VALLEY Anesthesia

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Date: September 20, 2016

From: Scott S. Schaus
Andrew Teich, CRNA
Valley Anesthesia, Inc.

Subject: 2016 Mixed Review and Questionnaire

Dear SRNA Friend and Soon-To-Be CRNA:

It is our expectation that you have put a great deal of energy into your preparations for the National Certification Examination (NCE). The enclosed content updates and supplements your review materials. Some of the items are updates and revisions of content we have dealt with previously. You should work hard to master this material as well as the information already in your hands. Specifically, we remind you that **mastering both** the MemoryMaster ***and*** the Course Manual content *along with* the Mixed Reviews helps ensure your success on the NCE. Further study in your "go-to" anesthesia text—the text that speaks to you—is strongly recommended as well. A former Valley attendee best summarized the approach to success: "It is not enough to know the material front-to-back, up-and-down, and inside-out; you must also know it sideways!!" There are no shortcuts—work hard and stay focused!

We suspect that some of the issues in the enclosed review & update packet will be new to you. You undoubtedly will be familiar with some of the items. We have worked long hours putting this information packet together and have made every attempt to document the answers to the questions accurately. If you think any of the items are incorrect, controversial, or contain grammatical errors, we would appreciate hearing from you. Please send Scott an email with your comments and suggestions.

After you take the Certification Examination and have received your results, we ask a favor: please complete and return the enclosed questionnaire and send it to us. Your response, input and feedback are particularly important to us.

Thank you very much for your attendance and participation in Valley Anesthesia's Review Course and best wishes for success on the NCE. ***Stay focused & Never Give Up***!!

Sincerely yours,

Scott and Andrew

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PLEASE COMPLETE THE FOLLOWING QUESTIONNAIRE AND RETURN TO:

Valley Anesthesia
5 Penn Plaza, Suite 2375
New York, NY 10001
customer-service@valleyanesthesia.com

I took the Certification Exam in _____________ /__________ (month/year).

I took the Valley Review Course at ______________________ (site) in ________ (year).

I passed the Certification Exam:

________ Yes!!

________ No @#*&%! ☹

Give Valley Anesthesia a call at **855-845-7277** or

e-mail us at **customer-service@valleyanesthesia.com**.

We will help you with your plan for success.

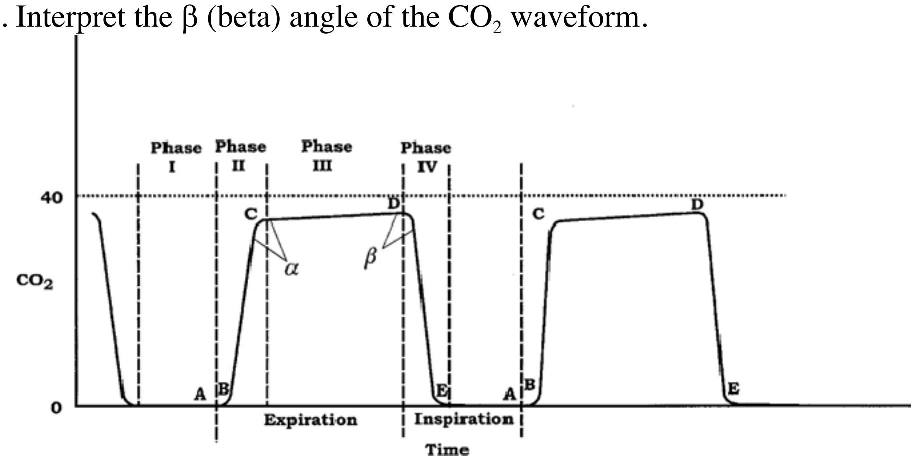
In what ways did Valley Anesthesia help you prepare for the examination (attach a sheet if you need more area for comments):

How might Valley Anesthesia improve the way it prepares SRNAs for the Certification Examination (attach a sheet if you need more area for comments):

1. Describe intermittent mandatory ventilation (IMV).
Intermittent mandatory ventilation (IMV) allows a patient to breath spontaneously around a baseline pressure (PEEP) in between mandatory breaths. IMV circuits provide a continuous supply of fresh gas flow for the spontaneous breaths between mechanical breaths. Note: with IMV the patient is breathing above the set minute ventilation. {Replaces IIA05:Q21.} [Sandberg W, Urman R, Ehrenfeld J. *The MGH Textbook of Anesthetic Equipment*, 2011:57; Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013: 1593; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013: 1291.]
2. What precaution should be taken when switching from synchronized intermittent mandatory ventilation (SIMV) to volume-controlled ventilation (VCV)?
When switching from synchronized intermittent mandatory ventilation (SIMV) to a volume-controlled ventilation (VCV), the I:E ratio does *not automatically reset*, therefore check and adjust the I:E ratio after switching to VCV. [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:275.]
3. When is intermittent mandatory ventilation (IMV) typically used?
Intermittent mandatory ventilation is often used to wean a patient from mechanical ventilation. NB: Barash makes the point that "weaning from mechanical ventilation" is better termed "liberation" or "separation" from mechanical ventilation. {Updates IIA05:Q5.} [Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:317; Sandberg W, Urman R, Ehrenfeld J. *The MGH Textbook of Anesthetic Equipment*, 2011:57; Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1594.]
4. Describe synchronized intermittent mandatory ventilation (SIMV).
Synchronized intermittent mandatory ventilation (SIMV) is a refinement of intermittent mandatory ventilation (IMV) in which the intermittent mandatory breaths are delivered *in synchrony with, and triggered by, the patient's spontaneous efforts*. SIMV can be used for full to partial support of ventilation and helps to prevent "fighting the ventilator" and "breath stacking." [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:274; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:75; Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:318.]
5. Is synchronized intermittent mandatory ventilation (SIMV) used in pressure or volume mode? What aspect of ventilation is detected to trigger synchronization with the patient's ventilatory effort?
Synchronized intermittent mandatory ventilation (SIMV) may be used in *either pressure- or volume-cycled mode*. A trigger window controls the amount of time during each expiratory cycle that the ventilator is sensitive to spontaneous breaths, by sensing negative (subatmospheric) pressure generated by the patient's diaphragm. [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:274; [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015: 3065; Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:318.]
6. Describe assist/control ventilation. (Note: assist/control is often stated as assist-control.)
In assist/control (AC) ventilation, the patient is allowed to set the respiratory rate by activating the inspiratory trigger function. In volume assist/control mode, each patient effort of sufficient magnitude will trigger the set tidal volume. In pressure assist/control, the patient again sets the frequency and the upper limit of pressure—the tidal volume varies, and consistency is sacrificed to prevent barotrauma by high pressures. As a safety measure, if no spontaneous effort occurs, the ventilator will deliver controlled breaths at a preselected backup rate. The variable used by the ventilator to cycle off the breath is time. {Revises IIA05:Q6.} [Miller

RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:3065; Hagberg C. *Benumof & Hagberg's Airway Management*, 3e, 2012:985.]

7. Identify nine (9) disadvantages of a closed circle system.
   The major disadvantages of a closed circle system stem from the complex design. Since there are ten or more connections, the circle system is prone to: (1) disconnects; (2) obstructions; (3) leaks; and, (4) malfunction of unidirectional valves. The larger size of a circle system (5) limits portability. Other shortcomings of a closed circle system are: (6) increased dead-space; (7) complications due to use of an absorbent; (8) difficulty predicting inspired gas concentration during low fresh gas flow; and, (9) some components are difficult to clean. {Revises and updates IIA07:Q3.} [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:674; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:268b; Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:274; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:40]
8. Into what shape should a lighted intubation stylet ("lightwand", Trachlight) be molded? What approximate angle is the bend of this shape?
   To facilitate oral intubation, an anterior "J" or "hockey stick" bend of approximately 75- to 90-degrees just proximal to the cuff is recommended. Sandberg recommends bending a Trachlight to an "L" shape. Care should be taken not to bend the stylet at the point at which the bulb meets the shaft. NB: the range of the bend for adult oral intubation is 75- to *120*-degrees in the texts. {Updates IIBQ15.} [Hagberg, *Benumof & Hagberg's Airway Management*, 3e, 2012:434; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1195; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1667, 1675; Sandberg W, Urman R, Ehrenfeld J. *The MGH Textbook of Anesthetic Equipment*, 2011:107.]
9. What advantage does CO_2 monitoring have over pulse oximetry or vital sign monitoring?
   Carbon dioxide monitoring detects *acute, complete airway obstruction* and *extubation* more rapidly than pulse oximetry or vital sign monitoring. {New … into IID03a.} [Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:705.]
10. Interpret the β (beta) angle of the CO_2 waveform.



