NEONATAL RESUSCITATION AT DELIVERY

1. AIM

- To provide neonatal resuscitation according to Australian and New Zealand Committee on Resuscitation (ANZCOR) Guidelines[1]

2. PATIENT

- Neonate requiring resuscitation

3. STAFF

- Medical, nursing and midwifery staff

4. EQUIPMENT

- **General**
  - Neonatal resuscitaire with radiant heat source
  - Light
  - Clock with timer in seconds
  - Warmed towels or blankets
  - Polyethylene bag and bonnet for neonate <32 weeks gestation
  - Stethoscope
  - Pulse oximeter with neonatal probe
  - Blood gas syringes/needles and analyser

- **Airway**
  - Mechanical suction/tubing – negative pressure source not to be >100 mmHg
  - Suction catheter – minimum of two of each size (8 F, 10 F or 12 F)
  - Oropharyngeal airways (size 0 and 00)
  - Laryngoscopes with infant blades – at least one each of size 00,0 and 1
  - Spare laryngoscope batteries
  - Endotracheal tubes (ETT) – minimum of two of each size (2.5, 3.0, 3.5 and 4.0 mm [uncuffed, no eye])
  - Endotracheal stylet or introducer
  - Supplies for fixing endotracheal tubes (e.g. scissors, tape)
  - End-tidal carbon dioxide detector (Pedicap®)
  - Meconium aspirator
  - Magill forceps
  - Laryngeal mask airway (LMA), size 1 (only suitable for neonate ≥34 weeks' gestation and ≥2 kg)

- **Breathing**
  - Positive-pressure ventilation device including:
    - T-piece resuscitator (Neopuff®)
    - Self-inflating bag (approximately 240 mL)
  - Appropriate size mask. BE AWARE, small masks (e.g. 35 mm), for extreme preterm neonate, are not routinely available on resuscitaire and need to be brought from the Newborn Care Centre (NCC) if required
  - Blended gas supply
  - Size 8 F feeding tubes and 10 mL syringe for gastric decompression

NEONATAL RESUSCITATION AT DELIVERY cont'd

- **Circulatory**
  - Peripheral intravenous cannulation (PIVC) equipment
  - Umbilical catheter insertion pack
  - Umbilical catheters: size 3.5 or 5.0 French (Fr) (or 5 Fr feeding tube)
  - 3-way tap
  - Intraosseous needles – 50 mm length
  - Tapes to secure Umbilical Vein Catheter (UVC)/PIVC
  - Syringes and needles
  - Skin preparation solution
- **Medication and fluids**
  - Adrenaline 1:10,000 concentration (0.1 mg/mL)
  - 0.9% Sodium Chloride

5. CLINICAL PRACTICE

Procedure

- Recognise high risk delivery where neonate may require resuscitation
- Summon appropriate level of assistance (see appendix 1). If assistance doesn't arrive call neonatal code blue on 2222
- Prepare equipment for resuscitation
- Double clamp cord for cord blood gas collection and perform analysis when time permits (arterial and venous)
- Dry the neonate **≥32 weeks' gestation** and keep warm (skin temp 36.5-37.5 °C)
- Place neonate **<32 weeks' gestation, DO NOT DRY** in a polyethylene bag up to neck immediately after birth, place bonnet/beanie on head
- Assess the neonate within 30 seconds of birth for respiration, heart rate (HR) (using auscultation with stethoscope) and tone (see Appendix 2)
- Provide routine care if respirations are regular and HR is >100 beats per minute (bpm).

Effective ventilation is the key to successful resuscitation of the neonate

Respirations irregular but HR >100 bpm

- Position neonate in a neutral position
- Ensure open airway
- Provide positive pressure ventilation (PPV) with 21% oxygen (O_2) using appropriate size face mask
- Start at peak inspiratory pressure (PIP) of 30 cm H_2O for a term neonate (20-25 cm H_2O preterm neonate) and positive end expiratory pressure (PEEP) of 5 cm H_2O at 40-60 breaths/minute
- Consider increasing PIP if there is minimal chest movement during inflation
- Use pulse oximetry when providing PPV (ask assistant to position probe on the neonate's right wrist, prior to connecting to monitor)
- Consider Continuous Positive Airway Pressure (CPAP) if respirations become regular but ongoing increased work of breathing

Respirations irregular and/or HR <100 bpm

- Recheck neutral position of the head to maintain open airway and ensure adequate face mask fit and seal
- Continue PPV
- Assess chest movement and adjust pressure to achieve adequate ventilation
- Use pulse oximetry (if not already applied)
- Provide blended O_2 and titrate it to maintain neonatal preductal O_2 saturations as per Appendix 2
- Consider intubation or LMA if adequate ventilation not achieved with mask ventilation

