Comparison of Ultrasound-guided Suprascapular Nerve Block and Extracorporeal Shock Wave Therapy in Reduction of Pain and Functional Disability in Adhesive Capsulitis of Shoulder: A Randomized Controlled Study

Tripti Swami, Akoijam Joy Singh, L Nilachandra Singh

ABSTRACT
Objectives: To compare the effectiveness of ultrasound-guided suprascapular nerve block (SSNB) and extracorporeal shockwave therapy (ESWT) in the management of adhesive capsulitis of the shoulder.

Study design: Randomized controlled trial.

Materials and methods: A total of 88 patients from September 2016 to August 2018 were recruited from outpatient of the Department of Physical Medicine and Rehabilitation, Regional Institute of Medical Sciences, Imphal. While the ESWT group received radial shock waves on average 2,000 impulses once weekly for 4 weeks, the SSNB group got ultrasound-guided single SSNB with 10 mL bupivacaine (0.5%). Range of motion (ROM) and shoulder pain and disability index (SPADI) were measured at week 1, week 4, and week 12.

Results: Both groups showed significant improvement in the mean score of ROM and SPADI (p < 0.05). Although SSNB was found to be significantly more effective than ESWT in the reduction of pain and disability in both short term and long term (p < 0.05).

Conclusion: The effectiveness of SSNB specifically in short-term pain control and ease of application under ultrasound guidance makes it preferable in the management of adhesive capsulitis of the shoulder. While ESWT also seems to be a promising therapy and a viable alternative to steroids for adhesive capsulitis in case of patients with diabetes.

Keywords: Adhesive capsulitis, Extracorporeal shockwave therapy, Range of motion, Shoulder pain and disability index, Suprascapular nerve block.

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INTRODUCTION

Adhesive capsulitis is a common painful debilitating condition characterized by progressive loss of both active and passive range of motion (ROM) in all planes of the glenohumeral joint in the absence of a known intrinsic shoulder disorder. Codman in 1934 used the term “frozen shoulder” and described it as pain over the deltoid insertion along with restricted elevation and external rotation. It has a self-limiting natural history, which usually lasts between 1 year and 3 years without intervention thereby negatively affecting patient's activities of daily living and reduces the quality of life.

Adhesive capsulitis occurs in around 2% of the general population with a predilection for age group of 40–70 years and female gender. It is seen commonly associated with diabetes mellitus, cervical pathology, prolonged immobilization, hyperthyroidism, stroke or myocardial infarction, and trauma.

Pathology has been described as an inflammation of the synovium and perivascular tissue with raised cytokines along with the proliferation of fibroblasts and collagen band formation, leading to decreased elasticity of joint. The classic frozen shoulder has three stages as described by most of the literature freezing or painful stage, frozen stage, and thawing stage.

Patients typically present with a gradual onset of pain and loss of both active and passive ROM of the shoulder with unremarkable radiographic findings. Treatment includes nonsteroidal antiinflammatory drugs, intra-articular steroids, pendulum motions, active-assisted, and passive mobilizations. With the failure of conservative treatment, rupture of intracapsular adhesions by hydraulic distention, manipulation under general anesthesia, arthroscopic capsular release, and finally open release can be tried.

Suprascapular nerve block (SSNB) was initially described by Wertheim and rovenstein. The volume most commonly used in the literature is 10 mL of 0.5% bupivacaine. Suprascapular nerve has 70% contribution to the sensory supply of the shoulder joint, thereby justifying the use of block for pain reduction.

Extracorporeal shock wave therapy (ESWT) has shown positive results in orthopedic conditions such as tendinitis, lateral epicondylitis, and rotator cuff disease. Shock waves are acoustic mechanical waves that act at the molecular, cellular, and tissue levels to produce a biological response. It causes neovascularization,
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Ultrasound image demonstrating needle tip and spread of local anesthetic was visualized (Fig. 1).

The suprascapular nerve in the suprascapular notch. Bupivacaine (0.5%) 10 mL was then injected and the spread of local anesthetic was visualized (Fig. 1).

