errors of equipment installation, assembly or use and have checking processes to minimise these risks.

References


ANZCOR Guideline 13.2 – Planning for Neonatal Resuscitation and Identification of the Newborn at Risk

1 Training and improving resuscitation team performance

All those who may need to provide resuscitation of the newborn should undertake training that specifically includes the necessary individual and teamwork skills.

Simulation is a methodology in resuscitation education that allows multiple participants to practice and be assessed in these skills without risk to vulnerable patients. Use of simulation as an adjunct to traditional education methodologies may enhance performance of healthcare professionals in actual clinical settings. The most effective interventions and evaluation methodologies for training, and for training of resuscitation instructors remain to be defined.¹ ANZCOR suggests that training of resuscitation instructors should incorporate timely, objective, structured, individually targeted, verbal and/or written feedback. (CoSTR 2015, weak recommendation, low quality evidence).²

Training requires regular reinforcement in clinical practice, and/or refresher courses. We suggest that training should occur more frequently than annually. This retraining may consist of specific tasks and/or behavioural skills depending on the needs of the trainee. (CoSTR 2015, weak recommendation, low quality evidence).²

Briefings and debriefings during learning activities while caring for simulated patients, and during clinical activities may also be helpful in improving individual and team skills.

2 Anticipation

A person trained in neonatal resuscitation should be available for normal, low-risk births and someone trained in advanced resuscitation should attend all births considered at high risk for neonatal resuscitation. If it is anticipated that the infant is at high risk of requiring advanced resuscitation more than one experienced person should be present at the birth. Local guidelines should be developed specifying who should attend which births. [Class A, expert consensus opinion].

The list below contains examples of maternal, fetal, and intrapartum circumstances that place the newborn infant at risk of needing resuscitation.
The list is not exhaustive, and the magnitudes of these risks vary considerably, but the list is included to encourage planning. The need for an advanced resuscitation expert at the birth will depend on the number and severity of problems.

Whenever the need for resuscitation is anticipated, there should be a consistent and coordinated approach from the obstetric and paediatric/neonatal teams in applying these guidelines and when possible, communicating with the parents to develop a management plan [Class A, expert consensus opinion].

**Maternal Risk Factors**

- Prolonged rupture of membranes (> 18 hours)
- Bleeding in second or third trimester
- Pregnancy-induced hypertension
- Chronic hypertension
- Substance abuse
- Drug therapy (e.g. lithium, magnesium, adrenergic blocking agents, narcotics)
- Diabetes mellitus
- Chronic illness (e.g. anaemia, cyanotic congenital heart disease)
- Maternal pyrexia
- Maternal infection
- Chorioamnionitis
- Heavy sedation
- Previous fetal or neonatal death
- No antenatal care

**Fetal Risk Factors**

- Multiple gestation (e.g. twins, triplets, etc.)
- Preterm gestation (especially <35 weeks)
- Post-term gestation (>41 weeks)
- Large for dates
- Fetal growth restriction
- Alloimmune haemolytic disease (e.g. anti-D, anti-Kell, or other antibody known to cause haemolytic disease of the fetus and newborn, especially if fetal anaemia or hydrops fetalis is present)
- Polyhydramnios, oligohydramnios
- Reduced fetal movement before onset of labour
- Congenital abnormalities which may affect breathing, cardiovascular function or other aspects of perinatal transition
- Intrauterine infection
- Hydrops fetalis

**Intrapartum Risk Factors**

- Non-reassuring fetal heart rate patterns on CTG
- Abnormal presentation
- Prolapsed cord
- Prolonged labour (or prolonged second stage of labour)
- Precipitate labour
- Antepartum haemorrhage (abruption, placenta praevia, vasa praevia)
• Meconium in the amniotic fluid
• Narcotic administration to mother within 4 hours of delivery
• Forceps delivery
• Vacuum-assisted (Ventouse) delivery
• Maternal general anaesthesia

References


ANZCOR Guideline 13.3 – Assessment of the Newborn Infant

Guideline

Evaluating the need to initiate and continue resuscitation should begin immediately after birth and proceed throughout the resuscitation.

The initial assessment should address:

- tone
- breathing
- heart rate.

Subsequent assessment throughout the resuscitation is based on the infant’s heart rate, breathing, tone and oxygenation, (which is preferably assessed using pulse oximetry). A prompt increase in heart rate remains the most sensitive indicator of resuscitation efficacy (extrapolated evidence).

Evaluation and intervention are simultaneous processes, especially when more than one resuscitator is present. However, for clarity, this process is described as a sequence of distinct steps shown in the algorithm.

1 Tone and Response to Stimulation

The assessment of tone is subjective and dependent on gestation, but an infant with good tone (moving the limbs and with a flexed posture) is unlikely to be severely compromised whereas an infant who is very floppy and not moving is very likely to need active resuscitation.

Most newborn infants will commence movement of all extremities, start breathing and their heart rates will rise to over 100 beats/minute soon after birth. They do not require any assistance and should not be separated unnecessarily from their mothers.

If these responses are absent or weak, brisk but gentle drying with a soft warmed towel should be used to stimulate the infant to breathe [Class A, expert consensus opinion]. The wet towel should then be replaced with a warm, dry one to prevent inadvertent heat loss. Note that for preterm or very low birth weight infants who are placed in/under a polyethylene bag/sheet to prevent evaporative heat loss (see Guideline 13.8), only the infant’s head needs drying. Drying the body and limbs beforehand is unnecessary and potentially counterproductive, but tactile stimulation can be provided through the bag or sheet, if needed. In non-vigorous, meconium-exposed infants if a decision to intubate and suction meconium from the trachea has been made, the intubation should be done immediately and stimulation should be withheld until suction is completed (see Guideline 13.4) [Class B, expert consensus opinion].
Slapping, shaking, spanking, or holding the newborn upside down are potentially dangerous and should not be used. During all handling, care should be taken to ensure that the infant’s head and neck are supported in a neutral position, especially if muscle tone is low [Class A, expert consensus opinion].

If the infant does not breathe, assisted ventilation should be started (see Guideline 13.4) [Class A, expert consensus opinion].

2 Breathing

The newborn infant initial should establish regular breaths sufficient to maintain the heart rate more than 100 per minute within 1-2 minutes after birth. Breathing may be difficult to assess well in the first minute or two after birth. Of term and near term infants 85% start breathing within 30 seconds of birth and 95% within 45 seconds. If the infant has good tone and can maintain a heart rate >100/min, immediate intervention may not be required, apart from ensuring that the head is in or near the midline and in a neutral position to maintain airway patency. If the tone is low and the heart rate is not maintained >100/min, if the baby is not breathing positive pressure ventilation is required, while CPAP can be used in the baby who has begun regular respiratory effort [Class A, expert consensus opinion].

Recession, retraction or indrawing of the lower ribs and sternum, or onset of persistent expiratory grunting are important signs that the baby is having difficulty expanding the lungs. If they persist, the infant will benefit from continuous positive airway pressure (CPAP) or positive pressure ventilation [Class B, expert consensus opinion].

Persistent apnoea, particularly associated with hypotonia (floppiness), and a heart rate <100/min is a serious sign and the infant urgently requires positive pressure ventilation.

3 Heart Rate

Heart rate can be determined by listening to the heart with a stethoscope (more reliable than cord palpation) or in the first few minutes after birth, by feeling for pulsations at the base of the umbilical cord [Class A, expert consensus opinion]. The base of the umbilical cord is preferable to other palpation locations, but if a pulse is not felt at the base of the cord this is not a reliable sign that the heart rate is absent. Other central and peripheral pulses are difficult to feel in newborn infants making the absence of these pulses an unreliable sign. Pulse oximetry can provide a continuous display of the heart rate within about a half a minute of application, even more quickly. Prompt use of pulse oximetry is recommended in any baby needing resuscitation because it can also give information about oxygenation. (Class A, expert consensus opinion)

ANZCOR suggests that ECG monitoring can also be used to more rapidly and accurately display heart rate in the first 3 minutes of life (CoSTR 2015, weak recommendation; very low quality of evidence). Therefore it has the potential to reduce inappropriate interventions that might be implemented based on falsely low estimates of heart rates as assessed by pulse oximetry or auscultation. However there is as yet no evidence whether outcomes are improved by early initiation of ECG monitoring.

