www.nclinmed.com
Novelty in Clinical Medicine. 2023; 2(3): 127-135
https://doi.org/10.22034/NCM.2023.403813.1092

Research Article Open Access

The outcomes of mobilization under continuous interscalene block versus mobilization and intraarticular steroid injection in frozen shoulder

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Received: 24 June 2023 **Revised:** 20 August 2023 **Accepted:** 27 August 2023 **e-Published:** 31 August 2023

Abstract

Background: Painless and early aggressive mobilization of the shoulder can give good outcomes in a frozen shoulder (FS).

Objectives: Our objective is to compare the early and late clinical and functional outcomes of mobilization under continuous interscalene block (CISB) and mobilization and intraarticular steroid injection (IASI) and to determine the effect of the addition of IASI on mobilization and CISB in adults with FS.

Methods: We conducted a prospective comparative study. Participants were divided into 3 groups of 20 patients. The allocation was performed by simple randomization. The primary outcomes of pain and patient satisfaction were assessed using VAS scores. Outcome measures such as pain, patient satisfaction, range of motion, and UCLA scores within the groups were assessed.

Results: The majority of patients were females. There was a significant improvement in early pain relief and range of motion in patients treated using mobilization under CISB. The late functional outcomes were similar in all groups irrespective of the method of treatment. The IASI had no significant effect on the early or late outcomes of mobilization under CISB.

Conclusion: Mobilization under CISB provides early pain relief, improvement in the range of movements, and good long-term functional outcomes in frozen shoulders. IASI does not affect early pain relief or improvement in the range of movements.

Keywords: Frozen Shoulder, Periarthritis Shoulder, Interscalene Block, Intraarticular Steroid Injection, Manipulation Under Analgesia.

Introduction

Frozen shoulder (FS) or adhesive capsulitis is characterized by pain and stiffness of the shoulder of unknown origin.[1] Primary FS is benign and self-limiting. Complete recovery occurs within 18 months.[2] Persistence of symptoms and loss of movement is seen in some cases.[3] The treatment aims to shorten the period of the disease process to reduce disability.

Nonsteroidal anti-inflammatory drugs (NSAIDs) and shoulder physiotherapy are common treatments.[4,5] Manipulation under anesthesia, prolotherapy using saline, and arthroscopic arthrolysis can be used to alleviate pain and improve mobility.[6,7] Intraarticular steroid injection and mobilization are successful in early pain relief and long-term results comparable to physiotherapy.[5,8] Interscalene block (ISB) and mobilization are effective treatments for FS.[9] Many studies have compared the efficacy of the various modalities. IASIs are more effective than NSAIDs and physiotherapy. There are controversies regarding the role of IASI alone and hydrodistension.[5,10-15] Mobilization under continuous analgesia (MUA) alone and in combination with IASI is also used for FS.[11] The efficacy of one over the other, however, is not conclusively proven and remains controversial.

The success of MUA depends on ensuring analgesia during mobilization. Regional blocks and NSAIDs can

provide analgesia during MUA.[16,17] Good functional improvements are seen when hydrodistension and MUA are combined with interscalene block.[12] Continuous ISB (CISB) is used for postoperative analgesia.[18] However, its potential use in providing adequate analgesia for MUA in frozen shoulder remains largely uninvestigated.

Objectives

Our objective is to compare the early and late clinical and functional outcomes of mobilization under CISB and mobilization and intraarticular steroid injection (IASI) and to determine the effect of the addition of IASI on mobilization and CISB in adults with FS.

Methods

This was a single-center prospective comparative study conducted in a tertiary care teaching hospital (Government Medical College Kozhikkode). Adult patients attending our outpatient clinic between January 2014 and October 2018 with pain and stiffness in the shoulder were selected for the study. Patients with FS between the ages of 40 and 60 years with no improvement with conservative treatments for at least 2 months were included. Patients with posttraumatic stiffness, radiographic abnormalities, infective foci around the shoulder, severe osteoporosis, previous surgeries of the shoulder, allergy to medications/local anesthetics, contraindications to steroids, and secondary adhesive capsulitis were excluded. Diabetic patients with uncontrolled sugar levels (HbA1C >7) and those who could not come for follow-up until the end of the study were also excluded.

