Pediatric Anesthesiology Review

Clinical Cases for Self-Assessment

Second Edition

Robert S. Holzman
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ISBN 978-3-319-48447-1 ISBN 978-3-319-48448-8 (eBook)
DOI 10.1007/978-3-319-48448-8

Library of Congress Control Number: 2017938117

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This text is designed for those who would become consultants in pediatric anesthesia. It is based on a curriculum developed in our department since 1992 to illustrate the breadth and depth of the practice of pediatric anesthesia. Weekly meetings are held with our fellows and many of our faculty who are or who have been associate examiners of the American Board of Anesthesiology. The program is an integral part of the didactic series in the Department of Anesthesiology, Perioperative and Pain Medicine at Boston Children's Hospital.

An ability to explain *why* various data are required before or during the care of a patient or *why* a certain anesthesia care plan was chosen was critical to us in our philosophy of the course, and we have tried to preserve that ideal during the crafting of this text. Although the interactive aspect of a dialog between examiner and examinee cannot be effectively recreated through a textbook, the reader is encouraged – strongly so – to use this book in creative ways to mimic the spontaneity achievable through conversation. First of all, a "buddy" system is advisable. Recording your answers is extremely useful when using the questions as prompts; the contemplative reader will listen critically to the responses he or she has offered into the recorder and then hopefully improve with time and practice. When all else fails, you can find the closest 4-year-old, who will gleefully ask you "why" after every response, uncannily similar to a board exam. Using materiality as the best endpoint for adequate answers, the discerning reader should attempt to answer the question to the satisfaction of an imaginary partner – whether the patient her- or himself, a parent, a surgeon, a pediatrician, or another anesthesiology colleague calling for help. With practice and introspection, it is amazing how similar, rather than different, the answers are to those diverse audiences.

The written examinations, seen at the beginning of the text as a baseline in pediatric medicine, are primarily knowledge-based, reflecting factual medical information necessary for the subspecialty practice of pediatric anesthesiology.

This second edition has the same purpose as the first – to accompany the reader's journey in attaining proficiency, expertise, and, finally, mastery in pediatric anesthesiology. The formatting of the book is designed to encourage the reader's free flow of ideas. One should begin with looking at both facing pages, then progress to

covering the answers on the right, and eventually cover the questions on the left, so that probing questions become self-generated. In this very simple, programmed text manner, practice at generating the appropriate breadth and depth of answers, and then questions, can be encouraged.

With this basic guidance, the reader is encouraged to be creative throughout this book, to use imagination as well as a fund of knowledge in bringing yourself "into the operating room" and managing the patient in an expert fashion, one that would, in the eyes of peers as well as patients and their families, merit the awarding of "consultant in pediatric anesthesiology."

Boston, MA, USA

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Part I
Pediatric Medicine for Pediatric Anesthesiologists

Chapter 1
Newborn Medicine

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R.S. Holzman et al. (eds.), *Pediatric Anesthesiology Review*,
DOI 10.1007/978-3-319-48448-8_1

Questions

1. In the neonatal period (day 0–28 of life), mortality is higher than any other period in infancy and childhood. Regarding neonatal mortality, the following is true:
   1. It is inversely correlated with birth weight with most deaths occurring in neonates with birth weights <1.5 kg.
   2. It is most commonly due to prematurity and its complications.
   3. Most neonatal deaths occur in the first week of life.
   4. The high neonatal mortality in African-American babies is due to the higher rate of premature births in this group.
      A. 1, 2, 3
      B. 1, 3
      C. 2, 4
      D. 4 only
      E. All of the above

2. Regarding apnea of prematurity:
   1. It occurs in nearly all infants born weighing <1000 g.
   2. It usually resolves by 36–37 weeks postconceptual age (PCA).
   3. It is treated with theophylline or caffeine.
   4. Infants with this problem require home monitoring until 60 weeks PCA.
      A. 1, 2, 3
      B. 1, 3
      C. 2, 4
      D. 4 only
      E. All of the above

