

## PedsCases Podcast Scripts

This is a text version of a podcast from PedsCases.com on “Neonatal Resuscitation Part 1.” 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.pedcases.com/podcasts](http://www.pedcases.com/podcasts).

### **Neonatal Resuscitation Part 1**

Developed by Colin Siu and Dr. Chloe Joynt for PedsCases.com.  
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Hi everyone, my name is Colin Siu and I’m a medical student at the University of Alberta. This podcast was developed with Dr. Chloe Joynt, a Neonatologist and Associate Professor at the University of Alberta and Stollery Children’s Hospital in Edmonton, Alberta, Canada. This PedsCases podcast will go over the principles of neonatal resuscitation for the term baby. Information covered in this podcast is applicable to newborn and neonates up to a few weeks old. This podcast is part one of a two-part series that focuses on neonatal resuscitation; the first podcast will go over initial resuscitation processes while the second podcast will go over more complex resuscitation procedures. The material presented in these podcasts is based on the Neonatal Resuscitation Program, otherwise known as NRP from the American Heart Association which is modified for Canadian practitioners by the Canadian NRP Steering Committee to reflect a Canadian review of the evidence and practice. The latest revisions by the AHA were published in 2015 and the Canadian revisions will be out in 2016. The material covered in these podcasts may change with the near future revisions of the NRP, and we ask that you refer to the guidelines most appropriate for your country of practice.

#### Case

Let’s start off by looking at a case. You are a medical student on an Emergency Medicine rotation and a 16-year-old female at 37 weeks gestation arrives in a precipitous labour. No meconium-staining is noted on the amniotic fluid. On arrival she is already fully dilated and it is clear that there is no time to transfer her to a labour and delivery unit. She gives birth to a baby boy, with a 3000g birthweight. The baby does not cry at birth, and is taken by the nurse to a warmer. What is your approach to managing this newborn?

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

- 1) Outline an approach to preparing for neonatal resuscitation.
- 2) Go over the basics of the NRP algorithm
- 3) Review indications for positive pressure ventilation of the neonate

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#### 4) Cover MR SOPA techniques in promoting effective ventilations

##### Preparing for Resuscitation

Without further ado, let's jump right into it! We will begin by going over what risk factors would increase the likelihood of requiring neonatal resuscitation. Antepartum risk factors which are associated with an increased need for neonatal resuscitation include maternal conditions such as diabetes, hypertension, infection, bleeding in the second or third trimester, polyhydramnios, oligohydramnios, premature rupture of membranes, multiple gestation, substance abuse, and diminished fetal activity. Intrapartum risk factors include instrument-assisted delivery, abnormal presentation, premature labour, chorioamnionitis, prolonged rupture of membranes, use of general anesthesia, narcotics given to the mother within 4 hours of delivery, meconium-stained amniotic fluid, and placenta previa. If any of these risk factors are present, gather other health care professionals in preparation for neonatal resuscitation and prepare all necessary equipment.

Let's look at all the equipment that we need to prepare for resuscitation starting off with equipment needed for initial resuscitation and going on to equipment for more complex resuscitation. First, preheat the overhead infant warmer by ensuring it is plugged in, turned on and the heating function is turned up to generate sufficient heat. Gather pre-warmed towels and blankets. Next, secure the suction catheter to the suction tubing which in turn should be attached to the wall or unit suction canister. Turn on the suction and set it at the "continuous" setting. Check that the suction catheter and suction equipment is functioning by pinching the suction tubing. When kinked or occluded, the suction reading monometer should read 80-110 mm Hg. Adjust the suction if needed. Have the meconium aspirator available. Then, turn on the oxygen flowmeter to 5 to 10 litres per minute, have the oxygen blender at 21% oxygen. This oxygen/ medical air will be used for your positive pressure ventilation device so ensure that your PPV device is connected accordingly. Ensure that the PPV device, (T-piece resuscitator, self-inflating or flow inflating bag) and different sized facemasks (0 and 1) are available. Confirm that the PPV bag inflates properly or that the T piece is generating appropriate pressures. Following this, gather a laryngoscope, stylet, laryngoscope blades (straight blade size 0 and 1), endotracheal tubes (sizes 3.5 for a term infant but ranges from 2.5-4), end tidal carbon dioxide detectors and laryngeal mask airways in preparation for possible intubation. Ensure you have a saturation probe and saturation machine available. Lastly, make sure that 1:10,000 concentration epinephrine and the supplies for giving the epinephrine and establishing an umbilical venous catheter are available. It is a good idea to familiarize yourself with the location of resuscitation equipment prior to a resuscitation event.

