The Egyptian Journal of Hospital Medicine (July 2021) Vol. 84, Page 1839-1845

Suprascapular Nerve Radiofrequency versus Intraarticular Steroid Injection in Chronic Shoulder Pain

Hamdy A. Youssef[1], Ossama H. Salman[2], Ahmed Y. Ahmed[2], Hesham H. Refae[3], Ghada Mahmoud Morsy[*2]

[1]Department of Anesthesiology, Faculty of Medicine, Assuit University, Assuit, Egypt.
[2]Department of Anesthesiology, Qena Faculty of Medicine, South Valley University, Qena, Egypt.
[3]Department of Orthopedics, Aswan Faculty of Medicine, Aswan University, Aswan, Egypt.
***Corresponding author:** Ghada Mahmoud Morsy, **Mobile:** (+20)01007544554, **E-Mail:** gmm_06@yahoo.com

ABSTRACT

Background: Chronic shoulder pain is a frequent clinical condition that often reduces patient's function and rehabilitation. **Objectives:** We aimed to compare efficacy of pulsed radiofrequency (PRF) to intra-articular steroid (triamcinolone acetonide) injection in controlling chronic shoulder pain as regard improvement of pain and function in six-month duration.

Patients and Methods: We carried out a prospective, randomized, controlled, single-blinded study enrolled 60 patients with shoulder pain randomly divided into 2 groups. Group I: PRF group enrolled 30 patients who were treated by PRF neuromodulation to the suprascapular nerve under fluoroscopy and Group II: steroid group enrolled 30 patients who were treated with intra-articular injection of 5 ml of 2% lidocaine with triamcinolone acetonide 40 mg.

Results: In Group 1 (PRF group) we reported statistically significant improvement of VAS, these positive effects lasted at least 6 months and the VAS decreased through 6 months from 6.5 to 3.5. In Group 2 VAS decreased through 6 months from 7 to 3.5. Both groups showed significant Oxford Shoulder Scale (OSS) improvement.

Conclusion: Intra articular injection of triamcinolone acetonide is more effective in improvement of chronic shoulder pain and function than PRF.

Keywords: Intra-articular steroid injection, PRF, OSS, Shoulder pain, VAS.

INTRODUCTION

Shoulder pain, which is one of the most common musculoskeletal maladies, may arise from diverse causes. Accurate diagnosis of shoulder pain is made difficult by the unique anatomy and position of the shoulder, which serves as a link between the upper extremity and the thorax [(1)].

Determining the source of shoulder pain is essential in order to recommend the proper method of treatment. The examining physician must be able to differentiate the occurrence of shoulder pain caused by intrinsic or local factors, extrinsic or remote factors, or a combination of the two. Intrinsic factors originate from the shoulder girdle and include glenohumeral and periarticular disorders, whereas extrinsic factors occur outside of the shoulder girdle with secondary referral of pain to the shoulder. An example of an extrinsic factor is left shoulder pain as the initial presentation of coronary artery disease. Hepatic, gallbladder, and splenic disease also may manifest initially as shoulder pain [(2)]. Accurate evaluation, diagnosis, and treatment require a thorough understanding of shoulder anatomy, including pain referral patterns. A complete and systematic physical examination is crucial for an accurate diagnosis [(2, 3)].

Nonetheless, most patients with a chronic shoulder disorder can initially be treated conservatively with some combination of activity modification, physical therapy, medications, and corticosteroid injections, if necessary [(4)]. Also using of radiofrequency was recommended in many studies as treatment of chronic shoulder pain [(5)].

We aimed to compare efficacy of pulsed radiofrequency (PRF) to intra-articular steroid (triamcinolone acetonide) injection in controlling chronic shoulder pain as regard improvement of pain and function in six-month duration.

PATIENTS AND METHODS

prospective, randomized, controlled, single-blinded study was carried on 60 patients suffered from shoulder pain for 6 months or more with or without limitation of movements; not responding to conservative treatment and requiring regular analgesia according to the following inclusion criteria, which consisted of (1) age: 30-80 years old, (2) shoulder MRI showing inflammatory or degenerative changes, (3) American Society of Anaesthetists (ASA) physical status was I or II, and exclusion criteria consisted of (1) shoulder pain less than 6 months' duration, (2) any previous surgical intervention to the shoulder, (3) morbid obesity (body mass index of more than 35), (4) infection at the site of application, (5) severe psychiatric illness, (6) cardiac, hepatic or renal compromised function, (7) allergy to local anesthetics, steroids or contrast materials, (8) general inflammatory disease.

