Table 40-3 Causes of Delayed Transition in Newborns

- Hypoxia
- Hypothermia
- Acidosis
- Meconium aspiration or pneumonia
- Delayed resorption of lung fluid (eg, cesarean section without labour)
- Maternal narcotics or anesthesia

age (SGA) or *large for gestational age* if the birth weight is greater than the 97th percentile for the gestation (LGA). All others are *appropriate for gestational age*, or AGA.

Arrival of the Newborn

Use any time available before the infant arrives to take a patient history and prepare the environment and equipment that may be necessary. Key questions you need to ask when you are at a scene involving a pregnant woman or a recent home birth include the mother's age; has she had antenatal care; how many babies is she expecting; length of the pregnancy (preferably expressed in weeks); the onset and frequency of contractions; the presence or absence of fetal movement; whether membranes have ruptured, including its timing and the makeup of the fluid (clear, meconium stained, or bloody); whether there have been any pregnancy complications (eg, diabetes, hypertension, ultrasound-diagnosed fetal anomalies); and any medications being taken. In the excitement of the moment these questions may seem trivial, but they help determine what resuscitation and equipment may be needed.

Notes from Nancy

Steps to Improve Fetal Circulation

- Roll the mother onto her side, to take the weight of her uterus off the great vessels.
- Administer 100% oxygen by mask to the mother.

Even if a piece of equipment is in a sealed sterile wrap, having it near at hand will expedite its use once the infant is delivered. At a minimum, you will need warm, dry blankets, a bulb syringe, two small clamps or ties, and a pair of clean scissors to cut the umbilical cord. Table 40-4 ▸ lists additional equipment that may be needed if more extensive resuscitation becomes necessary.

Special Considerations

A delay in clamping the umbilical cord and keeping the infant below the placenta may allow blood to flow into the infant, which can in turn lead to polycythemia (an abnormally high red blood cell count). The reverse is also true, and even more concerning in the short term, because the newborn may lose half of his or her blood volume into the placenta if it is held much higher than the placenta prior to cord clamping. Never "milk" the cord before clamping.

Table 40-4 Preparation of Area for Newborn Resuscitation*

Resuscitation Equipment and Supplies

- Suction equipment
- Bulb syringe or mechanical suction and tubing, suction catheters, 5F, 6F, 8F, or 10F
- 20-ml syringe
- Meconium aspirator

Bag-Valve-Mask Equipment

- Device for delivering positive-pressure ventilation
- Face masks, newborn and premature infant size (cushioned-rim masks preferred)
- Oral airways, newborn and premature size
- Oxygen source with flow meter (flow rate up to 10 l/min)
- Oxygen blender and pulse oximeter

Intubation Equipment

- Laryngoscope with straight blades, size 0 (preterm) and 1 (term)
- Extra bulb, batteries for laryngoscope
- Endotracheal tubes size 2.5, 3.0, and 3.5
- Stylet (optional)
- Scissors and tape for securing endotracheal tube
- CO_2 detectors
- Laryngeal mask airway (optional)

Medications

- Epinephrine 1:10,000 (0.1 mg/ml), 3- or 10-ml ampules
- Isotonic crystalloid (normal saline or lactated Ringer's solution), 100- or 250-ml bag
- Sodium bicarbonate, 4.2% (5 mEq/10 ml) (optional)
- Naloxone hydrochloride, 0.4- or 1.0-mg/ml ampule (optional)
- Dextrose, 10%, 250 ml

Umbilical Cannulation Equipment

- Sterile gloves
- Scalpel or scissors
- Antiseptic solution
- Umbilical tape
- Umbilical cannulas, 3.5F, 5F (a sterile 3.5F feeding tube can be used in an emergency)
- Three-way stopcock
- Syringes, 1, 3, 5, 10, 20, and 50 ml
- Needles, 25, 21, and 18 gauge

