

oxygen consumption. Thoroughly dry every infant, healthy, or depressed. Remove wet towels or blankets from around the baby after drying and replace them with clean, dry ones. This will take no more than 5 to 10 seconds.

Clear the Airway

The newly born's head is larger than an older child's or adult's compared to its overall body size, which leads to flexion of the neck in a supine position. This may cause airway **occlusion**. Extend the head slightly to place the airway in a neutral position. Repeat nasopharyngeal suctioning to make sure there is a patent airway.

Assess Breathing

Next, assess breathing. Most babies will be crying, indicating adequate respiratory effort! Breathing effort may be slightly irregular in normal newly borns. Gasping or grunting are signs of increased work of breathing and respiratory distress and indicate the need for assisted ventilation.

An **apneic** baby, with no visible respiratory effort, requires immediate treatment. Most apneic newly borns will start breathing simply with tactile stimulation. If the baby is apneic or has gasping respiration after drying and suctioning, further stimulation is not likely to improve respiratory effort. Begin bag-mask ventilation with supplemental (100%) oxygen (see “Depressed Newly Born Resuscitation”).

Advanced Life Support

A special situation occurs when the pre-hospital professional encounters a newly born with respiratory depression after delivery by a narcotic-addicted mother. Do not give **naloxone** to the baby if the mother is



Do not give naloxone to the newly born if the mother is addicted to narcotics.



Figure 9-13 Feel for a pulse at the base of the umbilical cord.

addicted to narcotics because the drug may precipitate acute narcotic withdrawal and seizures. Assist ventilation with bag-mask and follow the guidelines for care of a depressed newly born.

Assess Heart Rate

In the newly born, a low heart rate is usually due to hypoxia, not primary cardiac disease. The crying, active baby usually has an adequate heart rate. Assess heart rate carefully in a baby who is not active or who requires assisted ventilation. This is most easily accomplished by palpating a pulse at the base of the umbilical cord (**Figure 9-13**). Count the number of beats over 6 seconds and multiply this number by 10. Sometimes the umbilical vessels are constricted so that the pulse is not palpable. Therefore, if a pulse cannot be felt, listen for the heartbeat over the left side of the chest using a stethoscope.

Treat heart rates of less than 100 beats/min with bag-mask ventilation, even if the respiratory effort appears normal. Bradycardia usually responds rapidly to bag-mask



Assist ventilation in an infant with a heart rate less than 100 beats/min with bag-mask ventilation. Bradycardia usually reflects inadequate respiratory effort.

ventilation, in which case no further treatment is necessary (see “Depressed Newly Born Resuscitation”).

Assess Color

Skin color assessment in newly borns has several unique features. **In utero**, the fetus depends on placental delivery of oxygen, and blood oxygen concentrations are very low compared to conditions after birth. Therefore, prior to the initiation of respiration after delivery, the infant will appear cyanotic.

If the cyanotic newly born is apneic, immediately begin bag-mask ventilation. If the baby is breathing, but appears blue, determine if the cyanosis is central (on the trunk and face) or peripheral (limited to the hands and feet). This difference will help with decision making and therapy. If **central cyanosis** is present, true hypoxia is present. Administer supplemental oxygen at 15 L/min via a mask held loosely over the baby's face.

Peripheral cyanosis is also termed **acrocyanosis**. This is a common finding in newly borns through the first 24 to 48 hours of life and requires no therapy.

Apgar Score

All hospitals and some EMS systems use the **Apgar score** for newly born assessment. This score measures the baby's overall cardiopulmonary and neurologic function at 1 and 5 minutes of life, then every 5 minutes thereafter in the unstable baby. The APGAR may be helpful in assessing the effectiveness of resuscitation.

Depressed Newly Born Resuscitation

Depressed newly born resuscitation refers to the series of interventions used to stimulate spontaneous respiratory effort. When the baby remains depressed after drying, warming, and clearing the airway, begin resuscitation. Use the following sequence:

1. Dry the infant and place in the supine position in a warm environment.
2. Suction her mouth and nose.
3. Position the head in slight extension.
4. Assess breathing. If respiratory effort is absent or irregular, start bag-mask ventilation with 100% oxygen at 40 to 60 breaths/min.
5. Assess heart rate. If less than 100 beats/min, start bag-mask ventilation (**Figure 9-14**).
6. Assess heart rate after 30 seconds of ventilation. If less than 60 beats/min, proceed with chest compressions. Compressions should be delivered a depth of one third of the anterior-posterior diameter of the chest. The two thumb encircling hand technique is recommended (compressions with two thumbs with fingers encircling the chest and supporting the back). Deliver 90 compressions and 30 ventilations (120 events per minute). Continue bag-mask ventilation.
7. Continue positive-pressure ventilation until heart rate is above 100 beats/min and spontaneous breathing is present.