##### Apgar Scores

The Apgar score is a way of quantifying how the newborn is doing but often resuscitation occurs before the 1-minute mark at which the first Apgar score is taken. The Apgar scores at 1- and 5-minutes should still be recorded during your resuscitation

though the scores should not be considered in any resuscitation decisions. The APGAR scores will also change based on what resuscitative procedures are being performed for the baby at the 1 and 5 minute marks and thus careful recording of what is being done at these times is important. For more detailed information about APGAR scoring, please refer to the PedCases podcast on the APGAR Scoring System.

### Initial Stabilization

Now, let's go onto the actual neonatal resuscitation event. When you are presented with a newborn, the initial steps in NRP are to ask yourself 3 questions. Is it a term gestation? Does the newborn have good muscle tone? Is the newborn crying or breathing effectively? This can be summarized as the 3 M's: maturity, moving air and muscle tone. If the answer is yes to all of these 3 questions, no resuscitation is needed, and the baby can simply be placed on mom or dad's chest for continued observations. If the answer is no to one or more of these questions, initial resuscitation procedures should be initiated.

If the baby needs active resuscitation, the baby should immediately be brought to a warmer for further care. All babies are susceptible to heat loss and ensuring adequate heat sources while minimizing loss is important by putting the uncovered baby in a warmer. If the baby is anticipated to be on the warmer for more than 10 minutes, temperature monitoring is recommended.

First, the baby should be actively stimulated. This means drying the baby by rubbing their back gently or flicking the soles of their feet to stimulate breathing. Tilt the head back into a sniffing position to open the airway and look for any signs of obstruction; you may opt to slip a rolled blanket under the baby's shoulders to maintain the airway in this position. If necessary, suction the airway with a bulb syringe or a suction catheter. Turn the baby's head to the side so that secretions gather within the cheek and suction the mouth before the nose – remember "M" is before "N" in the alphabet. Remember to occlude the suction catheter side hole in order to create a vacuum within the suction catheter and, if using a bulb suction instead, to deflate the bulb of a bulb syringe prior to insertion into the oronasal passages as it is the action of the bulb reinflating that creates the suction. Deflating it in the oronasal passage may blow the secretions further into the airway instead of sucking them out.

Drying and stimulation should be done with concurrent checking of the heart rate. The heart rate is best obtained by auscultating in the precordium for 6 seconds or feeling for pulsations at the base of the umbilical cord. If available, a 3-lead ECG may be used to assess the heart rate. There should also be a concurrent effort to assess for effective breathing by the baby.

### Meconium-Stained Amniotic Fluid

Distressed neonates may pass their meconium, the thick black first stool of newborns, during or just prior to delivery leading to meconium-stained amniotic fluid. This can lead

to a form of neonatal respiratory distress called meconium aspiration syndrome. There has been controversy over the optimal resuscitation for these neonate; the 2015 American Heart Association guidelines have stated that “there is insufficient evidence to suggest routine tracheal intubation for suctioning in meconium-stained infants with low heart rate, tone and respiratory effort as opposed to no tracheal intubation for suctioning” (AHA, NRP Guidelines 2015). The Canadian NRP position has not yet been published and will be available in 2016. Currently, the recommendation is still to suction below the cords with an endotracheal tube and meconium aspirator prior to stimulation of said baby if the baby is born through meconium and does not have respiratory effort, with poor tone and a low heart rate.

