Original Research Article

Indian Journal of Anesthesia and Analgesia
2019; 6(3) (Part - II): 943-951
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.6319.36

Comparative Study on Ultrasound Guided Shoulder Block Versus Interscalene Brachial Plexus Block in Patients Undergoing Arthroscopic Shoulder Surgery

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Abstract

Background: Ultrasound (US)-guided Interscalene or Shoulder blocks are commonly used for Shoulder arthroscopic surgeries. *Aim:* The aim of this randomized study were to compare the block performance and onset times, effectiveness, incidence of adverse events and patient's acceptance of US-guided Interscalene or Shoulder blocks. *Methods:* 68 patients were randomized to two equal groups: Shoulder block (SB) and Interscalene group (ISN). Each patient received a mixture containing 0.75% Ropivacaine. The block performance and latency times, surgical effectiveness, adverse events and patient's acceptance were recorded. *Results:* The mean block performance time was 5.529 ± 1.022 mins in the ISN group and 8.559 ± 1.260 mins in the SB group. Onset of sensory block and motor block was early in ISN group. However, duration of sensory and motor block was higher in SB group. The total requirement of analgesic was higher in SB group and patients' satisfaction was slightly more in ISN group. Also, ISN group had more complications than SB group. The haemodynamic parameters (H.R, systolic BP, diastolic BP, RR and SpO_2) were recorded at 0, 4, 6, 12 & 24 hours. These parameters were all comparable in both the groups, thus statistically insignificant. *Conclusion:* Shoulder block can be considered in patients with Acute or Chronic respiratory distress, decreased pulmonary reserve, elderly patients, COPD patients and in patients with absolute contraindication to any degree of phrenic nerve block which almost always occurs in Interscalene nerve block.

Keywords: Brachial Plexus; Arthroscopic Shoulder surgery.

How to cite this article:

Manisha Sharma, Ram Mohan Gurram, Suneetha Chitithoti et al. Comparative Study on Ultrasound Guided Shoulder Block Versus Interscalene Brachial Plexus Block in Patients Undergoing Arthroscopic Shoulder Surgery. Indian J Anesth Analg. 2019;6(3):943-951.

Introduction

Major surgery such as Shoulder arthroscopy are associated with moderate to severe postoperative pain. These procedures are amenable to regional anaesthesia techniques which decrease neuroendocrine stress responses, central sensitization of nervous system and muscle spasms

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Received on 26.03.2019, **Accepted on** 04.05.2019

which occur in response to pain stimuli. Inadequate relief of postoperative pain may result in harmful physiological and psychological consequence that lead to significant morbidity. This may delay recovery and return to daily activities. Also, the presence of postoperative symptoms including pain contributes to patients' dissatisfaction with their surgical and anaesthetic experience. In addition, inadequately treated postoperative pain may lead to chronic pain. Various analgesic techniques for Shoulder arthroscopic surgeries such as intra-articular injection of local anaesthetics, parenteral opioids, brachial plexus block have been used with varying effectiveness, but not without side effects [1]. Continuous intra-articular Bupivacaine infusion is associated with Glenohumeral chondrolysis. Parenteral opioids are effective, but may result in adverse reactions such as nausea, vomiting, sedation and dizziness [1]. Regional anaesthetic techniques have specific advantages both for stand alone anaesthesia or as analgesic supplements for intraoperative and postoperative care [2,3]. Brachial plexus blockis preferred as analgesic supplement for its rapid onset, reliable anesthesia and as a safe technique for Shoulder arthroscopic surgeries for Rotator cuff tear (Supraspinatus, Infraspinatus, Subscapularis and Teres minor) [4,5]. There are many advantages of supplementing brachial plexus block with general anaesthesia for Shoulder arthroscopic surgeries, namely effective analgesia with good motor blockade, extended post-operative analgesia, early ambulation, early resumption of oral feeding, minimum number of drugs used so that polypharmacy is avoided, less incidence of post-operative nausea and vomiting, ideal operating conditions can be met, PACU and ward nurses particularly appreciate the use of regional anaesthesia. The Interscalene block (ISN) technique is more effective in controlling postoperative pain causing lower pain scores and less rescue opioid consumption for pain relief [4,5,6]. However, it is essentially associated with complications such as unintentional injection of local anaesthetic into the epidural space, spinal cord and brachial plexus injury, brain damage or adverse effects such as blockade of phrenic nerve, vagus nerve, recurrent laryngeal nerve, stellate ganglion, cervical sympathetic ganglion, Horners syndrome and respiratory complications such as respiratory distress and pneumothorax [7,8]. Phrenic nerve block occurs almost in all patients undergoing Interscalene nerve block. These side effects and complications lead to the development of an alternative regional anaesthetic technique or shoulder arthroscopic surgery. The combination of Suprascapular nerve block (SSN) and Axillary nerve (AXN) block called as Shoulder block (SB) has been reported to provide safe and effective intra-operative and post operative analgesia for Shoulder arthroscopic surgeries for Rotator cuff tear. Shoulder block could be considered especially in older patients with pulmonary comorbidities such as chronic obstructive pulmonary disease, restrictive lung disease, prior pneumonectomy on the opposite side and so on [9]. Since its introduction into clinical practice, Ultrasonography has become a valuable adjunct for peripheral nerve blocks. Initially used in conjunction with nerve stimulation, ultrasound guidance has increasingly been used as the sole modality to locate and anaesthetize the brachial plexus. By allowing the operator to visualize in real time, the nerve, needle, and local anesthetic spread, it has resulted in success rates equal or superior to 95% for the Interscalene, Suprascapular, Supraclavicular, Infraclavicular and axillary approaches**.** Nowadays; the intraoperative use of ultrasonography becomes more popular and much easier. Its use in these blocks increases the success rate and decreases complications. This is a prospective randomized controlled study to compare Shoulder block and Interscalene approaches for brachial plexus block using ultrasound guidance in patients undergoing Shoulder arthroscopic surgery for Rotator cuff tear.

