

1-1-2013

Perioperative management of interscalene block in patients with lung disease.

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Recommended Citation

Schwenk, Eric S.; Gandhi, Kishor; and Viscusi, Eugene R., "Perioperative management of interscalene block in patients with lung disease." (2013). *Department of Anesthesiology Faculty Papers*. Paper 26.

<https://jdc.jefferson.edu/anfp/26>

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As submitted to:

Case reports in anesthesiology

And later published as:

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

2013:986386

DOI: doi: 10.1155/2013/986386

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Funding: Departmental funding

Conflicts of Interest: The authors declare that there is no conflict of interests regarding the publication of this article.

Consent for publication: The patient and her family gave written permission to be included in this case report.

Author Roles:

Eric S. Schwenk took care of the patient, conceived the idea for the case report, and helped write the manuscript.

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.

Introduction

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

Case Description

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

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

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

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

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

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

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

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.

References

- ¹ Urmeý WF, McDonald M. Hemidiaphragmatic Paresis During Interscalene Brachial Plexus Block: Effects on Pulmonary Function and Chest Wall Mechanics. *Anesth Analg* 1992;74:352-7
- ² Sinha SK, Abrams JH, Barnett JT, et al. Decreasing the Local Anesthetic Volume From 20 to 10 mL for Ultrasound- Guided Interscalene Block at the Cricoid Level Does Not Reduce the Incidence of Hemidiaphragmatic Paresis. *Reg Anesth Pain Med* 2011;36:17-20
- ³ Sasaki N, Meyer MJ, Eikermann M. Postoperative Respiratory Muscle Dysfunction: Pathophysiology and Preventive Strategies. *Anesthesiology* 2013;118:961-78
- ⁴ Sprung J, Gajic O, Warner DO. Review article: age related alterations in respiratory function – anesthetic considerations. *Can J Anesth* 2006;53:1244-57
- ⁵ Pere P, Pitkanen M, Rosenberg PH, et al. Effect of continuous interscalene brachial plexus block on diaphragm motion and on ventilator function. *Acta Anaesthesiol Scand* 1992;36:53-7
- ⁶ Hartrick CT, Tang YS, Siwek D, et al. The effect of initial local anesthetic dose with continuous interscalene analgesia on postoperative pain and diaphragmatic function in patients undergoing arthroscopic shoulder surgery: a double-blind, randomized controlled. *BMC Anesthesiol* 2012;12:6
- ⁷ Liu SS, Gordon MA, Shaw PM, Wilfed S, Shetty T, YaDeau JT. A Prospective Clinical Registry of Ultrasound-Guided Regional Anesthesia for Ambulatory Shoulder Surgery. *Anesth Analg* 2010;111:617-23

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- ⁸ Mandim BLS, Alves RR, Almeida R, Pontes JPJ, Arantes LJ, Morais FP. Pneumothorax Post Brachial Plexus Block Guided by Ultrasound: a Case Report. *Rev Bras Anesthesiol* 2012;62:741-7
- ⁹ Montoro E, Ferre F, Yonis H, Gris C, Minville V, Pneumothorax as a complication of ultrasound-guided interscalene block for shoulder surgery. *Eur J Anaesthesiol* 2013;30:90-4
- ¹⁰ Kaufman MR, Elkwood AI, Rose MI, et al. Surgical Treatment of Permanent Diaphragm Paralysis after Interscalene Nerve Block for Shoulder Surgery. *Anesthesiology* 2013;119:484-7
- ¹¹ Mariano ER, Loland VJ, Ilfeld BM. Interscalene Perineural Catheter Placement Using an Ultrasound-Guided Posterior Approach. *Reg Anesth Pain Med* 2009;34:60-3
- ¹² Fredrickson MJ, Ball CM, Dalgleish AJ. Posterior Versus Anterolateral Approach Interscalene Catheter Placement. *Reg Anesth Pain Med* 2011;36:125-33
- ¹³ Urmev WF, Grossi P, Sharrock NE, Stanton J, Gloeggler PJ. Digital Pressure During Interscalene Block Is Clinically Ineffective in Preventing Anesthetic Spread to the Cervical Plexus. *Anesth Analg* 1996;83:366-70
- ¹⁴ Bennani SE, Vandenabele-Teneur F, Nyarwaya JB, Delacroix M, Krivosic-Horber R. An attempt to prevent spread of local anesthetic to the phrenic nerve by compression above the injection site during interscalene brachial plexus block. *Eur J Anaesthesiol* 1998;15:453-6
- ¹⁵ Sala-Blanch X, Lazaro JR, Correa J, Gomez-Fernandez MG. Phrenic Nerve Block Caused by Interscalene Brachial Plexus Block: Effects of Digital Pressure and a Low Volume of Local Anesthetic. *Reg Anesth Pain Med* 1999;24:231-5

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- ¹⁶ Lee JH, Cho SH, Kim SH, et al. Ropivacaine for ultrasound-guided interscalene block: 5 mL provides similar analgesia but less phrenic nerve paralysis than 10 mL. *Can J Anesth* 2011;58:1001-6
- ¹⁷ Renes SH, Rettig HC, Gielen MJ, Wilder-Smith OH, van Geffen GJ. Ultrasound-Guided Low-Dose Interscalene Brachial Plexus Block Reduces the Incidence of Hemidiaphragmatic Paresis. *Reg Anesth Pain Med* 2009;34:498-502
- ¹⁸ Riazi S, Carmichael N, Awad I, Holtby RM, McCartney CJL. Effect of local anaesthetic volume (20 vs 5 mL) on the efficacy and respiratory consequences of ultrasound-guided interscalene brachial plexus block. *Br J Anaesth* 2008;101:549-56
- ¹⁹ Thackeray EM, Swenson JD, Gertsch MC, et al. Diaphragm function after interscalene brachial plexus block: a double-blind, randomized comparison of 0.25% and 0.125% bupivacaine. *J Shoulder Elbow Surg* 2013;22:381-6
- ²⁰ al-Kaisy AA, Chan VW, Perlas A. Respiratory effects of low-dose bupivacaine interscalene block. *Br J Anaesth* 1999;82:217-20
- ²¹ Bolliger CT, Jordan P, Soler M, et al. Pulmonary function and exercise capacity after lung resection. *Eur Respir J* 1996;9:415-21
- ²² Pelletier C, Lapointe L, LeBlanc P. Effects of lung resection on pulmonary function and exercise capacity. *Thorax* 1990;45:497-502
- ²³ Sengul AT, Sahin B, Celenk C, Basoglu A. Postoperative lung volume change depending on the resected lobe. *Thorac Cardiovasc Surg* 2013;61:131-7

²⁴ Joshi GP, Ogunnaike BO. Consequences of Inadequate Postoperative Pain Relief and Chronic Persistent Postoperative Pain. *Anesthesiol Clin N Am* 2005;23:21-36

²⁵ Hedenstierna G, Strandberg A, Brismar B, et al. Functional Residual Capacity, Thoracoabdominal Dimensions, and Central Blood Volume during General Anesthesia with Muscle Paralysis and Mechanical Ventilation. *Anesthesiology* 1985;62:247-54

²⁶ Strandberg A, Tokics L, Brismar B, Lundquist H, Hedenstierna G. Atelectasis during anaesthesia and in the postoperative period. *Acta Anaesthesiol Scand* 1986;30:154-8

²⁷ Mason SE, Noel-Storr A, Ritchie CW. The impact of general and regional anesthesia on the incidence of post-operative cognitive dysfunction and post-operative delirium: a systematic review with meta-analysis. *J Alzheimers Dis* 2010;22:67-79