Normal newborn infants have a heart rate soon after birth of about 130/min, varying between 110 and 160/min. Heart rate should be consistently more than 100/min within two minutes of birth in an uncompromised newborn infant. An increasing or decreasing heart rate is the best sign that the infant’s condition is improving or deteriorating [extrapolated evidence].
If the heart rate is persistently less than 100/min, CPAP or assisted ventilation should be commenced.

4 Colour

Colour is difficult to assess accurately and is a poor means of judging oxygenation. Normal babies are blue at birth but start to look pink soon after the onset of breathing. Cyanosis can be difficult to recognise and is determined by examining the gums and mucous membranes in good ambient light. Bluish hands and feet are a normal finding after birth. If a baby appears persistently blue, it is important to check oxygenation with a pulse oximeter [Class A, expert consensus opinion].

Extreme pallor, especially if it persists after ventilation, can indicate severe acidosis, hypotension due to poor cardiac output with or without hypovolaemia, or sometimes, severe anaemia.

5 Pulse Oximetry

For babies requiring resuscitation and/or respiratory support, pulse oximetry is recommended both to monitor heart rate and to assess oxygenation. The device should be switched on and the sensor should be placed on the infant’s right hand or wrist before connecting the sensor to the cable instrument [Class A, LOE IV]. Heart rate monitored using an oximeter should be checked intermittently during resuscitation by ECG or auscultation. [Class B, expert consensus opinion].

Modern pulse oximeters, with probes designed specifically for newborns can provide readings of heart rate in less than a minute of application and saturations by 90 seconds, as long as there is sufficient cardiac output and peripheral blood flow for the oximeter to detect a pulse. Oximetry is recommended when the need for resuscitation is anticipated, when CPAP or positive pressure ventilation is used, when persistent cyanosis is suspected, or when supplemental oxygen is used [Class A, expert consensus opinion]. In babies resuscitated using supplemental oxygen, oximetry can play an important role in avoiding hyperoxaemia.

References


ANZCOR Guideline 13.4 – Airway Management and Mask Ventilation of the Newborn Infant

**Guideline**

**EFFECTIVE VENTILATION IS THE KEY TO SUCCESSFUL NEONATAL RESUSCITATION**

All personnel involved in the birth and care of newborn infants must be familiar with the ventilation equipment and be proficient in its use.

1. **Positioning and the Airway**

   The newborn infant who needs resuscitation should be placed on his or her back with the head in a neutral or slightly extended position (the sniffing position) [Class A, expert consensus opinion]. Particularly if moulding during birth has caused a very prominent occiput, a 2cm thickness of blanket or towel placed under the shoulders may be helpful in maintaining good positioning [Class B, expert consensus opinion].

   ![Positioning Diagrams](image)

   The slightly extended, or sniffing position of the baby illustrated in the middle panel results in optimal airway patency for resuscitation.

   If respiratory efforts are present but not producing effective ventilation (the heart rate does not rise above 100/min) the airway may be obstructed and consideration should be given to other methods to improve airway patency, including support of the lower jaw, opening the mouth, or in some cases upper airway suction [Class A, expert consensus opinion].

   1.1. **Mouth and Pharyngeal Suction**

   Normal newborn infants do not require suctioning of the nose, mouth or pharynx after birth [Class A, expert consensus opinion]. They clear their airways very effectively, and suctioning can delay the normal rise in oxygenation.\(^1\)

   The airway is sometimes obstructed by particulate meconium, blood clots, tenacious mucous or vernix and may need to be cleared.
However, pharyngeal suction can cause laryngeal spasm, trauma to the soft tissues and bradycardia. It can also prolong cyanosis and delay the onset of spontaneous breathing [LOE II]. Therefore, any pharyngeal suction should be done briefly and with care.

In general, suction should not be used except when babies show obvious signs of obstruction either to spontaneous breathing or to positive pressure ventilation [Class A, expert consensus opinion]. Pharyngeal suction may be required to visualise the vocal cords during intubation.

1.2. Management of the Airway in the Presence of Meconium Stained Liquor

Aspiration of meconium before or during birth, or during resuscitation can cause meconium aspiration syndrome (MAS) and all infants born through meconium stained fluid must be regarded as at risk.

1.2.1. Intrapartum pharyngeal suction

Suctioning the infant’s mouth and pharynx before the delivery of the shoulders makes no difference to the outcome of babies with meconium stained liquor and is not recommended [LOE II].

1.2.2. Endotracheal suction

For babies who are vigorous after exposure to meconium stained liquor, (breathing or crying, good muscle tone), routine endotracheal suctioning is discouraged because it does not alter their outcome and may cause harm [Class A, LOE II].

For babies who are not vigorous (not breathing or crying, low muscle tone) the available evidence does not support or refute the value of routine endotracheal suctioning in preventing MAS (CoSTR 2015). Observational studies suggest that these meconium-exposed depressed infants are at increased risk to develop MAS [LOE IV].

One small RCT in non-vigorous infants compared tracheal intubation and suctioning with no suctioning. No benefit was found in reducing MAS and or mortality. The other evidence in relation to tracheal intubation and suctioning is conflicting and is of very low quality. Taken together, ANZCOR suggests that there is insufficient published human evidence to suggest routine tracheal intubation for suctioning of meconium (CoSTR 2015). Potential benefits of removing meconium from the trachea need to be weighed against what is likely to be an urgent need for other resuscitation manoeuvres. Emphasis should be made on initiating ventilation rapidly in non-breathing or ineffectively breathing infants.

ANZCOR recommends that if tracheal suction is performed, it should be accomplished before spontaneous or assisted respirations have commenced, and very promptly so as to minimise delay in establishing breathing [Class A, expert consensus opinion]. Stimulation to breathe should not be provided beforehand. There is no evidence to support repeated intubation for endotracheal suction, and it is likely to cause further delays in resuscitation, so ANZCOR suggests against repeated intubation for suctioning.

2. Tactile Stimulation

Drying and stimulation are both assessment and resuscitative interventions. However, if in response, the term or preterm infant fails to establish effective respirations and heart rate does not increase to more than 100/min, CPAP or positive pressure ventilation should be commenced. If the infant is breathing, CPAP may be sufficient to augment endogenous effort. In the non-breathing infant intermittent positive pressure ventilation (IPPV) is necessary.
3. Positive Pressure Ventilation

After stimulation, positive pressure ventilation should be started if the heart rate is less than 100/min and either the infant remains apnoeic or the breathing is inadequate. (See also guideline 13.3).

The primary measure of effectiveness of ventilation is a prompt improvement in heart rate, which is then sustained. Chest wall movement and other cues to adequacy of lung inflation should be assessed if the heart rate does not improve.

If there is little or no visible chest wall movement the technique of ventilation should be improved. This includes assuring the facemask fits well on the face with minimal leak, and that the head and jaw position are correct. Two people may be able to provide mask ventilation more effectively than one, with one person supporting the jaw and holding the mask in place with two hands, and the other providing positive pressure inflations. If these manoeuvres are ineffective in moving the chest wall and increasing the heart rate, the inflating pressure must be increased until chest wall movement is seen and the heart rate increases [Class A, expert consensus opinion]. Suctioning of the airway is sometimes required. Occasionally an oro-pharyngeal airway is helpful, such as when the baby has an abnormally small jaw or large tongue.

3.1. Manual Ventilation Devices

A T-piece device, a self-inflating bag (approximately 240 mL), and a flow-inflating bag are all acceptable devices to ventilate newborn infants either via a facemask, laryngeal mask or endotracheal tube. [Class A, extrapolated evidence].