Materials and Methods

The present study conducted in patients at Yashoda Hospital, a multi speciality hospital in Secunderabad, during the period of February 2016 to May 2017.

The study protocol was approved by the Institutional Ethical committee and informed consent was taken from each of the patients.

The study included total 68 patients belonging to ASA grade I, ASA grade II and ASA grade III with age between 18 to 60 years posted for Shoulder arthroscopic surgeries. It is a prospective, randomized, double blinded and controlled study. After obtaining written informed consent, patients satisfying the inclusion criteria were randomized into 2 groups using a computer generated random number list.

Group I received USG guided SB with 20 mL of 0.75% ropivacaine (max 150 mg).

Group II received USG guided ISN block with 20 mL of 0.75% ropivacaine.

Group allocation was concealed in sealed, opaque envelopes. A pain nurse who had undergone prior education in assessment of postoperative analgesia and who was unaware of group assignment, collected data on each patient. Thus both the patients and the observer were blinded. A sample size of 34 patients each, randomly allocated into two groups, using computerized randomization. We planned for an inclusion of 34 patients in each group to compensate for any dropouts and the uncertainty in our estimated standard deviation.

Group SB: patients receiving ultrasound guided Shoulder block.

Group ISN: Patients receiving ultrasound guided Interscalene Nerve block. Patients of either sex between 18-60 years. Patients with American Society of Anaesthesiologists grade I, II and III physical status. Patients planned electively for Shoulder Arthroscopic surgery under general anaesthesia. Patients capable of giving an informed consent. Patients with ability to follow study protocol were included in the study.

Exclusion criteria: Patients with age less than 18 yrs and Age greater than 60 years, patients with ASA IV or V adults, patients with hypersensitivity to amide local anaesthetics, patients with uncontrolled anxiety, patients with significant cardiovascular disease, patients with uncontrolled diabetes, patients with schizophrenia or bipolar disorder, patients with peripheral neuropathy, patients with renal Impairment (Creatinine greater than 2.0 mg/dl), patients with liver impairment, patients with BMI greater than 35, patients with preexisting nerve damage (sensory or motor) in the extremity to be blocked, patients with history of chronic pain condition or daily intake of analgesics and steroids, patients with history or Ongoing drug abuse or alcohol abuse, patients with pregnancy, patients with daily use of gabapentin, pregabalin, tricyclic antidepressant, serotonin- norepinephrine reuptake inhibitor, tramadol were excluded from the study.

