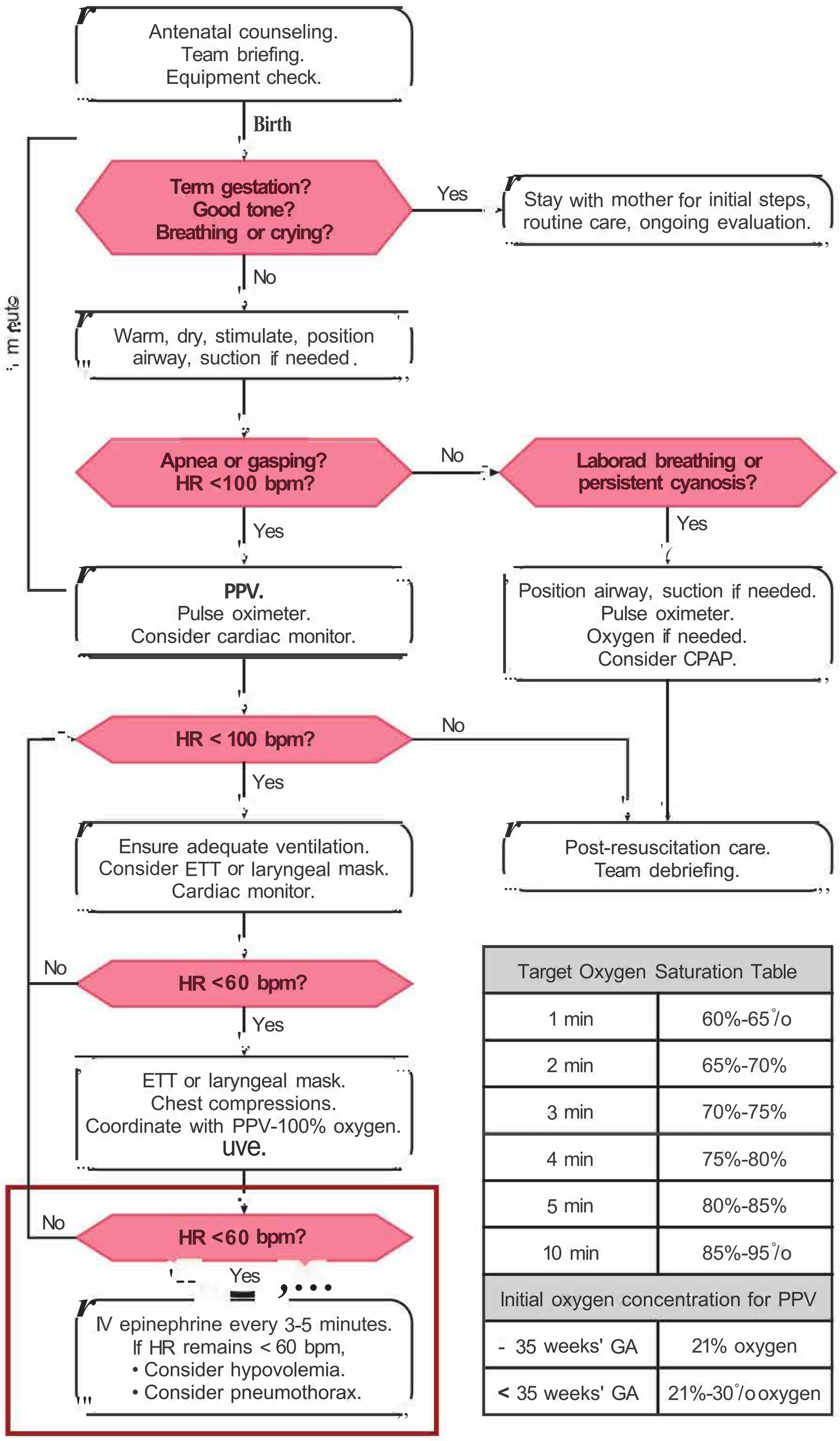
7

Medications

What you will learn

- When to give epinephrine during resuscitation
- How to administer epinephrine
- When to give a volume expander during resuscitation
- How to administer a volume expander
- What to do if the baby is not improving after giving intravenous epinephrine and volume expander
- How to insertan emergency umbilical venous catheter
- How to insertan intraosseous needle



Target Oxygen Saturation Table	
1 min	60%-65%
2 min	65%-70%
3 min	70%-75%
4 min	75%-80%
5 min	80%-85%
10 min	85%-95%
Initial oxygen concentration for PPV	
- 35 weeks' GA	21% oxygen
< 35 weeks' GA	21%-30% oxygen

Key Points

O Epinephrine is indicated if the baby's heart rate remains **less than 60 beats per minute (bpm)** after:

a. At least 30 seconds of positive-pressure ventilation (PPV) that inflates the lungs as evidenced by chest movement **and**

b. Another 60 seconds of chest compressions coordinated with PPV using 100% oxygen.

c. In most cases, ventilation should have been provided through a properly inserted endotracheal tube or laryngeal mask.

8 Epinephrine is not indicated before you have established ventilation that effectively inflates the lungs, as evidenced by chest movement.

E) Epinephrine recommendations

a. Concentration: 0.1 mg/mL = 1 mg/10 mL

b. Route: Intravenous *(preferred)* or intraosseous

i. The central venous circulation may be rapidly accessed using either an umbilical venous catheter or an intraosseous needle. Por babies requiring vascular access at the time of delivery, the umbilical vein is recommended.

ii. One endotracheal <lose may be considered while vascular access is being established.

c. Preparation:

i. Intravenous or Intraosseous: 1-mL syringe (labeled *Epinephrine-IV)*

ii. Endotracheal: 3- to 5-mL syringe (labeled *Epinephrine-ET ONLY)*

d. Dose:

i. Intravenous or intraosseous = 0.02 mg/kg (equal to 0.2 mL/kg)

a. May repeat every 3 to 5 minutes

b. Range = 0.01 to 0.03 mg/kg (equal to 0.1 to 0.3 mL/kg)

c. Rate: *Rapidly-as* quickly as possible

d. Flush: Follow intravenous or intraosseous <lose with a 3-mL saline flush

ii. Endotracheal = 0.1 mg/kg (equal to 1 mL/kg)

a. Range = 0.05 to 0.1 mg/kg (0.5 to 1 mL/kg)

b. If no response, recommend intravenous or intraosseous for subsequent doses

- Administration of a volume expander is indicated if the baby is not responding to the steps of resuscitation **and** there are signs of shock or a history of acute blood loss.

- Volume expansion recommendations

a. Solution: Normal saline (NS) or type O Rh-negative blood

b. Route: Intravenous or intraosseous

c. Preparation: 30- to 60-mL syringe (labeled NS or O- blood)

d. Dose: 10 mL/kg

e. Rate: Over 5 to 10 minutes

- If there is a confirmed absence of heart rate after all appropriate steps of resuscitation have been performed, cessation of resuscitation efforts should be discussed with the team and family. A reasonable time frame for considering cessation of resuscitation efforts is around 20 minutes after birth; however, the decision to continue or discontinue should be individualized based on patient and contextual factors.

Case: Resuscitation with positive-pressure ventilation, chest compressions, and medications

Your team is called to attend the birth of a woman at 36 weeks' gestation who arrived complaining of decreased fetal movement and vaginal bleeding. Fetal bradycardia is noted on the monitor. Your resuscitation team quickly assembles in the delivery room, completes a pre-resuscitation team briefing, and prepares supplies and equipment. An endotracheal tube, umbilical venous catheter, epinephrine, and volume replacement are prepared because an extensive resuscitation is anticipated. An emergency cesarean birth is performed and the obstetrician reports bloody amniotic fluid. The umbilical cord is immediately clamped and cut, and a limp, pale baby is handed to the resuscitation team. A team member begins documenting the resuscitation events as they occur.

You perform the initial steps under a radiant warmer; however, the baby remains limp without spontaneous respirations. You begin

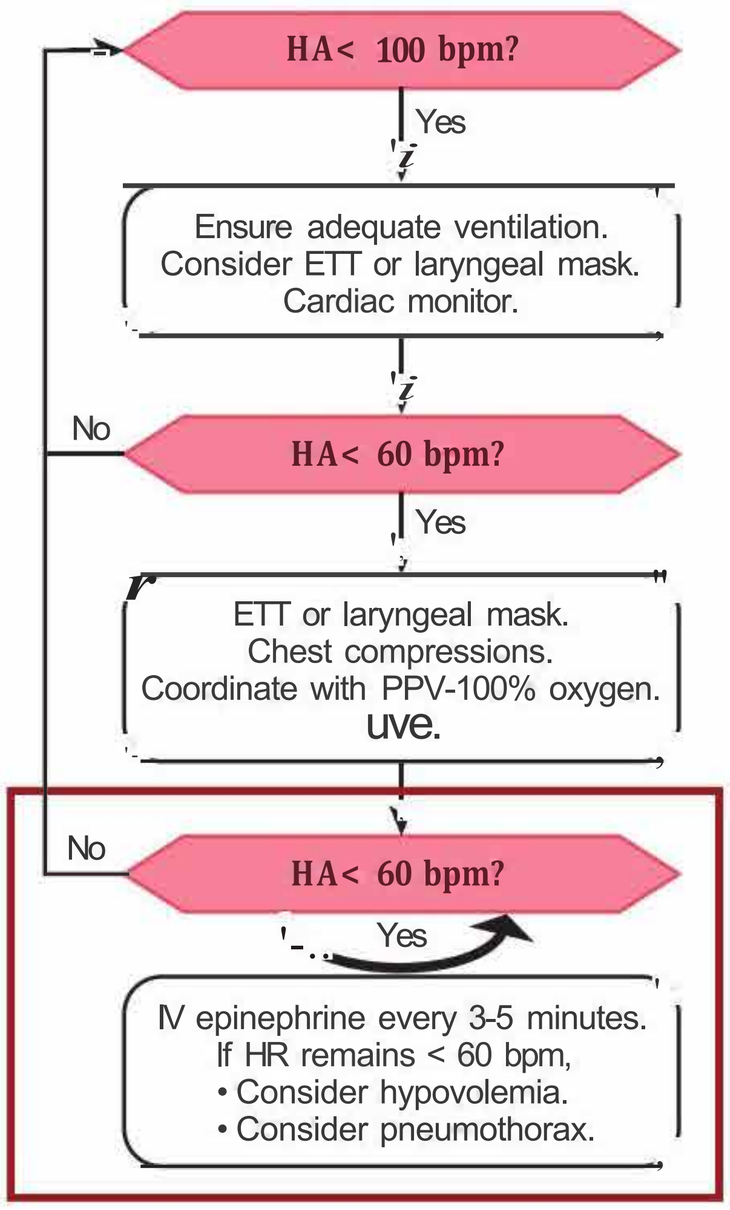
positive-pressure ventilation (PPV) with 21% oxygen, a pulse oximeter sensor is placed on the baby's right hand, and cardiac monitor leads are placed on the chest. The baby's heart rate is 40 beats per minute (bpm) by cardiac monitor and auscultation, but the pulse oximeter does not display a reliable signal. Despite PPV that moves the baby's chest, the heart rate does not improve. The baby is successfully intubated and PPV through the endotracheal tube is continued for 30 seconds, but the heart rate remains 40 bpm. Chest compressions are performed with coordinated PPV using 100% oxygen. A team member confirms the quality of compressions and ventilation, but, after 60 seconds, the baby's heart rate has slowed to 30 bpm.