Materials and Methods

This was a randomized controlled study conducted in the Department of Physical Medicine and Rehabilitation, Regional Institute of Medical Sciences, Imphal for the duration of 2 years from September 2016 to August 2018. Total 88 diagnosed cases of stage II and stage III adhesive capsulitis of age between 35 years and 60 years fulfilling the criteria as mentioned below were included in the study. Detailed history, clinical examination, and relevant investigations were done wherever indicated to rule out other causes.

Adhesive capsulitis diagnosis was made after the fulfillment of the following criteria:

- Gradual onset of pain.
- Loss of both passive and active ROM.
- Equal or more than 20% loss of passive glenohumeral ROM in atleast three of flexion, abduction, external rotation and internal rotation compared with the uninvolved side.
- Normal radiograph.

The patients who were not able to cooperate with clinical examination, any recent febrile or infectious disease, systemic inflammatory joint disease, any trauma, fracture, dislocation shoulder, history of autoimmune, and hematological disorders, intra-articular, or periarticular steroid injection to shoulder in the previous 2 months, allergy to local anesthetics were excluded.

The study variables were age, gender, side of affection, duration of symptoms, and ROM while the history, clinical examination, and relevant investigations were done wherever indicated to rule out other causes.

In this study, the mean improvement in SPADI and ROM was found to be statistically significant (p < 0.05) in both ESWT and SSNB groups using paired t test (Table 2).

For the pain and disability scales of SPADI and ROM the mean improvement was significant in both groups but statistically more significant in the SSNB group (p < 0.05) as calculated by independent t test (Table 3).

Results

Table 1 shows no statistically significant difference between the groups in characteristics and outcome measures at baseline.

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Discussion

Adhesive capsulitis is characterized by severe pain at rest and articular capsule rigidity. As the articular capsule is supplied by branches from the suprascapular nerve, the use of SSNB in the management of this disease is well justified. Few studies are available on the effect of extracorporeal shock wave therapy on the improvement of pain and functions in adhesive capsulitis.

Vahdatpour et al. assessed the efficacy of ESWT in the adhesive capsulitis shoulder where shockwave therapy was advised once a week for 4 weeks. The results showed significant improvement in the SPADI questionnaire, flexion, extension, and abduction, external rotation between the two groups (p < 0.05), but not in the mean internal rotation (p > 0.05). This study showed positive effects of ESWT on the treatment of adhesive capsulitis of shoulder.

All patients received tramadol for pain if required and were advised to perform a ROM and pendulum exercises of the involved shoulder two times a day. These exercises were followed by wall climbing, active-assisted, and passive mobilization to restore joint mobility. Outcome variables were measured at baseline before the intervention and follow-up assessment was performed at week 1, week 4, and week 12.

Data were collected in a pre-tested proforma. The analysis was done using Statistical Package for the Social Sciences, SPSS-23 version. The baseline characteristics between ESWT and SSNB were studied by Chi-square test for categorical data while the independent t test for continuous variables. For descriptive statistics, mean, and standard deviation were used. For analytical statistics, student t test for intra-group and independent t test for intergroup observations were used and p value <0.05 was taken as significant.

Fig. 1: Ultrasound image demonstrating needle tip and spread of bupivacaine in suprascapular notch
### Table 1: Baseline characteristics of study groups

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>ESWT (n = 44) (mean ± SD) (N)</th>
<th>SSNB (n = 44) (mean ± SD) (N)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years)</td>
<td>48.66 ± 7.03</td>
<td>50.20 ± 4.52</td>
<td>0.360</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>23</td>
<td>18</td>
<td>0.522</td>
</tr>
<tr>
<td>Female</td>
<td>21</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Side of affection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>18</td>
<td>17</td>
<td>0.055</td>
</tr>
<tr>
<td>Left</td>
<td>26</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Duration (months)</td>
<td>5.98 ± 1.51</td>
<td>6.45 ± 1.33</td>
<td>0.121</td>
</tr>
<tr>
<td>Range of motion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flexion</td>
<td>99.32 ± 6.52</td>
<td>95.95 ± 15.57</td>
<td>0.514</td>
</tr>
<tr>
<td>Abduction</td>
<td>88.93 ± 8.07</td>
<td>83.98 ± 16.23</td>
<td>0.471</td>
</tr>
<tr>
<td>Internal rotation</td>
<td>28.30 ± 6.26</td>
<td>26.20 ± 7.63</td>
<td>0.137</td>
</tr>
<tr>
<td>External rotation</td>
<td>22.48 ± 9.90</td>
<td>23.50 ± 5.01</td>
<td>0.585</td>
</tr>
<tr>
<td>SPADI pain</td>
<td>72.36 ± 2.99</td>
<td>74.48 ± 8.89</td>
<td>0.187</td>
</tr>
<tr>
<td>SPADI-disability</td>
<td>76.02 ± 6.09</td>
<td>76.70 ± 8.75</td>
<td>0.272</td>
</tr>
</tbody>
</table>

