Lesson S17: PreAnesthetic Assessment of the Patient for Lumbar Spinal Surgery – Part 2

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Read this article, reflect on the information presented, then go online and complete the lesson post-test and course evaluation before the termination date below. (CME credit is not valid past this date.) You must achieve a score of 80% or better to earn CME credit.

TIME TO COMPLETE ACTIVITY: 2 hours
RELEASE DATE: March 1, 2011
TERMINATION DATE: March 31, 2012

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Needs statement

Surgical interventions to alleviate back pain are the most common procedures performed by neurosurgeons and orthopedists. Patients frequently possess multiple comorbidities that impact anesthetic care. The use of regional anesthesia has been suggested as a means to improve outcome.

This is the second segment of two part activity. Part 1 addressed the surgical approach with a discussion of the performance of general patient history and physical examination including a detailed description of appropriate cardiac evaluation. Part 2 expands on co‐morbid conditions that are commonly seen in the older patent presenting for complex lumbar surgery and describes pulmonary evaluation, the problems of obstructive sleep apnea, obesity, renal insufficiency, diabetes, hematological considerations and drug interactions.

Learning Objectives

At the end of this activity, the participant should be able to:

1. State time for return of normal lung function after cessation of smoking.
2. Describe the ASA risk scoring system for OSAS.
3. Compare the ASA risk scoring with the STOP questionnaire.
4. Differentiate between creatinine and creatinine clearance.
5. Identify the relationship between carboxyhemoglobin and oxygen availability.
7. Describe the signs and symptoms of pulmonary hypertension.
8. Understand why polycythemia and thrombocytosis should be identified and treated.
9. Advise a patient as to which drugs should be discontinued prior to surgery.
10. Present an anesthetic plan.
Case History

A 67 year old gentleman with a height of 68 inches and weight of 295lbs was scheduled for T8-L4 laminectomies and instrumentation for intractable back pain. He had undergone 2 lumbar surgeries within the past 12 years and had been attending a pain clinic for 9 months with little improvement in his symptoms. Other medical history includes hypertension, treated with beta and calcium channel blockers for 20 years, hypercholesterolemia and a smoking history, 1 pack per day for 50 years. Recently Captopril®, an angiotensin converting enzyme inhibitor, was added to his medication regimen. Physical examination reveals a BP 155/95, HR 53, Hb 14.6, serum glucose 174. He wears eye glasses.

Risk Factors for Complications in Patients Undergoing Lumbar Spinal Surgery

Tobacco Use

The presence of either obstructive or restrictive pulmonary disease increases the patient’s risk of developing perioperative respiratory complications. Risk is compounded by placement in the prone position for several hours during surgery. Hypoxemia, hypercapnia, acidosis, and increased work of breathing can lead to further deterioration of an already compromised cardiopulmonary system. If significant pulmonary disease is suspected, documenting response to bronchodilators, and/or evaluation for the presence of carbon dioxide retention through arterial blood gas analysis may be justified. If there is evidence of infection, appropriate antibiotic therapy is critical. Steroids and bronchodilators may be indicated, although the risk of beta agonists and hyperglycemia causing dysrhythmias or myocardial ischemia by must be considered. Complete abstinence from tobacco intake for several weeks prior to surgery would allow regeneration of lung function but is unlikely.

Time required for regeneration of various functions is approximated in Table 1.

<table>
<thead>
<tr>
<th>Function</th>
<th>Time Required</th>
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<tbody>
<tr>
<td>Elimination of nicotine</td>
<td>12 hours</td>
</tr>
<tr>
<td>Elimination of carboxyhemoglobin</td>
<td>1 - 3 days</td>
</tr>
<tr>
<td>Return of ciliary function</td>
<td>6 - 7 days</td>
</tr>
<tr>
<td>Decrease of sputum production</td>
<td>6 - 8 weeks</td>
</tr>
<tr>
<td>Normalization of immune system</td>
<td>&gt; 8 weeks</td>
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A carboxyhemoglobin level of 15% can reduce the availability of oxygen by up to 25%. Although this level may not be significant in asymptomatic patients, it may present a considerable risk for patients with coronary artery disease in whom a favorable myocardial balance is critical. Such patients should be advised to refrain from smoking for at least 24 hours prior to surgery. While pulmonary function tests are not usually helpful in predicting postoperative pulmonary events or the need for mechanical ventilation, a low preoperative oxygen room air saturation or low partial pressure of arterial oxygen may identify patients at higher risk. Other important factors in determining postoperative pulmonary complications include the site and duration of the surgical procedure and the amount of blood lost.