One team member quickly inserts an umbilical venous catheter and another administers epinephrine and a saline flush through the catheter. Ventilation and compressions are continued, and, 1 minute later, the baby's heart rate has increased to greater than 60 bpm. Chest compressions are stopped. As the heart rate continues to increase, the pulse oximeter begins to detect a reliable signal and shows oxygen saturation 70% and rising. Assisted ventilation continues and the oxygen concentration is adjusted to maintain the baby's oxygen saturation within the target range. By 1Ominutes after birth, the baby makes an initial gasp. The baby is transferred to the nursery for post-resuscitation care. Shortly afterward, your team members conduct a debriefing to discuss their preparation, teamwork, and communication.

A very small number of newborns will require emergency medication.

Most newborns requiring resuscitation will improve without emergency medications. Before administering medications, you should ensure the accuracy of your heart rate assessment and check the effectiveness of ventilation and compressions. In most cases, you should have inserted an endotracheal tube or a laryngeal mask to improve the efficacy of ventilation.

Despite inflating the lungs and augmenting cardiac output with chest compressions, a very small number of newborns (approximately 1 per 1,000 newborns) will still have a heart rate less than 60 bpm. This occurs when blood flow into the coronary arteries is severely decreased, resulting in such low oxygen delivery to the newborn's heart that it cannot contract effectively. These newborns should receive epinephrine to improve coronary artery perfusion and oxygen delivery (Figure 7.1). Newborns with shock from acute blood loss (eg, bleeding vasa previa, fetal trauma, cord disruption, severe cord compression) may also require emergency volume expansion.



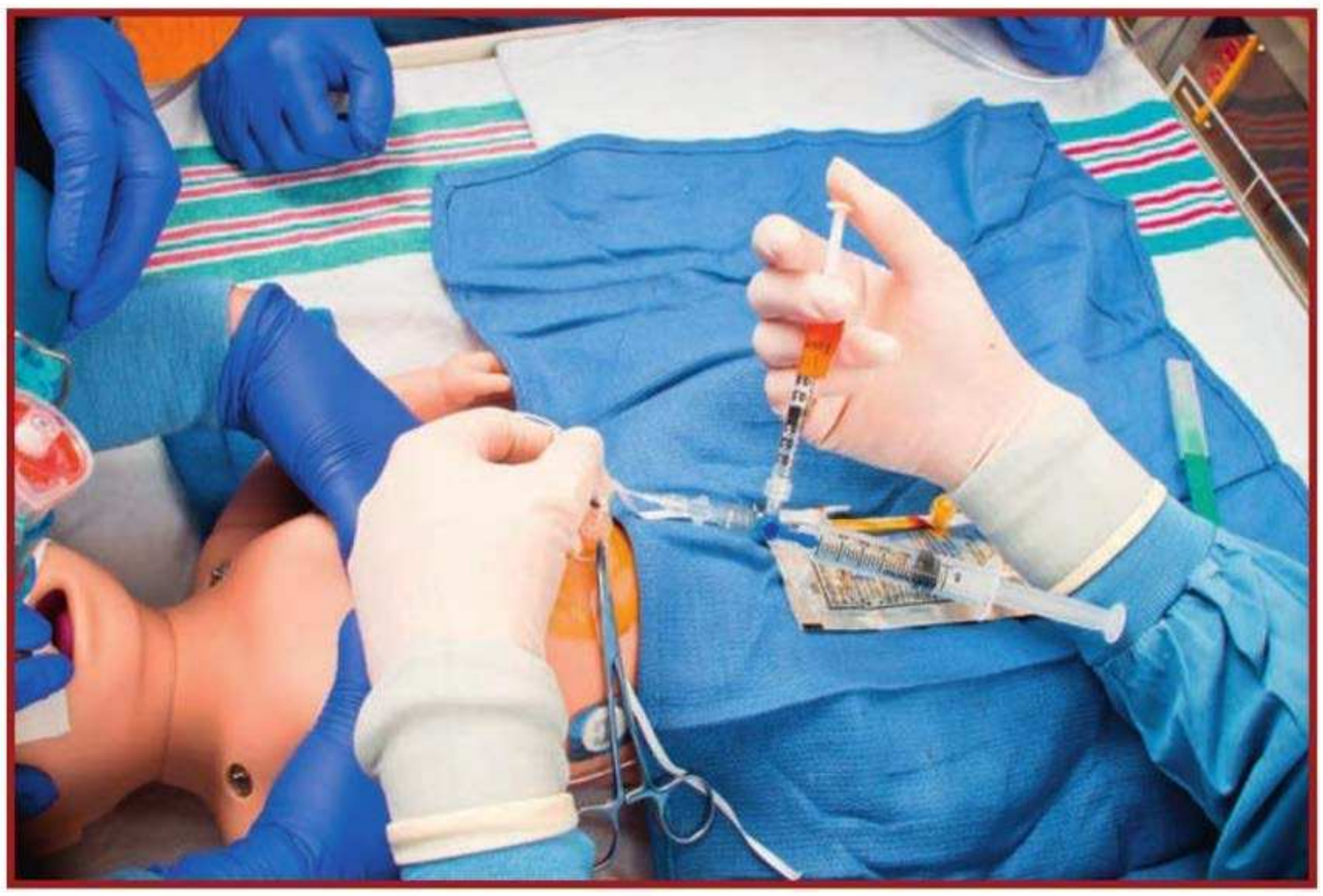


Figure 7.1. Few newborns require emergency medication to regain cardiac function.

What is epinephrine and what does it do?

Epinephrine is a cardiac and vascular stimulant. It causes constriction of blood vessels outside of the heart, which increases blood flow into the coronary arteries. Blood flowing into the coronary arteries carries the oxygen required to restore cardiac function. In addition, epinephrine increases the rate and strength of cardiac contractions.

When is epinephrine indicated and how should it be administered?

Indication

Epinephrine is indicated if the baby's heart rate remains **less than 60** b$_p$m **after**

- At least 30 seconds of PPV that inflates the lungs as evidenced by chest movement, **and**
- Another 60 seconds of chest compressions coordinated with PPV using 100% oxygen.

In most cases, ventilation should have been provided through a properly inserted endotracheal tube or laryngeal mask. Epinephrine is **not** indicated before you have established ventilation that effectively inflates the lungs.

Concentration

Caution: Epinephrine is available in 2 concentrations.

The only concentration that should be used for neonatal resuscitation is **labeled either 0.1 mg/mL or 1 mg/10 mL.** It is usually supplied in a 10-mL glass vial that is packaged in a box with an injection device.

Do not use the higher concentration epinephrine that may be stocked with emergency supplies for pediatric and adult resuscitation. This is often supplied in a small glass vial with a breakable top that <loes not have an injection device.

Route

Intravenous *(preferred)* or intraosseous: Epinephrine needs to rapidly reach the central venous circulation. Medications reach the central venous circulation quickly when administered into either an umbilical venous catheter or an intraosseous needle. For babies requiring vascular access at the time of delivery, the umbilical vein is recommended. When umbilical venous access is not feasible or successful, the intraosseous route is a reasonable alternative.

Attempting insertion of a peripheral intravenous catheter is not recommended for emergency medication administration in the setting of cardiovascular collapse. It is likely to be unsuccessful, result in epinephrine extravasation into the tissue, and delay the administration of potentially lifesaving therapy.

Endotracheal *{less effective):* Sorne clinicians may choose to give a <lose of epinephrine into the endotracheal tube while vascular access is established. Although it may be faster to give endotracheal epinephrine than intravenous epinephrine, studies suggest that absorption is unreliable and the endotracheal route is less effective. For this reason, the intravenous and intraosseous routes are recommended.

Preparation

Use a sterile connector or stopcock to transfer epinephrine from the glass vial injector to a syringe (Figure 7.2).

Intravenous/Intraosseous: Prepare intravenous or intraosseous epinephrine in a labeled **1-mL syringe. Clearly label the syringe:** ccEpinephrine-lV."

Endotracheal: Prepare endotracheal epinephrine in a **3- to 5-mL syringe.** Clearly label the syringe: ccEpinephrine-ET ONLY." Be certain not to use this larger syringe for intravenous or intraosseous administration.

Figure 7.2. Use a connector or stopcock to transfer epinephrine.

Dose

Intravenous or intraosseous: The suggested initial **intravenous or intraosseous dose** is **0.02 mg/kg** (equal to 0.2 mL/kg). You will need to estímate the baby's weight after birth.

- The recommended dose range for intravenous or intraosseous administration is 0.01 to 0.03 mg/kg (equal to 0.1 to 0.3 mL/kg).

Endotracheal: If you decide to give an endotracheal dose while vascular access is being established, the **suggested endotracheal dose is 0.1 mg/kg (equal to 1 mL/kg).** The recommended dose range is 0.05 to 0.1 mg/kg (equal to 0.5 to 1 mL/kg). This higher dose is **only** recommended for endotracheal administration. **DO NOT give the higher dose via the intravenous or intraosseous route.**

Administration

IV/IO Rate: Rapidly-give epinephrine as quickly as possible.

IV/IO Flush: Follow **IV or 10** doses with a **3-mL** flush of normal saline.

Endotracheal: When giving endotracheal epinephrine, be sure to give the drug directly into the tube, being careful not to leave it deposited in the tube connector. Because you will be giving a large fluid volume of epinephrine into the endotracheal tube, you should follow the drug with several positive-pressure breaths to distribute the drug into the lungs. No flush is recommended.

Closed-loop communication

Use closed-loop communication when giving a medication order. State individual digits for numbers. Say the leading zero and the decimal

point, but do not say trailing digits. Avoid using abbreviations during medication orders.

Por example:

- The medical provider (Liz) and person administering medications (Taylor) first agree on an estimated weight.
  - *Liz:* "Taylor, I estímate the baby's weight is three kilograms:'
  - *Taylor:* "Weight is three kilograms:'
- The medical provider then gives the medication name, concentration, <lose, and route. The order is repeated back by the person administering the medication.
  - *Liz:* "Taylor, give epinephrine, one milligram in ten milliliters concentration, zero-point-zero-two milligrams per kilogram, rapidly through the umbilical venous catheter, then give three milliliters of saline flush:'
  - *Taylor:* "I have epinephrine, one n1illigram in ten milliliters (show box). I'm giving zero-point-zero-two milligrams per kilogram, which is equal to zero-point-two milliliters per kilogram. The baby weighs three kilograms, so I will give zero-point-six milliliters (show syringe). I'm giving it rapidly through the umbilical venous catheter. Then I will flush \.\riththree milliliters of saline (show syringe) :'
- Once completed.
  - *Taylor:* "Liz, epinephrine has been given and the flush is completed:'

What should you expect to happen after giving epinephrine?