SPADI, shoulder pain and disability index

### Table 2: Outcome measures at baseline, week 1, week 4, week 12

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group</th>
<th>Baseline</th>
<th>Week 1</th>
<th>Week 4</th>
<th>Week 12</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPADI</td>
<td>ESWT</td>
<td>72.36 ± 2.99</td>
<td>53.18 ± 4.25</td>
<td>31.32 ± 4.28</td>
<td>17.91 ± 3.86</td>
<td>0.001</td>
</tr>
<tr>
<td>SPADI</td>
<td>SSNB</td>
<td>74.48 ± 8.89</td>
<td>44.09 ± 5.220</td>
<td>26.48 ± 4.87</td>
<td>11.95 ± 4.27</td>
<td>0.001</td>
</tr>
<tr>
<td>SPADI disability</td>
<td>ESWT</td>
<td>76.02 ± 6.09</td>
<td>55.56 ± 6.43</td>
<td>37.84 ± 5.33</td>
<td>25.14 ± 4.80</td>
<td>0.002</td>
</tr>
<tr>
<td>SPADI disability</td>
<td>SSNB</td>
<td>76.70 ± 8.75</td>
<td>52.15 ± 7.72</td>
<td>34.63 ± 6.73</td>
<td>14.40 ± 1.65</td>
<td>0.001</td>
</tr>
<tr>
<td>ROM Flexion</td>
<td>ESWT</td>
<td>99.32 ± 6.52</td>
<td>116.45 ± 10.68</td>
<td>137.64 ± 12.24</td>
<td>154.09 ± 10.11</td>
<td>0.005</td>
</tr>
<tr>
<td>ROM Abduction</td>
<td>ESWT</td>
<td>88.93 ± 8.07</td>
<td>106.02 ± 7.08</td>
<td>118.86 ± 6.27</td>
<td>141.82 ± 9.02</td>
<td>0.001</td>
</tr>
<tr>
<td>ROM Internal rotation</td>
<td>ESWT</td>
<td>28.30 ± 6.26</td>
<td>35.05 ± 5.83</td>
<td>50.07 ± 6.61</td>
<td>60.43 ± 3.57</td>
<td>0.017</td>
</tr>
<tr>
<td>ROM External rotation</td>
<td>ESWT</td>
<td>22.48 ± 9.90</td>
<td>31.66 ± 9.32</td>
<td>47.84 ± 9.35</td>
<td>59.43 ± 8.66</td>
<td>0.006</td>
</tr>
<tr>
<td>ROM Abduction</td>
<td>SSNB</td>
<td>95.95 ± 15.57</td>
<td>110.77 ± 12.33</td>
<td>144.82 ± 8.11</td>
<td>164.55 ± 5.08</td>
<td>0.002</td>
</tr>
</tbody>
</table>

*p value*: Paired t-test; SPADI, shoulder pain and disability index; ROM, range of motion; ESWI, extracorporeal shockwave therapy; SSNB, Suprascapular nerve block

### Table 3: Between group comparison of mean scores of shoulder pain and disability index and range of motion

<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Week 1</th>
<th>Week 4</th>
<th>Week 12</th>
<th>p value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPADI pain</td>
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</tbody>
</table>

