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Anesthesia Related Outcomes in Patients Receiving Regional Anesthesia for Shoulder Surgery in a CRNA-Only Practice In the Rural Setting

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Abstract

The purpose of this retrospective chart review was to characterize the complication rate and outcomes among a group of patients receiving regional anesthesia (RA) undergoing shoulder surgery in the rural setting utilizing a Certified Registered Nurse Anesthetist (CRNA) only model. Demographic information was obtained. Patients were primarily ASA 2 and 3 classifications and were outpatients with a mean age of 52.6 years. The most common preoperative diagnosis was rotator cuff tear. The recorded procedure was most often shoulder arthroscopy. RA was performed on 70 patients (92.1%) with 6 (7.9%) patients receiving no RA. General anesthesia (GA) was administered with RA to 68 (89.5%) patients with the remainder receiving sedation with RA. Pain scores as measured by visual analogue scale (VAS) reflected effective analgesia. The mean VAS score reported on arrival to PACU was 1.27, after one hour 1.69, and 0.38 upon discharge from PACU. Postoperative analgesics were required for 26 (34.2%) patients. The incidence of postoperative nausea or vomiting was 6.6% of patients reporting nausea and 2.6% patients experiencing emesis. The mean anesthesia time was 127.3 minutes with mean operating room time of 121.2 minutes. Mean time in PACU was 134.6 minutes. The descriptive data attained in the analysis demonstrate RA as a safe and effective supplement to GA administered by CRNAs in a rural setting. Future research is needed specific to CRNA-only practice models and rural settings and should include controlled randomized trials to evaluate outcomes in groups consisting of GA, GA+RA, RA + sedation and even RA alone in select populations.

INTRODUCTION

As the population in the United States ages and the demands on the healthcare system increase, so too does the pressure to provide superior anesthesia services that include safe, effective, efficient care with improved outcomes, greater patient satisfaction, and lower cost. This is particularly the case in rural areas of the United States, which account for nearly 72 million Americans who may have limited access to providers, where the drive to provide high quality care while reducing costs is paramount.[1] Regional anesthesia (RA) for shoulder surgery is a commonly used technique. The benefits have been studied and are well documented. One commonly used technique is the administration of an interscalene block (ISB) to supplement the administration of general anesthesia (GA) in combination with sedation, or even as a sole anesthetic, has gained favor. The avoidance or reduction of the hemodynamic instability and other adverse effects that may occur as a result of GA is one appeal to that practice.[2] In addition, regional anesthesia has been shown to provide postoperative pain relief for patients undergoing shoulder procedures. While single shot ISB has been shown to provide significant postoperative pain relief, it is of a short duration and is not without adverse effects.[3]

A review of the literature was conducted to examine the potential benefits of RA as compared to GA for shoulder surgery with a secondary intent to evaluate the presence of data collected in rural settings.

BACKGROUND

The electronic based search of the literature review was completed using the following databases: PubMed, Cochrane, INFOTRAC, MEDLINE, Ovid Medline, and CINAHL. The following subject headings and combinations were used: "interscalene + shoulder surgery", "regional anesthesia vs. general anesthesia", "regional anesthesia + shoulder surgery", "regional anesthesia", "ambulatory surgery", "rural anesthesia", "rural + anesthesia".

The search revealed many articles that compared RA with GA; however, there is a lack of articles with specificity to the rural setting. (See Table 1- Data-Extraction) A meta-analysis by Abdallah and colleagues[4] reviewed randomized and quasi-randomized controlled trials that compared ISB to GA and combined techniques. The authors examined studies conducted between 1994 and 2013 and represented 1090 patients over 23 trials. They reported reduced pain at rest and in motion at various intervals postoperatively in patients who received an ISB. The analysis also revealed decreased opioid consumption in the first 24 hours and longer time to request opioids in the ISB group. Other reported benefits of ISB included increased patient satisfaction, decreased time of stay in the post anesthesia care unit (PACU) and hospital admission and a lower incidence of postoperative nausea and vomiting (PONV). The authors concluded that ISB provided effective analgesia during the first 6 postoperative hours and reduced opioid related side effects.

