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Original Research Article

Comparison between USG Guided Interscalene Block Plus USG Guided Superficial Cervical Plexus Block (Single Prick) Versus USG Guided Interscalene Block Plus Landmark Guided Superficial Cervical Plexus Block (Two Prick) for Surgeries of the Clavicle: A Prospective Study

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Abstract:

Background: Fractures of the clavicle are common, comprising 2.6% to 4% of adult fractures, mainly resulting from trauma and accounting for 35% of shoulder girdle injuries. Surgical fixation of clavicular fractures has traditionally involved General Anesthesia (GA) due to challenges in nerve blocking. However, GA has associated with risks. Regional Anesthesia (RA) has emerged as a favorable alternative for clavicular surgeries, but its use as the sole technique is limited due to the complexity of nerve blocking. This study evaluates the efficacy of combined USG-guided SCPB and ISB as the sole RA technique for clavicular surgeries, addressing a research gap.

Methods: This prospective study at GMC Baramulla included adult patients undergoing clavicular fracture surgery. Ethical approval and informed consent were obtained. Sample size was calculated for 44 patients. Participants were randomized into two groups: Group A received USG-guided ISB and SCPB, while Group B received USG-guided ISB with landmark-guided SCPB. Anesthesia was administered by experienced anesthesiologists. Data on demographics, intraoperative details, anesthesia efficacy, success rate (The main outcome or success was defined as absence of cold sensation for all 4 branches of the superficial cervical plexus at 15 mins), and postoperative complications were collected. Statistical analysis was performed using SPSS 20.0 with significance set at $p < 0.05$.

Results: The baseline characteristics of 44 patients in Group A (n=21) and Group B (n=23) were comparable, including age, weight, height, BMI, surgical procedure, ASA class, and location of the fracture. Heart rate, systolic and diastolic blood pressure, and SPO2 remained consistent between the groups at various time points during the postoperative period. Group A had significantly shorter procedure time (15.73 ± 1.67 minutes) compared to Group B (18.62 ± 2.42 minutes). Single prick technique was more comfortable and acceptable by patients than two prick technique. However, there were no significant differences in the onset and duration of sensory and motor blocks, surgical procedure duration, conversion to general anesthesia, need for analgesic supplementation, success rate, or complications between the groups.

Conclusion: The anesthesia efficacy, success rate, and complication rates were comparable between the two groups. Anesthesiologists can consider the advantages of reduced procedural time when choosing between the two techniques, while also taking into account individual patient factors and institutional resources.

Keywords: Clavicle surgery, Regional anesthesia, Ultrasound-guided block, Interscalene block, Superficial cervical plexus block

Introduction

Fractures of the clavicle are prevalent, accounting for 2.6% to 4% world wide of all adult fractures, often resulting from trauma and comprising 35% of shoulder girdle injuries [1]. Historically, surgical fixation of clavicular fractures has involved General Anesthesia (GA) due to the challenges in adequately blocking the nerves supplying the surgical area [2]. However, GA comes with potential risks, including haemodynamic stress response, increased drug usage, Post-operative Nausea and Vomiting (PONV), and airway complications, especially for patients with co-morbidities [3]. Nerve Supply of Clavicle: (Figure 1) lateral 2/3rd of clavicle receives its sensory nerve supply from branches of the superficial cervical plexus, {supraclavicular nerve (C3-C4)}, brachial plexus {axillary nerve(C5-C6) nerve to Subclavius (C5-C6) suprascapular nerve (C5-C6)lateral pectoral nerve(C5-C7)} and medial 1/3 by spinal Accessory nerve(CNXI) [3].