Preoperative pulmonary therapy can serve to acquaint the patient with tools used in the postoperative period to maintain oxygenation. Clinical studies suggest that smoking is a risk factor in the progression of kidney disease, especially diabetic nephropathy. Nicotine promotes mesangial cell proliferation and fibronectin production. Smoking may also promote the progression of diabetic nephropathy by increasing the expression of profibrotic cytokines such as transforming growth factor and the extracellular matrix proteins fibronectin and collagen 1V. In smokers, especially those that are diabetics, evaluation of kidney function and glycemic status is important and drugs dependent on the kidney for excretion should be restricted or limited.

Nicotine is a significant risk factor for the development and progression of periodontal disease. The drug impacts gingival blood flow, increasing cytokine production and adversely affecting the immune system to cause tooth loss. The high sugar content of chewing tobacco also causes tooth decay. Oral cancers and leukoplakia may interfere with intubation or oral airway placement due to bleeding or ulceration. Exposure to ethanol appears to enhance adverse changes in the buccal mucosa in vitro in more than an additive effect. Studies to assess the benefit of referring patients preoperatively to telephone quitlines show that there is benefit in advising patients about the adverse effects of tobacco. Smoking has been identified as a major factor in failure to fuse and continued pain after lumbar surgery.

**Obesity**

The obese patient presents a number of perioperative challenges including initial assurance of a satisfactory airway, position difficulties, a high likelihood of obstructive sleep apnea and pulmonary hypertension. The airway must be carefully assessed for ease of intubation. Intubation can be complicated by a neck circumference greater than 17 inches and heavy jowls, often combined with small mouth opening and a large tongue. Appropriate plans should be made, including informing the patient of a possible awake intubation technique. As spinal disease is rarely confined to only the lumbar area, assessment of the range of motion of the neck and the patient’s ability to lie flat must also be documented.
Obstructive sleep apnea syndrome (OSAS)

The American Society of Anesthesiologists has introduced guidelines for anesthetic management of an increasing population of patients who snore and are obese but who have not been formally diagnosed as suffering from sleep apnea, a syndrome that can have serious complications perioperatively. A recent retrospective, case control study of patients having joint replacement surgery at the Mayo Clinic found that 24% of OSAS patients compared to 9% of controls had serious postoperative complications (dysrhythmias, myocardial ischemia, re‐intubations, and unplanned intensive care unit admissions) with most occurring within 72 hours of surgery, and resulting in increased length of hospitalization.

The use of nasal continuous positive airway pressure (nCPAP) for several weeks preoperatively has been found to be highly effective at preserving airway patency during sleep and anesthesia as well as diminishing reflex responses to hypoxia and hypercapnia. This effect may result from upper airway stabilization, a residual effect of nCPAP that begins to occur within as little as four hours of continuous use of nCPAP. Regular use of nCPAP preoperatively has been found to abolish mean, systolic, and diastolic blood pressure fluctuations. As a result, the risk of cardiac ST segment depression and recurrent atrial fibrillation is reduced. It is recommended that nCPAP and oral appliances be continued during the postoperative period. It is also important to note, that patients who have had corrective surgery for OSAS, such as uvulopalatopharyngoplasty, may still harbor the disease despite lessening or absence of current symptoms.

The undiagnosed OSAS patient proves to be a greater diagnostic dilemma as accurate risk stratification (low, moderate, or severe) is not available to guide intra- and postoperative management. A presumed diagnosis of OSAS can be inferred from a history of abnormal breathing during sleep (e.g., loud snoring and witnessed apneas by a bed partner), frequent arousals from sleep to wakefulness (e.g., periodic extremity twitching, vocalization, turning, and snorting), severe daytime sleepiness, a BMI of ≥ 35 kg/m2, increased neck circumference (≥17 inches for males, ≥16 inches for females), and the presence of coexisting morbidities (e.g., essential systemic hypertension, pulmonary hypertension, cardiomegaly).