Study Protocol:

Ethical approval:

Our study was conducted, after obtaining approval from Ethical Committee (committee no. 48,

Received: 09/01/2021
Accepted: 06/03/2021

2015), Faculty of Medicine, South Valley University. An informed written consent was obtained from every patient after explaining the procedures, the potential side effects and possible outcomes.

The following assessments were performed for all the patients before and after the procedure (1, 3 and 6 months), Pain was assessed by a blind-testing physician using the 10 standard visual analog scale (VAS). Patients were asked to mark their level of pain on a scale from 0 to 10, with 0 representing the least pain and 10 the maximum pain. Disability was assessed by blind-testing physician using Oxford Shoulder Scale (OSS). It is a score ranged between (0 to 60) with better result in higher scores. Score (0 to 19): severe shoulder arthritis; it is highly likely that patient may well require some form of surgical intervention. Score (20 to 29); moderate to severe shoulder arthritis; assessment and x-ray will be needed. Score (30 to 39) :mild to moderate shoulder arthritis; assessment and possible x-ray may be non-surgical treatment will be used. Score (40 to 48); satisfactory joint function, may not require any formal treatment [(6)]. Primary clinical outcome measure was reduction of VAS by 50% or more. Improvements in other shoulder symptoms as range of movement, and reduction of analgesic consumption by 25% at least and need to rescue analgesic (Diclofenac 50 mg IM) were considered secondary outcomes.

The patients were divided in randomized way into 2 groups using the closed envelope method. Group I: PRF; (n=30) we used PRF neuromodulation to the suprascapular nerve under fluoroscopy. Group II: Steroid group (n=30) 5 ml of 2% lidocaine with triamcinolone acetonide 40 mg were injected. Group I (PRF Technique): to perform the surgical procedure under sterile conditions, the PRF procedure was performed in the operating room, under fluoroscopy using NeuroTherm NT1000 radiofrequency generator. Each patient was placed in a prone position, and the skin overlying the operation area was prepared and draped. Fluoroscopy was adjusted to show the scapular notch at approximately 15 degree of lateral and 30 degrees of cephalocaudal angle. Entry point was marked and local anesthesia was applied. A disposable 22-gauge, 15-cm RF needle with a 5-mm active tip was introduced through the skin, 3 cm along the line of the spine in the upper outer quadrant, and then guided to the edge of the suprascapular notch. 2 Hz motor stimulation (<0.5 V) a 5 cm long RF needle with 0.5 cm active tip was advanced under fluoroscopic guidance. Contractions of infraspinatus and supraspinatus were observed. Correct entry of the needle was confirmed also by a 50 Hz sensorial stimulation producing paresthesia in the shoulder joint at voltage <0.7 V. In the end, placement of the needle was verified by both imaging and stimulations. After determining that the needle was in the right place; PRF at 45 V, 200 ms, 42 degrees was applied to patients. The total treatment time was 4 minutes [(7)].

Group II: (Intra-articular triamcinolone acetonide injection technique): to perform the surgical procedure under sterile conditions, the intra-articular injection procedure was performed in the operating room. Each patient was placed in a supine position, and the skin overlying the operation area was prepared and draped. Fluoroscopy was adjusted to show the shoulder joint in anterolateral position. Acromioclavicular joint entry point was marked and local anesthetic was applied to the skin (0.5 mL prilocaine). A 22 G spinal needle was inserted into the acromioclavicular joint. The injection was placed through the subacromial space and it was observed to penetrate into glenohumeral joint [(8)]. 5 ml of 2% lidocaine with triamcinolone acetonide 40 mg were injected.

Statistical Analysis

Quantitative data were expressed as median and IQR. Qualitative data were expressed as frequency and percentage. The following tests were done: Mann–Whitney U test: was used when comparing between two medians. Chi-square test: was used when comparing between non-parametric data. Kruskal Wallis Test (KW): when comparing between more than two medians. P-value < 0.05 was considered significant.

RESULTS

Table 1 showed demographic characteristics of both study groups. There was no statistically significant difference between both groups according to age and sex. There was statistically significant difference between studied groups as regard diabetes mellitus (DM).

Table (1): Baseline characteristics of study participants

Characteristics		Group I (N = 30)		Group II (N = 30)		P-value
Age (years)	**Median**	50.5		48.5		0.123
	IQR	38 - 60		45 - 50		
Sex	**Male**	15	50%	12	40%	0.436
	Female	15	50%	18	60%	
DM	**No**	18	60%	30	100%	< 0.001*
	Yes	12	40%	0	0%	
HTN	**No**	30	100%	27	90%	0.076
	Yes	0	0%	3	10%	

Abbreviations: DM, diabetes mellitus; **HTN**, hypertension. * Statistically significant.