3. Which of the following are associated with poor fetal growth and therefore SGA births?
   1. Reduced uteroplacental blood flow
   2. Intrauterine infection
   3. Chromosomal abnormalities
   4. Poor maternal nutrition
      A. 1, 2, 3
      B. 1, 3
      C. 2, 4
      D. 4 only
      E. All of the above

Answers

1. E. all of the above

Low birth weight, which is distinct from preterm birth (see definitions), occurs in approximately 7 % of live births in the USA. Mortality of low birth weight infants is higher than mortality of normal birth weight infants by approximately the following:

Moderately low birth weight (MLBW 1501–2500 g) 40 times increased, very low birth weight (VLBW 1000–1500 g) 200 times increased, and extremely low birth weight (ELBW <1000 g) 600 times increased.

Mortality for low birth weight infants has decreased with improvements in newborn care. Common causes for mortality in the newborn are different for term and preterm newborns.

Term: congenital anomalies, birth asphyxia, infection, and meconium aspiration syndrome.

Preterm: respiratory distress syndrome (RDS), intraventricular hemorrhage (IVH), infection, and necrotizing enterocolitis (NEC).

The LBW (<2500 g) rate in the USA has increased from 6.6 to 7.5 % from 1981 to 1997. The USA still lags behind many industrialized countries in neonatal mortality, while the rate of teen pregnancy exceeds that of many industrialized countries.

2. A. 1, 2, 3

Apnea is defined as cessation of airflow into the lungs for a specified period of time, usually 1–20 s. Once the known potential causes for apnea have been ruled out, the diagnosis of apnea of prematurity can be made. Infants with apnea of prematurity may be discharged home without monitoring provided they have had 7–10 days free of apneic spells. The incidence of SIDS does increase with decreasing birth weight, but apnea of prematurity is not an independent risk factor for SIDS.

3. E. all of the above

Intrauterine growth restriction can be considered a final common pathway for a myriad of influences on the fetus including genetic factors and environmental influences. The intrauterine environment is determined by uterine blood flow, placental function, and placental and umbilical circulation. Maternal factors that affect birth weight include maternal weight gain, maternal age, and medical conditions such as hypertension or diabetes mellitus.

4. What maintenance fluid would you order for a 2 kg, 2-week-old who will be NPO for 6 h?
   A. D5 0.2 NS at 8 mL/h
   B. D10 0.45 NS at 10 mL/h
   C. D5 LR at 10 mL/h
   D. D5 0.45 NS at 12 mL/h

5. Which of the following is (are) true regarding maintenance fluids, electrolytes, and glucose administration to the newborn after the first week of life?
   1. Approximately 100–125 mL/kg/day of water will replace urine output and insensible losses.
   2. Glucose utilization, 6–10 mg/kg/min, can be supplied with D10 given at 100 mL/kg/day.
   3. Excessive sodium losses, due to renal tubular immaturity, must be replaced with 0.9 % NS.
   4. Preterm newborns require less fluid than term infants because of their decreased urine output.
      A. 1, 2, 3
      B. 1, 3
      C. 2, 4
      D. 4 only
      E. All of the above

6. Newborns have difficulty maintaining temperature because:
   1. They have a large surface area relative to their weight.
   2. Their increased tone leads to excessive heat loss.
   3. Shivering thermogenesis is limited.
   4. Brown fat is a poor insulator.
      A. 1, 2, 3
      B. 1, 3
      C. 2, 4
      D. 4 only
      E. All of the above

4. D. D5 0.2 NS at 8 mL/h

Water administration to term older infants and children is related to caloric expenditure in the following manner on a 1 mL/cal basis:

0–10 kg: 100 cal/kg/day divided by 24 h/day = 4 mL/kg/h

10–20 kg: 50 cal/kg/day divided by 24 h/day = 2/mL/kg/h

20 kg: 20 cal/kg/day divided by 24 h/day = 1 mL/kg/h

Sodium requirements are in the neighborhood of 2–3 meq/kg/day. 0.2–0.45 % NS is adequate for sodium replenishment for children up to 45 kg.