The ASA task force on OSAS (May 2006) recommended a risk scoring system. The Risk Score considers the following with points assigned for each of three categories (a, b, c) and then totaled (d):

(a) Severity of sleep apnea: Points are assigned based on a sleep study (i.e., AHI) or clinical indicators if a sleep study is not available (i.e., presumptive diagnosis). No OSA = 0; Mild OSA = 1; Moderate OSA = 2; Severe OSA = 3.

One point may be subtracted if a patient has been on CPAP or bi-level positive airway pressure (BiPAP) prior to surgery and will be using this consistently during the postoperative period. One point should be added if a patient with mild or moderate OSA has a resting PaCO2 exceeding 50 mm Hg.
(b) Invasiveness of the surgical procedure and anesthesia: Points are assigned based on type of surgery/anesthesia. Superficial surgery under local or peripheral nerve block, anesthesia without sedation = 0; superficial surgery with moderate sedation or general anesthesia or peripheral surgery with spinal or epidural anesthesia (with no more than moderate sedation) = 1; peripheral surgery with general anesthesia or airway surgery with moderate sedation = 2; major surgery under general anesthesia or airway surgery under general anesthesia = 3.

(c) Requirement for postoperative opioids: Points are assigned as follows. No postoperative opioids = 0 points; low-dose oral opioids = 1; high-dose oral opioids or parenteral or neuraxial opioids = 3.

(d) Estimation of perioperative risk: Based on the overall score (0–6) derived from the points assigned to (a) added to the greater of the points assigned to (b) or (c).

Patients with overall score of ≥ 4 may be at increased perioperative risk from OSAS. Patients with a score of ≥5 may be at significantly increased perioperative risk from OSAS.

Recently, a new abbreviated version of the ASA questionnaire—the STOP Questionnaire—was introduced. The questionnaire consists of four questions are related to Snoring, Tiredness during the day, Observed apnea, and high blood Pressure. The creators of the tool applied the scoring system to 2,467 patients, and concluded that it was reliable and easy to use. Combined with body mass index, age, neck size and gender the tool had a high sensitivity especially in patients with moderate to severe OSAS.

**Pulmonary Hypertension**

Symptoms of pulmonary hypertension may develop very gradually and include shortness of breath, fatigue, non-productive cough, angina pectoris, fainting or syncope, peripheral edema, and rarely hemoptysis. The presentation of pulmonary venous hypertension differs from pulmonary arterial hypertension (PAH) in that patients typically have shortness of breath while lying flat or sleeping (orthopnea or paroxysmal nocturnal dyspnea).

Typical signs of pulmonary hypertension, include a widely split S2 or second heart sound, a loud P2 or pulmonic valve closure sound (part of the second heart sound), (para)sternal heave, possible S3 or third heart sound, jugular venous distension, pedal edema, ascites, hepatojugular reflux, and clubbing. Tricuspid insufficiency is consistent with the presence of pulmonary hypertension.

Procedures to confirm the presence of pulmonary hypertension and exclude other possible diagnoses include pulmonary function tests; blood tests to exclude HIV, autoimmune diseases, and liver disease; electrocardiography (ECG); arterial blood gas analyses; chest X-rays (followed by high-resolution CT scanning if interstitial lung disease is suspected); and ventilation-perfusion or V/Q scanning to exclude chronic thromboembolic pulmonary hypertension. Biopsy of the lung is usually not indicated unless the pulmonary hypertension is thought to be due to an underlying interstitial lung disease. Lung biopsies are fraught with risks of bleeding due to the high intrapulmonary blood pressure. Brain natriuretic peptide level is also used to follow the progress of patients with pulmonary hypertension.

