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Update for Canadian NRP providers: A case-based review

Developed by Dr. Julia DiLabio and Dr. Emer Finan 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 made in conjunction with PedsCases and the Canadian Paediatrics Society (CPS). It aims to summarize the recently published 2017 CPS Practice Point outlining the updated Neonatal Resuscitation Program (NRP) guidelines for Canadian providers. The podcast was developed with Dr. Emer Finan, a Staff Neonatologist and Assistant Professor in the Department of Paediatrics at the University of Toronto. Dr. Finan is the lead author of the CPS Practice Point that we will be reviewing today. For additional information and to view the complete CPS Practice Point, please visit www.cps.ca. The script for this podcast can be viewed at www.pedscases.com. For a detailed review of neonatal resuscitation, please listen to the two-part PedsCases NRP podcast.

Objectives

The goal of this podcast is to review the major changes to the 7th edition Neonatal Resuscitation Program guidelines released in 2016 and recently summarized in the 2017 CPS Practice Point. The 7th Edition NRP guidelines were informed by the evidence-based review conducted by the Neonatal Task Force of the International Liaison Committee on Resuscitation (ILCOR). Using a case-based approach we will focus on:

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- (1) The management of the non-vigorous infant born through meconium-stained amniotic fluid,
- (2) The management of the preterm infant born <32 weeks gestational age, and
- (3) Recommendations for the delivery of resuscitation training along with strategies to optimize ongoing learning for NRP providers

First Case Presentation

Let's begin with a clinical vignette. You are called to attend the delivery of a 39 week gestational age infant. Meconium-stained amniotic fluid is present during labour and the infant is non-vigorous at birth. How do you proceed with the resuscitation?

Approach to the Resuscitation of a Non-Vigorous Term Infant with Meconium-Stained Amniotic Fluid

As with any neonatal resuscitation, preparation begins before the delivery. The resuscitation team should consist of at least two individuals with NRP training, at least one of whom should have airway and vascular access skills. All necessary equipment should be prepared and checked prior to delivery. Pre-delivery briefing (aka the “huddle”) is essential to discuss the resuscitation plan, assign team roles, and anticipate potential complications. The 7th edition NRP emphasises the importance of team preparedness, communication, and leadership skills.

When the infant is born, initial questions to guide your resuscitation remain unchanged, these being:

- (1) Is the infant term?
- (2) Does the infant have good tone?
- (3) Is the infant breathing or crying?

As previously mentioned in this case, your assessment reveals that the infant is term, has poor tone, and is apneic. You recall that meconium is a risk factor for abnormal neonatal transition. This case highlights one of the major changes in the 7th Edition NRP

guidelines. **Routine** endotracheal intubation and suctioning below the cords is no longer recommended as the initial management of the non-vigorous infant born through meconium-stained amniotic fluid. The rationale for this change is to prioritize the administration of effective ventilation and avoid possible harm by delaying this step with attempted endotracheal intubation.

Initial steps of resuscitation comprise the provision of warmth along with drying, oral and nasal suction if necessary, and stimulation as required. If these steps fail to result in establishment of spontaneous respirations and the infant remains apneic, gasping, or the heart rate is below 100 bpm, positive-pressure ventilation, or PPV, should be administered. For the term infant, the recommended oxygen concentration for initiation of resuscitation is 21%. Seventh edition NRP recommends that the efficacy of ventilation is assessed after 15 seconds of PPV by evaluating heart rate response. If the heart rate is not increasing and chest movement is not seen, then ventilation is ineffective and corrective steps are required. The corrective steps comprise mask readjustment, repositioning the head into the “sniffing” position, suctioning the nose and mouth, opening the mouth including jaw thrust, increasing pressures, and finally considering an alternate airway such as endotracheal intubation. The mnemonic, MR. SOPA can help recall these corrective steps. After thirty seconds of effective ventilation the heart rate should be reassessed. In the event that thick meconium is thought to have obstructed the airway and the infant is intubated, the endotracheal tube can also be suctioned using a suction catheter or a meconium aspirator.

In this case, you dry and stimulate the infant on the radiant warmer. Despite this, the baby remains apneic and limp. You provide 30 seconds of effective PPV with an oxygen concentration of 21% using pressures of 20/5 cm H₂O and the infant establishes regular respirations. The heart rate is auscultated as >100 bpm and the pre-ductal oxygen saturation is within target range. You discontinue PPV and continue to observe the infant. You debrief with the team to discuss the successful resuscitation of the non-vigorous term infant born through meconium-stained amniotic fluid. You identify which aspects of the resuscitation went well and areas for improvement.

