PATIENT SURVEY OF CONTINUOUS INTERSCALENE ANALGESIA AT HOME AFTER SHOULDER SURGERY

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Brief summary statement for table of contents: Patients who went home with continuous interscalene analgesia at home were surveyed for quality of analgesia, catheter site infection, clear fluid leakage, premature catheter dislodgement, shortness of breath, residual neurological symptoms and overall comfort with this method of postoperative pain control.

Abstract

Background: The use of continuous peripheral nerve blocks at home (CPNBH) has improved patients' perioperative experience. In 30 months, 348 patients were sent home with interscalene CPNBH.

Methods: With the Institutional Review Board (IRB) approval, all patients were surveyed for quality of analgesia and complications. The patients and their caretaker received verbal and written instructions, including care of the catheter and pump, and a list of complications and side effects. All were instructed on catheter removal and were given a contact number, and patients were called once per day.

Results: 172 patients responded to this survey. The majority of patients (76%) had very good postoperative analgesia. There was a 9.3% incidence of leakage of clear fluid, a 5.8% incidence of premature dislodgement, and an 8.7% incidence of shortness of breath. Residual neurological symptoms persisted in 18.6% of responders, all resolving within two months except in one case. A large proportion (40%) required no oral analgesics, and half of the rest required less than 3 pain pills. Most (94.1%) felt comfortable removing the catheters at home by themselves or by a family member/caretaker.

Conclusion: This survey shows that CPNBH results in low pain scores and a low incidence of side effects. Many patients commented positively on their overall impression of their anesthesia care, particularly the level of attention that they received. This highlights the low incidence of those complications and neural injury.

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Introduction

Placement of continuous catheters near peripheral nerves for postoperative pain control has been shown to increase patient satisfaction[1], decrease narcotic requirements and resultant nausea and vomiting[2], improve quality of sleep[2], accelerate the rehabilitation process[3], and decrease hospital costs[4]. At the Michigan Orthopaedic Specialty Hospital, over 700 patients have been discharged with continuous peripheral nerve blocks at home (CPNBH). The majority have been those undergoing shoulder surgery and receiving a continuous brachial plexus catheter via an interscalene approach. There is one article in the literature, based on a telephone survey reviewing CPNBH from the patients' perspective, with 131 patients[5]. Of those, only 22 had interscalene catheters. The purpose of this retrospective study was to gather data on a larger patient sample and evaluate the quality of pain control and the frequency of side effects, particularly pulmonary, neurological and infectious complications.

Materials and Methods

With approval from Wayne State University's Institutional Review Board, all patients were mailed a letter and consent explaining the survey. Two weeks later, all were mailed a questionnaire (Table 1).

Table 1
Survey Questions

1 - How well was your pain controlled during the continuous infusion?
2 - Where there any catheter problems?
3 - Was there any infection, pus or drainage?
4 - Did you have any difficulty breathing?
5 - Did you have any residual numbness or tingling after catheter removal? If yes, for how long?
6 - How many pain pills did you take while the catheter was in place?
7 - When was the catheter removed?
8 - Did you feel comfortable removing the catheter at home?
9 - Would you recommend this technique?
10 - Rate your overall satisfaction.

Between March 2003 and August 2005 (30 months), 378 interscalene catheters were inserted for various shoulder procedures (Table 2).

Table 2
Types of surgeries

Types of surgeries	Total CPNB[1]	Survey responses
Open musculotendinous repairs	86	33
Shoulder arthroplasties	78	37
Open shoulder capsular repairs	39	26
Arthroscopic surgeries	148	65
Shoulder manipulation under anesthesia	27	11

1 continuous peripheral nerve blocks.

Most were sent home with CPNBH (Table 3) and 30 were removed prior to discharge (Table 4). All 348 patients who went home with CPNBH were included in this study.

Table 3
Outcome after surgery

Home on day-of-surgery with CPNBH[1]: 147
Home on POD#1[2] with CPNBH: 103
Home on PO#2[3] with CPNBH: 98
Catheter removed in-hospital prior to discharge: 30

1 continuous peripheral nerve blocks at home.
2 Post operative day one.
3 Post operative day two.