<table>
<thead>
<tr>
<th>Needs pressurised gas source</th>
<th>Self-inflating bag</th>
<th>Flow-inflating bag (with manometer)</th>
<th>T-piece resuscitation device (with manometer)</th>
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<tr>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assists user to detect mask leak</th>
<th>No</th>
<th>Yes</th>
<th>Yes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Peak inflation pressures</th>
<th>Inconsistent, may be very high</th>
<th>Consistency depends on user skills</th>
<th>Consistent, adjustable</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Delivers PEEP or CPAP</th>
<th>No</th>
<th>Depends on user skills</th>
<th>Yes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Can deliver sustained inflation</th>
<th>No</th>
<th>Depends on user skills</th>
<th>Yes</th>
</tr>
</thead>
</table>

3.2. Effectiveness of T Piece Devices Versus Self-Inflating Bags

ANZCOR suggests the use of a T piece device for delivery of IPPV or CPAP during newborn resuscitation. [Class B, expert consensus opinion]. In making this suggestion, we have diverged from the CoSTR Treatment Recommendation, which found insufficient evidence to recommend T piece resuscitators over self-inflating bags. In doing so, we take into account the level of resources for health care in Australia and New Zealand and we place higher value on the demonstrated benefits of PEEP in recruiting lung volume, the routine use of manometry to adjust inflating pressures and the reliable titration of oxygen concentration than on the lack of evidence from any large RCT showing improvement in outcome.

A flow-inflating bag with manometer is also suitable. The T Piece device or flow-inflating bag should be used with a blender and both compressed air and oxygen, to allow accurate titration of inspired oxygen concentration to meet the baby’s needs.
A self-inflating bag must always be available for back-up in case of failure of pressurised gas delivery [Class A, expert consensus opinion]. A self-inflating bag cannot deliver CPAP and may not be able to achieve PEEP even with a PEEP valve in place.

3.3. Facemasks

The appropriate size of facemask must seal around the mouth and nose but not cover the eyes or overlap the chin. Therefore, a range of sizes must be available for different sized babies. Masks with a cushioned rim are preferable to masks without one [Class A, LOE III-29]. With bag-mask ventilation it can be difficult to establish and maintain a good seal between the mask and the infant’s face30 and so it cannot be assumed that just because the mask is on the face, there is a good seal.

Suitable facemasks, with cushioned rims, are shown on the left. The one in the centre has an inflatable rim, which should be filled with air using a syringe until the rim is firm. The Rendell Baker style mask on the right should not be used.

The face mask should be applied using a rolling motion from chin to nose bridge and held in place using a suitable grip that minimises leaks. 21,22

3.4. Initiating Ventilation

The aim of ventilation is initially to clear lung liquid, establish lung aeration and enable gas exchange.23-26 The optimal strategy for this in newborns needing resuscitation has not been established, but some studies suggest that sustained initial breaths24 and positive end expiratory pressure27 are helpful, particularly in premature lungs. There is good support for these concepts from animal studies, but care must be taken to avoid high tidal volumes during resuscitation, which can cause sustained damage to immature lungs.28

The suggested initial pressures are 30 cm H$_2$O for term infants and 20-25 cm H$_2$O for premature infants. On devices that can deliver PEEP, 5 cm H$_2$O is the recommended initial setting. Pressures should be adjusted up or down according to response. For preterm infants, it is particularly important to avoid creation of excessive lung expansion during ventilation immediately after birth. Although measured PIP does not correlate well with volume delivered in the context of changing respiratory mechanics, monitoring of inflation pressure may help provide consistent inflations and avoid unnecessarily high pressures and excessive volumes.29

Higher inflation pressures may be required to aerate the lungs during the first few inflations than for subsequent inflations, particularly in infants who have not made any respiratory effort. If pressure is not being monitored, the minimal inflation required to achieve visible chest wall movement and an increase in heart rate should be used. When it becomes evident that the infant is responding to ventilation, in many cases inflation pressures and rate can (and should) be decreased.

Subsequent ventilation should be provided at 40-60 inflations/minute with an inspiratory time of 0.3-0.5 seconds.

For most infants, ventilation can be accomplished with progressively lower pressures and rates as resuscitation proceeds [Class A, expert consensus opinion].
3.5. PEEP During Resuscitation

PEEP has been shown to be very effective for improving lung volume, reducing oxygen requirements and reducing the incidence of apnoea in premature babies with respiratory distress syndrome. Studies in intubated premature animals demonstrate that it helps establish aerated lung volume.

There is low quality evidence indicating that PEEP produces only modest reduction in maximum oxygen concentration during preterm infant resuscitation. We place higher value on the evidence for routine use of PEEP during ventilation in infants receiving subsequent neonatal intensive care, the demonstrated benefits of PEEP in establishing lung aeration in newborn preterm animal models and the much stronger evidence that CPAP can be used to support spontaneous breathing in term and preterm infants with a variety of lung disorders. We place lower value on the absence of evidence of other benefits from human infant trials. ANZCOR recommends the use of PEEP (5-8 cm H2O pressure) during resuscitation of newborn infants wherever appropriate equipment is available [Class A, expert consensus opinion].

High levels of PEEP (>8 cm H2O) have the potential to reduce pulmonary blood flow and cause pneumothorax, and should be used with great caution.

3.6. Assessing the Effectiveness of Ventilation

The effectiveness of ventilation is confirmed by observing three things:
1. Increase in the heart rate above 100/min.
2. A slight rise of the chest and upper abdomen with each inflation.
3. Oxygenation improves.

If the chest and abdomen do not rise with each inflation, or the heart rate does not increase above 100 beats per minute, the technique of ventilation needs to be improved.

Tracheal intubation (or use of a laryngeal mask airway) should be considered if ventilation via a facemask is still ineffective despite the above measures [Class A, expert consensus opinion].

4. Continuous Positive Airway Pressure (CPAP)

For spontaneously breathing term newborns with respiratory distress ANZCOR suggests a trial of CPAP, although there are no studies to support this recommendation. For preterm infants, see Guideline 13.8.

5. Mouth-to-Mouth/Nose and Mouth-to-Mask Ventilation

Where neonatal inflation devices are not available, ANZCOR suggests mouth-to-mouth-and-nose ventilation can be used [Class B, extrapolated evidence]. To decrease the risk of infection to the resuscitator, maternal blood and other body fluids should first be wiped from the face of the infant. The rescuer should then apply the mouth over the mouth and nose of the infant and give small puffs at a rate of 40-60 breaths per minute to produce a small rise and fall of the chest, until the baby improves.

6. Supplemental Oxygen During Resuscitation

There are now many studies showing that the blood oxygen levels of normal newborns can take up to 10 minutes to rise above 90%. While insufficient oxygenation can impair organ function or cause permanent injury, there is increasing evidence that even brief exposure to excessive oxygenation can be harmful to the newborn during and after resuscitation.
Furthermore, visual assessment of the presence or absence of cyanosis bears a poor relationship to oxyhaemoglobin saturation measured with an oximeter.46

6.1. Pulse oximetry

Oximetry is recommended when the need for resuscitation is anticipated, when CPAP or positive pressure ventilation is used, when persistent cyanosis is suspected, or when supplemental oxygen is used (see Guideline 13.3) [Class A, expert consensus opinion].

6.2. Administration of supplemental oxygen

Meta-analyses of randomized controlled trials comparing neonatal resuscitation initiated in 21% versus 100% oxygen showed increased survival in infants for whom resuscitation was initiated with air.47,48 In the studies of term infants receiving resuscitation with intermittent positive pressure ventilation, 100% oxygen conferred no short term advantage and resulted in increased time to first breath and/or cry.49,50 However, there are no studies in term infants that compare commencing in oxygen concentrations other than 21% or 100%.

It is suggested that regardless of gestation, the goal of oxygen administration should be to aim for oxygen saturations resembling those of healthy term babies. The interquartile range of pre-ductal saturations measured in normal term infants at sea level are suitable targets [Class A, expert consensus opinion45]. ANZCOR suggests use of the following target range. Although the 75th centile for normal infants rises above 90%46, in the following table the upper saturation targets while administering oxygen have been capped at 90%, to avoid risk of exposing infants to excessive oxygen. Some infants achieve saturations over 90% without supplemental oxygen.

