Anesthesia for State of the Art Ambulatory Surgery

Beverly K. Philip, MD, Professor of Anaesthesia, Harvard Medical School, and Founding Director, Day Surgery Unit, Department of Anaesthesiology, Perioperative and Pain Medicine, Brigham and Women’s Hospital, Boston, MA

Minimally invasive surgery (MIS): patient benefits include less pain, quicker recovery, shorter facility stay, and better cosmesis; advances do not save lives but still valued by patients

Laparoscopic surgery: eg, gastric banding, hysterectomy, adrenalectomy; splenectomy—one study comparing open vs laparoscopic procedures found no differences in mortality or outcome; laparoscopic splenectomy associated with lower morbidity (30% vs 12%) and reduced length of hospital stay (9 days vs 4 days), compared with open procedure

Nonlaparoscopic MIS: initially used for cosmetic surgery (eg, mammoplasty); now used for, eg, mastectomy, carotid endarterectomy; greatest growth in orthopedic surgery, particularly knee replacement, with heavy market demand

Robotic surgery (RS): originally approved for cardiac surgery (although not widely adopted); now used most commonly in urology (eg, radical prostatectomy) and gynecology (eg, hysterectomy); procedure must be of high complexity to justify high cost; treatment of infertility, (eg, repair of fallopian tubes, myomectomy) huge area of growth; market demand high despite paucity of support from literature; growth driven by heavy promotion from manufacturers and intense competition among hospitals; efficacy of RS—quicker recovery of gastrointestinal function reported after gastrectomy for cancer; in study of Roux-en-Y gastric bypass that compared RS with open and conventional laparoscopic procedures, RS associated with lower rates of anastomotic leak and mortality; value possible in selected situations

Training of surgeons in RS: conventional teaching accomplished through courses, animal models, assisting other surgeons, and proctoring; telementoring—one-on-one mentoring when teaching of RS needed in remote site; remote mentor has audio and video input to operating room (OR); telementor can annotate anatomy and surgical instructions on screen; technology available allows telemantor to move camera and electronic equipment by voice control; postgraduate courses—sponsored by surgical societies; burgeoning opportunities also provided by commercial enterprises and manufacturers; separate DaVinci device available as educator; virtual reality simulation—courses include tutorials, orientation lessons, and simulation models to teach skills (eg, handling needles, tissue, performance of basic anastomoses)

Educational Objectives

The goal of this program is to improve the anesthetic management of patients undergoing minimally invasive procedures, the use of combined general and neuraxial anesthesia, and the perioperative management of patients with liver disease. After hearing and assimilating this program, the clinician will be better able to:

1. Consider new minimally invasive techniques.
2. Explain the risks and benefits of neuraxial anesthesia.
3. Evaluate the effects of neuraxial techniques on postoperative outcomes.
4. Perform a preoperative evaluation of a patient with liver disease.

5. Plan perioperative management of patients with liver disease.

Faculty Disclosure

In adherence to ACCME Standards for Commercial Support, Audio-Digest requires all faculty and members of the planning committee to disclose relevant financial relationships within the past 12 months that might create any personal conflicts of interest. Any identified conflicts were resolved to ensure that this educational activity promotes quality in health care and not a proprietary business or commercial interest. For this program, members of the faculty and planning committee reported nothing to disclose. In her lecture, Dr. Philip presents information that is related to the off-label or investigational use of a therapy, product, or device.

Barriers to RS: high cost, size, and weight; does not tolerate moves between OR suites; designed to be used in small surgical fields (eg, cardiac surgery), so use in more common procedures limited; because touch feedback absent, surgeon must rely on subtle visual cues to avoid damaging tissue and breaking sutures; technology for touch feedback—being developed; includes ability to sense how tightly device holding tissue; end effectors can now measure tool-tissue interaction in several degrees of rotational freedom; electronic gearing to enable transmission of feel; when clinically available, likely to increase safety

Natural orifice transluminal endoscopic surgery (NOTES): experimental alternative allowing access to peritoneal cavity through mouth, anus, or vagina; goal to eliminate abdominal incisions, scars, and (perhaps) anesthetic morbidity; first report of transoral transgastric appendectomy in appeared in 2006; 2 ongoing human trials studying transoral and transvaginal cholecystectomy; concerns include control of surgical field

Single-port laparoscopic surgery: procedure performed through single port, typically near umbilicus; utility noted in obese patients; advantages include use of conventional laparoscopic instruments, maintenance of familiar anatomic views, and maintenance of sterile surgical environment (in contrast to NOTES); technically more difficult (surgeon must be proficient at laparoscopy and learn to use specially articulating tools); instruments often collide (technology to avoid collisions under development)