Obtained ethical clearance from the instituitional ethical committee. Each patient was visited pre-operatively, procedure was explained and written informed consent was obtained. Pre-anaesthetic evaluation was done on the evening before surgery. A routine examination was conducted assessing general condition of the patients, airway assessment by Mallampatti grading and rule of 1-2-3, nutritional status, weight and height of the patient, a detailed examination of the cardiovascular system, a detailed examination of the respiratory system, the surface anatomy where the block was going to be given.

The following investigations were done in all the patients: Haemoglobin estimation, urine examination for albumin, sugar and microscopy, standard 12 lead ECG, X-ray chest, fasting and post prandial blood sugars, blood urea and serum creatinine. All patients included in the study were premedicated with the tablet Alprazolam 0.5 mg and Ranitidine 150 mg orally at night before surgery and were kept nil orally 11 PM onwards.

On arrival of patients in the operating room, a 20 guage intravenous cannula was inserted on the non-operating hand and infusion of normal saline was started. All patients were pre-medicated with I.V. 1 mg midazolam 20 minutes before giving the block. The patients were connected with monitor to record heart rate, non-invasive measurement of systolic blood pressure (SBP), diastolic blood pressure (DBP), continuous electrocardiogram monitoring and hemoglobin oxygen saturation (SpO_2). The baseline blood pressure, heart rate and SpO_2 level were recorded. Descriptive and inferential statistical analysis has been carried out in the present study.

Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. Significance levels (ascending order): * = $p<0.05$; ** = $p<0.01$; *** = $p<0.001$. The following assumptions on data are made: 1. Dependent variables should be normally distributed, 2. Samples drawn from the population should be random, and cases of the samples should be independent. Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters. ANOVA (analysis of variance test) has been used to find the significance of study parameters on categorical scale between two or more groups. The Statistical software namely Windostat version 9.2 was used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc. p value < 0.05 is considered to be significant and p value > 0.05 is considered to be non significant.

Results

Table 1: Demographic profile of patients.

Parameters	Group ISN (Mean ± SD)	Group SB (Mean ± SD)	p value
Age in years	26.529 ± 6.752	28.000 ± 6.719	0.140
Weight in Kgs	59.794 ± 3.844	58.853 ± 5.695	0.191
Height in cms	158.324 ± 4.367	157.353 ± 4.424	0.277

The p value was is not significant showing that the groups are comparable with regards to Age, Weight and height. There was statistically no difference between two groups.

Table 2: Comparison of onset of sensory block, comparison of onset of motor block.

	Group ISN (Mean ± SD)	Group SB (Mean ± SD)	p value
Onset of sensory block (min)	3.5 ± 0.862	13.676 ± 2.142	0.000
	Group ISN (Mean ± SD)	**Group SB (Mean ± SD)**	**p value**
Onset of motor block (min)	5.941 ± 1.071	11.765 ± 1.793	0.000

Onset time is the time from the completion of injection of the local anaesthetic to first loss of pinprick sensation in any of the dermatomes C5-T1. In group ISN, it was 3.500 ± 0.862 min and 13.676 ± 2.142 min in group SB. p value is 0.000 which is significant. This shows that Interscalene nerve block provides faster sensory block than Shoulder block. The total time required to achieve complete paralysis of the upper limb was considered as onset of motor block. In group ISN, it was 5.941 ± 1.071 min and 11.765 ± 1.793 min in group SB. P value is 0.000 which is significant.

Table 3: Comparison of duration of motor block, comparison of duration of sensory block.

	Group ISN (Mean ± SD)	Group SB (Mean ± SD)	p value
Duration of motor block (hrs)	11.559 ± 1.418	13.059 ± 1.757	0.000
	Group ISN (Mean ± SD)	**Group SB (Mean ± SD)**	**p value**
Duration of sensory block (hrs)	13.000 ± 1.348	13.882 ± 1.552	0.015

Duration of motor blockade was longer in group SB (13.059 ± 1.757 hrs) compared to group ISN (11.559 ± 1.418 hrs) and this difference was statistically significant. The above mentioned values compare the duration of sensory blockade in the two groups. Duration of sensory blockade was longer in group SB (13.882 ± 1.552 hrs) compared to group ISN (13.000 ± 1.348 hrs) and this difference was statistically significant.