Fluid requirements for the newborn change dramatically in the first few days of life. For DOL #1, the fluid needed by the newborn is 60–80 mL/kg/day, gradually increasing to 100–140 mL/kg/day over the subsequent several days. D10 provides sufficient glucose to the newborn.

5. A. 1, 2, 3

The newborn has higher insensible fluid losses than older children. Transdermal evaporative losses are affected by the ambient temperature, while respiratory evaporative losses are affected by the humidity. Maintenance glucose requirements can be met with the administration of 6–8 mg/kg/min. D5 at 100 mL/kg/day provides 5 g/kg/day or 5000 mg/kg/day of glucose or 3.5 mg/kg/min (5000 mg/kg/day × 1 day/1440 min/day = 3.5 mg/kg/min). D10 given at 100 mL/kg/day will provide 6.7 mg/kg/min of glucose. Normal newborns lose little sodium in the first few days of life, often receiving only D10W during the first 24 h of life. Preterm newborns require more fluid because of increased transdermal losses.

6. B. 1, 3

Surface area/weight in a newborn is three times that of an adult. Newborns lose heat at a rate approximately four times that of adults. Nonshivering thermogenesis, which occurs in the brown fat, is a neonatal response to cold. In nonshivering thermogenesis, fat is oxidized and oxygen consumption is increased.

7. The neutral thermal environment for a 10-day-old 1.5 kg infant lying on a warm mattress in a draft-free room of moderate humidity:
   1. Is a room temperature of 34–35 °C
   2. Is the environment at which the baby will be actively warmed
   3. Is the environment at which 02 consumption is lowest
   4. Includes warming lights
      A. 1, 2, 3
      B. 1, 3
      C. 2, 4
      D. 4 only
      E. All of the above

8. The Apgar score:
   1. Has a 0–10 scale
   2. Is a useful guide to interventions needed in neonatal resuscitation
   3. Can be used to estimate the likelihood of neonatal acidosis
   4. Was developed in the 1950s by Virginia Apgar, an anesthesiologist
      A. 1, 2, 3
      B. 1, 3
      C. 2, 4
      D. 4 only
      E. All of the above

9. The Apgar score includes all of the following, which are scored 0–2, except:
   1. Heart rate
   2. Presence of gag reflex
   3. Respiratory effort
   4. Tone
   5. Reflex irritability
   6. Color
      A. 1
      B. 2
      C. 3
      D. 4
      E. 5
      F. 6

7. B. 1, 3

The neutral thermal environment is one with the ambient temperature in which the newborn loses the least amount of heat while maintaining normal body temperature. A neutral thermal environment is one in which the infant neither gains nor loses heat. The newborn loses heat by four means:

Convection to the cooler surrounding air

Conduction to the cooler surfaces which contact the newborn's skin

Radiation to nearby solid objects

Evaporation from moist skin and lungs

Newborns respond to ambient temperature below the neutral thermal environment with increased oxygen consumption to produce heat. The increased oxygen consumption response is limited, however, and once this occurs, the temperature of the newborn begins to fall.

8. E. All of the above

This score is of value in assessment of the newborn at birth and the effectiveness of any resuscitation efforts. Apgar scores at 1 and 5 min correlate poorly with longer-term neurologic outcome. The American Academy of Pediatrics and American College of Obstetrics and Gynecology emphasize using the Apgar score only as a tool in evaluating the condition of the newborn at the time of birth.

9. F

The Apgar score range is 0–10. Term newborns without congenital anomalies with a normal cardiopulmonary adaptation to extrauterine life should have a score of 8–9. Newborns with a score of 0–3 require resuscitation. Most cases of low Apgar scores are due to inadequate ventilation, not to cardiac causes.

In her original work (Apgar, V Current Research in Anesthesia and Analgesia 1953:32;260), Dr. Virginia Apgar demonstrated that the score could differentiate between infants born to mothers who had general anesthesia and infants born to mothers who had spinal anesthesia.