Intraoperative image-guided procedures and non-OR procedures: large growth area replacing surgical procedures; three-dimensional visualization which combines ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI) with overlay technology; procedures include thermal ablation, cryoablation of lesions of liver, MRI-guided laser for lesions of brain, and focused ultrasonography with MRI-guidance; image registration allows overlaying of images from different modalities, which enhances precision

Neurosurgery: enhanced-reality visualization uses preoperative CT and MRI, which identify normal structures and pathology; images overlaid to provide 3-dimensional model; widely used for preoperative planning; intraoperative image guidance displays images on computer screen; surgeon can see tumor 3-dimensionally during operation; overlay imaging has lead to dedicated OR suites (ie, advanced multimodality image-guided OR); intraoperative molecular imaging also possible through application of probes that measure metabolic function and can ascertain whether tumor has been localized; robotic image-guided brain biopsy—3-dimensional volumetric imaging; as tumor resected, anatomy of brain altered; intraoperative MRI updates location of tumor, thereby increasing precision
Neuraxial vs General Anesthesia: A Basic Refresher

Angela F. Edwards, MD, Associate Professor Of Anesthesiology, and Section Head, Anesthesiology Preoperative Assessment Clinic, Wake Forest School of Medicine, Wake Forest Baptist Health, Winston-Salem, NC

Ideal anesthetic management: in administering general anesthesia (GA), consider anxiolysis, analgesia, amnesia, suppression of sympathetic nervous system responses to surgical incision, and akinesia; akinesia one of greatest challenges; optimize administration of paralytic agents, subsequent nondepolarizing agents, and timing of reversal

Combined GA and neuraxial anesthesia (NA): goals include effective pain management, quick extubation, and minimization of risk for pulmonary complications and respiratory failure; respiratory physiology — supine position in obese patient undergoing GA reduces tidal volume, functional residual capacity, and closing volume, all of which promote atelectasis and hypoxemia; akinesia — skeletal muscle relaxation necessary for abdominal wall incision and closure; NA optimizes conditions

Neuraxial anesthesia: includes spinal anesthesia (SA), epidural (EA), or combined spinal-epidural; can be used alone or in combination with GA or peripheral nerve blocks; all neuraxial techniques result in relative sympathetic block; techniques — subarachnoid block (single-shot technique); epidural catheter-based technique (typically uses local anesthetics with opioid infusion); clinical effects of NA — some degree of systemic hypotension almost always occurs; certain physiologic states contraindicate NA (eg, aortic stenosis); risks of NA — usually requires platelets >90,000/μL; complications include epidural hematoma and abscess; unintentional dural puncture; subarachnoid injection or spread; toxicity of local anesthetic; should be alternative plan; differences between EA and SA — risk for postanesthetic headache lower with EA; with insertion of catheter, anesthesia can be prolonged with EA; absolute contraindications — include patient refusal, infection at planned site of insertion, elevated intracranial pressure, and bleeding diathesis; relative contraindications — include bacteremia, preexisting neurologic conditions (eg, multiple sclerosis); patients with chronic back pain (mostly to ease concerns); NA generally not recommended for patients with mitral stenosis or hypertrophic cardiomyopathy

Case vignette: 58-yr-old man with obesity, diabetes, hypertension, chronic obstructive pulmonary disease, obstructive sleep apnea, and chronic pain disorder presents for urgent open colectomy; recommended technique — GA with NA (minimizes risk for postoperative pulmonary complications and need for pulmonary rescue); residual anesthetics most common reason for pulmonary rescue, particularly with use of opioids; use opioid-sparing techniques (local anesthetics via epidural; this technique decreases postoperative nausea and vomiting, and results in superior postoperative control of pain and fast extubation)

Clinical trials: preemptive analgesia — EA placed before incision effectively prevents pain cycle from getting started; Senturk et al (2002) compared patients given preincisional thoracic EA vs postincisional EA vs patient-controlled analgesia; in latter 2 groups, 62% had chronic pain; in preincisional group, visual analogue scores much lower and incidence of chronic pain lower at 3, 6, and 9 mo postoperatively; Cochrane review (2014) — based on 20 studies in >3000 patients; NA reduced 30-day mortality and postoperative pneumonia; when NA added to GA, incidence of postoperative pneumonia reduced even further; Popping et al (2008) — meta-analysis of 19 trials investigated effects of EA on pulmonary complications after major abdominal and thoracic procedures; EA associated with reduced need for prolonged mechanical ventilation, pulmonary rescue, and reintubation; Haisman et al (2014) — using data from National Surgical Quality Improvement Program, compared regional anesthesia with GA in patients with COPD; regional anesthesia associated with significantly reduced incidence of morbidity, mortality, pneumonia, and prolonged mechanical ventilation