Table 4: Comparison of tramadol requirements in 24 hrs, comparison of block performance time (BPT), comparison of patient satisfaction.

	Group ISN (Mean ± SD)	Group SB (Mean ± SD)	p value
Total amount of rescue tramadol in 24 hrs	24.265 ± 32.266	25.000 ± 27.524	0.920
	Group ISN (Mean ± SD)	**Group SB (Mean ± SD)**	**p value**
BPT	5.529 ± 1.022	8.559 ± 1.260	0.000
	Group ISN (Mean ± SD)	**Group SB (Mean ± SD)**	**p value**
Patient Satisfaction	2.088 ± 0.712	1.382 ± 0.652	0.000

Total amount of rescue analgesic i.e. Tramadol injections required in 24 hours in the two groups. The requirement of rescue injections in 24 hours was less in group ISN (24.265 ± 32.266) than group SB (25.000 ± 27.524). The difference was not statistically significant. Duration in group ISN was 5.529 ± 1.022 min and in group SB was 8.559 ± 1.260 min and this difference was statistically significant as p value is 0.000. The above mentioned values compare the satisfaction of patients in the two groups. It was 2.088 ± 0.712 in ISN group and 1.382 ± 0.652 in SB group and this difference was statistically significant as p value is 0.000.

Haemodynamic parameters (HR, systolic BP, diastolic BP, RR & SpO_2) were recorded at 0, 4, 6, 12 and 24 hours to record any incidence of bradycardia or hypotension. ANOVA test was used to compare all these variables over different intervals of time.

