Lesson S40: PreAnesthetic Assessment of the Patient for Lumbar Spine Surgery

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Professional Gaps

Anesthesiologists are generally aware that major back surgery is associated with the potential for serious complications. Many of these patients have multiple co-morbidities that impact anesthetic care, especially obesity. Recently, regimens for postoperative pain management and means to reduce the incidence of postoperative visual loss have been proposed.

Learning Objectives

At the completion of the activity, the reader will be able to:

1. Identify the most common reason for laminectomy
2. List the anesthetic considerations in anesthetizing an obese individual
3. Apply the STOP BANG questionnaire
4. Be able to assess levels of hypertension
5. Understand an “appropriate” level of glycemic control
6. Identify indicated tests
7. Draw up an anesthetic plan
8. Devise an appropriate scheme for postoperative pain management
9. Be aware of the risk factors for postoperative visual loss
10. Advise a patient about the risks of smoking in this case

Case

A 59 year old gentleman, height 68 inches and weight 245 lbs was scheduled for T8-L2 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 with little improvement in his symptoms for 9 months. Other medical history included 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 list. His vital signs revealed BP 155/95, HR 53. Laboratory testing revealed Hb 14.6 and blood sugar 174.

**Lumbar Level: Elective Surgery**

Many surgical procedures are performed on the lumbar spine ranging from a simple minimally invasive and endoscopic discectomy to multi-level reconstructive procedures with complex instrumentation. In line with complexity, anesthetic management varies from little more than local infiltration with some sedation to general anesthesia.

Spinal stenosis is the single most common diagnosis leading to any type of spine surgery. Laminectomy is a basic part of the surgical treatment. The lamina of the vertebra, which itself is not damaged, is removed to widen the spinal canal and create more space for the spinal nerves and thecal sac. Surgical treatment that includes laminectomy is the most effective remedy for severe spinal stenosis; however, most cases of spinal stenosis are not severe and respond to bed rest, non-steroidal anti-inflammatory agents and steroids. Laminectomy is generally indicated if symptoms include numbness, loss of function and neurogenic claudication. Fusion with instrumentation is usually required when the spinal column is unstable.

Spinal fusion and instrumentation is major surgery that is generally planned for many months. Thus patients have often undergone extensive evaluation before they are even seen in a preanesthetic assessment clinic. Several factors may need to be explored by the anesthetic care team.

**Preanesthetic assessment**

Patients presenting for major spinal surgery are more likely to be male with truncal obesity and frequently have multi-system disease. Some of the more typical findings are shown in Table 1.

**Table 1. Typical findings for patients presenting for major spinal surgery**

<table>
<thead>
<tr>
<th>FINDINGS and SYMPTOMS</th>
<th>ANESTHETIC IMPLICATIONS</th>
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<tbody>
<tr>
<td>Hypertension</td>
<td>Well controlled? Medications? Effects of general anesthesia?</td>
</tr>
<tr>
<td>Smoking</td>
<td>Respiratory function? Wound healing? Postoperative care?</td>
</tr>
<tr>
<td>Obesity</td>
<td>Obstructive sleep apnea? Airway difficulties? Pulmonary hypertension?</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>Perioperative glucose control?</td>
</tr>
<tr>
<td>Multiple pain managements</td>
<td>Drug interactions?</td>
</tr>
<tr>
<td>Renal disease</td>
<td>Diuretic therapy? Coronary artery disease?</td>
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<tr>
<td>Hematologic anomalies</td>
<td>Anemia? Polycythemia?</td>
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</tbody>
</table>
Hypertension

A long standing history of hypertension and hyperlipidemia is common, usually treated with several medications including diuretics, angiotensin converting enzyme (ACE) inhibitors, calcium channel and beta blockers and a statin. In assessing blood pressure, several values should be taken from both arms. An elevated blood pressure may indicate “white coat” syndrome or failure to adhere to the prescribed regimen. It is important to recognize that “white coat” syndrome may not be the benign condition it was once thought to be.\(^2\) Patients have been known to misinterpret the NPO order and believe that “nothing to eat or drink” excludes all medications. If the blood pressure is indeed recorded within a normal range, it is important to remember that, like a diabetic in whom a single measurement is normoglycemic, the disease is still present. Even though a mean blood pressure of 60-70mmHg may be well tolerated by a young man with normal vasculature, such a level may well be too low for someone who may have a baseline mean pressure of 110 (140/90) with medication.\(^3,4\)

