

Research Article

Use of Nerve Block in Addition to General Anesthesia Reduces Pain and Time in Post-Anesthesia Care Unit After Rotator Cuff Repair

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Purpose

To determine if use of nerve blocks during rotator cuff repairs will result in an overall improvement of post-operative pain and reduction of time spent in the post-anesthesia care unit (PACU) without any increases in avoidable emergency department (ED) or urgent care (UC) visits within 7 and 30 days.

Methods

A large integrated health system was queried for all rotator cuff repairs conducted between January 1, 2016 and December 31, 2017 and separated into two groups: general anesthesia only or general anesthesia with an additional nerve block. Maximal pain scores in the PACU, time spent in the PACU and avoidable visits to the ED/UC within 7 and 30 days were recorded and compared.

Results

A total of 3,128 patients undergoing rotator cuff repair were included (39.5% received general anesthesia with a nerve block). The use of an additional nerve block was associated with a 1.3 ($p < 0.001$) point reduction in maximum reported pain scores and a 15.7 (11.9%, $p < 0.001$) minute reduction in PACU time per patient. Furthermore, there

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was no statistically significant difference in avoidable ED/UC visits within 7 ($p = 0.432$) and 30 ($p = 0.454$) days between groups.

Conclusion

The use of a nerve block in addition to general anesthesia was associated with a significant reduction in maximum pain scores and time spent in the PACU with no increases in avoidable ED/UC visits within 7 or 30 days. Therefore, use of a nerve block in addition to general anesthesia could lead to longitudinally decreased costs in the rotator cuff repair surgical pathway.

Level of Evidence

III

INTRODUCTION

The advent of advanced arthroscopic techniques in conjunction with an aging U.S. population has led to an increased number of annual rotator cuff repair surgeries (Colvin et al. 2012). Orthopedic surgeons performing rotator cuff repair are concerned with numerous clinical outcomes, including postoperative pain. Shoulder surgery is generally reputed to be especially painful, with a significant proportion of patients reporting severe postoperative pain (Moote, Li, and Miniaci 1994). For operations such as rotator cuff repair, nerve blocks can be an effective method for providing regional anesthesia and to relieve initial pain after surgery (Borgeat et al. 2003; Iskandar et al. 2003; Neal et al. 2003). While some have advocated its use as a sole anesthetic, it is more commonly used in conjunction with general anesthesia (Hadzic et al. 2005). The interscalene block has been the gold standard for shoulder anesthesia, but other nerve blocks such as the suprascapular nerve block with axillary nerve block, supraclavicular block or sub-acromial block have also been used for shoulder surgery with acceptable results (Bowens and Sripada 2012; Singelyn, Lhotel, and Fabre 2004).

Nerve blocks have been recommended as part of the enhanced recovery after surgery (ERAS) pathway due to the importance of multimodal analgesia for early pain control (White et al. 2007). Furthermore, in a small previous study, it was shown that a suprascapular nerve block could reduce pain and PACU time (Ritchie et al. 1997). However, while implementation of nerve blocks as part of the ERAS pathway have been suggested to be associated with better postoperative pain management and quicker discharge (White et al. 2007), the use of nerve blocks in shoulder surgery has not yet been directly linked to large scale, system-wide PACU time savings. Furthermore, the effect of nerve blocks on system-wide return to emergency departments (ED) or urgent care centers (UC) has not been assessed.

The purpose of this study was to assess the effect of nerve blocks on time spent in the PACU, post-operative pain in the PACU and return to the ED or UCs in the short term post-operative period. We hypothesized that the use of nerve blocks will result in an overall improvement of post-operative pain and reduction of time spent in the PACU without any increases in avoidable ED/UC visits within 7 and 30 days.

METHODS

After IRB approval, a retrospective cohort study of a large integrated healthcare system was conducted. The electronic medical record was queried for all rotator cuff repairs conducted between January 1, 2016 and December 31, 2017. Patient factors including age and American Society of Anesthesiologists (ASA) class were collected. The type of anesthesia used was also collected, and patients were divided into two groups: a general anesthesia only (GA) group and a general anesthesia with additional nerve block (GANB) group. The patient reported maximal pain score (from 0 to 10, with 10 being the maximum), PACU time in minutes (recorded as time patient arrived in the PACU after surgery until discharge from the PACU) and avoidable ED/UC visits within 7 and 30 days were also recorded. Avoidable ED/UC visits were defined similarly to a previously published study as any visits for pain, nausea/vomiting, urinary retention or constipation (Navarro et al. 2018).