The angle between the end of phase III (alveolar plateau) and the descending (inspiratory) limb is called the β angle. The beta angle is normally 90 degrees. [Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:712; Ehrenwerth, *et al*. *Anesthesia Equipment: Principals and Applications,* 2e, 2013:248.]

11. What issues may increase the β angle of the CO_2 waveform? Decrease the β angle?
    The β angle of the CO_2 waveform is increased with *rebreathing*, malfunctioning inspiratory valves, and with prolonged response time compared to respiratory cycle time, especially in children. The beta angle will be decreased if the slope of phase III is decreased. [Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:712; Ehrenwerth, *et al*. *Anesthesia Equipment: Principals and Applications,* 2e, 2013:248.]
12. The capnogram baseline is elevated in the intubated patient who received a volatile agent/N_2O/narcotic anesthetic. Ventilation is adequate. What are the most likely causes of the elevated CO_2 baseline and what do you do?
    An elevated CO_2 waveform baseline indicates the patient is *rebreathing*, most likely due to a CO_2 absorbent issue or a malfunctioning unidirectional valve. Increasing fresh gas flow will lower the CO_2 in the circle system. {Updates IID03a:Q7.} [Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:414.]
13. Explain how a pulse oximeter works.
    Two different wavelengths of light are used: one is visible red light (λ = 660 nm) and the other infrared ((λ = **940** nm). Infrared light (940 nm) is absorbed by oxyhemoglobin whereas visible red light (660 nm) is absorbed by deoxyhemoglobin. The ratio of pulsatile to nonpulsatile light absorption at each frequency is calculated. The ratio is then correlated to SpO_2 through internal calibration. Note: a number of different infrared frequencies have been used in pulse oximeters over the years; the *most common currently-used* infrared wavelength is 940 nm. {Updates IID03b:Q1.} [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1545; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:702; Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:777f.]
14. Why might low or poor perfusion states interfere with accurate pulse oximeter readings?
    Pulse oximeters require *adequate pulsations* to distinguish light absorbed from arterial blood from venous blood and tissue light—this process is called plethysmographic analysis. Therefore, pulse oximeter readings may be unreliable or unavailable if there is loss or diminution of peripheral pulse. [Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:789; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:702; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1545; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:318.]
15. List 12 examples of poor perfusion states that limit pulse oximeter accuracy.
    Examples of poor perfusion states that may result in unreliable or unavailable pulse oximeter readings are: (1) proximal blood pressure cuff inflation; (2) external pressure; (3) improper positioning; (4) hypotension; (5) hypothermia; (6) Raynaud's phenomenon; (7) cardiopulmonary bypass; (8) low cardiac output; (9) hypovolemia; (10) peripheral vascular disease; (11) Valsalva maneuver, such as in laboring patient; and, (12) infusion of vasoactive drugs. {Revises IID03B:Q7.} [Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:789.]
16. List ten (10) factors other than poor perfusion that lead to *falsely low* pulse oximeter readings ($SpO_2 < SaO_2$).
    Ten factors that may lead to falsely low pulse oximeter readings are: (1) altered versions of hemoglobin, namely methemoglobin when the true $SaO_2 > 85\%$, and HbK; (2) intravenous dyes, i.e., methylene blue, indigo carmine, isosulfan blue, indocynanine green, and nitrobenzene; (3) motion artifacts from shivering or evoked potentials, for example; (4) anemia, especially if the hematocrit is <25%; (5) low saturation (SaO2 < 80%); (6) optical interference

from flickering or strong LED lights; (7) electromagnetic interference—electrocautery, cell phones, surgical stereotactic positioning systems; (8) henna (temporary body art dye); (9) nail polish, especially black, purple, or dark blue; and, (10) burns or pressure sores, pressure necrosis from LED of pulse oximeter (Note: the pulse oximeter LED generates heat). {Revises IID03b:Q8.} [Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:789-794; Miller RD, Cohen NH, Eriksson LI, *et al. Miller's Anesthesia*. 8e; 2015:1547t; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:319-320; Barash PG, Cullen BF, Stoelting RK*, et al. Clinical Anesthesia*. 7e; 2013:703; Sandberg W, Urman R, Ehrenfeld J. *The MGH Textbook of Anesthetic Equipment*, 2011:133t.]

17. List two factors that lead to *falsely high* pulse oximeter readings ($S_PO_2 > S_aO_2$).
    Carboxyhemoglobin (CO poisoning) and methemoglobin—when the true SaO2 < 85%—lead to falsely high pulse oximeter readings. {New Q … IID03B.} [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:320; Pino RM, et al. *Clinical Anesthesia Procedures of the Massachusetts General Hospital*, 9e, 2015:149; Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:702.]
18. Explain how the presence of methemoglobin can lead to *both* falsely high and falsely low pulse oximeter readings.
    Methemoglobin absorbs a significant amount of light at both 660 and 940 nm and thus the pulse oximeter detects equal amount of oxy- and deoxyhemoglobin which results in a reading of 80% to 85%. In other words, in the presence of significant methemoglobinemia the pulse oximeter reading is essentially "fixed" at 80% to 85%. Therefore, when the true SaO_2 is less than 85%, the reading is falsely high and the obverse is true as well. [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1547.]
19. List 5 factors the generally have *no significant effect* on pulse oximeter readings ($S_PO_2 = S_aO_2$).
    The following 5 factors have generally no significant effect on the pulse oximeter reading: (1) polycythemia; (2) skin pigmentation; (3) alternate hemoglobins, specifically HbF, HbS, HbH, and sulfHb; (4) *red* henna dye; and, (5) jaundice. {New Q … IID03B.} [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1547.]
20. When performing an epidural anesthetic, what should alert you to the fact an intrathecal (subarachnoid) injection has occurred?
    A profound motor and sensory block (numbness in legs and hands, for example) soon after an epidural injection should alert you that an unintended subarachnoid injection has occurred. A rapid onset of the triad of (1) severe hypotension, (2) bradycardia, and (3) respiratory insufficiency secondary to complete sympathetic block ensues. Apnea may result from prolonged hypotension (reduced perfusion of respiratory control centers in the brainstem). Nausea and loss of consciousness may proceed cardiovascular arrest. {Updates IIIH02:Q53.} [Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:927; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:967; Pino RM, et al. *Clinical Anesthesia Procedures of the Massachusetts General Hospital*, 9e, 2015:532; Hadzic A. *Hadzic's Peripheral Nerve Blocks and Anatomy for Ultrasound-Guided Regional Anesthesia*, 2e, 2012:262; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:1149.]