Perioperative Management of the Patient with Hepatic Disease

Brett A. Simon, MD, PhD, Lowenstein Professor Of Anesthesiology, Harvard Medical School, and Chief, Department Of Anesthesia, Critical Care, and Pain Medicine, Beth Israel Deaconess Medical Center, Boston, MA

Hepatic disease: places patients at high risk; risk stratification must be performed during preoperative evaluation; pathophysiology — effects hemodynamics, drug metabolism, coagulation, pulmonary physiology, ascites, glucose metabolism, sodium homeostasis, renal function, portal hypertension, cognition, and hepatic encephalopathy (HE); Child-Turcotte-Pugh (CTP) classification — A, B, or C, based on albumin, International Normalized Ratio (INR), bilirubin, ascites, and HE; patients with CTP class B have mortality rate of 30% with major abdominal surgery (80% with CTP class C); Model for End-stage Liver Disease (MELD) score — based on creatinine, INR, and bilirubin

Management of patients with hepatic disease: any findings on history or physical examination should prompt further workup, including laboratory tests, although bilirubin, albumin, increase in liver enzymes, blood glucose, sodium, platelets, and INR; elevated INR — begin trial of parenteral vitamin K (intravenous or intramuscular) to attempt to improve INR; failure to improve may require other interventions; significant improvement, administration of prothrombin complex concentrate; persistent or uncontrolled ascites, large-volume paracentesis and albumin replacement may be indicated; preoperative placement of transjugular intrahepatic portosystemic shunt not shown to improve ascites

Renal disease: optimize modifiable causes; diuretics may be required; paracentesis may reduce intrabdominal pressure and improve renal perfusion; consider whether drugs nephrotoxic; hepatorenal syndrome — defined as creatinine >1.5 mg/dL, without any other identifiable cause and not responsive to volume replacement; prognosis dismal; only cure is liver transplantation (LT)

Hypotension: treated with fluid restriction and discontinuation of diuretics; in perioperative period, overly rapid correction may cause risk for central pontine myelinolysis (try to limit change to <10 mEq/24 hr)

Malnutrition: may cause low albumin with reduced oncotic pressure, edema, hypovolemia, and muscle wasting; to reduce risk of HE, consider enteral or parenteral supplementation with formula high in carbohydrates and lipids and low in amino acids

Hepatic encephalopathy: consider subclinical HE if patient poor historian; identification of HE important because preoperative events may precipitate major encephalopathic episode; alkalosis, hypoxia, central nervous system depressant (eg, anesthetics), and infections can precipitate HE; treatment — oral lactulose to remove ammonia

Pulmonary involvement: hepatopulmonary syndrome — intrapulmonary shunting with resulting hypoxemia; type 1 responds to oxygen; type 2 does not respond to oxygen and prognosis very poor; portopulmonary hypertension — can result in right ventricular failure and death; LT only mode of primary treatment; patients usually require treatment with endothelin receptor blockers or phosphodiesterase inhibitors prior to LT

Risk factors for surgery: surgical procedure itself important risk factor; acute hepatitis contraindication for elective surgery; other contraindications include severe coagulopathy
with difficult correction, hypoxemia, hepatorenal syndrome, sequelae of portal hypertension (eg, variceal bleeding), and volume overload; **stratifying surgical procedures** — high-risk surgery includes major vascular procedures, lung resection, and intrathoracic operations; any upper abdominal surgery considered relatively high risk because hepatic blood flow sensitive to local mechanical alterations; risk great with high MELD or CTP scores (cancellation of surgery may be considered); if score moderate, consider whether surgical procedure is high or low risk and whether risk factors can be optimized

**Principles of intraoperative management**: maintain splanchnic and hepatic blood flow; be aware of altered drug kinetics (eg, altered plasma binding, altered volumes of distribution [higher initial doses of drug may be required], reduced pseudocholinesterase [causes effects of succinylcholine to be prolonged]);

**Anesthetic management** — halothane and enflurane should be avoided because of association with autoimmune hepatitis; use muscle relaxants with extrahepatic metabolism (eg, atracurium, cisatracurium); effects of hypnotics (eg, midazolam, barbiturates) may be prolonged (preferably avoided); propofol safe; doses of opioids may require reduction; synthetic opioids (eg, fentanyl, sufentanil, remifentanil) preferred over older agents (eg, morphine, meperidine)