<table>
<thead>
<tr>
<th>Time from birth</th>
<th>Target saturations for newborn infants during resuscitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 min</td>
<td>60-70</td>
</tr>
<tr>
<td>2 min</td>
<td>65-85</td>
</tr>
<tr>
<td>3 min</td>
<td>70-90</td>
</tr>
<tr>
<td>4 min</td>
<td>75-90</td>
</tr>
<tr>
<td>5 min</td>
<td>80-90</td>
</tr>
<tr>
<td>10 min</td>
<td>85-90</td>
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</tbody>
</table>

For term and near-term infants ANZCOR recommends that air should be used initially with supplemental oxygen reserved for those whose saturations do not meet the lower end of the targets despite respiratory support [Class A, expert consensus opinion]. If, despite effective ventilation there is no increase in oxygenation (assessed by oximetry wherever possible) or heart rate, a higher concentration of oxygen should be used.51-53 If the saturations reach 90% while supplemental oxygen is being administered, the concentration of oxygen should be decreased [Class A, expert consensus opinion].

For considerations of very preterm infants see guideline 13.8

In all cases, the first priority is to ensure adequate inflation of the lungs, followed by increasing the concentration of inspired oxygen only if needed [Class A, expert consensus opinion].
Newborn Life Support

At all stages ask: do you need help?

1 minute

Term gestation? Breathing or crying? Good tone?

YES
Maintain normal temperature, Stay with Mother

NO
Maintain normal temperature, Ensure open airway, Stimulate

HR below 100? Gasping or apnoea?

YES
Positive pressure ventilation SpO2 monitoring

NO
Laboured breathing or persistent cyanosis?

YES
Ensure open airway SpO2 monitoring Consider CPAP

NO
Post-resuscitation care

HR below 100?

YES
Ensure open airway Reduce leaks Consider: Increase pressure & oxygen Intubation or laryngeal mask

NO
Targeted pre-ductal SpO2 after birth

1 min 60-70%
2 min 65-85%
3 min 70-90%
4 min 75-90%
5 min 80-90%
10 min 85-90%

HR below 60?

YES
Three chest compressions to each breath 100% oxygen Intubation or laryngeal mask Venous access

NO
IV Adrenaline 1:10,000 solution

Gestation (weeks) Dose
23-26 0.1 mL
27-37 0.25 mL
38-43 0.5 mL
10-30 mcg/kg (0.1-0.3 mL/kg)

IV Adrenaline
Consider volume expansion
7. **Pace of Resuscitation**

In all infants, resuscitators should aim to ensure that effective spontaneous or assisted ventilation of the lungs has been established by 1 minute. The response to each set of actions in the algorithm should be assessed. If heart rate, breathing, tone and oxygenation do not improve or the infant is deteriorating, progress to the next step [Class A, expert consensus opinion].

**References**

35. Gonzales GF, Salirrosas A. Arterial oxygen saturation in healthy newborns delivered at term in Cerro de Pasco (4340 m) and Lima (150 m). Reprod Biol Endocrinol 2003;1:46.
42. Solas AB, Kutzsche S, Vinje M, Saugstad OD. Cerebral hypoxemia-ischemia and reoxygenation with 21% or 100% oxygen in newborn piglets: effects on extracellular levels of excitatory amino acids and microcirculation. Pediatr Crit Care Med 2001;2:340-5.
ANZCOR Guideline 13.5 – Tracheal Intubation and Ventilation of the Newborn Infant

1. Tracheal Intubation and Ventilation

1.1. Indications

A decision to perform tracheal intubation will depend on the gestation of the infant, degree of respiratory depression, response to facemask (or laryngeal mask) ventilation, and the skill and experience of the resuscitator. Preterm gestation or very low birth weight should not be the only factor that drives the decision to intubate.

Tracheal intubation may need to be performed:

- If ventilation via a facemask (or laryngeal mask) has been unsuccessful (heart rate remains low, oxygen saturation falling or failing to rise) or prolonged
- In special circumstances, such as congenital diaphragmatic hernia, or extremely low birth weight
- For infants born without a detectable heartbeat, consideration should be given to intubation as soon as possible after birth.

1.2 Laryngoscope and endotracheal tube size and depth of insertion

Endotracheal tube (ETT) internal diameter in millimetres can be calculated as gestational age in weeks divided by 10. Typically, a 2.5 tube is appropriate for infants <1kg weight, a 3.0 tube for infants weighing 1-2 kg, a 3.5 tube for infants 2-3 kg, and a 3.5 or 4.0 tube for infants over 3 kg.

A laryngoscope with a straight blade (size 1 [10 cm] for term infants and larger pre term infants, size 0 [7.5 cm] for premature infants < 32 w or 00 [6cm] for extremely low birth weight infants) is preferred. Some experienced operators use curved blades.

The approximate depth of insertion of the endotracheal tube from the middle of the upper lip, in centimetres, can be calculated as weight in kg + 6 cm.\(^1\) However, the following table is likely to result in greater precision.\(^2\) ANZCOR recommends its use for extremely low birth weight infants and premature infants after the newborn period [Class A, expert consensus opinion].
Table: Recommended ETT length to the nearest 0.5 cm by corrected gestation (gestation at birth plus postnatal age) and weight at time of intubation [Class B, LOE IV²].

Appropriate depth of insertion must always be verified by comparing the markings on the tube with the formula or table (see also "Verification of endotracheal tube position" below) [Class A, expert consensus opinion].

### 1.3 Equipment to Prepare for and Perform Endotracheal Intubation

- T-piece infant resuscitator (or flow-inflating bag) and self-inflating bag (~240 mL)
- Neonatal facemasks (range of sizes suitable for premature and term infants)
- Medical gases:
  - a source of medical oxygen (reticulated and/or cylinder, allowing flow rate of up to 10 L/min) with flow meter and tubing
  - a source of medical air plus air/oxygen blender
- Suction apparatus and suction catheters (6F, 8F, and either 10F or 12F)
- Laryngoscopes with infant blades (00, 0, 1) plus spare bulbs and batteries. Ensure end light is bright
- Endotracheal tubes (sizes 2.5, 3, 3.5, and 4 mm internal diameter). Important characteristics of the tube include:
  - uniform diameter, without a shoulder
  - no eye
  - uncuffed
  - standard curve
  - clear or translucent
  - radio-opaque
  - centimetre markings along the length to indicate depth of insertion
- Endotracheal stylet or introducer (optional for oral intubation, not used for nasal intubation)
- Supplies for securing endotracheal tubes (e.g. scissors, tape)
- Neonatal stethoscope
- Exhaled CO₂ detector
- Magill neonatal forceps (optional)

### 1.4 Ventilation technique

Considerations are similar to those for ventilation via a facemask (Guideline 13.4).
1.5 Verification of endotracheal tube position

The effectiveness of ventilation via an endotracheal tube is confirmed by three observations, which tend to occur in the following sequence:

1. Chest moves with each inflation
2. Increase in the heart rate to above 100/min
3. Oxygen saturations improve.

If the chest does not move and the heart rate does not increase, the location of the endotracheal tube and technique of ventilation need to be re-evaluated.

Other signs to verify correct endotracheal tube position

- By visual inspection of the endotracheal tube passing through the larynx.
- Mist may condense on the inside of the endotracheal tube during exhalation.
- Colour change in a colorimetric end-tidal CO₂ detector. A CO₂ detector, attached to the endotracheal tube adaptor, is recommended as the most reliable method to confirm endotracheal tube placement in neonates who have spontaneous circulation [Class A, LOE IV³]. However, false negative readings may occur in infants if there is very low or absent pulmonary blood flow (LOE IV³), so if the chest wall is moving well in a very depressed infant, some caution is needed to avoid unnecessary extubation and reintubation. False positives may occur with colorimetric devices contaminated with adrenaline (epinephrine) or surfactant (extrapolated evidence⁴).
- Symmetrical air entry over lung fields (upper chest) auscultated with a stethoscope.