21. During an epidural block the patient's blood pressure drops precipitously to 80/35, the heart rate falls to 50 bpm, and SaO_2 falls to 85%. What has probably happened?
Severe hypotension, bradycardia, and respiratory insufficiency during an epidural block are signs and symptoms of *subdural injection* of the anesthetic agent. You have noticed that these are the same signs and symptoms of a "high spinal," that is, sympathetic block with unopposed parasympathetic effects. The key factor is timing: with a subdural injection, the signs and symptoms are delayed by 15-30 seconds, in contrast to immediate onset following a total spinal. Other possible signs and symptoms of a subdural injection include *patchy* and *markedly asymmetric* extensive spread of analgesia. {Updates IIIH02:Q54.} [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1715; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:1149; Pino RM, et al. *Clinical Anesthesia Procedures of the Massachusetts General Hospital*, 9e, 2015:248-249.]
22. For epidural anesthesia, clinically useful doses of local anesthetics are based on volumes that permit an even filling of the anterior and posterior epidural spaces at the level of insertion. What is the suggested volume per spinal nerve segment at cervical and thoracic levels to provide epidural blockade?
The suggested volume of local anesthetic for epidural anesthesia at cervical and thoracic level is 0.7-1 mL per spinal segment to be anesthetized. {New Q … IIIH03 prior to Q11.} [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:1091.]
23. What is the suggested volume per spinal nerve segment at lumbar levels to provide epidural blockade?
The suggested volume of local anesthetic for epidural anesthesia at lumbar levels is 1-2 mL per spinal segment to be anesthetized. Note: Nagelhout & Plaus state 1.25-1.50 mL per segment for epidural block. {Revises IIIH03:Q11.} [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:1091; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1703; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:962-963; Hadzic, *Textbook of Regional Anesthesia and Acute Pain Management (*NYSORA), 2007:245, 257.]
24. List the local anesthetics and concentrations that produce minimal motor blockade when administered epidurally.
Bupivacaine (0.25%), ropivacaine (0.5%), and levobupivacaine (0.25%) provide satisfactory analgesia for acute pain with minimal to no motor block when administered epidurally. {Revises IIIH03:Q13 [Cousins MJ, Carr DB, Horlacker TT, et al. *Cousins and Bridenbaugh's Neural Blockade in Clinical Anesthesia and Pain Medicine*. 4e; 2008:255; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1704t; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:963t.]
25. Which four local anesthetics (and concentration) provide *potent sensory* analgesia and *minimal motor* block when administered epidurally?
Bupivacaine (0.5%), ropivacaine (0.5%), levobupivacaine (0.5%), and plain lidocaine (2%) provide potent sensory analgesia and minimal motor blockade when administered epidurally. {New Q … IIIH03:Q14.} [Cousins MJ, Carr DB, Horlacker TT, et al. *Cousins and Bridenbaugh's Neural Blockade in Clinical Anesthesia and Pain Medicine*. 4e; 2008:255; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1704t; Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:922.]

26. List two local anesthetics (and concentration) that provide *profound sensory* analgesia and *excellent muscle relaxation* when administered epidurally.
Lidocaine (2% with epinephrine) and etidocaine (1.5%) provide profound sensory analgesia and excellent muscle relaxation when administered epidurally. {Replaces IIIH03:Q14.} [Cousins MJ, Carr DB, Horlacker TT, et al. *Cousins and Bridenbaugh's Neural Blockade in Clinical Anesthesia and Pain Medicine*. 4e; 2008:255; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1704t; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:922.]
27. The tourniquet cuff fails during an intravenous block of the upper extremity (Bier block) and the patient develops a seizure. What should be done?
A seizure is a sign of local anesthetic toxicity in the CNS. Airway management remains the primary intervention because preventing hypoxia and acidosis are essential first steps. Oxygenation and ventilation should be maintained and the airway should be secured, if necessary. Hypoxemia, hypercapnia, and acidemia may exacerbate the local anesthetic toxicity; acidemia may enhance the toxicity by ion trapping of local anesthetic in the brain. Benzodiazepines are considered the drugs of choice because they are anticonvulsant without causing significant cardiac depression. When benzodiazepines are not available, small doses of propofol are appropriate. Succinylcholine may be useful to suppress intractable seizure-induced tonic-clonic muscle activity in spite of the lack of CNS effects. {Revises IIIH06:Q19.} [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:575; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:136.]
28. How can local anesthetic systemic toxicity (LAST) best be avoided?
The best practice for managing systemic local anesthetic intoxication starts with *vigilance* and *prevention*. Elevated plasma levels of local anesthetics can occur by inadvertent intravascular injections or systemic absorption. The risk for intravascular injections can be reduced by using a local anesthetic *test dose* (about 3 mL), frequently aspirating the injectate for signs of blood return, and *dividing the dose* of the local anesthetics. {Updates IIIH08:Q5.} [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:575; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:135-136, 138b, 140b; Hadzic A. *Hadzic's Peripheral Nerve Blocks and Anatomy for Ultrasound-Guided Regional Anesthesia*, 2e, 2012:120-121.]
29. After an epidural injection of local anesthetic, your patient complains of lightheadedness, dizziness, and ringing in the ears. What immediate actions should you take?
Lightheadedness, dizziness, and tinnitus are initial symptoms of local anesthetic systemic toxicity (LAST). Your immediate concern is airway management and circulatory support. Maintain ventilation with 100% oxygen and secure the airway, if necessary. Hypoxia, hypercapnia and acidosis will exacerbate the toxicity. Hypercapnia enhances cerebral blood flow and thus more rapid delivery of local anesthetic to the brain. In addition, both hypercapnia and acidosis decrease plasma protein binding of local anesthetics, increasing the proportion of free drug available for diffusion in the brain. {Updates IIIH08:Q4.} [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:575; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:135-136, 138b; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1047.]

30. You have just performed intercostal nerve blocks at 5 levels to provide analgesia for fractured ribs. The patient becomes hypotensive, bradycardic, and has a seizure. Describe seven (7) actions to manage the situation.
The patient with hypotension, bradycardia, and seizures following intercostal nerve blocks has local anesthetic systemic toxicity (LAST), most likely due to an intravascular injection of local anesthetics. The following checklist for managing LAST is provided by the American Society of Regional Anesthesia and Pain Medicine. (1) Get help. (2) Airway management: ventilate with 100% oxygen. (3) Seizure suppression, benzodiazepines are preferred. (4) BLS/ACLS with medication adjustments. (5) Infuse 20% lipid emulsion. (6) Alert the nearest facility having cardiopulmonary bypass capability. Failure to respond to lipid emulsion and vasopressor therapy necessitates institution of cardiopulmonary bypass. (7) Post LAST events at www.lipidrescue.org and report use of lipid to www.lipidregistry.org. [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:136-140; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:575; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:104-1049; Hadzic A. *Hadzic's Peripheral Nerve Blocks and Anatomy for Ultrasound-Guided Regional Anesthesia*, 2e, 2012:120-122.]
31. Describe the recommended lipid emulsion dosing for treatment of local anesthetic systemic toxicity (LAST).
The recommended lipid emulsion dosing for treatment of LAST is: (1) intravenous bolus of 1.5 mL/kg (LBW) of 20% lipid emulsion, such as Intralipid 20%, over 1 minute. (2) Continuous infusion at 0.25 mL/kg/min for at least 10 minutes after cardiac function returns. (3) If cardiovascular instability continues, repeat bolus once or twice and consider increasing the infusion to 0.5 mL/kg/min. (4) Recommended upper limit is 10 mL/kg lipid emulsion over the first 30 minutes. {New Q … IIIH08.} [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:136-140; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:575; Hadzic A. *Hadzic's Peripheral Nerve Blocks and Anatomy for Ultrasound-Guided Regional Anesthesia*, 2e, 2012:122.]
32. In question 29, you stated "BLS/ACLS with *medication adjustments*" for managing local anesthetic toxicity (LAST). What are the specific adjustments? What drugs should be avoided?
During the management and treatment of local anesthetic systemic toxicity (LAST), the following adjustments should be made to standard BLS/ACLS protocols. (1) Reduce individual epinephrine doses to less than 1 mcg/kg (epinephrine appears to reduce efficacy of Intralipid emulsion). (2) Avoid vasopressin. (3) Avoid calcium channel blockers. (4) Avoid beta-adrenergic antagonists (beta-blockers). (5) Avoid local anesthetics (!). Amiodarone is preferred for ventricular dysrhythmias. (6) Propofol (for seizures) should not be used when there are signs or expectation of cardiovascular instability. [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:136-140.]
33. Six mechanistic actions may contribute to lipid resuscitation during the management of local anesthetic systemic toxicity (LAST). List the six mechanisms of action of lipid emulsion rescue.
Six mechanistic actions may contribute to lipid resuscitation: (1) capture of local anesthetic in the blood (lipid sink effect); (2) increased fatty acid uptake by mitochondria (metabolic effect); (3) interference with local anesthetic binding of sodium channels (membrane effect); (4) activation of Akt cascade (a serine/threonine protein kinase important in cell survival, proliferation, and migration, also called protein kinase B; note: this is signal transduction)

leading to inhibition of GSK-3 which is glycogen synthase kinase (cytoprotective effect); (5) promotion of calcium entry via voltage-dependent calcium channels (ionotropic/inotropic effect); and (6) accelerated shunting (pharmacokinetic effects). [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:136-140; Authors.]