### Ventilations

If after stimulation and suction, a neonate’s heart rate is above 100 and the baby is breathing spontaneously, but they are exhibiting signs of respiratory distress such as laboured breathing or persistent cyanosis, CPAP, or continuous positive airway pressure can be administered. If CPAP is going to be applied, a pulse oximetry probe should be placed on the baby to determine the oxygen saturation. If the neonate does not improve on CPAP, oxygen, positive pressure ventilation and/or intubation should be considered.

On the other hand, if after stimulation and suctioning, the baby is apneic, gasping, has laboured breathing and is demonstrating ineffective respirations or a heart rate less than 100 beats per minute is present, you should start effective positive pressure ventilation immediately. It is essential that effective positive pressure ventilation is started if the baby has not responded to stimulation within 30 seconds. Once you embark on resuscitation that requires anything more than stimulation and drying, you should attach an oxygen saturation probe to the right wrist of the baby to help guide and monitor resuscitation. A quicker signal can be obtained by attaching the probe to the baby before connecting it to the pulse oximetry machine.

There are three main devices to deliver positive pressure ventilation: T-piece resuscitation, flow-inflating bag and self-inflating bag. Some centers use a T piece resuscitator as it eliminates the variability of pressures delivered with a flow inflating or self-inflating bagger. Prior to participating in resuscitations, it is helpful to check what method your hospital uses so that you have time to practice and become comfortable with the delivery of PPV. It is also important to choose the right size of mask – the mask should be placed on the chin, cover the mouth and nose but not the eyes, and small enough to allow for an effective seal. To create an effective seal, lightly press down on the rim of the mask and gently hold the mandible up to the mask, be sure to not accidentally overly flex or overly extend the neck which may close the airway or to rest your hand on the baby’s eyes.

The minimal inflation pressure required to achieve an increase in heart rate should be used. In general, for PPV the rule of thumb is to start at 20 mmHg of water for an inflation pressure (known as PIP, or positive inspiratory pressure), with 5 mmHg of

water for an end expiratory pressure (known as PEEP, or positive end expiratory pressure). PPV should be given at a rate of 40-60 breaths per minute.

An increase in heart rate is the key sign that PPV is effectively improving oxygenation. If an increase in heart rate is not observed, assess for effective ventilation by auscultating the chest for breath sounds and looking for chest movement with ventilations. If none of these are present, a series of adjustments should be made sequentially to promote effective PPV before moving on to consider an alternative airway, such as intubation. These adjustments can be remembered with the mnemonic MR. SOPA.

- M – Mask readjustment and ensure an effective seal
- R – Reposition the airway into the sniffing position
- S – Suction the mouth or nose for secretions
- O – Open the mouth slightly during ventilation
- P – Pressure increase. Gradually increase the positive pressure of ventilation every few breaths
- A – Alternative airways

If PPV has been ineffective in raising the heart rate and other MR SOPA techniques have been attempted, an alternative airway can be considered. Alternative airways include intubation with an endotracheal tube or a laryngeal mask airway. Endotracheal intubation is indicated if bag-mask ventilation is prolonged or ineffective and can be considered when CPR is being initiated – which should occur only after you have ensured adequate ventilation. There are several useful indicators that an endotracheal tube is correctly placed with the recommended being the use of an end-tidal carbon dioxide detector. However, the most useful sign is an increase in heart rate and saturations with ventilation. For newborns more than 34 weeks gestation, a laryngeal mask airway can be considered if face-mask ventilation or endotracheal intubation is unsuccessful, difficult, or the operator is inexperienced in intubation and PPV with a bagger is not effective.

If you anticipate requiring positive pressure ventilation for more than a few minutes, consider placing an orogastric tube to prevent abdominal distension and aspiration of gastric contents. An orogastric tube can be used to suction gastric contents and left in place to vent gas out of the abdomen throughout the PPV process.

### Oxygenation

Resuscitations of term neonates should be initiated using room air or an FiO<sub>2</sub> of 21%. For quite premature infants, the current recommendation is to start resuscitation between 21-100%; thus many institutions will start around 40% for quite preterm infants.

