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Comparison of Two Different Technique of Interscalene Block in Orthopedic Patients Undergoing Shoulder Surgery.

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ABSTRACT

Background: The traditional Interscalene brachial plexus block has a 100% incidence of diaphragmatic paralysis, resulting in a 25-30% reduction in forced vital capacity (FVC). A modified or low Interscalene block is defined as a brachial plexus nerve block below C6 but above the supraclavicular fossa. The purpose of our study was to determine if a modified Interscalene block would prevent diaphragmatic paralysis while providing an adequate pain control for patients undergoing shoulder surgery. **Methods:** 50 patients who were scheduled to undergo shoulder surgery were incorporated in the study. Patients were randomized to receive either a low (LI) or a traditional (TI) interscalene nerve block. Both groups received 15ml of 0.5% Bupivacaine diluted to 30ml for brachial plexus block. Post-block lung function was assessed using incentive spirometry. **Results:** The average decrease in lung volume in the group receiving the low-modified interscalene block was 900ml, while the decrease in the traditional group was 860ml. The decrease in lung volumes between the two groups was determined to be not significant (p= 0.525). **Conclusion:** Low interscalene brachial plexus blockade is often described as a technique used to prevent phrenic nerve blockade and hemi-diaphragmatic paralysis. Our study found that phrenic nerve blockade was low in LI group as compared to TI group. Postoperative pain scores, respiratory complications, need for supplemental oxygen, and delay in discharge did not occur in either group. We found that LI interscalene brachial plexus blockade not better than TI interscalene block.

Keywords: Brachial Plexus, Interscalene block, Shoulder surgery.

INTRODUCTION

Brachial plexus blockade can provide analgesia for ambulatory shoulder surgery.[1-3] Patients that undergo perineural anesthesia have higher rates of patient satisfaction, shorter PACU recovery times, decreased opioid consumption, and less nausea and vomiting than cohorts receiving parenteral opioids.[1-3] Interscalene brachial plexus blockade has been used routinely for ambulatory shoulder surgery for decades.[3] The traditional interscalene brachial plexus block (TI) has a 100 percent incidence of ipsilateral phrenic nerve blockade and subsequently unilateral hemi-diaphragmatic paralysis.[4-6] Patients undergoing TI interscalene block, with or without pre-existing pulmonary conditions, are more prone to intra and postoperative pulmonary complications. Two strategies are commonly suggested to preserve diaphragmatic function in the patients receiving interscalene brachial plexus blockade –

1. Use of a decreased volume of local anesthetic
2. Targeting the brachial plexus at a lower level in the neck.

Using a decreased volume of local anesthetic for interscalene blockade has been well studied, and it reliably decreases the incidence of hemi-diaphragmatic paralysis when performed under direct visualization using ultrasound guidance. Unfortunately, decreased volume blocks provide similar pain control initially; however, with the low-volume block, duration of action is much shorter.[11,13] A traditional interscalene brachial plexus block (TI) interscalene block is performed at the level of cervical vertebrae C6/.[14]

A low interscalene brachial plexus block (LI) is defined as being performed below the level of the C6 vertebrae, but above the supraclavicular fossa.[3] Below the level of C6, the phrenic nerve is located increasingly further away from the brachial plexus. In the general population, the incidence of hemi-diaphragmatic paralysis during brachial plexus blockade performed at the level of the supraclavicular fossa is 25%.[13-16] Although the

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incidence of hemi-diaphragmatic paralysis appears to be lower in the patient population undergoing LI interscalene block.. The purpose of this study was to determine if LIBPB preserves respiratory function in patients, determined by performance of inspiratory spirometry, while providing comparable pain relief.

MATERIALS AND METHODS

Patient Population This study was conducted after approval from the institutional review and ethics committee. Fifty patients undergoing shoulder surgery between August 2015 July 2016 were included in the study. To be eligible for enrollment, patients had to be at least 18 years of age, have a BMI ≤ 25, and have no history of contraindications to anesthesia. Patients were excluded on the basis of the following exclusion criteria.

1. Chronic opioid use
2. History of respiratory disorders, including COPD, asthma, lung cancer
3. Diagnosed acute respiratory infection within 6 week of surgery
4. Refusal of regional anesthesia
5. History of phrenic nerve paralysis or diaphragmatic abnormality

Informed consent was obtained from all eligible patients prior to the start of the study.

Study Design Prior to Surgery: All the subjects were randomly allocated to either the traditional TI or the LI group. All nerve blocks were performed in the preoperative area. Intravenous access was established and standard ASA monitors were applied. Conscious sedation was administered using midazolam and fentanyl. Sedation was titrated to effect with a maximum dose of 2mg of midazolam and 100mcg of fentanyl per patient. Oxygen was administered via nasal cannula, and the skin was prepped with chlorhexidine. A high-frequency transducer attached to a Sonosite ultrasound system was used for each block. The block was performed using a 2-inch 22-gauge stimulating needle and an inplane technique. Nerve stimulation was also used with an initial setting of 1.0 mA, 1 msec. A loss of nerve stimulation below 0.5 mA was used to avoid intraneural injection. Patients in the TI received an injection at the level of the C6 vertebrae. Patients in the LI received an injection below the level of the C6 vertebrae at the trunk level of the brachial plexus. At this level, the subclavian artery was visualized on ultrasound, and the block was performed above the level of the supraclavicular fossa. 15 mL of 0.5% bupivacaine plain was used for both treatment groups. Subsequently, all patients received general anesthesia for their shoulder surgery. The decision to use a laryngeal mask airway or endotracheal tube was determined by the intraoperative care team.