10. A newborn whose Apgar score was 2 at 1 min has been intubated and is being adequately and appropriately ventilated. The heart rate is now 60/min. The next intervention should be:
    1. Volume expansion with 10 cc/kg isotonic fluid
    2. Correction of acidosis with NaHCO3, 1 meq/kg slowly
    3. Observation and active warming in the special care nursery
    4. Closed cardiac massage
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

11. Intraventricular hemorrhage in preterm infants has been associated with:
    1. Acidosis
    2. Hypoxemia
    3. Cerebral blood flow alterations
    4. Germinal matrix hyperplasia
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

12. Possible consequences of germinal matrix hyperplasia (GMH)/intraventricular hemorrhage (IVH) include:
    1. A normal neurologic exam after grade I IVH
    2. Posthemorrhagic hydrocephalus (PHH)
    3. Motor and cognitive deficits in 50 % of infants with grade IV IVH
    4. Hydrocephalus in virtually all infants with grade III–IV IVH
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

10. D. 4

The goals of neonatal resuscitation are to prevent morbidity and mortality of hypoxic-ischemic damage and to reestablish spontaneous respiratory effort and cardiac output. Although the 1 min Apgar score is useful in evaluation of the newborn, there are occasions when intervention should be immediate. Please review resuscitation of the newborn in one of the references.

11. A. 1, 2, 3

Immature vessels in the gelatinous subependymal germinal matrix of preterm newborns are subject to various forces predisposing the preterm to intraventricular hemorrhage (IVH). Contributory factors include prematurity, respiratory distress syndrome (RDS), pneumothorax, hypotension, hypertension, and increased venous pressure. Most IVH occurs within the first week of life and can present with seizures, apnea, cardiovascular instability, and acidosis. The risk for IVH decreases with increasing gestational age. In many surveys, approximately one-half of infants with birth weights <1500 g have imaging evidence of IVH.

12. E. All of the above

The incidence of IVH increases with decreasing birth weight: 60–70 % of 500–750 g. Infants and 10–20 % of 1000–1500 g infants have IVH. There are four grades defined by ultrasound (done through the anterior fontanelle):

Grade I: bleeding in the germinal matrix

Grade II: blood in the ventricle filling <50 % of the ventricle

Grade III: >50 % of the ventricle filled with blood

Grade IV: grade III + intraparenchymal blood

Marked clinical deterioration (apnea, seizures, metabolic acidosis, decreased tone) accompanies the occurrence of the IVH, usually within the first week of life. Neurological sequelae are more severe in newborns with the more severe grades of IVH.

13. The initial laboratory evaluation of a healthy neonate with normal perinatal history who has a brief seizure and who is now clinically stable should include:
    1. Measurement of electrolytes, Ca+2, and glucose
    2. Neuroimaging
    3. An EEG
    4. A lumbar puncture
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

14. Regarding neonatal respiratory distress syndrome (RDS):
    1. It is rare in infants born after 30 weeks of gestation.
    2. It is due to surfactant deficiency.
    3. Lung compliance is decreased in infants with RDS.
    4. It is associated with the premature closure of the PDA (patent ductus arteriosus).
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

15. Which of the following are features of RDS?
    1. Grunting
    2. Nasal flaring
    3. Air bronchograms on CXR
    4. Central cyanosis with peripheral plethora
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

16. Therapies for RDS include:
    1. Distending airway pressure
    2. Administration of sodium bicarbonate
    3. Surfactant administration
    4. Hypertonic fluid administration
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

13. E. All of the above

The most common cause of seizures in the newborn is hypoxic-ischemic encephalopathy. Other causes include infectious, metabolic, hemorrhagic (see above), and structural abnormalities. Seizure types in the newborn include:

Myoclonic, involving the extremities

Focal, often involving the facial muscles

Subtle, involving chewing, blinking, and respiratory alterations including apnea and multifocal clonic seizures

14. A. 1, 2, 3

RDS occurs in approximately 75 % of infants born at <28 weeks of gestation and in about 5 % of those born after 37 weeks. Increased incidence (controlling for gestational age) is seen in infants of diabetic mothers, multi-fetal pregnancies, and cesarean delivery. Preterm white males have the highest incidence. Surfactant deficiency leads to higher surface tension within the alveoli, the development of atelectasis and a decreased FRC leading to hypoxemia.