*p value*: Independent t-test; SPADI, shoulder pain and disability index; ROM, range of motion; ESWI, extracorporeal shockwave therapy; SSNB, Suprascapular nerve block
The present study revealed that the mean age of the study population in ESWT group was 48.66 ± 7.03 years, while the control group (SSNB) had a mean age group of 50.20 ± 4.52 years. The most common age group described in literature for adhesive capsulitis is 40–60 years.19,20

The mean duration of symptoms in ESWT was 5.98 ± 1.51 months and SSNB group was 6.45 ± 1.33 months. The subjects selected for this study were stages II and III with restriction of ROM of at least 20%. In ESWT group, women were 47.7% (n = 21) and men were 52.3% (n = 23) and SSNB group constituted 59.1% (n = 26) women while men constituted 40.9% (n = 18). The association of adhesive capsulitis and female gender is well established in the literature, but specific causal factors are still unexplored.20

Majority of patients in the study had left-sided involvement, which is usually a nondominant side in the majority. The involvement of nondominant extremity is shown by several other previous studies.20 It can be explained as it is easier not to use the nondominant extremity due to pain while the other side can do the work leading to unchecked progression of the disease.

In the present study, there was a significant improvement in the mean score of all the outcome measures, SPADI and ROM scores in both the groups at week 1, week 4 and week 12 follow-up (p < 0.05).

The ESWT group was given shock waves from the anterior and posterior directions on the average 2,000 impulses at a frequency of 6 Hz once weekly for 4 weeks. According to arthroscopic findings, adhesions occur more in the descendent fold and surrounding synovium, therefore shockwaves from the anterior and posterior directions are more effective than the lateral direction. In the current study, the amount of energy used was higher than that of energy used in the study by Durante.22

In our study, significant pain reduction was found at week 1 but maximum at week 12. The pain improvement in ESWT group can be explained by the mechanism of action of shockwaves. It uses fine stimuli producing changes in cellular metabolism causing pain relief.13,14,23 It converts shockwaves into biochemical signals causing the release of transforming growth factor beta 1 (TGF-beta1) and insulin-like growth factor-1 (IGF-1), which helps in tissue repair and healing. Pain reduction is also by direct suppression of nociceptors and hyperstimulation analgesia.15 The significant improvement in ROM corresponds with improvement in pain and positive effects on capsular tissue, which affected exercise compliance too. Because there was pain and ROM improvement, SPADI disability score also showed improvement at week 1 and week 4.

A similar significant improvement was shown by Jones, Chattopadhyay24 and Ozkan et al.25 after SSNB in their studies. The mechanism described for effectiveness beyond the duration of action of bupivacaine has been explained as a decrease in central sensitization of dorsal horn nociceptive neurons or a “wind down” (because of a reduction of peripheral nociceptive input). Also contributed by reduction of substance p and nerve growth factor levels in the synovium and afferent C fibers of the glenohumeral joint.26

Patients who received SSNB and shockwave therapy did not have any serious adverse effects during or after the procedure.

Suprascapular nerve block is a simple, safe, cost-effective, radiation free, and easy procedure. The benefits of real-time imaging have any serious adverse effects during or after the procedure. However, the present study showed significant pain and function improvement with a single SSNB procedure. The effectiveness of shock wave for adhesive capsulitis has been shown in few other studies as described. Therefore, it can take advantage of ESWT because of its noninvasive, safe nature, lower treatment cost, no need for hospitalization, fewer visits to the hospital, and the lack of significant adverse events with the treatment. The limitations of this study are non-blinding of study subsequently, which might have led to bias in results, actual structural changes were not assessed and long-term complications were not studied.

**Conclusion**

Both extracorporeal shock wave therapy and SSNB have shown a significant effect on pain and disability reduction in adhesive capsulitis of the shoulder, but SSNB is significantly more effective in early follow-up than extracorporeal shock wave therapy. Therefore, effectiveness of SSNB specifically in early pain control and ease of application under ultrasound guidance makes it preferable over other conventional treatment methods. While ESWT also shows promise as a therapy for adhesive capsulitis, its efficacy, safety, and noninvasiveness justify its choice and can also represent a viable alternative to steroids for adhesive capsulitis treatment in case of patients with diabetes.

**References**