The long term ingestion of antihypertensive agents, especially ACE inhibitors, may cause a decrease in blood pressure intraoperatively, necessitating early administration of vasopressors such as vasopressin or even methylene blue. This syndrome, the vasoplegic syndrome, is characterized by profound vasodilation and loss of systemic vascular resistance leading to hypotension. The pathogenesis involves the activation of contact, coagulation and complement systems and the activation of leukocytes, platelets and endothelial cells resulting in an imbalance in the regulation of the vascular tone.\(^5\)

Cases for extensive spine instrumentation are often planned months in advance and the patient is typically evaluated by a cardiologist. The results and medications should be reviewed and documented. Long established beta blockade and statins should be continued with the understanding that bradycardia intraoperatively may mask hypovolemia and blood loss.

Guidelines from the American College of Cardiology and the American Heart Association have questioned the usefulness of extensive cardiac testing.\(^6\) Cardiac conditions that require further evaluation include:

- Unstable coronary syndrome
- Decompensated cardiac failure
- Severe angina
- Worsening or new onset failure
- Recent myocardial infarction
- Symptomatic dysrhythmias
- High grade AV block
- Mobitz II AV block
- Severe valvular disease

Smoking

A smoking history - either ongoing or in the recent past - is common. Both obstructive and restrictive pulmonary disease places the patient at increased risk of developing perioperative respiratory complications that are compounded by placement in the prone position for several hours during surgery. Abstinence from tobacco intake for several weeks prior to surgery would be ideal but is unrealistic. A carboxyhemoglobin level of 15% can reduce the availability of oxygen by up to 25% and
while this level may not be significant in asymptomatic patients, it may present a risk for patients with coronary artery disease in whom careful myocardial balance is critical. Patients should be advised to refrain from smoking for at least 24 hours prior to surgery. A low preoperative oxygen room air saturation or low partial pressure of arterial oxygen are better identifiers of patients at higher risk than pulmonary function tests.

Other less realized complications of cigarette smoking include progression of periodontal disease due to nicotine effects that decrease gingival blood flow, increase cytokine production, adversely affecting the immune system and loosening teeth.\textsuperscript{7} Chewing tobacco also causes tooth decay due to the high sugar content. Noting that surgery might present a teachable moment, several studies have been undertaken to assess the benefit of referring patients preoperatively to telephone quit-lines.\textsuperscript{8} While many of these reports are on small groups, there is benefit in advising patients on the adverse effects of tobacco and referring them for further help, especially by facilitating referral of smokers for counseling and follow up. Smoking has been identified as a factor in failure to fuse and continued pain after lumbar surgery although evidence has been conflicting.\textsuperscript{9,10}

Identification of infection requiring appropriate antibiotic therapy is critical prior to placement of hardware in the spinal area.

**Obesity**

The obese patient presents many perioperative challenges for the anesthesiologist. (Table 2)

**Table 2. Considerations for anesthetic management in the obese patient**

<table>
<thead>
<tr>
<th>Difficult intubation/extubation</th>
<th>Altered drug metabolism/interactions</th>
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<tbody>
<tr>
<td>Systemic/pulmonary hypertension</td>
<td>Diabetes</td>
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<tr>
<td>Renal/hepatic dysfunction</td>
<td>Positioning difficulties</td>
</tr>
<tr>
<td>Respiratory impairment</td>
<td>OSA / OHS</td>
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<tr>
<td>Hematologic disorders</td>
<td>Aspiration risk</td>
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Neck circumference > 17 inches and heavy jowls, often combined with small mouth opening and a large tongue may compromise intubation. However, the endotracheal tube is usually placed with relative ease and extubation becomes more problematic. Plans should be made to extubate only when the effects of all anesthetics, especially muscle relaxants have been reversed and the patient is in a semi-seated position. For patients with BMI > 50, it may be prudent to have 2 trained anesthetic providers available. A means to provide continuous airway pressure should also be at hand as well as the difficult airway cart.

**Obstructive sleep apnea (OSA) syndrome**

The American Society of Anesthesiologists (ASA) recently updated guidelines for perioperative 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.¹¹ Knowledge of these potential problems is required for all anesthesiologists. While these latest guidelines do not necessitate changes from earlier recommendations, they are based on a more rigid literature review and are presented as follows:

1. **Preoperative evaluation:** Most cases of OSA are not formally diagnosed. A simple means to identify patients at risk is by application of the STOP-BANG questionnaire. Positive answers to >3 raise a strong possibility of OSA. (Table 3) Surgeons and anesthesiologists should work together to develop a protocol that allows patients with suspected OSA to be evaluated and so that plans are developed prior to surgery. Patients and their families should be involved in decision making and risks/benefits discussed. Consideration should be given to the severity of the OSA, the invasiveness of the procedure and the need for postoperative analgesics. Decision as to whether the case be performed on an in- or out- patient basis is a judgment call.