T-tests were performed to compare continuous variables and Fisher's exact test was performed to compare categorical variables. Statistical analysis was conducted in R version 3.4.2 (R Foundation for Statistical Computing, Vienna, Austria). The level of statistical significance was set at $\alpha < 0.05$.

RESULTS

Over the study period, a total of 3,128 patients undergoing rotator cuff repair were included. In this cohort, 39.5% (1,891 GA patients and 1,237 GANB patients) of cases were done with a nerve block in addition to general anesthesia.

There was no statistically significant difference in the ages ($p = 0.681$) of those in the GA group only and those in the GANB group. (Table 1) While there was a greater proportion of males than females in both groups, there was no significant difference between groups ($p = 0.732$). BMI was also similar between both groups and showed no statistically significant difference ($p = 0.232$). The ASA class for both groups were relatively similar despite the statistically significant difference ($p = 0.001$). Both groups had similar proportions of ASA 1's and while the GA group had a greater proportion of ASA 3's, the GANB had the only ASA 4's in the entire cohort.

The nerve block was associated with 1.3 ($p < 0.001$) point reduction in maximum reported pain scores experienced in

Table 1. Patient Demographics

	General Anesthesia Only n = 1,891	General Anesthesia with Nerve Block n = 1,237	p-value
Age, (years), mean (SD)	59.0 (10.0)	59.1 (9.8)	0.681
Gender (%)			0.732
Female	41.4	42.0	
Male	58.6	58.0	
BMI, mean (SD)	29.5 (5.9)	29.3 (5.2)	0.232
ASA Class (%)*			0.001
1	7.8	7.5	
2	72.6	77.6	
3	19.6	14.7	
4	0.0	0.2	

*Per the American Society of Anesthesiologists (ASA) guidelines:

ASA I: A normal healthy patient. ASA II: A patient with mild systemic disease. ASA III: A patient with severe systemic disease. ASA IV: A patient with severe systemic disease that is a constant threat to life.

Table 2. Effect of Nerve Block in Addition to General Anesthesia

	General Anesthesia Only n = 1,891	General Anesthesia with Nerve Block n = 1,237	p-value
Maximum pain reported in PACU, mean (SD)	4.3 (3.2)	3.0 (3.1)	<0.001
PACU Time (mins), mean (SD)	132.0 (71.0)	116.2 (71.8)	<0.001
Avoidable ED/UC Visits within 7 days (%)	72 (3.8%)	40 (3.2%)	0.432
Avoidable ED/UC Visits within 30 days, n (%)	91 (4.8%)	67 (5.4%)	0.454

the PACU. (Table 2) There was a 15.7 ($p < 0.001$) minute difference per case in PACU time between the GA group and the GANB group, corresponding to a 11.9% difference in PACU time per case. Furthermore, there was no statistically significant difference in avoidable ED/UC visits within 7 ($p = 0.432$) and 30 ($p = 0.454$) days between those who received either treatment.

DISCUSSION

In this study, it was found that the use of a nerve block in addition to general anesthesia resulted in a statistically significant reduction of maximum pain scores in the PACU, a significant reduction in time spent in the PACU and no increases in avoidable ED/UC visits within 7 or 30 days.

In our cohort of patients undergoing rotator cuff repair, the use of nerve blocks in addition to general anesthesia was associated with a statistically significant 1.3-point reduction in maximal pain scores. Previous studies have suggested that a 1.1-point reduction in an 11-point (0-10) pain scale is the minimally clinically important difference, and therefore this amount of reduction in pain is clinically significant (Bodian et al. 2001; Salaffi et al. 2004). Previous studies have also showed the efficacy of using nerve blocks in addition to general anesthesia in orthopedics. In a small randomized controlled trial with 25 patients in each group, Ritchie et al. assessed the use of a suprascapular nerve

block compared to placebo in addition to general anesthesia in patients undergoing arthroscopic shoulder surgery and found significantly fewer patients reported severe pain in the PACU (Ritchie et al. 1997). Furthermore, a meta-analysis of single-shot interscalene blocks after shoulder surgery demonstrated that interscalene block can confer effective pain control up to 8 hours and an opiate-sparing effect up to 12 hours (Abdallah et al. 2015). These results were in line with the results from our study, which found a statistically significant reduction in pain with the usage of a nerve block.

