Current Reviews for Nurse Anesthetists®

Challenging Dogma: The Importance of Being an Evidence-based Anesthesia Provider

LESSON 2
Volume 39*
6/02/2016

Chuck Biddle, CRNA, PhD
Professor and Staff Anesthetist
Department of Nurse Anesthesia and Anesthesiology
Virginia Commonwealth University and Medical Center
Richmond, Virginia

*The use of this volume for CE Credits will expire 05/31/2018

Current Reviews for Nurse Anesthetists®

Publisher
And
Editor-in-Chief
FRANK MOYA, MD
Coral Gables, Florida

FRANK MOYA
CONTINUING
EDUCATION
PROGRAMS

Sponsor -
Frank Moya Continuing Education Programs, LLC

Subscription Office -
Current Reviews®
1828 S.E. First Avenue
Ft. Lauderdale, FL 33316
Phone: (954) 763-8003
Fax: (800) 425-1995
Email: info@currentreviews.com
www.currentreviews.com

Editorial Office –
Frank Moya, M.D.
1450 Madruga Ave
Suite 207
Coral Gables, FL 33146

Accreditation

This program has been prior approved by the American Association of Nurse Anesthetists for 26 Class A CE credits; Code Number 33803; Expiration Date May 31, 2018. Approved by Frank Moya Continuing Education Programs, LLC. Provider approved by the California Board of Registered Nursing, Provider Number CEP 1754, for 26 contact hours and Florida Board of Nursing, Provider Number FBN 2210 for 26 contact hours. In Accordance with AANA directives, you must get 80% of the answers correct to receive one credit for each lesson and **if there is a failure, there is no retaking.**

Disclosure Policy

Frank Moya Continuing Education Programs, LLC, in accordance with the Accreditation Council for the Continuing Medical Education's (ACCME) Standards for Commercial Support, will disclose the existence of any relevant financial relationship a faculty member, the sponsor or anyone else who may be in a position to control the content of this Activity has with any commercial interest. BEFORE STARTING, PLEASE SEE LAST PAGE OF LESSON TO READ WHETHER THERE ARE ANY RELEVANT RELATIONSHIPS TO DISCLOSE AND, IF SO, THE DETAILS OF THOSE RELATIONSHIPS.

Current Reviews® is intended to provide it's subscribers with information that is relevant to anesthesia providers. However, the information published herein reflects the opinions of it's authors and does not represent the views of Current Reviews in Clinical Anesthesia®, Current Reviews for Nurse Anesthetists®, or Frank Moya Continuing Education Programs, LLC. Anesthesia practitioners must utilize their knowledge, training and experience in their clinical practice of anesthesiology. No single publication should be relied upon as the proper way to care for patients. The information presented herein does not guarantee competency or proficiency in the performance of procedures discussed.

Challenging Dogma: The Importance of Being an Evidence-based Anesthesia Provider

Chuck Biddle, CRNA, PhD
Professor and Staff Anesthetist
Department of Nurse Anesthesia and Anesthesiology
Virginia Commonwealth University and Medical Center
Richmond, Virginia

LESSON OBJECTIVES

Upon completion of this lesson, the reader should be able to:

1. **Define evidence-based care.**
2. **Describe what is meant by dogma.**
3. **Provide examples of evidence that has challenged or questioned dogma.**
4. **Identify some adverse consequences of unnecessarily high concentrations of administered oxygen.**
5. **Critique the practice of only administering muscle relaxants once mask ventilation is verified.**
6. **Explain the desirable effects associated with mild-to-moderate permissive hypercarbia.**
7. **Assess the clinical implications of cerebral autoregulation and what may perturb it.**
8. **Describe the role that the anesthesia provider may play as a vector of infectious disease transmission.**
9. **Cite recent clinical research examining the dogmatic treatment of certain cancers.**
10. **Discuss the risks associated with practicing in a consistently dogmatic manner.**

Current Reviews for Nurse Anesthetists® designates this lesson for 1 CE contact hour in Clinical pharmacology/therapeutics.