**Postoperative care**: coagulopathy, HE, or worsening hepatic or renal dysfunction may occur 2 to 3 days postoperatively; continue to closely monitor to maintain intravascular volume and perfusion, ensure adequate ventilation and oxygenation, and detect developing HE

**Acknowledgments**

Dr. Philip spoke at **Aspen Anesthesia**, presented by Holiday Seminars, and held January 31 to February 7, 2015, in Snowmass Village, CO. For information on upcoming CME meetings sponsored by Holiday Seminars, please go to holidayseminars.com. Dr. Edwards spoke at the **10th Annual Perioperative Medicine Summit**, presented by Rush University Medical Center, Cleveland Clinic, and the Society for Perioperative Assessment and Quality Improvement, and held February 26-28, 2015, in Scottsdale, AZ. For information on upcoming CME meetings from Rush University Medical Center, please visit rushu.rush.edu/cme, for the Cleveland Clinic, please go to clevelandclinicmeded.com, and for the Society for Perioperative Assessment and Quality Improvement, please visit spaqi.org. Dr. Simon spoke at **Perioperative Management**, sponsored by The Johns Hopkins University School of Medicine and the Office of Continuing Medical Education, and held March 9-12, 2014, on Marco Island, FL. For information on upcoming CME meetings from the Johns Hopkins University School of Medicine, please visit hopkinscme.edu, or visit our website, Audio-Digest.org, and click on “Upcoming Meetings.” The Audio Digest Foundation thanks the speakers and the sponsors for their cooperation in the production of this program.

**Suggested Reading**


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**Estimated time to complete the educational process**:

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1. Which of the following is an advantage of laparoscopic splenectomy over open splenectomy?
   (A) Lower morbidity  (C) Lower mortality
   (B) Better overall outcome  (D) None of the above

2. Robotic surgery has been widely adopted for all of the following, except:
   (A) Cardiac surgery  (C) Hysterectomy
   (B) Radical prostatectomy  (D) Infertility surgery

3. Which of the following is true of single-port laparoscopic surgery?
   (A) Need for specialized laparoscopic instruments limits its use
   (B) Advantageous for obese patients
   (C) Level of technical difficulty similar to conventional laparoscopic surgery
   (D) Anatomic view differs from that with conventional laparoscopy

4. Which of the following is an absolute contraindication for epidural anesthesia?
   (A) Elevated intracranial pressure  (C) Multiple sclerosis
   (B) Bacteremia  (D) Mitral stenosis

5. Which of the following is the most appropriate anesthetic technique for a 58-yr-old man with morbid obesity,
   chronic obstructive pulmonary disease, obstructive sleep apnea, and chronic pain disorder who presents for
   urgent open colectomy?
   (A) General anesthesia (GA), with patient-controlled analgesia postoperatively
   (B) General anesthesia with epidural anesthesia
   (C) General anesthesia with combined spinal epidural anesthesia
   (D) Neuraxial anesthesia

6. According to the study by Hausman et al that compared regional anesthesia with GA in patients with chronic obstructive
   pulmonary disease, regional anesthesia is associated with which of the following?
   (A) Reduced morbidity  (C) Reduced mortality
   (B) Reduced postoperative pneumonia  (D) All the above

7. In patients with Childs-Turcotte-Pugh class B liver disease, which of the following is the mortality rate associated with
   major abdominal surgery?
   (A) 10%  (B) 15%  (C) 20%  (D) 30%

8. In a patient with hepatic disease who is undergoing neurosurgery, it is recommended that his or her
   International Normalized Ratio be:
   (A) <1.2  (B) 1.4  (C) 1.6  (D) 1.8

9. Hepatorenal syndrome is defined as a creatinine level of _______ without any other identifiable cause.
   (A) >1.5 mg/dL  (C) >2.0 mg/dL
   (B) >1.8 mg/dL  (D) >2.2 mg/dL

10. Which of the following anesthetic drugs is considered safe in patients with hepatic disease?
    1. Fentanyl
    2. Propofol
    3. Atracurium
    4. Midazolam
    (A) 1,3  (B) 2,4  (C) 1,2,3  (D) 1,2,3,4

Answers to Audio Digest Anesthesiology Volume 57, Issue 21: 1-B, 2-D, 3-B, 4-B, 5-C, 6-A, 7-D, 8-B, 9-D, 10-C