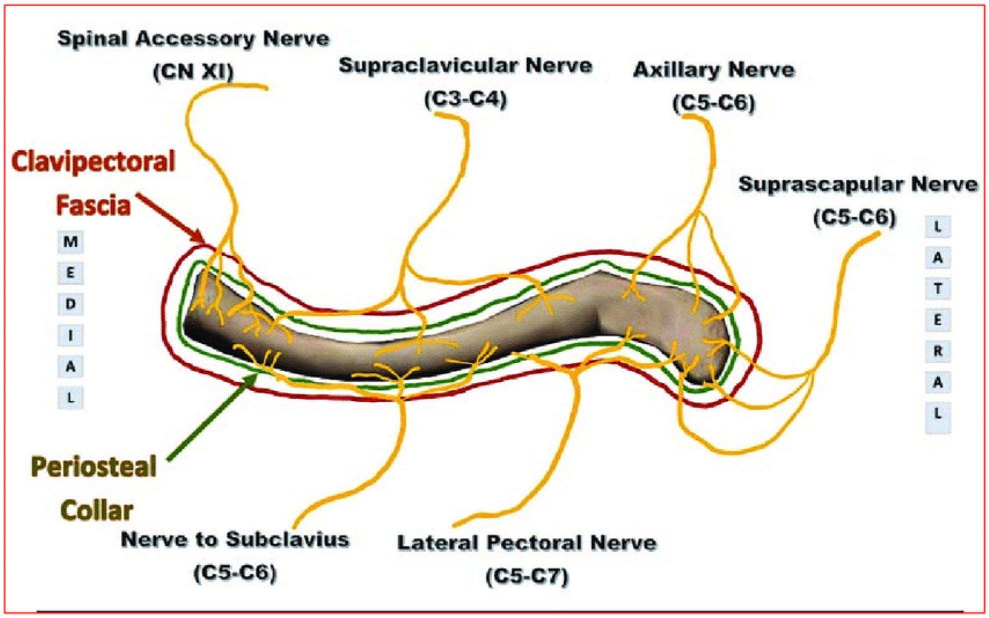

Figure 1: Nerve Supply to Clavicle

Anatomy of Cervical Plexus: The cervical plexus is a network of nerves formed by the ventral rami of the upper four cervical spinal nerves (C1-C4). It is located deep in the neck, just above the middle of the posterior border of the sternocleidomastoid muscle. The cervical plexus is responsible for innervating various structures in the neck and shoulder region, including the skin, muscles, and glands (Figure 2) [3].

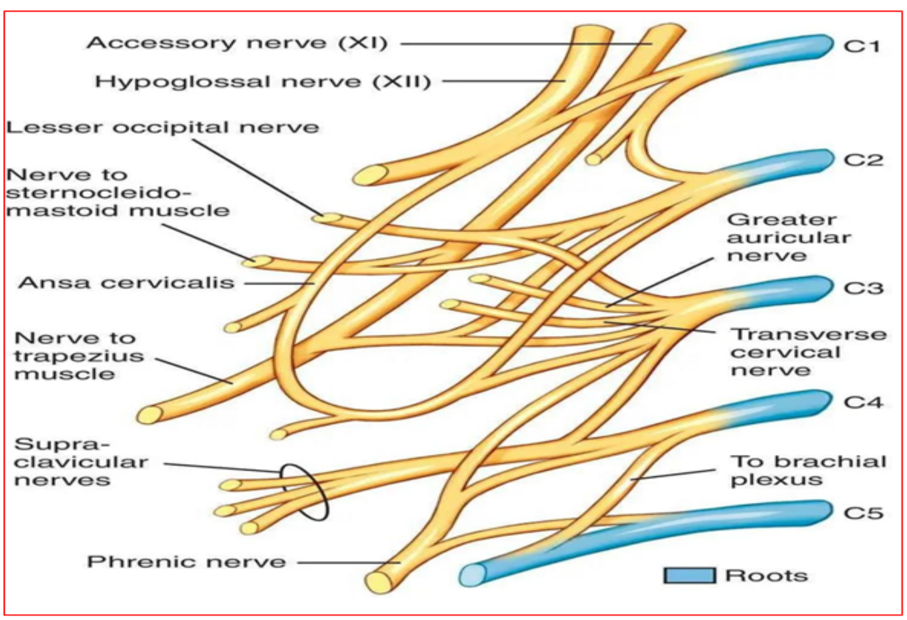

Figure 2: Anatomy of Cervical Plexus

The superficial cervical plexus gives rise to several important nerves, including the supraclavicular nerves, which supply the clavicle region. Understanding the anatomy of the cervical plexus is essential for the successful administration of regional anesthesia techniques, such as fracture clavicle and neck surgeries. These blocks can effectively provide anesthesia and analgesia, allowing for improved patient outcomes and early ambulation.