Introduction

The most important reason for practicing evidence-based care (EBC) is to enhance the probability of a good outcome in a given patient. Much more than a buzz-phrase, EBC as defined by Sackettin (1996) is "the integration of the best research evidence with clinical expertise and patient values to make clinical decisions." EBC is patient-centered, informed decisions that are individualized, effective, streamlined and dynamic, that is, designed to enhance outcome.

Dogma is a set of beliefs that are widely embraced without being questioned or doubted. Dogma is not necessarily bad, but in certain cases, unchallenged dogma is antithetical to EBC. Far too often decisions are made that embrace outdated, unchallenged, or ill-informed beliefs. In this lesson, I cite examples within, and outside of, the domain of anesthesia practice that illustrate the value of delivering EBC and the drawbacks of blindly accepting unchallenged dogma.

Appendicitis: Dogma in Evolution?

Traditional dogma indicated surgery for all cases of appendicitis. A growing body of evidence supports the use of antibiotics as an alternative to surgery for the treatment of uncomplicated acute appendicitis. In the June 16, 2015 issue of *JAMA*, a randomized controlled trial of surgery vs antibiotic therapy for acute uncomplicated appendicitis was reported. This is the most recent study of surgery vs antibiotics for appendicitis.

Here 273 patients were randomized to the surgery group, with 272 having successful surgery (one patient's symptoms resolved). Two patients in the surgery group had no pathologic findings of appendicitis. In the 256 patients randomized to antibiotic therapy, 186 (72%) did not require appendectomy in the year-long follow-up. Seventy patients underwent appendectomy at some time during the one-year follow-up and no patient developed a serious infection. The study authors, and an accompanying editorial, noted that while not suggesting that antibiotics were superior or even equivalent to surgery in treating appendicitis, there is a growing movement of treating each patient uniquely, not automatically defaulting to surgical dogma.

Overly rigid adherence to dogma, avoiding emerging evidence that challenges it, is not in the best interest of the patient.

Cough Syrup in Children

In 2008 the FDA issued an urgent and strong warning advising parents (and care providers) not to medicate children under the age of two with cough syrup. The FDA praised the voluntary actions of manufacturers who noted on their product labels that use be avoided in those under age four. Despite decades of dogmatically treating coughs with suppressants (dextromethorphan), expectorants (guaifenesin) and decongestants (pseudoephedrine), there is little to no evidence that such medications were beneficial, yet abundant evidence demonstrating adverse events.

One problem, among many, is that the medications had not undergone rigorous study in children, with side effects ranging from drowsiness to tachycardia, and to convulsions in some. Here clinical evidence challenged traditional dogma and changed practice.

Ear Infections in Children

Anesthesia providers are familiar with the child presenting for myringotomy with tube placement for chronic ear infections. While this group represents the 'tip of the iceberg,' many children are routinely exposed to antibiotic therapy despite evidence indicating that ear drops may work just as well, with infections often receding within days regardless of treatment. There is strong evidence that the same can be said for routine antibiotic treatment of pediatric bronchitis, sinusitis and sore throat.

In a June 2015 Cochrane Review, it was concluded that the benefits of antibiotics must be weighed against their possible harm, and that in most instances acute otitis media spontaneously remits without complications.[1] While some patients benefit from antibiotics and even surgery, for most children over the age of two with mild disease, an observational approach is justified. EBC is patient-centered and individualized, replacing the dogma of treating everyone in the same way.

Injected Medication for Acute and Chronic Back Pain

A frequent approach to back pain is to inject medication into some part of the spine (intervertebral, around a nerve root, directly into a disc, or into a trigger point). Corticosteroids, nonsteroidals, and opiates are used in those with subacute and chronic low-back pain.

While adverse consequences of such injections include dural puncture, infection, bleeding and nerve trauma, a 2011 Cochrane Review concluded that there is insufficient evidence to support injection therapy in subacute and chronic low-back pain. As drugs moderate only inflammation and not the anatomical lesion, the authors noted that "specific subgroups of patients may respond to certain types of injection therapy."[2] This affirms the value and safety of employing an EBC in each patient, rather than one based on dogma.