15. A. 1, 2, 3

Rapid, shallow breathing, indicative of poor compliance, is seen within minutes of birth in RDS. The natural course is one of progressive cyanosis and dyspnea. Newborns with RDS exhibit nasal flaring, grunting (in an effort to develop end-expiratory distending airway pressure), and tachypnea. Affected and untreated infants may develop mixed acidosis, hypotension, temperature instability, and apnea.

16. B. 1, 3

Impaired gas exchange in the lung is the basic pathophysiology requiring treatment. Warm humidified oxygen should be given to maintain Sp0 >90 %. If this is not accomplished with an Fi0 of 60 %, CPAP via nasal prongs should be started. At this point, administration of exogenous surfactant via endotracheal tube should also be considered, and assisted mechanical ventilation may be needed. Surfactant administration should be started within the first 24 h of life and may be repeated every 6–12 h for up to two to four doses depending upon the clinical situation.

17. Transient tachypnea of the newborn (TTN):
    A. Is primarily seen in prematures born between 30 and 34 weeks of gestation
    B. Can progress to chronic lung disease if untreated
    C. Resolves within 24–48 h
    D. Has a CXR identical to that seen with RDS

18. The ductus arteriosus:
    1. Has right to left blood flow in the normal fetus
    2. Closes in the postnatal period as a result of higher oxygen tension in the blood
    3. If open in the preterm, may lead to congestive heart failure
    4. If open in the newborn, causes a characteristic harsh diastolic murmur
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

19. The diagnosis of PDA is supported by:
    A. The presence of a shadow at the aortic knob on CXR
    B. The presence of diminished peripheral pulses due to excessive pulmonary blood flow
    C. The presence of pulsus paradoxus
    D. The findings of bounding pulses, tachypnea, and a systolic murmur

20. Which of the following maternal/perinatal factors is (are) often associated with congenital heart disease?
    1. The presence of a chromosomal abnormality
    2. Maternal rubella infection
    3. Maternal alcohol abuse during pregnancy
    4. Maternal cocaine use during pregnancy
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

17. C. Resolves within 24–48 h

TTN is seen in newborns following an uneventful term vaginal or cesarean delivery. The infants may have a minimal oxygen requirement. TTN resolves within 2–3 days. It is thought to be due to delayed absorption of fetal lung fluid. CXR will show prominent pulmonary vascular markings, fluid lines in the fissures, and over-aeration.

18. A. 1, 2, 3

In the fetus, RV output is 66 % of the combined ventricular output, and the ductus arteriosus carries 90 % of that RV output to the descending aorta, with 10 % going to the lungs. In the normal newborn, the patent ductus arteriosus (PDA) may have a continuous murmur, often described as machinelike. In newborns, a large PDA may present with bounding pulses, cardiomegaly, and other signs of CHF. Bounding peripheral pulses are the result of increased LV stroke volume due to the increased LV volume load and diastolic runoff due to the low diastolic pressure. A small PDA may be asymptomatic.

19. D. The findings of bounding pulses, tachypnea, and a systolic murmur

The CXR in a newborn with a large PDA will show increased pulmonary vascular markings and possibly cardiomegaly. The echo will show an enlarged left atrium, picked up by an abnormal LA/Ao ratio. The ductus can often be seen with 2D echo. The LA is enlarged due to the R to L shunt through the PDA. Spontaneous closure of the PDA beyond infancy is rare. The risk of endarteritis is such that all PDAs should be closed either surgically or via catheter closure.