Diagnosis of PAH requires the presence of pulmonary hypertension with two other conditions.
Pulmonary artery occlusion pressure (PAOP or PCWP) must be less than 15 mm Hg (2000 Pa) and pulmonary vascular resistance (PVR) must be greater than 3 Wood units (240 dyn•s•cm⁻⁵ or 2.4 mN•s•cm⁻⁵). Diagnosis of PAH requires right-sided cardiac catheterization. Cardiac output is more important in measuring disease severity than the pulmonary arterial pressure.

**Diabetes Mellitus**

Type II or insulin resistant diabetes is a common finding in patients presenting for major back surgery and its presence heightens the suspicion for cardiac disease, Lee et al identified insulin therapy as a significant risk factor for cardiac morbidity. Older patients with diabetes mellitus are more likely to develop cardiac failure postoperatively than those without diabetes mellitus even after adjustment for treatment with ACE inhibitors. Perioperative management of blood glucose levels may be difficult as stress and steroid administration increase hyperglycemia. However, many studies have shown that wound healing is impaired and neurologic damage increased when excess sugar is metabolized. Patients need careful treatment with adjusted doses or infusions of short-acting insulin based on frequent blood sugar determinations.

**Drug Interactions and Recommendations**

Commonly, patients presenting for major back surgery have been in severe and chronic pain for years and undergone multiple therapies including over the counter medications and herbal remedies. They may have become opioid resistant. Antidepressants including monoamine oxidase inhibitors and selective serotonin reuptake inhibitors are often among their drug armamentarium. Identification and documentation of ingested substances is essential for safe selection of agents intra and postoperatively. While perioperative supplementation of steroids is no longer advocated, ingestion of this class of drugs should be noted to perhaps explain hyperglycemia or cardiovascular instability intraoperatively.

Current recommendations regarding continuing drug therapies are as follows:

1. Statin and or beta-blocker therapy currently used by the patient should be continued.
2. Beta blocker therapy should not be started *de novo*.
3. ACE inhibitors may need to be discontinued on the day before surgery.
4. Patients with a bare metal stent should not have surgery for a month and patients with a drug eluting stent should continue clopidogrel for a year or more.
5. Clopidogrel, coumadin and aspirin should generally be stopped 10 days before surgery.

**Renal Impairment**

Renal dysfunction is associated with cardiac disease, diabetes and an increased risk of cardiovascular events. A large study demonstrated that preexisting renal disease (defined as preoperative serum creatinine levels 2 mg per dL or greater or reduced glomerular filtration rate) is an independent risk factor for postoperative renal dysfunction and increased long-term morbidity and mortality, especially cardiac complications after major noncardiac surgery.

Creatinine clearance, which incorporates serum creatinine, age, and weight to provide a more accurate assessment of renal function than serum creatinine alone, has been used to predict postoperative...
complications. After major surgery, mortality increased when both serum creatinine increased and creatinine clearance decreased, with creatinine clearance providing a more accurate assessment.

**Hematologic Disorders**

Patients are often advised to pre-donate blood prior to major back surgery which can produce a pre-operative anemia. Smokers generally have higher hematocrits (values > 50%) and thus a value of 36% may represent relative anemia in these patients although considered normal. Anemia imposes a stress on the cardiovascular system and was also identified in the American Society of Anesthesiologist Visual Loss Registry as a risk factor.

In the VA National Surgical Quality Improvement Program database, mild degrees of preoperative anemia or polycythemia were associated with an increased risk of 30-day postoperative mortality and cardiac events in older, mostly male, veterans undergoing major non-cardiac surgery. The adjusted risk of 30-day postoperative mortality and cardiac morbidity begins to rise when hematocrit levels decrease to less than 39% or exceed 51%.

Polycythemia, thrombocytosis, and other conditions that increase viscosity and hypercoagulability may increase the risk of thromboembolism or hemorrhage. Appropriate steps to reduce these risks should be considered and tailored to the individual patient’s particular circumstances.

**Consent Issues**

Several issues require special consideration during the preanesthetic assessment. The patient should be informed of the potential need for a blood transfusion. For some patients, it may be necessary to perform awake fiberoptic intubation and continue ventilatory support postoperatively. In practice guidelines, The American Society of Anesthesiologists recommends placing an arterial cannula. The ASA does not include placement of a central venous catheter or pulmonary artery catheter because these monitors do provide sufficient information for determining therapy.