Table 4
Catheters removed prior to discharge

Ineffective pain relief: 9
Catheter inadvertently dislodged: 2
Excessive fluid leakage: 4
No pain with CPNB turned off: 4
Redness at site: 2
In-hospital till POD#3[1], so catheter removed as planned: 3
Shortness of breath: 4
Disliked feeling of numb hand: 2

1 Post operative day three.

After pre-procedure instructions to the patient in the presence of their family member/ caretaker, patients were taken into a 'block room'. With noninvasive monitoring and after intravenous sedation, all interscalene catheters were placed using the modified lateral approach[6,7]. Stimulating catheters (Stimucath®, Arrow International, Reading, PA) were used for all cases. No solution was injected through the needle. All catheters were threaded 4-5 cm beyond the needle tip with continuous stimulation and tunneled subcutaneously toward the midline. Just before securing the catheters, the patient's family member/caretaker was brought into the 'block room',

to observe the taping process and learn about removal of the catheter. These were secured with Mastisol® liquid adhesive (Ferndale Laboratories, Ferndale, MI), SutureStripPlus® flexible wound closure strips (Derma Sciences, Princeton, NJ) and covered with a Tegaderm® (3M Corporation, St. Paul, MN). Catheter hubs were attached to the contralateral chest wall with a StatLock® (Venetec International, San Diego, CA). After a test dose of local anesthetic with epinephrine, all patients received an initial bolus through the catheter, with 40 ml mepivacaine 1.5% with epinephrine 1:400,000.

Prior to discharge, all patients received prescriptions for a nonsteroidal anti-inflammatory medication, an oral opioid and a stool softener. All postoperative home infusions consisted of bupivacaine 0.125%. All disposable home pumps were manufactured by I-Flow (Lake Forest, CA). Before March 2004, all patients were sent home with a pump delivering a fixed rate of 5 ml/hr, except those with adhesive capsulitis of the shoulder who were scheduled for outpatient physical therapy, as they received a pump with 5 ml/hr and patient-controlled boluses of 5 ml with a 60-minute lockout. After that date, patients with open shoulder procedures were sent home with a variable-rate pump capable of delivering a rate of zero to 14 ml/hr, in increments of 2 ml/hr, at the patient's discretion.

Patients and their caretakers received verbal and written instructions regarding the care of the catheter and pump. This included a list of complications and side effects, emphasizing catheter site infection, local anesthetic toxicity, shortness of breath and hand numbness. All were instructed on catheter removal and were given a contact number for the anesthesiologist-on-call. All patients were called once per day, including the day after catheter removal, with a list of specific questions (Table 5).

Table 5
Daily telephone follow-up

What is your pain level?
Do you have any nausea and/or vomiting?
Are you too sleepy/too groggy?
Do you have any shortness of breath?
Is the catheter site leaking?
Is there any swelling, redness, or bleeding at the catheter site?
What part of the limb is numb?
Is the "dead" feeling bothering you?
Any other concerns?
Additional questions after removal at home:
Were there any difficulties with catheter removal?
Did you see the silver-colored spring at the tip of the catheter?

Results

Thirty catheters were removed prior to discharge, because of the reasons listed in Table 4. Of the 348 patients who went home with CPNBH, 172 responded

Table 6
Responses to survey

Total responses:	172	Male: 76	Female: 96		
Age:	40 or less: 31	40-60: 74	61-80: 61	Over 80: 6	
VAS during CPNBH:	0-3: 131	4-7: 28	8-10: 13		
Catheter problems:	Leaking: 16	Dislodged: 10			
Other problems:	Subjective feeling of shortness of breath: 15	Residual neurologic symptoms: 32	Infection, pus, drainage: 0		
Neurologic symptoms lasted:	1 week or less: 19	2-4 weeks: 6	1-2 months: 6	More than 2 months: 1	
Catheter removal:	By self or family: 170	By doctor: 2			
Pain pills used:	None: 69	1-3 pills: 51	4-6 pills: 29	7-10 pills: 14	More than 10 pills: 9
Catheter removed:	POD # 0-1[1]: 23	POD#2-4[2]: 149			
Comfortable removing catheter at home:	Yes: 162	No: 10			
Overall satisfaction:	Very satisfied: 133	Somewhat satisfied: 25	Not satisfied: 14		

1 Post operative day zero to one.
2 Post operative day two to four.

to this survey, for a 49.4% response rate. Table 6 lists their answers.

The majority of patients (76%) had very good postoperative analgesia. There was a 9.3% incidence of leakage of clear fluid at the catheter site. Despite this taping and anchoring technique, the catheters were prematurely dislodged in 5.8% of cases. Fifteen patients (8.7%) had a subjective feeling of shortness of breath. Twelve hours after catheter removal, 32 patients (18.6%) had residual neurological symptoms, including tingling, 'pins and needles' and numbness. All resolved within two months, except one case. A large proportion (40%) required no oral analgesics, and half of those who took any breakthrough medications required less than 3 pain pills. Most catheters (86.6%) were removed between POD#2 and POD#4, and most patients (94.1%) felt comfortable removing the catheters at home by themselves or by a family member/caretaker.