34. What eight (8) factors are related to a greater likelihood of a post-dural puncture headache following neuraxial anesthesia?
    The likelihood of a post-dural puncture headache is related to: (1) age … younger > older; (2) gender … females > males; (3) BMI … low BMI > high BMI (increased intra-abdominal pressure is obese raises CSF pressure); (4) pregnancy … pregnant > non-pregnant; (5) needle size … larger gauge > smaller gauge; (6) needle bevel … less incidence when bevel is placed in long axis of the neuraxis (in other words, bevel parallel to dural fibers); (7) dural thickness … thicker dura, less incidence; and, (8) history of dural punctures … greater incidence with prior dural punctures. {Updates IIIH08:Q9.} [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1712t; Chestnut DH, Wong CA, Tsen, LC *et al*. *Obstetric Anesthesia,* 5e; 2014:720-722; Suresh, *et al*. *Shnider and Levinson's Anesthesia for Obstetrics*, 5e, 2013:428.]
35. What is the incidence of post-dural puncture headache with spinal anesthesia?
    The incidence of post-dural puncture headache with spinal anesthesia is up to **25%**. [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:926]
36. The frequency of post-dural puncture headache (PDPH) is related to needle size and needle style. Identify the frequency of PDPH for the following needles: Quincke 22g, Quincke 27g, Quincke 32g; Sprotte 22g, Pencan (Sprotte) 27g; Whitacre 20g, Whitacre 27g? What is the conclusion?
    The frequency of post-dural puncture headache (PDPH) associated with various needles is:
    Quincke 22g —36%
    Quincke 27g —1.5% to 5.6%
    Quincke 32g —0.4%
    Sprotte 22g —12.2%
    Pencan (Sprotte) 27g —0.98%
    Whitacre 20g —2% to 5%
    Whitacre 27g —0% to 1.7%
    Tuohy 16g —70%
    The conclusion: smaller, non-cutting needles are associated with a lower frequency of post-dural puncture headache as a complication of neuraxial anesthesia. {Updates IIIH08:Q11.} [Suresh, *et al*. *Shnider and Levinson's Anesthesia for Obstetrics*, 5e, 2013:428.]
37. What is the risk of accidental dural puncture with an epidural needle? What is the frequency of post-dural puncture headache with accidental dural puncture?
    There is a 1.5% risk of accidental dural puncture with an epidural needle. Of these accidental dural punctures, up to 50% to 80% will experience a post-dural puncture headache. {Replaces IIIH08:Q12.} [Chestnut DH, Wong CA, Tsen, LC *et al*. *Obstetric Anesthesia,* 5e; 2014:718; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:926.]
38. Diplopia following a spinal anesthetic results from palsy of which cranial nerve?
    Cranial nerve palsy, thought to be secondary to nerve traction due to low CSF volume, is occasionally associated with PDPH. The *sixth cranial nerve* (abducens nerve, CN VI) is most susceptible to traction during its long intracranial course. The traction results in failure of the involved eye to abduct, and patients may have diplopia. {Updates IIIH08:Q14.} [Chestnut

DH, Wong CA, Tsen, LC *et al. Obstetric Anesthesia,* 5e; 2014:718; Suresh, *et al. Shnider and Levinson's Anesthesia for Obstetrics*, 5e, 2013:429.]

39. What is a fascia iliaca block?
Fascia iliaca block is a low-tech alternative to femoral or a lumbar plexus block. The mechanism behind this block is that the femoral and lateral femoral cutaneous nerves lie under the iliacus fascia. Therefore, a sufficient volume of local anesthetic deposited beneath the fascia iliaca has the potential to spread underneath the fascia and reach these nerves. [Hadzic A. *Hadzic's Peripheral Nerve Blocks and Anatomy for Ultrasound-Guided Regional Anesthesia*, 2e, 2012:406.]
40. What are the indications for a fascia iliaca block?
The fascia iliaca block provides analgesia of the femoral, lateral femoral cutaneous, and obturator nerves and therefore is useful for anterior thigh and knee surgery, and to provide analgesia following hip and knee procedures. The fascia iliaca block may be effective in more than 90% of children, compared with 20% effectiveness of the 3-in-1 technique. [Hadzic A. *Hadzic's Peripheral Nerve Blocks and Anatomy for Ultrasound-Guided Regional Anesthesia*, 2e, 2012:405; Davis PJ, Cladis FP, Motoyama EK. *Smith's Anesthesia for Infants and Children*. 8e; 2011:488.]
41. Describe the anatomy of the fascia iliac block.
The three distal nerves of the lumbar plexus, the femoral, lateral femoral cutaneous, and obturator nerves, all emerge from the psoas muscle and *run along the inner surface of the fascia iliaca*. A fascia iliaca compartment block delivers local anesthetic between the fascia iliaca and iliacus muscles where it spreads to bathe the three nerves. [Davis PJ, Cladis FP, Motoyama EK. *Smith's Anesthesia for Infants and Children*. 8e; 2011:489.]
42. How much local anesthetic is required for a fascia iliaca block?
Since the fascia iliaca block depends on the spread of local anesthetic along a connective tissue plane, it is a *large-volume block*. Approximately 30-40 mL of injectate is necessary to accomplish a fascia iliaca block (0.5-1 mL/kg for pediatric patients). [Hadzic A. *Hadzic's Peripheral Nerve Blocks and Anatomy for Ultrasound-Guided Regional Anesthesia*, 2e, 2012:407; Davis PJ, Cladis FP, Motoyama EK. *Smith's Anesthesia for Infants and Children*. 8e; 2011:485t.]
43. List seven (7) side effects and complications of the interscalene brachial plexus block.
Side effects and complications from the interscalene brachial plexus block are related to the structures located in the vicinity of Chassaignac's tubercle (transverse process of C6).
(1) Ipsilateral diaphragmatic paresis occurs in 100% of patients, but is rarely of consequence unless respiratory compromise exists. The patient may experience *dyspnea* and need reassurance. (2) The vertebral artery passes posteriorly at the level of the sixth vertebra to lie in its canal in the transverse process that can be seen as a pulsatile structure deep to the plexus; direct injection into this vessel can rapidly produce *central nervous system toxicity and convulsions*. (3) Involvement of the ipsilateral vagus nerve, especially the recurrent laryngeal branch, may lead to *hoarseness*—this is more frequent on right side blocks. (4) The local anesthetic usually spreads by diffusion to reach the ipsilateral cervical sympathetic plexuses, leading to *Horner's syndrome*. (5) The cupola of the lung is close, particularly on the right side, and can be contacted if the needle is directed too far caudally. *Pneumothorax* should be considered if cough or chest pain is produced while exploring for the nerve. (6) If the needle is allowed to pass directly medially, it may enter the intervertebral foramen, and injection of local anesthetic may produce *spinal or epidural anesthesia*. (7) Severe hypotension and

bradycardia (Bezold-Jarisch reflex) can occur in awake, sitting patients undergoing shoulder surgery under an interscalene block. This reflex may be avoided by adequate hydration and prophylactic beta-adrenergic blockers. {Replaces IIIH08:Q38.} [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1726; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:961; Cousins MJ, Carr DB, Horlacker TT, et al. *Cousins and Bridenbaugh's Neural Blockade in Clinical Anesthesia and Pain Medicine*. 4e; 2008: 382-329; Hadzic A. *Hadzic's Peripheral Nerve Blocks and Anatomy for Ultrasound-Guided Regional Anesthesia*, 2e, 2012:160.]

44. Pain after total joint replacement, particularly total knee arthroplasty (TKA), is severe. Describe the traditional techniques for postoperative pain management following total joint replacement. What are the disadvantages of these techniques?
Traditionally, postoperative analgesia following total joint replacement was provided by either intravenous patient-controlled analgesia or epidural analgesia. Opioids do not consistently provide adequate pain relief and often cause sedation, constipation, nausea and vomiting, and pruritus. Epidural infusions containing local anesthetics (with or without an opioid) provide superior analgesia but are associated with hypotension, urinary retention, motor block limiting ambulation, and spinal hematoma secondary to anticoagulation. {Replaces IIIJ:Q7.} [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1450-1451; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2398.]