To address the drawbacks of GA and provide superior analgesia and early ambulation, Regional Anesthesia (RA) has emerged as a favorable alternative [4]. RA offers various advantages, including cost-effectiveness and avoiding the side effects associated with GA [5]. Although RA has been primarily used for analgesia in clavicular surgery, its role as a sole anesthetic technique has been limited due to the complexity of blocking multiple nerves, such as the supraclavicular nerves, subclavian nerve, and suprascapular nerve, supplying the clavicle area [6].

Combined Interscalene Block (ISB) and Superficial Cervical Plexus Block (SCPB) [7] has been tried for fracture clavicle lateral2/3rd. However, this RA method is not without potential side effects, with ISB possibly causing temporary complications such as ipsilateral phrenic nerve paralysis, Horner's syndrome, and recurrent laryngeal nerve palsy [8].

Ultrasound-guided techniques have significantly advanced anesthesia practice, offering numerous benefits to anesthetists. By providing real-time visualization, ultrasound enables precise needle placement and accurate local anesthetic deposition, leading to reduced doses of local anesthetics and more successful nerve blocks [9,10,11]. Nonetheless, conventional techniques for supraclavicular brachial plexus blocks remain popular among anesthesiologists due to cost-effectiveness and efficiency. Given the common occurrence of clavicle fractures requiring surgical intervention, the choice of anesthetic technique is crucial for patient outcomes. While RA has shown promise in other upper limb surgeries, its application for clavicular surgeries is not well-established. To our knowledge, there is a scarcity of research in this specific area, making our prospective study valuable in addressing this gap in the literature. So, our study aimed to evaluate the efficacy of a combined approach involving USG-guided SCPB and ISB as the sole RA technique for routine clavicular surgeries.

Materials and Methods

Study Design and Participants

This prospective study was conducted at GMC Baramulla and involved adult patients scheduled for surgical fixation of clavicular fractures (old and new cases). The study was conducted in accordance with the principles outlined in the Declaration of Helsinki and was approved by the Institutional Ethics Committee. Informed consent was obtained from all participants before their inclusion in the study. One patient having fracture over medial end of clavicle was done under general anaesthesia and was excluded from study because medial end of clavicle has nerve supply from XI cranial nerve which cannot be blocked by above method.

Sample Size Calculation

The sample size was determined based on a power analysis using an effect size of 0.5, alpha error of 0.05, and power of 0.8. Considering an anticipated dropout rate of 10%, a total of 44 patients were enrolled in the study.

Study Groups

Participants were randomized into two groups using a computer-generated randomization sequence. Group A received a single-prick approach involving USG-guided Interscalene block (ISB) and USG-guided Superficial Cervical Plexus block (SCPB). Group B received a two-prick approach involving USG-guided ISB combined with landmark-guided SCPB.

Anesthesia Technique

All nerve blocks were performed by experienced anesthesiologists proficient in ultrasound-guided techniques. For USG-guided ISB, a high-frequency linear ultrasound probe (6-13 MHz) was used to visualize the brachial plexus in the interscalene groove, between anterior and posterior scalene muscles, along the posterolateral border of SCM muscle. Under sterile conditions, a 22-gauge, 100-mm insulated stimulating needle was advanced in-plane with the ultrasound beam until appropriate nerve responses were elicited. After confirming correct needle placement, 20 mL of 0.5% ropivacaine was injected.

In Group A, after completing the USG-guided ISB, the same ultrasound probe was repositioned to visualize the superficial cervical plexus. A 22-gauge, 100-mm insulated stimulating needle was advanced to the C2-C3 level, cervical plexus block was performed as a plane block in the prevertebral fascia posterior to the SCM muscle, and 10 mL of 0.5%ropivacaine was injected after eliciting appropriate nerve responses.In Group B, after completing the USG-guided ISB, a landmark-guided technique was employed for SCPB. Under aseptic conditions, a 23-gauge, 50-mm needle was inserted at the posterior border of the sternocleidomastoid muscle at the level of the cricoid cartilage. A total of 10 mL of 0.5%ropivacaine was injected after negative aspiration.