NEONATAL RESUSCITATION AT DELIVERY cont'd

HR is persistently <60 bpm despite adequate assisted ventilation

- **Activate a CODE BLUE Call (Dial 2222)**
- Increase blended O_2 to 100%
- Continue PPV
- Start cardiopulmonary resuscitation (CPR):
  - 90 chest compressions to 30 breaths per minute [3:1]
  - Two thumb-encircling hands method is preferred
  - Compress 1/3 anterior-posterior chest
- Consider intubation or LMA if adequate ventilation not achieved with mask ventilation

HR is still <60 bpm after 30-60 seconds of effective PPV and chest compressions

- Continue CPR
- Prioritise intubation if skilled staff available (consider LMA if skilled staff not available)
- Administer adrenaline via ETT:
  - Solution 1 in 10,000
  - 0.5-1.0 mL/kg
- Insert UVC for medication and fluid volume administration
  - Insert to approximately 4-5 cm from stump for term neonate
  - Ensure blood returns freely upon aspiration of UVC
  - Secure UVC to abdomen with adhesive tape
- Consider second dose of ETT adrenaline if UVC insertion unsuccessful
- Administer adrenaline via UVC:
  - Solution 1 in 10,000
  - 0.1-0.3 mL/kg
- Ensure UVC is flushed with 0.9% sodium chloride after administration of medication
- Continue chest compressions after administration of adrenaline to ensure circulation of medication
- Repeat intravenously every few minutes when the HR remains < 60bpm
- Consider volume expansion (0.9% sodium chloride or whole blood if indicated [e.g. antepartum haemorrhage])
  - Use where there is suspected blood loss or the neonate appears pale, poorly perfused, has a weak pulse and has not responded adequately to other resuscitative measures
  - Give 0.9% normal saline 10 mL/kg by slow intravenous (IV) push over 5-10 minutes
  - Use O negative blood if available in the setting of massive blood loss. **O negative blood is kept in the Randwick Campus Operating Theatre and** can be **accessed by the nursing supervisor or senior medical staff**

Presence of meconium-stained liquor

- Provide routine care if neonate is vigorous with good respiratory effort, normal tone and HR >100 bpm
- Provide either of two pathways for neonate that is **not vigorous** at birth:
  - Clinicians with **advanced airway skills** may consider intubation and brief suctioning using a meconium aspirator
  - Clinicians **without** advanced airway skills should resuscitate the neonate as they would any other neonate. This may include suctioning obvious meconium under direct vision

  Regardless of the pathway chosen, it is extremely important to avoid any delay in commencing resuscitation i.e. AVOID prolonged or multiple intubation attempts, waiting for clinicians with advanced airway skills to arrive
- Provide PPV with 21% O_2 within the first 30 seconds after birth in the non-breathing, or ineffectively breathing neonate with poor muscle tone

NEONATAL RESUSCITATION AT DELIVERY cont'd

Blended Oxygen Use

- Aim for O_2 saturation that resembles that of a healthy term neonate regardless of gestation (Appendix 2)
- Use blended O_2 judiciously and be guided by pulse oximetry
- Use 21% O_2 at the commencement of resuscitation for **term neonate**
- Use either 21% O_2 or a low concentration O_2 (up to 30%) for **preterm neonate or a known congenital lung pathology**
- Consider higher concentration of O_2 if oxygenation (ideally guided by oximetry) remains unacceptable despite effective ventilation
- Apply pulse oximetry on the right wrist (for preductal saturations) at the commencement of resuscitation

Tracheal Intubation

- Select ETT size by estimated weight[1] e.g. <1 kg = 2.5; 1-2 kg = 3.0; 2-3 kg = 3.5; >3 kg = 3.5 or 4.0
- Use laryngoscope straight blade[1]:
    - size 1 (10 cm) for term infants and larger preterm neonates
    - size 0 (7.5 cm) for premature neonates < 32 weeks gestation
    - size 00 (6cm) for extremely low birth weight neonates

- Estimate depth of insertion of ETT (e.g. weight in kg + 6 cm or use table below)[5,6]

Table 1: Recommended ETT length to the nearest 0.5 cm by corrected gestation (gestation at birth plus postnatal age) and weight at time of intubation

Corrected gestation (weeks)	Actual weight (kg)	ETT mark at lip (cm)
23–24	0.5–0.6	5.5
25–26	0.7–0.8	6.0
27–29	0.9–1.0	6.5
30–32	1.1–1.4	7.0
33–34	1.5–1.8	7.5
35–37	1.9–2.4	8.0
38–40	2.5–3.1	8.5
41–43	3.2–4.2	9.0