A case of FS is defined as a person with shoulder pain for more than three months and progressive restriction of shoulder movements in a minimum of 2 directions; ≥30% restriction in passive external rotation and ≥30% restriction in the second plane when compared to the opposite side, and absence of radiological and ultrasonographic abnormalities. The primary outcome was pain and patient satisfaction measured by VAS scores. A visual analog scale of 0 to 10, where a score of 0 meant "no pain"/"not satisfied" and 10 meant "most severe pain"/"fully satisfied", was used to assess the severity of pain and patient satisfaction. The secondary outcomes included functional outcomes measured by the UCLA shoulder score and the change in range of motion (both active and passive). A UCLA shoulder score of more than 27 was considered good/very good, and a score less than 27 was considered a poor result.[19] Passive and active ROM was measured using a goniometer for forward flexion, extension, abduction, external rotation, and internal rotation. Internal rotation was measured by correlating the thumb position with the vertebral level on the back. The mean of 3 values was used for analysis.

With a prevalence of 5.3% for FS, a confidence interval of 90%, and a power of 80%, the sample size calculated was 45 (OpenEpi version 3). Assuming a dropout rate of 15 to 20%, the total sample calculated was 54. A total of 77 patients with shoulder pain and limitation of movement attended the outpatient clinic during the study period. Eight patients were excluded because of rotator cuff tears diagnosed by ultrasonography. We excluded patients with radiological anomalies (2), allergies to medication (4), hydradenitis suppurativa (1), neuropathic joints (1), and caries sicca. We selected 60 patients for the study (Figure 1). They were randomly divided into 3 groups of 20 each by simple randomization using randomization.com. The first group was treated using manipulation under CISB and mobilization (group A), the second group with an IASI and mobilization (group B), and the third group with a combination of IASI and CISB and mobilization (group C).

Demographic details, medical history, and duration of symptoms were recorded, after which patients were assigned to any one of the groups for the interventions. The pain, level of satisfaction, and functional scores were recorded before the intervention, at the end of the exercise program (1 month), and at 3, 9, and 12 months by a blinded investigator. Patients who showed no improvement at the end of the exercise program were further evaluated to rule out other causes.

Mobilization under continuous interscalene block

The interscalene block was administered by the same surgeon with the same technique. A prophylactic antibiotic of one gram of cefotaxime and a sedative of 2 mg midazolam intravenous injection was given 30 minutes

before the procedure. With the patient supine, the posterior edge of the sternomastoid muscle, the scalene triangle, and the cricoid cartilage were marked. The entry point was determined by drawing a horizontal line from the cricoid cartilage to the interscalene groove after turning the head to the opposite side. The intersection of this line with the posterior edge of the sternomastoid muscle was the level of entry of the needle. An AB Braun Contiplex needle (18 G insulated Tuohy needle, hemostasis valve with side port, 20 G polyamide-nylon catheter with closed tip, catheter connector) was inserted at this point and advanced in a caudal medial and posterior direction to elicit shoulder muscle contraction with an intensity of 2 mA stimulation. Upon observation of muscle contraction, the intensity of stimulation was decreased by 0.5 mA. A local anesthetic mixture (30 ml) consisting of 10 ml 0.25% bupivacaine, 10 ml 2% lidocaine, and 10 ml distilled water was injected. After that, a 20G catheter was inserted through the needle, which was then withdrawn, and the catheter was stitched to the skin after subcutaneous tunneling and stabilized with sterile adhesive plaster (Figure 2). ISB was confirmed by the presence of motor and sensory blocks in the upper limb. Patients were then administered 40 mg of intra-articular methylprednisolone injection through a 23G needle placed in the glenohumeral joint under ultrasound guidance.

