

## ***Is My Patient Too Sick for a Block? Decision Making in Regional Anesthesia.***

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### **Case:**

An 85-year-old man presents to the OR for debridement and possible amputation of the second and third fingers of his left hand. He has a history of ESRD (dialyzed the morning of surgery, potassium level normal), hypertension, ischemic heart disease, severe COPD (on home oxygen continuously), and diabetes type 2, poorly controlled. He recently had an arteriovenous fistula placed in the operative arm under supraclavicular block, which he tolerated well. This morning he notes some increasing shortness of breath, and a chest x-ray from this morning shows a bilateral pleural effusion, worse since yesterday. He has been receiving norepinephrine at 5 mcg/min since dialysis yesterday to maintain mean arterial pressures of 60 mm Hg. He is febrile to 39°C, WBC is 19,000/mcL, and his arterial saturation is 92% on 2L oxygen via nasal cannula.

### **Questions:**

What are the anesthetic options for this procedure?  
What are the benefits of a regional technique?  
What are the potential dangers of regional anesthesia in this patient?  
Does the history of COPD change your approach to regional anesthesia? General anesthesia?

### **Case, continued:**

A single-shot supraclavicular block is placed under ultrasound guidance. Visualization of the pleura is difficult, but the plexus and subclavian artery are clearly imaged. Local anesthetic is clearly seen spreading around the divisions of the brachial plexus, beneath the encompassing fascial sheath. After this procedure, a field blockade of the intercostobrachial cutaneous nerve is performed without ultrasound guidance. After 15 minutes, the patient demonstrates marked deltoid and biceps weakness, and reduced sensation over the ulnar, median, and radial nerve distributions in the hand. After 30 minutes, complete blockade of the brachial plexus is observed.

### **Questions:**

What are the advantages of a supraclavicular block for this patient?  
Would a continuous technique (i.e. supraclavicular catheter) be a better choice than single-shot?

What other regional techniques would be appropriate? Advantages/disadvantages compared with supraclavicular approach?

What are the infectious risks associated with regional anesthesia?

Is sepsis a contraindication to block placement? Catheter placement?

### **Case, continued:**

While waiting in the holding area, the patient becomes anxious and diaphoretic, complaining of dyspnea and chest pain. His SpO<sub>2</sub> drops to 80% on 2L oxygen via nasal cannula, and ST-segment depression is noted in lead V on the cardiac monitor. His blood pressure drops from 120/80 mmHg to 80/45 mmHg, and he is tachycardic to 130 beats per minute.

### **Questions:**

What is the differential diagnosis?

Any further evaluation needed? What physical examination findings would be helpful?

What is the initial treatment? How would you verify treatment response?

### **Case, continued:**

The patient deteriorates further, and the diagnosis of pneumothorax is presumed. Needle decompression is performed using a 14 ga angiocatheter in the 2nd intercostal space. No immediate rush of air is noted. A chest tube is placed, with the return of 200ml straw-colored fluid. The patient is intubated without difficulty while the chest tube is being placed. His blood pressure stabilizes, and his oxygen saturation returns to 100% on an FiO<sub>2</sub> of 0.4. His operation proceeds without difficulty, and he is later extubated in the intensive care unit.

### **Questions:**

What is the optimal management of suspected pneumothorax? Incidence?

Does the use of ultrasound change the risk of pneumothorax?

How likely is diaphragmatic paralysis after supraclavicular block? Clinical significance?

Should the risk of pneumothorax be part of informed consent for regional anesthesia?

Would general anesthesia from the beginning have been a better choice? Is it safer?

### **Discussion:**

The use of ultrasound guidance in regional anesthesia has led to increased use of regional anesthetic techniques, particularly when performing blocks (such as a supraclavicular block) associated with a significant risk of complications that could be prevented with ultrasound guidance (such as pneumothorax). Further, the use of peripheral nerve blocks can eliminate the need for general anesthesia, particularly in surgical procedures such as arteriovenous fistula creation. The use of regional

anesthesia also improves postoperative pain control, and may thus allow for limitation or elimination of opioid use, which may be particularly helpful in patients with end stage renal disease. The use of regional anesthesia (peripheral nerve block or neuraxial anesthesia) in lieu of general anesthesia has been shown in some investigations to reduce the incidence of postoperative pneumonia and unplanned intubation, and this is particularly true for patients with COPD.<sup>1</sup> These advantages, coupled with advances in ultrasound technology making it more portable and user-friendly, have together led to an ever-increasing use of regional anesthetic techniques in a wide variety of surgical procedures.

The choice of the particular block technique to use depends on several factors, including surgical site, patient body habitus (and presence of obesity), the presence of interfering vascular access catheters, and also the presence of other comorbidities such as contralateral diaphragmatic paralysis or pneumonectomy. The supraclavicular approach is often chosen because of its simplicity and reliability, though measured time to effective surgical anesthesia compared to axillary and infraclavicular blocks are often similar in most studies.<sup>2</sup> The interscalene approach to the brachial plexus is associated with a much higher incidence of phrenic nerve paralysis (approaching 100%), and often spares the inferior roots of the brachial plexus, which could result in inadequate surgical coverage for procedures beyond the mid-humerus. Supraclavicular catheters are often placed for postoperative pain control in situations where significant postoperative pain is expected; in the case of uncomplicated debridement, postoperative pain would not be expected to rise to the level of that seen with orthopedic procedures such as humerus fracture repair.