Miscellaneous

- Gloves and appropriate PPE protection
- Radiant warmer or other heat source
- Firm, padded resuscitation surface
- Clock with second hand, timer optional
- Towels, linen
- Stethoscope, neonatal or pediatric preferred
- Cardiac monitor or saturation monitor (optional at delivery)
- Oropharyngeal airways (0, 00, and 000 sizes or 30-, 40-, and 50-mm long)
- Manometer for PPV
- Pulse oximeter

*Adapted from the American Academy of Pediatrics Neonatal Resuscitation Program

If the infant is delivered in the ambulance, the foot of the mother's bed, covered with clean, warm blankets, can be used for the initial stabilization steps. The newborn can then be placed on mother's chest after you confirm adequate patency of the airway, breathing, and pulse rate. If more extensive resuscitation is needed, the foot of the mother's bed can be used.

Optimally the newborn will be transitioned to a second ambulance equipped with a neonatal transport incubator to allow maintenance of the baby's temperature and observation of the newborn's colour, respirations, and muscle tone.

If the umbilical cord comes out ahead of the baby (which is more common with polyhydramnios, a condition characterized by extra amniotic fluid or breech presentation), the blood supply through the umbilical cord may be cut off. In this case, relieving pressure on the cord can be lifesaving. This is done by having the mother assume a knee-to-chest, or Trendelenburg position. Then, using two gloved fingers inserted into the vagina, elevate the presenting part of the baby off of the cord and maintain this position. Finally, cover the exposed cord with a moist sterile dressing.

After the infant is delivered, keep the baby at the level of the mother, with the head slightly lower than the body, to facilitate drainage of secretions Figure 40-2 ▸. There is evidence for delaying cord clamping for at least 1 minute in term and preterm newborns not requiring resuscitation. However, do not delay cord clamping if the newborn requires resuscitation.

Clamp the umbilical cord in two places and cut between the clamps. Suctioning of the oropharynx was once routine, but is now reserved for babies who have an obvious obstruction to spontaneous breathing or require positive-pressure ventilation.

Dry the infant well to limit body temperature loss through convection, then wrap the infant in warm blankets or place on the mother's bare skin and cover to maintain the baby's temperature via conduction from the mother.

Your initial rapid assessment of the newborn may be done simultaneously with any treatment interventions. Note the time of delivery, and monitor the ABCs. In particular, assess respiratory rate, respiratory effort, pulse rate, and pulse oximetry measures on the right upper extremity.

Notes from Nancy

Don't milk the umbilical cord Figure 40-3 ▸.

Nearly 90% of newborns are vigorous term babies. All newborns are cyanotic immediately after birth, but quickly

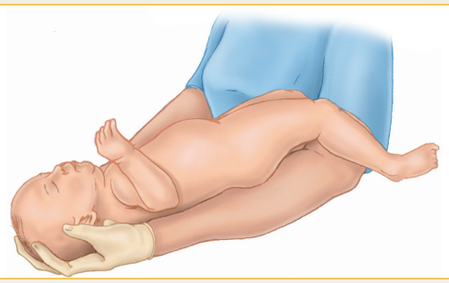

Figure 40-2 Positioning. Immediately after delivery, hold the baby with the head slightly lower than the body to facilitate drainage of secretions.

Figure 40-3

You are the Paramedic Part 2

Your patient tells you that this is her third pregnancy and that her first two pregnancies resulted in normal deliveries. At her last doctor's appointment, her obstetrician told her that he did not anticipate any problems and that the baby was in a head-down position in the uterus (fully engaged).

Your partner obtains baseline vital signs as you perform a visual examination of the patient's vaginal area and put on appropriate PPE attire. Your examination reveals crowning of the baby's head. You immediately position the patient appropriately and open the OB kit.

Vital Signs	Recording Time: 3 Minutes
Skin	Pink, warm, and moist
Pulse	110 beats/min, strong and regular
Blood pressure	106/60 mm Hg
Respirations	24 breaths/min; adequate tidal volume
Spo_2	98% on room air

4. What equipment and supplies should be available in case the infant requires resuscitation?

become centrally pink. The hands and feet will remain peripherally cyanosed with poor capillary refill typically for hours after delivery, so assessment of circulation should be done centrally, preferably over the sternum. If the newborn remains vigorous and pink, ongoing observation and continued thermoregulation with direct skin-to-skin contact with the mother should be maintained while on the way to a local hospital. Bonding with the mother should be encouraged in a well-appearing newborn.