<table>
<thead>
<tr>
<th>Table 3: STOP-BANG questionnaire.</th>
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<tr>
<td><em>Answering “yes” to &gt; 3 indicates a high probability of OSA</em></td>
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</tbody>
</table>

| 1. Snoring | Do you snore loudly (louder than talking or loud enough to be heard through closed doors)? Yes No |
| 2. Tired | Do you often feel tired, fatigued, or sleepy during daytime? Yes No |
| 3. Observed | Has anyone observed you stop breathing during your sleep? Yes No |
| 4. Blood Pressure | Do you have or are you being treated for high blood pressure? Yes No |
| 5. BMI | BMI more than 35 kg/m²? Yes No |
| 6. Age | Age over 50 yr. old? Yes No |
| 7. Neck circumference | Neck circumference greater than 40 cm? (Neck circumference is measured by staff) Yes No |
| 8. Gender | Gender male? Yes No |

2. **Preoperative preparation:** Initiation of a continuous positive airway pressure (CPAP) should be considered. Other considerations include weight loss, preoperative use of mandibular airway advancement devices or oral appliances. Patient who have undergone a uvulopalatopharyngoplasty should not be free of OSA until a normal sleep study has been obtained.

3. **Intraoperative management:** Because of the propensity for airway collapse and sleep deprivation, patients with OSA are susceptible to the respiratory depressant effects of opioids, sedatives and inhaled anesthetics. All efforts should be made to use regional blocks or local analgesia. During moderate sedation, continuous capnography is recommended. General
anesthesia with a secured airway is preferred to deep sedation. Patients should be extubated only when fully awake and effects of agents have been reversed and in a semi-sitting position.

4. **Postoperative management:** Opioids should be used sparingly, if at all, and continuous background infusions of patient controlled systems avoided. Non-steroidal anti-inflammatory agents and other modalities are encouraged. Supplemental oxygen is indicated for all patients at risk of OSA until they can maintain their baseline SPO₂ on room air. CPAP machines, preferably from home, should be used as appropriate. Positions other than supine are preferred. Discharge to any other setting other than a step down or monitored setting should not occur until the patient is no longer at risk of respiratory depression.

While sleep studies are considered the gold standard in the diagnosis of OSA, the test is rarely done. The ASA has also classified risk of complication secondary to OSA according to several factors.

a. **Severity of sleep apnea:** Based on a sleep study (i.e., apnea, hypopnea, AHI) or clinical indicators if a sleep study is not available (i.e., presumptive diagnosis). Points: 0 = None; 1 = Mild OSA; 2 = Moderate OSA; 3 = Severe OSA. One point may be subtracted if a patient has been on CPAP or bilevel 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:** Based on type of surgery/anesthesia. Points: 0 = superficial surgery under local or peripheral nerve block, anesthesia without sedation; 1 = superficial surgery with moderate sedation or general anesthesia or peripheral surgery with spinal or epidural anesthesia (with no more than moderate sedation); 2 = peripheral surgery with general anesthesia or airway surgery with moderate sedation; 3 = major surgery under general anesthesia or airway surgery under general anesthesia.

c. **Requirement for postoperative opioids:** Points: 0 = none; 1 = low-dose oral opioids; 3 = high-dose oral opioids or parenteral or neuraxial opioids.

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

*Diabetes Mellitus*

Type II or insulin-resistant diabetes is a common finding in patients with lumbar disc disease presenting for major back surgery. Recent studies have questioned optimal levels for glycemic control. Perioperative management of blood glucose levels may be difficult as stress and steroid administration will cause hyperglycemia. Moreover, over time during anesthesia, blood sugar levels rise. Certainly, high levels of blood sugar do delay wound healing and will increase the size and severity of any neural damage. Consensus now seems to be to ascertain a patient’s “normal” glycemic level, and keep it within that range. Nevertheless, patients need careful treatment with adjusted doses or infusions of short-acting insulin based on frequent blood sugar determinations throughout the perioperative periods and into the recovery phase.
Drug Interactions

Patients presenting for major back surgery have often been maintained on multiple medications for years, including opiates, antidepressants (e.g. monoamine oxidase inhibitors and selective serotonin reuptake inhibitors) and sleep medications. They typically have attended clinics and have undergone multiple therapies. They may have resorted to over the counter medications and herbal remedies. They may use narcotic patches and may have become relatively resistant to the effects of opioids.