Second Case Presentation

Let's discuss a second case. You are called to attend the delivery of a preterm infant at 27 weeks gestational age. The history does not reveal any risk factors for sepsis. What are the unique considerations in the approach to the resuscitation of the preterm infant?

Approach to the Resuscitation of a Preterm Infant <32 Weeks Gestational Age

Similar to the previous case, briefing (aka the “huddle”) should occur prior to delivery in order to review key aspects of the resuscitation and ensure team preparedness and appropriate role assignment. In the case of a pending preterm delivery, discussion should occur with obstetric colleagues in regard to delayed cord clamping. Neonatal antenatal counselling should ideally be offered to the family. Extremely preterm infants should ideally be delivered in a tertiary neonatal centre, but this is not always the case. Briefing, role assignment, and preparation of equipment should take place as with the previous case. For infants <32 weeks gestational age, supplies should be prepared to assist with thermoregulation, including polyethylene wrap or a specialized plastic bag.

If the preterm neonate is vigorous at birth, delayed cord clamping should be performed for 30-60 seconds. If the infant is non-vigorous at birth, the current recommendation is that the cord should be clamped and resuscitation commenced as per NRP guidelines. For preterm infants, emphasis is placed on maintenance of normothermia (36.5°C to 37.5°C). This may be achieved by setting an environmental temperature of 23°C to 25°C along with other interventions, such as placing the infant, without drying, in polyethylene wrap, using a preheated radiant warmer and monitoring skin temperature with a servo-controlled sensor to target normothermia. Thermal mattresses may also be used.

A team member should be assigned to place the saturation probe on the right wrist, attach the servocontrol temperature probe and ensure that the baby is placed in plastic wrap. If the preterm infant is vigorous at birth and breathing spontaneously with an adequate respiratory rate but with some respiratory distress, continuous positive airway

pressure (or CPAP) may be used. Based on available evidence, positive end expiratory pressure, or PEEP of 5-8 cm H₂O is suggested. The most recent ILCOR and NRP guidelines recommend resuscitation with an initial oxygen concentration of 21-30% for infants born <35 weeks gestational age. Avoidance of high initial oxygen concentrations may prevent oxygen toxicity. The oxygen concentration is then titrated to target pre-ductal oxygen saturation levels with ongoing monitoring of the infant's respiratory status.

In the event that the preterm neonate has apnea, ineffective respirations, or a heart rate below 100 bpm, PPV should be initiated with the aforementioned initial oxygen concentration. When PPV is required, the use of PEEP is recommended. The heart rate is then reassessed after 15 seconds of ventilation, with corrective steps taken if necessary, following the MR. SOPA mnemonic. If the heart rate is below 60 bpm after 30 seconds of effective ventilation, chest compressions should be initiated. Ideally, endotracheal intubation should be performed prior to initiation of chest compressions. The appropriate depth of endotracheal tube (ETT) insertion can be approximated using gestation-based guidelines or the nasal-tragus measurement (in cm) plus 1 cm. Endotracheal intubation may also be required if, following effective mask ventilation, the infant remains apneic, has ineffective respirations, or has respiratory distress necessitating the administration of surfactant. Ongoing monitoring of respiratory support is essential.

As previously mentioned, the indication for chest compressions remains unchanged, this being heart rate <60 bpm after 30 seconds of effective ventilation. The baby should receive 100% oxygen while receiving chest compressions. The ratio of compressions to ventilation remains 3:1. The updated NRP guidelines recommend the two-thumb encircling technique for chest compressions due to improved depth and consistency of compressions with less provider fatigue compared to the two-finger technique. The compressor moves to the head of the bed once the airway is secured, to allow access to the abdomen for potential emergency umbilical venous catheter placement. After 60 seconds of chest compressions, the heart rate should be reassessed. Electronic cardiac monitoring is the fastest and most accurate form of heart rate monitoring during chest

compressions. In the absence of electronic cardiac monitoring, auscultation and pulse oximetry may be used.

The indication for epinephrine is a heart rate less than 60 bpm despite effective ventilation and 60 seconds of chest compressions. The dose remains unchanged, that being 0.01 mg/kg intravenously (IV) or through an umbilical venous catheter (UV) or 0.1 mg/kg via ETT with a maximum dose of 0.3 mg (3 ml) by ETT. These doses are equivalent to 0.1 ml/kg IV or UV and 1 ml/kg by ETT of 1:10,000 concentration of epinephrine. If fluid resuscitation is required, normal saline should be used, as Ringer's lactate is no longer recommended as a fluid expander. The use of sodium bicarbonate during resuscitation is also no longer recommended.

