Chapter 42 Neonatal Care

Unit Summary

This chapter reviews the physiologic changes that occur in a newborn during birth, the care that should be provided during and immediately after birth, and the special needs of premature births or births complicated by other factors. It also reviews the steps involved in neonatal resuscitation and outlines the process of transporting an infant to a hospital or between hospitals.

National EMS Education Standard Competencies

**Special Patient Populations**

Integrates assessment findings with principles of pathophysiology and knowledge of psychosocial needs to formulate a field impression and implement a comprehensive treatment/disposition plan for patients with special needs.

***Neonatal Care***

Anatomy and physiology of neonatal circulation (pp 1963-1968)

Assessment of the newborn (pp 1963-1970)

Presentation and management

• Newborn (pp 1964-1967)

• Neonatal resuscitation (pp 1970-1977)

Knowledge Objectives

1. Explain terminology associated with infants, including newborn versus neonate. (p 1963)
2. List antepartum and intrapartum risk factors that can lead to a need for neonatal resuscitation. (pp 1963-1964)
3. Discuss the process of transitioning from a fetus to a newborn. (p 1964)
4. List causes of delayed transition in newborns. (p 1964)
5. Discuss measures to take to prepare for neonatal resuscitation. (pp 1964-1966)
6. List equipment for neonatal resuscitation. (pp 1964-1967)
7. Discuss the initial steps of assessment for neonates, including drying and warming, positioning, suctioning, and stimulation. (pp 1963-1970)
8. Explain how to measure essential parameters including pulse rate, color, and respiratory effort. (pp 1964-1967)
9. Discuss Apgar scores, including how and when to obtain them. (pp 1967, 1968)
10. Discuss how to determine whether a neonate requires resuscitation. (pp 1968-1970)
11. Discuss methods used to improve oxygenation during neonatal resuscitation, including the use of positive end-expiratory pressure, free-flow oxygen, oral airways, and bag-mask devices. (pp 1970-1975)
12. Describe the technique for using a bag-mask device on a neonate. (pp 1971-1972)
13. Discuss when endotracheal intubation is required in a neonate. (pp 1972-1973)
14. Describe vascular access considerations in the neonate. (p 1977)
15. Discuss pharmacologic interventions used to treat specific emergencies in a neonate, including bradycardia, low blood volume, acidosis, respiratory depression secondary to narcotics, and hypoglycemia. (pp 1977-1979)
16. Describe family and transport considerations that apply to neonatal emergencies. (p 1979)
17. Discuss the pathophysiology, assessment, and management of specific emergencies including pneumothorax, meconium-stained amniotic fluid, diaphragmatic hernia, and apnea or inadequate respiratory effort. (pp 1979; 1980-1982)
18. Discuss the pathophysiology, assessment, and management of hypoglycemia in a neonate. (p 1986)
19. Discuss the pathophysiology, assessment, and management of premature or low birth weight infants. (pp 1983-1984)
20. Discuss the pathophysiology, assessment, and management of seizures in neonates. (pp 1984-1986)
21. Discuss the pathophysiology, assessment, and management of emergencies related to thermoregulation, including fever and hypothermia. (pp 1988-1989)
22. Discuss the pathophysiology, assessment, and management of vomiting in a neonate. (pp 1986-1987)
23. Discuss the pathophysiology, assessment, and management of diarrhea in a neonate. (pp 1987-1988)

Skills Objectives

1. List the steps of neonatal resuscitation. (pp 1968-1977)
2. Describe the technique for performing endotracheal intubation in a neonate. (pp 1972-1975, ***Skill Drill 1***)
3. Describe the technique for inserting an orogastric tube in a newborn. (pp 1975-1976, ***Skill Drill 2***)
4. Explain how to perform chest compressions on a neonate. (pp 1975-1976)
5. Describe the technique for cannulating the umbilical vein in a newborn. (p 1977)

Readings and Preparation

• Review all instructional materials including Chapter 42 of *Nancy Caroline’s Emergency Care in the Streets*, Seventh Edition, and all related presentation support materials.

• Review all instructional materials including Chapter 41 of *Nancy Caroline’s Emergency Care in the Streets*, Seventh Edition, and all related presentation support materials.

Support Materials

• Lecture PowerPoint presentation

• Case Study PowerPoint presentation

• Skill Drill PowerPoint presentations

* Skill Drill 42-1, Intubating a Newborn
* Skill Drill 42-2, Inserting an Orogastric Tube in the Newborn

• Skill Evaluation sheets

* Skill Drill 42-1, Intubating a Newborn
* Skill Drill 42-2, Inserting an Orogastric Tube in the Newborn

Enhancements

• Direct students to visit the companion website to *Nancy Caroline’s Emergency Care in the Streets*, Seventh Edition, at http://www.paramedic.emszone.com for online activities.

• The Eunice Kennedy Shriver National Institute of Child Health and Human Development, offers links to neonatal research at the following website: http://www.nichd.nih.gov/research/supported/nrn.cfm

**Content connections:** This chapter directly relates to Chapter 7, 8, and 9 of *Nancy Caroline’s Emergency Care in the Streets*, Seventh Edition, which deal with anatomy, physiology, and life span development.

**Cultural considerations:** There are cultural issue that may effect the delivery of neonatal and newborn care. A good resource for information with case studies can be found at the Transcultural Nursing website: http://www.culturediversity.org

Teaching Tips

Treating newborns or neonates are some of the most intense calls a paramedic will encounter. It is important to place emphasis on the fact that these patients are not simply small adults. As long as your students perform a thorough and competent newborn/neonatal assessment, the care of the patient will become easier.

Unit Activities

**Writing activities:** Have students prepare a written paper discussing the controversy involving resuscitation with 100% oxygen in the care of newborns.

**Student presentations:** Students may present their written assignment or the group activity may be used.

**Group activities:** Assign each group one of the congential heart disorders discussed within the chapter. Students should be responsible for discussing the incidence, assessment, and prehospital care of their assigned topic.

**Visual thinking:** Provide color pictures of newborn infants to your students. Have the students determine the APGAR score for each picture.

**Medical terminology:** The terminology “newborn” and “neonate” is often a point of confusion. A newborn refers to an infant within the first few hours after birth; a neonate refers to an infant within the first month after birth.

Pre-Lecture

### You are the Medic

“You are the Medic” is a progressive case study that encourages critical-thinking skills.

### Instructor Directions

Direct students to read the “You are the Medic” scenario found throughout Chapter 42.

• You may wish to assign students to a partner or a group. Direct them to review the discussion questions at the end of the scenario and prepare a response to each question. Facilitate a class dialogue centered on the discussion questions and the Patient Care Report.

• You may also use this as an individual activity and ask students to turn in their comments on a separate piece of paper.

Lecture

I. Introduction

A. Newborn or neonate care must be adapted to meet the needs of the population.

1. Newborn: An infant within the first few hours after birth

2. Neonate: An infant within the first month after birth

B. If a newborn needs special support and intervention by trained caregivers, parents may feel inadequate.

1. Supporting the needs of both the newborn and caregivers is important.

a. Allow them to be as physically close as possible.

b. Explain what is happening.

c. Provide details for transport plan to the next level of care.

II. General Pathophysiology and Assessment

A. Additional skilled care intervention is needed for 10% of newborn deliveries.

1. Birth complications and mortality and morbidity increase as newborn’s birth weight and gestational age decrease.

a. Approximately 34,000 (8%) of newborns each year in the United States weigh less than 3 lb (1,500 g).

2. Initial steps of neonatal resuscitation include:

a. Airway (position and clear)

b. Breathing (stimulate to breathe)

c. Circulation (assess heart rate and oxygenation)

3. Initial steps of stabilizing a newborn include:

a. Warming the newborn to prevent hypothermia

i. Place on prewarmed towels or blankets and dry.

ii. Replace wet towels with dry, prewarmed ones.

iii. When resuscitation is complete, place the newborn on the mother’s chest or abdomen, another heat source, or under a radiant warmer.

b. Positioning the newborn

i. Position on the back or side with the neck in the sniffing position.

ii. Use a small shoulder roll to keep the head in this position.

c. Clearing the airway if necessary

i. Use a bulb syringe or suction catheter.

ii. Turn the head to the side.

iii. Suction the mouth before the nose to prevent aspiration.

(a) Suctioning hard or deeply can induce a vagal response and bradycardia.

iv. Return the head to the sniffing position.

d. Drying and stimulating breathing

i. Dry the head and body with towels to provide stimulation.

ii. Additional tactile stimulation methods include:

(a) Slapping/flicking soles of the feet

(b) Rubbing gently on the back or trunk

iii. Keep appropriate position of the head throughout stimulation.

4. Additional resuscitation steps include:

a. Providing supplemental oxygen

b. Assisting in ventilation by providing positive pressure

c. Intubating

d. Providing chest compressions

e. Administering medications

5. Complications during resuscitation must be anticipated and prepared for.

B. Transition from fetus to newborn

1. In utero, the fetus receives oxygen from the placenta.

2. As the fetus is delivered, fetal transition occurs, enabling the newborn to breath.

a. First breath triggered by mild hypoxia and hypercapnia from partial occlusion of the umbilical cord during delivery.

b. Tactile stimulation and cold stress promote early breathing.

c. Pulmonary vascular resistance drops as the lungs fill with air.

d. More blood flows to the lungs, picking up oxygen.

