

PedsCases Podcast Scripts

This is a text version of a podcast from PedsCases.com on “**Neonatal Resuscitation Program Guidelines.**” These podcasts are designed to give medical students an overview of key topics in pediatrics. The audio versions are accessible on iTunes or at www.pedscases.com/podcasts.

Neonatal Resuscitation Program Guidelines

Developed by developed by Drs. Julia DiLabio, Emer Finan, Colin Siu, and Chloe Joynt for PedsCases.com.
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Introduction:

Hello everyone, my name is Julia DiLabio and I am a third year Paediatrics Resident at SickKids Hospital and the University of Toronto. This podcast was developed with Dr. Emer Finan, a Staff Neonatologist and Assistant Professor in the Department of Paediatrics at the University of Toronto, in conjunction with PedsCases and the Canadian Paediatrics Society (CPS). The original podcast was developed by Chloe Joynt and Colin Siu from the University of Alberta and has been updated to reflect the 7th Edition Neonatal Resuscitation Program, or NRP guidelines released in 2016.¹

This podcast aims to summarize the principles of neonatal resuscitation and is applicable to term newborns and neonates under one month of age. For information on the management of preterm infants, please see the PedsCases podcast entitled “Update for Canadian NRP Providers: A Case-Based Review”. To view the complete CPS Practice Point summarizing the major changes in the 7th Edition NRP guidelines, please visit www.cps.ca. The script for this podcast can be viewed at www.pedscases.com. The material covered in this podcast may change with future revisions of NRP, and we ask that you refer to the guidelines most appropriate for your country of practice.

Case Presentation

Let’s start off by looking at a case. You’re on your Emergency Medicine rotation and a 30-year old woman arrives in active labour at 38 weeks gestation. She gives birth to a baby boy weighing 3 kg. The baby is apneic at birth. What is your approach to managing this newborn?

Introduction

This podcast will focus on the approach to resuscitation of the neonate. The learning objectives of this podcast are as follows:

- 1) To outline an approach to neonatal resuscitation

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- 2) To examine indications for positive pressure ventilation of the neonate
- 3) To describe indications and techniques for delivering chest compressions and use of medications in neonatal resuscitation
- 4) To summarize post-resuscitation care and outline considerations for limiting and/or discontinuing resuscitation

Pre-Delivery Briefing

Preparation for neonatal resuscitation should begin prior to the delivery. A resuscitation team should be assembled, consisting of at least one individual able to provide initial newborn care and positive pressure ventilation, if necessary. As per the 7th edition NRP, if risk factors are present, at least two people should be present to care for the baby. The textbook states that “a qualified team with full resuscitation skills should be identified and immediately available for every resuscitation. The resuscitation team should be present at the time of birth if need for extensive resuscitation measures is anticipated”.

Necessary equipment should be prepared and checked prior to delivery. In addition, pre-delivery briefing is essential to discuss the resuscitation plan, assign team roles, and anticipate potential complications.

Initial Stabilization

When you are presented with a newborn, ask yourself 3 questions:

- (1) Is it a term gestation?
- (2) Does the newborn have good muscle tone?
- (3) Is the newborn crying or breathing effectively?

If the answer is “yes” to all of these 3 questions, no resuscitation is needed. Delayed cord clamping should be performed for at least 30-60 seconds for vigorous term and preterm infants. Then, routine newborn care is provided and the infant is typically placed skin-to-skin with a parent with continued observation. If the answer is “no” to one or more of these questions, resuscitation procedures should be initiated.

Firstly, the baby should be dried, placed under a heat source such as a radiant warmer and have their head tilted back in the “sniffing” position to open the airway. If necessary, suction is provided using a bulb syringe or suction catheter with a negative pressure of 80 to 100 mmHg. The mouth should be suctioned before the nose with avoidance of deep or overly vigorous suction which could elicit a vagal response or cause tissue damage. Suctioning should be reserved for situations where the airway is thought to be obstructed by secretions or positive pressure ventilation is required. Of note, unlike the previous version of NRP, the 7th edition NRP does not recommend ***routine*** endotracheal intubation and suctioning below the cords as initial management for non-vigorous infants born through meconium-stained amniotic fluid.²

The infant should then be dried with subsequent removal of wet linen to avoid hypothermia. If after initial stimulation, the infant is still not effectively breathing, additional stimulation may be provided by rubbing the back or the soles of the feet. Such stimulation should be provided for a brief period; if the infant remains apneic or

has ineffective respirations in spite of these manoeuvres, positive pressure ventilation is required.