Assess the baby's heart rate 1 minute after epinephrine administration. As you continue PPV with 100% oxyge11 and chest compressions, the heart rate should increase to 60 bpm or higher within approximately 1 minute of intravenous or intraosseous epinephrine administration.

If the heart rate is less than 60 bpm after the first <lose of intravenous or intraosseous epinephrine, continue coordinated ventilation and compressions. You can repeat the epinephrine <lose every 3 to 5 minutes. If you started with the suggested initial <lose of 0.02 mg/kg or lower, you should consider increasing subsequent doses. Do not exceed the maximum recommended <lose. If there is not a satisfactory response after intravenous or intraosseous epinephrine, consider other problems such as hypovolemia and tension pneumothorax.

The response may take longer, or may not occur, if you give endotracheal epinephrine. If the first <lose is given by the endotracheal route and there is not a satisfactory response, a repeat <lose should be given as soon as an umbilical venous catheter or intraosseous needle is inserted. Do not delay. If the heart rate is less than 60 bpm, you do not

need to wait for 3 minutes after an endotracheal <lose to give the first intravenous or intraosseous <lose. Once an umbilical venous catheter or intraosseous needle has been inserted, ali subsequent doses should be given by the intravenous or intraosseous route.

In addition, check to be certain that

- A cardiac monitor is being used for the most accurate assessment of heart rate.
- The lungs are being adequately ventilated as indicated by chest movement. Insertion of an endotracheal tube or a laryngeal mask should be strongly considered if not already done. If PPV is provided through an endotracheal tube or a laryngeal mask, there should be equal breath sounds.
- The endotracheal tube is not displaced, bent, or obstructed by secretions.
- Chest compressions are being given at the correct depth (one-third of the anterior-posterior [AP] diameter of the chest) and correct rate (90/min).
- Interruptions in chest compressions are minimized because each interruption decreases coronary artery perfusion.

Epinephrine Summary

Concentration
O.1 mg/ml epinephrine = 1 mg/ 10 ml
Route
Intravenous *(preferred}* **or Intraosseous**
Option: Endotracheal only while intravenous or intraosseous access is being established
Preparation
Intravenous or Intraosseous: 1-ml syringe labeled "Epinephrine-lV"
• Prepare a 3-ml saline flush
Endotracheal: 3- to 5-ml syringe labeled "Epinephrine-ET only"
Dose
Intravenous or Intraosseous = 0.02 mg/kg (equal to 0.2 ml/kg).
• *Range=0.01 to 0.03 mg/kg (equal to 0.1 to 0.3 mL/kg)*
Endotracheal = O.1 mg/kg (equal to 1 ml/kg)
• *Range =O.05 to O.l mg/kg (equal to 0.5 to l mL/kg)*
Administration
Intravenous or Intraosseous • **Rapidly-as** quickly as possible. • **Flush with 3 ml normal saline.** • **Repeat every 3 to *5* minutes if heart rote remains less than 60 bpm.**
Endotracheal: Administer PPV breaths to distribute into lungs. No flush.

When should you consider administering a volume expander?

If there has been an acute fetal-maternal hemorrhage, bleeding vasa previa, extensive vaginal bleeding, a placenta! laceration, fetal trauma, an umbilical cord prolapse, a tight nuchal cord, or blood loss from the umbilical cord, the baby may be in h_{yp} ovolemic shock. The baby may have a persistently low heart rate that <loes not respond to effective ventilation, chest compressions, and epinephrine.

Babies with h_{yp} ovolemic shock may appear pale, have delayed capillary refill, and/or have weak pulses. In sorne cases, there will be signs of shock with no obvious evidence of blood loss.

- Administration of a volume expander is indicated if the baby is **not responding** to the steps of resuscitation **and there are signs of shock or a history of acute blood loss.**
- Volume expanders **should not be given routinely** during resuscitation in the absence of shock or a history of acute blood loss. Giving a large volume load to a heart that is already injured may actually worsen cardiac output and further compromise the newborn.

What volume expanders should be considered and how should they be administered?

Crystalloid fluid

The recommended crystalloid solution for acutely treating hypovolemia is normal saline (0.9% NaCl).

Lactated Ringer solution is an acceptable alternative but is not as commonly available. It co11tains sodium, potassium, calcium, and lactate. Because it contains calcium, it cannot be infused in the same intravenous line as packed red blood cells.

Packed red blood cells

Packed red blood cells should be considered for volume replacement when severe fetal anemia is suspected. If fetal anemia was diagnosed before birth, the donor unit can be cross-matched to the mother to ensure compatibility with any maternal antibodies transferred to the baby. If cross-matched blood is not immediately available, use *emergency, non-cross-matched, type* O *Rh-negative packed red blood cells.*

Dose

The initial <lose of the selected volume expander is 1OmL/kg. If the baby <loes not improve after the first <lose, you may need to

give an additional 10 mL/kg. In unusual cases of large blood loss, administration of additional volume may be considered.

Route

Options for emergency access to the vascular system during hypovolemic shock include an umbilical venous catheter or an intraosseous needle. Attempting insertion of a peripheral intravenous catheter is not recommended for emergency volume administration in the setting of cardiovascular collapse.

Preparation

Fill a large syringe (30-60 mL) with the selected volume expander.

If using crystalloid fluid, label the syringe to clearly identify its contents.

Administration

In most cases, acute hypovolemia resulting in a need for resuscitation should be corrected quickly. No clinical trials have established a preferred infusion rate, but, in most cases, a steady infusion over 5 to 1Ominutes is reasonable.

In preterm newborns less than 32 weeks' gestation, volume boluses given during the first day of life, volume boluses given rapidly, and volume boluses greater than 1OmL/kg have been associated with an increased risk of intracranial hemorrhage.

Volume Expander Summary

Solution
Normal Saline (0.9% NaCI) *Suspected severe anemia: Type O Rh-negative packed red blood ce/ls*
Route
Intravenous or Intraosseous
Preparation
30- to 60-ml syringe (labeled NS or O- blood)
Dose
1O ml/kg
AcIministration
Over 5 to 1O minutes *(Use caution with preterm newborns less than 32 weeks' gestation.)*

What do you do if the baby is not improving after giving intravenous epinephrine and volume expander?

While continuing to administer chest compressions and ventilation, your team needs to quickly reassess the quality of ventilation and compressions. Intravenous epinephrine may be repeated every 3 to 5 minutes.

If you have not inserted an alternative airway, this procedure should be performed now. In addition, a STAT chest x-ray may provide valuable information. If necessary, call for additional expertise.

Quickly ask each of the questions in Table 7-1 and confirm your assessment as a team.

Table 7•1• Questions to Ask When Heart Rate Is Not Improving With Compressions, Ventilation, Epinephrine, and Volume Expansion

1. Is the chest moving with each breath?
2. Is the airway secured with an endotracheal tube or a laryngeal mask?
3. Are 3 compressions coordinated with 1 ventilation being delivered every 2 seconds?
4. Is the depth of compressions one-third of the AP diameter of the chest?
5. Is 100% oxygen being administered through the PPV device?
6. Was the correct dose of epinephrine given intravenously?
7. Is the umbilical venous catheter or intraosseous needle in place or has it been dislodged?
8. Is a pneumothorax present?

You have followed the Neonatal Resuscitation Program® (NRP®) Algorithm, but the newly born baby still has no detectable heart rafe (Apgar O). For how long should you continue?

Newly born babies with no detectable heart rate after 10 to 20 minutes of resuscitation frequently do not survive, and those who survive frequently have serious neurologic disabilities, but survival without neurodevelopmental impairment is possible. A small number of newborns who experienced return of circulation and survived without severe disabilities despite an absent heart rate for 20 or more minutes after birth have been reported. The decision to discontinue resuscitative efforts must balance the possibility of stopping too early, when return of circulation and long-term survival may still be achievable, and continuing too long, when return of circulation is not

possible and continued interventions offer no benefit or the baby may survive but with a significant burden of neurologic injury.

When making the decision to discontinue resuscitation, variables to be considered may include

- Uncertainty about the duration of asystole
- Whether ali appropriate interventions have been performed
- The baby's gestational age
- The presence of serious congenital anomalies
- The specific circumstances prior to birth such as the presumed etiology and timing of the perinatal events leading to cardiorespiratory arrest
- The family's stated preferences and values
- The availability of post-resuscitative resources such as neonatal intensive care and therapeutic hypothermia

Given these considerations, it is unlikely that a single time interval after birth or a uniform duration of cardiopulmonary resuscitation will be appropriate for all newborns.

- If there is a confirmed absence of heart rate after all appropriate steps of resuscitation have been performed, cessation of resuscitation efforts should be discussed with the team and family.
- A reasonable time frame for considering cessation of resuscitation efforts is around 20 minutes after birth; however, the decision to continue or discontinue should be individualized based on patient and contextual factors.

There are other situations, such as prolonged bradycardia without improvement, where, after complete a11dadequate resuscitation efforts, discontinuation of resuscitation may be appropriate. However, there is not enough information on outcomes in these situations to make specific recommendations. Decisions on how to proceed in these circumstances must be made on a case-by-case basis. If possible, emergency consultation with a colleague or individual with additional expertise may be helpful.

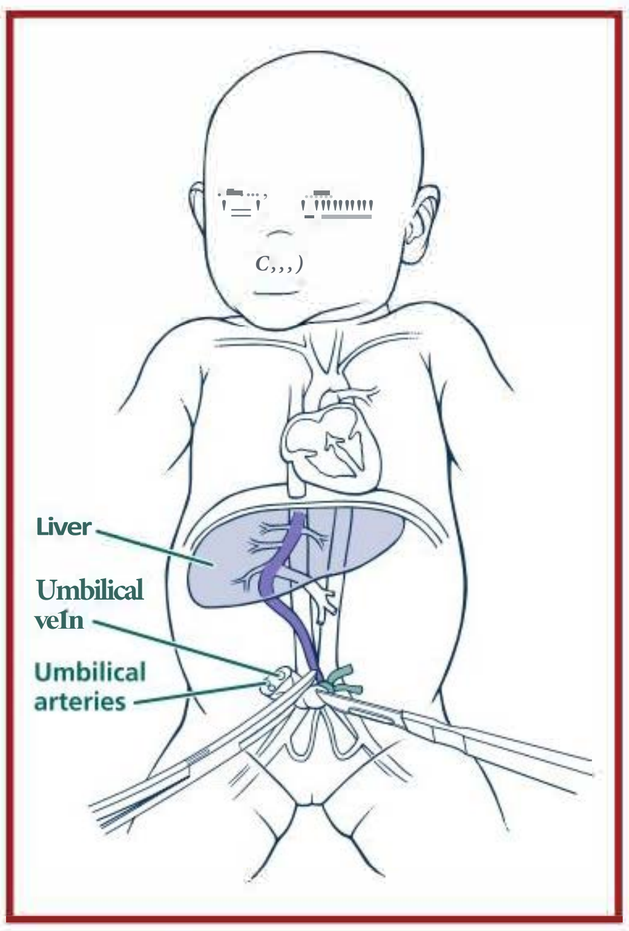


Figure 7.3. The umbilical vein travels through the liver to join the central venous circulation.