20. A. 1, 2, 3

Infants born to mothers who abused cocaine have many problems, but an increased incidence of congenital heart disease is not one of them. Problems these children do have as a result of intrapartum cocaine exposure include spontaneous abortion, preterm birth, IUGR, microcephalus, abnormal EEG, poor expressive language and verbal comprehension, and later behavioral problems.

21. In persistent pulmonary hypertension of the newborn (PPHN):
    1. Pulmonary blood flow is decreased.
    2. There is systemic hypoxemia.
    3. Blood flow through the PDA is right to left.
    4. The systemic vascular resistance is much lower than it was during fetal life.
    A. 1, 2, 3
    B. 1, 3
    C. 2, 4
    D. 4 only
    E. All of the above

22. At birth, the right ventricle:
    A. Is hypoplastic
    B. Is approximately as thick-walled as the left ventricle
    C. Has much thicker walls than the left ventricle
    D. Has poor contractility until PVR decreases

23. Which of the following congenital heart defects is the most common in full-term newborns?
    A. Coarctation of the aorta
    B. Tetralogy of Fallot
    C. Patent ductus arteriosus
    D. Ventricular septal defect
    E. Hypoplastic left heart syndrome

24. Hypoglycemia is seen in the following neonates:
    1. SGA newborns
    2. Infants with polycythemia/hyperviscosity
    3. Preterm newborns
    4. Infants with Beckwith-Wiedemann syndrome (macroglossia, visceromegaly, omphalocele)
    A. 1, 2, 3
    B. 1, 3
    C. 2, 4
    D. 4 only
    E. All of the above

21. A. 1, 2, 3

PPHN may occur in term and postterm infants after birth asphyxia, meconium aspiration, group B streptococcal sepsis, or polycythemia. The normal decline in pulmonary vascular resistance (PVR) that usually occurs after birth does not occur. Excessively high PVR leads to a return to a fetal pattern of circulation, with increased right to left flow through the PDA from the RV and markedly diminished pulmonary blood flow.

Labile hypoxemia, out of proportion to CXR findings, is seen. Hypoxemia, hypercarbia, and acidosis worsen the degree of pulmonary vasoconstriction. A transthoracic echocardiogram can confirm the diagnosis and rule out other causes of profound hypoxemia such as congenital heart disease.

22. B. Is approximately as thick-walled as the left ventricle

During fetal life, the RV delivers approximately 90 % of its output to the systemic circulation via the open ductus arteriosus and 10 % to the very high-resistance pulmonary circulation. The ECG of a newborn shows prominent right-sided forces with right axis deviation and large R waves. The upright T waves in the precordial leads seen at birth often revert to negative within a few days after birth.

23. D. Ventricular septal defect

Ventricular septal defects (VSD) comprise approximately 25 % of all congenital cardiac lesions, exclusive of PDA in preterms, bicuspid aortic valves, and peripheral pulmonic stenosis. The majority are of the membranous type, located posteroinferiorly, anterior to the septal leaflet of the tricuspid valve. The severity of the VSD can be characterized by the ratio of pulmonary to systemic flow (Qp/Qs). An infant with a ventricular septal defect with a Qp/Qs >2:1 will exhibit clinical signs and symptoms of congestive heart failure (CHF) such as effortless tachypnea, diaphoresis, and poor feeding (the equivalent of “exercise intolerance” in the newborn).

24. E. All of the above

There are four groups of newborns at risk for hypoglycemia: infants of diabetic mothers, IUGR newborns, very immature and/or ill newborns, and newborns with metabolic/genetic disorders such as galactosemia, glycogen storage diseases, etc.