3. Delay in pulmonary pressure leads to:

a. Delayed transition

b. Hypoxia

c. Brain injury

d. Death

4. Gestation times:

a. Preterm—less than 37 completed weeks

b. Term—38 to 42 completed weeks

c. Post-term—more than 42 weeks

C. Arrival of the newborn

1. Obtain a patient history, and prepare the environment and equipment with any available time.

a. Key questions to help determine resuscitation and needed equipment include:

i. Woman’s age

ii. Length of pregnancy

iii. Presence and frequency of contractions

iv. Presence or absence of fetal movement

v. Any pregnancy complications

vi. If membranes have ruptured

(a) Timing

(b) Makeup of fluid

vii. Medications being taken

2. 90% of newborns are vigorous and at term, and transition well with basic intervention.

a. Minimum needs:

i. Warm, dry blankets

ii. Bulb syringe

iii. Two small clamps or ties

iv. A pair of clean scissors

b. Complications need prompt management.

3. If delivered in the ambulance:

a. Cover the foot of the stretcher with clean, warm blankets for the initial stabilization.

b. After confirming adequate airway, breathing, and pulse rate, place the newborn on the mother’s chest.

c. If more extensive resuscitation is necessary, transition newborn to a second ambulance with a neonatal transport incubator.

4. Suction the mouth, then the nose with a bulb syringe once the head is delivered.

5. Keep the newborn at the level of the mother after delivery, with head slightly lower than the body.

6. Clamp the umbilical cord in two places and cut cord between clamps.

a. If the cord comes out ahead of the newborn, the blood supply to the fetus may be cut off.

i. Relieve pressure on the cord by gently moving the newborn’s body off the cord and pushing the cord back.

7. Do an initial rapid assessment simultaneous with treatment interventions.

a. Note time of delivery.

b. Monitor ABCs.

c. Assess airway patency, respiratory rate and effort, tone, pulse rate, and color.

8. Newborn is at risk for hyperthermia.

a. Ensure thermoregulation by:

i. Placing the newborn on prewarmed towels or radiant warmer

ii. Drying the head and body thoroughly

iii. Discarding wet towels and covering with a dry towel

iv. Covering the head with a cap

9. Position the newborn to ensure a patent airway, clear secretions, and assess the respiratory effort.

10. All babies are cyanotic right after birth.

a. If the newborn stays vigorous and begins to turn pink in the first 5 minutes:

i. Maintain ongoing observation.

ii. Continue thermoregulation with direct skin-to-skin contact with mother while en route.

D. The Apgar score

1. The Apgar score helps record the newborn’s condition in the first few minutes after birth.

a. Helps paramedics determine specific resuscitation measures needed and their effectiveness

b. Each sign is given a value of 0, 1, or 2.

c. Recorded at 1 and 5 minutes after birth.

i. If the 5-minute score is less than seven, an additional score should be done every 5 minutes until 20 minutes after birth.

d. If resuscitation is necessary, the Apgar score is done by determining the resuscitation results.

E. Algorithm for neonatal resuscitation

1. Approximately 10% of newborns need additional assistance, and 1% need major resuscitation.

2. The American Academy of Pediatrics and the American Heart Association have developed an algorithm to optimize the outcome of resuscitation for complicated births.

a. Interventions, assessment, and determination of need to progress to the next level delineated in 30-second intervals.

3. Following delivery, the initial resuscitation steps should be done for 30 seconds.

a. If no response, further intervention is needed.

b. Asses respiratory rate and effort, pulse rate, and color.

i. Determine respiratory and pulse rate per minute by counting them for 6 seconds and multiplying by 10.

ii. Determine pulse rate by auscultation or feeling the base of the umbilical cord at the baby’s abdomen.

iii. Many newborns have blue hands and feet (acrocyanosis) after they turn pink.

(a) If there is a normal breathing pattern and pulse rate greater than 100 beats/min, but central cyanosis of the trunk or mucous membranes, provide supplemental free-flow oxygen.

iv. If still apneic or has a pulse rate of less than 100 beats/min after 30 seconds of drying, stimulation, and oxygen:

(a) Begin positive-pressure ventilation (PPV) by a newborn-sized bag-mask device.

(1) Be careful to not squeeze the bag too hard in order to avoid delivering too much volume.

(2) If blended oxygen is not available, start with room air, then switch to 100% oxygen if needed.

(3) If pulse rate is less than 50 beats/min, begin chest compressions in addition to PPV.

4. Fewer than 1% of deliveries result in bradycardia that requires chest compressions.

a. Most common etiology is hypoxia, which is reversed by PPV.

b. A less common etiology is tension pneumothorax, which is treated with needle decompression.

c. If ventilation and chest compression do not improve the bradycardia, administer epinephrine via IV line or ET intubation.

III. Specific Intervention and Resuscitation Steps

A. Drying and stimulation

1. After ensuring airway patency, dry and stimulate the newborn.

a. Nasal suctioning stimulates the newborn to breathe.

i. Position on the back or side with the neck in the sniffing position.

ii. If airway is not clear, suction with the head turned to the side.

iii. Suction mouth before nose.

b. Flick the soles of the feet and gently rub the back.

B. Airway management

1. Free-flow oxygen

a. If a newborn is cyanotic or pale, provide supplemental oxygen.

i. Clinical cyanosis only becomes apparent when 5 g/dL of hemoglobin is deoxygenated.

(a) Provide oxygen to a pale newborn until a pulse oximeter reading can give an accurate reading.

b. If PPV is not indicated, oxygen can initially be delivered through:

i. Oxygen mask

ii. Oxygen tubing cupped and held close to the newborn’s nose and mouth.

c. Oxygen flow rate should be 5 L/min.

2. Oral airways

a. Rarely used on newborns.

b. Conditions that may require oral airways:

i. Bilateral choanal atresia

ii. Pierre Robin sequence

iii. Macroglossia (large tongue)

iv. Craniofacial defects that affect the airway

c. In all these cases (except bilateral choanal atresia), an ET tube is inserted down a nostril.

i. Keep the mouth open to provide adequate ventilation.

d. Bilateral choanal atresia: Bony or membranous obstruction of the back of the nose

e. The Pierre Robin sequence: Series of developmental anomalies that include:

i. Small chin

ii. Posteriorly positioned tongue

3. Bag-mask ventilation

a. Indicated when a newborn:

i. Is apneic

ii. Has inadequate respiratory effort

iii. Has a pulse rate of less than 100 beats/min after:

(a) Airway is cleared of secretions.

(b) Tongue obstruction is relieved.

(c) Newborn is dried and stimulated.

b. Signs of respiratory distress suggesting need for bag-mask ventilation include:

i. Periodic breathing

ii. Intercostal retractions

iii. Nasal flaring

iv. Grunting on expiration

c. Three devices to deliver bag-mask ventilation to newborns:

i. Self-inflating bag with an oxygen reservoir—most likely to be found in the field

ii. Flow-inflating bag—needs a gas source, more common in surgery

iii. T-piece resuscitator—needs a gas source; usually found in neonatal intensive care units

d. When using the self-inflating bag, always use the infant size (240 mL) when available.

i. Only one tenth of the bag’s volume will be used for each breath.

ii. If a neonatal bag is not available, use a bag designed for adults or larger children provided that:

(a) The delivered breath size is appropriately small.

(b) Chest rise is monitored for excessive volumes of delivered breaths.

e. When administering bag-mask ventilation with 100% oxygen, the face mask should provide an airtight seal.

i. Airway should be patent and head should be in the sniffing position.

ii. The first few breaths after birth frequently need higher pressures (possibly 30 mm Hg).

iii. Subsequent breaths should have enough pressure to deliver a visible but not excessive chest rise.

f. The correct ventilation time (40 to 60 breaths/min) is important because a higher rate can cause:

i. Hypocapnia

ii. Air trapping

iii. Pneumothorax

g. Continue PPV as long as the pulse rate is less than 100 beats/min or the respiratory effort is ineffective.

i. If more than 1 minute of PPV is needed, hook the system to a pressure manometer.

h. Causes of ineffective bag-mask ventilation:

i. Inadequate mask seal on the face

ii. Incorrect head position

iii. Copious secretions

iv. Pneumothorax

v. Equipment malfunction

4. Intubation

a. Indicated when:

i. Meconium-stained fluid is present and the newborn is not vigorous (tracheal suctioning is indicated).

ii. Congenital diaphragmatic hernia is known and suspected, and respiratory support is necessary.

(a) Abdominal organs herniate through an opening in the diaphragm into the chest cavity.

iii. No response to bag-mask ventilation and chest compressions, necessitating ET administration of epinephrine

iv. Prolonged PPV needed

v. Craniofacial defects impede an adequate airway.

b. The following equipment should be available:

i. Suction equipment

ii. Laryngoscope

iii. Blades—straight

iv. Shoulder roll

v. Adhesive tape

vi. ET tube

vii. Stylet (used by some paramedics—must be secured at top of ET tube)

c. To properly intubate a newborn, refer to ***Skill Drill 42-1***.

d. Complications of ET tube placement include:

i. Oropharyngeal or tracheal perforation

ii. Esophageal intubation with subsequent persistent hypoxia

iii. Right mainstem intubation

e. Risks can be minimized by:

i. Ensuring optimal placement of laryngoscope blade

ii. Noting how far the ET tube is advanced

5. Gastric decompression

a. Indicated if:

i. Prolonged bag-mask ventilation (more than 5 to 10 minutes)

ii. Abdominal distention is impeding ventilation.

iii. Diaphragmatic hernia or gastrointestinal congenital anomaly

(a) Diaphragmatic hernias are suspected if:

(1) Decreased breath sounds on left side

(2) Scaphoid or concave abdomen

(3) Increased work of breathing

b. To properly insert an orogastric tube in the newborn, refer to ***Skill Drill 42-2***.