After ensuring complete sensory and motor block in the ipsilateral upper extremity, patients were seated in a semireclined position. Manipulation of the glenohumeral and scapulothoracic joints was performed by single orthopedists with minimum force to avoid fracture and other injuries. A palpable or audible rupture of the capsule or intra-articular adhesions is often observed. The flexion and extension manipulation forces were applied as close to the shoulder joint to minimize the torque rupture of the inferior capsule. Abduction of the glenohumeral joint was performed by scapular stabilization using a downward thrust on the scapula to complete the inferior capsular rupture. External rotation of the shoulder joint at 90 degrees of abduction was carried out gently to rupture the anterior and inferior capsules. Adduction and external rotation ruptured the superior glenohumeral ligament and anterior capsule. Cross-body adduction and combined internal rotation and abduction helped rupture the posterior capsule. The full range of movement in all directions without giving excessive force was achieved in the operating room itself. Postoperative mobilization was started after 4-6 hours on the same day and was continued under continuous interscalene analgesia. The analgesia was obtained by continuous delivery of 0.125% isobaric bupivacaine solution with an easy pump at a rate of 5 ml per hour through the catheter throughout the day. Short sessions of exercise for ten to fifteen minutes were repeated several times a day and were taught to the patients and their families. Both active-assisted and passive stretching exercises were practiced during each session. The position of the catheter was checked on the second postoperative day, after which the patient was discharged and advised to continue the exercise at home. A follow-up visit was scheduled one week later for catheter removal. Thereafter, the patient was advised to start normal activities along with the exercise program, which was continued for one month.

Intra-articular corticosteroid injection

Patients in this group received 40 mg of intra-articular methylprednisolone injection through a 23G needle placed in the glenohumeral joint under ultrasound guidance. Mobilization started after this procedure (group B). Mobilization under continuous interscalene block with intraarticular steroid injection was performed for group C.

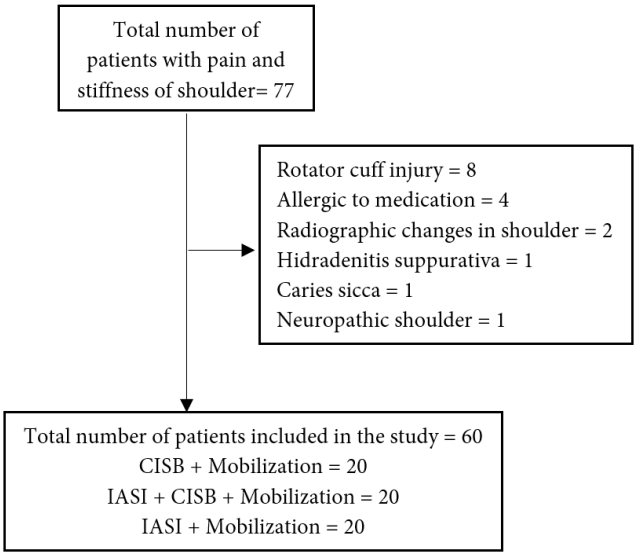

Figure 1. Patients included in the study

Statistical analysis

All statistical analyses were performed with SPSS (version 19.0, SPSS Inc, Chicago, IL, USA). P<0.05 was considered significant. Continuous variables; pain, patient satisfaction, range of motion, and UCLA scores were expressed as the mean and were analyzed using ANOVA. Categorical variables are expressed as proportions and were analyzed using the Kruskal–Wallis test.

Ethical considerations

We conducted this study after obtaining institutional research committee approval, and we obtained informed consent from all the participants. The study was conducted in accordance with the Declaration of Helsinki. The present study did not interfere with the process of diagnosis and treatment of patients.