The Apgar Score

The Apgar score, named after Dr. Virginia Apgar, who developed this measure in 1953, helps determine the need for and the effectiveness of resuscitation. The Apgar score is determined on the basis of the newborn's condition at 1 and 5 minutes after birth Table 40-5. If the 5-minute Apgar score is less than 7, the newborn's condition should be reassessed and a new score assigned every 5 minutes until 20 minutes after birth. Normal newborns have Apgar scores of 7 or 8 and 9 at 1 and 5 minutes, respectively.

Need for Resuscitation

Not all deliveries go so smoothly. Approximately 6% to 10% of newborns need additional assistance and 1% need major resuscitation to survive.

After the initial steps following delivery (bulb suctioning mouth and nose, drying, stimulating) are followed for 30 seconds, if the newborn has not responded, further intervention is indicated. Assess the newborn's respiratory rate, respiratory effort, pulse rate, and colour. Count the respiratory rate and pulse rate for 6 seconds and then multiply by 10 to quickly determine the rate per minute. The pulse rate can be determined either by auscultation or by feeling the base of the umbilical cord at the baby's abdomen, as the umbilical artery should still have pulsatile flow Figure 40-4. Many newborns become centrally pink but have blue hands and feet (acrocyanosis). If the baby maintains central cyanosis of the trunk or mucous membranes, provide supplemental free-flow oxygen as well as stimulation.

If the baby is apneic (ie, has a 20-second or longer respiratory pause) or has a pulse rate less than 100 beats/min after 30 seconds of drying and stimulation and supplemental free-flow (blow-by) oxygen, begin positive-pressure ventilation (PPV) by bag-valve-mask device, being sure to use a newborn sized bag-valve-mask. You should use caution when squeezing the bag in order to avoid inadvertently delivering too much volume, potentially resulting in a pneumothorax. It is preferable to have a manometer attached to the bagging circuit to reduce the risk of barotraumas. An inspiratory pressure of 25 to 33 mm Hg is often needed to move the chest of a term newborn. After 30 seconds of adequate ventilation by PPV with 100% oxygen via a bag-valve-mask device, if the infant's pulse rate is less than 60 beats/min, begin chest compressions. Effective chest compressions should result in palpable femoral and brachial pulses.

Fewer than 1% of deliveries involve bradycardia that requires treatment with chest compressions. The most common etiology for bradycardia in a neonate is hypoxia, which is readily reversed by effective PPV. Profound hypoxia or shock is also the cause of cardiac arrest, which is almost always a secondary event in these small patients. If ventilation and chest compressions do not improve the bradycardia, administer epinephrine via the IV route, preferably an umbilical venous line. The drug may also be given via endotracheal (ET) intubation, but requires 10-fold dosing to be effective. Infants who have required active resuscitation for 20 minutes or longer rarely have positive long-term outcomes. If a spontaneous heartbeat has not been established after 10 minutes, you should consider stopping resuscitation. If spontaneous breathing has not been established after 20 minutes of resuscitation, the outcomes are likely very poor. You should seek further advice regarding

Table 40-5 The Apgar Score

Condition	Description	Score
Appearance—skin colour	Completely pink	2
	Body pink, extremities blue	1
	Centrally blue, pale	0
Pulse rate	> 100	2
	< 100, > 0	1
	Absent	0
Grimace—irritability	Cries	2
	Grimaces	1
	No response	0
Activity—muscle tone	Active motion	2
	Some flexion of extremities	1
	Limp	0
Respiratory—effort	Strong cry	2
	Slow and irregular	1
	Absent	0

Figure 40-4 Feel for a pulse at the base of the umbilical cord.

discontinuation of life support. However, newborns are very resilient, and most respond readily to interventions.