Data Collection

Baseline demographic data, including age, weight, and ASA physical status classification, were recorded for all participants. Intraoperative data, including the time taken for the procedures, success rate of nerve blocks (absence of cold sensation for all 4 branches of the superficial cervical plexus at 15 mins), onset and duration of the block, and any perioperative complications, were documented.

Assessment of Anesthesia

The efficacy of anesthesia was evaluated by assessing the sensory and motor block of the shoulder and clavicle region using the pinprick test and modified Bromage scale, respectively. The onset of sensory and motor block was recorded, and the duration of the block was monitored until complete recovery of nerve function. The success rate of nerve blocks was defined as complete anesthesia in the targeted area.

Postoperative Monitoring

Patients were closely monitored for any postoperative complications, including Horner's syndrome, recurrent laryngeal nerve palsy, phrenic nerve paralysis, and signs of local anesthetic toxicity. Postoperative pain scores were assessed using a standardized pain scale.

Statistical Analysis

Data were analyzed using SPSS 20.0. Continuous variables were presented as mean ± standard deviation (SD) based on their distribution, and categorical variables were presented as frequencies and percentages. Group A and B comparisons were performed using the Student's t-test or Mann-Whitney U test for continuous variables and the chi-square or Fisher's exact test for categorical variables. A p-value less than 0.05 was considered statistically significant.

Results

The demographic characteristics and distribution of variables between Group A (n=21) and Group B (n=23) are presented in Table 1. In our study, we saw only young male got fracture clavicle reason could be male drive and do at risk, outdoor activities. more than female in our setup. Likewise, the mean age, weight, height, and BMI were comparable between the two groups, showing no statistically significant differences ($p > 0.05$ for all). The most common surgical procedure performed in both groups was open reduction and internal fixation (ORIF), with 71.4% in Group A and 60.9% in Group B undergoing this procedure ($p = 0.460$). The remaining participants underwent implant removal. All the participants were falling in the American Society of Anesthesiologists (ASA) class I. Furthermore, there were no significant differences in the location of the fracture (lateral, or midshaft) between the two groups ($p = 0.972$). These results indicate that the two groups were well-matched in terms of baseline characteristics, allowing for a valid comparison of the anesthesia techniques for surgeries of the clavicle.

Table 1: Comparison of baseline characteristics of the patient in two groups

Variables	Group A (n=21)	Group B (n=23)	P value
Mean age (in years)	38.92±16.72	37.76±17.83	0.825
Mean weight (in kg)	69.21±9.29	68.96±8.87	0.927
Mean height (in cm)	171.26±6.82	170.88±7.23	0.858
Mean BMI (in kg/m2)	23.67±4.31	23.75±4.28	0.951
Surgical procedure			
ORIF	15 (71.4)	14 (60.9)	0.460
Implant removal	6 (28.6)	9 (39.1)	
ASA class*			
I	21 (100.0)	23 (100.0)	-
Location of fracture*			
Lateral	7 (60.0)	9 (64.3)	0.581
Midshaft	6 (40.0)	5 (35.7)	

*Includes patients who underwent ORIF

The Figure 3 presents the mean values (± SD) for heart rate, systolic blood pressure, diastolic blood pressure, and SPO2 assessments at various time points in Group A and Group B. At 0 minutes, the mean heart rate in Group A was 93.57±14.32/minute, and in Group B, it was 93.42±15.8/minute, with a mean difference of 0.17. The t-value was 0.043, and the p-value was 0.97, indicating no statistically significant difference (NS) between the two groups. At 0 minutes, the mean systolic blood pressure in

