Comparative study of anatomical landmark-guided versus ultrasound-guided suprascapular nerve block in chronic shoulder pain

ABSTRACT

Background: Suprascapular nerve block (SSNB) is an effective method for the treatment of shoulder disorders. The present study was conducted to evaluate and compare the effectiveness of SSNB under ultrasonographic guidance with anatomical landmark-guided (LMG) technique in the treatment of chronic shoulder pain.

Materials and Methods: A total of fifty patients with shoulder pain were enrolled in the present prospective randomized study. Patients in Group I ($n = 25$) received SSNB using the anatomical LMG as technique described by Dangoisse, in whom a total of 6 ml of drug (5 ml of 0.25% bupivacaine and 40 mg methylprednisolone) was injected. Group II patients ($n = 25$) were given SSNB using the ultrasound guidance with the same amount of drug. Pain was measured using visual analog scale (VAS), range of motion and Shoulder Pain and Disability Index (SPADI) were recorded. Observations were recorded before the block, immediately after the block, and 1 and 4 weeks after the block.

Results: There was no statistically significant difference between the VAS score, range of motion and SPADI before the procedure ($P > 0.05$) in both the groups. Both the groups showed statistically similar improvement of VAS, range of motion and SPADI at 4-week ($P > 0.05$) follow-up. In Group I, VAS decreased from baseline value of 6.64 ± 1.50–2.04 ± 0.94 at 4 weeks ($P < 0.001$). In Group II, the VAS decreased from 6.92 ± 1.00 to 1.84 ± 1.03 at 4 weeks ($P < 0.01$).

Conclusion: In our study, both the techniques have produced comparable relief of pain, improvement in shoulder movement, and decreased SPADI 4 weeks after the block.

Key words: Chronic shoulder pain; suprascapular nerve block; ultrasound-guided suprascapular nerve block

Introduction

Chronic shoulder pain is a common complaint, especially among the elderly population leading to functional disability and decrease in quality of life. Shoulder pain may originate in the joint itself or from any of the surrounding muscles, ligaments, or tendons.[1,2] It has a prevalence of 15%–30% in the adult population. Activity modification, physiotherapy, and analgesics comprise the initial treatment in these patients. In several patients, it is difficult to treat as it responds poorly to conservative management (pharmacological and physical therapies) leading to progressive limitation of movement ultimately resulting in adhesive capsulitis. For this reason, it is important to consider interventional options such as

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suprascapular nerve block (SSNB) when conservative therapy fails.[1-3]

A SSNB is an effective method for the treatment of shoulder disorders. It has been successfully used for the management of acute and chronic shoulder pain as well as for the diagnosis of suprascapular neuropathy.[4] SSNB has been found to be effective in common conditions that result in chronic shoulder pain which include rotator cuff lesions, adhesive capsulitis (frozen shoulder), calcifying tendinitis, shoulder arthritis, rheumatoid arthritis, and stroke sequel.[5-9] The surface landmark technique of SSNB has undergone several modifications since it was first described by Wertheim and Rovenstien in 1941.[10] The most commonly used surface landmark technique of SSNB is the one described by Dangoisse *et al*.[11] The accuracy of surface landmark techniques can be improved using image guidance, which includes fluoroscopy, computed tomography (CT), and ultrasound. Ultrasound guidance has the advantage that it does not expose the patient and personnel to radiations, and it is a real-time procedure in which one can actually notice the infiltration of the drug around the suprascapular nerve (SSN) and recess site.[4]

There are limited studies comparing efficacy of the SSNB using ultrasound-guided (USG) technique with the landmark-guided (LMG) technique in shoulder pain. Hence, we conducted this prospective study to compare and evaluate the anatomical LMG technique of SSNB with USG technique of SSNB in patients with chronic shoulder pain with regard to decrease in pain, increase in range of motion, and improvement of shoulder function.