C. Circulation

1. Chest compressions

a. Indicated if pulse rate remains at less than 60 beats/min despite:

i. Positioning

ii. Clearing airway

iii. Drying and stimulations

iv. 30 seconds of effective PPV

b. Two people are needed for effective chest compressions while ventilating.

c. Two different techniques:

i. Thumb technique

(a) Preferred: Generates superior peak systolic and coronary arterial perfusion pressure while causing less fatigue in the provider

(b) Encircle the torso with both hands, with fingers supporting the spine.

(c) Place two thumbs side by side (one over the other in a small preterm baby) over the lower third of the sternum.

(d) Once the airway is secure or the newborn is intubated, chest compressions can be delivered from the head of the bed.

(1) Allows easier access to the umbilicus

ii. Two-finger technique

(a) Place the tips of index and middle fingers of one hand over the lower third of the sternum.

(b) The second hand supports the spine.

d. The compression depth is one third of the anteroposterior diameter of the chest.

i. The thumbs or fingers should be in contact with the chest at all times.

ii. Allow the chest to completely recoil after each compression.

e. Chest compressions and artificial ventilation should not be delivered simultaneously.

i. Coordinate 90 compressions and 30 breaths/min—equaling 120 events per minute (1/2 second each)

ii. The person doing the compressions should count out loud.

f. Pulse rate should not be assessed for at least 45 to 60 seconds after ventilation and chest compressions are established.

i. Interruption of chest compressions to assess the pulse may decrease perfusion of coronary arteries.

ii. If pulse rate is above 60 beats/min:

(a) Chest compressions can be stopped.

(b) Effective ventilation should continue at 40 to 60 breaths/min.

(c) Recheck pulse rate after 30 seconds.

iii. When the pulse rate goes above 100 beats/min, gradually slow the rate and decrease PPV pressure.

2. Vascular access

a. Emergent access is necessary for:

i. Fluid administration to support circulation

ii. IV resuscitation medication and therapeutic drugs

b. The umbilical vein can be catheterized with an umbilical vein line.

i. Clean the cord with antiseptic.

(a) Drape area with sterile towels, keeping the stump exposed.

(b) Place a sterile tie firmly around the base of the cord to control bleeding.

ii. Attach a 3-mL syringe and stopcock to a sterile 3.5F to 5F umbilical vein line catheter and prefill, turning the stopcock to off toward the patient.

iii. Cut the cord with a scalpel between the clamp and the cord tie, keeping about 1 to 2 cm from the skin.

iv. Insert a “low-UV line” into the umbilical vein

(a) Insert the catheter into this vein for a distance of 2 to 4 cm (less in preterm newborns) until blood can be aspirated.

(1) If advanced into the liver, may cause irreversible damage

(2) If advanced into the heart, may cause dysrhythmias

v. Flush the catheter with 0.5 mL of normal saline and tape into place.

c. A peripheral IV or IO line can be used, but a smaller needle should be used in newborns.

IV. Pharmacologic Interventions

A. Medications are rarely needed in newborn resuscitation because they can usually be resuscitated with ventilator support.

1. Medication dosages are based on weight.

a. A full-term newborn usually weighs 6½ to 9 lb and is 20 inches long.

b. A newborn at 28 weeks of gestation usually weighs 2½ lb and is 14¾ inches long.

B. Bradycardia

1. Often the result of inadequate ventilation and will respond to effective PPV

2. Epinephrine administration is indicated when a newborn still has a pulse rate of less than 60 beats/min after effective ventilation and chest compressions.

a. Recommended concentration: 1:10,000

b. Recommended dose: 0.1 to 0.3 mL/kg of 1:10,000 epinephrine IV, administered rapidly

i. Followed by 0.5- to 1-mL saline flush

c. The preferred method during resuscitation is through a low umbilical vein catheter.

d. Epinephrine can also be administered via ET tube while IV access is being established.

i. Recommended dose: 0.5 to 1 mL/kg of 10,000 epinephrine

e. Check pulse rate 1 minute after administering epinephrine (longer if by ET tube).

i. May repeat dose every 3 to 5 minutes for persistent bradycardia, ensuring that:

(a) Ventilation is adequate and effective

(b) ET tube is not dislodged

(c) Chest compressions are given to adequate depth

C. Low blood volume

1. If there is significant intravascular volume depletion, fluid resuscitation may be needed.

2. Causes may include:

a. Placenta abruptio

b. Twin-to-twin transfusion

c. Placenta previa

d. Septic shock

3. Signs of hypovolemia include:

a. Pallor

b. Persistently low pulse rate

c. Weak pulses

d. No improvement in circulatory status after adequate resuscitation efforts.

4. Place a low umbilical vein line in a newborn.

a. If more than a few days old, place a peripheral IV or IO line.

5. Fluid bolus in a newborn is 10 mL/kg given IV every 5 to 10 minutes of:

a. Saline

b. Lactated Ringer’s

c. O Rh-negative blood

6. Multiple boluses may be given if needed.

D. Acidosis

1. Suspected metabolic acidosis if bradycardia persists after:

a. Adequate ventilation

b. Chest compressions

c. Volume expansion

2. A saline bolus of 10-mL/kg normal saline may improve perfusion and clear acid.

E. Respiratory depression secondary to narcotics

1. If the mother is a drug addict, administration of naloxone (Narcan) to the newborn may cause potentially fatal seizures.

2. If a newborn has respiratory suppression from the mother’s chronic use of narcotics:

a. Provide ventilator support.

b. Transport immediately.

3. If respiratory depression is from the mother being treated acutely with narcotics:

a. 0.1 mg/kg of naloxone may be administered via IV or intramuscularly

F. Hypoglycemia

1. Most often seen in newborns:

a. Who are small for gestational age

b. Who are large for gestational age

c. Whose mothers were diabetic during pregnancy

2. Neurologic symptoms include:

a. Jitteriness

b. Decreased response to stimuli

c. Hypotonia

d. Apnea

e. Poor feeding

f. Seizures

3. Obtain baseline vital signs and oxygen saturation readings.

a. Provide as necessary:

i. Additional oxygen

ii. Assisted ventilation

iii. Blood pressure support

iv. IV access

4. If the blood glucose level is less than 40 mg/dL:

a. An IV bolus of 10% dextrose solution (2 mL/kg) can be given.

b. Recheck blood glucose level in about 30 minutes.

c. Dextrose IV administration may need to be followed by a 10% dextrose infusion at 60 to 100 mL/kg/d.

V. Family and Transport Considerations

A. Transport to the nearest facility to provide the next level of care once the newborn is stabilized as much as possible.

1. Contact the facility for advice regarding care and disposition.

2. Provide ongoing communication with the family about the current care.

a. Do not be specific about survival statistics.

b. If you cannot answer questions, tell them you will help find those who can.

3. During transport, monitor the newborn and frequently assess for status changes.

a. Vital to check:

i. Thermoregulation

ii. Respiratory effort

iii. Airway patency

iv. Skin color

v. Pulse rate

B. Development of new techniques for newborn care has reduced mortality among high-risk newborns.

1. It may be necessary to transfer critically ill newborns to a regional center to get needed treatment.

2. Transport of a high-risk newborn should include the following steps:

a. A physician at the referring hospital initiates a request for transport.

i. A physician at the region control center decides which intensive care nursery can accommodate the patient.

b. A mode of transportation is chosen depending on distance, availability, and weather conditions.

c. The transport team is mobilized and equipment assembled.

i. Ideal team consists of:

(a) A nurse with special training in neonatal intensive care

(b) A respiratory therapist with similar training

(c) A paramedic with an apprenticeship in neonatal intensive care

(d) A physician (for particularly critical patients)

ii. Highly specialized equipment includes:

(a) Appropriately designed ventilation and oxygenation units

(b) An incubator meeting stringent criteria

d. On arrival at the referring hospital, the transport team continues to stabilize the newborn.

i. Conditions that should be treated before leaving the referring hospital:

(a) Hypoxemia

(b) Acidosis

(c) Hypoglycemia

(d) Hypovolemia

e. The team collects information while stabilizing the newborn, including:

i. A copy of the mother’s and infant’s charts

ii. Any radiographic studies of the newborn

VI. Pathophysiology, Assessment, and Management of Specific Conditions

A. Apnea

1. Common in newborns delivered before 32 weeks of gestation

a. Rarely seen in the first 24 hours

b. Defined as respiratory pause of greater than 20 seconds

c. Can lead to hypoxemia and bradycardia

d. Often follows hypoxia or hypothermia

e. Other causes include:

i. Maternal or infant narcotic exposure

ii. Airway or respiratory muscle weakness

iii. Septicemia

iv. Prolonged or difficult labor and delivery

v. Gastroesophageal reflux

vi. Central nervous system abnormalities

vii. Metabolic disorders

f. Pathophysiology depends on the underlying etiology.

g. Newborns need respiratory support to minimize hypoxic brain damage and other organ damage.