Signs that the endotracheal tube is not in the trachea

- No chest movement with inflations.
- A heart rate <100 beats per minute that does not increase soon after intubation and inflation is started.
- No expired CO₂ detected.
- No improvement in oxygenation.
- The absence of breath sounds in the axillae.

The lack of symmetrical chest movement with adequate inflating pressure may indicate that the endotracheal tube is too far down. The depth of insertion should be checked.

Devices to monitor gas flow and volume have been shown to improve mask ventilation technique in simulation training and there is limited evidence of feasibility in clinical settings. However to date, there is insufficient evidence of clinical benefit, so ANZCOR suggests against the routine use of flow and volume monitoring or end tidal CO₂ monitoring during newborn resuscitation. (CoSTR 2015, weak recommendation, low quality of evidence⁵)

2. Laryngeal Masks

A laryngeal mask (LM) should be considered during resuscitation of the term and near term newborn (>34 weeks, approximately 2000 grams) if facemask ventilation is unsuccessful. (CoSTR 2015, weak recommendation, low quality evidence⁵)
In particular, it should be considered as an alternative to tracheal intubation if facemask ventilation is unsuccessful and tracheal intubation is unsuccessful or not feasible. [Class A, expert consensus opinion] The LM may be considered as a primary alternative to a facemask for positive pressure ventilation among newborns weighing more than 2000 grams or delivered ≥34 weeks gestation, although there is insufficient evidence to support its routine use in this setting.  
A size 1 LM is suitable for infants up to 5 kg.

Effectiveness of ventilation should be checked using signs indicated above for endotracheal ventilation (chest wall movement, improvement in heart rate, improvement in oxygenation). In addition, the chest should be auscultated. For newborns receiving ventilation via an LM, the accuracy of colorimetric CO2 detectors to confirm position and seal has not been reported. The LM has not been evaluated during chest compressions.

References


ANZCOR Guideline 13.6 – Chest Compressions during Resuscitation of the Newborn Infant

The normal newborn infant has a heart rate above 100/min once breathing has been established, usually within two minutes of birth.1 The normal range of heart rate thereafter is 110 to 160/min.1 In newborn infants cardiac output is rate dependent. If the heart rate is too slow the circulation will be inadequate to support tissue oxygenation.

1. Indications for starting chest compressions

Chest compressions are indicated when the heart rate is <60/min despite adequate assisted ventilation provided for 30 seconds (chest wall obviously moving with each inflation).

Because ventilation is the most effective action in neonatal resuscitation and because chest compressions are likely to compete with the performance and assessment of effective ventilation, resuscitators should ensure that assisted ventilation is being delivered optimally before starting chest compressions [Class A, expert consensus opinion].

Nevertheless, once compressions are started, they should be continued with as little interruption as possible until there is clear evidence of improvement in spontaneous heart rate [Class A, expert consensus opinion].

As soon as a decision has been made to perform chest compressions, preparation should commence to establish vascular access and administer intravenous adrenaline (epinephrine) (see ANZCOR Guideline 13.7).

2. Chest compression technique

Chest compressions should be centred over the lower third of the sternum (above the xiphisternum and just below the nipples)2-4 and should compress the chest one third of the chest anterior-posterior diameter [Class A, extrapolated evidence3,4, and expert consensus opinion5].

ANZCOR suggests a technique using two thumbs on the lower third of the sternum, superimposed or adjacent to each other according to the size of the infant, with the fingers surrounding the thorax to support the back (CoSTR 2015, weak recommendation, very low quality of evidence).2
Usually the resuscitator faces the baby’s head (figure 1), but in special circumstances, such as when access is needed to the baby’s abdomen, this position can be reversed (figure 2).³

![Figure 1.](image1.png)  
![Figure 2.](image2.png)

ANZCOR suggests the two-thumb technique over the two-finger technique because it achieves superior peak systolic and coronary perfusion pressure, provides compressions more consistently over long periods of time, and it is easier and less tiring for the resuscitator (CoSTR 2015, weak recommendation, very low quality of evidence).² The only circumstance in which the two-finger technique should be considered is when only a single resuscitator is available. [Class A, expert consensus opinion].

ANZCOR suggests that inflations and chest compressions should be performed with a 3:1 ratio of 90 compressions per minute and a half second pause after each 3rd compression to deliver an inflation (CoSTR 2015, weak recommendation, very low quality of evidence).² Compressions and inflations should be coordinated to avoid simultaneous delivery of a compression and a breath [extrapolated evidence⁷]. There is no compelling evidence suggesting a benefit to other ratios for the newborn. Since asphyxia is the predominant cause of cardiovascular collapse in the newborn, effective resuscitation requires significant focus on ventilation.² Continuous chest compressions at 120 compressions per minute without interruptions for breaths can be considered in the intubated patient.

The chest should fully expand between compressions⁸, but the rescuer’s hands should not leave the chest [Class A, expert consensus opinion⁹].

## 3. Oxygen During Chest Compressions

Effectively delivered chest compressions will result in pulsations evident on an oximeter. As soon as chest compressions are commenced, it is usual practice to increase inspired oxygen to 100% if a lower concentration has previously been used. By the time chest compressions are deemed to be needed, then the steps of trying to achieve return of spontaneous circulation with lower oxygen concentrations should already have been attempted, and would have failed to increase the heart rate. Thus it seems prudent to try increasing the supplementary oxygen concentration. However, animal studies show no advantage of 100% oxygen over air in terms of return of spontaneous circulation in these circumstances and there are no human studies. ANZCOR suggests that if 100% oxygen is used then it should be weaned as soon as possible after the heart rate has recovered. (CoSTR 2015, weak recommendation, very low quality of evidence)²
Once chest compressions have been commenced, they should be performed with as little interruption as possible. Do not stop unless assessment is needed to make treatment decisions. Signs of improvement in spontaneous cardiac output may include improvement in spontaneous heart rate, a rise in oxygen saturation, and commencement of some spontaneous movement or breaths. Chest compressions should continue until it is obvious that the heart rate is >60/min.

**References**


Medications and fluids are rarely indicated for resuscitation of newborn infants.\textsuperscript{1-3}

Bradycardia is usually caused by hypoxia and inadequate ventilation. Apnoea is due to insufficient oxygenation of the brainstem. Therefore establishing adequate ventilation is the most important step to improve the heart rate. However, if the heart rate remains less than 60/min despite adequate ventilation (chest is seen to move with inflations) and chest compressions, adrenaline (epinephrine) may be needed. As adrenaline (epinephrine) exerts part of its effect by action on the heart it is important to give it as close to the heart as possible, ideally as a rapid bolus through an umbilical venous catheter.

Ventilation and chest compressions must be delivered continuously during preparation to administer IV medication or fluids.

### 1. Routes of Administration

#### 1.1. Umbilical vein

An umbilical vein catheter (UVC) is the most rapidly accessible intravascular route for adrenaline (epinephrine) and it can also be used for fluid administration. It can also be used for continued vascular access until an alternative route is established after admission to a neonatal unit. Blood gases obtained from the UVC during resuscitation are sometimes useful in guiding treatment decisions.
1.2. **Endotracheal tube**

Vascular access for adrenaline (epinephrine) is a high priority in any infant receiving chest compressions. There is little research to support the use of endotracheal adrenaline (epinephrine) and there are concerns that even in higher doses, it may still result in lower levels of adrenaline (epinephrine) than the intravenous route.\(^5\,^5\) If vascular access cannot be obtained then endotracheal adrenaline (epinephrine) may be considered. If the endotracheal dose fails to increase heart rate > 60 then an intravascular dose should be given as soon as feasible.

1.3. **Peripheral vein**

Inserting a peripheral venous cannula can be very difficult in a shocked neonate and can take too long.

1.4. **Intraosseous lines**

Intraosseous lines are not commonly used in neonates because of the more readily accessible umbilical vein, the fragility of small bones and the small intraosseous space, particularly in a premature infant. However, depending on operator training and experience, this route can be used as an alternative, especially if umbilical or direct venous access is not available [Class B, LOE IV\(^6\,^7\)].