45. Pain after total joint replacement, particularly total knee arthroplasty (TKA), is severe. Describe three newer techniques for postoperative pain management following total joint replacement.
Single-dose and *continuous peripheral nerve techniques* that block the lumbar plexus (fascia iliaca, femoral, psoas compartment blocks), with or without sciatic nerve blockade, can be used with success for patients having total joint replacement. *Unilateral peripheral nerve block* provides a quality of analgesia and surgical outcomes similar to that of continuous epidural analgesia, but with fewer side effects. *High-volume local wound infiltration/infusion techniques* with a combined administration of local anesthetics, NSAIDs, and epinephrine [local infiltration analgesia (LIA)] provide positive results for TKA, more so than THA (total hip). [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1450-1451; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2399.]

46. How do you assess volume status in the anesthetized patient?
Assessment of the adequacy of intraoperative fluid resuscitation *integrates multiple clinical variables*, including heart rate, blood pressure, urinary output, arterial oxygenation, and pH. Tachycardia is an insensitive, nonspecific indicator of hypovolemia. In patients receiving potent inhalational agents, maintenance of a satisfactory blood pressure implies adequate intravascular volume. Preservation of blood pressure, accompanied by a central venous pressure (CVP) of 6 to 12 mm Hg, more strongly suggests adequate replacement. In the absence of glycosuria or diuretic administration, a urinary output of 0.5 to 1 mL/kg/hr during anesthesia suggests adequate renal perfusion. In patients undergoing extensive procedures, direct arterial pressure measurements are more accurate than indirect techniques and provide convenient access for obtaining arterial blood samples. Finally, during high-risk surgical procedures is the use of esophageal Doppler or transesophageal echocardiography (TEE) best assesses the adequacy of cardiac preload. {Replaces IIIK:Q19.} [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 340-341; 2013:340-341; 1786; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:740; Pino RM, et al. *Clinical Anesthesia Procedures of the Massachu-*

setts General Hospital, 9e, 2015:217; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:649.]

47. Inadequate intravascular volume during the perioperative period can cause a range of adverse physiologic effects: describe these effects.
    The major complications of hypovolemia, aside from hemodynamic instability, include decreased oxygenation of surgical wounds (which predisposes to wound infection), decreased collagen formation, impaired wound healing, and increased wound breakdown. At the most extreme levels of hypovolemia, ATP production to support normal cell functions in those tissues with the worst perfusion may be inadequate, leading to cell death and organ dysfunction. [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:321; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1787.]
48. What are the adverse effects of perioperative hypervolemia?
    The major complications associated with hypervolemia include pulmonary edema, congestive heart failure, edema of gut with prolonged ileus, and possibly an increase in cardiac arrhythmias. Note that edema will develop in compliant tissues—lungs, muscle, and bowel. Further potential effects of excessive intravascular fluid include reduced tissue oxygenation with impaired healing, pulmonary congestion predisposing to pulmonary infection, and increased myocardial work resulting from ventricular filling beyond the optimum portion of the Starling curve. [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:321; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1787.]
49. What are the four (4) anesthetic goals for intracranial aneurysm surgery?
    Contemporary management of intracranial aneurysms calls for early intervention after subarachnoid hemorrhage (SAH), ideally within 24 hours and certainly within 48 hours. Anesthetic goals for intracranial aneurysm surgery are: (1) absolutely avoid acute hypertension with its attendant risk of re-rupture—**limit the risk of aneurysm rupture**; (2) achieve intraoperative brain relaxation to facilitate surgical access to the aneurysm—**facilitate surgical exposure**; (3) maintain high-to-normal MAP to prevent critical reduction of CBF in recently insulted and now marginally perfused areas of brain, or in regions critically dependent on collateral pathways—**prevent cerebral ischemia**; and, (4) be prepared to perform precise manipulations of MAP as the surgeon attempts to clip the aneurysm or to control bleeding from a ruptured aneurysm or during periods of temporary vascular occlusion—**be ready to precisely manipulate MAP**. {Updates IVA03:Q19.} [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2179; Hines RL, Marschall KE. *Stoelting's Anesthesia and Co-Existing Disease*. 6e; 2012:236--237; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:718; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:606—607.]
50. What is the *main* anesthetic goal for a patient with a cerebral aneurysm?
    The prevention of paroxysmal hypertension is the only absolute requirement in patients undergoing aneurysm clipping. Rebleeding kills and the poorly organized clot over the aneurysms of patients undergoing early post-subarachnoid hemorrhage clipping makes them particularly prone to rebleeding. A rebleed at induction is frequently fatal. {Updates IVA03:Q21.} [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2179; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1013.]
51. What techniques are used to produce a "relaxed brain" during intracranial aneurysm surgery?
    Optimization of brain relaxation during intracranial aneurysm surgery is an important part of anesthetic maintenance. Combinations of (1) lumbar CSF drainage, (2) mild hyperventila-

tion, (3) administration of loop and/or osmotic diuretics, and (4) proper positioning to facilitate cerebral venous drainage can help to optimize surgical exposure of the brain and facilitate dissection. {Updates IVA03:Q24.} [Hines RL, Marschall KE. *Stoelting's Anesthesia and Co-Existing Disease*. 6e; 2012:238.]

52. What is a major dilemma in the patient with an open eye-full stomach?
The dilemma in the patient with an open eye-full stomach is to protect the patient from pulmonary aspiration and at the same time to protect the eye from acute changes in intraocular pressure, which could cause vitreous loss, retinal detachment, and blindness. In other words, you must weigh the risk of aspiration against the risk of blindness. [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2521; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1389; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:993—994.]
53. Describe the plan for induction in an open eye-full stomach patient. Is succinylcholine contraindicated?
An open eye-full stomach scenario usually calls for a rapid-sequence induction; however, succinylcholine raises intraocular pressure (IOP), as you know. At induction of general anesthesia, there are many activities that raise IOP to a much greater degree than succinylcholine, including crying, Valsalva maneuver, forceful blinking, rubbing eyes, and coughing or bucking. There are 2 key binary questions, in this order: (1) "Is this an easy airway?" If yes, then avoid succinylcholine and use high-dose rocuronium. If no, this is not an easy airway, then ask: (2) "Is the eye viable?" If yes, then use succinylcholine (Nagelhout & Plaus). {Updates IVA06:Q34.} [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:993—994; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1389.]
54. Identify the two (2) major perioperative goals for the patient with Graves' disease.
The most important preoperative goal for the patient with Graves' disease is to make the patient *euthyroid* before surgery, if possible. The other major perioperative goal is to prevent sympathetic nervous system stimulation. This is accomplished by providing sufficient anesthetic depth and avoiding medications that directly or indirectly stimulate the sympathetic nervous system. [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1329; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:874.]
55. Your patient with Graves' disease has achieved an euthyroid state and has no evidence of airway obstruction. What is the best induction method for this patient?
Induction in the euthyroid patient with Graves' disease may be achieved with a number of intravenous agents. No controlled study has shown an advantage of any induction drug over another. Because of the increased incidence of myasthenia gravis and skeletal muscle weakness in the hyperthyroid patient, precaution dictates *careful titration of muscle relaxant* doses with use of a peripheral nerve stimulator. {Revises IVA08:Q8.} [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:874; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1174; Fleisher LA. *Anesthesia and Uncommon Diseases*. 6e; 2012:415.]
56. Which agents must be *avoided* in the patient with Graves' disease? Why?
During induction, avoid ketamine because it is a CNS stimulant. Also avoid pancuronium—it increases heart rate. [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1329; Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:874.]
57. Define "hypertensive crisis" (hint: think arterial blood pressure measurements).
Hypertensive crisis is defined as arterial blood pressure ≥180/120 mm-Hg. [Hines RL, Marschall KE. *Stoelting's Anesthesia and Co-Existing Disease*. 6e; 2012:109.]