How do you establish rapid intravascular access during resuscitation?

The umbilical vein

The umbilical vein is a rapidly accessible, direct intravenous route in the newborn (Figure 7.3). If the use of epinephrine can be

anticipated because the baby is not responding to PPV, a member of the resuscitation team should prepare to insert an umbilical venous catheter while others continue to provide PPV and chest compressions.

Emergency umbilical venous catheter insertion

O Put on gloves and quickly prepare an area for your equipment (Figure 7.4). Although you should attempt to use sterile technique, you must balance the need to rapidly secure emergency venous access with the risk of possibly introducing infection. If central venous access will be needed after stabilization, the emergency umbilical venous catheter will be removed and a new catheter will be inserted using full sterile technique.

f) Fill a 3.SF or SF single lumen umbilical catheter with normal saline using a syringe (3-10 mL) connected to a stopcock. Once filled, close the stopcock to the catheter to prevent fluid loss and air entry (Figure 7.4). Be certain that you know which direction is «off„ on the stopcock used in your practice setting.

Figure 7.4. Umbilical catheter (inside the plastic sleeve) prepared for emergency insertion

E) Quickly clean the umbilical cord with an antiseptic solution. Place a loose tie at the base of the umbilical cord (Figure 7.5) around Wharton's jelly or the skin margin. This tie can be tightened if there is excessive bleeding after you cut the cord. If the tie is placed around the skin, be sure that it <loes not compromise skin perfusion.

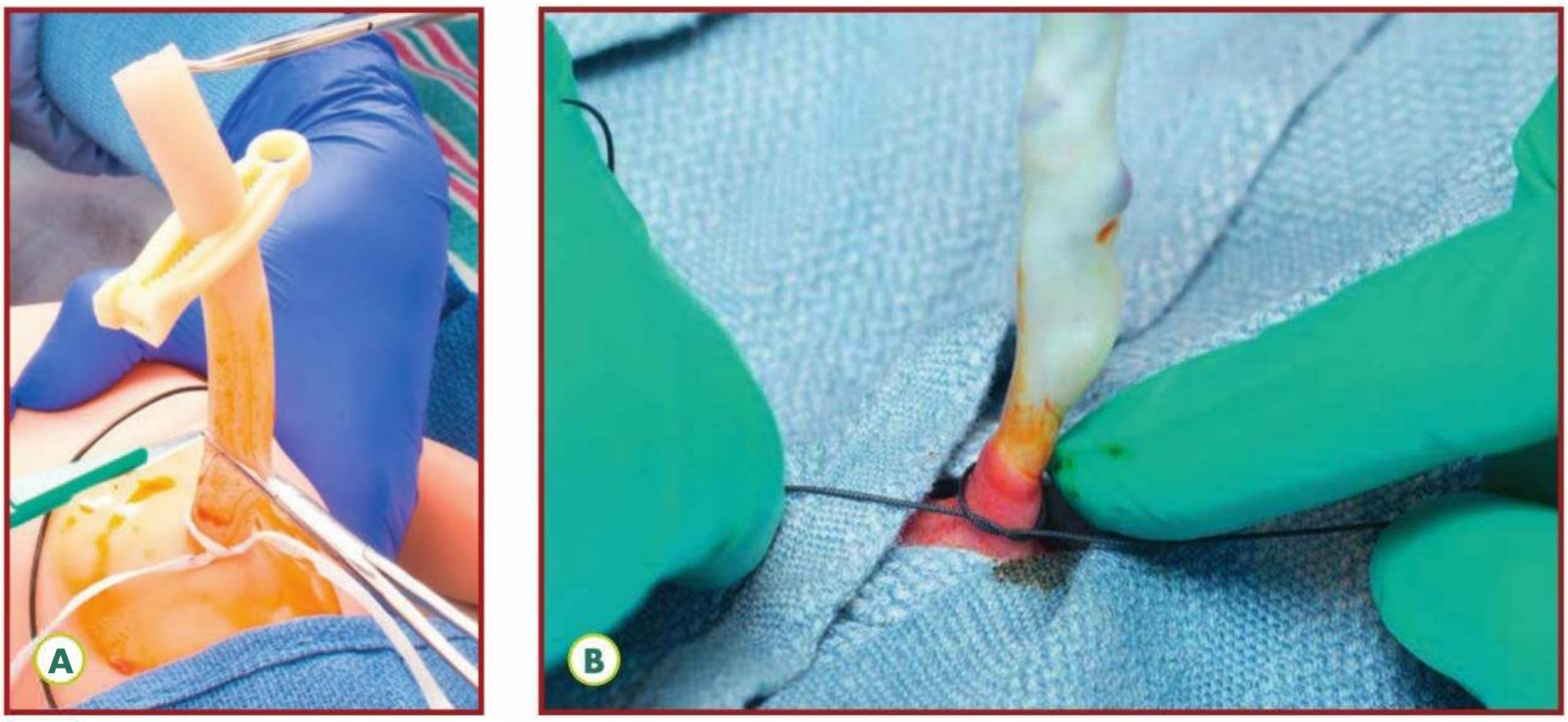


Figure 7.5. Tie placed around Wharton's jelly (A) or the skin margin (B). (Figure 7.5B used with permission of Mayo Foundation for Medica! Education and Research.)

- Briefly stop chest compressions and caution the team that a scalpel is entering the field. Cut the cord with a scalpel below the umbilical clamp and about 1 to 2 cm above the skin line (Figure 7.6). Attempt to cut straight across the cord rather than at an angle.

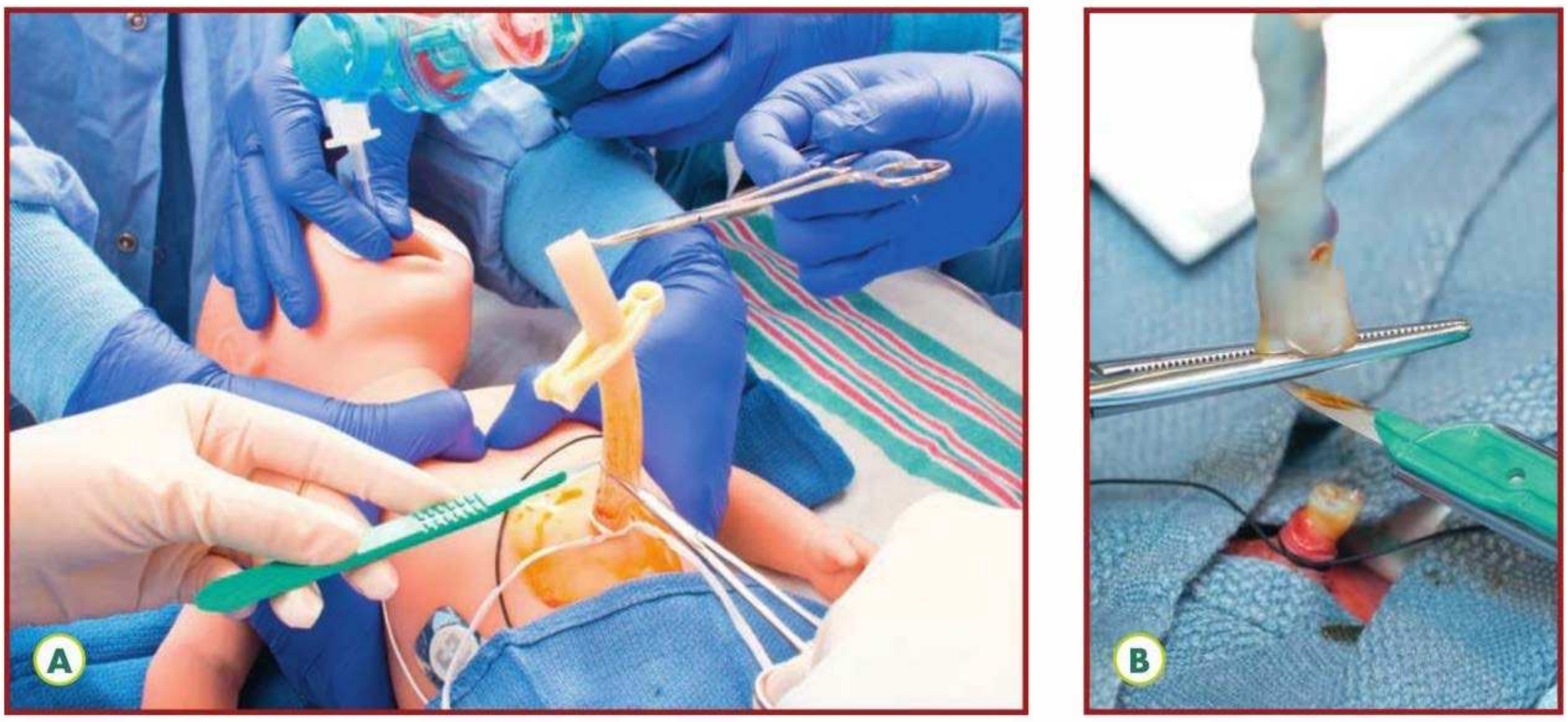


Figure 7.6. Cut the umbilical cord 1 to 2 cm above the skin line. (Figure 7.6B used with permission of Mayo Foundation for Medica! Education and Research.)

- The umbilical vein will be seen as a larger, thin-walled structure, often near the 12-o'clock position. The 2 umbilical arteries are smaller, have thicker walls, and frequently lie close together

(Figure 7.7). The arteries coil within the cord and their position will vary depending on where you cut the cord.

- Insert the catheter into the umbilical vein (Figures 7.8 and 7.9).
  a. Continue inserting the catheter 2 to 4 cm until you get free flow of blood when the stopcock between the baby and the syringe is opened and gently aspirated.
  b. Por emergency use, the tip of the catheter should be located only a short distance into the vein-only to the point at which blood can be aspirated. If the catheter is inserted farther, there is risk of infusing medications directly into the liver, which may cause hepatic injury (Figure 7.10).
  c. Continue to hold the catheter securely in place with 1 hand until it is either secured or removed.