Hadzic and colleagues[5] conducted a randomized, blinded, prospective study comparing the techniques of ISB to GA with respect to the recovery profiles and patient satisfaction in patients having outpatient shoulder surgery. Data were collected from a total of 50 patients placed equally into 2 groups consisting of those receiving an ISB and those receiving GA. Primary outcome measures included: patients eligible for bypass of phase I PACU instead going directly to phase II, hospital admission rates, and time to discharge. Secondary outcome measurements included: reports of moderate/severe pain, treatment of pain, nausea, vomiting, sore throat, ambulation, oral intake, and time to home readiness. The authors reported that more patients receiving ISB (76%) were eligible to bypass phase I of PACU than patients receiving GA (16%). No patients receiving ISB were admitted to the hospital, while 16% of the GA group was admitted overnight due to intractable pain. Time to discharge of ISB patients was found to be 2.5 hours less than patients receiving GA. No patients in the ISB group reported moderate to severe pain as compared to 80% of those in the GA group. Pain score values and analgesic use differences between the two groups were not statistically significant; however, the authors report these findings as "statistically underpowered". The authors report that patient satisfaction with anesthesia was higher in the ISB group with 79% reporting that they would choose the same anesthetic again while 36% of the patients in the GA group stated they would choose GA again.

Lehmann and colleagues[6] conducted a randomized controlled study of 120 subjects that evaluated the use of ISB versus GA, or a combined ISB + GA for patients undergoing shoulder arthroscopy. The primary outcome variable measured was opioid consumption on the day of surgery with secondary outcomes being post-op monitoring times, anesthesia times, patient satisfaction, and the ability to bypass the recovery room. In addition, subjective outcomes such as perceived pain and nausea were measured. Following surgery, the authors found that 27 of 40 subjects receiving ISB only were able to bypass the PACU completely and had the shortest monitoring time necessary in the PACU compared to GA or GA + ISB. On the day of surgery, opioid consumption was significantly reduced in the patients receiving ISB but they found no significant difference in opioid consumption between the ISB and ISB + GA groups. Patient satisfaction scores in the ISB and ISB + GA groups were significantly higher than scores reported by GA only patients. Patients in the ISB group reported less nausea and vomiting as compared to the other groups and reported their experience as "better than expected" more frequently than patients in both the GA and the GA + ISB groups.

In a retrospective chart review, Yauger and colleagues[7] compared outcomes between patients undergoing either shoulder arthroscopy or knee arthroscopy receiving GA or RA in a military same day surgery unit (SDSU) in a certified registered nurse anesthetist (CRNA) only practice model. The study reviewed 342 cases, with 161 GA and 181 RA. Combined GA and RA procedures were excluded. Regional anesthetic techniques included interscalene block (ISB) for shoulder arthroscopy or femoral nerve block (FNB) for knee arthroscopy. Results included a 13 minutes longer pre-op time for GA patients than the RA group, with a slightly less intra-operative time. The GA group also utilized 25.9 minutes less anesthesia provider time. The RA group spent 20.3 minutes less time in PACU than did the GA group and SDSU. Pain scores post-operatively were significantly increased in the GA group, with increased morphine equivalent opioid use by the GA group relative to the RA group. This study suggests that CRNA-administered regional anesthesia provided a safe and effective alternative anesthetic for outpatient shoulder and knee arthroscopy, with improved quality indicators such as a reduction of PONV, pain, and opioid consumption as compared to GA.