2. Assessment and management

a. Assessment includes:

i. Careful history to find etiologic risk factors

ii. Performing a physical exam focusing on:

(a) Neurologic signs

(b) Signs and symptoms of infection

b. Differentiate between:

i. Primary apnea

(a) After a relatively short period of hypoxia, may have a period of rapid breathing followed by apnea and bradycardia

(b) Drying and stimulation may cause resumption of breathing and pulse rate improvement.

ii. Secondary apnea

(a) If hypoxia continues during primary apnea, the newborn will gasp and go into the secondary phase.

(b) PPV by bag-mask device is then necessary.

B. Bradycardia

1. Most frequently occurs in newborns because of inadequate ventilation

a. Often responds to effective PPV

b. Other causes include:

i. Hypothyroidism

ii. Acidosis

iii. Congenital atrioventricular block in newborns whose mothers have lupus

iv. Prolonged suctioning or attempts at intubation

v. Vagal stimulation from an inadequately secured ET tube or orogastric tube

c. Morbidity and mortality are determined by underlying cause and how quickly it is corrected.

2. Assessment and management

a. Heart rate is assessed by auscultation or palpating base of umbilical cord.

b. If heart rate is less than 100 beats/min, provide PPV.

c. Assess airway patency.

d. If less than 60 beats/min in spite of effective bag-mask ventilation:

i. Begin chest compressions per NRP guidelines.

e. If less than 60 beats/min after 30 seconds of effective ventilation and 30 seconds of chest compression:

i. Administer epinephrine.

(a) Recommended concentration: 1:10,000

(b) Recommended IV dose: 0.1 to 0.2 mL/kg of 1:10,000, administered rapidly, followed with a normal saline flush

(c) Recommended ET tube dose (if IV line not established): 0.3 to 1 mL/kg of 1:10,000

ii. Repeat dose every 3 to 5 minutes for persistent bradycardia.

C. Pneumothorax evacuation

1. Pneumothorax can occur if:

a. Infant inhales meconium at birth

b. Lung is weakened by infection

c. PPV is needed.

2. Signs of significant pneumothorax:

a. Severe respiratory distress unresponsive to PPV

b. Unilateral decreased breath sounds

c. Shift of heart sounds if pneumothorax on left side

3. Assessment and management

a. Clean area with alcohol around second intercostals space, midclavicular line

b. Prepare equipment:

i. 22-g butterfly needle attached to extension tubing

ii. Three-way stopcock

iii. 20-mL syringe

c. Palpate upper edge of second rib, and insert needle above it.

i. At the same time, a second provider pulls back on the syringe.

ii. Slowly advance the needle until air is recovered.

d. If syringe fills with air:

i. Turn stopcock off to newborn.

ii. Push air out from the syringe.

iii. Open stopcock to the newborn.

iv. Continue withdrawing air.

e. Remove the needle when there is no more air to be withdrawn.

f. If symptomatic ongoing air leak, insert a 22-g angiocatheter in a similar location.

i. May further tear the lung and is more likely to kink than the butterfly needle.

g. Tubing may be taped to chest and briefly occluded.

i. Place tubing in a small bottle of sterile water and release the tubing occlusion.

ii. Relieves pressure buildup until patient can be transported.

h. During transport, monitor for reaccumulation of the pneumothorax.

D. Meconium-stained amniotic fluid

1. Carries a high risk of morbidity

a. More common in:

i. Postterm newborns

ii. Those small for their gestational age

iii. Newborns stressed before or during delivery

2. If newborns pass stool before birth, they may inhale the meconium-stained amniotic fluid.

a. Airway may become plugged, causing:

i. Hypoxia, which can lead to:

(a) Atelectasis

(b) Persistent pulmonary hypertension

(c) Hypoxemia

(d) Aspiration pneumonitis

ii. Ball-valve effects with an increased risk of pneumothorax

b. May cause a delayed drop in pulmonary vascular resistance , which can cause:

i. Right-to-left shunting across the foramen ovale or the patent ductus arteriosus (persistent pulmonary hypertension of the newborn)

c. To decrease the risk of persistent pulmonary hypertension:

i. Ensure a clear airway.

ii. Keep newborn warm.

iii. Minimize stimulation.

iv. Provide supplemental oxygen when necessary.

3. If meconium aspiration occurs, follow closely for signs of deterioration.

4. Assessment and management

a. Determine if fluid is thin and green-stained or thick with particulates.

b. Assess activity level.

i. If crying and vigorous, use standard interventions.

ii. If depressed, do not dry or stimulate..

(a) Clear meconium from airway

(b) Intubate the trachea.

(c) Attach a meconium aspirator and suction catheter to the end of the ET tube.

(d) Suction the ET tube while withdrawing the tube from the trachea.

(e) Cover the meconium aspirator hole with your finger while suctioning.

c. If intubation is unsuccessful and the newborn is bradycardic, continue standard resuscitation per NRP guidelines.

i. Start with room air.

ii. If hypoxia persists, provide blended oxygen or 100% oxygen to reverse hypoxia.

(a) Preductal oxygen saturation takes about 10 minutes after birth to reach 90%.

iii. If the newborn remains bradycardic after effective PPV, initiate chest compressions and further interventions.

iv. Suspect airway occlusion or pneumothorax if the newborn does not respond well to resuscitation.

d. Take steps to minimize hypothermia.

e. Frequently reassess to ensure the newborn’s condition has not changed.

f. When transporting a newborn with these issues, stay in communication with a facility skilled at managing high-risk newborns.

E. Diaphragmatic hernia

1. An abnormal opening in the diaphragm

a. Causes the abdominal contents to herniate into the chest cavity

b. Causes the heart and mediastinum to shift to the contralateral side of the hernia

c. Postnatal signs and symptoms:

i. Respiratory distress

ii. Heart sounds shifted to the right

iii. Decreased breath sounds on the left

iv. Bowel sounds heard in the chest

v. Scaphoid abdomen

d. Mortality may be as high as 50%.

2. Assessment and management

a. A newborn may demonstrate:

i. Few or no symptoms

ii. Severe hypoxia and increased work of breathing

b. Resuscitate on 100% oxygen.

i. Bag-mask ventilation will distend intestines and compromise ventilations further.

ii. If PPV is necessary, place an ET tube, and deliver a peak ventilatory pressure of 25 mm Hg or less.

iii. Place an orogastric tube, and provide intermittent suctioning to minimize distention.

c. Monitor heart rate continuously during transport.

d. Ultimately requires surgical correction, so transport to a facility with a neonatal intensive care and pediatric surgery.

F. Respiratory distress and cyanosis

1. Single most common cause in the neonate is prematurity.

a. Respiratory causes include:

i. Airway obstruction

ii. Aspiration

iii. Pneumonia

iv. Pneumothorax

v. Tracheoesophageal fistula

vi. Congenital diaphragmatic hernia

vii. Immature lungs

b. Other causes:

i. Any process resulting in a delay in drop of pulmonary vascular resistance after birth leading to shunting of blood across the patent ductus arteriosus and patent foramen ovale

ii. Central nervous system depression

iii. Septic shock and severe metabolic acidosis

iv. Cardiac anomalies

2. Assessment and management

a. Ensure patent airway.

b. Check that the breathing is adequate.

c. Check to see that pulse is present.

d. Assess respiratory rate, respiratory effort, and breath sounds.

e. Ask parents about increased symptoms with feeding attempt.

f. Treatment includes:

i. Establishing patent airway

ii. Ensuring adequate oxygen delivery

iii. Establishing effective ventilation

iv. Ensuring adequate circulation

g. If resuscitative efforts do not result in improvement, needle thoracentesis may be a necessary.

G. Premature and low birth weight infants

1. Premature—newborns delivered before 37 weeks of gestation.

a. Often idiopathic, but maternal conditions associated with preterm labor and delivery include:

i. Maternal infection (including urinary tract infection)

ii. Chorioamnionitis

iii. Maternal illness leading to dehydration

iv. Placental insufficiency

v. Polyhydramnios

vi. Preeclampsia/eclampsia

vii. Pregnancy-induced hypertension

b. In addition to increased mortality, a number of morbidities are associated with prematurity:

i. Respiratory distress syndrome

ii. Respiratory suppression and apnea

iii. Hypothermia

iv. Sepsis

v. Central nervous system compromise

(a) Intraventricular hemorrhage

(b) Periventricular leucomalacia

c. Low birth weight—newborns weighing less than 5½ lb (2,500 g)

i. The most common etiology is prematurity

ii. Factors that can predispose a woman to deliver prematurely include:

(a) Genetic factors

(b) Infection

(c) Cervical incompetence

(d) Abruption

(e) Multiple gestations (twins, triplets)

(f) Previous delivery of a premature infant

(g) Drug use

(h) Trauma

iii. Other factors contributing to low birth weight include:

(a) Chronic maternal hypertension

(b) Smoking

(c) Placental abnormalities

(d) Chromosomal abnormalities

d. Morbidity and mortality are related to degree of prematurity.

i. Most delivered after 28 weeks of gestation who receive cardiovascular support survive long term.

ii. Those born at 24 weeks of gestation have high morbidity and mortality.

2. Assessment and management

a. To determine prematurity, rely on:

i. Physical features

(a) Maturity of skin

(b) Size of infant

(c) Degree of respiratory distress

ii. Information from family about gestational dating

(a) Last menstrual period

(b) Estimated due date

(c) Ultrasound dating

iii. Information related to maternal or fetal complications

b. To optimize survival for a newborn delivered prematurely in the field:

i. Provide cardiorespiratory support.

ii. Provide a thermoneutral environment.

iii. Use only minimum pressure necessary to move chest when providing PPV.