1.5 **Umbilical artery**

The umbilical artery is not recommended for administration of resuscitation drugs. There are serious concerns that complications may result if hypertonic or vasoactive drugs (e.g. adrenaline (epinephrine)) are given into an artery.

2. **Types and Doses of Medications**

2.1. **Adrenaline (epinephrine)**

**Indications**

ANZCOR recommends that if adequate ventilation has failed to increase the heart rate to > 60 beats per minute and chest compressions have been commenced, then adrenaline (epinephrine) should be given intravenously as soon as possible [Class A, expert consensus opinion\(^1\,^2\,^8\)]

In making this recommendation we have placed higher value on animal research that indicates that chest compressions without adrenaline (epinephrine) are insufficient to increase cerebral blood flow. Furthermore there is the potential for long delays (up to several minutes) in establishing access and administering adrenaline (epinephrine). We have put lower value on the absence of human infant studies demonstrating benefit of early adrenaline (epinephrine) administration.

**Dosage**

The recommended intravenous dose is 10-30 microgram/kg (0.1-0.3 mL/kg of a 1:10,000 solution) by a quick push [Class A, expert consensus opinion]. (1 mL contains 0.1mg of adrenaline (epinephrine), so 0.1 mL = 10 microgram of adrenaline (epinephrine)). It should be followed by a small saline flush. This dose can be repeated every few minutes if the heart rate remains <60 beats
per minute despite effective ventilation and cardiac compressions.

The studies in newborn infants are inadequate to recommend routine use of higher doses of adrenaline (epinephrine). Based on studies in children and young animals, higher doses may increase risk of post-resuscitation mortality and risk of intracranial haemorrhage and are not recommended [Class A, expert consensus opinion9-11].

There is insufficient evidence for the use of endotracheal adrenaline (epinephrine), but it is likely that a higher dose will be required to achieve similar blood levels and effect. If the tracheal route is used, doses of 50-100 microgram /kg (0.5-1 mL/kg of a 1:10,000 solution) should be used [Class B, extrapolated evidence12,13]. The efficacy and safety of these doses have not been studied.8

2.2 Volume Expanding Fluids

Indications

Intravascular fluids should be considered when there is suspected blood loss, the infant appears to be in shock (pale, poor perfusion, weak pulse) and has not responded adequately to other resuscitative measures [Class A, expert consensus opinion]. Isotonic crystalloid (e.g. 0.9% sodium chloride or Hartmann’s solution) should be used in the first instance, but may need to be followed with red cells and other blood products suitable for emergency transfusion, in the setting of critical blood loss.8 Use of a specific protocol is suggested whenever critical blood loss is suspected.

Since blood loss may be occult, in the absence of history of blood loss, a trial of volume administration may be considered in babies who are not responding to resuscitation [Class B, expert consensus opinion8]. However, in the absence of history of blood loss, there is limited evidence of benefit from administration of volume during resuscitation unresponsive to chest compressions and adrenaline (epinephrine) [LOE IV14], and some suggestion of harm from animal studies [extrapolated evidence15,16].

Dosage

The initial dose is 10 mL/kg given by IV push (over several minutes) [Class B, expert consensus opinion]. This dose may be repeated after observation of the response.

References


ANZCOR Guideline 13.8 – The Resuscitation of the Newborn in Special Circumstances

1 Prematurity

1.1 Temperature management

Very premature infants are at particular risk of hypothermia. Close attention to maintaining their body temperature is essential. To prevent burns, care should be taken with external heat sources.

Very premature infants, (especially below 28 weeks gestation) very easily become cold and ANZCOR suggests they are best kept warm after birth by using a radiant warmer and placing the infant immediately after birth (without drying) in a polyethylene bag or under a polyethylene sheet (appropriate size, food or medical grade, heat resistant), up to the neck.\(^1\) The bag or sheet should not be removed during resuscitation and it should be kept in place until temperature has been checked and other measures (e.g. pre-warmed, humidified incubator) are ready to ensure that heat loss does not ensue.

ANZCOR suggests that additional measures that may be needed either alone or in combination (CoSTR 2015, weak recommendation, very low quality evidence)\(^6\) include:

- establishing an ambient temperature of at least 26°C
- exothermic warming mattresses
- warmed humidified resuscitation gases
- covering the head (except the face) with a hat or folded bedding.

1.2 Handling and skin protection

Gentle handling is essential for all infants, but especially premature infants, who are at greater risk of damage, both to skin and to internal organs. If vascular access is required, antiseptic solutions should be applied sparingly, particularly those containing alcohols, which can cause serious damage to immature skin. For umbilical catheterisation, apply antiseptic solution to the cord and only a small area of skin, using a sterile drape to cover other areas. Avoid letting excess solution pool around the infant’s groin and flanks. Adherence to good infection control procedures is essential.
1.3 Respiratory Support

Most very preterm infants need some respiratory support immediately after birth, but some uncertainty remains as to the best strategy.

Role of CPAP

For spontaneously breathing preterm infants < 32 weeks gestation who have signs of respiratory distress in the delivery room and require respiratory support, ANZCOR suggests commencing CPAP in the first minutes after birth rather than intubation and ventilation. (CoSTR 2015, weak recommendation, moderate quality of evidence)\(^6\) The evidence suggests reduction of the combined outcome of death and bronchopulmonary dysplasia (BPD) but with no benefit to death, BPD, air leak, severe intraventricular haemorrhage (IVH), necrotising enterocolitis (NEC) or severe retinopathy of prematurity (ROP). When making this suggestion it is noted that risk reduction of adverse outcomes is small and that infants recruited into the trials had a high rate of antenatal steroids but value is placed on this less invasive approach (CoSTR 2015, Values and Preferences statement).

If CPAP is used, pressure of at least 5 cm H\(_2\)O should be used. Nasal prongs are a suitable alternative to a facemask to deliver early CPAP. CPAP cannot be administered with a self-inflating bag.

The role of an intubation-surfactant-extubation ("INSURE") approach, or other methods to administer artificial surfactant without endotracheal intubation in order to facilitate early stabilisation on CPAP soon after birth\(^7\) compared to other strategies of respiratory support remains uncertain.\(^8,9\)

Role of Initial Sustained Inflation Breaths

To establish initial lung inflation in apnoeic newborn preterm infants, initiation of intermittent positive pressure ventilation at birth can be accomplished with or without several initial prolonged inflation breaths. Various regimens have been suggested, from 5 breaths lasting 2-3 seconds to one breath lasting 5-10 seconds.

ANZCOR suggests against routine use of an initial sustained inflation (> 5 seconds) in preterm infants but SI may be considered in individual clinical circumstances or in research settings. (CoSTR 2015, weak recommendation, low quality of evidence)\(^6\) Studies indicate a reduced need for intubation at 72 hours after a sustained inflation but the study protocols have varied sufficiently widely that there is a lack of clarity as to how to administer sustained lung inflation. Furthermore no longer-term benefits have been demonstrated. Recent evidence has indicated that in some circumstances, SI may cause unintended glottis closure.\(^10\)

Positive Pressure Ventilation

For infants who do not commence spontaneous breathing within the first minute after birth positive pressure ventilation is required.

For those needing assisted ventilation, the optimal ventilation strategy is not known, but both animal\(^11\) and human studies suggest the benefits of PEEP (at least 5 cm H\(_2\)O\(^12,13\)) and avoidance of high tidal volumes. Administration of endotracheal surfactant should be considered very early during the stabilisation of premature infants who have needed intubation for resuscitation [Class A, LOE I\(^14\)].
Oxygen

In studies of premature infants < 32 weeks, initial use of air or 100% oxygen was found to be more likely to result in hypoxaemia or hyperoxaemia (as defined by the investigators) respectively than when initiating resuscitation with blended air and oxygen and titrating according to oxygen saturation\(^{15,16}\). There is moderate quality evidence (downgraded for inconsistency, and/or imprecision) from randomised trials that high initial concentrations of oxygen (65-100%) confer no benefit in reducing mortality before discharge, bronchopulmonary dysplasia (BPD), intraventricular haemorrhage (IVH) or retinopathy of prematurity (ROP). Therefore, ANZCOR recommends against initiating resuscitation of preterm infants < 35 weeks gestation in high oxygen concentrations (65-100%)\(^6\). The optimal starting oxygen concentration and the most appropriate time-specific target saturations for preterm infants remain to be determined.