Identification and documentation of ingested substances are essential for safe selection of the perioperative plan. Patients should be advised to discontinue the use of herbal preparations such as ginseng, garlic, gingko and ginger, all of which may interfere with coagulation. Many patients presenting for laminectomy have received steroids either as a 7-day pack to decrease swelling or as part of pain management (epidural steroid injections). While perioperative supplementation of steroids is no longer advocated, ingestion of this class of drugs should be noted to help explain hyperglycemia or cardiovascular instability intraoperatively.

Given that the patient may be well known to the pain department, it may be useful to obtain the services of a member of that group in planning developing a postoperative pain management plan.

Blood Replacement

Patients are often advised to pre-donate their blood prior to major back surgery. As a result, they may present with relative anemia. Smokers generally have a higher hematocrit and thus these patients while presenting with values of 36% or even higher may normally have values of >50%. Notation should be made of available autologous blood with a plan to replace it promptly. The availability of a cell saver technique is very important. Guidelines from the ASA note that transfusion is rarely needed when the Hb level is >10gm and almost always needed when it is <6gm. However, these numbers do not take into account the preoperative level, rate of loss or co-morbidities, especially as it pertains to cardiac function.14 Certainly, no transfusion trigger has been identified but available autologous blood should be replaced earlier. Risks of transfusion cannot be ignored and must be taken into account. 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.

Complications

Perhaps the most devastating complication after spine surgery is postoperative visual loss (POVL) due to ischemic neuropathy. In 1999, the ASA developed a registry to collect data. Findings were presented in 2006:15,16

- The cause of postoperative blindness appeared to be ischemic optic neuropathy in about 90% of cases. In only 6% (n=3) was central retinal artery occlusion diagnosed (i.e. POVL is rarely due to pressure on the eyes).
- The prone position places patients at risk. The incidence dramatically increases for prone times between 5 and 9 hours.
- Younger age does not appear to be protective as many patients are under 60 years. Occurrence
in healthier individuals suggests that intraoperative physiologic variables such as edema formation and venous congestion in the prone position as well as “normal” physiologic variation in ocular hemodynamics may be important etiologic factors.

- Measurement of intraocular pressure (IOP) over time in the prone position indicates about 100% increase over 6 hours and uniform increases from baseline of 20 +/- 7mmHg to 29 +/- 9mmHg in the initial prone position to 41 +/- 10mmHg at the end of surgery. Given this increase in IOP, decreased mean arterial blood pressure could markedly reduce ocular perfusion pressure.

- In all cases there was considerable blood loss and replacement with large volumes of crystalloid solutions.

However, several factors were not considered by the Registry initially, namely rate of blood loss and time to replacement, types and amount of fluid used, urine output, and levels of glucose and blood pressure control, especially in patients identified as hypertensive but now well controlled by combinations of beta and calcium channel blockers and angiotensin converting enzyme inhibitors. Hypertension is a disease state and recovery to blood pressure levels within a normal range does not necessarily equate to cure. Development of a compartment syndrome within the eye has been described associated with facial edema and blindness and confirmed by magnetic resonance imaging (MRI)\textsuperscript{17,18}. Dilated superior ophthalmic veins suggest that an increase in orbital venous pressure during surgery may contribute to the development of POVL\textsuperscript{19}. Concern has been raised that fluid resuscitation is over-generous and contributes to complications such as pulmonary edema, myocardial dysfunction, bacterial translocation and development of sepsis and multiorgan failure.\textsuperscript{20,21} Patients who developed postoperative blindness after lumbar surgery had very large positive fluid balances. Use of tranesophageal Doppler monitoring and/or pulse pressure variation is advised to guide fluid therapy.

Another review of risk factors has identified male sex, obesity, Wilson frame use, anesthesia duration, blood loss, and colloid as percent of non-blood replacement.\textsuperscript{22} Current recommendations include the use of a Jackson frame, staging the case if possible, earlier replacement of blood, reasonable glycemic and blood pressure control, restricting crystalloid fluids and adding colloid.