(a) Risk of retinopathy of prematurity, worsened by long-term oxygen exposure

c. Management focuses on:

i. Clearing airway

ii. Gentle stimulation

iii. Providing supplemental oxygen and PPV if needed

(a) Provide peak inspiratory pressures to maintain physiological chest rise.

iv. Provide chest compressions if effective ventilation does not result in adequate heart rate.

v. Maintain a warm environment.

H. Seizures in the newborn

1. Most distinctive sign of neurologic disease in the newborn

a. More common in premature newborns

b. Identified by direct observation in the field

i. Diagnosis is confirmed by electroencephalogram in the hospital.

c. The following are often mistaken for seizures in the newborn:

i. Normal movements when a newborn is drowsy or asleep

ii. Jitteriness

iii. Gastroesophageal reflux and choking episodes

d. Seizures are usually related to an underlying abnormality.

e. Seizures may interfere with:

i. Cardiopulmonary function

ii. Feeding

iii. Metabolic function

f. Prolonged seizures may cause brain injury.

2. Types of seizures

a. Subtle seizure—characterized by:

i. Eye deviation

ii. Blinking

iii. Sucking

iv. Pedaling leg movements

v. Apnea

b. Tonic seizure—characterized by:

i. Tonic limb extension

ii. Possible flexion of arms and leg extension

c. Focal clonic seizure—characterized by clonic, localized jerking

d. Myoclonic seizure—characterized by flexion jerks of upper or lower extremities

3. Multifocal seizure: Clonic activity that involves more than one site, is asynchronous, and is usually migratory

4. Generalized seizure: Activity that is bilateral, synchronous, and nonmigratory

5. Causes of seizures

a. Seizure onset up to 3 days after delivery are often caused by:

i. Hypoxic ischemic encephalopathy

ii. Hypoglycemia

iii. Other metabolic disturbances

b. Seizures that begin 3 days or longer after birth are likely from other causes:

i. Intracranial infections (meningitis)

ii. Epileptic syndromes

iii. Intracranial hemorrhage

iv. Development defects

v. Hypocalcemia

vi. Meningitis

vii. Encephalopathy

viii. Drug withdrawal

c. Hypoxic ischemic encephalopathy: Most common cause of seizures in newborns

d. Occur 12 to 24 hours after hypoxic event

i. Usually more severe over first 2 to 3 days of life.

e. Metabolic abnormalities include disturbances in:

i. Levels of:

(a) Glucose

(b) Calcium

(c) Magnesium

(d) Other electrolytes

ii. Amino acids

iii. Organic acids

iv. Blood ammonia

v. Certain toxins

6. Assessment and management

a. Quickly evaluate prenatal and birth history.

b. Perform a careful physical exam.

i. Hypoglycemia must be recognized and treated quickly with:

(a) Blood glucose measurement and dextrose administration

c. Obtain baseline vital signs and oxygen saturation readings.

d. Provide additional oxygen, assisted ventilation, blood pressure evaluation, and IV access as necessary.

e. If blood glucose level is less than 40 mg/dL, give an IV bolus of 10% dextrose solution and recheck in 30 minutes.

f. Before giving an anticonvulsant medication, consult medical control.

i. May interfere with respiratory and cardiac function

g. Monitor respiratory status and oxygen saturation carefully.

h. Maintain normal body temperature.

i. Keep family informed as you transport the newborn.

I. Hypoglycemia

1. A blood glucose level of less than 45 mg/dL in full-term or preterm newborns

a. An imbalance between glucose supply and utilization, with low glucose levels due to:

i. Inadequate intake or storage

ii. Increased glucose utilization

b. Most newborns are asymptomatic until glucose level falls below 20 mg/dL.

c. May result in:

i. Seizures

d. The newborn may be at risk for hypoglycemia due to:

i. Disorders related to decreased glycogen stores

(a) Small for gestational age

(b) Prematurity

(c) Postmaturity

ii. Increased use of glucose

(a) Newborn of a diabetic mother

(b) Large for gestational age

(c) Hypoxia

(d) Hyperthermia

(e) Sepsis

2. Assessment and management

a. Symptoms may be nonspecific, including:

i. Cyanosis

ii. Apnea

iii. Irritability

iv. Poor sucking or feeding

v. Limpness

vi. Irregular respirations

vii. Eye rolling

viii. Hypothermia

b. Symptoms may be associated with:

i. Lethargy

ii. Tremors

iii. Twitching or seizures

iv. Coma

v. Tachycardia

vi. Tachypnea

vii. Vomiting

c. Check blood glucose level in all sick newborns and evaluate vital signs.

d. Manage hypoglycemia after taking care of the ABCs.

i. If the blood glucose level is less than 45 mg/dL, medical control may order a bolus of 2 mL/kg IV of 10% dextrose solution.

e. Maintain normal body temperature.

J. Vomiting

1. Common in newborns

a. Ranges from spitting up to severe, bloody, or bilious projectile vomiting

i. Bilious and/or bloody emesis needs medical treatment.

ii. Persistent vomiting is a warning sign and can cause:

(a) Excessive fluid loss

(b) Dehydration

(c) Electrolyte imbalances

b. Persistent vomiting in the first 24 hours may indicate:

i. Upper digestive tract obstruction

ii. Increased intracranial pressure

c. Vomitus with dark blood indicates gut bleeding and may be a sign of life-threatening illness.

d. Vomitus aspiration may cause respiratory insufficiency or airway obstruction.

2. Causes of vomiting

a. Esophageal atresia: Failure to develop the distal lumen

i. Newborns seen with excessive frothing soon after birth

ii. Possible choking when trying to feed

b. Pathogenic gastroesophageal reflux (GER)

i. May vomit either immediately or a few hours after feeding

ii. In infants and young children, presents as:

(a) Typical or atypical crying and/or irritability

(b) Apnea and/or bradycardia

(c) Poor appetite

(d) Apparent life-threatening event

(e) Vomiting

(f) Wheezing

(g) Stridor

(h) Weight loss or poor growth

(i) Hoarseness

(j) Laryngitis

c. Infantile hypertrophic pyloric stenosis (IHPS): Hypertrophy and hyperplasia of the two muscular layers of the pylorus

i. Pylorus thickens and obstructs the end of the stomach.

ii. Stomach muscles cannot contract to overcome the obstruction.

iii. Patients present with:

(a) Projectile vomiting

(b) Dehydration

(c) Malnutrition

(d) Electrolyte changes

d. Malrotation: Congenital anomaly of midgut rotation

i. Predisposes infant to midgut volvulus and secondary obstruction of intestinal blood supply

ii. Vomitus is bile stained and possibly feculent if obstruction is distal in intestines.

iii. Early mortality rate ranges from 23% to 33%, with most deaths resulting from:

(a) Bowel dysfunction

(b) Malnutrition

e. Congenital conditions where parts of the bowel may not have developed properly (intestinal atresia) or are narrow (intestinal stenosis)

i. Conditions affecting the upper bowel may present with bilious vomiting.

ii. Lower bowel obstruction may present as feeding intolerance and abdominal distention.

f. Meconium plug seen in Hirschsprung disease

i. The last colon segment fails to relax, causing mechanical obstruction.

ii. Infant usually has history of not passing meconium in the first 24 hours of life.

g. Sudden, unexpected, and forceful vomiting may occur in conjunction with:

i. Asphyxia

ii. Meningitis

iii. Hydrocephalus

h. Withdrawal symptoms in an addicted newborn can include vomiting.

3. Assessment and management

a. Stomach may be distended due to vomiting.

b. Suspect infection if newborn has a fever or hypothermia, or has been in contact with ill people.

c. May also note:

i. Temperature instability

ii. Apnea/bradycardia

iii. Abdominal tenderness/guarding

iv. Minimal or absent bowel sounds

d. Start management with ABCs.

i. Maintain a patent airway—newborns may aspirate vomitus.

ii. Keep face turned to one side to prevent aspiration.

iii. Suction or clear vomitus from airway with a suction catheter or suction bulb.

iv. Provide either free-flow supplemental oxygen or bag-mask ventilation as necessary.

e. Consider a nasogastric or orogastric tube to decompress the stomach.

f. Do not administer antiemetics in the field.

g. The newborn may need fluid resuscitation of normal saline if signs point to dehydration:

i. Dry mucous membranes

ii. Tachycardia

iii. Sunken fontanelle

h. Place newborn on the side when transporting to a facility that can manage a high-risk newborn.

K. Diarrhea

1. Five or six stools a day is normal, especially when breastfeeding.

a. Diarrhea is excessive loss of electrolytes and fluid in the stool.

b. Causes include:

i. Viral infection (most common, especially rotavirus infection)

ii. Poisoning, which may have the following additional symptoms:

(a) Profuse sweating

(b) Lacrimation

(c) Hypersalivation

(d) Abdominal cramps

(e) Intussusception

(f) Malrotation

(g) Increased ICP

(h) Metabolic acidosis

iii. Gastroenteritis

iv. Lactose intolerance

v. Neonatal abstinence syndrome

vi. Thyrotoxicosis

vii. Cystic fibrosis

c. Severe cases can cause dehydration and electrolyte imbalance, with physical signs of:

i. Ill general appearance

ii. Poor vital signs

iii. Capillary refill of greater than 2 seconds

iv. Dry mucous membranes

v. Absent tears

vi. Weight loss

vii. Low urine output

2. Assessment and management

a. Estimate the number and volume of loose stools, decreased urinary output, and degree of dehydration based on:

i. Skin turgor

ii. Mucous membranes

iii. Presence of sunken eyes

b. Patient management begins with ABCs.

i. Ensure adequate oxygenation and ventilation.

ii. Perform chest compressions in addition to PPV if pulse rate is less than 60 beats/min.

iii. Fluid therapy may be necessary.