In this study, it was shown that patients who underwent nerve blocks did not have increased risk for returning to the ED/UC for any avoidable causes, suggesting that nerve blocks are a well-tolerated adjunct to general anesthesia. While our study found that there was no significant difference in the rate of avoidable returns to the ED/UC, there have been reports of lower unexpected admission rates in patients undergoing anterior cruciate ligament reconstruction (ACLR) who received regional anesthesia in addition to general anesthesia (Williams et al. 1998). The reduction in immediate post-operative pain may be helpful for early patient comfort; however, it should be noted that nerve blocks provide only temporary relief. In a previous study that used nerve blocks for ACLR, Williams et al. reported that 13% of readmissions after the procedure were due to uncontrollable pain after the nerve block had worn off (Williams et al.

2004). Therefore, appropriate patient counseling is key to prevent lapses in analgesic coverage and to ensure that patients bridge over to longer-term pain management modalities. To help with this situation in our integrated health-care system, patients are counseled on pain management at their preoperative visit and are given prescriptions for postoperative pain to be filled the day before surgery.

To help improve early patient outcomes, our medical system has begun to implement policies derived from the Enhanced Recovery After Surgery (ERAS) protocol. The ERAS pathway is a comprehensive care package that includes various pre-, peri- and postoperative recommendations to help patients recover more quickly from surgery and anesthesia (Shaw and Ternent 2016; White et al. 2007). Nerve blocks when possible are recommended as part of the ERAS pathway to create a multimodal approach for analgesia. In this study, the reduction in PACU time and reduction in pain supports the use of nerve blocks to achieve the aims of the ERAS pathway.

In this study, there was a significant reduction in PACU time with the use of a nerve block in addition to general anesthesia. If over the period of study all the general-only cases were done with a nerve block, this could have resulted in a potential savings of 162.3 hours per year of PACU time. Previous studies have also found time savings with nerve block in addition to general anesthesia for arthroscopic shoulder surgery (Ritchie et al. 1997; Lehmann et al. 2015). In 2011, economists Kaplan and Porter applied the concept of time-driven activity-based costing (TDABC) to healthcare (Kaplan and Porter 2011). Under this model of cost analysis, there are two parameters needed to assess the cost of any healthcare process: (1) the cost of each resource used and (2) the amount of time of that the patient spends with each resource. With this methodology, providers can more clearly understand the patient-level sources of costs in healthcare and this framework can then be used to improve efficiency and resource allocation (Kaplan and Porter 2011; Anzai et al. 2017; Palsis et al. 2018). Under the TDABC model, saving time in the PACU would directly contribute to lowering costs associated with rotator cuff repair, which may be quantified in future studies.

This study has several limitations including the amount of time it takes for anesthesiologists to place the block,

which was not accounted for. Under the TDABC model, this could possibly increase costs incurred by the patient if it adds more time to the procedure. However, placing nerve blocks are relatively quick procedures (Sandhu and Capan 2002) that may be performed preoperatively in the waiting area or during patient preparation in the OR without substantially increasing resource utilization. Furthermore, there are several different nerve block approaches that anesthesiologists may use depending on patient factors or physician preferences. The specific nerve block approaches by the anesthesiologist were not collected, and different approaches may differ in efficacy (Lanz, Theiss, and Jankovic 1983). The decision to undergo nerve block was generally a combination of surgeon and patient preference. Therefore, patients were not randomly assigned to either group, leading to the possibility of selection bias. Additionally, it is known that factors such as suture methods may also affect postoperative pain; however, data was not collected to assess for the role such factors may have played in this study (Randelli et al. 2017).

CONCLUSION

The use of a nerve block in addition to general anesthesia resulted in significant reductions in maximum pain scores in the PACU, a significant reduction in time spent in the PACU, and no increases in avoidable ED/UC visits within 7 or 30 days. The use of a nerve block in addition to general anesthesia could lead to longitudinally decreased costs in the rotator cuff repair surgical pathway.

