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Original Research Article

Role of ultrasound guided suprascapular nerve block aided mobilization physiotherapy in frozen shoulder recovery: a prospective study

Mufassir Musthafa[1], Deepanshu Bandil[1]*, Shilpi Singh[2], Aman Verma[1]

[1]Department of Orthopaedics, Gandhi Medical College, Bhopal, Madhya Pradesh, India
[2]Department of Anesthesia, Gandhi Medical College, Bhopal, Madhya Pradesh, India

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***Correspondence:**
Dr. Deepanshu Bandil,
E-mail: andildeepanshu16@gmail.com

ABSTRACT

Background: Frozen shoulder is debilitating condition marked by progressive shoulder pain and restricted mobility, affecting sleep and activities of daily living of a person. The objective of this study was to evaluate the efficacy of USG guided suprascapular nerve block aided mobilization physiotherapy for management of frozen shoulder so as to improve the quality of living of patients.
Methods: This prospective interventional study was conducted at the Department of Orthopaedics of a teaching institute of Central India from January 2021 to April 2023 after obtaining ethical clearance. Patients diagnosed with frozen shoulder and giving written consent were included in this study after considering the inclusion and exclusion criteria. Baseline demographics, symptom duration, degree of active and passive shoulder range of movement, Shoulder pain and disability index (SPADI) score were documented on day of presentation (preintervention) after which USG guided suprascapular nerve block was given. Post SSNB, 10 sessions of supervised mobilization physiotherapy was given. SPADI scores and degree of active and passive range of movement were noted at 3rd, 6th and 12th week and compared using statistical tests namely repeated measure ANOVA and chi square test of independence.
Results: A total of 54 patients enrolled in the study after meeting inclusion criteria, only 46 completed the follow up and their mean SPADI pain score and mean SPADI disability score at presentation significantly reduced at 12 weeks post intervention. Range of flexion, abduction and external rotation of shoulder also showed significant increase (p value<0.05). Number of participants with severe restriction of shoulder internal rotation also decreased after SSNB aided physiotherapy.
Conclusions: USG guided suprascapular nerve block aided physiotherapy exercise schedule is a safe and effective outpatient treatment for frozen shoulder providing early pain relief and improving shoulder mobility.

Keywords: Frozen shoulder, Adhesive capsulitis, Suprascapular nerve block, Physiotherapy, Shoulder pain and disability index

INTRODUCTION

Adhesive capsulitis of the shoulder, also known as 'frozen shoulder' is a common self-limiting condition characterized by disabling pain and gradual loss of shoulder mobility in all directions.[1] The term 'adhesive capsulitis' believed to represent the underlying pathology more accurately, was favoured in literature.[2] However, current ISAKOS guidelines favour use of the term "frozen shoulder" and discourage adhesive capsulitis as there are no adhesions in the shoulder joint.[3] From a pathological perspective, there is capsular inflammation leading to fibrosis and contracture of the glenohumeral joint capsule and soft tissues around the rotator interval.[4]

In most cases, there is no identified etiology (primary adhesive capsulitis). Secondary adhesive capsulitis can result from shoulder trauma, diabetes mellitus, thyroid abnormalities, etc.[5] Most well-known is the association between diabetes and frozen shoulder.[6] Prolonged immobilization after injuries is an important risk factor for adhesive capsulitis.[2] Adhesive capsulitis is more common among women, especially in their 40s to 60s.[6] Reports suggests adhesive capsulitis-related night-time pain disrupts sleep which can negatively impact one's quality of life, activities of daily living (ADL).[7] Codman suggested that frozen shoulder will resolve spontaneously.[6] However, clinicians often encounter patients complaining of residual pain and loss of motion even at 2 years after the onset of the disease.[8]