Group A was 126.23±10.66 mmHg, and in Group B, it was 128.37±9.52 mmHg, with a mean difference of 2.13 mmHg. The t-value was 0.818, and the p-value was 0.417, indicating no statistically significant difference (NS) between the two groups. At 0 minutes, the mean diastolic blood pressure in Group A was 83.07±8.36 mmHg, and in Group B, it was 84.20±7.52 mmHg, with a mean difference of 1.13 mmHg. The t-value was 0.552, and the p-value was 0.583, indicating no statistically significant difference (NS) between the two groups. At 0 minutes, the mean SPO2 in Group A was 98.9±0.92 %, and in Group B, it was 99.07±0.83 %, with a mean difference of 0.167 %. The t-value was 0.736, and the p-value was 0.464, indicating no statistically significant difference (NS) between the two groups. Similarly, at 5, 10, 15, 20, 25 minutes, and 1, 2, 4, and 8 hours, there were no statistically significant differences (NS) in heart rate, systolic blood pressure, diastolic blood pressure, and SPO2 between Group A and Group B. The mean differences and t-values for each time point were not significant, suggesting that the heart rates in both groups remained comparable throughout the assessment period. The results indicate that the anesthesia techniques employed in both Group A and Group B had no significant impact on the heart rate, systolic blood pressure, diastolic blood pressure, and SPO2 of the participants during the postoperative period.

Figure 3: Comparison of intraoperative variations in vital parameters among patients in the two groups. A: Heart rate. B: SPO2. C: Systolic blood pressure. D: Diastolic blood pressure

The Table 2 presents the comparison of outcome variables between Group A and Group B. The mean duration of time taken by the procedure was significantly shorter in Group A (15.73 ± 1.67 minutes) compared to Group B (18.62 ± 2.42 minutes) with a p-value of < 0.0001. The mean duration of onset of sensory block showed no significant difference between Group A (10.93 ± 8.23 minutes) and Group B (11.03 ± 8.56 minutes) with a p-value of 0.968. Similarly, the mean duration of onset of motor block exhibited no significant difference between Group A (20.22 ± 3.24 minutes) and Group B (20.96 ± 3.65 minutes) with a p-value of 0.482.

The mean duration of the surgical procedure was comparable between Group A (76.41 ± 23.97 minutes) and Group B (78.29 ± 24.38 minutes) with a p-value of 0.798. Additionally, the mean duration of sensory block and motor block in hours were similar in both groups, with p-values of 0.906 and 0.783, respectively. There was no statistically significant difference in the conversion rate to general anesthesia between Group A (9.5%) and Group B (13.0%), with a p-value of 0.713. The need for analgesic supplementation showed no significant difference between Group A (23.8%) and Group B (21.7%) with a p-value of 0.869. The success rate of the anesthesia technique was high in both groups, with no significant difference between Group A (100.0%) and Group B (100.0%). Regarding complications, both groups had similar occurrences of vomiting, nausea, and itching, with no statistically significant differences (p-values > 0.8). There were no instances of vessel puncture, nerve injury, pneumothorax, phrenic nerve block, Horner's syndrome, or recurrent laryngeal nerve block in either group. Also, single prick technique was better acceptable by patients than two pricks, and procedural discomfort was less in single prick than two pricks.

Table 2: Comparison of intraoperative and postoperative outcomes of patients in the two groups

Variables	Group A	Group B	P value
Mean duration of time taken by procedure (in minutes)	15.73±1.67	18.62±2.42	< 0.0001
Mean duration of onset of sensory block (in minutes)	10.93±8.23	11.03±8.56	0.968
Mean duration of onset of motor block (in minutes)	20.22±3.24	20.96±3.65	0.482
Mean duration of surgical procedure (in minutes)	76.41±23.97	78.29±24.38	0.798
Mean duration of sensory block (in hours)	5.01±1.38	4.96±1.43	0.906
Mean Duration of Motor block (in hours)	5.56±1.02	5.47±1.13	0.783
Analgesic supplementation			
Yes	5 (23.8)	5 (21.7)	0.869
No	16 (76.2)	18 (78.3)	
Success rate	21 (100.0)	23 (100.0)	-
Complications			
Vessel puncture	0 (0.0)	0 (0.0)	-
Vomiting	1 (4.8)	1 (4.3)	0.947
Nausea	4 (19.0)	5 (21.7)	0.825
Itching	4 (19.0)	4 (19.0)	0.886
Nerve injury	0 (0.0)	0 (0.0)	-
Pneumothorax	0 (0.0)	0 (0.0)	-
Phrenic nerve block	0 (0.0)	0 (0.0)	-
Horner's syndrome	0 (0.0)	0 (0.0)	-
Recurrent Laryngeal Nerve block	0 (0.0)	0 (0.0)	-