Evidence-based Decision Making in Delivering Anesthetic Care

In the course of my own career I have seen dramatic evolution in the way that anesthesia care is rendered (Table 1). What has permitted these advancements to gain traction is their grounding in an overwhelming body of clinical evidence.

Table 1
A Few Noteworthy Advancements in *Routine* Anesthetic Practice*

- **Pulse oximetry and capnography**
- **Increasingly low-soluble inhalation agents**
- **Availability of novel intubating devices (e.g., fiberoptics)**
- **Laryngeal mask airway (LMA)**
- **Electronic record keeping**
- **Ultrasonography for central line placement and nerve blocks**
- **New drugs such as propofol, dexmeditomidine**
- **Expanding use of adjuncts such as dexamethasone, clonidine**
- **Expanding use of total intravenous anesthesia (TIVA)**
- **Instruments that process brain signals providing insight into depth of anesthesia**

**All occurring during my career that were grounded in 'evidence.'*

Table 2
Reported Deleterious Effects of Oxygen-Free Radicals*

- **Damage to tissue proteins, including DNA**
- **Accelerated aging**
- **Heart disease**
- **Pulmonary disease**
- **Diabetes**
- **Damage to eyes/vision**
- **Damage to immune system**
- **Renal and hepatic injury**
- **Damage to vascular system**

*Oxygen-free radicals are more reactive than the O_2 form. Generated in mitochondria during cellular metabolism they are managed by various antioxidants. Hyperoxia tips the balance in favor of free radicals with the result that "it is possible to have too much of a good thing."

Despite these advances there are many areas of practice still seemingly held hostage by dogma. Among these I would cite the use of 'toxic' amounts of oxygen, the insistence by many that a muscle relaxant should only be administered after demonstrating that a patient can be mask ventilated, targeting the end-tidal CO_2 level in the mid-30 mmHg range, viewing cerebral autoregulation as a constant in all patients, and the view that anesthesia providers rarely are vectors in infectious disease transmission. What follows is an evidence-based examination of each of these 'dogmas.' The primary goal of which is to seek a better understanding of how patient-specific EBC might be delivered.

Oxygen: The More the Better?

It is indisputable that O_2 is vital to life. Yet O_2 is two-faced with a considerable adverse event profile when administered excessively. In contemporary practice one would be hard-pressed to find a single anesthetic administered in the U.S. where a hyperoxic mixture is not delivered. The evidence is substantial that O_2 supplementation is a component of safe anesthetic care; likewise there is abundant evidence noting its detrimental effects due to the creation of O_2-free radicals with damage to body tissues and organs (Table 2).

Hyperoxia enhances oxidative injury by increasing reactive O_2 metabolites (free radicals) that have widespread, detrimental effects, even at the level of the mitochondrion. These adverse effects are particularly relevant in the very young, the very old, and the critically ill.[3,4] Oxidative stress is greatly increased even in normal volunteers breathing supplemental O_2 for as little as 30 minutes.[5]

The dogma of using high concentrations of O_2 at induction and emergence is inculcated early in our training; likewise, the intraoperative course is often conducted with excessively high concentrations of O_2. A sentinel study examined the use of O_2 during anesthetic induction and emergence revealing a high rate of atelectasis forming in the 100% O_2 group compared to patients who received either 80% or 60% O_2 in N_2.[6] Such studies do not suggest we never use supportive 100% O_2, rather they urge us to titrate delivered O_2 to a desired effect, as we would any drug, and not routinely overdose.

Dogmatic use of high O_2 concentrations without a broad view of its potential deleterious effects flies in the face of EBC decision making. Goal directed administration of O_2 is recommended. Figure 1 is an overview of suggested O_2 concentrations administered throughout the perioperative course.

Administration of a muscle relaxant prior to verifying the ability to mask ventilate is an acceptable practice in most cases.

Do Not Inject a Neuromuscular Blocking Drug Until You Can Ventilate the Patient!