Ventilation

If the baby remains apneic, gasping, or the heart rate is below 100 bpm after initial stimulation, positive pressure ventilation, or PPV, should be started immediately. For infants with ineffective respirations or bradycardia, positive pressure ventilation should be started within 60 seconds of birth. The minimum pressure required to achieve adequate chest movement should be used. Inflation pressures should be monitored and an initial inflating pressure of 20-25 cm H₂O is recommended. Assisted ventilation should be given at a rate of 40-60 breaths per minute. The efficacy of ventilation should be assessed after 15 seconds of PPV by evaluating heart rate response.

If an increase in heart rate is not observed and inadequate chest movement is noted, ventilation is ineffective and corrective steps are required. These steps include re-adjusting the mask, re-positioning the airway, suctioning the mouth and then nose, opening the mouth, increasing the pressure or using an alternative airway. The mnemonic, MR. SOPA can help recall these corrective steps. After thirty seconds of effective ventilation the heart rate should be reassessed.

If non-invasive PPV is required for a prolonged period of time or fails to produce adequate chest rise or heart rate response, an alternative airway is indicated.

Alternative airways include endotracheal tubes and laryngeal mask airways; the latter of which may be appropriate for infants >34 weeks gestation and >2 kg if non-invasive PPV or endotracheal intubation are unsuccessful or challenging. If intubation is deemed necessary, the size of uncuffed endotracheal tube, or ETT, can be approximated based on the newborn's estimated weight as follows: infants >2 kg receive size 3.5, infants 1-2 kg receive size 3, and infants <1 kg receive size 2.5. The appropriate depth of ETT insertion can be approximated using gestation-based guidelines or the nasal-tragus measurement (in cm) plus 1 cm. Bilateral chest auscultation and an exhaled carbon dioxide detector should be used to ascertain correct ETT placement, though an increase in heart rate is the best sign that PPV via an endotracheal tube is effective.

Oxygenation

Non-invasive PPV may be supplemented with oxygen and monitored using pre-ductal pulse oximetry using a probe attached to the neonate's right hand or wrist. Pulse oximetry is recommended whenever supplemental oxygen or PPV are required. The recommended initial oxygen concentrations for resuscitation are 21% for term infants and 21-30% for infants <35 weeks gestation. Oxygen concentrations can then be titrated to target minimum pre-ductal oxygen saturations of 60% at 1 minute, 70% at 3 minutes, and 80% at 5 minutes of life. If the neonate's heart rate is less than 60 bpm after optimal ventilation for 30 seconds, the oxygen concentration should be increased to 100% with commencement of chest compressions. An important point is that ventilation has been shown to be the most effective measure in neonatal resuscitation and thus providers should ensure that optimal ventilation has been provided before proceeding to chest compressions.

CPAP

If a neonate is breathing effectively with a heart rate >100 bpm, but is exhibiting signs of respiratory distress or has persistently low oxygen saturations, continuous positive airway pressure, or CPAP can be administered. Positive-end expiratory pressure, or PEEP of 5-8 cm H₂O is suggested. If the neonate does not improve with administration of CPAP, positive pressure ventilation, and/or endotracheal intubation may be required.

Chest Compressions

Less than 1% of neonates requiring resuscitation will require chest compressions, as the vast majority of infants will respond to effective ventilation. The indication for chest compressions is a heart rate <60 bpm after 30 seconds of effective ventilation, ideally through an alternative airway such as an ETT. Heart rate is most rapidly and accurately assessed using continuous electronic cardiac monitoring; however, if unavailable, assessment of heart rate is best achieved using the pulse oximeter or by auscultation. The infant should receive 100% oxygen during chest compressions. The compressor should move to the head of the bed once the airway is secured, to allow access to the abdomen for potential emergency umbilical venous catheter placement.