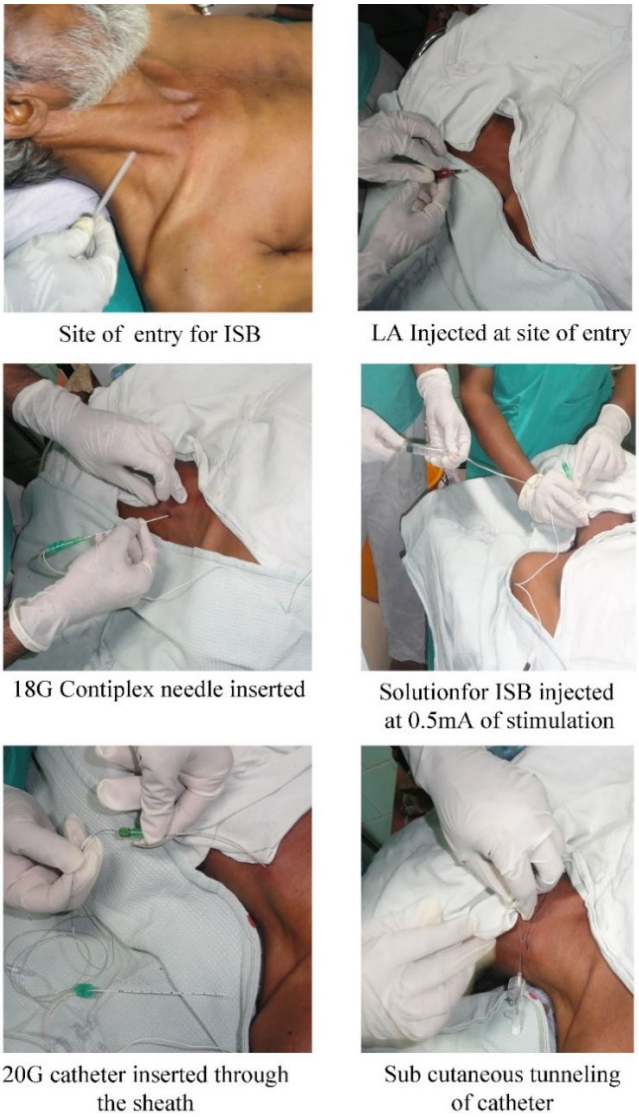

Figure 2. Photograph showing the different steps in the procedure of giving interscalene block and mobilization

Results

The three groups were similar in terms of various demographic and clinical parameters (Table 1).

Primary outcomes

The VAS score for pain showed significant improvement in all three groups at one year. There was a significant decline in the VAS score in groups A & C compared to group B after 4 weeks. A similar improvement was noticed until 12 weeks. There was no significant difference in the pain score at 9 months and 1 year of follow-up between the three groups (Figure 3).

The VAS score for patient satisfaction was significantly higher than the baseline in all three groups at one year (p<0.01). The difference in the VAS score between the two groups was significantly higher in the CISB group (7.3±1.2 vs. 4.2±1.2; p<0.001), and the difference remained significant until 12 weeks. All included patients had improvement in VAS scores except for two patients in the IASI group. They had persistent scores of 8-9 at one year. Both of them also had no improvement in VAS pain scores.

Secondary outcomes

The ROM of the shoulder showed improvement in all groups with time. There was a significant improvement in forward flexion in all groups at 4 weeks (group A p=0.0002, group B p=0.03, and group C p=0.002). There was a statistically significant improvement in forward flexion in group A (137±8.23 to 151.5±5.9; p=0.04) and group C (139±10.23 to 154.5±7.9; p=0.002) between 4 weeks and 12 weeks. However, there was no significant improvement in group B patients (105 °±18.7 to 114°±12.24; p=0.96) during this period. The range of flexion at 4 weeks was significantly higher in groups A and C and remained so until 12 weeks compared to group B (p=0.0008). The flexion ranges in the groups were similar at the 9-month and 1-year follow-ups, except for two in group B.

Patients in all three groups showed significant improvement in extension at 4 weeks (group A 32 ± 5.86 to 45.5 ± 3.68; p=0.0003, group B 30°±8.16 to 43°± 8.56; p=0.0008 and group C: 35 ± 7.86 to 44.5 ± 2.58; p=0.0004). The difference in improvement from 4 weeks to 1 year was

not significant in all the groups. The range of extension between the groups was similar at 4 (p=0.62), 12 (p=0.96), and 48 weeks (p=0.83) of follow-up.

A significant improvement in abduction was present in all groups at the 1-year follow-up. The patients in group A and group C achieved significant improvement in abduction by 4 weeks, whereas group B showed significant improvement by 12 weeks. After 12 weeks, there was no difference in the improvement of abduction among the three groups (Figure 4).

Group A and group C patients had significantly earlier restoration of external rotation than group B patients at 4 weeks (p=0.003), and the difference remained significant until 12 weeks (p=0.008). In internal rotation, patients in all the groups showed an improving trend over time, but it was not significant. However, between the groups, Group A and Group C had earlier restoration than Group B at 12 weeks (p=0.003) (Figure 5).

Shoulder function in terms of the UCLA score showed significant improvement within the groups at 1 year (group A p=0.002, group B p=0.02, and group C p=0.003). There was an increasing trend in functions in all groups over time, but it was not significantly different among groups at 4, 12, and 36 weeks. The difference in the UCLA score between the groups was significantly higher in groups A and C than in group B at 4 and 12 weeks (Table 2).

Two patients had a pull-out of the CISB catheter during an exercise program that needed reinsertion. There were no complications, such as Horner syndrome, hoarseness of voice, paralysis of the hemidiaphragm, rotator cuff tear, septic arthritis, or any other complications related to CISB or IASI.

