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Clinical Cases for Self-Assessment

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Preface

This text is designed for those who would become consultants in pediatric anesthesia. It is based on a curriculum developed over 15 years in our department to illustrate the breadth and depth of the practice of pediatric anesthesia, consisting of weekly meetings between 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 Children's Hospital Boston.

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 try to mimic the spontaneity achievable through conversation. First of all, a "buddy" system is advisable. Secondly, a small hand-held tape recorder 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 tape and then hopefully improve as the taping continues. 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 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 these 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.

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

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Part I
Pediatric Medicine for Pediatric Anesthesiologists

Chapter 1
Newborn Medicine

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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 are 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 <1,000 gm.
   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

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:

- MLBW(moderately low birth weight 1,501–2,500 gm) 40 times increased
- VLBW (very low birth weight 1,000–1,500 gm) 200 times increased
- ELBW (extremely low birth weight <1,000 gm) 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, meconium aspiration syndrome.

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

The LBW (<2,500 gm) rate in the USA has increased from 6.6 to 7.5% from 1981 to 1997. The US 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 air flow 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 apneac 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 which 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. D_5 0.2 NS at 8 mL/h
   B. D_{10} 0.45 NS at 10 mL/h
   C. D_5 LR at 10 mL/h
   D. D_5 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 a 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. D_5 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. D_{10} 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. D_5 at 100 mL/kg/day provides 5 g/kg/day or 5,000 mg/kg/day of glucose or 3.5 mg/kg/min (5,000 mg/kg/day × 1 day/1440 min/day = 3.5 mg/kg/min). D_{10} 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 $D_{10}W$ 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 3 times that of an adult. Newborns lose heat at a rate approximately 4 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 infants neither gain nor lose 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 and
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. B.

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 vs. 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 70/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 (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