INTERSCALENE BLOCK ANESTHESIA AT A AMBULATORY SURGERY CENTER

PERFORMING PREDOMINATELY REGIONAL ANESTHESIA:

A Prospective study of 133 patients undergoing shoulder surgery.

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Running Title: Complication with ISB anesthesia in Shoulder Surgery.

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ABSTRACT

Introduction: Interscalene brachial plexus block (ISB) is frequently used for patients undergoing ambulatory shoulder surgery. We previously reported that the incidence of postoperative complaints (neuropraxia) after an ISB was low (3% at 2 weeks), but objective neurological assessment was not included in the study. The present study combines subjective findings with both preoperative and postoperative objective sensory and motor assessments following an ISB.

Methods: We prospectively evaluated 133 patients undergoing elective ambulatory shoulder surgery.   ISB anesthesia was accomplished using 1.5% mepivacaine alone or in combination with bupivacaine (0.5-0.75%) using a paresthesia technique and a 23g needle. All of the blocks were performed by experienced anesthesiologists (performing ~150 ISBs/physician/year). Number of passes with the needle, site of paresthesia, ease of performing the block, and success of the ISB were recorded for each patient. Neurological assessment was performed preoperatively and up to two weeks postoperatively by one of four health care professionals, but not by the anesthesiologists who performed the ISB and included: diminished sensation; localized nerve pain; Semmes-Weinstein monofilament pressure threshold sensibility; Weber static 2-point discrimination; and grip strength changes. Patients with postoperative changes were followed until resolution of symptoms.

Results: Successful surgical anesthesia was achieved for 98% of the patients. There was one major perioperative complication (0.7%), a seizure that occurred within 5 minutes of the ISB. Two patients (1.4%) complained of transient postoperative neuropraxias. One patient had dysesthesias on the posterior aspect of the arm to the elbow with resolution by 9 days postoperatively. The other patient developed paresthesias over the dorsum of her

thumb, which resolved after 2 months. Neither patient had any changes in objective

sensory and motor measurements. Hence, there was no correlation between subjective

complaints and objective findings in this study.

Conclusion: This study demonstrates that in the hands of anesthesiologists doing

predominately regional anesthesia, there is a 1.4% incidence of neurological

complications following ISB. ISB is a safe and effective technique for patients

undergoing ambulatory shoulder surgery when an anesthesiologist experienced with

regional anesthesia is involved.

INTRODUCTION

Despite multiple studies outlining the benefits of interscalene brachial plexus block (ISB) anesthesia compared to general endotracheal anesthesia (GETA), ISB anesthesia has not gained wide acceptance [1, 6, 12, 17]. Many anesthesiologists believe it is often inadequate for surgical anesthesia and fear postoperative neuropraxias [15]. However, ISB offers several advantages over GETA [1, 6, 12, 17]: postoperative analgesia from long-acting local anesthetics, avoidance of intubation (which can be difficult in the arthritic population), and lower incidence of postoperative nausea and vomiting.

Major complications of ISB anesthesia are uncommon, and include: pneumothorax with respiratory arrest; intravascular injection with seizure or cardiac arrest; epidural or spinal anesthesia; and permanent neurologic injuries [2, 8, 10, 11, 13, 16, 20]. More commonly, transient neuropraxias occur, possibly due to anesthetic toxicity, ischemia, hematoma, or direct nerve injury from the needle [14, 15, 18]. Transient Horner's syndrome, hoarseness, and ipsilateral phrenic nerve paralysis are common and generally without sequellae.

At our institution, ISB is the primary anesthesia used for shoulder surgery (1500 cases/year). The purpose of this study was to evaluate the efficacy of ISB anesthesia for ambulatory shoulder surgery patients and the incidence of postoperative neuropraxias. We hypothesized that the neurologic complication rate would be higher, when documenting pre- and post-operative objective and subjective neurologic function, than that reported in our previous study, which collected only postoperative subjective data.

METHODS

After institutional approval, we prospectively evaluated a convenience sample of

133 patients undergoing elective ambulatory shoulder surgery with interscalene block

anesthesia (ISB) from September 2000 to July 2001.   Patients were recruited and

consented on the day of their surgery. Procedures included: subacromial decompression;

rotator cuff repair and debridement; open and arthroscopic stabilization; and labral repair

and debridement. Patients undergoing procedures that had a potentially higher incidence

of neurologic injury (eg. manipulation under anesthesia or a capsular release), and those

patients with diabetes mellitus, neurologic diseases, and cervical radiculopathy were

excluded from the study but did receive the same anesthesia options under informed

consent.