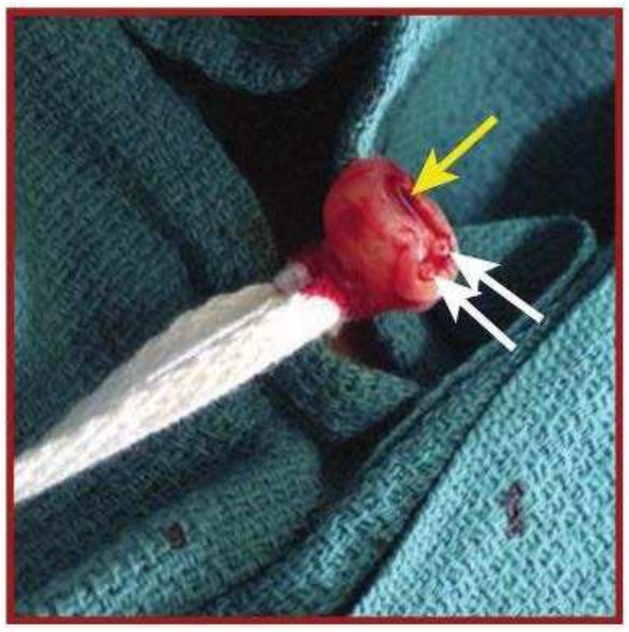


Figure 7.7. The umbilical cord ready for catheter insertion. The umbilical vein is shown by the yellow arrow. The 2 umbilical arteries are shown by the white arrows.

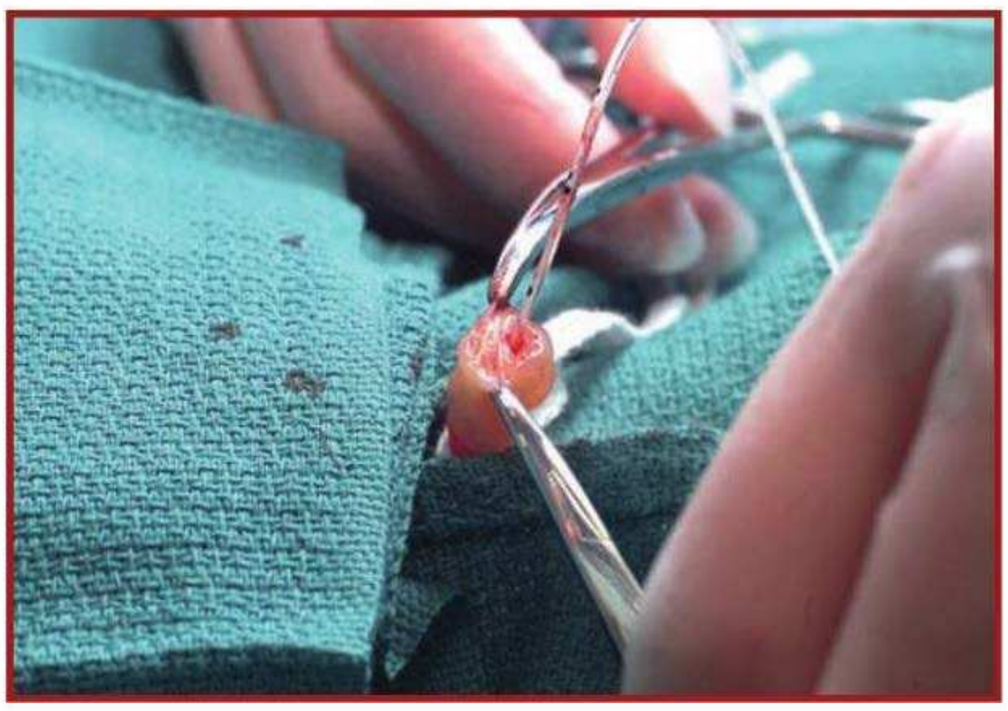


Figure 7.8. Saline-filled catheter inserted into the umbilical vein. Note the black centimeter markings on the catheter.

Figure 7.9. Advance the catheter until blood can be aspirated and the catheter can be easily flushed.

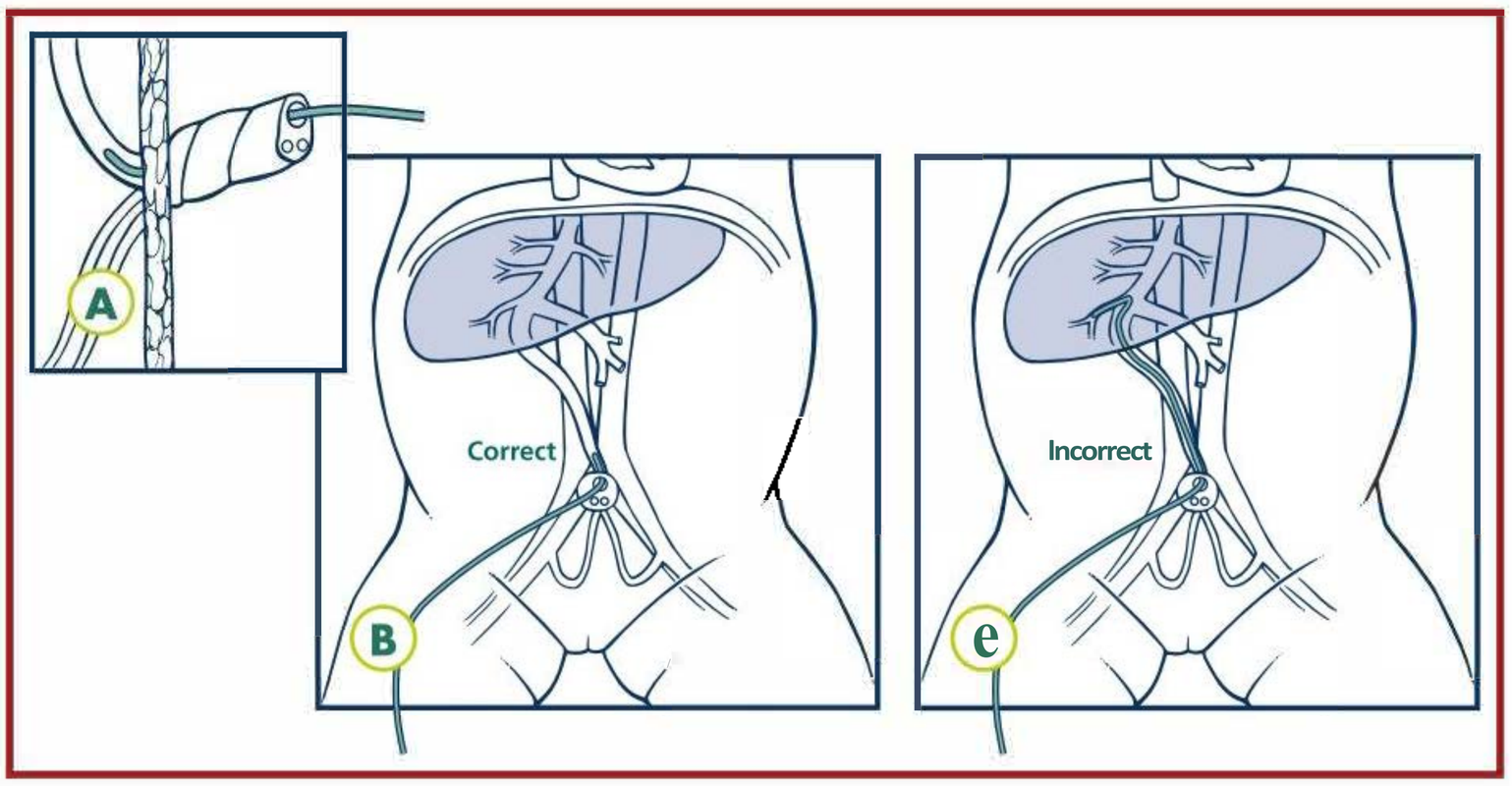


Figure 7.10. Correct (A and B) and incorrect (C) umbilical venous catheter insertion

e) Attach the syringe containing either epinephrine or volume expander to the available stopcock port, turn the stopcock so that it is open between the syringe and the catheter, ensure that there are no air bubbles in the syringe or catheter, administer the appropriate <lose, and flush the catheter (Figure 7.11). Avoid dislodging the catheter by asking an assistant to infuse the medication while the operator holds the catheter in place.

e) After medications have been administered, either remove the catheter or secure it for temporary intravenous access as the baby is transported to the nursery. If you decide to leave the catheter in place during stabilization or transport, it should be secured. A clear adhesive dressing can be used to temporarily secure the line to the newborn's abdomen (Figure 7.12). Suturing and "goal post" tape are effective methods for securing the catheter for prolonged use, but they take time and may not be the best choice during resuscitation.

Figure 7.11. Open the stopcock toward the baby and infuse the medication.

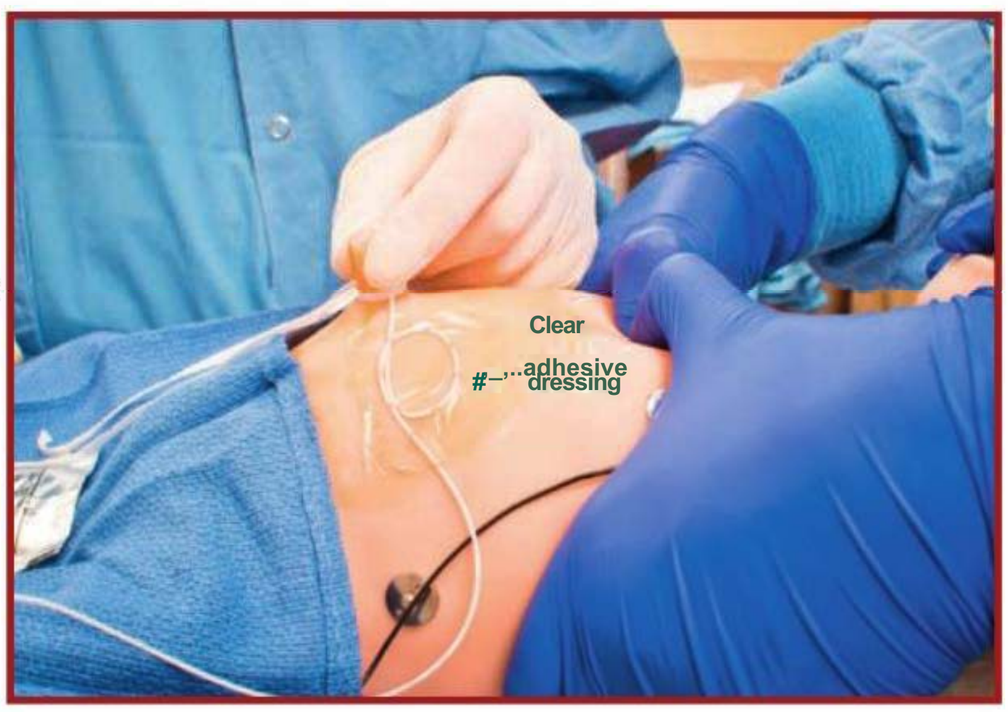


Figure 7.12. Temporarily secure the umbilical catheter with a clear adhesive dressing.

f) If the umbilical venous catheter is not removed, the insertion site should remain uncovered and visible to monitor for bleeding.