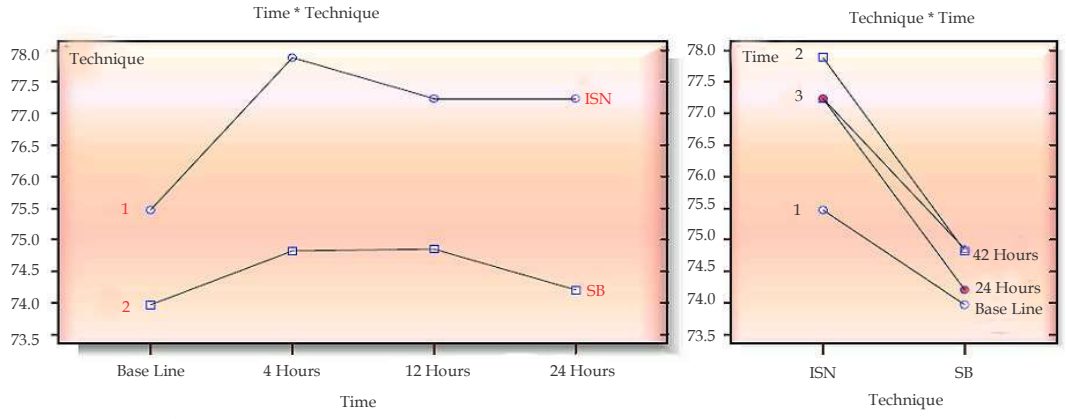

Fig. 1: ANOVA for heart rate

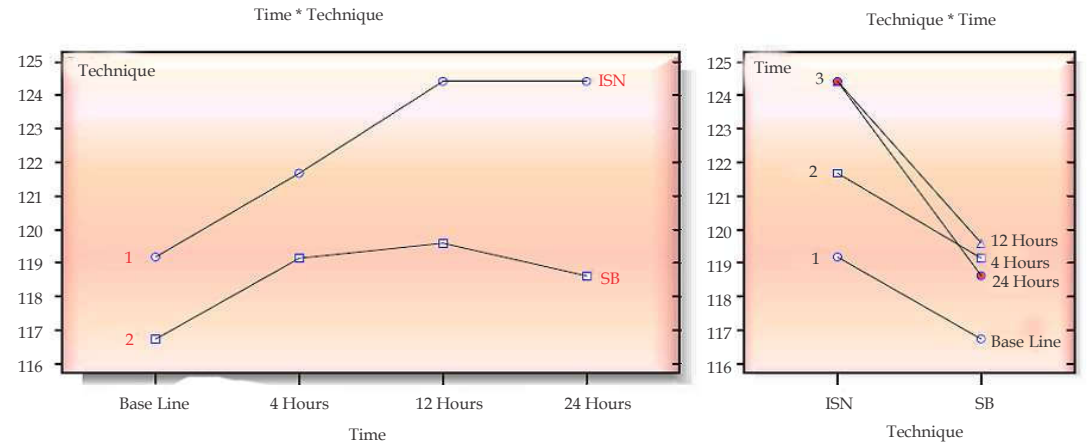

Fig. 2: ANOVA for systolic BP

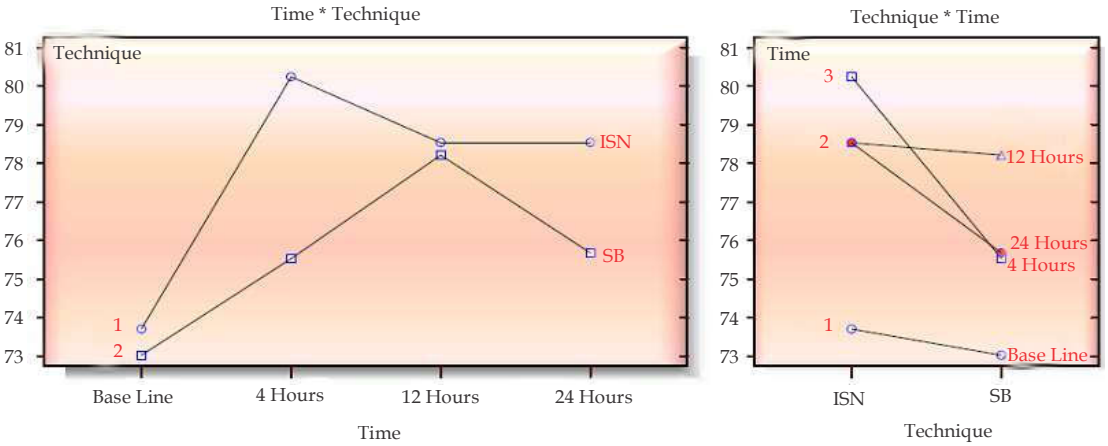

Fig. 3: ANOVA for diastolic BP

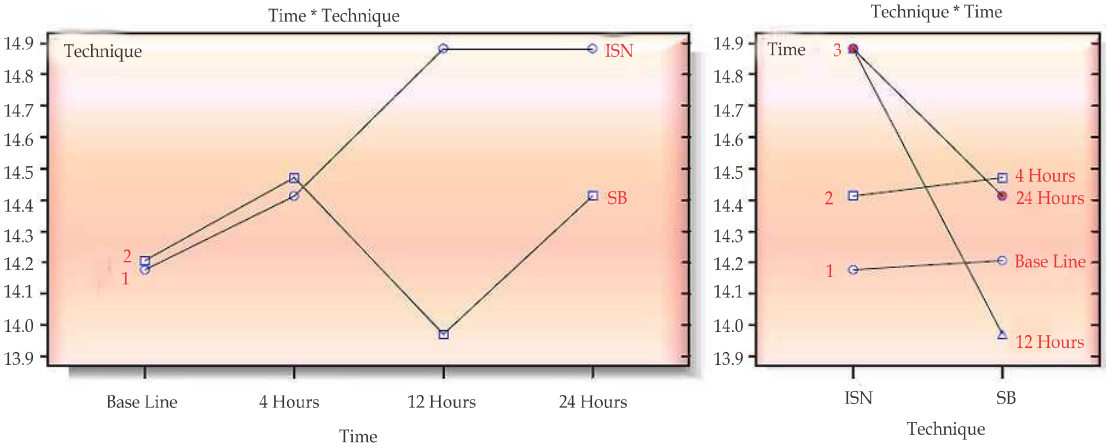

Fig. 4: ANOVA for respiratory rate

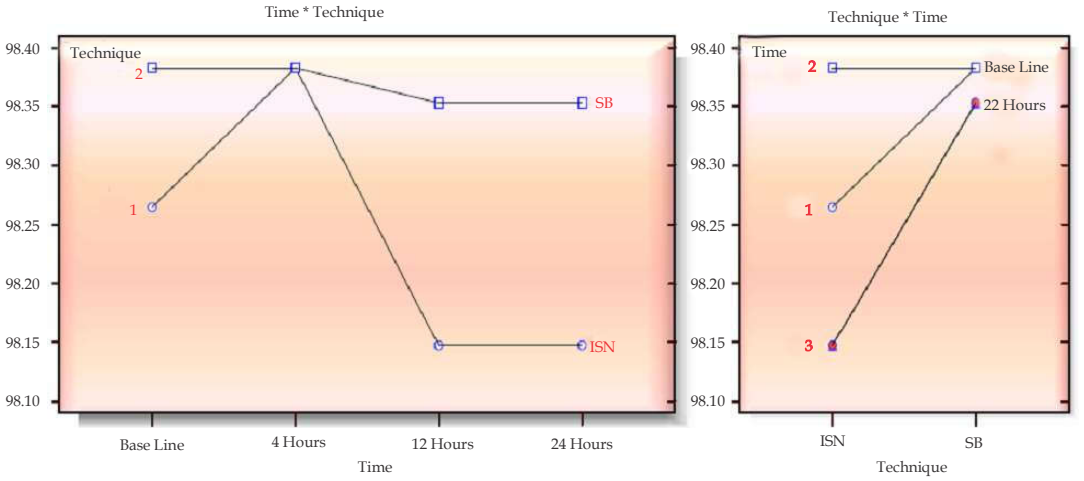

Fig. 5: ANOVA for SpO_2

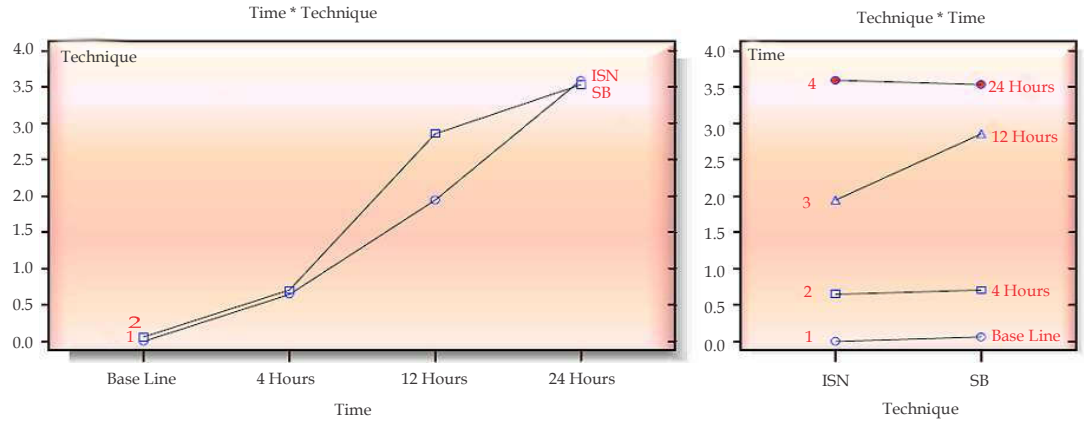

Fig. 6: ANOVA for numerical rating scale

There was no significant statisitical difference among the two groups in HR, Systolic BP, Diastolic BP, RR and SpO_2 during the first 24 hours. Numerical rating scale (NRS) scores were also recorded at 0, 4, 6, 12 and 24 hours. ANOVA was applied for statistical analysis of NRS scores in the two groups over the various time intervals. Data displayed on graph are mean NRS scores of that time interval. In our present study we found that NRS scores were initially higher in SB group but in the total 24 hour period post surgery, NRS scores of both the groups remained comparable. Differences in NRS scores of the two groups was statistically significant. (p=0.030). However, clinically this significance is not of much importance as during the first 24 hours post surgery, NRS scores remain less than 4 on a scale of 10.

Bromage scale scores were also recorded at 0, 4, 6, 12 and 24 hours. ANOVA was applied for statistical analysis of Bromage scores in the two groups over the various time intervals. Bromage scores were initially higher in ISN group indicating a denser motor block in ISN group but in the total 24 hour period post surgery, Bromage scores of both the groups remained comparable. Differences in Bromage scores of the two groups was statistically significant. (p=0.000). However, clinically this significance still remains debatable.

In ISN group of patients, there were incidences of Horners syndrome, hoarseness of voice, respiratory distress, pneumothorax, paraesthesia in arm and nausea & vomiting. While in SB group of patients there were procedural complications such as intravascular injection, haematoma, nausea & vomiting and LAST (local anaesthetic systemic toxicity).