Anesthesiologists experienced with the technique (~150 ISB/physician/year)

performed or assisted less experienced anesthesiologists with the ISB. Twenty-five

anesthesiologists were involved. The paresthesia technique described by Winnie [22] was

utilized in unpremedicated patients. A 23-gauge 1-inch standard disposable needle was

inserted into the interscalene groove (between the anterior and middle scalene muscles) at

the level of the cricoid cartilage, and advanced inferiorly, posteriorly, and medially. At

the first elicited shoulder, arm, or hand paresthesia, 55 ± 8cc of bicarbonated 1.5%

mepivacaine (10mg kg^{-1}) with epinephrine ($1/200,000$) alone or with 10cc of 0.75 %

bupivacaine (<2 mg kg^{-1}) (total local anesthetic volume ~55cc) was injected [18].

Intraoperatively all patients were monitored with an ECG, blood pressure cuff, and pulse

oximetry and received oxygen by nasal cannula. Patients were sedated with midazolam,

fentanyl, and propofol after assessing the quality of the block [18].   The anesthesiologist

recorded the following information at the time of block administration: type and volume

of local anesthetic used, number of needle advances, site of paresthesia, success and ease

of performing the ISB, and immediate complications to the block. Following the

operation, the anesthesiologist evaluated the patient for hoarseness and Horner's

syndrome.

Perioperative complications were classified as local anesthetic toxicity (seizure)

and failed block (defined by inadequate anesthesia to perform procedure within 30

minutes of injection).   If the ISB was deemed a failure, the patient underwent general

anesthesia, a second block, or sedation.

Neurological assessment was performed preoperatively and during postoperative follow-up

visits (~14 days after surgery) in the outpatient clinic by one of four health care professionals

(excluding the anesthesiologists) using both objective and subjective criteria. Objective sensory

testing included threshold sensibility with Semmes-Weinstein monofilaments for axillary,

musculocutaneous, radial, median, and ulnar nerve distributions, and Weber static two point

discrimination (S2PT) for median and ulnar distributions for S2PT. Objective motor testing

included bilateral Jamar grip strength. Subjective assessment included paresthesias, dysesthesias,

hoarseness, and pain and bruising at the ISB site. Patients with postoperative complaints of

paresthesias or dysesthesias or objective neurological deficits were followed until resolution of

symptoms. Descriptive statistics were run on all variables. In most cases the complications were

too few for an analysis to have any statistical power. Associations between demographic data and

complications were assessed using students t-test, Pearson's chi-squared analysis or the non-

parametric Mann-Whitney and Kruskal-Wallis tests as appropriate.

RESULTS

During the 10-month study period (September 26, 2000 to July 31, 2001), 133

patients undergoing ambulatory shoulder surgery with ISB were included. Complete

objective data was collected on 126 patients and subjective postoperative data via

telephone was collected on the remaining seven patients.

Demographics are outlined in **Table 1**. There were 97 males and 36 females with

a mean age of 43 ± 17 years. Sixteen patients had had prior surgery on the operated side

and 10 had a prior ISB. Six patients had a prior neck injury. There were no statistical

correlations between demographic data and developing a complication with ISB

anesthesia.

The anesthesia specifics are outlined in Table 2. The majority of the patients

received only 1.5% Mepivacaine as the anesthetic, however 35% also received the longer

acting local anesthetic bupivacaine which in contrast to a previous report [18] was not

associated with an increased risk of neurological complications. An average of two

needle advances (range 1-8) were required to elicit the preferred paresthesia; with 70% of

the paresthesias elicited in the shoulder region. The majority of patients developed

perioperative hoarseness (68%) and Horner's syndrome (59%), which all resolved within

a day.