From day one of training, we are taught that a muscle relaxant should not be given before face mask ventilation is verified. In the scenario where ventilation cannot be established, the dictum is to awaken the patient and use a supraglottic airway. In examining this dogma it is clear that this is unrealistic before profound hypoxemia ensues, when in fact, face mask ventilation becomes easier after relaxant administration. **A body of evidence including systematic reviews, randomized controlled trials and authoritative editorials provide evidence supporting the use of relaxants prior to establishing mask ventilation**.[7-9] Ventilation is more effective after relaxant administration, and the ability to ventilate with a face mask prior to relaxant use does not always translate into easy ventilation following paralysis.

A paradox in the dogma is when rapid sequence induction is planned; attempting mask ventilation is considered contraindicated before relaxants are administered citing gastric insufflation and regurgitation of gastric contents as grave concerns! The dogma of "no relaxant prior to establishing face mask ventilation" should be modified in the face of current evidence. The decision should be made on a patient-centered basis. Consider too that we have at our disposal intubating and rescue devices unavailable even 10 years ago. Where an obvious difficult mask

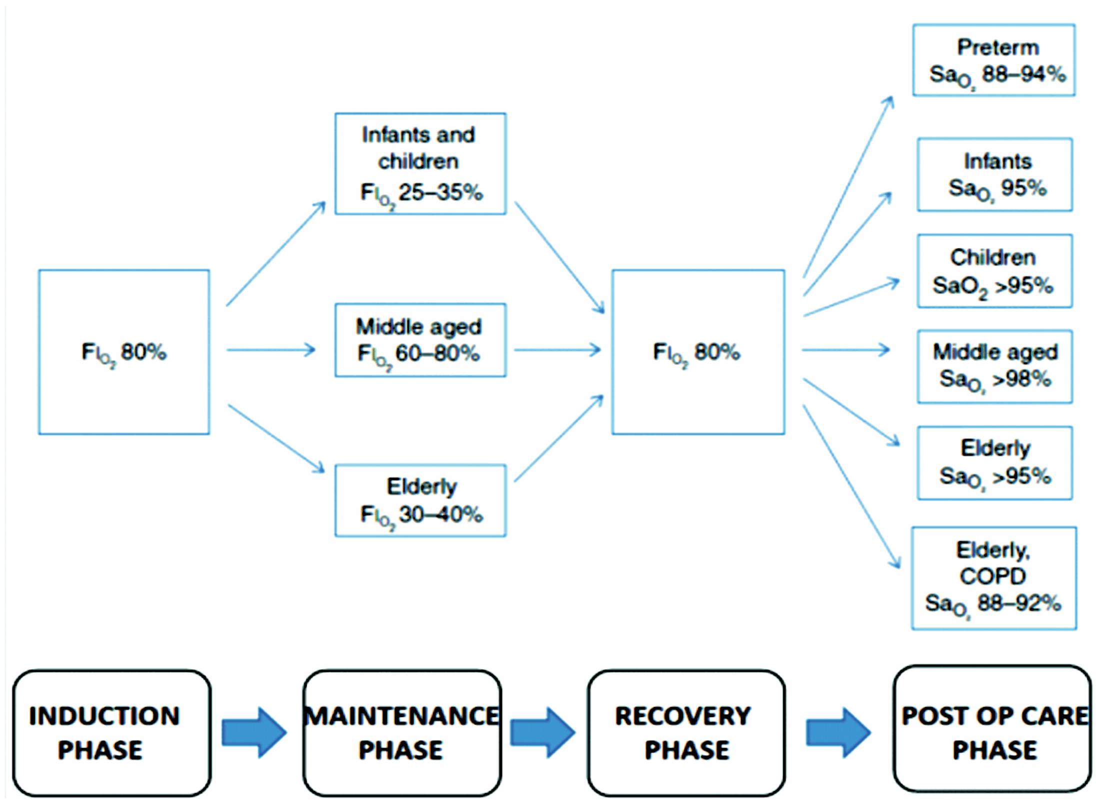

Figure 1. Suggested O_2 'Dose' Based on Target Outcome (SaO_2). These are merely suggested 'doses' with many factors influencing decision making. This underscores the value and intent of patient-centered care.

ventilation or intubation is predicted, then awake or fiberoptic intubation should be considered in the spontaneously breathing patient.