Gonano and colleagues[8] evaluated the differences between ultrasound (US) guided ISB and GA for arthroscopic shoulder surgery. The total sample size was 40 patients with equal distribution into each group. Researchers recorded all drugs and disposable equipment used and evaluated each method in terms of cost. Other costs were calculated considering anesthesia-related workflow and total anesthesia time, total time in PACU, and readiness for discharge. A decreased total cost for patients receiving ISB (33 +/- 9 €) was reported as compared to the GA group (41 +/- 7 €). The authors found that anesthesia time was significantly less in the ISB group [12 (+/- 4) minutes] versus the GA group [23 (+/- 6) minutes]. PACU time was significantly reduced in the ISB group (45 +/- 17 min) versus the GA group (70 +/- 20) minutes. The review of the literature suggests that RA not only allows for excellent surgical anesthesia, but also reduces length of patient stay, intra and post-operative opioid requirements, post-operative pain, PONV, and overall cost, while simultaneously improving patient satisfaction scores. The review also demonstrates a need for research to explore best practices specific to rural anesthesia practice.

PURPOSE OF THE STUDY

Although there is a significant body of literature comparing regional anesthesia to general anesthesia, there are few studies looking at these techniques for shoulder surgery specifically in the

rural population. The purpose of this retrospective chart review was to characterize the complication rate and outcomes among a group of patients receiving regional anesthesia in patients undergoing shoulder surgery in the rural setting utilizing a Certified Registered Nurse Anesthetist only model. Complications measured in this review included nausea, vomiting, and delayed discharge. Need for opioid analgesia was also measured.

MATERIALS AND METHODS

DESIGN

The Institutional Review Board at the University of Detroit Mercy approved the project through expedited review. It is a retrospective chart review of patients undergoing shoulder surgery at Hillsdale Community Health Center (HCHC) during 2014. HCHC utilizes a CRNA only anesthesia practice model. It has 47 acute care beds and is located in Southwestern Michigan, 112 miles from Detroit, in a county of approximately 47,000 people. The project was also approved by the administration of HCHC who granted access to the patient electronic records.

DATA COLLECTION

The authors developed the data collection sheet used to gather patient information. (Appendix 1) Inclusion criteria included all patients undergoing shoulder surgery. The hospitals electronic medical system was utilized to retrieve records of patients through coding indicating they met inclusion criteria during the identified time period. To maintain confidentiality and anonymity, patient identifiers were not collected. Collected data included patient demographics of gender, age, ASA status, height, weight, and BMI. In addition preoperative diagnosis, surgical approach (open versus arthroscopic), surgical procedure, and type of anesthetic administered were recorded. Times were measured reflecting anesthesia time, operating room time, and PACU time in minutes. The occurrence of nausea or vomiting was recorded as was prophylactic and rescue agents administered. Pain measurements upon arrival to PACU, one hour later, and upon discharge from PACU were also recorded using the VAS. Opioid and other analgesic administration was recorded for pre, intra, and postoperative periods.

RESULTS

Seventy nine patient records were reviewed. Three patient records were excluded because of incompleteness of crucial data in the records leaving a sample population of 76 patients. Descriptive analysis of the data was performed. Demographic data is summarized in table 2.

The most common preoperative diagnosis was rotator cuff tear (47.4%) followed by impingement syndrome (14.5%) and ankylosis (6.6%) with a variety of other diagnoses comprising the remainder in near equal numbers. The recorded procedure was most often shoulder arthroscopy (76.3%). A combined RA with GA technique was performed on nearly all patients so comparisons between RA and GA were not attainable. (Table 3) Bupivicaine 0.5% was utilized in 65 (85.5%) of the RA procedures with ropivicaine 0.5% utilized in the remainder. Only 3 patients (3.9%) received preoperative analgesia. Pain scores as measured by VAS reflected effective analgesia. (Table 4)

The overall rate of PONV as well as rescue medication for PONV was low. Prophylaxis for PONV was administered to most patients with ondansetron 4 mg alone or in combinations with dexamethasone 4mg or metaclopromide 10mg most often utilized. (Table 5)

The mean anesthesia time was 127.3 minutes with mean OR time of 121.2 minutes. Mean time in PACU was 134.6 minutes. Blocks were administered in the preoperative holding area so that OR time was not prolonged. Two blocks were deemed to be ineffective in PACU and were re-administered. One patient was admitted unplanned for intractable pain. No other adverse events were reported.