Materials and Methods

This present prospective randomized study was conducted after the approval of Local Institutional Research Committee and written informed consent from the patient. Fifty patients of either sex, between 40 and 70 years of age, with chronic shoulder pain (visual analog scale [VAS] >4) of duration more than 3 months not responding to at least 2 weeks of oral analgesics and conservative therapy, referred to pain clinic were enrolled in the study. Patients with known contraindications for block interventions (e.g., infection at the site of block, coagulopathy etc.), history of adverse reactions to steroids and bupivacaine, uncontrolled diabetes mellitus, and patient not consenting for SSNB were excluded from the study. The patients were randomly divided in two groups of 25 each by a computer generated randomized number table. Patients in Group I (*n* = 25) were administered SSNB using the anatomical landmark technique described by Dangoisse *et al*.[11] Patients in Group II (*n* = 25) received SSNB using

the USG technique. Both groups received same amount of drug. In Group I, nerve block was performed with patient in sitting position, after skin preparation and local anesthesia, a 21-gauge × 38 mm needle was introduced through the skin, 2 cm cephalad to the midpoint of the spine of scapula. The needle was advanced parallel to the blade of the scapula until bony contact was made with the floor of suprascapular fossa. After negative aspiration for blood, 5 ml of 0.25% bupivacaine and 40 mg methylprednisolone were slowly injected [Figure 1]. In Group II, patients received SSNB under ultrasound guidance using SonoSite M-Turbo ultrasound machine with 6–13 MHz linear probe. With the patient in sitting position and arm by the side, the ultrasound probe was placed in the coronal plane over the suprascapular fossa with slight anterior tilt. Suprascapular fossa was scanned from medial to lateral side to identify SSN and artery in the floor of fossa between the suprascapular notch and spinoglenoid notch. A 23-gauge Quincke spinal needle was used to pierce the skin after local infiltration with local anesthetic solution, in a mediolateral direction at an angle of 30–45 to the vertical, under the guidance of ultrasound [Figure 2]. After identification, 5 ml of 0.25% bupivacaine and 1 ml (40 mg) methylprednisolone were injected slowly under the visualization into the area around the nerve.[12]

The parameters to determine the efficacy of SSNB were pain, range of motion, and disability pain was assessed using VAS, 0–10 cm. Patients were familiarized with the use of VAS for the assessment of pain (where 0 denotes no pain and 10 is worst pain imaginable). Patients were asked to move the affected limb before rating their pain. Flexion, extension, abduction, internal rotation, and external rotation were recorded using a goniometer. Disability was assessed using Shoulder Pain and Disability Index (SPADI), which is a self-administered questionnaire that consists of two dimensions, one for pain and the other for functional

Figure 1: The surface landmarks of Dangoisse's technique

activities. The pain dimension consists of five questions regarding the severity of an individual's pain, while dimensions for functional activities are assessed with eight questions designed to measure the degree of difficulty an individual has with various activities of daily living that require upper extremity use.[13]

Pain and range of motion were recorded at the following intervals: before the procedure, 30 min, 1 week, and 4 weeks after the SSNB, while SPADI were recorded before the block, 1 week and 4 weeks after the block. Procedural complications and side effects such as pleural puncture, vascular puncture, hematoma at the injection site, rash, itching, numbness, tingling, and paresthesia if any were recorded.

The primary end point of this study was assessment of SPADI score after 1 week. Based on earlier studies, we assumed that the difference of 10 in SPADI scores between the two groups was considered clinically significant, At two-sided type 1 error of 0.05, 90% power and standard deviation (SD) of 10, a sample size of 25 per group was required to detect a significant difference. Statistical testing was conducted with the statistical package for the social science system version SPSS 17.0 ((SPSS Inc. Released 2008. SPSS Statistics for Windows, Version !7.0 Chicago: SPSS Inc)). Continuous variables are presented as mean ± SD, and categorical variables are presented as absolute numbers and percentage. The comparison of normally distributed continuous variables between the groups was performed using Student's *t*-test and within the Group I (LMG) and Group II (USG), paired *t*-test was used. Nominal categorical data between the groups were compared using Chi-squared test or Fisher's exact test as appropriate. $P < 0.05$ was considered statistically significant.
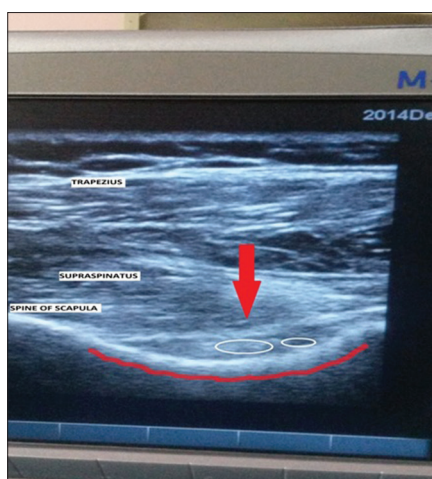