Targeting the End-tidal CO_2

Dogma has traditionally led us to assume that the arterial value of CO_2 is approximately 3-5 mmHg higher than the end-tidal displayed valued, resulting in our adjusting intraoperative ventilation to an end-tidal CO_2 of 32-38 mmHg. Not only is the veracity of this dogma subject to many variables that can magnify the gradient significantly, there is both clinical research and rational physiology suggesting that there are advantages to mild-to-moderate permissive hypercarbia with end-tidal CO_2 in the mid-to-upper 40 range.[10-11]

Among the advantages of a higher arterial CO_2 tension are an increase in both cerebral and coronary blood flows, a shift in the O_2 dissociation curve promoting O_2 unloading at the tissue level, and a general activation of the sympathetic nervous system maintaining blood pressure. In certain patients permissive hypercarbia would not be the goal (e.g., hyperkalemic state, increased intracranial pressure, pulmonary hypertension, congestive heart failure). In delivering EBC, widespread application of dogma should be replaced by unique, patient-centered decision making.

Oxygen, like any other drug, should be titrated to effect and overzealous use of hyperoxia may have significant negative consequences.

Autoregulation Ensures Constant Brain Blood Flow at a Mean Arterial Pressure of 50-150 mmHg

Autoregulation, which is under the influence of a variety of mechanisms, is the ability of an organ to maintain a constant blood flow despite changes in perfusion pressure. Traditional teaching that cerebral autoregulation occurs over a range of mean pressures of 50-150 mmHg may be flawed given the variation in the physiology of the cerebral circulation.

For example, autoregulation is shifted rightward in hypertensive patients (Figure 2), and the curve's plateau may not exist at all, with cerebral blood flow becoming highly dependent on systemic blood pressure in a linear manner.[12] Use of phenylephrine may result in a paradoxical worsening of cerebral blood flow despite a rise in blood pressure.[13]

There are many case reports and studies of patients with impaired cerebral function after head-up (beach chair) positioning during general anesthesia. **The commonly quoted lower limit of autoregulation (mean = 50 mmHg) may be too low to adhere to in all patients due to inter-individual variation (genetics) as well as drug-induced and pathophysiologic perturbations.** During general anesthesia, we should not embrace a dogma that assumes a lower limit of 50 mmHg assures adequate cerebral perfusion in all.

Infectious Disease Transmission by the Anesthesia Provider

I would venture to say that the average provider views their workspace, and themselves, as 'clean' from an infectious disease perspective. We wear gloves (usually), don masks, use alcohol wipes on vials (inconsistently), administer antibiotics as indicated, and generally go about delivering our care, with the dogma that infection, when it occurs, is a result of surgical field contamination.

In fact there is now an *overwhelming body of knowledge* that implicates the anesthesia provider as a major vector in infectious disease transmission.[14-17] Not only are we haphazard with hand hygiene in general, but we contaminate our anesthesia machine, electronic record keeper, carts, intravenous injection ports and every component of the workstation with biologic material from the current and previous patients every day.

Mild-to-moderate permissive hypercarbia is associated with beneficial physiologic effects in selected cases.

The facts are sobering when we realize that bacterial transmission in the anesthesia work domain is a primary cause of 30-day postoperative infections affecting as many as 17% of patients who undergo surgery.[13] The anesthesia workstation is a virtual reservoir of infectious organisms that, for a variety of reasons (e.g., task density, poor hand hygiene, complex patients, hard to clean surfaces/equipment, etc.), predisposes for pathogenic transmission from one patient to another, as well as from provider to patient.

It is certainly time to retire the dogma that the anesthesia provider is not a contributor to perioperative nosocomial infection. With minor practice changes (e.g., double gloving with removal of the outer pair after contact with biological material, vigilance in hand hygiene performance, cleaning work surfaces, single use vials/syringes, etc.) we can reduce nosocomial infection (Table 3).