Table 1. Demographic characteristics of patients included in the study

Parameter	Group A (20)	Group B (20)	Group C (20)	P-value
Mean age+/- SD	54.7±9.05	55.2±8.23	54.8±10.23	0.324
Gender (M/F)	4/16	2/18	3/17	0.375
Duration of symptoms (months)	7±2.1	7±1.8	7±2.3	0.723
Dominant/nondominant side (R/L)	5/15	6/14	5/15	0.465

SD = Standard deviation, M = males, F = females, R = right, L = left

Table 2. Comparison of mean UCLA score with time in the groups

Duration of follow up	Before intervention	4 weeks	12 weeks	36 weeks	48 weeks
Group A	13.65±6.9	27.5 ±7.2	29.2±5.8	30.1± 6.5	33.1± 2.3
Group B	13.54±7.2	19.3±6.8	21.4±6.2	25.3±4.3	31.2±3.2
Group C	13.58±8.1	26.4±5.2	31.2±3.8	28.4±5.2	34.5± 2.1
Difference between groups	P=0.092	P=0.045	P=0.032	P=0.065	P=0.841

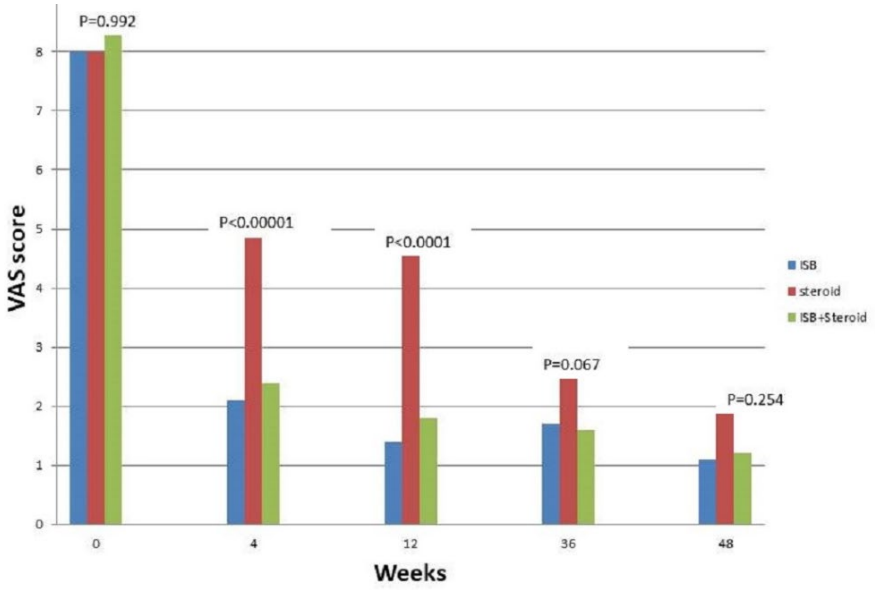

Figure 3. Diagrammatic representation of a comparison of VAS scores for pain between the three groups over time.