In this case, this 27 week gestational age infant is born by caesarean section for maternal indications and is vigorous at birth. Delayed cord clamping is performed for 60 seconds. The infant requires minimal respiratory support and is transported to the NICU on CPAP and low oxygen concentration. After following up with the parents, you sit with your team to review the resuscitation and team performance. Overall, optimal resuscitation of preterm infants requires effective communication among obstetric and pediatric care providers, team preparation, and effective team communication and performance. Team-based training through simulation activities can optimise team function.

Reflecting on Provider Education and Training

This leads to our last topic of discussion – the delivery of resuscitation training and retention of skills. The recent ILCOR review found that retention of skills and effectiveness of performance decline over time after initial training. Neonatal Resuscitation Program training should be completed by neonatal care providers at a minimum frequency of every 2 years. Latest ILCOR guidelines recommend more frequent ongoing learning; however, the optimal timing and type of resuscitation skills training has not been well established for different types of learners. It has been proposed that frequent training should be completed based on individual learner needs.

In terms of the method of ongoing training, case-based scenarios can be very beneficial. Training should include the following 3 elements: (1) briefing or identifying the task objectives, (2) practice performing the required task, and (3) reflection or debriefing. Neonatal resuscitation training should involve an element of realism related to the complexity of the task, ranging from heart rate response for bag-mask ventilation training to high-fidelity simulations for complex resuscitations. Organizations should facilitate ongoing learning by encouraging repeated, frequent, deliberate practice to reinforce psychomotor skills, achieve expertise, and retain proficiency. An example of this type of skills training would be delivering bag-mask ventilation while incorporating corrective steps to achieve appropriate heart rate and saturation response. Mock codes and other simulation exercises with multiple members of the interprofessional team can be very helpful for non-technical skills and teamwork training. Finally, training should involve briefing and debriefing with reflection to optimize learning and retention of skills.

Summary

We will close with ten take-home points highlighting the key updates from the 7th edition Neonatal Resuscitation Program guidelines and ILCOR review:

- (1) An emphasis has been placed on pre-delivery briefing (aka the “huddle”), with a focus on communication, teamwork, and leadership skills.
- (2) For vigorous term and preterm infants, delayed cord clamping for 30 to 60 seconds is recommended.
- (3) For non-vigorous infants born through meconium-stained amniotic fluid, ***routine*** endotracheal intubation for suctioning below the cords is no longer recommended. Resuscitation comprises initial steps followed by PPV as per recommendations for infants born without the presence of meconium stained amniotic fluid. A team with advanced neonatal resuscitation skills should be present, however, given that meconium is a risk factor for abnormal transition.

- (4) Initial resuscitation gas for the term infant remains 21% oxygen and 21-30% oxygen is recommended for initial resuscitation of preterm infants born <35 weeks gestational age.
- (5) Heart rate should be assessed after 15 seconds of PPV. If heart rate is not increasing and chest rise is not seen, ventilation is ineffective. Corrective steps should be taken using the mnemonic MR. SOPA to improve the effectiveness of PPV. Heart rate should be reassessed after 30 seconds of effective ventilation.
- (6) Effective ventilation for 30 seconds through an alternate airway should ideally precede chest compressions. Chest compressions should be administered using the two-thumb encircling technique with a 3:1 compression to ventilation ratio. The heart rate should be reassessed after 60 seconds of compressions. Continuous ECG monitoring is the fastest and most effective method of heart rate assessment when administering compressions. In the absence of electronic cardiac monitoring, auscultation or pulse oximetry can be used.
- (7) For preterm infants <32 weeks gestational age, emphasis is placed on promoting normothermia during resuscitation. A combination of methods including environmental temperature, polyethylene wrap and thermal mattress can be used.
- (8) Initial use of CPAP is recommended for preterm infants who are spontaneously breathing but have respiratory distress. If PPV is required, the use of PEEP is recommended for preterm infants.
- (9) If fluid resuscitation is required, Ringer's lactate is no longer recommended as a volume expander. The use of naloxone for infants with respiratory depression secondary to maternal narcotic administration and the use of sodium bicarbonate during resuscitation are no longer recommended.
- (10) Formal NRP training should be completed at a minimum of every 2 years. Ongoing learning is recommended but the precise type and timing of training depends on the learner and their specific needs. Frequent training focused on specific objectives and combining practical skills training with simulation and debriefing is suggested to optimize learning and retention of skills.

Conclusion

This concludes our podcast on the updated 7th Edition Neonatal Resuscitation Program guidelines, brought to you by PedsCases and the Canadian Pediatric Society. We would like to thank the co-authors of the CPS Practice Point, Drs. McNamara, Campbell and Aziz for their thoughtful review and feedback. Thank you for listening to this PedsCases podcast.

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