Discussion

The clavicle receives its sensory nerve supply from branches of the cervical plexus, particularly the superficial cervical plexus. The sensory innervation to the clavicle is derived from the C2-C3 spinal nerves through the branches of the cervical plexus. These nerves play a crucial role in providing sensation to the clavicle region. The clavicle is an important bone in the shoulder girdle, and adequate anesthesia in this region is essential to minimize intraoperative pain and postoperative discomfort. The cervical plexus is a complex network of nerves formed by the ventral rami of the upper four cervical spinal nerves (C1-C4). It is located deep in the neck, just above the middle of the posterior border of the sternocleidomastoid muscle. The cervical plexus is responsible for innervating various structures in the neck and shoulder region, including the skin, muscles, and glands [1,3].

Key nerves that arise from the cervical plexus include the supraclavicular nerves and the superficial cervical plexus. The supraclavicular nerves provide sensory innervation to the clavicle region, while the superficial cervical plexus plays a crucial role in providing sensory innervation to the anterior and lateral aspects of the neck and shoulder. Understanding the nerve supply and anatomy of the cervical plexus is crucial for the successful administration of regional anesthesia techniques, such as the combined ultrasound-guided ISB and SCPB in our study. Properly blocking the nerves supplying the clavicle region using these techniques can result in effective anesthesia and analgesia, reducing the need for general anesthesia and its associated risks and complications. Furthermore, it allows for improved patient outcomes, reduced postoperative pain, and early ambulation [10,11].

The use of Interscalene Brachial Plexus Block (IBPB) and Superficial Cervical Plexus block (SCPB) has been explored for pain management following clavicular surgery. Studies by Reverdy et al., Vandepitte et al., and Dillane et al., have reported on their successful application in various cases and retrospective studies [2,6,12]. In this study, we compared the efficacy and safety of two anesthesia techniques: Group A, which received USG-guided Interscalene Block plus USG-guided Superficial Cervical Plexus Block (SCP), and Group B, which underwent USG-guided Interscalene Block plus landmark-guided SCP for surgeries of the clavicle. Balaban et al, has also conducted a retrospective analysis of Ultrasound-Guided Combined Interscalene-Cervical Plexus Block for Surgical Anesthesia in Clavicular Fractures, using a similar technique [13]. Kline et al., reported a case of ultrasound-guided placement of combined Superficial Cervical Plexus and Selective C5 Nerve Root Catheter for clavicular pain management [14]. Additionally, Mukhopadhyay et al., and Kanthan et al., have used SCPB as an alternative to general anesthesia in oral and maxillofacial surgical practice and selected neck surgeries [15,16].

Firstly, our study revealed that Group A, receiving the USG-guided single-prick approach, had a significantly shorter duration of time taken by the procedure compared to Group B, which underwent the landmark-guided two-prick approach. This finding indicates that the USG-guided technique offers a more efficient and time-saving method for administering regional anesthesia in clavicle surgeries. The reduced procedural time in Group A can be attributed to the real-time visualization of anatomical structures provided by ultrasound, enabling precise needle placement and accurate deposition of local anesthetic drugs, as opposed to the reliance on anatomical landmarks in Group B. However, when landmark techniques are used for these plexus blocks, the chances of a failed block are higher, and the fear of local anesthetic toxicity should be considered, as it involves two separate plexus blocks. Study by Tran et al., showed that general anesthesia has been the preferred method for clavicle surgeries, with SCPB or interscalene blocks used for postoperative analgesia [3]. Study by Valdés-Vilches et al., employed low-volume selective supraclavicular nerve blockade, along with a low-volume brachial plexus supraclavicular approach to achieve adequate blockade depth for clavicle surgeries [5].Choi et al., achieved successful postoperative analgesia for clavicle fracture surgery using a cervical plexus block via a classic approach with 0.5% bupivacaine, providing a pain-free interval of 14 hours after surgery [4]. Andrew et al., showed ultrasound-guided SCPB efficacy in emergency care settings for pain treatment [17].

