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Perioperative management of interscalene block in patients with lung disease.

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**Perioperative Management of Interscalene Block in Patients
with Lung Disease: A Case Report and Discussion**

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Kishor Gandhi took care of the patient and helped write the manuscript.

Eugene R. Viscusi helped write the manuscript.

Abstract

Interscalene nerve block impairs ipsilateral lung function and is relatively contraindicated for patients with lung impairment. We present a case of an 89-year-old female smoker with prior left lung lower lobectomy and mild to moderate lung disease who presented for right shoulder arthroplasty and insisted on regional anesthesia. The patient received a multimodal perioperative regimen that consisted of a continuous interscalene block, acetaminophen, ketorolac, and opioids. Surgery proceeded uneventfully and postoperative analgesia was excellent. Pulmonary physiology and management of these patients will be discussed.

A risk/benefit discussion should occur in patients with impaired lung function before performance of interscalene blocks. In this particular patient with mild to moderate disease, analgesia was well managed through a multimodal approach including a continuous interscalene block, and close monitoring of respiratory status took place throughout the perioperative period, leading to a successful outcome.

1 **Introduction**

2 Impaired lung function has traditionally been considered a relative contraindication to
3 interscalene plexus block (ISB). ISB has been shown to cause ipsilateral hemidiaphragmatic
4 paresis virtually 100% of the time^{1,2} with significant decreases in several pulmonary
5 measurements.¹ Knowledge of the potential complications is critical, even if they occur rarely.
6 At the same time, opioids impair respiratory function and should be minimized if lung function is
7 tenuous.³ The elderly in particular are sensitive to the depressant effects of anesthetics and
8 medications that cause muscle weakness,⁴ especially opioids. Excellent postoperative analgesia,
9 therefore, is a key component in the prevention of postoperative pulmonary complications in this
10 population.

11

12

1 **Case Description**

2 The patient was an 89-year-old woman, American Society of Anesthesiologists Physical
3 Status 3, with hypertension, hypothyroidism, and a 58-pack-year history of smoking who five
4 years prior had undergone a left lung lower lobectomy for cancer. She was scheduled to undergo
5 a right total shoulder replacement for worsening degenerative disease and pain. Pulmonary
6 function testing performed 17 months prior to surgery revealed a FEV₁/FVC ratio of 0.68,
7 indicating mild obstructive disease, and a diffusion capacity (DLCO) of 9.5 mL/mm Hg/min,
8 indicating a moderate gas transfer defect. Physical examination revealed clear lung fields
9 bilaterally and a short hyomental distance on airway exam. Preoperative pulse oximetry on room
10 air revealed an oxygen saturation of 100%. The patient and her family wished to proceed with
11 surgery only under regional anesthesia after consulting with her primary care physician. After
12 discussion of the risks and benefits of regional anesthesia, including the possibility of impaired
13 lung function, pneumothorax on the operative side postoperatively, and mechanical ventilation
14 postoperatively, the patient agreed to surgery under a continuous interscalene nerve block
15 (CISB) with light sedation.

16 The block was performed using continuous ultrasound guidance (GE Logic E, Wauwatosa,
17 WI) and nerve stimulation (B. Braun, Bethlehem, PA). An in-plane, posterior approach
18 technique was utilized for needle insertion and visualization, based on the preference of the
19 anesthesiologist performing the procedure (Figure 1). A total of 30 mL of ropivacaine 0.5%
20 were injected incrementally after negative aspiration to the area adjacent to the C5 and C6 nerve
21 roots and a 20-g multi-orifice peripheral nerve catheter (B. Braun Medical, Inc, Bethlehem, PA)
22 was inserted 5 cm beyond the needle tip. Sensory block was confirmed with decreased pinprick
23 sensation in the C5 and C6 dermatomes. The patient was given a propofol infusion of 15-25

1 mcg/kg/min for sedation with oxygen via nasal cannula and surgery proceeded uneventfully.

2 In the postoperative anesthesia care unit (PACU) the patient had excellent analgesia.
3 Intravenous fentanyl and morphine were available but she requested no rescue opioids or other
4 medications. Close postoperative monitoring was continued on a surgical ward with frequent
5 pulse oximetry measurements. Analgesia consisted of a multimodal regimen including CISB
6 with ropivacaine 0.2% running at 8 mL/h without a demand function and ketorolac, aspirin, and
7 pregabalin, with a morphine PCA for breakthrough pain. She consumed the equivalent of
8 morphine 17.5 mg IV for breakthrough pain during the first 24 h postoperatively. She reported
9 no side effects and denied significant dyspnea while the catheter was in place, receiving no more
10 than 2 L/min of oxygen via nasal cannula as a precautionary measure during her admission. She
11 used her incentive spirometer multiple times per day. She was discharged home on
12 postoperative day #2 after the continuous interscalene catheter had been removed.

14 **Discussion**

15 *Pulmonary Function Changes after ISB*

16 Although ISB has traditionally been relatively contraindicated in those with decreased
17 pulmonary function, we presented a case of an elderly woman with prior partial lung resection
18 who experienced a successful outcome through minimizing opioids and close postoperative
19 monitoring. Urmey and McDonald¹ demonstrated that multiple indices of lung function,
20 including forced vital capacity (FVC), forced expiratory volume in one second (FEV₁), and
21 midexpiratory flow rate, are depressed when an ISB is performed. These findings have been
22 subsequently confirmed by others.^{2,5,6} Such changes are mostly due to the ipsilateral
23 hemidiaphragmatic paresis that occurs with ISB, which likely persists for greater than four

1 hours² and in one study extended to beyond eight hours post-block.⁵ The affected
2 hemidiaphragm, in fact, will move in a paradoxical (i.e. cephalad) fashion after an ISB in many
3 patients.² There is some evidence that partial compensation by the contralateral hemidiaphragm
4 may occur⁶, however, which may explain why some patients with mild respiratory impairment
5 can tolerate ISB without difficulty.