**Consent Issues**

During the preanesthetic assessment, the patient should be informed that there will most probably be a need for blood transfusion. Awake fiberoptic intubation may be indicated and the patient may require continued ventilatory support postoperatively. In practice guidelines, the ASA has recommended the placement of an arterial cannula. Placement of a central venous catheter or pulmonary artery catheter is not recommended, given the limited amount of useful information obtained from these two monitors in determining therapy.\textsuperscript{16} Anesthesiologists are also advised to tell patients that there is a low but real risk of postoperative blindness. The American College of Surgeons has been silent on this issue to date.
Indicated Tests

Several preoperative tests should be completed including:

- type and cross match blood for intraoperative use
- complete blood count to establish baseline
- coagulation profile to ensure reversal of effects of all anticoagulant medications
- room air saturation to assess pulmonary function
- appropriate cardiac evaluation depending on the patient’s status
- chest X-ray to ensure there are no infective processes that require preoperative treatment
- basal metabolic panel to obtain electrolyte and sugar levels
- creatinine clearance for renal function
- brain natriuretic peptide as further assessment of cardiac function
- carotid and deep venous Doppler scans, if indicated, to assess other vascular disease

Management of the Case

After discussion of the risks and benefits of the planned procedure, with appropriate documentation, the patient was taken into the operating room. Preemptive analgesia with gabapentin, acetaminophen and celecoxib was given. A #18 intravenous cannula was placed and the patient was induced with propofol, fentanyl and midazolam. Intubation was facilitated with succinylcholine. The left radial artery was cannulated. As evoked potential monitoring was required, anesthesia was continued with a propofol infusion and <.5 MAC sevoflurane. Vecuronium was used while maintaining 2:4 twitches. Over the 6 hour course of the case, Plasmalyte® 2.5 l was infused with albumin, 2 units. Cell saver blood was replaced early as was 1 unit of autologous blood. Near the end of the case, intravenous acetaminophen was given and the surgeon placed an epidural catheter for local anesthetic infusion. The patient was extubated and admitted to the Postanesthetic Recovery Unit. Orders were written for patient controlled analgesia with monitoring of ventilation and oxygenation. The patient’s CPAP machine was available. Approximately 4 hours later, he was transferred to the step down unit and made a full uneventful recovery.
REFERENCES

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### Post-test

1. **Indicated tests prior to multilevel laminectomy are least likely to include:**
   
   a. Type and cross for blood  
   b. Pulmonary function tests  
   c. Serum creatinine  
   d. Complete blood count

2. **Blood pressure elevation from “white coat syndrome”:**
   
   a. Can be ignored  
   b. Indicates that the case should be cancelled  
   c. Means that extra propofol should be given  
   d. May not be a benign process

3. **Topics in the preoperative discussion with a patient scheduled for a multi-level laminectomy are least likely to include:**

   a. The need for postoperative mechanical ventilation  
   b. The risk for postoperative visual loss  
   c. Likelihood of wound dehiscence and infection  
   d. The need for blood replacement

4. **The STOP BANG questionnaire does not include ____________ in the assessment.**

   a. Weight  
   b. Sex  
   c. Obesity  
   d. Renal dysfunction

5. **Further evaluation is indicated for a patient with:**

   a. Age > 75 years  
   b. Mobitz II AV block  
   c. Stable atrial fibrillation  
   d. None of the above
6. **Guidelines from the ASA regarding blood transfusion state:**
   
   a. There is a trigger of 10gm
   b. Blood should be given if the Hb falls below 8gm
   c. Transfusion is usually required if the Hb is <6gm
   d. No numbers are quoted

7. **Risk factors identified most recently for POVL include:**
   
   a. Use of the Wilson frame
   b. Male gender
   c. Positive fluid balance
   d. All of the above

8. **Postoperative visual loss is least likely to be due to:**
   
   a. Age greater than 60 years
   b. Large volume of crystalloid solutions
   c. Prone position > 5 hours
   d. Considerable blood loss

9. **Which of the following should be avoided in the postoperative management of a patient with OSA?**
   
   a. Opioids for pain management
   b. PCA with continuous background infusion
   c. Supine position
   d. All of the above

10. **A true statement regarding patients with Diabetes mellitus is:**
    
    a. DM is not common among patients with lumbar disc disease.
    b. Stress and steroids cause hypoglycemia.
    c. High blood sugar levels can increase the severity of neural damage.
    d. Over time during anesthesia, blood sugar levels drop.