Figure 2: Sonoanatomy of suprascapular region. Pointer showing the target site where the suprascapular nerve runs with the suprascapular artery covered by fascia of supraspinatus muscle

Results

The data of all fifty patients were analyzed. The maximum number of patients in both the groups were the diagnosis of periarthritis shoulder followed by rotator cuff injury, postcerebrovascular accident sequel, impingement syndrome, and shoulder arthritis. The distribution of patients according to the age, sex, duration of pain, and diagnosis in the two groups was comparable ($P > 0.05$) [Table 1]. In Group I, the VAS for pain decreased from baseline value of 6.64 ± 1.50–2.12 ± 0.97 immediately after the block, further decreased to 2.12 ± 0.83 at 1 week and 2.04 ± 0.94 at 4 weeks. In Group II, the VAS decreased from baseline value of 6.92 ± 1.00–2.76 ± 1.30 immediately after the block, further decreased to 2.68 ± 1.25 at 1 week and 1.84 ± 1.03 at 4 weeks. Mean SPADI score improved from baseline score of 66.66 ± 10.79 in Group I and 65.07 ± 13.47 in Group II, to 34.24 ± 8.01 and 25.89 ± 14.30, respectively, at 1 week, and to 28.85 ± 5.19 and 24.37 ± 9.97 respectively at 4 weeks. The reduction of VAS in both the groups immediately after the block, after 1 week and after 4 weeks was found to be statistically significant ($P < 0.001$) in both the groups when compared with the baseline value. There was significant ($P < 0.001$) improvement in the SPADI at 1 week and 4 weeks after SSNB in both the groups [Table 2]. There was an overall significant ($P < 0.05$) improvement in all range of shoulder movements, i.e., flexion, extention, abduction, internal rotation, and external rotation in both the groups from the baseline value immediately following the SSNB which was maintained at 1 week and at 4 weeks after the procedure [Table 3].

There were no statistically significant differences between the two groups in VAS score, SPADI, and range of shoulder motion before the procedure ($P > 0.05$). The VAS score and range of motion of the two groups were statistically comparable with each other immediately after the block, 1 week and 4 weeks following the block. The USG group showed rapid improvement of shoulder function, had significantly ($P = 0.02$) better SPADI score than Group I at 1 week. The SPADI at 4 weeks in Group I and Group II was statistically insignificant ($P = 0.054$). Repeat block was required in 4 patients of Group I and 3 patients of Group II ($P = 1.00$.). Two patients in the Group I complained transient vagal symptoms which improved after some time and did not require any intervention. No complications were

Table 1: Demographic data

	Group I	Group II
Age in years (mean±SD)	51.12±8.76	57.12±12.31
Sex distribution (male/female)	17/8	19/6
Duration of pain (range)	3.5-7.5	3-6

SD: Standard deviation

Table 2: Comparison of visual analog scale and Shoulder Pain and Disability Index

	VAS		P (I vs. II)	SPADI		P (I vs. II)
	Group I	Group II		Group I	Group II	
Before block	6.64±1.50	6.92±1.00	0.440	66.66±10.79	65.07±13.47	0.647
Immediately after block	2.12±0.97*	2.76±1.30*	0.054	-	-	-
1 week after block	2.12±0.83*	2.68±1.25*	0.069	34.2±8.01*	25.89±14.30*,+	0.002
4 week after block	2.04±0.94*	1.84±1.03*	0.475	28.85±5.19*	24.37±9.97*	0.054