Good ventilation will usually reverse bradycardia.



Figure 9-14 Using a bag-mask device on a newly born.

Advanced Life Support

Endotracheal Intubation and Epinephrine Administration

Check the heart rate after 30 seconds. If less than 60 beats/min, prepare for endotracheal intubation and administration of **epinephrine** (0.01–0.03 mg/kg = 0.1–0.3 mL/kg of 1:10,000 solution). The endotracheal route may be associated with lower blood levels of the drug. IV access should be obtained as soon as possible. The recommended dose is (0.01–0.03 mg/kg 1:10,000). The same as the endotracheal intubation dose.

Continue chest compressions and give repeated doses of epinephrine every 3 to 5 minutes until heart rate is above 60 beats/min.

The Inverted Pyramid

The inverted pyramid (**Figure 9-15**) illustrates the relative need for interventions in depressed newborns.

Basic life support (BLS) is usually all that is required during deliveries and therefore comprises the largest area at the top of the inverted pyramid. In contrast, advanced life support (ALS) interventions such as chest compressions, intubation, and medication administration are rarely required, and comprise the smallest area at the bottom of the inverted pyramid.

Meconium Aspiration

A child born with thin meconium staining who appears active and without respiratory distress needs only routine oral and nasal suctioning and standard newborn care. On the other hand, a child born with thick

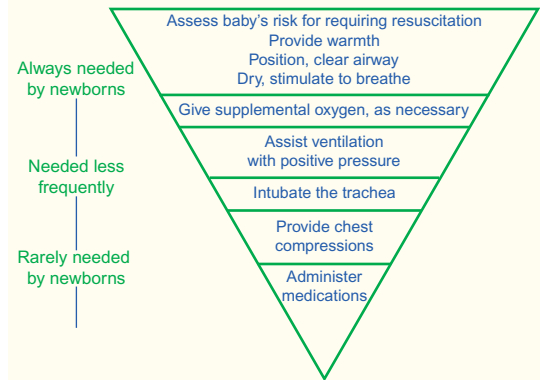


Figure 9-15 The relationship between resuscitation procedures and the number of newly born babies who need them. Source: Kattwinkel J, ed. *Textbook of Neonatal Resuscitation*. 5th ed. Elk Grove, IL: American Academy of Pediatrics and American Heart Association; 2006:1–2.

meconium staining who is not vigorous despite suctioning on the perineum needs further aggressive suctioning of the mouth and nose. *However, suctioning of meconium should not distract from the need for emergent oxygenation and ventilation of the newly born.* In the patient with meconium aspiration and respiratory failure or apnea, quickly perform endotracheal suctioning of meconium. Then provide ventilation with a clean endotracheal tube or by bag-mask device.

A meconium aspirator device may facilitate endotracheal suctioning in an intubated newborn with absent or ineffective respiratory effort. However, the use of this device has not been studied in the prehospital setting and its impact on clinical outcome is unknown.

Controversy

A meconium aspirator device may facilitate tracheal suctioning in an intubated newly born with absent or ineffective respiratory effort. However, the use of this device has not been studied in the prehospital setting and its impact on clinical outcome is unknown.

Shock

Shock at birth is most commonly due to **asphyxia** (severe hypoxia in the womb or during delivery) and **acidosis**. Blood loss during delivery due to umbilical cord avulsion or fetal-placental transfusion is an uncommon cause of shock in the newly born. Signs and symptoms of shock, whatever the cause, include abnormal appearance (lethargy, hypotonia), abnormal color (pallor, mottling), tachycardia, and prolonged capillary refill time. Hypothermia may also mimic these findings.

Advanced Life Support

Treatment of Shock

Because intrauterine or perinatal asphyxia is the most common cause of depression in the newly born, initial resuscitative efforts should ensure adequate oxygenation and ventilation. Volume resuscitation is rarely needed. In exceptional circumstances where hypovolemic shock is suspected, consider placing an IO line. Isotonic crystalloid is recommended at a dose of 10 mL/kg. Fluid resuscitation should be limited in premature infants, as giving volume expanders too rapidly has

been associated with intraventricular hemorrhage. The only medication likely to be used in newly born resuscitation is epinephrine, which may be administered via the endotracheal tube or through an IV or IO line.