Measurement of Respiratory Function: Prior to sedation and performance of peripheral nerve blockade, all the patient were given an incentive spirometer and instructed on its use. After each patient was appropriately acquainted with the incentive spirometer, they were asked to perform sustained maximal inspiration (SMI) three times. The average SMI was recorded. SMI was measured at three time points during the course of the study – baseline (prior to nerve block), 30 min post-nerve block, and 60 min post-operation.

Post-Operative Assessment: Patients were admitted to the post-anesthesia care unit (PACU) following the operation. The following measurements were recorded by perioperative nursing staff at 15 minute intervals for the first hour in the PACU – heart rate, blood pressure, oxygen saturation, and pain score using a numeric scale from 1-10. In addition, the administration of any pain medication or supplemental oxygen therapy at any time during PACU stay, and the total time spent in the PACU was recorded.

Statistical Analysis: All statistical analyses were performed by statastician. All study variables were assessed for normality using a Shapiro-Wilk test. Normally distributed continuous variables were expressed as means and compared using either an independent samples T-test, one-way ANOVA or repeated-measures ANOVA. Nonparametric continuous variables were expressed as medians and compared using a Mann Whitney U-test or Kruskal-Wallis ANOVA. Categorical variables were expressed as percentages and compared using a Chi-square analysis. For all tests, a p-value ≤ 0.05 were considered statistically significant.

RESULTS

A total of 50 patients were enrolled in this study. 25 patients were randomized into the each experimental LI group while 25 patients received the standard TI. Subject demographic information is summarized in [Table 1].

Table 1: ?

	LI	TI	P value
Age (mean±SD)	58 ±13	64±9	.867
Sex (% females)	48	78	.001
Weight (mean±SD)	55±10	54±11	.545

Table 2: Comparison of sustainable maximal inspiration.

	LI(N 25)	TI(N25)	PVALUE
Baseline SMI MEAN±SDml	3080±456	2306±580	.036
30MIN POST Block SMIml	2089±611	1540±544	.154
60 MIN POST OP SMIml	1930±580	1453±496	.148

A repeated measures ANOVA was performed to detect differences in the mean SMI at baseline, 30 min post-nerve block, and 60 min post-operatively.

Within the entire population, there was significant change in mean SMI over time (p<.001; however, this effect was not attributed to block type (p=0.525). The mean SMIs for both the LI and TI at each study time point are displayed in [Table 2].

At baseline, mean SMI was higher in the patients in the experimental LI group compared to the TI group (p=0.036); however, there were no group differences in mean SMI at 30 min post- nerve block (p=0.154) and 60 min postoperative (p=0.148). Lastly, while the LI group had a slightly greater reduction in SMI from baseline to 30 min post nerve block (-991 ± 551 mL) compared to TIBPB (-865 ± 503 mL), this change was not statistically significant (p=0.324). Lastly, there was no difference in the percentage of patients that required supplemental oxygen therapy in the PACU between the LI and TI group (p=0.657)

DISCUSSION

Our study sought to examine the efficacy of performing interscalene brachial plexus blockade lower in the neck, and the potential for sparing of the phrenic nerve. An adequate volume and concentration of local anesthetic was used to avoid decreased duration of the block. We found that phrenic nerve blockade routinely occurred when using 15mL of 0.5% bupivacaine for an interscalene block in patients. Both the low and traditional interscalene groups experienced equivocal reductions in sustained maximal inspiration, suggesting phrenic nerve paralysis occurred in both groups. Moving the location of the block to lower in the neck, without modifying other parameters of block technique, is not an effective strategy for preventing phrenic nerve blockade. Some thought was given to the potential increased risk of pneumothorax that may result from low brachial plexus blockade. Pneumothorax would be a devastating and difficult to treat complication in this population. There is no data for the incidence of pneumothorax during low brachial plexus blocks. However, the most feared complication of a supraclavicular block is pneumothorax, with incidence as high as 6.1% reported during the 1960's.[14] However, recent literature indicates that the use of ultrasound guidance by an experienced provider substantially reduces the risk of clinically significant pneumothorax during supraclavicular blockade to 0.06%,[17] demonstrating further similarities in terms of safety between the two blocks. The LI and TI groups were also otherwise similar in terms of their post-operative course. Post-operative pain scores and pain medication requirements were similar between the two groups. Neither group required supplemental oxygen in the PACU, other than routine brief use of nasal cannula immediately post-operatively. There were no respiratory complications or unplanned admissions in either group. Length of time in the PACU was not prolonged. In addition, several of the patients found post-block use of the incentive spirometer to be distressing when they were unable to achieve pre-block sustained maximal inspiration volumes. In conclusion, low-modified interscalene brachial plexus blockade in patients provides no respiratory benefit. Moving the location of brachial plexus blockade to lower in the neck has been described as a strategy to avoid phrenic nerve blockade; however, our group found no statistically significant evidence to support this claim. Although use of interscalene peripheral nerve blocks in these patients uniformly caused hemi-diaphragmatic paralysis, the effects of reduction in FVC do not appear to cause clinically significant respiratory complications or increase PACU length of stay.

CONCLUSION

Both low modified and traditional interscalene brachial plexus blockade appear to be safe and provide adequate analgesia in patients. Due to similar safety profiles and pain control, neither seems to have a distinct advantage over the other. Decision to use either block can be based on ease of performance and patient comfort.

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