There is no consensus regarding the most effective treatments for this condition.[9] While oral anti-inflammatory medications provide certain pain relief, they offer limited effectiveness in addressing the underlying issue.[10] Early use of intra-articular corticosteroid injections (IACI) has shown short-term effectiveness in reducing pain, disability, and improving function. However, repeated corticosteroid injections increase the risk of both iatrogenic infection and steroid arthropathy.[10] Steroid injections must be avoided in patients with uncontrolled diabetes, especially if baseline glucose level is more than 250 mg/dl.[3] Procedures like hydrodilatation can lead to shoulder stiffness. Manipulation under anaesthesia also comes with risk of soft tissue damage, capsular tears, labral detachment, and inadvertent fractures. Arthroscopic capsular release and hydrodilatation tends to yield less favourable outcomes in diabetic patients.[3]

Isolated physiotherapy (PT) methods like stretching, range of motion (ROM) and strengthening exercises, used to improve joint mobility are usually painful and make individuals less compliant in the rehabilitation program. Ultrasound (USG) guided suprascapular nerve block is an outpatient procedure that has believed to give pain relief in various shoulder conditions, without any significant complications as noticed after intra articular steroid injections. Literature on suprascapular nerve block aided physiotherapy for frozen shoulder are sparse. The aim of the study was to evaluate the efficacy of suprascapular nerve block aided mobilization physiotherapy for management of frozen shoulder.

METHODS

Study design

This single-center prospective interventional study was conducted at the Department of Orthopaedics, Gandhi Medical College, Bhopal- a tertiary care teaching institute in Central India after permission from the Institutional Ethical Committee (27305/MC/IEC/2021) from January 2021 to April 2023. Patients diagnosed with adhesive capsulitis of shoulder at orthopaedic department of our center were included in this study after considering the inclusion and exclusion criteria.

Inclusion criteria were pain in shoulder with restricted passive and active shoulder range of movement especially forward flexion, abduction and external rotation for more than 1 month duration; age>18 years; normal radiological appearance (anteroposterior and scapular Y-views); and patients gave written consent

The exclusion criteria were patients with shoulder pain due to recent trauma (less than 1 month), fracture-dislocation around shoulder, bony deformity; pain due to glenohumeral joint arthritis (e.g.- inflammatory arthritis), acromioclavicular joint pathology or rotator cuff disorder; patients with known contraindications for block intervention, e.g. any bleeding disorder, infection (acute or chronic) at the site of block, any known bupivacaine or methylprednisolone drug allergy; history of previous shoulder surgery, any intra-articular injections in the last 3 months; comorbidities like cardiac problems, malignancy, psychiatric disorder, cervical radiculopathy, connective tissue disorders, neurologic disorders and patients who refused USG guided suprascapular nerve block (SSNB) intervention.

Degree of active and passive shoulder range of movement; pain and disability scores using Shoulder pain and disability index (SPADI) were documented on day of presentation (preintervention) and subsequent follow ups at 3rd week, 6th and 12th week after suprascapular nerve block injection.

Technique of SSNB

Patients received a single dose of USG guided SSNB followed by physiotherapy. With patient in sitting position and ipsilateral hand on opposite shoulder, scapular region cleaned with antiseptic solution. A *L16-4 Hs Linear Transducer* (Mindray MX8 MSK, Shenzhen, China) was placed parallel to scapular spine and moved cephalad to identify suprascapular notch. The suprascapular notch was seen covered by trapezius, supraspinatus and transverse scapular ligament. Suprascapular fossa was scanned from medial to lateral side to identify suprascapular nerve and artery in the floor of fossa. The suprascapular nerve was identified as hyperechoic structure beneath the transverse scapular ligament in the scapular notch. Suprascapular artery was identified as a pulsating point lateral to nerve and avoided. A 21-gauge×50 mm short bevel needle was introduced through the skin, after local infiltration with local anaesthetic 0.5% lignocaine solution, medial to the long axis of USG probe in a mediolateral direction towards the scapular notch. After negative aspiration for blood, SSNB block was given by a mixture of 9 ml of 0.5% bupivacaine plus 1 ml (40 mg) methylprednisolone acetate. All injections were performed by the same anaesthesiologist. Sensitivity testing was done before giving the block. Relief in pain as told by patient and

elevation of transverse scapular ligament as seen in USG marked successful injection.