G) If you remove the catheter, do it slowly and be prepared to control bleeding by tightening the cord tie, squeezing the umbilical stump, or applying pressure above the umbilicus.

The intraosseous needle

Although an umbilical venous catheter is typically the preferred method of obtaining emergency vascular access in the delivery room, an intraosseous needle is a reasonable alternative if umbilical venous access is unsuccessful or not feasible. Intraosseous needles

are frequently used for emergency access in prehospital settings and emergency departments. An intraosseous needle (Figure 7.13) is inserted through the skin into the flat portion of a large bone and advanced into the bone marrow cavity (Figure 7.14). When medications and fluids are infused, they quickly reach the central venous circulation and have the same hemodynamic effect as intravenous administration. Ali medications and fluids that can be infused into an umbilical venous catheter can be infused into an intraosseous needle. Small case series have shown that intraosseous needles are feasible to insert in term and preterm newborns, have similar efficacy to intravenous routes, and can be inserted quickly. However, there is a risk of severe complications, including infections, bone fractures, and limb ischemia. The rate of successful insertion in very premature newborns is unknown.

Figure 7.13. Examples of intraosseous needles. Sorne needles are inserted with a dril! (left) and others are inserted manually (right).

Severa! different types of intraosseous needles are commercially available. Sorne are intended to be manually inserted using a twisting motion to penetrate the skin and bone. Other needles are inserted using a battery-operated drill. Consult the manufacturer,s literature to identify the correct-sized needle for your patient. The intraosseous needle will have a stylet that is used during insertion and must be removed before infusion.

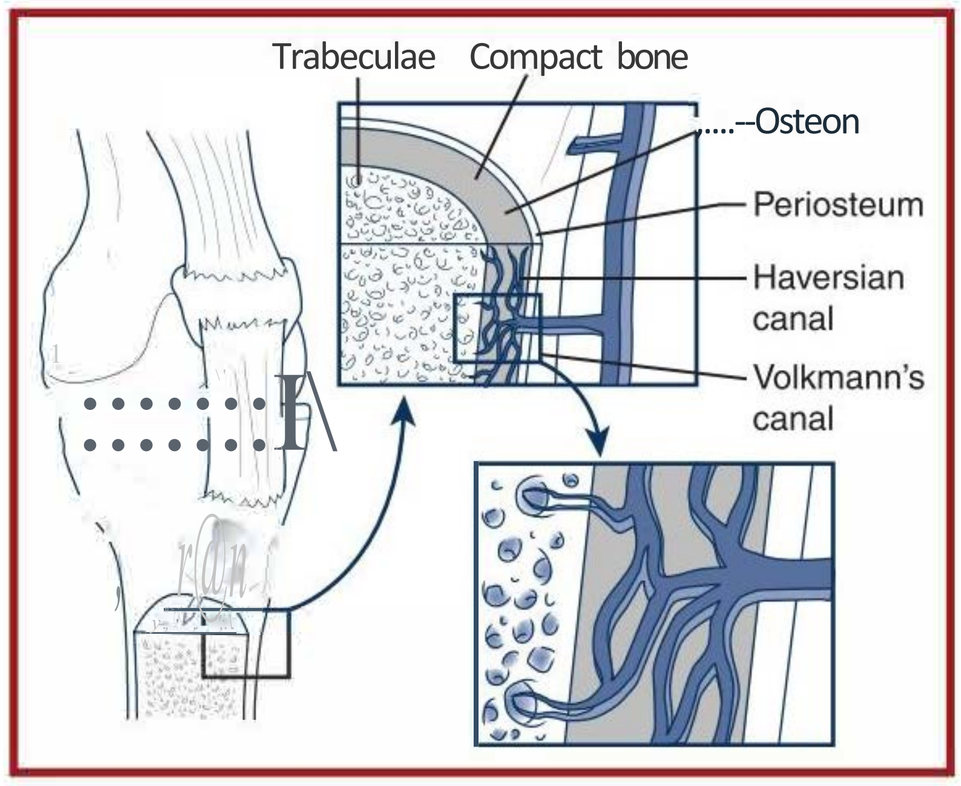


Figure 7.14. Intraosseous needle in the bone marrow cavity. Infused medications and fluids reach the central venous circulation quickly. (Adapted from Teleflex Incorporated. ©2016 Teleflex Incorporated. All rig hts reserved.)

Intraosseous needle insertion

- Identify the insertion site. For term newborns, the preferred site is the flat surface of the lower leg, approximately 2 cm below and 1 to 2 cm medial to the tibial tuberosity (the bony bulge below the kneecap) (Figure 7.15).

Figure 7.15. Needle insertion site along the flat anteromedial surface of the tibia

f) Clean the insertion site with antiseptic solution (Figure 7.16).

Figure 7.16. Ouickly clean the insertion site.

E) Hold the intraosseous needle perpendicular to the skin and advance the needle through the skin to the surface of the bone (periosteum) (Figure 7.17).

Figure 7.17. Insertion using an intraosseous drill

8 Direct the needle perpendicular to the bone and advance the needle through the bone cortex into the marrow space. If advancing the needle by hand, use strong downward pressure with a twisting motion. If advancing the needle with an electric drill, press the trigger while holding downward pressure as described in the manufacturer's instructions. When the needle enters the marrow space, a distinct change in resistance ("pop") is noticeable.

- Follow the manufacturer's instructions for removing the stylet and securing the needle (Figure 7.18).

Figure 7.18. Remove the intraosseous needle stylet.

- Connect an infusion set (prefilled with normal saline) to the needle's hub, open the stopcock toward the needle, flush the needle with 3 to 5 mL of norn1al saline to open the bone marrow space, and administer the medication and saline flush (Figure 7.19).

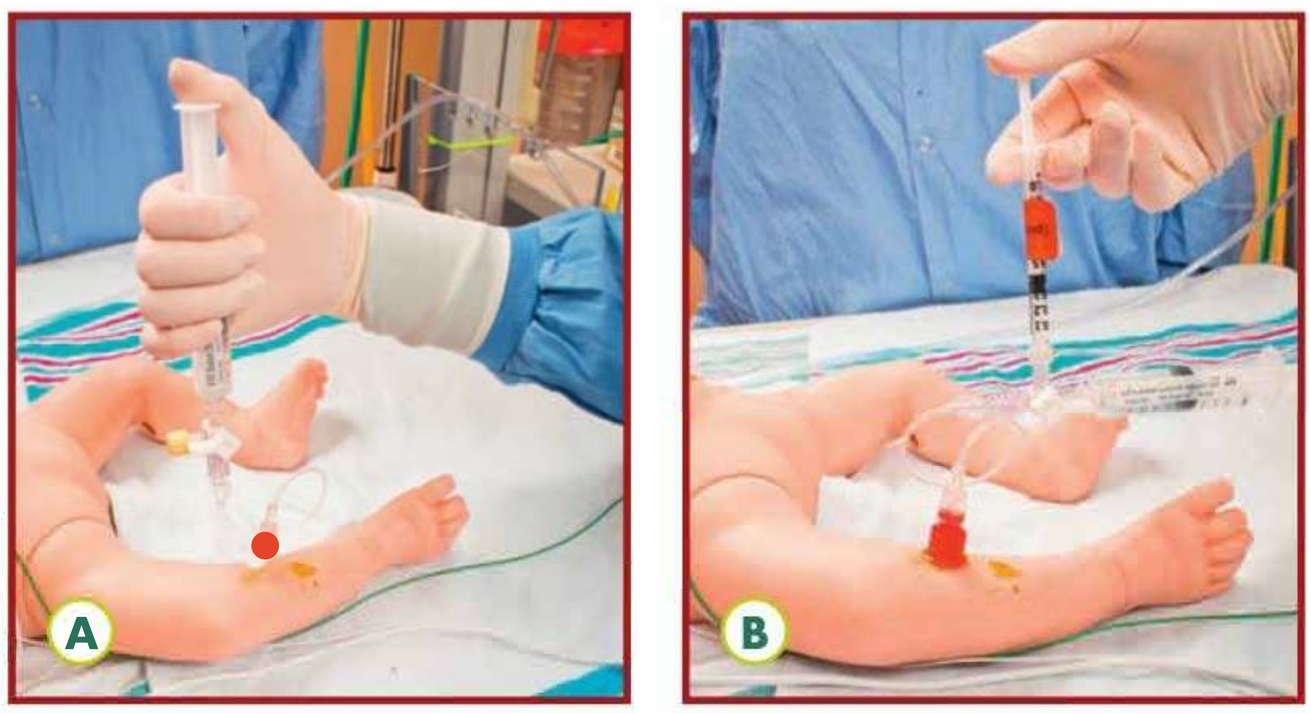


Figure 7.19. Connect an infusion set to the intraosseous needle, open the stopcock toward the needle, flush the needle (A), and infuse the medication or fluid (B).

- Monitor the insertion site for evidence of swelling or fluid extravasation.

Focus on Teamwork

The administration of epinephrine and a volume expander during resuscitation highlights severa! opportunities for effective teams to use the NRP Key Behavioral Skills.

Behavior	Example
Anticípate and plan. Use available information.	If perinatal risk factors suggest that the fetus may hove experienced acute blood loss or hove severe cardiorespiratory compromise (eg, prolonged fetal bradycardia), prepare an umbilical venous catheter or an intraosseous needle, epinephrine, and fluid for volume expansion before the birth. Emergency insertion of an umbilical venous catheter or intraosseous needle and blood administration are infrequently used skills, and teams must practice them frequently to be certain that they can be performed correctly and efficiently during an emergency. If a baby requires chest compressions, it is likely that epinephrine also will be required. Once compressions are started, a team member should prepare epinephrine and an umbilical venous catheter oran intraosseous needle so that intravascular epinephrine can be administered without delay.
Know your environment.	Your team needs to know where emergency type O Rh-negative blood is stored, how it will be obtained when needed, and what additional equipment will be needed to prepare and infuse it without delay. Your team needs to know where the emergency vascular access equipment is stored.
Call for additional help when needed.	If epinephrine or volume expansion is required, you will need additional help. It will likely take more than 4 team members to continue effective ventilation and compressions, quickly insert and secure emergency vascular access, prepare and administer epinephrine or fluid, monitor the passage of time, monitor the quality of compressions and ventilations, document events as they occur, and provide support for the baby's family.
Allocate attention wisely. Clearly identify a team leader.	If the team leader becomes involved in umbilical catheter insertion, their attention is focused primarily on that task and they may not be able to pay full attention to the baby's condition, the passage of time, or the adequacy of ventilation and compress1ons. Any team member who has mastered the NRP Algorithm and has strong leadership skills can become the team leader. Clearly announce the change in leadership when it occurs.
Use available resources.	If you hove difficulty inserting an emergency umbilical venous catheter, use an intraosseous needle.
Communicate effectively. Maintain professional behavior.	Use efficient, directed, closed-loop communication when epinephrine or volume expanders are requested. When you give an instruction, direct the request to a specific individual, call the team member by name, make eye contact, and speak clearly. After giving an instruction, ask the receiver to report back as soon as the task is completed. After receiving an instruction, repeat the instruction back to the sender. During a complex resuscitation, it is easy for the quality of communication to deteriorate. It is critically important for the leader to establish and maintain calm and professional behavior.

