

## References

1. Auyong DB, Hanson NA, Joseph RS, Schmidt BE, Slee AE, Yuan SC: Comparison of anterior suprascapular, supraclavicular, and interscalene nerve block approaches for major outpatient arthroscopic shoulder surgery: A randomized, double-blind, noninferiority trial. *ANESTHESIOLOGY* 2018; 129:47–57
2. Rodrigues CFS, Lima FJC, Barbosa FT: Importance of using basic statistics adequately in clinical research [article in Portuguese]. *Rev Bras Anesthesiol* 2017; 67:619–25

(Accepted for publication March 6, 2019.)

## Supraclav Suprascap Interscalene Shoulder Surgery: Reply

### In Reply:

We thank Dr. Ganesamoorthi *et al.* for their interest in our article<sup>1</sup> and their commentary regarding our research. We would like to address each of their concerns.

First, the primary outcome revealed analgesic non-inferiority of an anterior suprascapular block compared to an interscalene block for rotator cuff shoulder surgery ( $P = 0.012$ ) in the postanesthesia care unit. In contrast, non-inferiority was not shown when comparing supraclavicular to interscalene blocks with the same criteria ( $P = 0.088$ ). The discussion in our initial publication addresses these findings at length along with our best interpretation for the collected data. Indeed, the injection endpoint for the supraclavicular group was at the superior and middle trunks. However, the exact postinjection distribution of the 15 ml of local anesthetic remains unknown. Clinical care of our patients should be based more on clinically relevant outcomes<sup>1,2</sup> rather than

conjecture of how local anesthetic anatomically flows around the brachial plexus at various points of injection.

Second, our pain variables did not exceed the expected skew for the normal distribution (conventionally  $-1$  to  $1$ ), although the means were higher than the medians, reflecting a few subjects with higher pain scores (table 1). While within-subject changes are typically more normally distributed than individual values, analyzing pain in terms of a change from baseline is not typically performed in our field of study and we have been asked to remove these analyses from previous research. Our methods and plan for the analysis of pain was always a comparison of means and we did not feel that there was sufficient reason to deviate from that plan given the realized data.

The final topic addressed is whether mean pain is an appropriate statistic, as the CIs include scores less than 0 and are impossible values. On the numerical rating scale, scores of 2.1 and 2.6 (the mean average pain scores) are also improbable values for individual patients, as patients rarely respond with such precision when asked for a numerical rating scale pain score of 0 to 10. Studies designed using comparisons of means tend to be more powerful than comparisons based on other statistics, and the mean may be a useful measure—at least mathematically—to compare groups.<sup>3–5</sup> However, the mean of the distribution may be less useful for communicating expectations to patients. In this study, half the subjects had scores less than 2 for average pain. While we were pleased with this low pain burden across groups, we agree that it complicates the interpretation of comparisons based on means. When pain score changes are appropriate—for example, the change from 24 to 48 h—the proportion of subjects with reduced pain is a highly useful statistic. Consensus on critical thresholds in the numerical rating scale might allow for comparisons of proportions of subjects with levels of severity of pain. However, the numerical rating pain scale is applied to a wide variety of surgeries and other types of pain, so this consensus may be difficult to reach and is outside the scope of this research. Regardless, these decisions should be made before commencement of the study to be appropriately incorporated into the statistical design.

### Competing Interests

The authors declare no competing interests.

**Table 1.** Numerical Rating Scale Average and Median Postanesthesia Care Unit Pain Scores

Block	Mean	SD	Skewness	25th Percentile	Median	75th Percentile
Interscalene	2.1	2.5	0.6	0	0	4.7
Supraclavicular	2.6	3.0	0.9	0	1.5	4.0
Anterior suprascapular	2.6	2.6	0.5	0	2	4.8

David B. Auyong, M.D., Neil A. Hanson, M.D., Raymond S. Joseph, M.D., Brian E. Schmidt, M.D., April E. Slee, M.S., Stanley C. Yuan, M.D. Virginia Mason Medical Center, Seattle, Washington (D.B.A.). David.Auyong@VirginiaMason.org