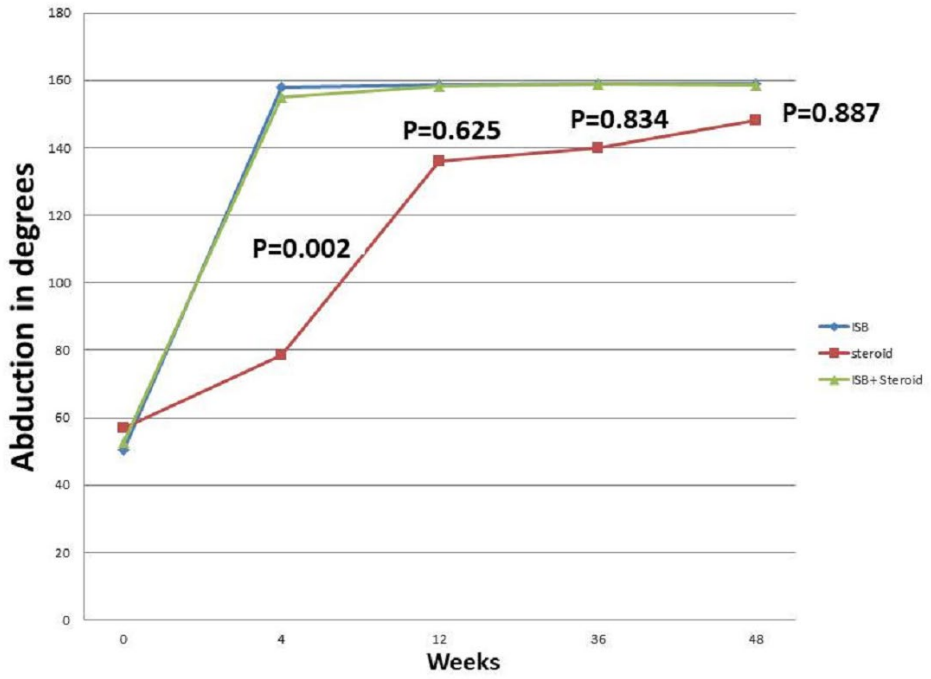

Figure 4. Diagram showing a comparison of abduction between the three groups with time. Between the groups, the difference in the degree of abduction was significantly higher in group A and group C at 4 weeks; however, there was no difference noted from 12 weeks onward.

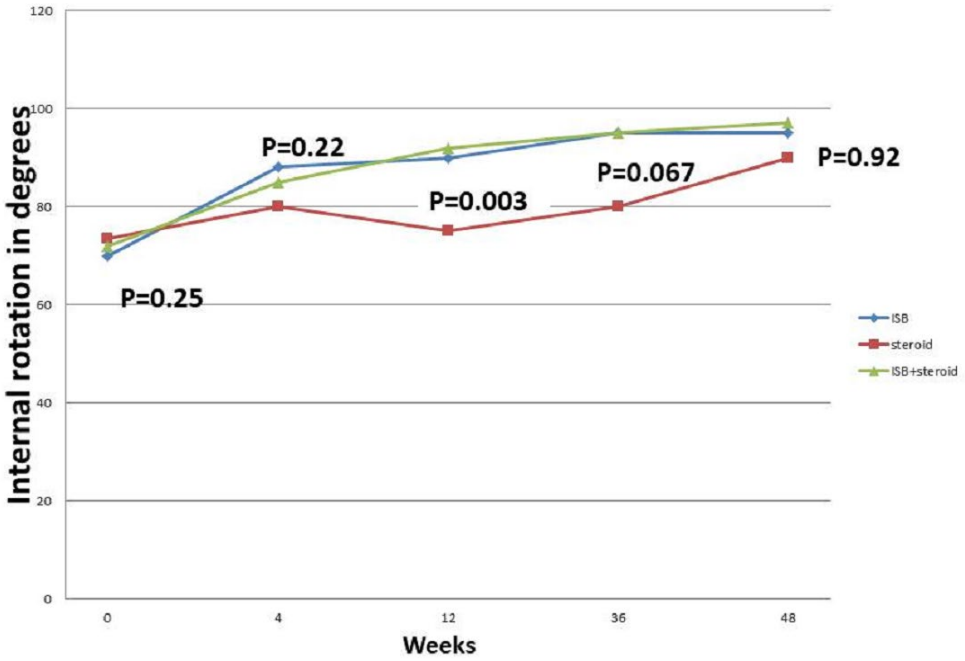

Figure 5. Diagram showing a comparison of internal rotation between the three groups over time

Discussion

Our study demonstrated that mobilization under analgesia, in combination with IASI or CISB, is effective in reducing pain and improving the range of movements and functions in adults with frozen shoulders. Among the three methods, the IASI and mobilization lag behind others in achieving a reduction in pain and improvement in the range of movements in the first 3 months. There was a steady improvement in the functions of all groups. Patients treated with MUA and CISB showed an increase in function in the early phase irrespective of IASI. CISB provides continuous analgesia during the initial days of

mobilization. This helped the patients to perform early mobilization and exercises.