ETHICAL APPROVAL

Kaiser Permanente Southern California (KPSC) Institutional Review Board (IRB)
IRB#: 11141

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REFERENCES

- Abdallah, Faraj W., Stephen H. Halpern, Kazuyoshi Aoyama, and Richard Brull. 2015. "Will the Real Benefits of Single-Shot Interscalene Block Please Stand Up? A Systematic Review and Meta-Analysis." *Anesthesia and Analgesia* 120 (5): 1114–29. <https://doi.org/10.1213/ANE.0000000000000688>.
- Anzai, Yoshimi, Marta E. Heilbrun, Derek Haas, Luca Boi, Kirk Moshre, Satoshi Minoshima, Robert Kaplan, and Vivian S. Lee. 2017. "Dissecting Costs of CT Study: Application of TDABC (Time-Driven Activity-Based Costing) in a Tertiary Academic Center." *Academic Radiology* 24 (2): 200–208. <https://doi.org/10.1016/j.acra.2016.11.001>.
- Bodian, Carol A., Gordon Freedman, Sabera Hossain, James B. Eisenkraft, and Yaakov Beilin. 2001. "The Visual Analog Scale for Pain: Clinical Significance in Postoperative Patients." *Anesthesiology* 95 (6): 1356–61. <https://doi.org/10.1097/0000542-200112000-00013>.
- Borgeat, Alain, Alexander Dullenkopf, Georgios Ekatothramis, and Ladislav Nagy. 2003. "Evaluation of the Lateral Modified Approach for Continuous Interscalene Block after Shoulder Surgery." *Anesthesiology* 99 (2): 436–42. <https://doi.org/10.1097/0000542-200308000-00026>.
- Bowens, Clifford, Jr., and Ramprasad Sripada. 2012. "Regional Blockade of the Shoulder: Approaches and Outcomes." *Anesthesiology Research and Practice* 2012 (February): 971963. <https://doi.org/10.1155/2012/971963>.
- Colvin, Alexis Chiang, Natalia Egorova, Alicia K Harrison, Alan Moskowitz, and Evan L Flatow. 2012. "National Trends in Rotator Cuff Repair." *The Journal of Bone and Joint Surgery. American Volume* 94 (3): 227–33. <https://doi.org/10.2106/jbjs.j.00739>.
- Hadzic, Admir, Brian A. Williams, Pelin Emine Karaca, Paul Hobeika, George Unis, Jeffrey Dermksian, Marina Yufa, Daniel M. Thys, and Alan C. Santos. 2005. "For Outpatient Rotator Cuff Surgery, Nerve Block Anesthesia Provides Superior Same-Day Recovery over General Anesthesia." *Anesthesiology* 102 (5): 1001–7. <https://doi.org/10.1097/0000542-200505000-00020>.
- Iskandar, Henri, Antoine Benard, Joelle Ruel-Raymond, Gyslaine Cochard, and Bertrand Manaud. 2003. "The Analgesic Effect of Interscalene Block Using Clonidine as an Analgesic for Shoulder Arthroscopy." *Anesthesia and Analgesia* 96 (1): 260–62. <https://doi.org/10.1097/0000539-200301000-00052>.
- Kaplan, Robert S., and Michael E. Porter. 2011. "How to Solve the Cost Crisis in Health Care." *Harvard Business Review* 89 (9): 46–61.
- Lanz, Egon, Dieter Theiss, and Danilo Jankovic. 1983. "The Extent of Blockade Following Various Techniques of Brachial Plexus Block." *Anesthesia and Analgesia* 62 (1): 55–58. <https://doi.org/10.1213/0000539-198301000-00009>.
- Lehmann, Lars J., Gregor Loosen, Christel Weiss, and Marc D. Schmittner. 2015. "Interscalene Plexus Block versus General Anaesthesia for Shoulder Surgery: A Randomized Controlled Study." *European Journal of Orthopaedic Surgery & Traumatology* 25 (2): 255–61. <https://doi.org/10.1007/s00590-014-1483-3>.
- Moote, Carol A., M. Li, and A. Miniaci. 1994. "Random Double Blind Comparison of Intrarticular Bupivacaine and Placebo for Analgesia After Outpatient Shoulder Arthroscopy." *Anesthesiology* 81 (A49).
- Navarro, R.A., C. Lin, A. Foroohar, S. Crain, and M. Hall. 2018. "Unplanned Emergency Department/Urgent Care Visits after Outpatient Rotator Cuff Repair: Potential for Avoidance." *The Journal of Shoulder and Elbow Surgery*, June, 993–97. <https://doi.org/10.1016/j.jse.2017.12.011>.
- Neal, Joseph M., Susan B. McDonald, Kathleen L. Larkin, and Nayak L. Polissar. 2003. "Suprascapular Nerve Block Prolongs Analgesia after Nonarthroscopic Shoulder Surgery but Does Not Improve Outcome." *Anesthesia and Analgesia* 96 (4): 982–86. <https://doi.org/10.1213/01.ane.0000052380.69541.d4>.
- Palsis, John A., Thomas S. Brehmer, Vincent D. Pellegrini, Jacob M. Drew, and Barton L. Sachs. 2018. "The Cost of Joint Replacement: Comparing Two Approaches to Evaluating Costs of Total Hip and Knee Arthroplasty." *The Journal of Bone and Joint Surgery. American Volume* 100 (4): 326–33. <https://doi.org/10.2106/JBJS.17.00161>.
- Randelli, Pietro, Carlo Alberto Stoppani, Carlo Zaolino, Alessandra Menon, Filippo Randelli, and Paolo Cabitza. 2017. "Advantages of Arthroscopic Rotator Cuff Repair With a Transosseous Suture Technique: A Prospective Randomized Controlled Trial." *The American Journal of Sports Medicine* 45 (9): 2000–2009. <https://doi.org/10.1177/0363546517695789>.
- Ritchie, Ewan D., Doris Tong, Frances Chung, Andrew M. Norris, Anthony Miniaci, and Santhira D. Vairavanathan. 1997. "Suprascapular Nerve Block for Postoperative Pain Relief in Arthroscopic Shoulder Surgery: A New Modality?" *Anesthesia and Analgesia* 84 (6): 1306–12. <https://doi.org/10.1097/0000539-199706000-00024>.
- Salaffi, Fausto, Andrea Stancati, Carlo Alberto Silvestri, Alessandro Ciapetti, and Walter Grassi. 2004. "Minimal Clinically Important Changes in Chronic Musculoskeletal Pain Intensity Measured on a Numerical Rating Scale." *European Journal of Pain (London, England)* 8 (4): 283–91. <https://doi.org/10.1016/j.ejpain.2003.09.004>.
- Sandhu, N. S., and L. M. Capan. 2002. "Ultrasound-Guided Infraclavicular Brachial Plexus Block." *British Journal of Anaesthesia* 89 (2): 254–59. <https://doi.org/10.1093/bja/aef186>.