58. Hypertensive crisis (ABP ≥180/120 mm-Hg) is further categorized as either hypertensive *urgency* or hypertensive *emergency*. What differentiates hypertensive urgency from hypertensive emergency?
Hypertensive crises (ABP ≥180/120 mm-Hg) can be categorized as either a hypertensive urgency or a hypertensive emergency, based on the *presence or absence of impending or progressive target organ damage*. Patients with chronic systemic hypertension can tolerate a higher systemic blood pressure than previously normotensive individuals and are more likely to experience urgencies rather than emergencies. {New Question … IVA10b:Q6b.} [Hines RL, Marschall KE. *Stoelting's Anesthesia and Co-Existing Disease*. 6e; 2012:109.]
59. What is the treatment goal for the patient in a hypertensive *emergency*?
The treatment goal for the patient in a hypertensive emergency is to decrease the blood pressure promptly but gradually. A general guideline is to decrease arterial blood pressure by 20% to 25% within 30 to 60 minutes. {Revises IVA10b:Q6.} [Hines RL, Marschall KE. *Stoelting's Anesthesia and Co-Existing Disease*. 6e; 2012:109; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2471b.]
60. What is the drug of choice for hypertensive emergency?
For most hypertensive emergencies, sodium nitroprusside (SNP) 0.5-10.0 mcg/kg/min IV is the drug of choice; however, treatment with SNP is complicated by cyanide toxicity and lactic acidosis, as you know. Other treatment alternatives are nicardipine, fenoldopam, esmolol, and labetalol. Note: table 5-6 in *Stoelting's Co-Existing Diseases* is a gold mine for treating hypertensive crises. {Revises IVA10b:Q6.} [Hines RL, Marschall KE. *Stoelting's Anesthesia and Co-Existing Disease*. 6e; 2012:110.]
61. What recently FDA-approved drug may be the new drug of choice for treating a hypertensive emergency?
Clevidipine (Cleviprex), a third-generation dihydropyridine calcium channel blocker with ultrashort duration of action and selective arteriolar vasodilating properties has recently been approved by the Food and Drug Administration. The pharmacokinetics and pharmacodynamics of clevidipine are favorable for use of this drug in clinical situations in which tight blood pressure control is essential. [Hines RL, Marschall KE. *Stoelting's Anesthesia and Co-Existing Disease*. 6e; 2012:110.]
62. What is the leading cause of postoperative hypertension and tachycardia?
Pain remains the leading cause of hypertension and tachycardia in the PACU and results in stimulation of the somatic afferent nerves, producing a pressor response called the *somatosympathetic reflex*. {Updates IVA10b:Q8.} [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:1230.]
63. What is the leading cause of postoperative hospital admission?
Inadequate pain relief is the #1 cause of postoperative hospital admission. [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2633.]
64. Postoperative hypertension is common and multifactorial; what factors contribute to postoperative hypertension?
Postoperative hypertension is common and multifactorial … the multiple causes of postoperative hypertension include: (1) respiratory compromise or distress; (2) stimulation of the sympathetic nervous system; (3) visceral distension; and, (4) volume overload. [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:1230; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:387.]

65. As the population ages and remains physically active through their sixth decade, major orthopedic joint replacement procedures are increasingly more common. Cementless ("press-in") prostheses generally last longer and may be advantageous for younger or more active patients. In which patient population is a cemented prostheses preferred?
Cemented prostheses are generally preferred for older (>80 years) and less active patients because cementless ("press-in") prostheses require natural bone to grow into them. Bone growth is more robust in younger and more active individuals. [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:1004; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:791.]
66. During a total hip arthroplasty (THA), what signs indicate bone cement implantation syndrome (BCIS, formerly bone cement toxicity) has occurred?
Bone cement implantation syndrome (BCIS, formerly bone cement toxicity) is characterized by a number of clinical features that may include *sudden hypotension*, hypoxia, cardiac arrhythmias, increased pulmonary vascular resistance (PVR), unexpected loss of consciousness when regional anesthesia is administered, and cardiac arrest. *A fall in end-tidal carbon dioxide concentration may be the first indication of clinically significant BCIS under general anesthesia*. Early signs of BCIS in the *awake patient* undergoing regional anesthesia include dyspnea and altered sensorium. {Revises IVA10g:Q21.} [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:1004; Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1454; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:790—791.]
67. List nine (9) significant factors for developing bone cement implantation syndrome.
Nine significant factors for developing bone cement implantation syndrome are:
(1) preexisting cardiovascular disease; (2) preexisting pulmonary disease; (3) ASA class 3 or greater; (4) New York Heart Association Class 3 or 4; (5) Canadian Heart Association Class 3 or 4; (6) surgical technique; (7) pathologic fracture; (8) intertrochanteric fracture; and, (9) long-stem arthroplasty. [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:1004b.]
68. What prophylactic measures can be taken to minimize the risk of bone cement implantation syndrome (BCIS)? What inhalational agent should be discontinued before methyl methacrylate instillation?
Adequate hydration and maximizing inspired oxygen concentration minimize the hypotension and hypoxemia that can accompany cementing of the prosthesis. Because air can be entrained during this procedure, *nitrous oxide should be discontinued* several minutes before this point. {Updates IVA10g:Q23a.} [Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1454.]
69. Describe the treatment plan if bone cement implantation syndrome (BCIS) is suspected?
If bone cement implantation syndrome (BCIS) is suspected, the inspired oxygen concentration should be increased to 100% and supplementary oxygen should be continued into the postoperative period. It has been suggested that cardiovascular collapse in the context of BCIS be treated as right-sided heart failure. Aggressive fluid resuscitation is recommended and hypotension should be treated with α-agonists. [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:1004; Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1454.]
70. How does methyl methacrylate (bone cement) produce hypotension?
Hypotension following bone cement instillation has been attributed to: (1) absorption of the volatile monomer of methyl methacrylate; (2) embolization of air and bone marrow during

femoral reaming; (3) lysis of blood cells and marrow induced by the exothermic reaction; and, (4) conversion of methyl methacrylate to methacrylate acid. The exothermic reaction necessary to harden the bone cement produces intramedullary hypertension (>500 mm-Hg!!) which can cause the air and bone marrow embolization and absorption of residual monomers. {Revises IVA10g:Q22.} [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1454; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:790—791.]

71. The trauma patient has suffered massive blood loss and is unconscious. Describe the fluid resuscitation for this patient. What fluids should be avoided?
Resuscitation of the patient in hemorrhagic shock should be initiated with either ***whole blood*** or ***blood products***. If the patient's *blood type is known*, administer type-specific whole blood or packed red blood cells (PRBCs). If the patient's blood type is *not known*, administer O-negative packed red blood cells (PRBCs). Others advise a fixed ratio (1:1:1) of PRBCs, fresh-frozen plasma (FFP), and platelets to approximate whole blood (Stoelting). Avoid hydroxyethyl starch solutions (e.g. Hespan), which are associated with increased rates of renal replacement therapy and adverse events. Also *avoid dextrose-containing solutions* which may exacerbate ischemic brain damage. {Updates IVA11a:Q8.} [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1842; Hall JE. *Guyton and Hall Textbook of Medical Physiology*. 13e; 2015:301; Flood P, Rathmell JP, and Shafer S. *Stoelting's Pharmacology & Physiology in Anesthetic Practice*. 5e; 2015: 663.]

72. Fluid resuscitation is essential in the early care of the burned patient. State the guidelines for fluid replacement when the thermal injury is <15% total body surface area (TBSA)?
Fluid resuscitation for the burn patient with smaller burns (<15% TBSA) can be managed with replacement at 150% of the calculated maintenance rate and careful monitoring of fluid status. Intravascular volume should be restored with utmost care to prevent excessive edema formation in both damaged and intact tissues resulting from the generalized increase in capillary permeability caused by the injury. [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1516.]

73. Fluid resuscitation is essential in the early care of the burned patient. State the guidelines for fluid replacement when the thermal injury is >15% total body surface area (TBSA)?
Fluid replacement for major burns (>15% TBSA) is given by the modified Brooke formula, the Parkland formula, or the ABA (American Burn Association) consensus formula. [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1516—1517; Nagelhout & Plaus, *Nurse Anesthesia,* 5e, 2013:905.]