Post SSNB physiotherapy schedule

A mobilization physiotherapy program with five weekly outpatient sessions, each lasting 20 minutes for two consecutive weeks was started at Physiotherapy department of our hospital after giving the suprascapular block. First week involved passive range of movement of involved shoulder and stretching in all planes of movement. Active mobilization along with passive range of movement was encouraged from second week. Each session was supervised by the same experienced physiotherapist for all patients. Following the end of two weeks, patients were advised to continue shoulder exercise at home and follow up at 3, 6 and 12 weeks after the SSNB block.

Outcome measures

Active and passive ROM for forward flexion, abduction and external rotation with arm by side were measured using goniometer. Participants were assessed for shoulder internal rotation using the Hand behind Back method, with a Likert scale based on specific anatomical landmarks. Thumb positions were recorded on a six-point scale: 1- representing optimal internal rotation with the thumb reaching the inter-scapular region; 2- indicating the inferior tip of the scapula as a specific point; 3- extending to the level of the 12th rib; 4- reaching the lumbosacral junction; 5- reaching the contralateral buttock; and 6- extending to the contralateral thigh. For statistical purposes, thumb positions 1-2 were categorized as indicative of minimal restriction of internal rotation, positions 3-4 representing a moderate restriction, and positions 5-6 suggestive of significant restriction.

The SPADI focuses on subjective assessment of shoulder pain and disability. It is a 13-item self-report questionnaire in which patients rate the severity of their pain and how it affects their ability to perform specific activities. Its categories include 'pain' (5 items) and 'disability' (8 items), with the total score, resulting from the summation of each component. A pain scale calculated as sum of points from the 5 pain items, divided by 50 and multiplied by 100. A disability scale computed as sum of points from the 8 disability items, divided by 80 and multiplied by 100. A total SPADI score calculated as sum of points from all items, divided by 130 and multiplied by 100. Percentage score of 0 indicating less shoulder disability and 100 indicating more shoulder dysfunction. SPADI is sensitive to changes over time and captures patient perceived improvements.

Statistical analysis

All the data was entered in the excel sheet. Normalcy of data checked through Kolmogorov Smirnov test and was found to have normal distribution. The results were analyzed using the statistical software SPSS (version 26.0, SPSS Inc., Chicago, IL). The mean values of outcome measures were compared using Repeated Measured ANOVA (Analysis of Variance) test and Chi-square test of independence. P value<0.05 was accepted as statistically significant.

RESULTS

This non blinded clinical study assessed the effectiveness of USG guided suprascapular nerve block-assisted physiotherapy for treating shoulder adhesive capsulitis in patients aged over 18, of any gender, who agreed to participate and fitted in criteria of inclusion. Statistical analysis was performed in line with the study's goals. A total of 54 patients were included in the study. However eight patients lost to follow up. Hence total 46 patients were analysed for outcome.

The mean age of the 46 participants in this study was 55.4 years (SD=6.2), and their ages ranged from 46 to 81 years. The majority of patients fell within the 50-70 year age group. Out of the 46 participants, 16 were male, while 30 were female. The right shoulder was the most commonly affected, with 28 cases. Additionally, 87% of study participants were right-handed (n=40), while 13% were left-handed (n=6). The mean duration of symptoms reported by participants was 9.8 months (SD=2.3), with the maximum reported symptom duration reaching 15 months. Approximately 39% of study participants (n=18) had a diagnosis of diabetes. Relevant demographic data is depicted in Table 1.

Table 1: Demographic characteristics of the participants.

Characteristics	Data
Total number of participants	46
Age range (years)	46-81
Mean age (years)	55.4±6.2
Gender distribution	Male- 16
	Female-30
Affected shoulder	Right shoulder-28
	Left shoulder-18
Handedness	Right-handed-40
Duration of symptoms	Mean-9.8±2.3 months (maximum reported duration -15 months)
Prevalence of diabetes	39% (n=18)

The initial mean SPADI Pain, SPADI disability and SPADI total score exhibited a significant decrease over successive weeks, as depicted in Table 2. As pain scores improved significantly, patients' range of shoulder movement also showed positive change as shown in Table 3. Both active and passive range of movement of shoulder showed an increasing trend in forward flexion, abduction and external rotation. Level of restriction of shoulder

internal rotation, both active and passive, also significantly reduced among study participants as observed in Table 4 and Table 5.