*$P<0.001$ when observation compared with the baseline of the same group. +$P<0.05$ Group I versus Group II. VAS: Visual analog scale; SPADI: Shoulder Pain and Disability Index. -: Not Applicable

Table 3: Comparison of range of motion

	Before block	Immediately after block	1 week after block	4 week after block
Abduction				
Group I	111.48°±4346°	142.48°±37.48°*	141.40°±35.45°*	143.04°±34.91°*
Group II	101.36°±40.39°	146.20°±34.34°*	144.60°±28.44°*	151.60°±27.22°*
Internal rotation				
Group I	38.52°±18.83°	56.60°±15.73°*	57.80°±15.21°*	58.20°±16.08°*
Group II	37.80°±16.65°	57.40°±17.74°*	58.52°±16.95°*	58.52°±16.95°*
External rotation				
Group I	23.96°±12.18°	34.00°±12.33°*	35.00°±12.91°*	37.08°±4.11°*
Group II	25.80°±12.63°	39.00°±14.7°*	38.44°±12.91°*	39.48°±12.95°*
Flexion				
Group I	95.04°±19.84°	122.08°±17.71°*	115.40°±21.36°*	125°±11.99°*
Group II	88.40°±26.80°	121.28°±29.21°*	118.52°±19.33°*	129.48±16.04*

*$P<0.05$ when observation compared with the baseline of the same group

observed in Group II. The occurrence of complications in both the group was statistically comparable ($P > 0.05$).

Discussion

SSNB is a safe, simple, and effective technique for the management of chronic shoulder pain which can be easily performed in the outpatient department. In our study, both the techniques of the SSNB, i.e., USG and LMG resulted in decreased pain score, improved range of motion, and decreased SPADI scores after 4 weeks of administration of block. However, when both the techniques were compared with each other the improvement in pain score and shoulder movement and decrease in SPADI scores were comparable. None of them proved to be better than the other except USG technique resulted in early improvement in shoulder function (significantly lower SPADI scores) at 1 week.

SSNB is being increasingly used for acute and chronic shoulder pain control and postoperative analgesia after shoulder surgery. SSNB is also preferred over other therapeutic options such as anti-inflammatory drugs and intraarticular steroid injections which have their limitations in the elderly population who have many comorbidities such as diabetes and renal dysfunction.[8,14-16]

The SSN is mixed nerve, possessing both motor and sensory fibers, accounting for 70% of sensory supply to the shoulder joint, mainly the posterior and superior capsule. It originates from the ventral rami of the fifth and sixth cervical nerve roots. It emerges from the lateral aspect of the upper trunk of the brachial plexus, then courses posteriorly and laterally to the scapular notch. It enters the supraspinous fossa through the suprascapular notch below the superior transverse scapular ligament. The suprascapular artery and vein pass above this ligament. In the supraspinous fossa, the nerve is in direct contact with bone and exits the suprascapular fossa to infrascapular fossa lateral to the spinoglenoid notch. The superior articular branch given off in the supraspinous fossa, provides sensory supply to the the coracoclavicular, coracohumeral ligaments, the acromioclavicular joint, glenohumeral joint, and subacromial bursa. SSN also gives off motor branches for the supraspinatus and the infraspinatus muscle.[4,17-19] The SSN is targeted either in the suprascapular notch (posterior approach) or the supraspinous fossa (superior approach) to obtain interruption of sensory impulses; hence, it is important to know the anatomical details of the nerve. The posterior approach techniques guide the needle into the notch which may be absent in 15% of patients and may result in pneumothorax as the trajectory of the needle is toward the thoracic cavity. On the other hand, superior technique does not require the localization of nerve; the needle is directed in the lateral half of the fossa as supraspinatus muscle originates from the medial half. The advantages offered by this technique are extremely low risk of pneumothorax, ease of access, and it is not necessary to