Figure (1) shows causes of shoulder pain as rotator cuff tear represented the major pathology for shoulder pain in our study.

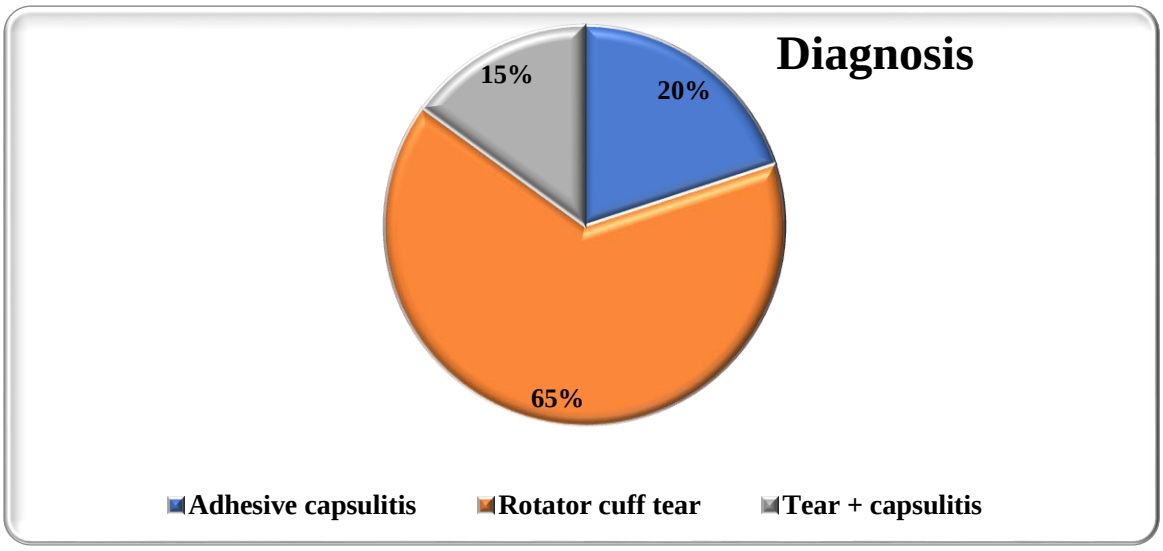

Fig. (1): Description of diagnosis in all studied patients

Table (2) reported statistically significant difference between studied groups as regard VAS at first and third months.

Table (2): Comparison between studied groups as regard VAS

VAS		Group I (N = 30)	Group II (N = 30)	P-value
Pre	**Median**	6.5	7	0.636
	IQR	5 – 8	6 – 8	
First	**Median**	3	3	**0.004** *
	IQR	3 – 5	2 – 3	
Third	**Median**	3.7	3	**0.018** *
	IQR	3 – 5	2 – 3	
Sixth	**Median**	3.5	3.5	0.096
	IQR	3 - 5	3 - 4	

* Statistically significant.

Figure (2) reported improvement in both groups with statistically significant difference between studied groups as regard OSS in first, third and sixth months as better improvement was detected in group II compared to group I.