L. Neonatal jaundice

1. Results from immaturity of the liver to conjugate bilirubin in the first week.

a. Considered pathologic when:

i. Clinically visible in first 24 hours after birth

ii. Total serum bilirubin increases by more than 5 mg/dL/d.

iii. Total bilirubin exceeds 12 mg/dL in full-term infants.

iv. Conjugated bilirubin exceeds 15 to 20 mg/dl.

v. Persists for more than 1 week in full-term infants and for more than 2 weeks in preterm infants

b. Can result from:

i. Hemolysis

ii. Red blood cell deficiencies

iii. Polycythemia

iv. Bowel obstruction

c. Cholestasis can present after first 2 weeks.

2. Assessment and management

a. Transport is essential for bilirubin measurement at the hospital.

b. Additional assessments not available in the field include:

i. Blood type and Rh of mother and infant

ii. Antiglobulin (Coombs) test on the infant

iii. Hematocrit value

iv. Reticulocyte count

c. Start on IV fluids if the neonate shows significant clinical jaundice.

d. Communicate with medical control about any newborn with jaundice.

e. If potential cholestasis, management includes diagnostic testing and treatment of cause.

VII. Pathophysiology, Assessment, and Management of Conditions Related to Thermoregulation

A. Thermoregulation is limited in a newborn.

1. Average normal temperature of newborn—37°C (99.5°F)

a. Range for neonate—36.6°C to 37.2°C (97.9°F to 99°F)

b. The production of heat by metabolism (nonshivering thermogenesis) is the newborn’s primary source of heat production.

i. Brown fat is unique to newborns.

(a) Deposited in fetus after 28 weeks of gestation

(b) Stored around the scapula, kidneys, adrenal glands, neck, and axilla

2. Heat loss occurs through:

a. Evaporation—water evaporates from the skin and respiratory tract.

b. Convection—heat lost to cooler surrounding air

c. Conduction—heat lost to cooler solid objects in direct contact to the newborn

d. Radiation—heat lost to cooler objects not in direct contact to the newborn

B. Fever

1. Fever: Rectal temperature greater than 38°C (100.4°F).

a. Oral temperature—0.6°C (1°F) lower than rectal temperature on average

b. Axillary temperature—1.1°C (2°F) lower than rectal temperature on average

2. A newborn may not always present with fever in an illness or infection because of the immaturity of its temperature regulation system.

a. May become hypothermic or hypoglycemic instead

b. No matter the presenting symptoms, it is imperative to identify serious bacterial infection in newborns so they can be treated.

i. Of infants younger than age 28 days with a temperature of more than 38°C (100.6°F), approximately 13% will have serious bacterial infection.

3. Fever may be caused by overheating or dehydration.

4. Limited ability to control their temperature

a. Do not sweat when they are hot

b. Do not shiver to raise temperature

c. Core temperature may drop in newborns with serious life-threatening infection, giving them a higher risk of:

i. Hypoglycemia

ii. Metabolic acidosis

5. Signs and symptoms include:

a. Irritability

b. Somnolence

c. Decreased feeding

d. Warm to touch

6. Assessment and management

a. Examine for presences of rashes, especially:

i. Petechiae

ii. Pinpoint pink or red skin lesions

b. Obtain a careful history about:

i. General activity

ii. Feeding

iii. Voiding

iv. Stooling

c. Note increased respiratory rate and work of breathing.

d. Obtain vital signs, and ensure adequate oxygenation and ventilation.

i. Provide free-flow supplemental oxygen and chest compressions as necessary.

e. Antipyretic agents are controversial in the field.

i. Do not give ibuprofen.

f. To cool:

i. Remove additional layers of clothing.

ii. Improve ventilation in environment.

C. Hypothermia

1. A drop in body temperature to less than 25°C (95°F)

a. Linked to impaired growth and infection vulnerability

b. Moderate hypothermia linked with increased risk of death in low birth weight newborns

c. Newborns have increased surface area-to-volume ratio and are sensitive to environmental conditions, especially when wet after delivery

i. Metabolic function increase to overcome heat loss can cause:

(a) Hypoglycemia

(b) Metabolic acidosis

(c) Pulmonary hypertension

(d) Hypoxemia

d. If a newborn is hypothermic, investigate for infection.

2. Assessment and management

a. Hypothermic newborns may be:

i. Cool to the touch, initially in the extremities

ii. Pale with acrocyanosis

b. May present with:

i. Decreased respiratory effort

ii. Apnea

iii. Bradycardia

iv. Cyanosis

v. Irritability

vi. Weak cry

vii Sclerema (hardening of the skin associated with reddening and edema) on the back, limbs, or over the entire body.

c. Preventive measures include:

i. Warming hands before touching the newborn

ii. Drying thoroughly after birth and removing wet blankets

iii. Placing a cap on the head

iv. Placing the newborn “skin-to-skin” with the mother and placing warm blankets over the newborn

d. Treatment includes:

i. Ensure adequate oxygenation and ventilation, performing chest compressions if needed.

ii. If glycemic, administer D10W.

iii. Administering warm IV fluids if indicated.

iv. Once stabilized, the critically ill newborn should be placed in a prewarmed incubator.

v. If not available, place on mother’s chest and cover with a blanket.

vi. Continue until temperature reaches normal or the feet are not cold.

VIII. Pathophysiology, Assessment, and Management of Common Birth Injuries in the Newborn

A. Birth trauma comes from injuries resulting from mechanical forces during the delivery process.

1. Most are self-limiting with a favorable outcome.

a. Birth injuries account for 2% to 3% of all infant deaths.

b. Newborn injuries can occur because of:

i. Newborn size

ii. Position during labor and delivery

c. Conditions associated with a difficult birth include:

i. Primigravida (first pregnancy)

ii. Prolonged labor

iii. Cephalopelvic disproportion

iv. Rapid labor

v. Abnormal presentation

vi. Large size

vii. Shoulder dystocia

viii. Prematurity

ix. Low birth weight

2. Birth trauma injuries include:

a. Those that can involve instruments used during delivery

i. Abrasions

ii. Lacerations

iii. Bruises

iv. Subcutaneous fat necrosis

b. Excessive molding of the head and overriding parietal bones

c. Caput succedaneum: Swelling of soft tissue of the scalp from pressing against the dilating cervix

i. Usually disappears in a day or two after birth

d. Cephalhematoma: Area of bleeding between the parietal bone and the covering periosteum

i. Often appears several hours after birth as a raised lump on the head

ii. May take 2 weeks to 3 months to resolve

iii. Do not try to drain because it may worsen or prolong bleeding.

e. Linear skull fractures

i. Avoid pressure to involved areas.

ii. Displaced fractures need neurosurgical evaluation.

f. Brachial plexus injuries

i. Usually occurring in large newborns

ii. Erb palsy (most common)—involvement of C5, C6

iii. Klumpke paralysis (rare)—involvement of C7, C8, T1

(a) Results in intrinsic hand muscle weakness

g. Facial nerve palsy

i. Findings include asymmetric faces when crying.

ii. Full resolution of cranial nerves may take several weeks.

h. Diaphragmatic paralysis

i. May occur from cervical root injury or a brachial plexus injury

ii. Symptoms may include:

(a) Respiratory distress with hypoxemia

(b) Hypercapnia

(c) Acidosis

i. Laryngeal nerve injury resulting from intrauterine posture

i. Presents with stridor or hoarse cry

ii. Paralysis often resolves in 4 to 6 weeks.

j. Spinal cord injury resulting from:

i. Excessive traction (breech delivery)

ii. Rotation and torsion (vertex delivery)

3. Clavicle is most frequently fractured bone in the newborn.

a. Most often an unpredictable and unavoidable complication

b. Risk factors include:

i. Large size

ii. Mid-forceps delivery

iii. Shoulder dystocia

c. May present with pseudoparalysis to minimize pain

d. Examination will show:

i. Crepitus

ii. Palpable bony irregularity

iii. Possible lack of arm movement on affected side

4. Long bone fracture may present as loss of spontaneous arm or leg movement.

a. Treatment includes splinting.

b. Check for signs of radial nerve injury with a humerus fracture.

5. Intra-abdominal injury is uncommon in newborns.

a. Possible injuries include:

i. Liver contusion or fracture

ii. Spleen rupture

iii. Adrenal hemorrhage

b. Bleeding either catastrophic or insidious

c. Consider in every newborn presenting with:

i. Shock or unexplained pallor

ii. Abdominal distension

6. Hypoxia and shock could be caused by birth trauma.

IX. Pathophysiology, Assessment, and Management of Cardiac Conditions in Newborns

A. Pathophysiology

1. Congenital heart disease (CHD)

a. Most common birth defect, occurring in 8 per 1,000 live births

i. Approximately 1/3 are critical.

ii. Accounts for approximately 40% of deaths caused by congenital anomalies

b. Use pulse oximetry to detect oxygenated versus nonoxygenated blood.

i. The highest sensitivity and highest specificity in monitoring is with the right hand and one foot.