6 Phrenic nerve function is affected by the presence of a CISB, even after the primary block
7 has resolved. Pere and colleagues⁵ demonstrated that some patients will have persistent
8 impairment of diaphragm function for the duration of the continuous infusion. The implication
9 is that sending an ambulatory patient with compromised respiratory function home with a
10 continuous catheter could create a dangerous situation, and should probably be avoided. The
11 catheter for the patient described here was removed before discharge.

12 Pneumothorax following ISB is another consideration that should be discussed. Although
13 many believe pneumothorax is less likely following ISB than supraclavicular block, and a recent
14 prospective registry of more than 1,100 brachial plexus blocks (ISB and supraclavicular blocks)
15 reported no pneumothoraces,⁷ caution must still be exercised. Several recent case reports
16 document the occurrence of pneumothorax after ISB.^{8,9} Such a complication may go unnoticed
17 in a healthy patient but could have serious consequences in someone with underlying lung
18 disease or prior lung surgery. A pneumothorax could have been devastating for this patient, as it
19 would have further decreased the lung area for gas exchange, potentially to a critical level, given
20 her pre-existing moderate gas exchange defect. Extra caution and discussion of this specific risk
21 of ISB should precede its performance in a patient with prior lung resection or compromise for
22 any other reason.

1 Finally, the long-term consequences of interscalene blocks are rarely discussed but a recent
2 case series¹⁰ describing 14 patients who experienced long-term phrenic nerve paresis after ISB
3 must be taken into context and factored into each case. These patients required surgical
4 intervention to restore respiratory function. Unlike the patient in this case, all 14 patients were
5 overweight or obese males.

6 7 *Effects of Posterior versus Anterolateral Approach for the Interscalene Block*

8 The anesthesiologist performing the block used an in-plane, posterior approach in which
9 the entire needle is visualized, theoretically providing increased safety, more precise needle
10 positioning, and avoidance of the surgical field.¹¹ This was chosen based on the preference of
11 the anesthesiologist. However, the only prospective trial comparing the two approaches
12 concluded that the anterolateral (out-of-plane) approach provided more pain-free time in the
13 recovery room and easier catheter placement.¹² The issue remains unresolved but, as it applies to
14 this patient, evidence is lacking to support either technique reducing pulmonary complications.

15 16 *Effects of Digital Pressure During Interscalene Block on Pulmonary Function*

17 Digital pressure above the level of the ISB has been studied as a technique used to decrease
18 the spread of local anesthetic to the phrenic nerve. Despite initial enthusiasm, this has been
19 shown repeatedly to be ineffective.^{13,14,15}

20 21 *Effects of Reducing Local Anesthetic Volume or Concentration on Pulmonary Function*

22 Several investigators have studied the effects of decreasing the local anesthetic volume on
23 hemidiaphragmatic paresis and other respiratory parameters. The results have been inconclusive,

1 with some reporting an improvement in pulmonary function^{16,17,18} and others finding that the
2 diaphragm remains impaired.^{2,6}

3 Studies examining the effects of using dilute local anesthetic solutions suggest that doing so
4 may decrease some of the unwanted respiratory side effects.^{19,20} However, duration of analgesia
5 would likely be shorter and potentially require the addition of a continuous catheter to provide
6 adequate analgesia.

7

8 *Comparison of Risks and Benefits*

9 It has been shown that FVC, FEV₁, and total lung capacity are reduced after lung
10 lobectomy,^{21,22} which for this patient resulted in mild obstructive disease and moderate gas
11 exchange defect. Sengul et al²³ found that pulmonary compensation after lower lobectomy in
12 particular is achieved by expansion of the contralateral lung. A pneumothorax on the right
13 (surgical) side for this patient, therefore, could have been especially deleterious. However, these
14 concerns must be weighed against the pain and its detrimental effects on recovery. The benefits
15 of adequate analgesia extend past the immediate postoperative period, as poorly controlled
16 perioperative pain can lead to delayed hospital discharge and chronic pain syndromes.²⁴

17 Opioids remain an option but their unwanted side effects, in particular respiratory
18 depression, limit their effectiveness in patients with compromised lung function. Specifically,
19 opioids impair the diaphragm and thoracic muscles, decreasing functional residual capacity and
20 leading to atelectasis.³ A multimodal analgesic approach that includes regional analgesic
21 techniques, nonsteroidal anti-inflammatory drugs (NSAIDs), acetaminophen, and opioids as
22 rescue agents is ideal. The risks of ISB must be weighed against the potential respiratory effects
23 of larger doses of opioids. For the intraoperative management, the decrease in functional

1 residual capacity²⁵ and the atelectasis²⁶ that often occur under general anesthesia must be
2 considered. Finally, some data have shown that regional anesthesia may reduce the risk of
3 postoperative cognitive dysfunction in the elderly when compared to general anesthesia.²⁷

4 In summary, this 89-year-old woman was a motivated patient who understood the risks
5 involved. Despite having mild to moderate lung disease, this patient was fairly well
6 compensated and symptom-free on the day of surgery. Although this was reassuring, the
7 potential for respiratory complications was nevertheless present. We believed that the benefits of
8 regional anesthesia outweighed those of general anesthesia, taking the physiologic changes,
9 patient preferences, and our own preferences into account. Through close observation in the
10 PACU and continuing on the surgical ward, her respiratory status was maintained and clinically
11 significant dyspnea and hypoxia were avoided. We believe this was a result of maximizing non-
12 opioid agents and minimizing the consumption of opioids, encouragement of incentive
13 spirometer use, and close monitoring for any change in respiratory status.

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