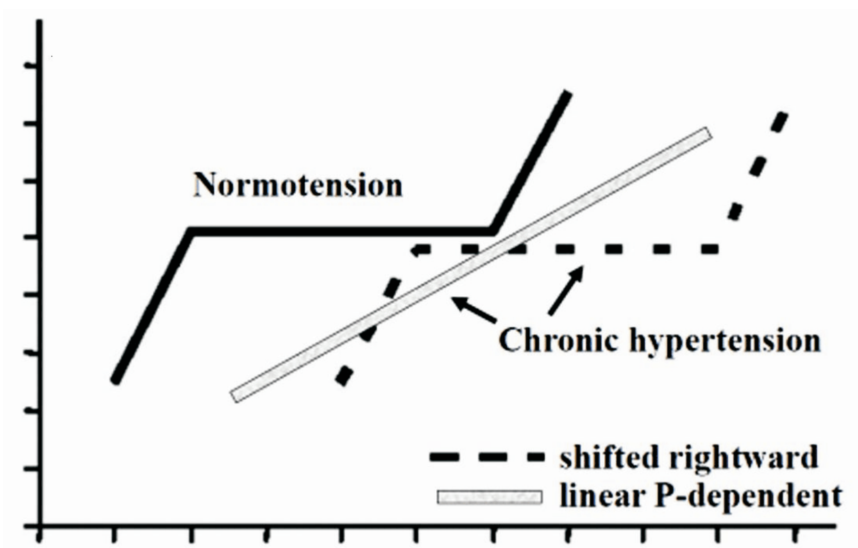

Figure 2. Cerebral Autoregulation in Chronic Hypertension. Autoregulation is shifted rightward in chronic hypertension; new evidence suggests cerebral perfusion may be highly pressure dependent in a direct linear manner in some. (Figure based on Sander et al. Cerebral perfusion under pressure. *Anaesthesia* 2011; 66:965-976.)

Table 3 Decreasing Our Role as Vectors of Infectious Disease Transmission
▪ Meticulous attention to hand hygiene
▪ Clean the anesthesia workstation during cases
▪ Clean the anesthesia workstation between cases
▪ Timely administration of antibiotics
▪ Maintain normoxia and normothermia
▪ Asepsis when drawing up drugs
▪ Exquisite attention to asepsis when injecting into stopcocks
▪ Avoiding contamination of 'clean' areas with soiled hands/equipment

Conclusion

I have provided a glimpse of healthcare-related dogma that should be challenged, with particular emphasis on anesthetic care. Other examples of EBC that challenged dogma abound: understanding that we may have a role in cancer recurrence based on our choice of anesthetic, modification of entrenched preoperative fasting guidelines, skepticism of the role of the Sellick's maneuver in preventing aspiration of gastric contents, and greater tolerance of low hemoglobin levels in judging the need for transfusion, to mention a few.

Cerebral autoregulation is subject to great variability due to intrinsic (genetic) patient factors, administered drugs and pathophysiological processes.

A final example that may change a life. New research, ignored by many traditional oncologists and cancer surgeons, reveals that intraperitoneal chemotherapy for ovarian cancer is associated with significantly improved outcomes compared to the dogma of exclusive IV therapy.[18] Dogma may constrain not only treatment, but penetration of novel innovations that optimize patient care.

The risks of dogmatically assuming that everyone is treated the same brings to mind a favorite British artist. TS Lowrey depicted in his 'matchstick men,' the notion that a society's citizens are herded about like cattle, with little to no differentiation among them (Figure 3). This is antithetical to engaging in EBC where patients are treated in a highly patient-centric manner.

Figure 3. The Fallacy in Seeing Everyone, and Treating Everyone, the Same. "Going to work" 1959, TS Lowry. People depicted as herded about, much like sheep, disregarding their individualism. We risk doing the same if we treat each patient in a dogmatic, "cookbook" manner.