DISCUSSION

This analysis provided current data related to demographics and outcomes in patients undergoing shoulder surgery in a CRNA-only rural practice setting. Quality outcomes data are crucial to continuously provide supportive data speaking to the safety and efficacy of CRNA solo practice. The descriptive data attained demonstrates effective RA as a supplement to GA. As a result, a decrease in Mean Alveolar Concentration (MAC) of inhaled agent can be assumed and small intraoperative doses of opioid were required allowing a reasonable assumption of a correlation to reduced opioid side effects.

A very low incidence of PONV occurred suggesting that low opioid use, inhalation agent, and/or prophylactic antiemetic administration was effective. The PONV incidence was lower than reported in the studies reviewed here and lower than the incidence reported by Gohl and colleagues[9] in a 2001 study comparing ISB to GA techniques in which they found 66% of GA patients experienced nausea and 25% for those receiving ISB and GA combined.

The measured mean anesthesia time represented only 6.1 minutes longer than OR time. So the institutional practice of performing the regional technique in the preoperative holding area did not significantly increase valuable time in the OR.

This study is not without limitations. Foremost, a randomized prospective design comparing GA to RA or a longer retrospective study period to mine data from patients who underwent shoulder surgery prior to the predominate practice of most frequently employing RA would provide better comparative data. Since the target population was a rural setting with CRNA-only practice the findings cannot be generalized to larger facilities with other anesthesia care models.

This study provides supportive data that RA added to the anesthesia plan for shoulder surgery in a rural, CRNA-only practice is safe, effective and efficient. Although questions could not be answered through comparison of groups in this study, the data revealed low incidences of postoperative adverse events, effective analgesia during the postoperative period, and minimal anesthesia time beyond operating room time needed.

Implications for Clinical Practice and Future Research

The current trends in healthcare in the United States point towards increasing patient satisfaction and quality while reducing costs. Regional anesthesia has long been recognized as a safe alternative or adjunct to general anesthesia in select patient populations and surgical procedures. As the reviewed literature

suggests, a regional approach to outpatient shoulder surgery can reduce costs and improved outcomes, with the added benefit of improved patient satisfaction. Future research is needed specific to CRNA-only practice models and rural settings and should include controlled randomized trials to evaluate outcomes in groups consisting of GA, GA+RA, RA + sedation and even RA alone in select populations. Research exploring the potential benefits of the use of ultrasound-guided blocks versus more traditional approaches and the use of lower doses of local anesthetics and optimization of outcome measures need also to be conducted.

Further, it may prove beneficial to evaluate the effectiveness of continuous infiltration of local anesthetic in the outpatient setting. An additional area of future research should include a focus on rural anesthesia and the costs associated with providing anesthetic care in this setting. This review of the current literature as well as the descriptive evaluation of this practice points to promising reduction of costs and increased efficiency, both areas that could drastically impact the bottom line in the often budget-compromised rural healthcare setting.

Table 1-Data Extraction

Authors/Study	Design, Purpose and Sample	Results and Conclusions	Critique of Strengths and Weakness
Hadzic A, Williams BA, Karaca PE. et al. For Outpatient Rotator Cuff Surgery, Nerve Block Anesthesia Provides Superior Same-day Recovery over General Anesthesia. Anesthesiology. 2005; 102:1001–1007.	**Design:** Prospective, randomized study comparing the use of ISB to GA for outpatient shoulder surgery. **Purpose:** To compare which technique (nerve block vs. GA) provides more efficient recovery and greater patient satisfaction. **Sample:** 50 patients	**Result:** * 76% of ISB patients and 16%of GA patients bypassed PACU * 0 ISB patients and16% of GA patients were admitted * 0 (0 %) ISB patients and 20 (80 %) GA patients were treated for pain in PACU * Discharge time for ISB was 123 +/- 57 min and 286 +/- 100 min for GA patients **Conclusions:** The authors conclude that ISB increased PACU bypass, faster same-day recovery, better analgesia, and fewer adverse events following outpatient rotator cuff surgery as compared to GA.	**Strengths:** Randomized, blinded study Aldrete scoring used on all patients initially to assess ability to bypass PACU Follow-up was through 2 week period **Weaknesses:** Small sample size GA patients received PONV prophylaxis, ISB patients did not GA patients received nitrous oxide 50%, an agent known to produce PONV