Anesthesiologists are also advised to tell patients that there is a low but real risk of postoperative vision loss (POVL). The American College of Surgeons has been silent on this issue to date. It appears that certain patients are at risk of developing POVL. Although presence of any single factor listed below may not place the patient at increased risk, the combination of several circumstances should be considered as potentially problematic. Identified factors are as follows:

1. **Repeat spinal surgery and the prone position.** Chronic pain patients may often have a history of multiple surgeries and can present for potentially long procedures requiring extensive instrumentation. In such circumstances, considerable blood loss should be anticipated and plans should be in place for availability of pre-donated blood. The prone position is associated with a decrease in intraocular perfusion pressure.

2. **Body habitus and social conditions.** Disc disease is often associated with smoking, obesity and sedentary life style. Obesity was identified in many of the Registry patients. Hypoxia and/or bronchospastic disease may occur during anesthesia.

3. **Hypotension.** Hypertensive patients are often unstable intraoperatively and ocular perfusion...
pressure may be seriously decreased if any period of hypotension occurs or if it is prolonged.

4. **Hyperglycemia.** Diabetes and increased perioperative glucose levels have been associated with poor neurologic outcome as hypoxic or ischemic tissue is unable to metabolize sugar through normal pathways and the size of infarcted areas is increased. Patients undergoing spinal surgery are often treated prophylactically with steroids to decrease edema formation, which further increases blood glucose levels. Stress also contributes to hyperglycemia. Recent studies have emphasized the need for tighter perioperative glycemic control (80-155mg/dl).30

5. **Anemia, blood loss and hemodilution.** Hemodilution and pre-donation of blood may result in anemia. Earlier guidelines for care of the young trauma victim suggested that blood could be replaced with crystalloid in the amount of 1 to 3 ml. However, patients for prolonged spinal surgery are usually not healthy. Crystalloids circulate for less than an hour before leaking to other tissues. In the prone position, especially if there is a degree of Trendelenberg tilt, fluid will gravitate to dependent soft tissues in the face and around the eyes causing edema and increasing venous pressure. Excess fluid also fills the intestinal wall, further increasing intra-abdominal pressure. This increase in intra-abdominal pressure decreases renal output (treated with fluid boluses) and increases risk of bleeding from epidural venous plexuses. Average blood loss in complicated spine surgery is 4,000 ml. Current guidelines advocate replacement of blood as necessary to maintain adequate oxygen delivery. Excessive crystalloid replacement may contribute to POVL31 and cause the development of a compartment syndrome within the eye. Preoperative volume loading may not be necessary in most cases. The classic third space probably does not exist.32

Demand related regimens should be followed to improve patient outcome. Perioperative fluid shifting must be minimized. Fluid balance should be maintained. The tetrastarches, hydroxyethyl starch 130/0.4, recently approved in the United States, have been shown to represent a substantial advance in colloid therapy, offering good volume replacement with a low risk of side effects.33 Colloids used for perioperative fluid replacement, such as hydroxyethyl starch, can improve tissue oxygen tension (pti02) significantly more than crystalloids resulting in improved microperfusion and less endothelial swelling.34

Given the wide range perioperative parameters and the enormous variability in patient factors and condition, a specific means for accurately assessing appropriate fluid replacement is still lacking. The intravascular space is not static. The esophageal Doppler supplies continuous real time objective data, and analysis of pulse pressure variation. This strategy may well emerge as a monitor of preload conditions and assist in managing cardiac contractility and the effect of afterload impedance on left ventricular performance.35

6. **Long surgery.** The average length of surgery exceeded 5 hours in the Registry study.28

**Laboratory Testing**

Tests should be ordered following history and physical examination and depend on specific findings as follows:

1. **Type and cross match blood for intraoperative use**
2. Complete blood count to establish baseline
3. Coagulation profile to ensure reversal of effects of all anticoagulant medications
4. Room air saturation to assess pulmonary function
5. Appropriate cardiac evaluation depending on the patient’s status
6. Chest X-ray to ensure there are no infective processes that require preoperative treatment
7. Basal metabolic panel to obtain electrolyte and sugar levels
8. Creatinine clearance for renal function
9. Brain natriuretic peptide as further assessment of cardiac function
10. Carotid and deep venous Doppler scan to assess other vascular disease