Quality Improvement Opportunities

Ask yourself the following questions and begin a discussion with your team if you find a difference between the NRP recommendations and what is currently done in your own hospital setting. Consider using the suggested process and outcome measures to guide your data collection, identify areas for improvement, and monitor if your improvement efforts are working.

Quality improvement questions

- Who are the providers that can insert an umbilical venous catheter and intraosseous needle in your delivery room setting?
- Is someone with these skills immediately accessible if needed?
- Is a kit with ali necessary supplies for emergency vascular access immediately accessible if needed?
- Do providers know where to obtain an intraosseous needle?
- Does your emergency medication cart/box only include the dilute (O.l mg/mL) solution of epinephrine for newborn resuscitation, or <loes it also have the concentrated (1 mg/mL) solution?
- How often do NRP providers practice how to calculate and prepare a <lose of epinephrine for neonatal resuscitation?
- Do you have a weight-based emergency medication chart/table near each radiant warmer?
- Do NRP providers know how to access emergency type O Rh-negative blood in your delivery room setting? Do they know the procedure for blood administration?

Process and outcome measures

- How often do newborns receive epinephrine in your delivery room setting?
- How often do newborns receive volume expanders in your delivery room setting?
- When emergency medications are required, how often is a skilled provider present at the time of birth?

- How often is the first <lose of epinephrine given by the intravascular route?
- What percentage of resuscitation team members have demonstrated that they can properly calculate and prepare emergency epinephrine in a simulation setting each year?

Frequently Asked Questions

Why has the suggested dose of epinephrine been changed to a single dose instead of using the full range?

The new suggested <lose for epinephrine is based on a desire to simplify the dosing for educational efficiency. This single <lose may be easier for NRP providers to remember in an emergency, may improve teamwork by allowing the team member preparing epinephrine to anticipate the requested <lose, and may allow easier preparation across a wide range of newborn weights. Although sorne studies suggest that the lower end of the dosing range may be less effective, the current suggested <lose is not based on evidence of superior efficacy and <loes not represent an endorsement of any particular <lose within the recommended dosing range. The ideal epinephrine <lose for persistent, severe neonatal bradycardia and asystole remains an important knowledge gap and additional research is needed.

Why has the flush volume after intravascular epinephrine administration been increased from 1 ml to 3 ml?

Evidence from an animal study has suggested that a 1-mL flush volume may leave a significant amount of epinephrine in the umbilical vein or liver instead of carrying it to the heart. Pending additional studies to identify the ideal flush volume in newly born humans, this program recommends a 3-mL flush volume for babies of all gestational ages after intravascular epinephrine administration.

When ordering emergency epinephrine, is it safer to express the dose as a mass (mg/kg) or a volume (ml/kg)?

Because this question has not been fully resolved, this program describes the <lose using both mass (mg/kg) and volume (mL/kg) expressions. Each method has risks and benefits. If the <lose is expressed using the mass method, the team member preparing the

<lose will need to convert milligrams to milliliters, and there is a risk of making a decimal point error. If the <lose is expressed using the volume method, the provider preparing the <lose <loes not have to convert between units, but there is a risk of giving a 1O-times overdose if the provider accidently uses the concentrated (1 mg/mL) epinephrine solution. This medication error is preventable by ensuring that the dilute (0.1 mg/mL) solution of epinephrine is the ONLY concentration included in neonatal emergency supplies.

Whichever dosing method is used, the providers should use closed-loop communication, repeat back the intended <lose, include the desired units and the baby's estimated weight when ordering and preparing the <lose, confirm the concentration of the epinephrine solution used by showing the box to another team member, and compare the prepared <lose with a weight-based chart or table to ensure accuracy.

Why is the intravenous route for epinephrine administration preferred over the endotracheal route? Isn't the endotracheal route easier and faster?

Epinephrine given into the endotracheal tube may be absorbed by the lungs and enter blood that drains directly into the heart. Although it may be faster to give epinephrine to an intubated baby through the endotracheal tube, the process of absorption by the lungs makes the response time slower and more unpredictable than if epinephrine is given directly into the blood. Data from both animal models and clinical studies suggest that the standard intravenous <lose is ineffective if given via the endotracheal tube. There is sorne evidence in animal models that giving a higher <lose can compensate for the delayed absorption from the lungs; however, no studies have confirmed the efficacy or safety of this practice in newborns. If the need for medications is anticipated, advance preparation of an umbilical venous catheter, before delivery, allows rapid administration of intravenous epinephrine without delay.

After intraosseous needle insertion, is it necessary to aspirate the syringe before infusing fluid?

No. In the newborn, aspiration of the intraosseous needle is not a reliable indicator of correct needle insertion and is not necessary. If the needle is correctly inserted, it should feel firmly secured in the bone and not "wiggle:' When fluid is infused, the soft tissue surrounding the bone should not swell.

Previous editions of the *Textbook of Neonatal Resuscitation* suggested that it may be reasonable to stop resuscitative efforts if the heart rote was undetectable after 10 minutes of resuscitation. Why does this edition suggest that the time interval to consider stopping resuscitative efforts should be around 20 minutes?

Since the last recommendation was published, additional studies have been completed. Although the scientific evidence is weak because of incomplete reporting, a recent systematic review completed by the International Liaison Committee on Resuscitation (ILCOR) found that stopping resuscitative effort at 10 minutes may preclude survival of sorne newborns who would have survived without significant disabilities. Improvements in neonatal intensive care and the availability of neuroprotective interventions, such as therapeutic h_{yp} othermia, may be improving the long-term outcome for these newborns. Extending the time frame to consider discontinuing resuscitative efforts may allow the resuscitation team more time to complete ali appropriate interventions, achieve the correct balance between continuing too long and stopping too soon, make an individualized decision, and include the family in decision-making and care for their newborn.

LESSON 7 REVIEW

1. Ventilation that moves the chest has been performed through an endotracheal tube for 30 seconds, followed by coordinated chest compressions and 100% oxygen for an additional 60 seconds. Epinephrine is indicated if the baby's heart rate remains less than (60 beats per minute)/(80 beats per minute).

2. The preferred route for epinephrine is (intravenous)/(endotracheal).

3. Your team is resuscitating a baby born at term. The baby's heart rate is 40 beats per minute after 30 seconds of ventilation through an endotracheal tube and an additional 60 seconds of coordinated chest compressions and ventilation using 100% oxygen. You determine that epinephrine is indicated. Your team should (quickly attempt to insert a peripheral intravenous catheter in the baby's right hand)/(insert an umbilical venous catheter).

4. The recommended concentration of epinephrine for newborns is (0.1 mg/mL)/(1 mg/mL).

5. The suggested initial intravenous <lose of epinephrine is (0.02 mg/kg)/(0.1 mg/kg).

6. Intravenous epinephrine should be administered (slowly)/(as quickly as possible), followed by a (3-mL)/(l-n1L) normal saline flush.

7. If the baby's heart rate remains less than 60 beats per minute, you can repeat the <lose of epinephrine every (3 to 5 minutes)/(8 to 10 minutes).

8. If an emergency volume expander is indicated, the initial <lose is (1 mL/kg)/(10 mL/kg).

Answers

1. Epinephrine is indicated if the baby's heart rate remains less than 60 beats per minute.

2. The preferred route for epinephrine is intravenous.

3. Your team should insert an umbilical venous catheter or an intraosseous needle. During cardiopulmonary collapse, a peripheral intravenous catheter is unlikely to be successful and attempts at insertion may delay appropriate therapy.

4. The recommended concentration of epinephrine for newborns is 0.1 mg/mL.

5. The suggested initial intravenous <lose of epinephrine is 0.02 mg/kg.

6. Intravenous epinephrine should be administered as quickly as possible, followed by a 3-mL normal saline flush.

7. If the baby's heart rate remains less than 60 beats per minute, you can repeat the <lose of epinephrine every 3 to 5 minutes.

8. The initial <lose is 1OmL/kg.

LESSON 7: PRACTICE SCENARIO

Medications

Comprehensive Skills TestScenario for Neonatal Resuscitation Program (NRP) Advanced Providers

Learning Objectives

- Identify when the newborn requires epinephrine and a volume expander during resuscitation.
- Demonstrate preparation and administration of epinephrine and volume expander.
- Demonstrate preparation and insertion/assistance with insertion of an emergency umbilical venous catheter.
- Demonstrate how to secure an emergency umbilical venous catheter.
- Practice NRP Key Behavioral Skills to ensure effective communication and teamwork during this critica! component of neonatal resuscitation.

This Practice Scenario is for review/practice and evaluation. This scenario may also be used as the Comprehensive Skills Test("test out") option for NRP Advanced providers during a Provider Course.

This is the suggested Practice Scenario sequence.

- **Review the Knowledge Check Questions** with your NRP instructor.
  a. What are the indications for epinephrine during neonatal resuscitation?
  b. What epinephrine concentration is used during neonatal resuscitation?
  c. What is the preferred route of administration? What is the alternative route while vascular access is being established?
  d. What is the correct <lose range for each route? Where is the pre-calculated drug dosage chart our hospital uses during a neonatal code?

e. How quickly should you expect to see a rising heart rate after giving intravenous epinephrine? How often can you repeat epinephrine?

f. If the heart rate does not respond to intravenous epinephrine, what clinical conditions might be considered?

g. What are signs of shock in a newborn, indicating the need for volume expander?

h. What volume expanders are used? What is the <lose of the selected volume expander?

i. What is the route of the volume expander and how fast is it administered?

f) **Practice/review these skills** with your NRP instructor.

a. Draw up epinephrine for administration via endotracheal tube and emergency umbilical venous catheter using a 3-way stopcock and/or connector.

b. Prepare the emergency umbilical venous catheter for use.

c. Perform the procedure or assist with insertion of the emergency umbilical venous catheter.

d. Apply a clear adhesive dressing to secure the emergency umbilical venous catheter during resuscitation.

e. Practice giving and/or confirming an order for intravenous epinephrine using closed-loop communication.

f. Draw up normal saline for volume administration.

E) **Practice the scenario** with your NRP instructor and team until you need little or no assistance or coaching.