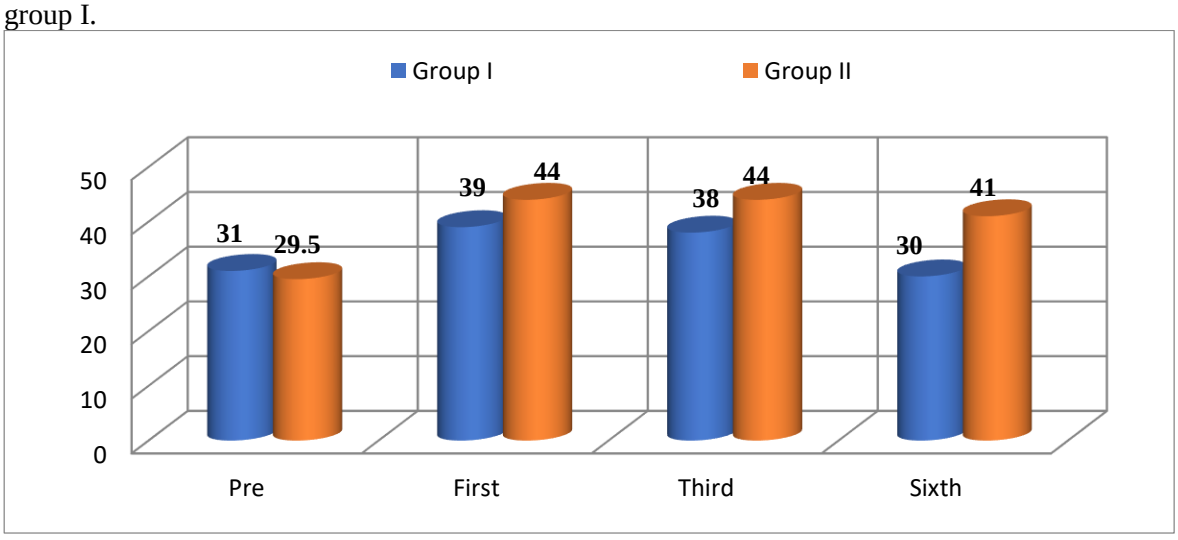

Fig (2): comparison between studied groups as regard OSS

Table (3) showed statistically significant difference between studied groups as regard rescue analgesic. This decrease was found to be greater in group II compared with group I.

Table (3): Comparison between studied groups as regard rescue analgesic

		Group I (N = 30)		Group II (N = 30)		P-value
Rescue analgesic	-	9	30%	24	80%	**< 0.001**
	+	12	40%	6	20%	
	++	9	30%	0	0%	

Table (4) showed statistically significant improvement of pain VAS and OSS in group 1.

Table (4): Comparison between VAS and OSS follows up in group I

Group I		VAS (N = 30)	OSS (N = 30)
Pre	**Median**	6.5	31
	IQR	5 – 8	25 – 34
First	**Median**	3	39
	IQR	3 – 5	34 – 40
Third	**Median**	3.7	38
	IQR	3 – 5	33 – 40
Sixth	**Median**	3.5	38
	IQR	3 - 5	33 – 40
p-value		< 0.05	< 0.05

Table (5) showed statistically significant improvement of pain VAS and OSS in steroid group**.**

Table (5): Comparison between VAS and OSS follows up in group II

Group II		VAS (N = 30)	OSS (N = 30)
Pre	**Median**	7	29.5
	IQR	6 – 8	24 – 33
First	**Median**	3	44
	IQR	2 – 3	39 – 45
Third	**Median**	3	44
	IQR	2 – 3	39 – 45
Sixth	**Median**	3.5	41
	IQR	3 - 4	36 - 44
p-value		< 0.05	< 0.05

DISCUSSION

This study was a prospective, randomized, controlled, single-blinded study, it enrolled 60 patients with shoulder pain randomly divided into 2 groups using the closed envelope method. Group I: PRF group enrolled 30 patients were treated by PRF neuromodulation to the suprascapular nerve under fluoroscopy and group II: steroid group enrolled 30 patients were treated with intra-articular injection 5 ml of 2% lidocaine with triamcinolone acetonide 40 mg.

The age of participants in current study was in median of 50.5 years old for PRF group and 48.5 years as a median for steroid group, with no statistical significant difference between both groups. Male and female were equally presented in group I and female were higher (60%) in group II with no statistical significant difference between both groups.

In this study we performed PRF treatment for shoulder pain as PRF neuromodulation to the suprascapular nerve SSN under fluoroscopy This is in line with **Jang et al.** [9] who enrolled 11 patients with chronic persistent shoulder pain. They used the PRF treatment of the SSN via C-arm fluoroscopy. On other side **Lüleci et al.** [10] study, aimed to evaluate patient satisfaction, efficacy and safety of the pulsed radiofrequency (PRF) technique, PRF was applied to the suprascapular nerve blindly according to the anatomical landmarks. We also differed from other studies used ultrasound (US) guided PRF as **Ergonenc and Beyaz** [8] and **Lee et al.** [11] as US guided has safety in experienced hands, thus reducing the complications (pneumothorax and intravascular injection), not including the radiation. We did not use ultrasound guided technique in this study due to lack of suitable device in our place of work at start of the study, we considered this as limitation of our study.

We used in current study visual analogue scale (VAS) for pain; as all measurements were assessed at four points of time, before the intervention, one, three and six months afterwards. Pain scores were recorded on the VAS. Patients were asked to mark their level of pain on a scale from 0 to 10, with 0 representing the least pain and 10 the maximum pain [12].