Following suprascapular nerve block, no complication or adverse events related to the procedure were noted in any study participant. Patients were able to sleep better, perform their activities of daily living with ease.

Table 2: Comparison of mean scores of SPADI (pain, disability and total) at pre-intervention, week 3, week 6 and week 12.

SPADI	Baseline	Week 3	Week 6	Week 12	P value
SPADI pain	75.21±2.69	64.58±2.83	58.30±0.89	43.06±2.14	0.001
SPADI disability	71.95±2.27	61.55±2.69	54.99±2.49	42.59±3.38	
SPADI total	78.48±2.66	66.72±1.77	53.43±1.78	46.58±2.61	

Note: P value- repeated measured ANOVA test.

Table 3: Comparison of mean values of shoulder range of movements at pre-intervention, week 3, week 6 and week 12.

ROM (range of movement)		Baseline (pre-intervention)	Week 3	Week 6	Week 12	P value
Flexion	Active	89.39±4.49	109.43±6.72	128.54±5.85	143.85±4.21	0.001
	Passive	100.76±5.23	121.11±6.34	136.39±6.13	150.78±4.25	
Abduction	Active	86.22±3.93	97.61±6.05	117.61±6.25	127.22±6.32	0.001
	Passive	85.04±4.16	102.78±6.39	122.78±4.19	130.73±5.39	
External rotation	Active	36.39±1.98	40.83±1.32	46.5±1.68	56.2±1.28	0.001
	Passive	40.83±1.32	48.69±1.38	57.48±1.72	62.5±1.13	

Note: P value- repeated measured ANOVA test.

Table 4: Distribution of restriction levels of active internal rotation of shoulder at pre-intervention, week 3, week 6 and week 12.

Active internal rotation	Baseline (pre-intervention)	Week 3	Week 6	Week 12	P value
Severely restricted (6,5)	26	18	10	5	0.001
Moderate restricted (3,4)	16	19	20	10	
Minimal restricted (1,2)	4	9	16	31	

Note: P value- Chi square test of independence.

Table 5: Distribution of restriction levels of passive internal rotation of shoulder at pre-intervention, week 3, week 6 and week 12.

Passive internal rotation	Baseline (pre-intervention)	Week 3	Week 6	Week 12	P value
Severely restricted (6,5)	26	18	10	5	0.001
Moderate restricted (3,4)	16	19	20	10	
Minimal restricted (1,2)	5	11	16	32	

Note: P value- Chi square test of independence.

DISCUSSION

Shoulder pain along with limitation of movement of shoulder joint resulting from adhesive capsulitis is a very common presentation in orthopedic clinics. This is especially true for females in the 50-80 year age group. The relationship between shoulder pain and stiffness in frozen shoulder can indeed be described as symbiotic, as they often coexist and can exacerbate each other.[5] Shoulder pain often leads to reduced shoulder use to minimize discomfort, which can cause stiffness due to thickening and tightening of joint capsule and surrounding tissues.

Therefore, managing frozen shoulder should primarily focus on early pain relief and restoring function through early intervention. As frozen shoulder is believed to be a self-limiting condition, conservative management is the first choice.[1] Physical therapy, through various exercises and stretching routines can help patients gradually increase the range of motion and reduce stiffness.[2] More recently, there has been a growing interest in suprascapular nerve blockage as a potential treatment option for frozen shoulder with significantly faster improvement in pain scores.[5,10-12] Some studies have also reported improved quality of life scores after suprascapular nerve block for frozen shoulder.[7,13]

The suprascapular nerve is responsible for providing around 70% of the sensory nerve fibers to the shoulder joint.[12] While the exact pain relief mechanism is not fully understood, the 'wind-down' phenomenon hypothesis suggests that suprascapular nerve block might reduce central sensitization of pain neurons, decrease pain-inducing substances in the synovium. This reduction in pain allows patients to better tolerate physiotherapy, leading to improved treatment outcomes.[14] Present study assessed the effectiveness of suprascapular nerve blockage aided physiotherapy in reducing shoulder pain and restoring shoulder function. Main attributes of this study include: (a) meticulous exclusion of conditions other than frozen shoulder, (b) ultrasound-guided precise suprascapular nerve block, (c) a physiotherapy protocol for post-SSNB strength and function restoration, and (d) the use of both subjective Shoulder Pain and Disability Index and objective measure of shoulder range of movement for evaluation.