Discussion

This survey shows that CPNBH is safe, with low pain scores and a low incidence of side effects. A recent meta-analysis of nineteen randomized controlled trials found that, compared to parenteral opioids, CPNB analgesia results in statistically and clinically significant improvements in pain control and decreases the opioid-related side effects of nausea/vomiting, sedation and pruritus[8]. With improvements in the major anesthetic morbidities of death and hypercoagulable states, there is a new focus on these very issues, also called patient-centered nontraditional outcomes, or 'minor' morbidities[9].

Bupivacaine was chosen over ropivacaine because of cost: At our Institution, there is a ten-fold difference in the cost of 500ml ropivacaine 0.2% versus 500ml bupivacaine 0.125% ($70.00 versus $7.00 respectively). At these concentrations, the argument for using ropivacaine is not its cardiac safety profile, since the blood concentrations achieved with this dilute bupivacaine are safe[10]. Instead, the issue is that of neurologic sequelae: Ropivacaine preferentially blocks sensory fibers over motor fibers[11] and causes less hand numbness with continuous interscalene analgesia[12]. It is less myotoxic than bupivacaine in bolus form[13]. However, it is unclear whether at these concentrations and drip rates, ropivacaine may have resulted in less long-term neurologic sequelae.

This series shows no cases of infection. However, two patients had some redness at the insertion site and had their catheters removed prior to discharge. In the literature, there is a high incidence of catheter colonization[14,15], but only a total of five cases of catheter infection after peripheral nerve blocks[7,15-18], four of whom were diabetic.

The disposable home infusion pumps were all from the same manufacturer (I-Flow, Lake Forest, CA). It seems that a fixed rate of 5 ml/hr is adequate for interscalene analgesia. After the rate-variable pump became available, most patients used a setting of 4 or 6 ml/hr. Some chose to decrease the infusion rate in the daytime, accepting mild discomfort but avoiding hand numbness, and they would increase the rate at night, so they can sleep without pain. There is no consensus in the literature on the ideal infusion rate or the need for intermittent boluses. The stimulating catheters may allow for slower rates and therefore may render many of the studies with nonstimulating catheters obsolete[19].

The incidence of leakage of clear fluid was 9.3%. Adding the four cases of leakage among those 30 patients whose catheters were removed prior to discharge, the incidence increases to 9.9%. This is slightly lower than that reported by others[2,5] and may be related to the low rate of infusion with stimulating catheters, or the ability to thread a stimulating catheter further from the insertion site, or that tunneling decreases leakage[20].

The incidence of accidental dislodging of catheters was 5.8% (increases to 5.9% by adding the two that were dislodged while inpatient). This incidence is lower than in previous reports[5,15] and will probably continue to decrease with the ongoing development of new anchoring techniques and liquid adhesives.

Four catheters (1.05% of 378 patients) were removed before discharge because of shortness of breath, and fifteen patients (8.7%) had a subjective feeling of shortness of breath. Unlike others[15], no patients developed acute respiratory failure requiring admission to the intensive care unit. There are rare case reports of pulmonary complications after continuous interscalene blocks[21,22]. These may be related to phrenic nerve paresis. A study using the paresthesia technique

found an incidence of 100% phrenic nerve paresis with single-shot interscalene blocks[23]. Newer work shows a lower incidence with the nerve stimulator technique and an even lower incidence with injections through a catheter[24], perhaps because the latter allows injection at a more distal site[1]. In the only study of the effects of continuous interscalene analgesia with 0.125% bupivacaine on pulmonary function, the infusion was stopped after 24 hours, at which point ipsilateral hemidiaphragmatic motility was at 50% of preoperative values, yet pulmonary function tests (forced vital capacity, forced expiratory volume in one second and peak expiratory flow) were only decreased by 10%. The author suggested that the loss of diaphragmatic function on one side is compensated by all other respiratory muscles, resulting in this minimal decrease in pulmonary function[25]. Although there is no study comparing the effects of CPNBH with bupivacaine and ropivacaine on phrenic nerve and pulmonary function, similar results have been found with ropivacaine, along with the same compensatory increased activity of the contralateral hemidiaphragm[1].