(a) Cutoff values of less than 95% or a greater than 3% difference between the two

ii. Department of Health and Human Services and the American Academy of Pediatrics recommend pulse oximetry screening for full-term healthy newborns.

c. Pulmonary stenosis: Pulmonic valve near the right ventricle becomes damaged.

i. Patient will have a decrease in blood flow to the lungs and will present with:

(a) Jugular vein distention

(b) Cyanosis

(c) Right ventricular hypertrophy

ii. Typically associated with CHD

d. Septal defects can exist in either the atrias or the ventricles.

i. With an atrial septal defect (ASD), deoxygenated blood can shift from the right or left atrium to the other atria and mix with oxygen-rich blood.

(a) May occur if the foramen ovale, which allows the fetus to receive oxygen-rich blood from the placenta, does not close after birth.

(b) Hemodynamic status is dependent on how much blood flow is shunted.

ii. In a ventricular septal defect (VSD), blood flows back into the right ventricle when the left ventricle contracts.

(a) Causes an increase in the right ventricle pressure

(b) Results in pulmonary hypertension

e. Patent ductus arteriosus (PDA): The ductus arteriosus does not close after birth.

i. Before birth, an open ductus arteriosus allows blood flow to bypass the right ventricle and lungs.

ii. After birth, it should evolve into the ligamentum arteriosum.

iii. Congestive heart failure may be the result of an untreated PDA.

f. Coarctation of the aorta (CoA): Narrowing of the aorta

i. The heart must work harder to keep the blood flowing past the narrowed area.

ii. Signs and symptoms include:

(a) Shortness of breath

(b) Chest pain

(c) Hypertension

(d) Headaches

(e) Muscle weakness

iii. Treatment is usually heart surgery.

g. Truncus arteriosus: The pulmonary and aorta arteries are combined as one vessel.

i. Greatly increases blood flow into the lungs, causing congestive heart failure

ii. Patient will have slightly lower oxygen levels early in life, eventually resulting in cyanosis.

iii. Will require surgical intervention

h. Tricuspid atresia: The tricuspid valve is missing.

i. Results in an undersized or absent right ventricle

ii. Will have a significantly decreased blood flow into the lungs, leading to severe hypoxemia and death

iii. May require a Fontan procedure to redirect the inferior vena cava and hepatic vein into the pulmonary circulation

i. Hypoplastic left heart syndrome (HLHS): The left side of the heart is completely underdeveloped.

i. Left side of the heart is unable to fulfill circulation needs.

ii. Patients present with murmur or cyanosis.

iii. Heart transplant is necessary.

j. Tetralogy of Fallot (ToF): Combination of four heart defects

i. Defects:

(a) Ventricular septal defect—Hole in the septum separating the right and left ventricles, allowing blood flow between the two

(b) Pulmonary stenosis—Narrowing of the pulmonary valve

(c) Right ventricular hypertrophy—Thickening of the right ventricle

(d) Overriding aorta—Aorta connected between the left and right ventricles over the VSD

ii. Results in poor oxygenation

iii. Open heart surgery is required.

k. Transposition of the great arteries (TGA): Blood goes to the lungs for oxygenation, then returns to the lungs, while blood from the body to the heart goes back to the body without becoming oxygenated.

i. Patients present with:

(a) Shortness of breath

(b) Finger and toe clubbing

(c) Cyanosis

ii. May require surgical intervention

l. Total anomalous pulmonary venous return (TAPVR): The four pulmonary veins connect to the right atrium instead of the left atrium.

i. Results in diminished oxygen and increased load on the right ventricle

B. Assessment and management

1. Critical CHD presents in the neonatal period.

a. Rapid detection and transport are mandatory.

b. Communication with medical control is critical to have adequate services available upon arrival at the emergency facility.

X. Summary

A. Newborn or neonate care must meet the unique needs of this population. Complication rates increase as birth weight and gestational age decrease. Approximately 10% of newborns need additional assistance to survive.

B. Initial steps of neonatal resuscitation include positioning and clearing the airway, stimulating the newborn to breathe, and assessing heart rate and oxygenation. Resuscitation efforts focus on airway establishment and adequate ventilation.

C. Short- and long-term outcomes are linked to initial stabilization efforts, including warming the newborn; positioning; clearing the airway; drying the head, face, and body; and stimulating the newborn. Others steps that may be necessary include supplemental oxygen, assisting ventilation by providing positive pressure, intubation, chest compressions, and administering any needed medications.

D. At birth, a fetus transitions from receiving oxygen from the placenta to receiving oxygen from breathing. A series of events must rapidly occur so the newborn can breathe. Delay of this decline in pulmonary pressure may lead to delayed transition, hypoxia, brain damage, and death.

E. During delivery, use any available time to obtain a patient history and to prepare the environment and equipment you may need for neonatal resuscitation.

F. The initial rapid assessment of the newborn may be done simultaneously with any interventions. Note patency of the airway, respiratory rate, respiratory effort, pulse rate, color, and capillary refill.

G. The Apgar score determines the need for and effectiveness of resuscitation. It includes scores for appearance, pulse rate, grimace or irritability, muscle activity, and respiratory effort, obtained at 1 and 5 minutes after birth.

H. Follow the neonatal resuscitation algorithm developed by the American Academy of Pediatrics and the American Heart Association.

I. Thermoregulation is limited in the newborn, so take an active role in keeping body temperature in the normal range. Place the newborn directly on the mother’s chest, and dry the head and body with towels. Cover the newborn with a dry towel and the head with a cap. Position the newborn to ensure a patent airway.

J. If the newborn does not respond in 30 seconds after initial stabilization efforts (bulb suctioning of the mouth and nose, drying, stimulation), further intervention is needed.

**1. If normal breathing pattern and pulse rate of greater than 100 beats/min but still has central cyanosis of the trunk or mucous membranes, provide supplemental free-flow oxygen.**

**2. If still apneic or has a pulse rate of less than 100 beats/min, begin positive-pressure ventilation by bag-mask device.**

**3. If the pulse rate is less than 60 beats/min after 30 seconds of adequate positive-pressure ventilation, begin chest compressions.**

K. If the newborn is cyanotic or pale, administer warmed, humidified free-flow oxygen. If the newborn has an airway obstruction, insert an oral airway. If not effective and newborn is apneic, has inadequate respiratory effort, or is bradycardic, perform bag-mask ventilation. If this does not work, endotracheal intubation is required.

L. If prolonged bag-mask ventilation (more than 5 to 10 minutes) is used, gastric decompression with an orogastric tube is indicated if abdominal distention impedes ventilation or if there is a diaphragmatic hernia or gastrointestinal congenital anomaly.

M. Perform chest compressions if the pulse rate remains below 60 beats/min despite positioning, clearing airway, drying and stimulation, and 30 seconds of effective positive-pressure ventilation.

N. Emergent vascular access is necessary if fluid administration is needed for circulation support or if resuscitation medications or therapeutic drugs be given IV. Newborn vascular access is via the umbilical cord.

O. Most newborns are resuscitated with effective ventilator support, but medications may be needed for bradycardia, low blood volume, acidosis, respiratory depression secondary to narcotics, and hypoglycemia. Neonatal medication doses are based on weight.

P. Transport to the nearest facility once the newborn is stabilized as much as possible.

Q. Ongoing communication with family is necessary. Do not be specific about survival statistics. If an answer is not available from prehospital personnel, connect the family with those who can answer their questions.

R. Bradycardia in a newborn is usually from hypoxia, which can normally be reversed with effective positive-pressure ventilation. If caused by tension pneumothorax, a needle decompression is necessary. If ventilation and chest compressions do not improve bradycardia, administer epinephrine via and IV line or ET tube.

S. There is a high risk of morbidity if a newborn is delivered through meconium-stained amniotic fluid. If depressed, do not dry or stimulate. Instead, clear the airway of meconium, intubate the trachea, attach a meconium aspirator and suction catheter to the end of the endotracheal tube, and suction the ET tube while withdrawing the tube from the trachea.

T. Diaphragmatic hernia is an abnormal opening in the diaphragm. If a newborn has this condition and positive-pressure ventilation is needed, endotracheal intubation along with an orogastric tube will be necessary to minimize intestinal distention. Surgical correction is required.

U. If born before 37 weeks gestation, newborns are considered premature. Provide cardiorespiratory support and a thermoneutral environment.

V. Seizures are distinctive of neurologic disease in the newborn. Evaluate prenatal and birth history, and perform a careful physical exam. Consult with medical control before administering anticonvulsant medication.

W. Non-bilious vomiting is common in newborns. Keep the face turned to one side to prevent further aspiration. Suction or clear vomitus from the airway with a suction catheter or bulb. Ensure adequate oxygenation and consider fluid resuscitation. Transport on his or her side.

X. If the infant has diarrhea, estimate the number and volume of loose stools, decreased urinary output, and degree of dehydration. Ensure adequate oxygenation and ventilation. Perform chest compressions in addition to positive-pressure ventilation if the pulse rate is less than 60 beats/min. Administer fluid therapy.

Y. If fever is suspected, observe for rashes. Obtain a careful history and vital signs. Ensure adequate oxygenation and ventilation. Remove additional clothing layers, and improve ventilation in the environment. Perform chest compressions if necessary. Do not administer antipyretic agents.

Z. Birth trauma includes avoidable and unavoidable injuries resulting from mechanical forces during delivery. A difficult birth or injury can occur because of the newborn’s size or position during labor and delivery.

AA. Cardiac emergencies in newborns can come from various congenital heart diseases or malformations.