Supplemental oxygen therapy is required when the baby's saturation remain below target levels for minute of life. Oxygen can be given via an oxygen mask over the baby's face, a mask from a flow-inflating bag or T-piece resuscitator, or oxygen tubing held close to the baby's face. Then, oxygen concentration should be titrated to reach the

recommended oxygenation values for either term or preterm neonates. To remember the values for term neonates, just remember that the recommended value is 60-65% oxygen saturation at 1 minute (ie 60% at 60 seconds) after birth and then simply add 5% for each additional minute up to 5 minutes after birth, after which the saturation remains stable at 85- 95% up to 10 minutes after birth. Therefore, the recommended values are 60-65% oxygen saturation at 1 minute after birth, 65-70% at 2 minutes, 70-75% at 3 minutes, 75-80% at 4 minutes, 80-85% at 5 minutes and 85-95% at 10 minutes. Ventilation has been shown to be the most effective measure in neonatal resuscitation and thus rescuers should ensure that optimal ventilation and appropriate oxygenation has been given (remember MR SOPA) before proceeding on to chest compressions. If the neonate's heart rate is less than 60 beats per minute after optimal ventilation and supplemental oxygen has been given (not waiting for more than 30 second), increase oxygen concentration to 100% and start chest compressions.

### Case Conclusion

Now, let's take what we have learned and apply it back to our case. So remember, that we have had our mother deliver in the Emergency Department. The newborn is term and has poor muscle tone. Remembering your neonatal resuscitation protocols, you jump into action. You call for help and ask for NICU to be called. You note that there is NO meconium at delivery. You dry the baby, place him under a heat source, clear his airway and attempt to stimulate breathing by rubbing his back. He remains apneic and the heart rate on auscultation is 40 beats per minute. You immediately start positive pressure ventilation and put a saturation probe on his right hand. You begin assisted ventilation for the neonate at a rate of approximately 40-60 breaths / minute at 21% oxygen saturation. As you are providing positive pressure ventilation, you note that the HR is 60 . The O2 sats are 60% which is appropriate at 1 minute of life; however, the low heart rate is concerning. Remembering that most neonatal compromise is due to ventilation difficulties, you remember to use MR. SOPA. You re-adjust the mask, repositioning the airway by putting the baby in a sniffing position, suction the airway, and open the mouth. Finally, with these maneuvers, you are able to increase the heart rate to 105 beats per minute with an oxygen saturation of 78%, thus avoiding the need to intubate. You check to ensure that the baby is breathing well. He is now crying well and breathing at 60 breaths per minute. He has good tone and you note that he is starting to pink up. You stop as oxygen saturation is 90% at 5 minutes. As part of post-resuscitation care, you continue monitoring the child's vital signs, and temperature.

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

- 1) Prior to delivery, identify any risk factors that may place the delivery at a higher risk for requiring neonatal resuscitation. Next, prepare all necessary equipment for resuscitation including adequate personnel and a warmer or warm blankets if a warmer is not available.
- 2) When the baby is born, you want to ask and check that the baby is breathing and has good tone and check the baby's gestational age.

- 3) The initial stabilization process involves drying and warming the baby, clearing the airway and stimulating breathing while checking the HR and looking for effective breathing. This process should take less than 30 seconds.
- 4) Positive pressure ventilation should be started immediately if heart rate is below 100 beats per minute or the patient is apneic, gasping or having ineffective breathing. If attempts to ventilate do not increase the heart rate or appear to be ineffective, MR. SOPA should be used to trouble shoot the ventilation technique. Alternative airways including laryngeal masks and endotracheal tubes may facilitate effective ventilation if the other steps of MR. SOPA do not assist in effective ventilation.
- 5) 5) Start at 21% oxygen supplementation for all term neonates. Titrate the oxygen concentration judiciously if recommended oxygen saturation values are not reached.

This marks the end of our first podcast on neonatal resuscitation, thanks for listening! Stay tuned for our second podcast on neonatal resuscitation which will focus on more complex procedures including intubation, chest compressions, medical management and post-resuscitation care.

### References

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