Successful surgical ISB anesthesia was achieved in 130 patients (98%). Of the

three failures one patient required general anesthesia after multiple failed attempts at ISB

(this was the only patient that received GETA in our study); the second had a successful

second ISB after 30 minutes, and the third required intensive monitored sedation after

seizing. There was one major perioperative complication (0.7%), a seizure from an

intravascular injection of the local anesthetic. Postoperatively, six patients complained of

paresthesias and eight of dysesthesias; only two (1.4%) of which were new onset; that is,

twelve of these patients complained of the same neurologic symptom preoperatively. One patient (0.7%) complained of dysesthesias on the posterior aspect of the arm with resolution by 9 days. The other patient (0.7%) developed paresthesias over the dorsum of her thumb, which resolved after 2 months. Neither patient demonstrated changes in objective sensory measurements. Twenty-four patients (18%) developed neck pain and 13 patients (10%) had neck bruising. There was no correlation between neck pain, bruising, or number of needle passes with postoperative subjective or objective paresthesias or dysesthesias. Both major (seizure) and minor (dysesthesias, paresthesias, neck pain and bruising) complications resolved completely.

  Tables 3, 4, and 5 outline the objective sensory data results for the monofilaments, two-point discrimination and grip strength. There was no correlation between objective sensory findings and subjective complaints. Furthermore, those patients with decreased objective sensory findings with S2PT did not necessarily have significant decreased sensory findings with the monofilaments. Similarly, patients with decreased objective sensory findings did not necessarily have decreased motor (grip strength) findings. No correlation existed between these data. It is interesting that some patients' objective sensory and motor scores actually improved. This may be due to memory of the preoperative test and improvement with repeated testing.

DISCUSSION

At this institution, ISB anesthesia was a safe and effective technique for ambulatory shoulder surgery patients with a success rate of 98%. This is a higher success rate than reported by others [1, 7, 17, 21]. Our major complication rate was low, comprising one seizure (0.7%). This complication rate is lower than previously reported [5, 7, 18, 21]. Our minor complication rate was 29.4% consisting mainly of and two neuropraxias (1.4%) and neck pain and bruising (28%).

Two retrospective and three prospective studies addressed neurologic complications associated with ISB anesthesia [4, 5, 7, 18, 21]. In one retrospective study, Weber et al. [21] reviewed ISB anesthesia in the community setting over a three-year period. In this sample, 218 patients underwent ISB anesthesia using a nerve stimulator technique. Eighty-two percent of patients required GETA despite use of ISB anesthesia. There was a 3.6% rate of major complications, and two patients had neuropraxias at six week. The authors felt many transient neuropraxias were missed due to the retrospective data collection. Included in this publication was a survey of all American Shoulder and Elbow Surgeons (ASES) members regarding their experience with ISB anesthesia and neuropraxias: ASES orthopedists reported 57 transient neuropraxias and 25 permanent neuropraxias (seven of these leading to litigation against the orthopedist).

In contrast, the other retrospective study was from an academic institution. Conn et al. [5] reported an 82% success rate for 100 patients with the paresthesia technique. They had 4% major complications including three cases of respiratory depression and one seizure. Two patients had postoperative neuropraxias: a C7 radiculopathy at 18 months and a median nerve neuropraxia at seven months.

The three prospective studies collected subjective data only in the postoperative period. In the first study, Urban and Urquhart [18] studied 226 patients with either the

nerve stimulator or paresthesia technique. Their success rate was 97% with no major

complications. Two patients experienced local anesthetic toxicity but neither progressed

to seizure or cardiac arrest. At two weeks, 3% of patients had persistent neurologic

symptoms, with complete resolution in all but one by 6 weeks. This patient's symptoms

resolved after an ulnar nerve transposition. The risk of neuropraxia was associated with

combining bupivacaine with the local anesthetic, using a nerve stimulator, and eliciting

posterior paresthesias. The authors speculated that several factors might have contributed

to these complications. First, adding bupivacaine extended the block time and, thus the

risk of nerve compression (especially while the patient is in a sling) without the patient

being aware. Other factors relate to increased trauma to the nerves during needle

probing. Posterior paresthesias are associated with a higher anesthetic failure rate, and,

thus, are accepted as a last resort for ISB anesthesia. Hence, in these patients more

needle probing may have occurred before the posterior paresthesia was used for injection

of the local anesthetic. However, an association between the number of needle advances

and postoperative neuropraxias could not be demonstrated in this or the current study.

Urmey et al. [19] recently demonstrated that the use of a peripheral nerve stimulator (PNS)

may actually cause more nerve trauma than using the paresthesia technique even though

this is the accepted practice at most institutions. They found that in patients in whom

paresthesias had been elicited with a PNS needle, 15 out of 20 patients had no motor

response when the PNS was turned on at 0.1 m Amp and increased to 1.0 m Amp.