## References

1. Auyong DB, Hanson NA, Joseph RS, Schmidt BE, Slee AE, Yuan SC: Comparison of anterior supracapular, supraclavicular, and interscalene nerve block approaches for major outpatient arthroscopic shoulder surgery: A randomized, double-blind, noninferiority trial. *ANESTHESIOLOGY* 2018; 129:47–57
2. Auyong DB, Yuan SC, Choi DS, Pahang JA, Slee AE, Hanson NA: A double-blind randomized comparison of continuous interscalene, supraclavicular, and supracapular blocks for total shoulder arthroplasty. *Reg Anesth Pain Med* 2017; 42:302–9
3. MacCallum RC, Zhang S, Preacher KJ, Rucker DD: On the practice of dichotomization of quantitative variables. *Psychol Methods* 2002; 7:19–40
4. Royston P, Altman DG, Sauerbrei W: Dichotomizing continuous predictors in multiple regression: A bad idea. *Stat Med* 2006; 25:127–41
5. Anderson JJ: Mean changes *versus* dichotomous definitions of improvement. *Stat Methods Med Res* 2007; 16:7–12

# Hospital-level Neuraxial Use in Orthopedics: Comment

## To the Editor:

In a large retrospective study, Memtsoudis *et al.*<sup>1</sup> demonstrated that patients receiving neuraxial anesthesia for primary hip and knee arthroplasties had lower costs of hospitalization. Presumably, neuraxial anesthesia may provide a clinical benefit (e.g., decreased incidence of deep vein thrombosis, reduced cardiopulmonary complications, reduced opiate consumption, and lower incidence of postoperative delirium) when compared to general anesthesia for total joint replacements. Curiously, none of the clinical outcomes assessed in this study reached a level of significance, leaving three possible explanations for their results: a type II error, an accounting error, or some other downstream clinical benefit not measured in this trial. We believe that the first explanation is unlikely given the size of the study population and the third will require further study. However, the second explanation deserves a closer examination.

Previously, Adam *et al.*<sup>2</sup> established that variability in costing methods applied raises questions about the validity of study results. Memtsoudis *et al.* extracted all the study data from the Premier Healthcare (Charlotte, North Carolina) database where the data elements associated with costs were dependent on each hospital's accounting methodology. Further complicating the picture is the fact that a smaller number of hospitals submitted charges, which were subsequently converted using Medicare cost-to-charge ratios, for the purposes of the study. Incorporating charge data into costing analysis can be misleading because of the lack of fixed relationship between costs and charges. Although it is possible that the clinical benefits of neuraxial anesthesia extend beyond the intraoperative period, it is unlikely that a reduction in the length of stay or lower anesthesia costs led to the results from the study. Basques *et al.*<sup>3</sup> showed no difference in length of stay between general and spinal anesthesia for total hip arthroplasty in more than 20,000 patients included from the American College of Surgeons National Surgical Quality Improvement Program (Chicago, Illinois) database. Even when it comes to anesthesia supply costs for neuraxial *versus* general anesthesia, Wanderer *et al.*<sup>4</sup> recently argued that intraoperative “savings resulting from interventions focused on the clinical practice of attending anesthesiologists may be negligible.”

Long ago, Macario *et al.*<sup>5</sup> suggested that “anesthesia practice patterns may influence downstream events in the hospitalization, some of which may have substantial economic impact.” Indeed, Memtsoudis *et al.* build upon the work examining the operative, safety, and patient-centered outcomes for a perioperative surgical home focused on total joint replacements.<sup>6</sup> By including a cost analysis, however inaccurate, the results show that the preferred anesthetic of choice for primary arthroplasties may be some form of neuraxial anesthesia. Whether or not the administration of spinal and/or epidural anesthesia will result in indelible cost savings will remain a mystery until more rigorous cost accounting is undertaken.

## Competing Interests

The authors declare no competing interests.

Jacob A. Martin, M.D., Brandon P. Lentine, M.D., Mitchell H. Tsai, M.D., M.M.M. Larner College of Medicine, University of Vermont, Burlington, Vermont (J.A.M.). jacob.martin@uvmhealth.org

## References

1. Memtsoudis SG, Poeran J, Zubizarreta N, Olson A, Cozowicz C, Mörwald EE, Mariano ER, Mazumdar M: Do hospitals performing frequent neuraxial anesthesia for hip and knee replacements have better outcomes? *ANESTHESIOLOGY* 2018; 129:428–39
2. Adam T, Koopmanschap MA, Evans DB: Cost-effectiveness analysis: Can we reduce variability in