Discussion

In our study, the two groups were comparable in age, sex, weight, height and ASA physical grade. All this imply that there was no statistically significant difference in age, sex, weight, height

and ASA physical grading among both the groups with p= 0.140, p= 0.810, p = 0.191, p= 0.277, p= 1.000 respectively. Analgesic requirement i.e. Tramadol in first 24 hours was low in ISN than SB, still it was non significant (p= 0.920).

Onset of sensory block, onset of motor block was earlier in ISN than SB which were statistically significant (p= 0.000 & p= 0.000 respectively). Duration of sensory and motor block was more in SB at p values of 0.015 & 0.000 respectively, thus statistically significant.

However, block performance time was less and patient satisfaction was more in ISN which were also statistically significant (p= 0.000 & p= 0.000 respectively).

In our study, haemodynamic parameters (H.R, systolic BP, diastolic BP, RR and SpO_2) were recorded at 0, 4, 6, 12 & 24 hours. These parameters were all comparable in both the groups, thus statistically insignificant.

Numerical rating scale (NRS) scores were also recorded at 0, 4, 6, 12 and 24 hours. Numerical rating scale scores were initially higher in SB but in 24 hour period it were comparable with the scores of ISN. NRS scores were statistically significant p= 0.030. However, clinically this significance is not of much importance as during the first 24 hours post surgery, NRS scores remain less than 4 on a scale of 10 in both the groups.

Bromage scale scores were also recorded at 0, 4, 6, 12 and 24 hours. In our present study we found that Bromage scores were initially higher in ISN group indicating a denser motor block and in ISN group but in the total 24 hour period post surgery, Bromage scores of both the groups remained comparable. Differences in Bromage scores of the two groups was statistically significant. (p=0.000). However, clinically this significance still remains debatable.

1. Onset of sensory block

In our study, we observed that onset time was 3.500 ± 0.862 min in group ISN and 13.676 ± 2.142 min in group SB. (P =0.000). Onset time is the time from the completion of injection of the local anaesthetic to first loss of pinprick sensation in any of the dermatomes C5-T1. This shows that Interscalene nerve block provides faster sensory block than Shoulder block.

2. Onset of motor block

In our study, we observed that onset of motor block was earlier in study group ISN having the mean value of 5.941 ± 1.071 min and in comparison, the SB group had a mean value of 11.765 ± 1.793, which is statistically significant (p = 0.000). The total time required to achieve complete paralysis of the upper limb was considered as onset of motor block. This shows that Interscalene nerve block provides faster motor block than Shoulder block.

3. Duration of motor block

The duration of motor block, in our study was 11.559 ± 1.418 hours in group-ISN and 13.059 ± 1.757 hours in group-SB, which is statistically significant (p= 0.000). This shows that SB has a longer duration of motor block than ISN block.

4. Block performance time

The block performance time in our study was 5.529 ± 1.022 mins in group-ISN and 8.559 ± 1.260 mins in group-SB, which is statistically significant (p= 0.000). This shows that ISN block is performed in a shorter time than SB.

5. Duration of sensory block

In our study, we observed that duration of sensory block was longer in study group SB having the mean value of 13.882 ± 1.552 hours and in comparison, the ISN group had a mean value of 13.000 ± 1.348 hours, which is statistically significant (p = 0.015). This shows that SB provides a longer duration of pain relief in patients than ISN block but clinically it still remains insignificant.

6. Duration of analgesia

Pain was assessed using a standard Numeric Rating Scale (NRS) by an independent anaesthesiologist. Time for first request for postoperative analgesic (duration of analgesia) was noted when NRS score was 4. In our present study we found that NRS scores were initially higher in SB group but in the total 24 hour period post surgery, NRS scores of both the groups remained comparable. Differences in NRS scores of the two groups was statistically significant. (p=0.030). However, clinically this significance is not of much importance as during the first 24 hours post surgery, NRS scores remain less than 4 on a scale of 10. The duration of analgesia, in our study was 13.000 ± 1.348 hoursin group-ISN and 13.882 ± 1.552 hours in group-SB, which is statistically significant (p = 0.015).