Various studies have explored the efficacy of SSNB along different physiotherapy interventions such as heat therapy, TENS, lasers, etc., for treatment of frozen shoulder and have reported good outcomes.[2,7,15] Present study also showed quick pain relief after SSNB and improved shoulder mobility with hospital supervised physiotherapy, comprising passive and active exercises, and strength training. Although we did not study the outcome according to the stage of adhesive capsulitis, we believe that natural course of adhesive capsulitis may play significant role in outcomes.

During initial stage, pain increases especially at night and at later stages shoulder becomes stiffer while the pain becomes localized. Pain further prevents patients to move their shoulder, hence early pain relief to aid shoulder movement should be emphasised. A few studies reported no difference in outcomes of hospital-based shoulder exercise regime and home-based exercise programs for adhesive capsulitis.[16,17] This may be attributed to factors such as patient adherence, the effectiveness of the exercises themselves, and the appropriate guidance provided in both settings.

Many studies have reported short term benefits in pain relief and range of movement after SSNB.[5,10,12,18] But only one study has raised question about the long-term benefits of SSNB in terms of pain relief, active and passive shoulder range of motion, disability, and overall quality of life; citing no improvement in assessment scores from 3 to 12 months post intervention.[19] This point of conflict could be due to natural healing process, heterogeneity of study population, variability of assessment tools, and adjunctive therapies.

A few studies mention the use of local anaesthetic alone as an injectant for SSNB.[14,19] On the contrary, a mixture of local anaesthetic (bupivacaine) and corticosteroid (methylprednisolone) as an injectant was used for SSNB in this study, like other previous studies.[5,10,20]

Furthermore, certain research findings have indicated that the co-administration of steroids alongside local anaesthetics can extend the duration of nerve block effectiveness by 1.5-2 times and lead to reduced pain scores.[2] Whether the pain relief is a result of the local anaesthetic or the steroid remains unresolved and needs further research. In our study, we administered a single ultrasound-guided SSNB injection, a procedure endorsed as both safe and devoid of radiation exposure, in agreement with previous research.[20]

Additionally, it enables direct visualization of the drug's infiltration around the suprascapular nerve (SSN). However, there is a lack of agreement regarding the recommended frequency of SSNB injections, and the volume of anaesthetic to be administered during the procedure in the available literature. Multiple SSNB injections have yielded better results as compared to single injection in a study by Mortada et al.[21]

Literature suggests that females are more affected with adhesive capsulitis as compared to males, and this was observed in present study also.[22] No complication or side effect of suprascapular nerve block like pneumothorax, nerve injury etc., was reported in this study. Recent studies have also highlighted the simplicity and safety of performing the SSNB procedure in an outpatient setting.[23]

Limitations

Our study has few limitations to mention. Firstly, it lacks a control or comparison group, which could have provided valuable insights into the relative effectiveness of SSNB compared to other modalities such as intra-articular steroid injections or hydrodilatation. Secondly, due to the nature of the study design, blinding of participants to their treatment was not feasible, potentially introducing bias. Lastly, our study is a single center study, which may limit the generalizability of the findings to a broader population.

CONCLUSION

This study presents compelling evidence that suprascapular nerve block assisted physiotherapy is a safe, efficacious, cost effective, well-received treatment option, without need of hospitalization for individuals suffering from frozen shoulder. It can be conveniently administered in a routine outpatient setting, offering an alternative or supplementary approach to conventional oral medication and intra-articular steroid injections. The findings of this study underscore that this treatment not only alleviates pain but also diminishes disability. Exploring the potential for extended pain relief duration and the combination of nerve block with other pain management approaches presents an area of promising future research.

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