For preterm infants ANZCOR recommends commencing resuscitation either using room air or blended air and oxygen up to an oxygen concentration of 30% (CoSTR 2015, strong recommendation, moderate grade of evidence)\(^6\). We place higher value on reducing oxygen burden on preterm newborns and the absence of benefit of higher FiO2 in reducing mortality, BPD, IVH or ROP. As for term infants, supplemental oxygen should be given judiciously, ideally guided by pulse oximetry [Class A, expert consensus opinion]. Both hyperoxaemia and hypoxaemia should be avoided. If a blend of oxygen and air is not available, resuscitation should be initiated with air [Class B, extrapolated evidence\(^{17-20}\)].

2 Congenital Upper Airway Obstruction

An infant who is pink when crying but cyanotic, with or without laboured breathing when quiet, should be evaluated for choanal atresia or other upper airway obstruction. An oral airway may provide adequate relief from obstruction. For an infant with a small pharynx, such as occurs when there is a small mandible, prone positioning and/or placement of an endotracheal tube via the nostril into the pharynx, as a mechanical stent to prevent the tongue obstructing the airway, may improve the airway. Infants with compromising craniofacial malformations may require laryngeal mask or tracheal intubation. This can be difficult, and expert assistance may be required.

3 Congenital Diaphragmatic Hernia

Infants with congenital diaphragmatic hernia (CDH) who need respiratory support should not receive bag and mask ventilation. Where respiratory support is needed, early intubation or use of a laryngeal mask is recommended to minimise air entry into the gastrointestinal tract [Class A, expert consensus opinion]. Breath sounds following tracheal intubation may be asymmetrical, depending on the location of the CDH (and the ETT). A wide bore oro gastric tube should be placed for intermittent suction to avoid air accumulation in intrathoracic small bowel, and minimise lung compression by it. As many of these infants only have one functioning lung the ventilation needs to be gentle with low tidal volumes.

4 Infant with Unexpected Congenital Anomalies

Unless there has been prior discussion and the development of a care plan with the parents, usually all infants should receive a complete and thorough resuscitation.
Those infants with life-limiting congenital anomalies are often best evaluated in the neonatal unit after resuscitation when more information will be available and the parents can be part of management discussions.

5 **Pneumothorax**

Pneumothorax is a rare cause of failure to respond to resuscitation immediately after birth. Chest recession/retraction, tachypnoea, unilaterally decreased breath sounds, bulging of the chest wall on one side, especially in the setting of deterioration after initial response to resuscitation, may indicate the presence of a pneumothorax. The diagnosis is best confirmed by chest radiograph, but emergency treatment may be required. Transillumination can be helpful in premature infants, but in term infants it may be falsely negative. If the clinical history suggests lung hypoplasia (which can predispose to pneumothorax) is likely, preparation (before birth) of equipment for bedside diagnosis and emergency treatment of pneumothorax may be advisable.

6 **Pleural Effusions or Ascites (Including Fetal Hydrops)**

Severe body wall oedema, pleural effusions and ascites at birth can cause lung hypoplasia, and interfere with initial lung expansion. Ventilation can usually be established by using higher pressures, allowing thoracentesis to be done after radiographic and/or ultrasound examination, with cardiorespiratory monitoring and with control of ventilation. However, emergency thoracocentesis is sometimes required.

7 **Pneumonia/Sepsis**

Congenital pneumonia can result in very poor lung compliance, necessitating high ventilation pressures during resuscitation to open the lungs. It presents like severe respiratory distress syndrome.

8 **Congenital Heart Disease**

Infants who remain cyanotic despite adequate ventilation, oxygenation and circulation may have cyanotic congenital heart disease or persistent pulmonary hypertension. Very rarely, congenital heart block is the cause of persistent bradycardia. Early NICU admission and echocardiographic evaluation in such cases is essential.

9 **Abdominal Wall Defects**

Infants born with gastroschisis or a large omphalocoele require special consideration to protect the exposed abdominal contents from trauma, drying, heat loss or contamination and to prevent expansion of the extra-abdominal bowel with air. A polyethylene wrap (e.g. food wrap) or bag (e.g. a surgical “bowel bag” used to protect bowel during abdominal surgery) can be used to enclose the abdomen or the whole lower body in order to reduce drying, heat loss or contamination. Care should be taken to enclose the bowel lightly and position it so that blood flow is optimised. Caring for the baby in a side-lying position can be helpful.
An orogastric tube should be inserted to (repeatedly) remove swallowed air.

If respiratory support is needed, CPAP or positive pressure ventilation via a facemask should be avoided because they may increase intra-abdominal gas, which can imperil the blood supply to the exterior gut and can increase the difficulty in reducing the bowel into the abdomen later. If respiratory support is required, a low threshold for endotracheal intubation is suggested in preference to a facemask. There is no literature and little experience in relation to use of a laryngeal mask in these circumstances, but because it promotes tracheal ventilation and oesophageal occlusion, it may be preferable to a facemask if respiratory support is needed and endotracheal intubation is not possible.

10 Multiple Births

Multiple births are more frequently associated with a need for resuscitation because of prematurity, abnormalities of placentation, compromise of cord blood flow, and/or mechanical complications during delivery. Monozygotic multiple fetuses may have discrepant blood volumes from twin-to-twin transfusion syndrome and rarely, one twin may need urgent transfusion, usually after initial resuscitation. There should always be at least one skilled resuscitator for each infant.

11 Fetal Haemorrhage

Maternal vaginal bleeding before birth may be a sign of placental abruption, placenta praevia or vasa praevia as the source of the bleeding. Although most commonly, the majority of blood loss will be maternal, if even a small portion is fetal the baby may be hypovolaemic. Major transplacental haemorrhage into the mother’s circulation (feto-maternal haemorrhage) can cause neonatal hypovolaemia with no apparent antenatal bleeding.

Exsanguinated newborn infants are typically very pale even after a good heart rate has been restored. They may be difficult to resuscitate and intravenous fluid is often required before the infant will respond fully to resuscitative measures. As noted in Guideline 13.7, isotonic crystalloid (0.9% sodium chloride or Hartmann’s) should be used in the first instance, but may need to be followed with blood suitable for neonatal transfusion. Some infants have lost a large proportion of their blood volume and may require activation of a critical bleeding protocol that addresses both restoration of oxygen carrying capacity and the likely accompanying coagulopathy.

12 Umbilical Artery Cord Blood Gases

Cord blood gases should be measured in every resuscitated newborn infant as the most objective way to assess the condition just before birth [Class A, expert consensus opinion]. They are also one criterion for assessing whether there was an intrapartum cause for subsequent cerebral palsy.\(^{21}\) Comparison of paired samples drawn from both vein and artery is advisable, because of the risk that the umbilical artery has not been correctly identified. Normal umbilical artery values are given in the following table.\(^{22}\) The effect of deferred cord clamping procedures on these values is uncertain.\(^{23-25}\)
<table>
<thead>
<tr>
<th></th>
<th>2.5th centile</th>
<th>Mean</th>
<th>97.5th centile</th>
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<tr>
<td>pH</td>
<td>7.1</td>
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<td>7.38</td>
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<tr>
<td>Base excess</td>
<td>-11</td>
<td>-4</td>
<td>1</td>
</tr>
<tr>
<td>pO₂ (mm Hg [kPa])</td>
<td>6 [0.8]</td>
<td>17 [2.3]</td>
<td>30 [4]</td>
</tr>
<tr>
<td>pCO₂ (mm Hg, kPa)</td>
<td>35 [4.7]</td>
<td>52 [6.9]</td>
<td>74 [9.8]</td>
</tr>
</tbody>
</table>

References

ANZCOR Guideline 13.9 – After the Resuscitation of a Newborn Infant

1 Documentation of Resuscitation

For clinical and medicolegal reasons the observations, interventions and times during neonatal resuscitation must be fully documented.