74. What fluids are preferred for the *first day* following thermal injury?
Crystalloid solutions are preferred for resuscitation during the first day following a burn injury. In contrast to fluid management for blunt and penetrating trauma, which discourages crystalloids, burn fluid resuscitation emphasizes crystalloids, particularly lactated Ringers (LR). [Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1516; Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:809.]

75. Describe the modified Brooke formula for fluid resuscitation in adults and children >20 kg.
The modified Brooke formula for fluid resuscitation in adults and children >20 kg is 2.0 mL lactated Ringers per kilogram per % TBSA burn for the first 24 hours; one half in the first 8 hours, the other half in the next 16 hours. [Nagelhout & Plaus, *Nurse Anesthesia,* 5e, 2013:905; Barash PG, Cullen BF, Stoelting RK, *et al*. *Clinical Anesthesia*. 7e; 2013:1517t.]

76. Describe the Parkland formula for fluid resuscitation in adults and children >20 kg.
The Parkland formula for fluid resuscitation in adults and children >20 kg is 4.0 mL lactated Ringers per kilogram per % TBSA burn for the first 24 hours. [Nagelhout & Plaus, *Nurse Anesthesia,* 5e, 2013:905; Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1517t.]
77. Describe the ABA (American Burn Association) consensus formula for fluid replacement in adult burn patients.
The ABA (American Burn Association) consensus formula for fluid replacement in adult burn patients is lactated Ringer's 2--4 mL per kg body weight per % TBSA burned. [Nagelhout & Plaus, *Nurse Anesthesia,* 5e, 2013:905b.]
78. What are the guidelines for fluid resuscitation following thermal injury in the first 24 hours for *children <20 kg*?
The guidelines for fluid resuscitation in the first 24 hours for children <20 kg are crystalloid 2-3 mL/kg per % burn per 24 hours or crystalloid *with 5% dextrose* at maintenance rate of 100 mL/kg for the first 10 kg and 50 mL/kg for the next 10 kg for 24 hours. [Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1517b.]
79. What colloid may be administered after the first day following thermal injury? What is the rate of administration of this colloid?
Albumin 5% may be administered after the first day following thermal injury at a rate of 0.3, 0.4, or 0.5 mL/kg of the percentage burned per 24 hours for burns of 30% to 50%, 50% to 70%, or 70% to 100% TBSA, respectively. [Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1517.]
80. Administration of fluids during the initial phase following thermal injury should be *titrated* to specific goals. List eight (8) clinical endpoints indicating adequate fluid resuscitation following thermal injury.
Eight criteria and clinical endpoint indicating adequate fluid resuscitation following thermal injury are: (1) urine output 0.5—2.0 mL/kg/hour; (2) pulse 80—140 bpm (age-dependent); (3) systolic blood pressure 60 mm-Hg for infants, 70—90 + (2x age years) for children, MAP > 60 mm-Hg for adults; (4) base deficit <2 (Nagelhout lists < --5); (5) blood lactate < 2 mmol/L; (6) gastric intramucosal pH >7.32; (7) cardiac index 4.5 L/min/m^2; and, (8) oxygen delivery index (DO_2I) 600 mL /min/m^2. [Nagelhout & Plaus, *Nurse Anesthesia,* 5e, 2013:905; Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1517t.]
81. What are the guidelines for blood replacement following thermal injury?
Following thermal injury, blood replacement is usually not initiated until the hematocrit is *below 20% in healthy patients* requiring limited operations, approximately *25% in those who are healthy but need extensive procedures*, and *30% or more when there is a history of pre-existing cardiovascular disease*. {Updates IVA11b:Q24.} Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1517.]
82. The treatment of kidney stones by open surgical procedures and extracorporeal shock wave lithotripsy (ESWL) has largely been displaced by less invasive or entirely noninvasive procedures. List 3 cystoscopic and one entirely noninvasive therapies that have largely replaced open surgical and invasive treatment of kidney stones.
Kidney stones is now commonly treated by (1) flexible urteroscopy with stone extraction; (2) cystoscopic stent placement; and, (3) intracorporeal lithotripsy (laser or electrohydraulic). Medical expulsive therapy (MET) has become the primary treatment of choice by many

clinicians. [Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:677; Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1431.]

83. Describe the medical expulsion treatment (MET) for kidney stones.
The medical expulsive therapy (MET) to promote ureter relaxation and the spontaneous passage of small ureteral stones involves treatment with calcium-channel blockers (e.g., nifedipine),α-blockers (e.g., tamsulosin, doxazosin, or terazosin), and sometimes, corticosteroids. {New Question … IVA11d:Q2.} [Butterworth JF, Mackey DC, Wasnick J. *Morgan & Mikhail's Clinical Anesthesiology*, 5e, 2013:677; Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1431.]
84. Extracorporeal shock wave lithotripsy (ESWL) is the treatment of choice for what two kidney stone situations?
Extracorporeal shock wave lithotripsy (ESWL) is the treatment of choice for disintegration of *intrarenal stones of 4-mm to 2 cm* (nephrolithiasis) and kidney stones in the *upper part of the ureter* (ureterolithiasis). [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2235.]
85. First generation lithotripters required patients be placed in a hydraulic chair and lowered into a heated water bath to create an interface between the shock wave and the patient. What challenges and complications are associated with water-bath immersion during extracorporeal shock wave lithotripsy (ESWL)?
In addition to the *significant positioning maneuvers* associated with the water bath immersion during ESWL, patients are prone to *hypothermia* during the procedure. *Dysrhythmias* can be a special problem as the transmission of the ultrasonic pulse is timed and triggered by the ECG. *Significant respiratory and hemodynamic changes* are associated with immersion and emergence from the water bath, which can be problematic particularly for patients with cardiopulmonary disease. {Replaces IVA11d:Q1-5.} [Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1432; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2235.]
86. List three (3) cardiovascular and five (5) respiratory changes on immersion in the water bath of a first-generation lithotripter.
The cardiovascular changes upon immersion in the water bath of a first-generation lithotripter are: (1) increased CVP; (2) increased central blood volume; and, (3) increased pulmonary artery pressure. Expected respiratory changes include: (1) increased pulmonary blood flow; (2) decreased vital capacity; (3) decreased FRC; (4) decreased tidal volume; and (4) increased respiratory rate. [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2236b.]
87. Second- and third-generation lithotripters do not require immersion of the patient in a water bath---these modern "dry" SWL uses a smaller water-filled coupling device to provide an interface with the patient, which simplifies the procedure considerably. There are still complications associated with the shock wave: list nine (9) complications from all forms of shock wave lithotripters.
Although shock waves pass through most tissues relatively unimpeded, they do cause tissue injury, the extent of which depends on the tissue exposed and the shock wave energy at the tissue level. (1) Skin bruising and (2) flank ecchymoses can occur at the entry site. Painful (3) hematoma in the flank muscles may occur. (4) Hematuria is almost always present at the end of the procedure and results from shock wave–induced endothelial injury to the kidney

and ureter. Adequate hydration is necessary to prevent clot retention. (5) Lung tissue is especially susceptible to injury by shock waves, as are the (6) colon and small intestines. (7) Diabetes, (8) new-onset hypertension, or (9) permanently decreased renal function may also result. [Nagelhout & Plaus, *Nurse Anesthesia,* 5e, 2013:754; Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2236.]

88. State two (2) absolute contraindications to shock wave lithotripsy (SWL).
Two absolute contraindications to shock wave lithotripsy are: (1) bleeding disorder or anticoagulation, and (2) pregnancy. [Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1432b; Nagelhout & Plaus, *Nurse Anesthesia,* 5e, 2013:754.]

89. What are five (5) relative contraindications to shock wave lithotripsy (SWL)?
Five relative contraindications to shock wave lithotripsy (SWL) are: (1) untreated (active) urinary tract infection; (2) large calcified aortic or renal artery aneurysms; (3) obstruction distal to the calculi; (4) pacemaker, ICD, or neurostimulation implant; and, (5) morbid obesity. [Barash PG, Cullen BF, Stoelting RK*, et al*. *Clinical Anesthesia*. 7e; 2013:1432b; Nagelhout & Plaus, *Nurse Anesthesia,* 5e, 2013:754.]