The goal of this lesson is to prompt thinking about practices that you may routinely, if not dogmatically engage in, and to ask yourself two things when performing a patient intervention: 1) what is the evidence that supports what I am doing, and 2) is there a better way, grounded in strong evidence, to do it?

————————

Chuck Biddle, CRNA, PhD, Professor and Staff Anesthetist, Department of Nurse Anesthesia and Anesthesiology, Virginia Commonwealth University and Medical Center, Richmond, Virginia. cjbiddle@vcu.edu

References

1. http://www.cochrane.org/CD000219/ARI_antibiotics-for-acute-middle-ear-infection-acute-otitis-media-in-children
2. http://www.cochrane.org/CD001824/BACK_injection-therapy-for-subacute-and-chronic-low-back-pain
3. Habre W, Petal F. Perioperative use of oxygen. *Br J Anaesth* 2014; 113:26-36.
4. Declaimer S. Oxygen: friend or foe in perioperative care? *Anaesthesia* 2013; 68:8-12.
5. Phillips M et al. Effect of oxygen on breath markers of oxidative stress. *Eur Respir J* 2003; 21:48-51.
6. Edmark L, et al. Optimal oxygen concentration during induction of general anesthesia. *Anesthesiology* 2003; 98:28-33.
7. Waters R et al. The effect of neuromuscular blocking drugs on mask ventilation. *Anaesthesia* 2011; 66:163-77.
8. Salem M, Ovasspian A. Difficult mask ventilation: what needs improvement? *Anesth Analg* 2009; 109:1720-22.
9. El-Orbany M, Woehlck H. Difficult mask ventilation. 2009; 109:1870-80.
10. Akca O. Optimizing the intraoperative management of carbon dioxide concentration. *Curr Opin Anaesthesiol* 2006; 19:19-25.
11. Pohl A, Cullen D. Cerebral ischemia during shoulder surgery in the upright position. *J Clin Anesth* 2005; 17:463-69.
12. Moerman A et al. Assessment of cerebral autoregulation patterns. *Anesthesiology* 2015; 123: 327-35.
13. Meng L et al. Effect of phenylephrine and ephedrine bolus on cerebral oxygenation. *Br J Anaesth* 2011; 107:209-17.
14. Shafer S. Making a difference in perioperative infection. *Anesth Analg* 2015; 120:697-98.
15. Loftus R et al. The dynamics and implications of bacterial transmission events arising from the anesthesia work area. *Anesth Analg* 2015; 120: 853-60.
16. Biddle C, Shah J. Quantification of anesthesia providers' hand hygiene: what would Semmelweis think? *Amer J Infect Control* 2012; 40:756-759.
17. Hopf H. Bacterial reservoirs in the operating room. *Anesth Analg* 2015; 120:700-2.
18. http://jco.ascopubs.org/content/early/2015/08/03/JCO.2015.61.4776.full.pdf+html

Tips for your Clinical Practice: Key Points

- Modern anesthesia care should be **patient-centered** such that dogma and cookbook approaches are replaced by evidence-based care decisions.
- Research and clinical expertise applied in the unique patient setting suggest that **muscle relaxants administered before mask ventilation is verified** is associated with greater ease in ventilating the patient.
- The administration of **unnecessarily high concentrations of oxygen** should be avoided; instead it should be titrated to a clinically desired effect to avoid its adverse consequences.
- Rigid adherence to **traditional cerebral autoregulation** limits does not account for variability in patients and in some cases may set the stage for cerebral hypoperfusion.
- It is dogma, or even worse myth, that the anesthesia provider does not contribute to **nosocomial infection**; we must adhere to good hand hygiene and workstation asepsis to protect the patient.

Chuck Biddle, CRNA, PhD
Richmond, Virginia

MARK ALL ANSWERS ON BOTH THIS PAGE AND YOUR ANSWER CARD | **2** LESSON

MARK ONLY THE ONE BEST ANSWER PER QUESTION ON YOUR ANSWER CARD. MARK THIS PAGE AND KEEP FOR YOUR RECORDS.