The Apgar scores quantify and summarise the response of the newborn infant over the first few minutes of life. The Apgar score is assessed and recorded based on observations made at 1 and 5 minutes after birth and then sequentially every 5 minutes until the heart rate and breathing are normal. Interventions for depressed infants should not await Apgar scoring.

2 Continuing Care of the Newborn Infant after Resuscitation

Once adequate ventilation and circulation have been established, the infant who has required resuscitation remains at risk and should be assessed in an intensive or special care nursery where monitoring, appropriate evaluation and care can be provided. An infant who has experienced perinatal compromise or has ongoing respiratory distress may have dysfunction or delayed perinatal adaptation of brain, heart, gastrointestinal tract, kidneys or other organs. Fluid balance and nutrition should be monitored carefully for the first few days.

2.1 Cardiorespiratory management

Usually, any infant who has been intubated and ventilated for resuscitation should not be extubated until the infant has been carefully assessed and the risk of the need for re-intubation has been assessed as being low. Preterm infants and selected others may benefit from surfactant administration. The assessment of infants who have required assisted ventilation should include oxygen saturation, heart rate, respiratory rate and effort. Blood pressure, blood glucose measurement and blood gas analysis are also often indicated.

2.2 Blood glucose management

Blood glucose level should be checked soon after resuscitation. Infants who require resuscitation are more likely to develop hypoglycaemia. Although no exact threshold level at which outcomes worsen has been identified, maintaining a blood glucose level above 2.5 mmol/L for infants who have required resuscitation is unlikely to cause harm.
[Class B, expert consensus opinion]. A glucose infusion of 4-6 mg/kg/min will usually be sufficient. Large bolus doses of glucose (>100-200 mg/kg) should be avoided (1 ml of 10% glucose contains 100 mg) [Class B, expert consensus opinion].

2.3 Antibiotics

The need for resuscitation can be a consequence of the onset of sepsis. Very soon after resuscitation, consideration should be given to the need for relevant investigations and antibiotic treatment.

2.4 Induced Hypothermia for Hypoxic Ischaemic Encephalopathy (HIE)

Inducing hypothermia in infants with evolving moderate to severe hypoxic ischaemic encephalopathy will reduce the degree of brain injury in some [LOE II]. Local guidelines should be developed to identify term and near term infants (gestation ≥ 35 weeks) who meet any of the following criteria, that resemble those used in clinical trials of induced hypothermia:

- Need for prolonged resuscitation; e.g. need for assisted ventilation and/or chest compressions at 10 min
- Apgar score at 10 minutes ≤5
- Acidosis as determined by cord blood gas or sample taken from the infant soon after birth, e.g. pH <7.0 or base excess worse than -12 mmol/L.

Many but not all such infants will have experienced an intrapartum sentinel event such as cord prolapse, severe abruption, or severe dystocia. The absence of such a recognised event does not preclude the possibility that the baby will benefit from induced hypothermia.

Infants who are at risk should have their neurological status assessed over the first few hours after birth. Those who develop signs of moderate or severe encephalopathy should have induced hypothermia commenced within 6 hours.

Any infant who is considered a candidate for therapeutic hypothermia should be discussed promptly with a neonatologist, and plans should be made for admission to a neonatal intensive care unit [Class A, expert consensus opinion]. Cooling should be conducted under carefully defined protocols, consistent with those used in the randomized, controlled trials, i.e. commence within 6 hours after birth, cool to 33-34°C, continue for 72 hours and re-warm gradually, monitor for known adverse effects of cooling, and plan long term follow-up for all treated infants [Class A, expert consensus opinion]. Cooling can be initiated without specialized equipment. 5

2.5 Stabilisation and Transfer

It is well established that wherever possible, babies who are likely to require neonatal special or intensive care should be born at a centre that can provide an appropriate level of care [Class A, expert consensus opinion]. Babies born elsewhere who require intensive or special care should be transferred [Class A, expert consensus opinion]. Early consultation should be undertaken to discuss management and arrange transport or retrieval [Class A, expert consensus opinion].
3 Continuing Care of the Family

Regardless of the outcome, witnessing the resuscitation of their baby is distressing for parents. Every opportunity should be taken to prepare parents for the possibility of a resuscitative effort when it is anticipated and to keep them informed as much as possible during and certainly after the resuscitation. Whenever possible, information should be given by a senior clinician. Early contact between parents and their baby is important.

Difficult resuscitations are also stressful for the staff involved, regardless of seniority, and efforts should be made to debrief after such events. Well-conducted debriefing also represents an opportunity to improve skills.

References


ANZCOR Guideline 13.10 – Ethical Issues in Resuscitation of the Newborn Infant

Guideline

1 Initiating Resuscitation

The birth of extremely premature infants and those with severe congenital anomalies raises questions with the parents and among clinicians about initiation of resuscitation.\textsuperscript{1,2} Resuscitation does not mandate continued support. Not starting resuscitation or starting intensive care which is stopped later, when the details of the infant’s condition are known, are ethically and legally equivalent.\textsuperscript{8} The latter approach allows time to gather more complete clinical information and for discussions with the family. If there is doubt whether to initiate or withhold resuscitation, it is best to start and later withdraw treatment when the situation has been clarified. Exceptions include infants with anencephaly and extremely immature infants for whom there is very little possibility of intact survival. Together, clinicians and parents may decide to withhold or withdraw treatment on the basis of futility and in the ‘best interests’ of the infant.\textsuperscript{8}

When gestation, birth weight, or congenital anomalies are associated with almost certain early death and an unacceptably high morbidity is likely among the rare survivors, resuscitation is not indicated.\textsuperscript{9}

In conditions associated with a high rate of survival and acceptable morbidity, resuscitation is nearly always indicated. In conditions associated with uncertain prognosis, when there is borderline survival and a relatively high rate of morbidity, and where the burden to the child is high, the parents’ views on resuscitation should be supported.\textsuperscript{9}

Recently, prognostic scores have been developed to assist in decision-making about resuscitation for infants born < 25 weeks gestation. ANZCOR suggests that there is insufficient evidence to support the routine use of these scores in an Australian and New Zealand setting, when compared to prognostication based on estimated gestational age assessment alone (CoSTR 2015).\textsuperscript{10}

Whenever possible, there should be a consistent and coordinated approach from the obstetric/midwifery and neonatal teams in applying this guideline and in communicating with the parents to develop an agreed-upon management plan.
2 Discontinuing Resuscitation

In a newly born late preterm and term baby, ANZCOR suggests that it is reasonable to stop resuscitation if the heart rate is undetectable and remains so for 10 minutes, because both survival and quality of survival deteriorate precipitously by this time. However, the decision to continue resuscitation efforts beyond 10 minutes when there is no heart rate, or a very low heart rate is often complex and may be influenced by issues such as whether the resuscitation was considered to be optimal, availability of advanced neonatal intensive care (including therapeutic hypothermia), presumed etiology and timing of the arrest, the gestation of the baby, specific circumstances prior to delivery (e.g. known timing of the insult) and wishes expressed by the family. (CoSTR 2015, weak Recommendation, very low quality of evidence)\(^\text{10}\)

The absence of spontaneous breathing or an Apgar score of 1-3 at 20 minutes of age in babies > 34 weeks but with a detectable heart rate are strong predictors of mortality or significant morbidity. In resource-limited settings, such as in areas remote from neonatal intensive care, it may be reasonable to stop assisted ventilation in babies who meet this criterion. (CoSTR 2015, weak recommendation, very low quality of evidence)\(^\text{10}\) Consultation with a neonatologist or paediatrician is recommended, if possible.

If it is decided to withdraw or withhold resuscitation, care should be provided in a way that is focused on the baby’s comfort (if signs of life are still present) and dignity, and on support of the parents.

References