Compressions should be performed on the lower third of the sternum (just below the nipple level) at a depth of approximately 1/3 of the anterior-posterior diameter of the neonate's chest. Both thumbs should compress the sternum while the other fingers encircle the neonate's body and support the back, allowing the chest to re-expand fully between compressions. The compression to ventilation ratio is 3:1 and each set of 3 compressions to 1 breath should take 2 seconds such that there are 120 "events" per minute. After 60 seconds of chest compressions, the heart rate should be reassessed. Continuous ECG monitoring is the fastest and most accurate method of heart rate monitoring during chest compressions. In the absence of electronic cardiac monitoring, auscultation and pulse oximetry may be used.

Medication Administration

If the heart rate remains below 60 bpm despite adequate ventilation and 60 seconds of chest compressions, administration of epinephrine is indicated. The preferred route of administration is the intravenous route, at a dose of 0.01 mg/kg (equivalent to 0.1 mL/kg of 1:10,000 concentration). This should be followed with a 0.5-1 mL flush of normal saline. As there is often a delay in achieving IV access during resuscitation and an endotracheal tube is often rapidly secured, the first dose of epinephrine may be given via the ETT at a dose of 0.1 mg/kg, equivalent to 1 mL/kg of 1:10,000 concentration (to a maximum of 0.3 mg or 3 mL). Following endotracheal administration, a number of positive pressure breaths should be provided to ensure the drug has been effectively dispersed. If intravenous access is secured shortly after endotracheal administration and the heart rate remains less than 60 bpm, a further dose of epinephrine can be administered intravenously without delay using the IV dosing as outlined. While the most common route of emergency medication administration is the intravenous route (through an emergency umbilical venous catheter placement), the 7th edition NRP also

recommends the intraosseous route as an alternate route for term infants >3 kg. If the heart rate remains less than 60 bpm in spite of aforementioned interventions, alternative etiologies should be considered including hypovolaemia and tension pneumothorax. As per the most recent NRP guidelines, the use of naloxone is not recommended in the management of the infant with respiratory depression following maternal intrapartum administration of narcotics. Ineffective respirations should be managed with positive pressure ventilation as required.

Volume Expansion

Volume expansion is indicated if there is a history suggestive of blood loss and clinical signs such as poor perfusion, pallor and a weak pulse. Normal saline or blood can be given at a dose of 10 mL/kg. If there is no response to an initial bolus of fluid, a further 10 mL/kg can be administered. The 7th edition NRP no longer recommends the use of Ringer's Lactate solution as a crystalloid volume expander. It should be noted that routine administration of volume expansion is not recommended and should be reserved for situations where there are clinical signs of shock, suspicion of blood loss, and the infant is not responding to resuscitative efforts¹.

Post-Resuscitation Care

If the heart rate rises above 60 bpm, chest compressions can be stopped. Positive pressure ventilation can be stopped once the heart rate is above 100 bpm and there is adequate and effective breathing from the neonate. Oxygen supplementation can be weaned once the recommended saturation values are met. After resuscitation, the neonate's heart rate, oxygen saturation, blood pressure, and temperature should be monitored continuously or at regular intervals. Blood glucose should also be closely monitored with administration of intravenous dextrose solution as required. Regulation of temperature and glucose is particularly important for preterm infants <32 weeks gestational age.

Infants born at 36 weeks or greater of gestation and who have clinical evidence of moderate to severe hypoxic-ischemic encephalopathy, according to unit specific guidelines, should be considered for therapeutic hypothermia. Therapeutic hypothermia should be started within 6 hours of birth for patients that meet prescribed criteria for cooling and after discussions with a referral centre which can provide this therapy. After resuscitation, debriefing with the team is essential to discuss aspects of the resuscitation that went well and identify areas for improvement. This is also an opportunity for members of the resuscitation team to provide and receive feedback.