Authors/Study	Design, Purpose and Sample	Results and Conclusions	Critique of Strengths and Weakness
Lehmann L, Loosen G, Weiss C, Schmittner M. Interscalene plexus block versus general anaesthesia for shoulder surgery: A randomized controlled study. Eur J Orthop Surg Traumatol. 2015; 25(2) 255-61. doi: 10.1007/s00590-014-1483-3. Epub 2014 May 15. Accessed June 4th, 2015	**Design**: Randomized, controlled, clinical trial **Purpose**: Evaluates the post-op opioid consumption in patients receiving ISB, ISB + GA, or GA alone for shoulder arthroscopy **Sample**: 120 patients total. ISB: N= 40 ISB + GA: N= 40 GA: N= 40	**Result**: * Opioid requirements of ISB and ISB + GA were similar and less than GA alone. * ISB had significantly higher patient satisfaction scores * ISB led to significantly less PONV and lower pain scores than GA or GA + ISB * ISB had increased rate of bypassing PACU and discharge from the recovery room than ISB or ISB + GA **Conclusions**: When compared to GA, patients receiving ISB or ISB + GA had a reduction in post-op opioid consumption, time to oral intake and	**Strengths**: • Randomized, blinded study • Large sample sizes **Weaknesses**: • The authors cite their choice of LA and volume of dosing as a weakness of the study

Authors/Study	Design, Purpose and Sample	Results and Conclusions	Critique of Strengths and Weakness
Yauger, Y, Bryngelson J, Weiss C, et al. Patient outcomes comparing CRNA-administered peripheral nerve blocks and general anesthetics: A retrospective chart review. AANAJ. 2010.78(3) 215-220.	**Design**: Retrospective chart review **Purpose**: To compare quality indicators and operative time demands between patients undergoing shoulder or knee arthroscopy under GA vs. RB. **Sample**: 342 patients undergoing shoulder or knee arthroscopy, with either GA or RA. RA in this study refers to either interscalene block for shoulder arthroscopy or femoral nerve block for knee arthroscopy.	**Result**: * The GA group used 25.9min less anesthesia provider time overall but spent 20.3 min longer in PACU than the RA group. * 15.5% of GA patients had PONV vs. 10.0% of RB patients, a statistically insignificant difference. * RA patients had a significant decrease in pain scores post-operatively and used less opioid than the GA group. * 12 patients in the RA group bypassed the PACU, while no patients in the GA did. **Conclusions**: Significantly less opioid use and pain scores when RA is used over GA.	**Strengths**: • Large sample size • CRNA- only study **Weaknesses**: • Only ASA 1 and 2 patients. • Only GA or RB, no combined technique patients • Retrospective study

Authors/Study	Design, Purpose and Sample	Results and Conclusions	Critique of Strengths and Weakness
Gonano C, Kettner SC, Ernstbrunner M, Schebasta K, Chiari A, Marhofer P. Comparison of economical aspects of interscalene brachial plexus blockade and general anesthesia for arthroscopic shoulder surgery. British Journal of Anaesthesia. 2009; 103 (3): 428–33 (2009) doi:10.1093/bja/aep173. Accessed June 4th, 2015.	**Design**: Randomized clinical trial **Purpose**: This study was designed to evaluate the potential economic advantage of US- guided ISB vs. GA for arthroscopic shoulder surgery. The emphasis in this study is placed on the use of ultrasound for block placement and the economic impact vs. GA. **Sample**: 40 patients total ISB group: N= 20 GA group: N= 20	**Result**: * Costs are minimally lower in the ISB group compared to the GA group. Cost savings seen in faster turnover time when ISB performed in block room. * PACU time, opioid use, PONV rates all reduced in the ISB group. * 10% of ISB patients needed vasopressor and fluid therapy vs. 60% of GA patients. **Conclusions**: ISB is a cost-effective method of providing anesthesia for arthroscopic shoulder surgery. ISB is associated with less total anesthesia related cost and improved time efficacy.	**Strengths**: • Looked specifically at costs • Looked at US-guided blocks **Weaknesses**: • Small sample size • Australian study- may not be able to extrapolate to US