The remaining two prospective studies both used the PNS technique. Fanelli et

al. looked at 171 patients undergoing ISB and reported a 4% transient neurologic

dysfunction, which resolved by seven weeks. Ekatodramis el al. divided their patients

into ISB and interscalene catheter with 287 and 234 patients, respectively. They found

no increase in neuropraxias using the catheter. At 10 days, 14% of their patients had

neuropraxias, which decreased to 4 % by three months. One patient was still

symptomatic at nine months. EMG studies were performed on symptomatic patients at

one and three months. Most of the studies were normal; however, 25% had identifiable

pathology at 3 months (carpal tunnel syndrome, sulcus ulnaris syndrome, complex

regional pain syndrome) and 40% at 3 months (carpal tunnel syndrome, complex regional

pain syndrome, plexus damage, and neuropathy). They had two major complications:

pneumothorax and seizure.

This is the first study to prospectively collect objective data in addition to the

subjective questions asked by the previous studies, and the first to collect data both pre-

and postoperatively. While eight patients reported postoperative neurologic symptoms,

only two patients actually had a change from their preoperative state. No correlations

were found between objective and subjective postoperative data or between objective

sensory and motor data. Lack of correlation between these data may be due to the lack

of severity and infrequent occurrence of neurologic complications with ISB as greater

correlation has been found with axillary block anesthesia (where incidence and severity

of neurologic complications is higher) [9].

These neuropraxias have been attributed to ISB anesthesia; however, other factors

may have contributed. It is common practice at our institution to use an arm holder in the

"beach chair" position. Traction could have been a factor since the neuropraxias were all

around the thumb. In addition, surgery itself is known to have its share of neurologic

injuries. This study excluded those procedures with higher neurologic risks

(manipulations and capsular releases). However, Boardman and Cofield [3] reported a

comprehensive review of the literature and found neurologic injuries in 1% to 2% of

patients undergoing rotator cuff surgery and 1% to 8% of patients undergoing surgery for

anterior instability.

CONCLUSION

At our institution where there is a predominance of regional anesthesia performed, ISB was associated with a 1.4% incidence of neurological complications. Our major complication rate was 0.7% (a seizure) and our minor complication rate was 28% (neck pain and bruising). In conclusion, ISB is a safe and effective technique for patients undergoing ambulatory shoulder surgery in the hands of an anesthesiologist experienced in regional anesthesia.

ACKNOWLEDGMENTS

TABLES

Table 1: Demographics (N=133)

Age (years)	43 ± 17
Male (n)	97 (73%)
Height (inches)	69 ± 7
Weight (pounds)	176 ± 39
Right-hand dominant (n)	119 (89 %)
Right sided (n)	76
Past shoulder surgery (n)	16
Past ISB (n)	10
Past neck injury (n)	6

Table 2: Anesthesia Data

Mepivacaine only (n)	86 (65%)
Volume (cc)	55 ± 8
Needle advances (n)	2 ± 1.4
Paresthesia region (shoulder) (n)	93 (70%)
Ease (Easy) (n)	69 (52%)
Block duration (hours)	8.4 ± 6.4
Hoarseness (n) †	91 (68%)
Horner's syndrome (n) †	78 (59%)
Effective block (n)	130 (98%)

† Resolved immediately postoperatively

Table 3: Two-Point Discrimination

Distribution (>2mm)†	Better	Worse
Median (n)	4	3
Ulnar (n)	4	10

† Those patients with a pre- and postoperative S2PT discrimination difference of greater than 2 mm. p=0.4 (Mann-Whitney test)

Table 4: Monofilament Sensory Changes†

Distribution	Better	Worse
Axillary (n)	10	3
Musculocutaneous (n)	7	2
Radial (n)	7	0
Median (n)	0	0
Ulnar (n)	0	0

† Those patients with a pre- and postoperative difference of greater than one monofilament diameter. $p=0.5$ (Kruskal-Wallis test)

Table 5: Grip Strength Changes (>5kg) †

Side	Better	Worse
Right (n)	21	26
Left (n)	30	14

† Those patients with a pre- and postoperative difference of greater than 5 kg.

p=0.04 (Mann-Whitney test).

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