Patricia Falcao Pitombo et al. [1], in his study found that the duration of analgesia was longer in Shoulder block group compared with Interscalene

nerve block group, 26.3 ± 7.7 hours versus 20.4 ± 6.8 hours respectively (p=0.002).

This shows that Shoulder block group provided prolonged analgesia than Interscalene group in shoulder arthroscopic surgeries.

7. Patient satisfaction

In our study patient satisfaction was 2.088 ± 0.712 in ISN group and 1.382 ± 0.652 in SB group and this difference was statistically significant as p value is 0.000.

Hala E. Zanfaly et al. [10] in his study evaluated the patients with a questionnaire on a 10 point scale for pain. He found that patient satisfaction was higher in the Interscalene nerve block group of patients {9 (9-10)} than the Shoulder block group of patients {8 (8-9)} (p< 0.001).

8. Requirement of rescue analgesic

In our study we found that the requirement of rescue injections i.e Tramadol in 24 hours was less in group ISN (24.265 ± 32.266) than group SB (25.000 ± 27.524). The difference was not statistically significant.

Hala E. Zanfaly et al. [10] in his study found that the time to first analgesic request, was significantly longer in Interscalene group of patients {10 (9-10) hours} than Shoulder group of patients {9 (9-10) hours} (p< 0.001). He also concluded that the total mean morphine consumption (rescue analgesic) over 24 hours postoperatively was significantly higher in Shoulder block group {6 (6-7) mg} than Interscalene group of patients {6(5-6) mg} (p< 0.001).

9. Haemodynamic variables

In our study we found that there was no significant statisitical difference among the two groups in HR, Systolic BP, Diastolic BP, RR and SpO_2 during the first 24 hours.

10. Adverse effects

In our study, incidence of haematoma, nausea and vomiting (because of opioids), intravascular injection and LAST (local anaesthetic systemic toxicity) were reported in Shoulder block group of patients during the first 24 hours post surgery.

In the Interscalene group, almost all patients had ipsilateral diaphragmatic palsy because of the phrenic nerve involvement leading to respiratory distress or respiratory arrest. Also incidence of Horners syndrome due to the involvement of stellate ganglion, pneumothorax, hoarseness of voice because of recurrent laryngeal nerve involvement, paraesthesia in arm and nausea & vomiting (because of opioids), were reported.

All the complications were managed efficiently.

Waleed Abdalla et al. [11] in his study recorded more complications in Interscalene group i.e dyspnea (13.33%), Horner's syndrome (16.67%), hoarseness of voice (6.67%), major weakness of upper arm (53.33%), pain during needle entry (10%), and postoperative nausea and vomiting (PONV) (6.7%). On other hand fewer number of complications were recorded in Shoulder block group of patients pain during needle entry (16.67%) and postoperative nausea and vomiting (PONV) (13.33%).

Hala E. Zanfaly [11] et al. in his study found that the Shoulder block group of patients had the lowest incidence of complications compared with the Interscalene group. In Interscalene group, patients reported Horner's syndrome (36%) and weakness in the arm postoperatively (28%). The difference was significant (p < 0.001). He stated that the higher incidence of the potentially serious complications in Interscalene group was due to unpredictable spread of local anaesthetic to important adjacent neural structures such as phrenic and vagus nerves and the stellate ganglion.

Patrícia Falcao Pitombo et al. [1] in his study too reported complications with Interscalene group of patients such as unintentional injection of local anaesthetic into the vertebral artery, epidural space, spinal cord and brachial plexus injury; or adverse effects such as blockade of phrenic nerve, vagus nerve, recurrent laryngeal nerve, stellate ganglion, pneumothorax and transient neurological complications

Hence, Shoulder block can be considered in patients with Acute or Chronic respiratory distress [12], decreased pulmonary reserve [12], elderly patients, COPD patients [12] and in patients with absolute contraindication to any degree of phrenic nerve block which almost always occurs in Interscalene nerve block.

Conclusion

This study shows that onset of sensory and motor time is earlier in Interscalene nerve block group. Duration of sensory and motor time is more in Shoulder block group. Performance time of the block technique is less for Interscalene approach than combined Suprascapular and Axillary

approach for brachial plexuses block. Patients were well satisfied in both groups with more adverse effects observed in interscalene nerve block group.

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