Summary of Depressed Newly Born Resuscitation

The typical newly born response to hypoxia is apnea and bradycardia. *The primary treatment of the depressed newly born therefore involves reversal of hypoxia with immediate bag-mask ventilation with supplemental (100%) oxygen.* If the child does not improve, begin chest compressions and perform endotracheal intubation on the scene before transport. Shock is rare, and is most commonly the result of asphyxia. Hypovolemia is an uncommon cause of shock in the newly born. If hypovolemic shock is suspected, transport immediately and initiate volume resuscitation via IV or IO line on the way to the hospital.

Advanced Life Support

Vascular Access

Vascular access is rarely needed in newly borns in the field because resuscitation is largely focused on airway management and breathing.

In reality, establishing vascular access is challenging in the newly born and its benefits must be carefully weighed against prolonged on scene time and potential complications. IV access may be attempted in the **antecubital fossae** or the **saphenous vein** at the ankle. Intraosseous infusion is an alternative.



Treat a hypovolemic newly born like an acute trauma patient with life-threatening blood loss.

When there is no IV or IO access, give resuscitation medications such as epinephrine through the endotracheal tube. Do not give other solutions such as sodium bicarbonate or dextrose through the endotracheal tube, as these are damaging to the lungs.

Umbilical catheterization in the field is a controversial procedure. While this route of vascular access is widely used in the neonatal intensive care unit, there will be very few opportunities for the prehospital professional to practice and maintain this skill, and serious complications can occur. *Intraosseous infusion may be preferable if vascular access is clearly necessary for resuscitation, and a peripheral IV cannot be placed.*

Stabilization for Transport

The active term infant requires no intervention or electronic monitoring during transport. Be sure the child is restrained as per local EMS system policy. In some systems it is acceptable to restrain the mother appropriately and allow her to hold the baby during transport. Encourage her to breastfeed the active infant if possible. This may prevent hypoglycemia and promote maternal-infant bonding, uterine contractions, and decreased uterine bleeding. Provide a warm environment in the ambulance.

Transport of the Compromised Newly Born

Oxygen Therapy

Give supplemental oxygen if the newly born is hypoxic (pulse oximetry < 95% on room air).

Monitoring

After resuscitation, reassess the status of the infant throughout transport. Place cardiac leads in the same position as in an adult. A heart rate between 120 and 160 beats/min is normal in a newly born. If heart rate decreases, follow the procedures for depressed newly born management.

Attach an infant pulse oximetry probe on a finger or toe. If unable to get an accurate reading, the probe may have to be placed around the hand or the foot. Saturations between 90% and 100% are normal. Although there are negative effects of **hyperoxia** (high oxygen saturation) in the newly born, if the baby is distressed, the goal in the field should be to ensure adequate oxygenation through administration of supplemental oxygen and assisted ventilation when needed.

Hypothermia

Hypothermia develops quickly in newly borns. Oxygen demand triples when skin temperature drops by 1 degree. Signs of hypothermia are similar to those of shock. Keep the baby warm during transport. Have



If commercial warm packs are used to prevent or treat hypothermia in the newly born, place a towel between the infant's skin and the device. The combination of thin skin, little subcutaneous fat, and an inability to communicate discomfort puts them at high risk for burns.

a small knit cap available to cover the infant's head. Turn the heat on in the ambulance even at the risk of discomfort to the mother and crew. Place the baby on the mother's bare chest (skin-to-skin contact) and cover both of them to maintain the infant's temperature.

Advanced Life Support

Transport of the Compromised Newly Born: Hypoglycemia

The depressed newly born or prematurely delivered baby is at risk for hypoglycemia, but this complication is unlikely to develop

in the first 30 minutes of life. If transport times are longer, measure a bedside glucose level at approximately 30 minutes after birth, or immediately in any baby who has a drastic change in responsiveness or perfusion. If a serum glucose of less than 40 mg/dL is documented in a depressed newly born, and an IV or IO line can be established in transport, give 10% dextrose in a 2 mL/kg push. Re-check serum glucose every 30 minutes during long transports. If the infant has documented hypoglycemia but is active, in no respiratory distress, and has a **suck reflex**, allow her to breastfeed or offer her 20 to 30 mL of 5% dextrose by bottle.

Case Study 3

Upon arriving at the home of a family who had called 9-1-1 for labor, you find a woman has just delivered an apparently term female infant that is still attached to the umbilical cord and is not crying or moving.

1. Discuss the scene management of the baby.
2. What is the role of vascular access?