Table 2 Demographics

N =76	Gender	Age Years	Weight kg	BMI Kg/m^2	ASA status
	M = 37 (51%)	-	-	-	1=1
Mean	F = 39 (49%)	52.9	83	30.4	2= 3
Min		19	51	18.2	3= 52
Max		83	159	51.8	4=1

Table 3 Techniques

Anesthetic	Airway Adjunct	Surgical Approach
RA+GA= 68 (90%)	ETT= 65	Open= 58
GA only= 6 (8%)	LMA= 3	Arthroscopy= 15
RA+ sedation= 2 (2%)	-	Not indicated= 3

Table 4 VAS Scores

N =76	VAS Arrival	VAS 1 hr.	VAS DC
Mean	1.27	1.69	0.37
Reported score of 0	59 (77.6%)	48 (63.2%)	59 (77.6%)

Table 5 PONV Data

Postop Nausea	Postop Vomiting	PONV Prophylaxis	PONV Rescue
5 (6.6%)	2 (2.6%)	69 (90.8%)	3 (3.9%)

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Appendix 1 Data Collection Tool

Case Number (1, 2, 3 etc.):_____
Demographics
Age: _____Gender: Male _____ Female _____
Height (cm): Weight (kg): BMI (kg/m2): ASA Status _____
Co-morbidities: _____
Inpatient _____ Outpatient_____
Diagnosis: _____
Upper Extremity Surgical Procedure: _____
Surgical Approach: Open incision_____ Scope_____
Type of Anesthesia
_____Regional and General Anesthesia
Type of Block: _____
General using LMA: _____ OET: _____
_____Regional with Sedation
Type of Block_____
_____ General without Block
_____ Local/MAC
Comments: _____
OR and PACU Times (minutes)
Total OR time _____Total Anesthesia time: _____ Total PACU time: _____

Perioperative Data
Preoperative Pain Medications
Opioid: _____ Amount: _____ Route: IV_____ PO_____IM_____
NSAID: _____ Amount: _____ Route: IV_____ PO_____IM_____
Acetaminophen Amount: _____ Route: IV_____ PO_____
Other Type: _____ Amount: _____ Route: IV_____ PO_____IM_____
Intraoperative Pain Medications
Opioid: _____ Amount: _____ Route: IV_____ PO_____IM_____
NSAID: _____ Amount: _____ Route: IV_____ PO_____IM_____
Acetaminophen Amount: _____ Route: IV_____ PO_____
Other: _____ Amount: _____ Route: IV_____ PO_____IM_____
Postoperative Pain Management
Local Anesthesia Infiltrated at Incision Site (by surgeon): YES____ NO_____
Catheter placed for post op pain: YES_____ NO_____
Pain scores in PACU:
Arrival VAS _____
1 hour VAS_____
Pain score at discharge: VAS_____
Comments: _____
Pain Medication Use in PACU
Opioid: _____ Amount: _____ Route: IV_____ PO_____IM_____
NSAID: _____ Amount: _____ Route: IV_____ PO_____IM_____
Acetaminophen: Amount: _____ Route: IV_____ PO_____
Other: _____ mount: _____ Route: IV_____ PO_____IM_____
PONV and Treatment
Nausea: (Y/N) Vomiting: (Y/N)
PONV Prophylaxis given: Drug:_____Dose:_____Route: _____
Rescue meds for PONV: Drug:_____Dose:_____Route: _____
Complications
Delay in discharge: (Y/N) Reason: _____ Length of Delay: _____
Unplanned postop hospital admission: (Y/N) Reason_____
Other: _____