Ilfeld and Enneking[19] have pointed out that, in the process of moving this method of pain control from an in-patient to an outpatient setting, one must be mindful of complications, as they may become more difficult to treat at home. This is where the initial use of mepivacaine 1.5% helps identify those patients where respiratory compromise may become symptomatic. If there is a complaint of subjective feeling of shortness of breath, the block wears off sooner than with a long-acting local anesthetic and the catheter can be removed, thus avoiding a prolonged period of respiratory compromise. There is another patient population who benefits from using mepivacaine: Those undergoing total shoulder arthroplasty, where there is a need to assess the integrity of the brachial plexus after surgery. The block is used to decrease intraoperative anesthetic requirements and wears off early in the postanesthesia recovery room where, after post surgical confirmation of neuromuscular integrity, additional local anesthetics can be given.

Thirty patients (18.5%) reported residual neurological symptoms after catheter removal, with complete resolution within two months in all except one case. That patient had prolonged numbness in the radial distribution, which resolved completely after 5 months. She had excessive numbness throughout the infusion period and was not reached via telephone until her fourth postoperative day. Typically, at this Institution, patients with excessive hand numbness are instructed to intermittently clamp the pump tubing. As discussed above, it is unclear whether the use of ropivacaine may have decreased this problem. This neural deficit in one patient results in an incidence of 0.26%, similar to findings by others[7,15]. Preexisting neurological deficits, perioperative positioning and surgical traction may have contributed to this, in what has been termed the 'double-crush injury'[26].

Ten patients (7.5%) reported they were "not comfortable" removing the catheter at home, and would have preferred to return to the hospital for this, and two patients did return. This is similar to the results of Ilfeld et al[5], where two of their 22 patients (9%) with interscalene catheters preferred to return for removal.

Fourteen patients were not satisfied with their care. This was not intended to be a 'satisfaction study', since that portion of the survey was limited to a single global rating. In general, patient satisfaction is multifactorial and includes emotional, cultural, psychological and cognitive elements, and a more detailed psychometric questionnaire would have been required to measure satisfaction[27]. Nevertheless, this low rate may reflect the active involvement of the anesthesiologists in the patients' perioperative care. Many patients commented positively on their overall impression of their anesthesia care, with comments about the level of preoperative attention that they received, the postoperative teaching and the daily follow-up phone calls.

This is a retrospective patient survey and therefore not as reliable as a prospective randomized study. It is an attempt to highlight current practice at this Institution, with the low incidence of those complications that are most worrisome to the anesthesia community: Infection, pulmonary complications and neural injury[28]. There are no guidelines on CPNBH. For instance, some prefer to wear a sterile gown[15], some use non-stimulating catheters[1], some prefer ropivacaine[2], some coach their patients on catheter removal while simultaneously on the phone with them[5]; there is no consensus on infusion rate or the need for patient-controlled boluses, or the length of time catheters can be left in place. At this

time, anesthesiologists go by their own Institutional preferences.

In conclusion, this survey reaffirms that CPNBH is safe and has few side effects. It reinforces the need for daily contacts with patients and ties in with the anesthesiologist's role as the perioperative physician who cares about the patient-centered morbidities[9] of improved postoperative pain, decreased nausea, improved quality of sleep, and improved rehabilitation.