- Check signs of successful intubation:
    - Visualisation of tube passing through vocal cords
    - Colour change towards yellow on carbon dioxide (CO_2) detector
    - Auscultation of equal breath sounds
    - Chest movement with each breath
    - Improved HR and oxygen saturations

Post Resuscitation Care

- Report and record events accurately using the newborn resuscitation record (top drawer of resuscitaire)
- Obtain cord pH (ideally arterial and venous) for neonate needing active resuscitation
- Report immediately to neonatal medical team if arterial pH is <7.10

NEONATAL RESUSCITATION AT DELIVERY cont'd

- Admit for formal observations for 4-6 hours and consider discharge after documented review by medical staff if:
  - Intubated during resuscitation
  - Need for prolonged resuscitation (e.g. assisted ventilation and/or chest compressions at 10 minutes)
  - Apgar score at 10 minutes ≤5
  - Acidosis as determined by cord blood gas or sample taken from the neonate soon after birth (e.g. pH <7.0 or base excess worse than -12 mmol/L)
  - If received naloxone at birth (see educational notes)
- Insert an orogastric tube (size 8 Fr) to aspirate and decompress the stomach of any neonate that required prolonged ventilation
- Invite the relevant support person (if present) to accompany the resuscitation team and neonate to NCC
- Consider discontinuation of resuscitative efforts if the neonate in cardiorespiratory arrest does not return to spontaneous circulation (detectable heart rate) after 10-20 minutes of adequate resuscitation (**MUST be discussed with on-call neonatologist**)

6. DOCUMENTATION

- Medical record
- Newborn Resuscitation Record
- NICUS database

7. EDUCATIONAL NOTES

- ANZCOR neonatal guidelines for resuscitation are drawn from consensus treatment and resuscitation recommendations from:
  - International Liaison Committee on Resuscitation (ILCOR), which includes representation from the Australian Resuscitation Council (ARC) and the New Zealand Resuscitation Council (NZRC)[2]
  - American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care (Neonatal) 2015[3]
  - European Resuscitation Council Guidelines for Resuscitation 2015[4]
- World Health Organisation (WHO) definitions:
  - Extremely preterm (<28+0 weeks)
  - Very preterm (28+0 to 31+6 weeks)
  - Moderate to late preterm (32+0 to 36+6 weeks)
  - Term (37+0 weeks and over)
- The temperature of a non-asphyxiated neonate should be maintained between 36.5°C and 37.5°C after birth. The admission temperature should be recorded as a predictor of outcome as well as a quality indicator
- Maintenance of temperature: At < 32 weeks' gestation, placing the neonate in a plastic bag and placing a bonnet on the head has been shown to be effective in reducing hypothermia.
- Meconium: Tracheal intubation should not be routine in the presence of meconium and should only be performed for suspected tracheal obstruction. The emphasis should be on initiating ventilation within the first minute of life in non-breathing or ineffectively breathing neonates and this should not be delayed
- Air/O_2: Ventilatory support of term neonates should start with air. For preterm neonates, either air or a low concentration of O_2 (up to 30%) should be used initially. If, despite effective ventilation, oxygenation (ideally guided by oximetry) remains unacceptable, use of a higher concentration of O_2 should be considered
- CPAP: Initial respiratory support of spontaneously breathing preterm neonates with respiratory distress may be provided by CPAP rather than intubation