Limiting or Discontinuing Resuscitation

Limiting or discontinuing resuscitation are sensitive issues that always require communication with the parents about the infant's situation and the parents' wishes. Ideally, antenatal counselling should be offered to the family prior to the delivery. Limiting resuscitation may be considered in conditions associated with high morbidity and mortality including extreme prematurity and lethal congenital anomalies. It is important to note that commitments to limiting or providing resuscitation are not

absolute and can be tailored upon assessment of the newborn after birth or following assessment of response to treatment. Most recent guidelines suggest that discontinuation of resuscitation may be considered in situations where the APGAR score is 0 and there is no heart rate auscultated after 10 minutes of resuscitation efforts.³

Case Conclusion

Now, let's take what we have learned and apply it back to our case. Recall that the mother has delivered in the Emergency Department. The boy is term and has poor muscle tone. You call for help and ask for the NICU to be called. You place him under the heat source, position the airway and dry and stimulate the baby. He remains apneic and the heart rate that you auscultate is 60 bpm. You immediately start bag-mask ventilation and ask an assistant to place a saturation probe on his right hand. You begin administering PPV at a rate of 40-60 breaths per minute with pressures of 20/5 cm H₂O in 21% oxygen. As you are providing PPV, you notice that there is insufficient chest rise and the heart rate remains low at 80 bpm. Recalling that most neonatal compromise is due to ventilation difficulties, you remember to use corrective steps through MR. SOPA; you re-adjust the mask placement and reposition the airway in a "sniffing" position. These manoeuvres lead to effective chest rise and a heart rate of 120 bpm with an oxygen saturation of 80% at 3 minutes of life. You check to ensure that the baby is breathing well. He is now crying and has effective respirations at 60 breaths per minute, so you discontinue PPV.

As part of post-resuscitation care, you continue monitoring the infant. His heart rate, breathing, color and saturations are normal for his age. He is able to maintain his temperature as he is held skin-to-skin with his mother. After consultation with the paediatrician and obstetrician, as well as careful consideration of the underlying etiology for the baby's presentation at birth, the baby is monitored for a short period of time. His heart rate and breathing remain normal and he is transferred to the postpartum unit with his mother for further observation for 24 hours.

Summary

Let's end with a few summary notes from what we covered today:

- 1) The approach to neonatal resuscitation in chronological order is as follows: pre-delivery briefing, initial stabilization, followed by ventilation and oxygenation, chest compressions, epinephrine and/or volume expansion, post-resuscitation care, and team debriefing.
- 2) The initial stabilization process involves warming and drying the baby, clearing the airway and providing stimulation if required. This process should take less than one minute.
- 3) For non-vigorous infants born through meconium-stained amniotic fluid, **routine** endotracheal intubation and suctioning below the cords is not recommended. A team with advanced neonatal resuscitation skills should be present given that meconium is a risk factor for abnormal transition.

- 4) Following initial steps, positive pressure ventilation should be started if the heart rate is below 100 bpm or the infant is apneic, gasping or has ineffective breathing. Heart rate should be reassessed after 15 seconds of PPV. If the heart rate does not increase and there is inadequate chest movement, MR. SOPA corrective measures should be used. An alternative airway such as the laryngeal mask airway or endotracheal intubation may facilitate effective ventilation if the other steps of MR. SOPA have not resulted in effective ventilation.
- 5) Recommendations for initial oxygen concentrations are 21% oxygen for term neonates and 21-30% for neonates <35 weeks gestational age. The oxygen concentration should be titrated until target oxygen saturations are achieved.
- 6) Chest compressions should be started if the heart rate remains below 60 bpm after 30 seconds of effective ventilation. An alternative airway should ideally be in place and oxygen should be increased to 100% when chest compressions are initiated. The two-thumb encircling technique should be used with a 3:1 compression to ventilation ratio.
- 7) Epinephrine should be used if the heart rate remains below 60 bpm despite adequate ventilation followed by 60 seconds of chest compressions.
- 8) Volume expansion may be considered if the history is suggestive of volume loss and there are signs of shock. The recommended crystalloid solution is normal saline 10 mL/kg. If there is concern for significant blood loss, packed cells should be considered, and O-negative blood can be administered in emergency situations.
- 9) Post-resuscitation care involves clinical monitoring, maintenance of normothermia, prevention of hypoglycemia, and consideration of therapeutic hypothermia for those with suspected hypoxic ischemic encephalopathy.

This concludes our podcast on the 7th Edition Neonatal Resuscitation Program guidelines. Thank you for listening to this PedsCases podcast.

References

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