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Trends in incentive spirometry after long-acting interscalene nerve block with liposomal bupivacaine or ropivacaine infusion

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Introduction

Hemidiaphragmatic paralysis due to phrenic nerve blockade is a known complication of interscalene brachial plexus block (ISB) that can lead to respiratory complications, most commonly dyspnea. Patients with underlying lung disease or morbid obesity are at particularly high risk (1). However, the incidence of postoperative dyspnea after ISB remains high, around 9%, even in patients without known lung pathology (2). This can present a challenge in cases where more prolonged analgesia is desired. In addition to providing protracted pain relief, long-acting anesthetics such as liposomal bupivacaine or continuous anesthetic infusions likely prolong diaphragmatic paralysis and respiratory compromise. It is unclear at this time whether the risk for prolonged diaphragmatic paralysis is equivalent for patients who receive a continuous nerve infusion versus a single injection of a long-acting anesthetic such as liposomal bupivacaine.

To help minimize the risk of postoperative respiratory complications after long-acting ISB, our institution has begun providing patients with incentive spirometers for use in the postoperative period. While incentive spirometry is most commonly used as an intervention (e.g. for the prevention of respiratory complications in the postoperative period), it has also been used as an outcome measure for tracking respiratory compromise after rib fractures (3-4) and has been shown to correlate well with vital capacity (5). In this retrospective study, we examine postoperative changes in incentive spirometry (as a surrogate for changes in respiratory function) between patients who received ISB with liposomal bupivacaine versus a continuous infusion of ropivacaine for postoperative pain control after shoulder surgery.

Materials and Methods

Approval was obtained by the Duke Institutional Review Board (IRB Pro 00109961). Adult patients who received an interscalene nerve block with either liposomal bupivacaine or a continuous nerve catheter for shoulder surgery at Duke University Hospital, Duke North Pavilion or Duke Arringdon Surgery Center were considered for inclusion. Patients must also have received an incentive spirometer preoperatively for inclusion. Baseline incentive spirometer values were obtained prior to interscalene block. Postoperative incentive spirometer values were obtained by phone interview on postoperative days 1 and 2 (POD1&2). Descriptive statistics were used to describe patient characteristics including age, BMI,

type of surgery and incentive spirometry values (baseline, POD1, POD2). Comparisons were made between the groups using t-tests. A mixed ANOVA was used to investigate the impact of local anesthetic group (ropivacaine infusion versus liposomal bupivacaine) and time (baseline vs POD1 vs POD2) on incentive spirometer value. Post-hoc pairwise comparisons were also performed for each time point.

Results/Case Report

Twenty six patients were included in the analysis, 12 in the catheter group and 14 in the liposomal bupivacaine group. Results by group are summarized in Table 1. There were no significant difference between local anesthetic groups in terms of age, BMI or incentive spirometry values at baseline or on PODs 1-2. Incentive spirometer values at baseline were 2779.17ml in the catheter group versus 2746.43ml in the liposomal bupivacaine group. Values were 1933.33ml in the catheter group vs 2330.77ml in the liposomal bupivacaine group on POD1 and 2178.57ml vs 2308.33ml on POD2. Mixed ANOVA showed no significant effect for local anesthetic group and time ($p=0.294$)(Figure 1). A significant effect was found for the interaction of time alone ($p=0.0005$). Post-hoc pairwise comparisons demonstrated a significant difference between incentive spirometry values at baseline and on PODs 1 and 2. However, there was still no significant difference between the groups.

Discussion

In this retrospective study, we found that type of long-acting anesthetic (continuous ropivacaine infusion versus liposomal bupivacaine) did not significantly affect changes in incentive spirometry after interscalene block for shoulder surgery. However, our study is limited by a small sample size and by its retrospective nature. As might be expected, there was a significant reduction in incentive spirometry values on POD1 which persisted to POD2 in both groups. This drop in incentive spirometry suggests persistent phrenic nerve blockade with either technique, although postsurgical atelectasis or splinting could contribute. A more direct measure of diaphragm paralysis would be needed to confirm persistent hemidiaphragmatic paralysis with long-acting interscalene block. As this study encompassed only the first two postoperative days, we do not know when respiratory function returns to a patient's preoperative baseline or how much risk is inferred with the reduction in function we demonstrated in our study. These remain areas for future study.