NEONATAL RESUSCITATION AT DELIVERY cont'd

- It is mandatory for all health care professionals involved in the direct care of neonates to attend a teaching and assessment of basic neonatal life support session annually
- The 2016 Newborn Life Support Flow diagram has renewed focus on the first minute after birth (see Appendix 2). The emphasis is on rapid assessment and prompt initiation of first response interventions. It is imperative to ensure that each step is being performed well.
- Timing of cord clamping:[1]
  - Cord clamping should be delayed for at least one minute in neonates who do not require resuscitation
  - Delayed cord clamping is recommended for preterm neonates not requiring immediate resuscitation after birth
  - There is insufficient evidence to recommend an approach to cord clamping for compromised preterm neonates requiring immediate resuscitation after birth
- Medications are rarely indicated in resuscitation of the neonate as bradycardia is usually the result of inadequate lung inflation or profound hypoxia. Adequate ventilation is the most important step in correcting bradycardia.
- The following medications may be used in special circumstances but are not available on the resuscitation trolleys:
  - **Naloxone** for reversal of respiratory depression in a neonate whose mother received narcotics within 4 hours of birth.
    - Ensure adequate ventilation and circulation before administration
    - Dose: 0.1 mg/kg of a 0.4 mg/mL solution given intramuscularly or intravenous
    - **DO NOT** administer naloxone to neonate born to woman suspected of narcotic dependence (may cause abrupt withdrawal and seizure)
  - **Sodium Bicarbonate** in the case of prolonged resuscitation and/or unresponsive to other therapy.
    - Should be given only after all attempts to establish ventilation and circulation
    - Dose: 1-2 mEq/kg of a 0.5 mEq/mL solution
    - Dilute in equal volume with water for injection and give by slow intravenous push over at least 2 minutes
    - **DO NOT** give via ETT
- The umbilical vein is the most accessible IV route for volume expansion and administration of medication. Consider UVC when chest compressions are required.
- Endotracheal route may be used for administration of adrenaline only.
- In a newly born late preterm and term neonate, 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 aetiology and timing of the arrest, the gestation of the neonate, specific circumstances prior to delivery (e.g. known timing of the insult) and wishes expressed by the family.[1]
- 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.[1]
- If it is decided to withdraw or withhold resuscitation, care should be provided in a way that is focused on the neonate's comfort (if signs of life are still present) and dignity, and on support of the parents.[1]

8. RELATED POLICIES/PROCEDURES/CLINICAL PRACTICE LOP

- NSW Health Guideline GL2018_016 – Maternity - Resuscitation of the Newborn Infant
- Neonatal Observations Guideline
- Admission of a neonate to Newborn Care Centre

NEONATAL RESUSCITATION AT DELIVERY cont'd

9. RISK RATING

- Medium

10. NATIONAL STANDARD

- Standard 1 - Clinical Governance
- Standard 4 - Medication Safety
- Standard 5 - Comprehensive Care
- Standard 6 - Communicating for Safety
- Standard 7 - Blood Management
- Standard 8 - Recognising and Responding to Acute Deterioration

11. REFERENCES

1. Australian and New Zealand Council of Resuscitation (ANZCOR) Guidelines: Section 13 – Neonatal Guidelines. 2016-17. https://resus.org.au/guidelines/
2. Wyllie J, Perlman JM, Kattwinkel J, et al. Part 7: Neonatal resuscitation: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. Resuscitation. 2015;95: e169-201.
3. Wyckoff MH, Aziz K, Escobedo MB, et al. Part 13: Neonatal Resuscitation: 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation 2015;132: S543-60.
4. Wyllie J, Bruinenberg J, Roehr CC, Rudiger M, Trevisanuto D, Urlesberger B. European Resuscitation Council Guidelines for Resuscitation 2015: Section 7. Resuscitation and support of transition of babies at birth. Resuscitation 2015; 95:249-63.
5. Peterson J, Johnson N, Deakins K, et al. Accuracy of the 7-8-9 Rule for endotracheal tube placement in the neonate. J Perinatol 2006; 26:333-6.
6. Kempley ST, Moreiras JW, Petrone FL. Endotracheal tube length for neonatal intubation. Resuscitation 2008; 77:369-73.

12. AUTHOR

Primary	2.7.2019	RHW NCC LOPs Committee

REVISION & APPROVAL HISTORY

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Approved Patient Care Committee 4/9/08
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…./Appendices

Appendix 1

Deliveries requiring paediatric attendance at birth

Risk Factor	Minimum Level of Assistance Required
CTG abnormality in “red zone”	Paediatric RMO/Paediatric Registrar
Emergency caesarean according to risk factor	Depends on indication for caesarean – at least Paediatric RMO
Significant Fetal abnormality	Paediatric RMO/Registrar
Fetal scalp blood sampling; pH <7.20 or lactate ≥4.8	Paediatric Registrar
General anaesthetic	Paediatric RMO/Paediatric Registrar
Hydrops fetalis	Paediatric Registrar and Fellow/Consultant
Instrumental delivery	Paediatric RMO
Intrauterine growth restriction	Paediatric RMO
Breech presentation	Paediatric RMO
Meconium	Paediatric Registrar
Multiple gestation	Paediatric RMO and Paediatric Registrar +/- Neonatal Intensive Care Nurse if other risk factors
Placental and cord accidents (e.g. cord prolapse or placental abruption)	Paediatric Registrar
Prematurity <32 weeks	Neonatal Consultant or Fellow and Paediatric Registrar and Neonatal Intensive Care Nurse
Prematurity 32 weeks to <37 weeks	Paediatric Registrar
Shoulder dystocia	Paediatric Registrar
Fetal concerns	Paediatric RMO/Registrar

Appendix 2

ANZCOR Newborn Life Support Algorithm