Post-Lecture

This section contains various student-centered end-of-chapter activities designed as enhancements to the instructor’s presentation. As time permits, these activities may be presented in class. They are also designed to be used as homework activities.

## Assessment in Action

This activity is designed to assist the student in gaining a further understanding of issues surrounding the provision of prehospital care. The activity incorporates both critical thinking and application of paramedic knowledge.

### Instructor Directions

**1.** Direct students to read the “Assessment in Action” scenario located in the Prep Kit at the end of Chapter 42.

**2.** Direct students to read and individually answer the quiz questions at the end of the scenario. Allow approximately 10 minutes for this part of the activity. Facilitate a class review and dialogue of the answers, allowing students to correct responses as may be needed. Use the quiz question answers noted below to assist in building this review. Allow approximately 10 minutes for this part of the activity.

**3.** You may wish to ask students to complete the activity on their own and turn in their answers on a separate piece of paper.

### Answers to Assessment in Action Questions

**1.** **Answer:** D. Positive-pressure ventilation

**Rationale:** Newborns, especially those who are born prematurely, may be born with an inadequate respiratory effort that requires your assistance. Opening the airway and providing positive-pressure ventilations is the first step required to deliver breaths at an adequate rate and volume.

**2.** **Answer:** C. 40 to 60 breaths/min

**Rationale:** Newborns start their life with small lungs, which means the volume inhaled with each breath is small. In order for the appropriate minute ventilation to be achieved, newborns have a built-in respiratory rate of 40 to 60 breaths/min. Therefore, it is important that the care you provide matches the newborn’s natural respiratory rate and volume.

**3.** **Answer:** A. If the newborn’s pulse rate remains below 60 beats/min following 30 seconds of positive-pressure ventilation via a bag-mask device.

**Rationale:** Unlike adults and children, the resuscitation of newborns begins with providing positive-pressure ventilations via a bag-mask device for 30 seconds. If the pulse rate does not increase above 60 beats/min after 30 seconds of positive-pressure ventilations, then chest compressions should be started and positive-pressure ventilations continued.

**4.** **Answer:** C. One third the anteroposterior diameter of the chest

**Rationale:** 2010 American Heart Association guidelines for neonatal resuscitation state that the appropriate depth of compressions is one third the diameter of the chest.

**5.** **Answer:** C. 3:1

**Rationale:** There should be a 3:1 ratio of compressions to ventilations with 90 compressions and 30 breaths being delivered each minute. This equals 120 events per minute.

**6.** **Answer:** B. 0.1 to 0.3 mL/kg; 1:10,000

**Rationale:** The appropriate dose of epinephrine for neonatal resuscitation via the IV route is 0.1 to 0.3 mL/kg of 1:10,000 epinephrine, best administered via the umbilical vein, or 0.01 to 0.03 mg/kg of 1:10,000 epinephrine. The appropriate dose of epinephrine for neonatal resuscitation via the ET route is three times that of IV administration, 0.3 to 1 mL/kg of 1:10,000 epinephrine.

**7.** **Answer:** A. ventilatory support.

**Rationale:** Newborns are transitioning to lung breathing; therefore, inflation of the lungs is the most important measure. The most important and effective action in neonatal resuscitation is to ventilate the newborn’s lungs. Lack of ventilation results in sustained constriction of the pulmonary arterioles, preventing systemic arterial blood from becoming oxygenated.

When a fetus or newborn first becomes deprived of oxygen, an initial period of attempted rapid breathing is followed by primary apnea and a dropping pulse rate that will improve with tactile stimulation. If oxygen deprivation continues, secondary apnea ensues accompanied by a continued fall in pulse rate and blood pressure. Secondary apnea cannot be reversed with stimulation; assisted ventilation must be provided.

Initiation of effective positive-pressure ventilation during secondary apnea usually results in a rapid improvement in heart rate.

### Additional Questions

**8. Rationale:** Several things can lead to premature delivery and unfortunately, most of them are beyond the control of the woman. Risk factors include genetic abnormalities, infection, early opening of the cervix (cervical incompetence), placental abruption, multiple gestation, past history of a premature delivery, smoking, and trauma.

## Assignments

A. Review all materials from this lesson and be prepared for a lesson quiz to be administered (date to be determined by instructor).

B. Read Chapter 43, *Pediatric Emergencies*, for the next class session.

## Unit Assessment Keyed for Instructors

1. What is the difference between a newborn and a neonate?

**Answer:** A newborn refers to an infant within the first few hours after birth; a neonate refers to an infant within the first month after birth.

(p 1963)

2. What are the initial steps in the stabilization of a newborn?

**Answer:** The initial stabilization of a newborn includes the following specific steps: Warming the newborn to prevent hypothermia, positioning the newborn, clearing the airway if necessary as well as drying and stimulating breathing.

(p 1963)

3. What is the preferred method of maintaining a newborn’s body heat?

**Answer:** The newborn can be kept warm by placing him or her on prewarmed towels or blankets, drying, and then replacing the wet towels with dry, prewarmed towels. Once resuscitation is complete, the newborn can stay warm if placed on the mother’s chest, or abdomen, on another heat source, or under a radiant warmer.

(p 1963)

4. What is the fetal transition stage, and why is it vital in resuscitation?

**Answer:** In utero (ie, in the pregnant woman’s womb), a fetus receives its oxygen from the placenta . The fetal lung is collapsed and filled with fluid, receiving only 10% of the total blood supply. As the fetus is delivered, a rapid series of events needs to occur to enable the newborn to breathe. This process is called fetal transition . The first breath is triggered by mild hypoxia and hypercapnia related to partial occlusion of the umbilical cord during normal delivery. Tactile stimulation and cold stress also promote early breathing. As the newborn’s lungs become filled with air, the pulmonary vascular resistance drops, causing more blood to flow to the lungs, picking up oxygen to supply to the body. Any event that delays this decline in pulmonary pressure can lead to delayed transition, hypoxia, brain injury, and, ultimately, death.

(p 1964)

5. What is the APGAR score, and why is it used?

**Answer:** The Apgar score, named after Dr. Virginia Apgar, who developed the measure in 1953, helps record the condition of the newborn in the first few minutes after birth based on five signs. This score can help paramedics determine the need for specific resuscitation measures and the effectiveness of their resuscitation efforts to facilitate the transition from fetus to newborn. Each sign is assigned a value of 0, 1, or 2. The Apgar score is the sum total of these values and is typically recorded at 1 and 5 minutes after birth. If the 5-minute Apgar score is less than 7, the newborn’s condition should be reassessed and an additional score assigned every 5 minutes until 20 minutes after birth. If resuscitation is necessary, the Apgar score is completed by determining the result of the resuscitation.

(p 1967)

6. What is the difference between acrocyanosis and central cyanosis?

**Answer:** Many newborns become centrally pink but have blue hands and feet (acrocyanosis). This is considered normal. If the newborn has a normal breathing pattern and a pulse rate of greater than 100 beats/min but maintains central cyanosis of the trunk or of the mucous membranes, provide supplemental free-flow oxygen. If there is no other warming source available, keep the newborn on the mother’s chest and continue to manage the airway.

(p 1968)

7. When should bag-mask ventilation be used on a newborn?

**Answer:** Bag-mask ventilation is indicated when a newborn 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 newborn. Signs of respiratory distress that suggest a need for bag-mask ventilation 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.

(p 1971)

8. When are chest compressions indicated for a newborn?

**Answer:** Chest compressions are indicated if the pulse rate remains at less than 60 beats/min despite positioning, clearing the airway, drying and stimulation, and 30 seconds of effective PPV. Two people are needed to deliver effective chest compressions while continuing ventilation.

(p 1975)

9. What considerations should be taken into account with the family of an ill newborn?

**Answer:** Throughout the care process, you should provide ongoing communication with the family regarding what is being done for the newborn and what care is planned to help allay their fears. Do not be specific about survival statistics. Many factors play into mortality and morbidity, and you do not want to be misleading. If family members have questions you cannot answer, be straightforward. Tell them that you do not have a definite answer, but you will help put them in touch with the people who do.

(p 1979)

10. How can you tell if a newborn has been delivered through meconium, and how does this finding affect your initial care?

**Answer:** When a newborn is delivered through meconium-stained amniotic fluid, determine whether the fluid is thin and green-stained versus thick and particulate. Assess the newborn’s activity level. If the newborn is crying and vigorous, employ standard interventions. If the newborn is depressed (poor muscle tone, bradycardia of less than 100 beats/min, inadequate ventilation, no respiratory effort), do not dry or stimulate the newborn. Clear the airway of meconium, intubate the trachea, attach a meconium aspirator and suction catheter to the end of the ET tube, and suction the ET tube while withdrawing the tube from the trachea. Be sure to cover the hole of the meconium aspirator with your finger while you are suctioning

(p 1981)

## Unit Assessment

1. What is the difference between a newborn and a neonate?

2. What are the initial steps in the stabilization of a newborn?

3. What is the preferred method of maintaining a newborn’s body heat?

4. What is the fetal transition stage, and why is it vital in resuscitation?

5. What is the APGAR score, and why is it used?

6. What is the difference between acrocyanosis and central cyanosis?

7. When should bag-mask ventilation be used on a newborn?

8. When are chest compressions indicated for a newborn?

9. What considerations should be taken into account with the family of an ill newborn?

10. How can you tell if a newborn has been delivered through meconium, and how does this finding affect your initial care?