Anesthetic plan

Patients for lumbar spinal surgery often require general anesthesia with standard ASA monitors and arterial cannulation, as transpired in this case. Blood sugar level should be managed below 150mg/dl by sliding scale insulin and frequent measurements. Fluid replacement should be minimal with blood replaced early and not dictated by urine output alone. Colloids are often useful to maintain intravascular volume and should be used with crystalloids. Recently there has been resurgence in the use of regional anesthesia, especially for single level discectomies. Advantages for this approach are decreased blood loss, better pain management especially if epidural clonidine is added to the technique, less nausea and vomiting and a decreased incidence of deep venous thrombosis.36 Endoscopy may be used posteriorly for discectomy and anteriorly for instrumentation. A plan for postoperative pain management is essential and should consider patient controlled analgesia, neuraxial block as well as break through bolus orders and use of other drug classes.

Conclusion

Patients presenting for lumbar surgery often have many co morbidities that require careful preanesthetic assessment to ensure the best outcome with minimal perioperative complications.

Dr. Elizabeth A.M. Frost, who is the editor of this continuing medical education series, is clinical professor of anesthesiology at The Mount Sinai School of Medicine in New York City. She is the author of Clinical Anesthesia in Neurosurgery (Butterworth-Heinemann, Boston) and numerous articles. Dr. Frost is past president of the Anesthesia History Association and former editor of the journal of the New York State Society of Anesthesiologists, Sphere. She is also editor of the book series based on this CME program, Preanesthetic Assessment, Volumes 1 through 3 (Birkhäuser, Boston) and 4 through 6 (McMahon Publishing, New York City).
REFERENCES


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Post-test

1. After smoking cessation, elimination of nicotine will occur in approximately:
   a. 3 days
   b. 12 hours
   c. variable time frame depending on alcohol use
   d. more than 8 weeks

2. Regarding drug therapy:
   a. All hypertensive patients should be started on a statin
   b. Patients on beta blockers should continue to take their medications on the day of surgery
   c. There is no risk in stopping clopidogrel in a patient with a drug eluting stent
   d. No medications should be discontinued

3. Factors identified by the ASA registry for POVL include:
   a. Surgery lasting > 5 hours
   b. Prone position
   c. Large blood loss
   d. All of the above

4. The advantages of a regional anesthetic technique for lumbar surgery are least likely to include:
   a. Better pain management
   b. Decreased incidence of nausea and vomiting
   c. No blood loss
   d. Decreased incidence of deep venous thrombosis

5. Regarding postoperative loss of vision (POVL):
   a. Patients should be advised that there is a small risk
   b. The American College of Surgeons supports informing patients
   c. Best not to mention it as the complication is so rare
   d. Only discuss it if the patient specifically asks
6. **Polycythemia:**
   
   a. Increases the risk of thromboembolism
   b. Is rarely encountered in a smoker
   c. Is avoided by pre-donation in all patients
   d. Decreases viscosity

7. **Fluid replacement is best managed by:**
   
   a. Replacement of blood by 3:1 crystalloids
   b. Combination of crystalloids and colloids
   c. Blood replacement only
   d. Giving enough fluid to keep urine output at 1ml.kg.h

8. **Which of the following statements is TRUE regarding intubation of a patient with lumbar disc disease:**
   
   a. A neck size of 15 inches is associated with difficult intubation
   b. Morbid obesity rarely poses a problem for intubation
   c. Assessment of range of motion in the neck is important
   d. Rapid sequence intubation is always the technique of choice

9. **The least reliable guide to fluid replacement therapy is:**
   
   a. Esophageal Doppler studies
   b. Pulse pressure variation
   c. Urine output
   d. Visual assessment of blood loss

10. **Factors contributing to hyperglycemia in patients presenting for lumbar surgery include:**
    
    a. Preexisting diabetes.
    b. Steroids
    c. Stress
    d. All of the above