The goal of treatment is to achieve permanent recovery with pain relief and improvement of function. FS can be treated successfully with physiotherapy. However, severe shoulder pain and an extremely limited range of motion can hamper the effectiveness of exercise programs.[20] Analgesia during mobilization is essential for the success of any method of treatment for FS. The range of movement provided by manipulation under general anesthesia without any surgical procedure cannot be sustained throughout the rehabilitation period due to severe pain.[21] Interscalene brachial plexus block is a technique used in shoulder surgery for anesthesia and postoperative analgesia.[15]

There is a dearth of studies in the literature evaluating the effectiveness of CISB for analgesia in the treatment of FS. Resistant FS treated by manipulation under anesthesia and intermittent interscalene block with mobilization exercises achieved 95% improvement in abduction and 81% improvement in external rotation.[10] Manipulation under brachial plexus block using 20 ml of 0.375% bupivacaine followed by exercise therapy at six-hour intervals under simultaneous interscalene analgesia with a bolus dose of 0.25% bupivacaine and reported patient satisfaction of 100% with no requirement for additional analgesia.[16] Glenohumeral gliding manipulation under interscalene brachial plexus block followed by exercise showed improvement in pain and range of motion.[21]

Intraarticular steroid injection is a widely used treatment for frozen shoulders. In a comparative study of glenohumeral joint injection using corticosteroids and six weeks of physical therapy, a significant improvement in pain, disability, and range of motion was observed in the steroid injection group at 3 and 7 weeks.[22] There was no difference in outcomes between the two groups treated with intraarticular steroid injection alone or steroid injection and distension with lidocaine at 26 and 52 weeks.[12] The success of treatment with intraarticular corticosteroids is dependent on the duration of symptoms.[14] The results of a systematic review of various randomized control studies on IASI concluded that multiple injections were beneficial until sixteen weeks from the date of the first injection.[23]

The complications of interscalene brachial plexus block are infection, displacement of the catheter, cardiac arrest, cervical and thoracic epidural block, and pneumothorax. Even then, it is a safe procedure. We had two cases of displacement of the catheter. We overcame the problem of catheter displacement through regular catheter care, attention to placement, stitching of the catheter to the skin, and fixation with sterile adhesive tape. Two cases failed to show any improvement after the treatment. An MRI scan showed full-thickness rotator cuff tears in both patients. Both patients belonged to group B. According to Ramirez et al., in 53 patients who underwent subacromial injection for shoulder pain, 17% showed full-thickness rotator cuff tears following the procedure.[24] In yet another study, it was shown that there is no correlation between rotator cuff tendon tears and subacromial injection.[3] We are not sure if the ruptures in our cases were due to the injection or the manipulations.

Our results are comparable with other studies for treating FS using arthroscopic release, surgical release, and manipulation under anesthesia. CISB and mobilization is a minimally invasive and safe technique for the treatment of FS. The procedure is less cumbersome and has a short learning curve. There is less hospital stay, and the patient/caregiver can learn the technique of mobilization and practice at home. The patients can assess the improvement in the range of motion and function during the entire treatment period.

There are certain shortcomings to our study. The sample size was small. We did not have a placebo group without any interventions. The natural course of the disease might have affected our results. We think further studies with a larger population are needed for external validation of our results.

Conclusions

Mobilization under continuous interscalene block gives early pain relief, improvement in the range of movements, and good long-term functional outcomes in frozen shoulders. Intraarticular steroid injection alone or in combination with interscalene block does not affect early pain relief or improvement in the range of movements.

Acknowledgment

None.

Competing interests

The authors declare that they have no competing interests.

Abbreviations

Frozen shoulder: FS

Continuous interscalene block: CISB;

Intraarticular steroid injection: IASI;

Interscalene block: ISB;

Nonsteroidal anti-inflammatory drugs: NSAIDs;

Mobilization under continuous analgesia: MUA.

Authors' contributions

Corresponding author - conceptualized the idea, helped in collecting data, analyzing, statistics, writing, and editing the manuscript.

Coauthor 1 - collecting data, analysis, statistics, writing, and editing the manuscript.

Coauthor 2 - collecting data, analysis, statistics, writing the manuscript.

All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

Funding

None.

Role of the funding source

None.

Availability of data and materials

The data used in this study are available from the corresponding author on request.

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval was obtained. The present study did not interfere with the process of diagnosis and treatment of patients and all participants signed an informed consent form.

Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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How to Cite this Article:
Zacharia B, Roy A, Vasu NK, Prakas A. The outcomes of mobilization under continuous interscalene block versus mobilization and intraarticular steroid injection in frozen shoulder. Novel Clin Med. 2023;2(3):127-135. doi: 10.22034/NCM.2023.403813.1092