8 **Pass the Lesson 7 Practice Scenario evaluation** by leading practice scenario(s) and performing the skills relevant to your role and responsibilities. If a technical skill included in a scenario is not within your scope of responsibility, delegate the skill to a qualified team member and perform the role of assistant if appropriate.

0 When you can lead the scenario(s) and perform the skills with little or no instructor coaching, learners may proceed to the Simulation and Debriefing component of the Provider Course.

Practice Scenario

"You are called to attend an emergency cesarean birth due to umbilical cord prolapse with fetal bradycardia. How would you prepare for the resuscitation of the baby? As you work, say your thoughts and actions aloud so I will know what you are thinking and doing."

Critical Performance Steps	
Assess perinatal risk.	
Assesses perinatal risk (learner asks the 4 pre-birth questions and instructor ["OB provider"] responds)	
Gestation?	**"Term."**
Fluid clear?	**"Fluid is clear."**
Additional risk factors?	**"Cord prolapse and fetal bradycardia for the last 3 minutes."**
Umbilical cord management plan? **"We'll assess the baby at birth. If the baby's not vigorous, I'll give brief stimulation, and if there's no improvement, I'll clamp the cord and bring the baby to the radiant warmer."**	
Assemble team.	
Assembles team based on perinatal risk factors. If risk factors are present, at least 2 qualified people should be present solely to manage the baby. The number of team members and qualifications vary depending on risk.	
Perform a pre-resuscitation briefing.	
Identifies team leader. Assesses risk factors, delegates tasks, identifies who will document events as they occur, determines supplies and equipment needed, identifies how to call for additional help.	
Perform equipment check.	
	"The baby has been born."
Rapid evaluation.	
• Term?	**"Appears term."**
• Tone?	**"No tone."**
• Breathing or crying?	**"No breathing."**
Initial steps.	
Receives baby at radiant warmer, dries, stimulates, positions airway, suctions mouth and nose	
Assess breathing. If breathing, assess heart rate.	
Checks breathing **"The baby is apneic."**	**(Heart rate = 50 bpm, if assessed)**
Begin PPV within 60 seconds of birth.	
Begins PPV in 21 % oxygen (room air). Within 15 seconds of beginning PPV, learner asks the assistant to assess the heart rate and state if heart rate is rising. **Heart rate = 40 bpm, not increasing**	
Assess chest movement.	
• If chest movement observed, continues PPV x 15 seconds (for total of 30 seconds) • If no chest movement observed, proceeds through corrective steps (MR. SOPA) until chest movement; then administers PPV x 30 seconds • *If no chest movement with corrective steps M and R, S and O, and P, learner indicates need for alternative airway and proceeds directly to intubation or faryngeaf mask insertion*	

Critical Performance Steps (cont)	
Check heort rote after 30 seconds of PPV that moves the chest.	
	Checks heart rate **Heort rote= 30 bpm, not increasing** Indicates need for alternative airway
	Places cardiac monitor leads and connect to monitor in anticipation of alternative airway (if not already done).
Insert alternative airway (endotracheal tube [preferred] or laryngeal mask). **NOTE: Administration of epinephrine into a laryngeal mask is not recommended.**	
	• Intubates (size 1 blade and size 3.5 endotracheal tube) or inserts laryngeal mask (size 1) • Checks for CO_2 detector color change, rising heart rote; also checks for bilateral breath sounds and chest movement with PPV • For endotracheal tube: checks tip-to-lip insertion depth using nasal-tragus length (NTL) or insertion depth chart • Asks assistant to secure endotracheal tube or laryngeal mask
	If device not successfully inserted, **"Color is not changing on the CO_2 detector and the chest is not moving."** **Heort rote = 30 bpm and not increasing** • Removes device • Resumes PPV by face mask • Repeats insertion attempt
	If device successfully inserted, **Note: Color might not change on the CO_2 detector dueto low heart rote.** **Heort rote = 30 bpm, not increosing** **"The baby's chest is moving, breath sounds are equal, pulse oximeter has no signal."** • Operator continues PPV x 30 seconds • Assistant checks tip-to-lip depth using gestational age/weight table or NTL measurement - If using NTL, measures distance from the nasal septum to the ear tragus (insertion depth [cm]= NTL + 1 cm) • Assistant secures endotracheal tube
Check heart rote after 30 seconds of PPV with alternative airway.	
	Checks heart rate by observing cardiac monitor (may also auscultate heart rote) after 30 seconds of PPV that moves the chest with an alternative airway **Heort rote= 30 bpm and not increasing "Pulse oximeter has no signal."**
Begin chest compressions.	
	• Calls for additional help • Asks assistant to increase oxygen to 100% • Asks assistant to place servo-controlled temperature sensor on baby, if not already done, and adjust to maintain baby's temperature 36.5°C to 37.5°C • Administers compressions from head of bed with coordinated ventilation (thumbs on lower one-third of sternum, compressions one-third of the anterior-posterior [AP] diameter of the chest, 3 compressions: 1 ventilation every 2 seconds)

Critical Performance Steps (cont)

Check heart rate after 60 seconds.	
	Pauses compressions, continues PPV, and checks heart rote after 60 seconds of compressions and ventilations. **Heart rate = 30 bpm and not increasing** Indicates need for emergency vascular access.
Medication administration vio endotracheal tube (optional, while umbilical venous catheter is being established}.	
	Requests epinephrine vio endotracheal tube Concentration: 0.1 mg/ml= l mg/10 ml Suggested endotracheal tube dese: 0.1 mg/kg (l ml/kg) • Requests estimated weight: **"The baby's estimated weight is 3 kg."** • Orders epinephrine for endotracheal tube for a baby weighing 3 kg: 0.3 mg epinephrine vio the endotracheal tube (equal to 3 ml in syringe) • Uses closed-loop communication with confirmation of medication, dese, and route • Assistant checks medication label, opens medication, attaches stopcock or syringe connector and 5-ml syringe • Assistant prepares correct volume, labels syringe with medication name and intended route
	Administers endotracheal epinephrine (can be performed by assistant or operator) • Gives the epinephrine directly into the endotracheal tube, does not leave it deposited in the tube connector. • Follows the drug with several positive-pressure breaths to distribute the drug into the lungs. • Announces *"ET epinephrine given."*
	Requests heart rote check after 60 seconds. Pauses compressions briefly and observes cardiac monitor; may also auscultate heart rote. **Heart rote = 30 bpm and not increasing** Continues PPV and compressions.
Prepare emergency umbilical venous catheter (may be performed by assistant or operator).	
	• Obtains syringe with normal saline flush • Attaches 3-way stopcock to umbilical venous catheter • Flushes catheter and stopcock with normal saline • Closes stopcock to catheter
Insert emergency umbilical venous catheter.	
	• Cleans lower segment of umbilical cord with antiseptic solution • Ties umbilical tape loosely at base of cord • Cuts cord about l to 2 cm above base (may request compressions pause) • lnserts catheter into vein, opens stopcock and gently aspirates syringe, advances catheter approximately 2 to 4 cm until blood return is detected • Flushes catheter and closes stopcock toward catheter • Ensures catheter is being held in place; may secure with clear adhesive dressing
Administer medication via umbilical venous catheter.	
	Requests epinephrine vio umbilical venous catheter Concentration: 0.1 mg/ml = l mg/l O ml Suggested intravenous dese: 0.02 mg/kg (0.2 ml/kg) every 3 to 5 minutes. • Requests estimated weight if not already known: **"The baby's estimated weight is 3 kg."** • Orders epinephrine for umbilical venous catheter for a baby weighing 3 kg: .06 mg epinephrine vio the umbilical venous catheter (equal to 0.6 ml in syringe) • Uses closed-loop communication with confirmation of medication, dese, and route • Assistant checks medication label, opens medication, attaches stopcock or syringe connector and l-ml syringe • Assistant prepares correct volume, labels syringe with medication name and intended route

Critical Performance Steps (cont)	
Administer medication vio umbilical venous catheter (cont).	
	Administers epinephrine vio the umbilical venous catheter (can be performed by assistant or operator) • Ensures that catheter is being held in place; attaches syringe to stopcock, opens stopcock to catheter and syringe, administers epinephrine rapidly without air bubbles. • Flushes umbilical venous catheter with 3 ml of normal saline. • Announces "IV epinephrine given."
Check heort rote ofter 60 seconds.	
	• Continues PPV and compressions • Pauses compressions and checks heart rote 60 seconds after intravenous epinephrine **Heort rote= 50 bpm** **"Pulse oximeter has no signol. The baby is pole."** • Continues PPV and compressions
Administer volume exponder.	
	Requests 30 ml (10 ml/kg) of normal saline per umbilical venous catheter over 5 to 10 minutes using closed-loop communication • Draws up correct volume or uses prefilled syringes. Numbers more than one syringe (#1, #2, #3). • Ensures that catheter is being held in place; attaches syringe to stopcock, opens stopcock to catheter and syringe, administers volume in slow infusion over 5 to 10 minutes without air bubbles (or use an infusion pump).
Check heort rote every 60 seconds.	
	• Continues PPV and compressions. • Monitors heart rote vio cardiac monitor while volume administered. May also auscultate heart rote. • Pauses compressions, continues PPV while heart rote is assessed. NOTE: The instructor may compress time and announce, ***"The 30-mL infusion of normal saline has been given."*** **Heort rote = 80 bpm and increasing** **SPO_2 = 68%** **"Color is changing on CO_2 detector. Pulse oximeter has a reliable signal."**
Discontinue compressions-Continue PPV.	
	• Discontinues chest compressions • Continues PPV with higher ventilation rote (40-60 breaths/min) **Heort rote is > 100 bpm** **SPO_2 = 80%** **"There ore no spontaneous respirations."**
Check vital signs.	
	Continues PPV and adjusts oxygen concentration per pulse oximetry **Heort rote is > 100 bpm** **SPO_2 = 90%** **"The baby has fair muscle tone and some spontaneous respirations."**
End scenario.	
	Supports baby with PPV and supplemental oxygen per Target Oxygen Saturation Table. Monitors heart rote, respiratory effort, oxygen saturation, activity, and temperature. Prepares to move baby to post-resuscitation care setting. Communicates with perinatal team. Updates parents and informs them of next steps. Debriefs the resuscitation.

Sample Debriefing Questions

O What went well during this resuscitation?

f) What will you do differently when faced with this complex resuscitation in a future scenario?

8 Do you have additional comments or suggestions for your team? For the leader?

O Why <lid this baby receive volume expander?

0 Give me an example of how you used at least one of the NRP Key Behavioral Skills.

NRP Key Behavioral Skills

- Know your environment.
- Use available information.
- Anticípate and plan.
- Clearly identify a team leader.
- Communicate effectively.
- Delegate the workload optimally.
- Allocate attention wisely.
- Use available resources.
- Call for additional help when needed.
- Maintain professional behavior.