In accordance with AANA directives, you must get 80% of the answers correct to receive one credit for each lesson, and "if there is a failure, there is no retaking".

POST-STUDY QUESTIONS

1. **Sacket defined evidence based care (EBC) as:**
   ☐ A. Combining best evidence, clinical expertise and patient values to make clinical decisions.
   ☐ B. Seeking legal authority to administer clinical care.
   ☐ C. Exclusively based care on research findings published only in the most recent 5 years.
   ☐ D. Exclude patient values and preferences as patients are not the experts.

2. **A "dogma" might best be viewed as:**
   ☐ A. An established set of principles, guiding clinical care, entirely grounded in evidence.
   ☐ B. A belief or practice proven to be the best way to perform a task.
   ☐ C. A set of beliefs, widely embraced, that are not questioned or doubted.
   ☐ D. A practice that has been used for more than 10 years.

3. **Evidence that has challenged or questioned dogma outside the immediate domain of anesthesiology includes:**
   ☐ A. Antibiotics as a possible alternative to surgery in treating appendicitis.
   ☐ B. Caution in using cough syrup in the very young.
   ☐ C. Routine or overzealous use of injected drugs for back pain.
   ☐ D. All the above.

4. **Adverse consequences of unnecessarily high concentrations of administered oxygen during anesthetic care primarily involve which mechanism?**
   ☐ A. Atelectasis formation and cellular injury from free radicals.
   ☐ B. Fully saturating the hemoglobin molecule.
   ☐ C. Paradoxical carbon monoxide formation.
   ☐ D. Reflex hypercarbia is provoked.

5. **Select the TRUE statement regarding the use of muscle relaxants and mask ventilation:**
   ☐ A. Relaxants are absolutely contraindicated in all cases until mask ventilation is assured.
   ☐ B. Patients known to have a difficult airway may best be approached with awake or fiberoptic intubation in the spontaneously breathing patient.
   ☐ C. Muscle relaxants make mask ventilation impossible.
   ☐ D. There is no evidence supporting the use of relaxants prior to assuring mask ventilation.

6. **Which of the following is NOT associated with mild-to-moderate permissive hypercarbia?**
   ☐ A. Shift of the oxyhemoglobin dissociation curve facilitating oxygen unloading to tissues.
   ☐ B. Increased cerebral and coronary blood flow.
   ☐ C. Stimulation of the sympathetic nervous system that may support blood pressure.
   ☐ D. Profound respiratory alkalosis.

7. **Select the FALSE statement about cerebral autoregulation:**
   ☐ A. It is the brain's ability to maintain a constant blood flow over a range of blood pressures.
   ☐ B. It is traditionally taught that the brain autoregulates over mean pressures of 50-150 mmHg.
   ☐ C. Autoregulation is not altered by patient genetics, drugs or pathophysiological processes.
   ☐ D. There may be significant variability in autoregulation in some patients.

8. **The anesthesia provider serving as a vector of infectious disease transmission during care is likely related to:**
   ☐ A. Poor or inconsistent hand hygiene practices in the setting of high task density.
   ☐ B. Contamination of vials, syringes and IV injection stopcocks.
   ☐ C. Soiled work surfaces such as drug cart, anesthesia machine, electronic record keeper, etc.
   ☐ D. All of the above.

9. **Recent clinical research examining the dogma of IV-only chemotherapy for ovarian cancer revealed:**
   ☐ A. Better outcomes with intraperitoneal chemotherapy.
   ☐ B. Worse outcomes with intraperitoneal chemotherapy.
   ☐ C. Better outcomes with IV-only chemotherapy.
   ☐ D. No difference in outcomes with IV vs intraperitoneal chemotherapy.

10. **What is the risk of practicing in a consistently dogmatic manner?**
    ☐ A. It accelerates the introduction of novel treatment innovations.
    ☐ B. It makes anesthetists treat patients in a patient-centered fashion.
    ☐ C. It promotes research into the etiology of disease states.
    ☐ D. It can impede the development of novel innovations that optimize patient care.