90. What special concern exists in children undergoing extracorporeal shock wave lithotripsy? How is this concern addressed?
Children are more likely to sustain pulmonary damage from shock waves because of the shorter distance of the lung bases from the kidneys than in adults. It is recommended that a Styrofoam sheet or Styrofoam board be placed under the back in children to shield the lung bases from shock waves during ESWL. [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:2236.]

91. What is the etiology of epiglottitis (supraglottitis)?
Epiglottits is the most dreaded airway-related infection, especially in the pediatric population. In the past (into the 1990s), the infection was most often due to *Haemophilus influenza* B. Vaccination against *H. influenza* B has been so effective that epiglottitis is now usually caused by **group A β-hemolytic *Streptococcus***, ***Staphylococcus aureus***, and ***Candida*** (yeast) infections. {Revises IVB03:Q7.} [Miller RD, Cohen NH, Eriksson LI, *et al. Miller's Anesthesia*. 8e; 2015:2529, 2890; Davis PJ, Cladis FP, Motoyama EK. *Smith's Anesthesia for Infants and Children*. 8e; 2011:811; Coté CJ, Lerman J, Anderson, BJ. *Coté and Lerman's A Practice of Anesthesia for Infants and Children,* 5e, 2013:672.]

92. What is the typical presentation of epiglottitis?
Acute epiglottitis is a clinical diagnosis with primary signs of upper airway obstruction. The typical presentation is sore throat, dysphagia, muffled voice, and fever. In children, the 4 "Ds" are pathognomic: (1) **D**ysphagia; (2) **D**ysphonia; (3) **D**yspnea; and, (4) **D**rooling. An expiratory snore is often heard rather than inspiratory stridor; this lends to the diagnostic acronym "SNORED": **S**eptic (patient looks "toxic"), **NO** cough, **R**apid onset, **E**xpiratory snore, and **D**rooling. {Revises IVB03:Q8.} [Miller RD, Cohen NH, Eriksson LI, *et al. Miller's Anesthesia*. 8e; 2015:2529, 2890; Davis PJ, Cladis FP, Motoyama EK. *Smith's Anesthesia for Infants and Children*. 8e; 2011:811; Coté CJ, Lerman J, Anderson, BJ. *Coté and Lerman's A Practice of Anesthesia for Infants and Children,* 5e, 2013:672-673.]

93. Children of what ages get epiglottitis?
    In the past, epiglottitis usually afflicted children from 2 to 6 years old. Now, due to the advent of the *H influenza* vaccine, epiglottitis occurs more commonly at older childhood ages, and even into adulthood. {Revises IVB03:Q9.} [Davis PJ, Cladis FP, Motoyama EK. *Smith's Anesthesia for Infants and Children*. 8e; 2011:672; Miller RD, Cohen NH, Eriksson LI, *et al. Miller's Anesthesia*. 8e; 2015:2890.]
94. Where is the optimal location for initial treatment and intubation of the patient with epiglottitis?
    First and foremost, *the child with epiglottitis should never be left unattended* by medical personnel, because the disease can progress so rapidly that complete upper airway obstruction may ensue within minutes. As soon as epiglottitis is suspected or diagnosed in the emergency department, the child should be brought to the OR calm and undisturbed. If it takes the presence of a parent to achieve this, then that is what should be done. The patient is kept in a sitting or tripod position with an oxygen mask in place and with pulse oximetry monitoring. In the OR, with equipment and personnel who can insert a surgical airway immediately present, a precordial stethoscope and other standard monitors are applied. {Revises IVB03:Q10.} [Davis PJ, Cladis FP, Motoyama EK. *Smith's Anesthesia for Infants and Children*. 8e; 2011:811; Coté CJ, Lerman J, Anderson, BJ. *Coté and Lerman's A Practice of Anesthesia for Infants and Children,* 5e, 2013:673.]
95. In what position would you induce the pediatric patient with epiglottitis?
    General anesthesia for the pediatric patient with epiglottitis should be induced with the child sitting upright, either in the lap of the anesthetist or parent. {Revises IVB03:Q15.} [Coté CJ, Lerman J, Anderson, BJ. *Coté and Lerman's A Practice of Anesthesia for Infants and Children,* 5e, 2013:673; Davis PJ, Cladis FP, Motoyama EK. *Smith's Anesthesia for Infants and Children*. 8e; 2011:811; Miller RD, Cohen NH, Eriksson LI, *et al. Miller's Anesthesia*. 8e; 2015:2529.]
96. What inhalation agent is used to induce general anesthesia in the pediatric patient with epiglottitis?
    General anesthesia for the pediatric patient with epiglottitis is induced with *sevoflurane in oxygen* with the child sitting upright. A *moderate continuous positive pressure* (10 to 15 cm H_2O) must be maintained to minimize the inspiratory collapse of laryngeal airways by the Ventura effect, and ventilation must be assisted with moderate continuous positive airway pressure while avoiding inflating the stomach with excessive pressure. {Revises IVB03: Q14.} [Coté CJ, Lerman J, Anderson, BJ. *Coté and Lerman's A Practice of Anesthesia for Infants and Children,* 5e, 2013:673; Davis PJ, Cladis FP, Motoyama EK. *Smith's Anesthesia for Infants and Children*. 8e; 2011:811; Miller RD, Cohen NH, Eriksson LI, *et al. Miller's Anesthesia*. 8e; 2015:2529.]
97. What endotracheal tube size is needed for the pediatric patient with epiglottitis?
    Endotracheal intubation in the pediatric patient with epiglottitis is performed orally with a styletted tube *one or two sizes smaller* than usual. Visualization of the classic cherry-red epiglottis under direct laryngoscopy confirms the diagnosis. {Revises IVB03:Q11.} [Coté CJ, Lerman J, Anderson, BJ. *Coté and Lerman's A Practice of Anesthesia for Infants and Children,* 5e, 2013:673; Davis PJ, Cladis FP, Motoyama EK. *Smith's Anesthesia for Infants and Children*. 8e; 2011:811; Miller RD, Cohen NH, Eriksson LI, *et al. Miller's Anesthesia*. 8e; 2015:2529.]

98. When can the pediatric patient with epiglottitis be extubated?
    Once the airway is secured, a culture of the pharynx and blood cultures are obtained, and aggressive medical therapy beginning with antibiotics should be commenced. When the child resumes swallowing and the fever abates, usually *24 to 48 hours after initiation of therapy*, the acute supraglottic edema should be resolving and the child may be prepared for tracheal extubation. A return of normal body temperature and increased leaks around the nasotracheal tube are major signs of recovery. {Combines and revises IVB03:Q12-13.} [Coté CJ, Lerman J, Anderson, BJ. *Coté and Lerman's A Practice of Anesthesia for Infants and Children,* 5e, 2013:673; Davis PJ, Cladis FP, Motoyama EK. *Smith's Anesthesia for Infants and Children*. 8e; 2011:811.]

Note: Page numbers followed by a "b" indicate a box in the listed reference (e.g. [Nagelhout JJ, Plaus KL. *Nurse Anesthesia*. 5e; 2013:268b]). Page numbers followed by an "f" indicate a figure in the listed reference (e.g., [Dorsch JA, Dorsch SE. *Understanding Anesthesia Equipment*. 5e; 2008:777f]). Page numbers followed by a "t" indicate a table in the listed reference (e.g., [Miller RD, Cohen NH, Eriksson LI, *et al*. *Miller's Anesthesia*. 8e; 2015:1547t.]).

- Keep in mind that mastery of the *entire* content of Valley Anesthesia's study resources—Review Course Manual ("Sweat Book"), MemoryMaster, and Mixed Reviews—is highly recommended.

- **The NBCRNA has an updated *NCE Bibliography*, a list of the texts used by the NBCRNA as the basis for questions on the certification examination. To obtain the PDF and further information, visit: http://www.nbcrna.com/certification/Pages/NCE-Bibliography.aspx**.