References

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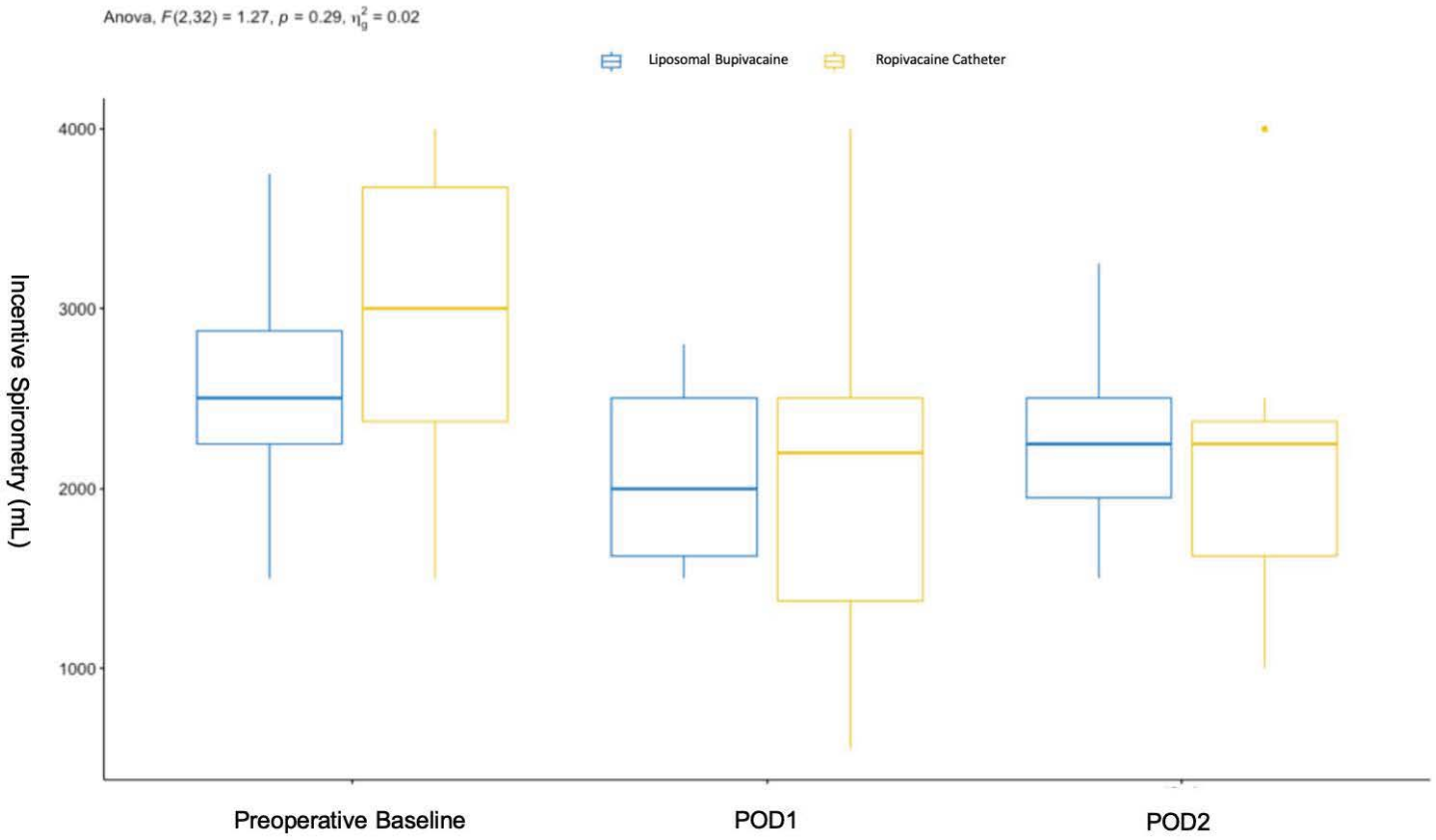
Disclosures

No

Tables / Images



	Liposomal Bupivacaine	*Continuous Catheter*	
Variable	**Mean (SD)**	**Mean (SD)**	**p-value**
Number of Subjects	14	12	
Age (years)	55.79 (12.45)	52.75 (16.46)	0.598
BMI	27.24 (4.38)	29.30 (5.68)	0.307
Baseline Incentive Spirometry (mL)	2746.43 (686.54)	2779.17 (931.14)	0.919
POD1 Incentive Spirometry (mL)	2330.77 (727.02)	1933.33 (887.63)	0.232
POD2 Incentive Spirometry (mL)	2308.33 (514.27)	2178.57 (975.90)	0.706

Procedure Type	Number of Subjects (%)	Number of Subjects (%)
AC Joint Reconstruction	1 (7.1)	0 (0)
Acromioplasty & Distal claviculectomy	1 (7.1)	0 (0)
Arthroscopic Lysis of Adhesions	3 (21.4)	7 (58.3)
Primary Total Shoulder	1 (7.1)	0 (0)
Reverse Total Shoulder	3 (21.4)	0 (0)
Rotator Cuff Repair	5 (35.7)	4 (33.3)
SLAP	0 (0)	1 (8.3)