Despite the differences in procedural time, both groups exhibited comparable mean durations of onset of sensory and motor blocks. This suggests that both techniques were effective in achieving the desired anesthesia for the surgeries. Additionally, the mean durations of the surgical procedures, sensory blocks, and motor blocks were not statistically different between the two groups. These findings indicate that both approaches provided adequate anesthesia for the surgeries and were clinically comparable in terms of block onset and duration. Study by Dillane et al., showed the use of a combination of ultrasound-guided blocks as the sole anesthetic technique in a patient undergoing Open Reduction and Internal Fixation (ORIF) for clavicle fracture [2].

The success rate of regional anesthesia was high in both groups, with no statistically significant difference observed between Group A and Group B. This indicates that both techniques were equally effective in achieving successful anesthesia for clavicle surgeries. Furthermore, the low incidence of complications in both groups, such as vomiting, nausea, and itching, highlights the safety of both approaches. Study by Shrestha et al., showed that Interscalene and Superficial Cervical Plexus Blocks can be used as a technique for clavicle fracture procedures, especially in cases where general anesthesia is considered unsafe [18]. Pal et al., described a case of fracture clavicle surgery in a patient with Dilated Cardiomyopathy, where they used a peripheral nerve stimulator to block these plexuses successfully [7]. Studies by Tobias et al., and Ciftci et al., SCPB has also been utilized for surgical anesthesia in procedures such as lymph node biopsy, excision of thyroid nodules, and placement of hemodialysis catheters [19,20]. Interestingly, there were no cases of vessel puncture, nerve injury, pneumothorax, phrenic nerve block, Horner's syndrome, or recurrent laryngeal nerve block reported in either group. This indicates that both techniques were safe and did not result in major nerve-related complications. However, it is essential to acknowledge that the absence of complications may also be attributed to the relatively small sample size and the expertise of the anesthesiologists performing the procedures. Study by Ueshima et al., showed the performance of selective supraclavicular nerve block and fifth, sixth nerve blocks for clavicle fracture repair in a patient with bilateral pneumothorax using 0.75% levobupivacaine [21].

It is worth noting that the need for analgesic supplementation was similar in both groups, indicating that both techniques provided sufficient analgesia during the post-operative period. This is particularly important in clavicle surgeries, as effective analgesia contributes to improved patient outcomes and satisfaction. G¨urkan et al., used bilateral cervical plexus blocks guided by ultrasound for postoperative analgesia following thyroid surgeries [22].

Overall, the findings of this prospective study demonstrate that both USG-guided single prick approach (Group A) and landmark-guided two prick approach (Group B) are effective and safe for regional anesthesia in clavicle surgeries. The USG-guided approach offers the advantage of shorter procedural time, potentially leading to improved efficiency in the operating room. However, the choice between the two techniques may also depend on the expertise of the anesthesiologist, availability of ultrasound equipment, and patient-specific factors.

Limitations

Limitations of our study include the relatively small sample size and the lack of blinding, which could have introduced bias in the assessment of outcomes. Additionally, the study was conducted at a single center, which may limit the generalizability of the findings to other settings. Further multicenter studies with larger sample sizes are warranted to validate our results and to explore additional factors that may influence the choice of anesthesia technique for clavicle surgeries. We can’t anaesthetise medial 2/3rd of clavicle by above technique, because it's supplied by cranial nerve XI.

Conclusion

In conclusion, Group A, which underwent a USG-guided Interscalene Block plus USG-guided Superficial Cervical Plexus Block with a single prick, demonstrated a significantly shorter procedure time and procedural comfortability to the patient and doctor, compared to Group B, which underwent USG-guided Interscalene Block plus landmark-guided Superficial Cervical Plexus Block with two pricks. The anesthesia efficacy, success rate, and complication rates were comparable between the two groups.

Anesthesiologists can consider the advantages of reduced procedural time and procedural comfort with single prick technique, when choosing between the two techniques, while also taking into account individual patient factors and institutional resources. Further research is warranted to explore long-term outcomes and to establish guidelines for selecting the most appropriate anesthesia technique for clavicle surgeries.

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