Peripheral nerve blocks are not without risk, and the impact of ultrasound use on complication rates may vary depending on the complication and type of peripheral block. Neurological complications of regional anesthesia are very rare, ranging from 2.2% immediately following the surgical procedure to as low as 0-0.2% after a year.<sup>3</sup> However, the risk of nerve injury over all is not affected by the use or avoidance of peripheral nerve blockade, demonstrating the complex and multifactorial nature of perioperative nerve injury. Supraclavicular block has been associated with a risk of pneumothorax from inadvertent pleural puncture, with an incidence as high as 6.1% in some studies.<sup>2</sup> This risk declines significantly with the use of ultrasound guidance, with current estimates of risk at about 0.4 per 1000 ultrasound-guided blocks.<sup>4</sup> Diaphragmatic paralysis is much more common with interscalene blockade compared with supraclavicular blockade, but without ultrasound still may occur in up to 67% of patients after supraclavicular block. However, the use of ultrasound allows for a more posterior approach to the plexus, and may also allow for the use of lower volumes of local anesthetic, decreasing the incidence to 0-12% in some studies.<sup>2</sup>

In the absence of pneumothorax, respiratory distress leading to endotracheal intubation and mechanical ventilation may still occur. Unilateral phrenic nerve blockade leads to a decrease in FVC by as much as 25% in normal subjects, but this does not normally lead to respiratory impairment. Patients with significant pulmonary disease such as severe COPD, and clearly patients with contralateral diaphragmatic paralysis or contralateral pneumonectomy cannot tolerate phrenic nerve blockade. Morbidly obese patients may also be at risk for respiratory embarrassment following phrenic nerve blockade. Further, the spread of the local anesthetic in a cephalad fashion may result in

pareses of the scalene muscles, leading to respiratory failure in patients that are dependent on accessory muscles of respiration to maintain their required minute ventilation; this group may include morbidly obese patients without other risk factors for respiratory failure. In some case series, patients with end stage renal disease without other known or documented cardiopulmonary disease are at increased risk for respiratory failure and intubation following supraclavicular block. This risk should prompt vigilant monitoring of the patient's respiratory status and ventilation following placement of the block, and also careful assessment of the patient's airway with a plan for airway instrumentation following block placement should the need arise.<sup>5</sup>

Pneumothorax may occur despite ultrasound guidance.<sup>6</sup> Signs include progressive hypoxemia, chest pain, dyspnea, and absent breath sounds on the affected side. Importantly, these signs may be identical to those encountered in respiratory distress due to hemidiaphragmatic paralysis, and initial management should include urgent chest radiography to confirm pneumothorax if time allows. If pneumothorax is confirmed, decompression with placement of a thoracostomy tube or needle compression in the event of tension pneumothorax with imminent circulatory and respiratory collapse should commence. Serial chest radiography can be used to confirm reduction of the pneumothorax, and the patient will require inpatient management until the chest tube can be removed.

The use of regional anesthesia in patients with known systemic or local infection brings concern over the possibility of causing an abscess at the site of the block. The placement of catheters is certainly associated with the risk of infection - up to 3.2% in some studies, although the risk of clinically significant infection is probably much lower, on the order of 0.1-0.9%.<sup>7-9</sup> The duration of catheter placement (greater than 48 hours) is a consistent risk factor, along with intensive care unit stays, history of trauma, catheter location (femoral and axillary highest), hyperglycemia, and absence of antibiotic therapy. The risk of single-shot peripheral nerve block is generally considered to be less than that associated with continuous block, but serious infections related to single shot blocks have been reported, including fatal streptococcal necrotizing fasciitis after axillary nerve block.<sup>10</sup> Guidelines for performance of regional anesthetic techniques focus on maneuvers to decrease this risk that are based on the performance of neuraxial anesthetic procedures (spinal and epidural injections), and include meticulous hand hygiene, the use of sterile gloves, skin preparation with alcohol-based chlorhexidine solution, and the use of surgical masks and hair covers for the proceduralist.<sup>9</sup> Further, one clear source of infection is that associated with the infusion apparatus itself, as well as inadvertent bacterial contamination of the infusate solution due to inadequate or improper handling. Most studies specifically addressing infection associated with regional anesthesia in the setting of systemic infection have focused on neuraxial anesthesia; in most cases some association is found between dural puncture and meningitis in the setting of known systemic infection, and hence caution is advised when performing these procedures in patients with known infection and in whom treatment has not been initiated or has not been effective (i.e. no apparent reduction in fever).

In summary, the benefits of regional anesthesia are many: avoidance of positive pressure ventilation, superior pain control, limitation of opioid requirements, and improved pulmonary outcomes in some patient groups. Peripheral nerve blocks are very

safe, with the rates of some complications much reduced by the use of ultrasound. The risk of pneumothorax after supraclavicular block is very low, but not zero, and hence anesthesiologists should be vigilant for the signs and symptoms of this complication, and should remain ready to intervene should it occur. Further, supraclavicular block is not without the risk of respiratory impairment due to phrenic nerve impairment, and backup airway management should always be a part of the anesthetic plan. The risk of infection with peripheral nerve block is low, though also not zero; risk factors are many and particularly include risk factors for infection in a general sense, such as ICU stays. The choice and implementation of any anesthetic plan is always a balance between risk and benefit, and regional anesthesia is one of many tools to accomplish the same end: a safe anesthetic experience with a good surgical outcome.

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