- Shaw, Darcy, and Charles A. Ternent. 2016. "Perioperative Management of the Ambulatory Anorectal Surgery Patient." *Clinics in Colon and Rectal Surgery* 29 (1): 7–13. <https://doi.org/10.1055/s-0035-1570023>.
- Singelyn, François J., Laurence Lhotel, and Bertrand Fabre. 2004. "Pain Relief after Arthroscopic Shoulder Surgery: A Comparison of Intraarticular Analgesia, Suprascapular Nerve Block, and Interscalene Brachial Plexus Block." *Anesthesia and Analgesia* 99 (2): 589–92. <https://doi.org/10.1213/01.ANE.0000125112.83117.49>.
- White, Paul F., Henrik Kehlet, Joseph M. Neal, Thomas Schricker, Daniel B. Carr, Franco Carli, and Fast-Track Surgery Study Group. 2007. "The Role of the Anesthesiologist in Fast-Track Surgery: From Multimodal Analgesia to Perioperative Medical Care." *Anesthesia and Analgesia* 104 (6): 1380–96. <https://doi.org/10.1213/01.ane.0000263034.96885.e1>.
- Williams, Brian A., Barbara M. DeRiso, Chiara M. Figallo, Joel W. Anders, Lori B. Engel, Kari A. Sproul, Hakan Ilkin, et al. 1998. "Benchmarking the Perioperative Process: III. Effects of Regional Anesthesia Clinical Pathway Techniques on Process Efficiency and Recovery Profiles in Ambulatory Orthopedic Surgery." *Journal of Clinical Anesthesia* 10 (7): 570–78. [https://doi.org/10.1016/s0952-8180\(98\)00083-x](https://doi.org/10.1016/s0952-8180(98)00083-x).
- Williams, Brian A., Michael L. Kentor, Molly T. Vogt, William B. Vogt, Kim C. Coley, John P. Williams, Mark S. Roberts, Jacques E. Chelly, Christopher D. Harner, and Freddie H. Fu. 2004. "Economics of Nerve Block Pain Management after Anterior Cruciate Ligament Reconstruction: Potential Hospital Cost Savings via Associated Postanesthesia Care Unit Bypass and Same-Day Discharge." *Anesthesiology* 100 (3): 697–706. <https://doi.org/10.1097/0000542-200403000-00034>.