identify the notch.[4] The landmark guide technique used by Dangoisse *et al.* is a superior approach.[11] To improve the accuracy of the LMG techniques image guidance such fluoroscopy, CT and more recently ultrasound have been used. The technique of USG SSNB was first described by Harmon and Hearty in 2007. They suggested that the ultrasonographic view of the suprascapular region pertinent to the SSN block was the suprascapular notch and transverse ligament. The intended target of the ultrasound-guided injection was the notch.[20] Later, Peng *et al.* conducted a fluoroscopic and cadaveric study which suggested the reinterpretation of the sonoanatomy. When the US probe is positioned in the coronal plane over the suprascapular fossa with a slight anterior tilt, the SSN was visualized on the floor of the scapular spine between the scapular notch and the spinoglenoid notch. The concave shape of the floor was misinterpreted as the suprascapular notch, and the fascia of the supraspinatus muscle as the transverse scapular ligament. The target site for the SSN block was suprascapular fossa at this site where it forms a compartment, and the final needle-tip position was away from the notch with a potential decrease in the risks of pneumothorax or spread of local anesthetic toward the brachial plexus.[21] Hence, the superior approach LMG techniques and the USG technique target the nerve in the same area.

Shanahan *et al.* conducted a study to compare anatomical landmark approach of SSNB versus CT-guided SSNB for shoulder pain in patients with degenerative joint rotator cuff disease. The patients were reviewed at 1, 4, and 12 weeks after injection. Similar to our findings, they observed that there were no significant differences in the improvement in pain and disability between the two approaches at any times. The study concluded that CT-guided and landmark approaches to performing SSNBs result in similar significant and prolonged pain and disability reductions and both approaches are safe.[22] Our results are also in consensus to study by Arcila Lotero *et al.* who evaluated the clinical efficacy and safety of ultrasound-guided SSNB in patients with chronic shoulder pain. They found significant improvement in VAS score after USG SSNB. In their study, the proportion of patients with reduced pain 2 days and 1 month after the procedure was 78.3% and 48.7%, respectively.[12] Ozkan *et al.* administered SSNB under fluoroscopic guidance using a nerve stimulator needle in patients with frozen shoulder and diabetes mellitus unresponsive to intraarticular steroid injections.[6]

Gorthi *et al.* conducted a prospective randomized case–control study in fifty patients with perishoulder pain to analyze the effectiveness of SSNB under ultrasonographic guidance. Patients in the study group ($n = 25$) underwent nerve block using ultrasonographic guidance and control group ($n = 25$) patients were given the nerve block by without ultrasonographic guidance using a technique described by Moore. Degree of pain is assessed using a VAS and shoulder function was evaluated using the constant shoulder score (CSS). In contrast to our results, they observed that the study group showed better VAS and CSS patterns than the control groups at 1-month follow-up ($P < 0.05$). No complications occurred in the study group. In control group, there were two cases of arterial puncture and three cases of direct nerve injury with neurological deficit for 2 months.[23] The difference in results can be attributed to the Moore's technique of LMG SSNB used by them which targets the nerve in the suprascapular notch[24] while LMG technique used by us blocks the nerve in the supraspinous fossa.

The probable reason for similar result in both the groups could have been due the volume used by us, i.e., 6 ml, which was sufficient to fill the lateral half of suprascapular fossa in all patients. Feigl *et al.* in a cadaver study concluded that 5 ml volume is enough to fill in lateral half of suprascapular fossa.[25] If we had used a smaller volume of drug, it could have produced different results, i.e., USG group could have been better because more targeted injections are given under guidance. USG SSNB is a new technique and there are only few studies which have compared LMG technique and USG technique of SSNB in chronic shoulder pain.

The limitation of the present study was short-term follow-up of patients following the block; hence, long-term outcome of both the techniques could not be assessed. Another limitation was a small sample size, a large sample size could have helped us to validate our results more emphatically.

Conclusion

The anatomical LMG described by Dangoisse *et al.* and the USG techniques of SSNBs are safe and efficient methods for the management of chronic shoulder pain. They decrease shoulder pain, increase range of movement, and improve shoulder functions. The two techniques used in the present study were comparable to each other in all aspects except the USG group resulted in early improvement of shoulder function. Since only a few studies have evaluated USG SSNB for management of chronic shoulder pain, further studies are required to evaluate and compare it with other LMG techniques of SSNB.

Conflicts of interest

There are no conflicts of interest.

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