References

1. Borgeat A, Perschak H, Bird P, Hodler J, Gerber C: Patient-controlled interscalene analgesia with ropivacaine 0.2% versus patient-controlled intravenous analgesia after major shoulder surgery. *Anesthesiology;* 2000, 92:102-8.
2. Ilfeld BM, Morey TE, Wright TW, Chidgey LK, Enneking FK: Continuous interscalene brachial plexus block for postoperative pain control at home: A randomized, double-blinded, placebo-controlled study. *Anesth Analg;* 2003, 96:1089-95.
3. Capdevila X, Barthelet Y, Biboulet P, Ryckwaert Y, Rubenovitch J, D'athis F: Effects of perioperative analgesic technique on the surgical outcome and duration of rehabilitation after major knee surgery. *Anesthesiology;* 1999, 91:8-15.
4. Williams BA, Kentor ML, Williams JP, Figallo CM, Sigl JC, Anders JW, Bear TC, Tullock WC, Bennett CH, Harner CD, Fu FH: Process analysis in outpatient knee surgery. Effects of regional and general anesthesia on anesthesia-controlled time. *Anesthesiology;* 2000, 93:529-38.
5. Ilfeld BM, Esener DE, Morey TE, Enneking FK: Ambulatory perineural infusion: The patient's perspective. *Reg Anesth Pain Med;* 2003, 28:418-23.
6. Borgeat A, Ekatodramis G: Anaesthesia for shoulder surgery. *Best Pract Res Clin Anaesthesiol;* 2002, 16:211-25.
7. Borgeat A, Dullenkopf A, Ekatodramis G, Nagy L: Evaluation of the lateral modified approach for continuous interscalene block after shoulder surgery. *Anesthesiology;* 2003, 99:436-42.
8. Richman JM, Liu SS, Courpas G, Wong R, Rowlingson AJ, McGready J, Cohen S, Wu C: Does continuous peripheral nerve block provide superior pain control to opioids? A meta-analysis. *Anesth Analg;* 2006, 102:248-57.
9. Wu CL, Fleisher LA: Outcomes research in regional anesthesia and analgesia. *Anesth Analg;* 2000, 91:1232-42.
10. Tuominen M, Haasio J, Rosenberg P: Continuous interscalene brachial plexus block: Clinical efficacy, technical problems and bupivacaine plasma concentrations. *Acta Anesthesiol Scand;* 1989, 33:84-8.
11. Bader AM, Datta S, Flanagan H, Covino BG: Comparison of bupivacaine and ropivacaine-induced conduction blockade in the isolated rabbit vagus nerve. *Anesth Analg;* 1989, 68: 724-27.
12. Borgeat A, Kalberer F, Jacob H, Ruetsch YA, Gerber C: Patient-controled interscalene analgesia with ropivacaine 0.2% versus bupivacaine 0.15% after major open shoulder surgery: the effects on hand motor function. *Anesth Analg;* 2001, 92: 218-23.
13. Zink W, Sef C, Bohl JRE, Hacke N, Braun PM, Sinner B, Martin E, Fink RHA, Graf BM: The acute myotoxic effects of bupivacaine and ropivacaine after continuous peripheral nerve blockades. *Anesth Analg;* 2003, 97:1173-9.
14. Cuvillon P, Ripart J, Lalourcey L, Veyrat E, L'Hermite J, Boisson C, Thouabtia E, Eledjam JJ: The continuous femoral nerve block catheter for postoperative analgesia: Bacterial colonization, infectious rate and adverse effects. *Anesth Analg;* 2001, 93:1045-9.
15. Capdevila X, Pirat P, Bringuier S, Gaertner E, Singelyn F, Bernard N, Choquet O, Bouaziz H, Bonnet F: Continuous peripheral nerve blocks in hospital wards after orthopedic surgery. *Anesthesiology;* 2005, 103:1033-45.
16. Bergman BD, Hebl JR, Kent J, Horlocker TT: Neurologic complications of 405 consecutive continuous axillary catheters. *Anesth Analg;* 2003, 96:247-52.
17. Adam F, Jaziri S, Chauvin M: Psoas abscess complicating femoral nerve block catheter. *Anesthesiology;* 2003, 99:230-1.
18. Nseir S, Pronnier P, Soubrier S, Onimus T, Saulnier F, Mathieu D, Durocher A: Fatal streptococcal necrotizing fasciitis as a complication of axillary brachial plexus block. *Br J Anaest;* 2004, 92:427-9.
19. Ilfeld BM, Enneking FK: Continuous peripheral nerve blocks at home: A review. *Anesth Analg;* 2005, 100:1822-33.
20. Ekatodramis G, Borgeat A: Subcutaneous tunneling of the interscalene catheter. *Can J Anaesth;* 2000, 47:716-7.
21. Souron V, Reiland Y, Delaunay L: Pleural effusion and chest pain after continuous interscalene brachial plexus block. *Reg Anesth Pain Med;* 2003, 28:535-8.
22. Sardesai AM, Chakrabarti AJ, Denny NM: Lower lobe collapse during continuous interscalene brachial plexus local anesthesia at home. *Reg Anesth Pain Med;* 2004, 29:65-8.
23. Urmey WF, Talts KH, Sharrock NE: One hundred percent incidence of hemidiaphragmatic paresis associated with interscalene brachial plexus anesthesia as diagnosed by ultrasonography. *Anesth Analg;* 1991, 72:498-503.
24. Boezaart AP, deBeer JF, duToit C, van Rooyen K: A new technique of continuous interscalene nerve block. *Can J Anaesth;* 1999, 46:275-81.
25. Pere P: The effects of continuous interscalene brachial plexus block with 0.125% bupivacaine plus fentanyl on diaphragmatic motility and ventilatory function. *Reg Anesth;* 1993, 18:93-7.
26. Upton AR, McComas AJ: The double crush in nerve entrapment syndromes. *Lancet*; 1973, 2:359-62.
27. Fung D, Cohen MM: Measuring patient satisfaction with anesthesia care: A review of current methodology. *Anesth Analg;* 1998, 87:1089-98.
28. Klein SM: Continuous peripheral nerve blocks: Fewer excuses. *Anesthesiology;* 2005, 921-3.