Specific Intervention and Resuscitation Steps

Drying and Stimulation

After ensuring the patency of the airway by bulb suctioning of the newborn's mouth and nose, dry and stimulate the infant. Flick the soles of the baby's feet and gently rub the baby's back. Avoid rubbing too roughly or slapping the baby, since these actions may lead to traumatic injury.

Free-Flow Oxygen

If an infant is cyanotic or pale, provide supplemental oxygen. Given that 50 g/l of deoxygenated hemoglobin is needed before clinical cyanosis becomes apparent, a severely anemic hypoxic infant will be pale, but not cyanotic. Warm and humidify the oxygen if it will be provided for more than a few minutes. If PPV is not indicated (ie, the pulse rate is greater than 100 beats/min and the infant has adequate respiratory effort), oxygen can initially be delivered through an oxygen mask or via oxygen tubing within a hand that is cupped and held close to the infant's nose and mouth Figure 40-5. For babies at term, the administration of oxygen should be regulated by blending oxygen and air, and the amount delivered guided by pulse oximetry monitored from the right upper arm. Hyperoxia can be toxic to newborns, particularly the preterm baby. The oxygen flow rate should be set at 5 l/min. Do not blow oxygen directly into the newborn's eyes.

Oral Airways

Oral airways are rarely used for neonates, but they can be lifesaving if airway obstruction leads to respiratory failure. Bilateral choanal atresia (bony or membranous obstruction of the back of the nose preventing air flow) can be rapidly fatal, but usually responds to placement of an oral airway (or a gloved finger to maintain an open mouth until an adequate oral airway is located). The Pierre Robin sequence includes a small chin, a cleft palate, and posteriorly positioned tongue that frequently leads to airway obstruction. Positioning the patient prone (chest down) may relieve the obstruction, as the tongue flops forward. If not, insert an oral airway. As with infants and small children, use a tongue blade to depress the tongue and insert the oral airway without rotating it.

Figure 40-5 Free-flow oxygen device.

Bag-Valve-Mask Ventilation

Bag-valve-mask ventilation is indicated when an infant is apneic, has inadequate respiratory effort, or has a pulse rate of less than 100 beats/min (bradycardia) after you clear the airway of secretions, relieve obstruction from the tongue, and dry and stimulate the infant. Signs of respiratory distress that suggest a need for ventilation support include periodic breathing, intercostal retractions (sucking in between the ribs), nasal flaring, and grunting on expiration. Respiratory distress occurs in approximately 8 of every 1,000 live births and accounts for approximately 15% of neonatal deaths. Table 40-6 summarizes the most common conditions leading to respiratory distress.

Three devices may be used to deliver bag-valve-mask ventilation to a neonate. First, you may use a self-inflating bag with an oxygen reservoir (an oxygen source is not necessary to provide PPV but is necessary to provide supplementary oxygen). Second, you may use a flow-inflating bag, though it needs a gas source to provide PPV; this technique is therefore more common in the operating room. Third, you may apply a T-piece resuscitator (mostly found in neonatal intensive care units) or delivery suites.

In the prehospital setting, you will most likely use a self-inflating bag for bag-valve-mask ventilation. If available, always use the infant size (240 ml). Given that the breath size (tidal volume) of a neonate is only 5 to 8 ml/kg, less than one tenth of the bag's volume will be used for each breath—which explains why a larger bag can easily create problems.

Table 40-6 Common Causes of Respiratory Distress

- Hyaline membrane disease
- Lung immaturity in very premature infants
- Wet lungs, transient tachypnea of newborn
- Meconium aspiration
- Congenital diaphragmatic hernia
- Pneumothorax
- Shock due to sepsis or hypovolemia
- Cardiac abnormality (eg, transposition of the great arteries, total anomalous pulmonary venous drainage, hypoplastic left heart syndrome)
- Persistent pulmonary hypertension
- Choanal atresia
- Tracheo-esophageal fistula (TEF) and/or esophageal atresia (EA)
- Pneumonia
- Metabolic derangement (eg, hypoglycemia, polycythemia)
- Central nervous system disorders (eg, vein of Galen anomaly)