25. Hypoglycemia in the term neonate:
    1. Is diagnosed only by the presence of signs and symptoms and not a specific number
    2. Should only be treated if it occurs after the first 3–4 h of life
    3. Is very rarely seen in large, term infants
    4. Is commonly defined as a glucose of <45 g%
    A. 1, 2, 3
    B. 1, 3
    C. 2, 4
    D. 4 only
    E. All of the above

26. Symptoms and signs of hypoglycemia in the neonates include:
    1. Tremors or seizures
    2. Apnea
    3. Lethargy
    4. Poor feeding
    A. 1, 2, 3
    B. 1, 3
    C. 2, 4
    D. 4 only
    E. All of the above

27. In the treatment of glucose of <30 mg% in a newborn under anesthesia in the OR, an IV bolus of 200–300 mg/kg glucose (2–3 mL/kg of D10) is given, followed by:
    1. 4 mL/kg/h of D10
    2. D5.2 NS at maintenance
    3. 6–8 mg/kg/min glucose
    4. Glucagon 0.3 mg/kg IM up to a maximum of 1.0 mg
    A. 1, 2, 3
    B. 1, 3
    C. 2, 4
    D. 4 only
    E. All of the above

28. Regarding hemoglobin in the newborn:
    1. The mean venous hemoglobin in term infants is 18 g/dl.
    2. The physiologic anemia in preterm infants lasts longer and has a lower nadir than that seen in full-term infants.
    3. Hemoglobin concentration increases during the first few days of life as plasma volume decreases.
    4. RBC survival is normal (120 days) in term infants.
    A. 1, 2, 3
    B. 1, 3
    C. 2, 4
    D. 4 only
    E. All of the above

25. D. 4

The incidence of hypoglycemia varies with the definition used, the population studied, and the method of measurement. In term infants, a glucose of less than 35 mg% requires intervention, while symptomatic infants with glucose measurements >40 mg% also may be treated. Preterm newborns are not more tolerant of low glucose than full-term newborns. Term infants and preterm newborns are equally at risk for severe neurodevelopmental sequelae if left with a low serum glucose.

26. E. All of the above

In the newborn, hypoglycemia may present with neurologic (apnea, seizures, lethargy, coma) or sympathomimetic (pallor, palpitations, diaphoresis) symptoms. The brain in a newborn uses glucose at a rate of approximately 20 mg/min or 4–5 mg/100 g brain/min. The rate of glucose utilization of 5–7 mg/kg/min for a 3.5 kg newborn leads to an overall rate of glucose utilization of 17–24 mg/min.

27. B. 1, 3

Treating hypoglycemia with larger amounts of glucose than 200–300 mg/kg results in rebound hypoglycemia. If the hypoglycemic newborn is seizing, 400 mg/kg may be given. The infusion is begun following the bolus and the glucose level is closely followed afterward. The prognosis of asymptomatic hypoglycemia is generally quite good. If hypoglycemia is accompanied by seizures, it is associated with abnormal intellectual development.

28. A. 1, 2, 3

Hemoglobin levels in very low birth weight (VLBW) infants are 1–2 g lower than those of term infants.

29. The physiologic anemia (expected drop in hemoglobin) of infancy:
    1. Is due to decreased erythropoiesis in the oxygen-rich postnatal environment
    2. Occurs more rapidly and has a lower nadir in preterm infants compared to term infants
    3. Occurs at 10–12 weeks of age in term infants
    4. Has its nadir at 9–10 g/dl in term infants
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

30. Neonatal polycythemia:
    1. Is seen in infants of diabetic mothers
    2. Is diagnosed with a venous HCT >65 %
    3. Is treated with partial exchange transfusion in symptomatic infants
    4. Can lead to development of seizures, CNS damage, or necrotizing enterocolitis (NEC)
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

31. Polycythemia in the neonate (a venous HCT >65 % on two separate specimens):
    1. Is commonly idiopathic
    2. Occurs in infants of diabetic mothers
    3. Is associated with prolonged labor and fetal distress
    4. Occurs in newborns with intrauterine growth restriction
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above

32. Polycythemia in the neonate should be treated:
    1. In all infants whose venous HCT is >65 %
    2. With simple phlebotomy to reduce the HCT to <60 %
    3. With exchange transfusion to reduce the HCT to <45 %
    4. With partial exchange transfusion in all symptomatic infants whose venous HCT is >65 % on two separate specimens
        A. 1, 2, 3
        B. 1, 3
        C. 2, 4
        D. 4 only
        E. All of the above