In PRF group we reported; highly statistical significant improvement of VAS. These positive effects lasted at least 6 months and the VAS decreased through 6 months from 6.5 to 3.5. It is near to that in **Gofeld et al.** [13] placebo-controlled study, as the 6-month follow-up results revealed that VAS scores decreased from 6.3 to 2.9. In line with ours **Ergonenc and Beyaz** [8] study, showing significant improvement in pain from baseline to the 6 month post treatment and **Jang et al.** [9] as their patients with adhesive capsulitis and/or rotator cuff tear reported a significant reduction in pain (VAS score). We also agree with other studies (but differ with them in timeing of VAS measure) as in the trial of **Taverner and Loughnan** [14] the active PRF group got significant improvement of VAS at night and during movement rather than VAS at rest in 4 and 12 weeks. **Wu et al.** [15] found that the PRF group gained significant improvement of all scoring systems in 1, 4, and 12 weeks comparing with the control group. Also, **Korkmaz et al.** [16], study who compared the efficacy of pulse radiofrequency applied to the suprascapular nerve with the efficacy of conventional transcutaneous electrical nerve stimulation treatment in patients with shoulder pain and found pain improvement in VAS for only 12 weeks. Furthermore, as a novel treatment modality, PRF therapy is commonly used in the management of pain in today's practice. It is a non-neurolytic, effective, and easily applicable method, which offers long-term relief with a single session of therapy. This type of therapy to the nerves has also been reported to stimulate nociceptive nerve endings and, thereby, pro-longed depression in the first synapses. In addition, PRF therapy has been suggested to increase the production of anti-inflammatory cytokines by producing an electric field on the immune cells, and progression of this process is regulated by increasing levels of pro-inflammatory cytokines such as interleukin (IL)-1b, tumor necrosis factor-alpha (TNF-α), and IL-6 [17].

In intraarticular corticosteroid injection, current study mentioned statistically significant improvement of VAS shoulder pain. These positive effects lasted at least 6 months and the VAS decreased through 6 months from 7 to 3.5. In line with ours a **Prestgaard et al.** [18] double-blind, placebo-controlled randomized study of ultrasonography guided intra-articular and rotator interval corticosteroid injections in 122 patients with AC, a notable decrease in shoulder pain at 6 weeks was observed. These results were maintained at 12 weeks but were no longer notable at 26 weeks, and are in agreement with **Maund et al.** [19] who reported that a single intraarticular injection of corticosteroid under fluoroscopy significantly reduced pain compared with placebo at 3 months. **Griesser et al.** [20] performed a systematic review of randomized-controlled trials (RCTs) and concluded that intra-articular corticosteroid injections lead to greater improvements in pain relief and ROM, both in the short and the long terms, but compared to other treatments, the effects were similar in the long term. **Sun et al.** [21] compared steroid injection with nonsteroidal anti-inflammatory agents (NSAIDs) and physiotherapy **Sun et al.** [22] for shoulder pain and concluded that steroid injection and physiotherapy were equally effective for patients with adhesive capsulitis of the shoulder (ACS) and provided slightly more improvement in shoulder function without superiority in pain relief or risk of complications at 4

to 6 weeks comparing with NSAIDs. Systematic reviews and meta-analyses have shown only a minimal and short-lived decrease in pain from rotator cuff tendinosis after corticosteroid injection [23]. The anti-inflammatory mechanism of corticosteroids involves many actions, including suppression of gene transcription as well as cyclooxygenase and lipoxygenase pathways through inhibition of phospholipase A2. This results in reduced peripheral nerve sensitization, inflammatory nociceptive signalling, inflammatory cell recruitment, and vascular permeability, among many other effects [24].

The Oxford Shoulder Score (OSS) is a patient-based questionnaire used to assess shoulder pain. It is a condition specific questionnaire. It contains a mixture of pain and function questions, derived from over 200 initial question models based on in-depth patient and clinician interviews. It has been validated against clinician-based and general health status measures. The OSS is sensitive to clinical change, is simple to complete and has proved to be consistently reliable in determining the outcome from shoulder surgery [16]. Our study reported significant improvement in OSS for group I, it agrees with **Jang et al.** [9] study with A significant OSS improvement ($p<0.05$) was observed. We differs with other studies used different questionnaire as **Gofeld et al.** [13] and **Wu et al.** [15] who used SPADI scores that showed improvement on PRF group.

In comparison between both groups regarding pain improvement, there were highly statistically significant difference between studied groups as regard VAS in (first and third months), and OSS in (first, third and sixth months). With better improvement in corticosteroid group as it was (29.5 to 41) in preintervention and 6th month respectively but in PRF group it was 31 and 83 in pre and at 6th months respectively.

In agreement with **Eyigor et al.** [7] study; when 2 treatment groups have been compared, the higher rate of improvement was in the steroid treatment groups especially in the first weeks according to pain and the continuation of the positive effect on pain up to week 12. Current study differs with recent study that compared the effectiveness of steroid injections and PRF therapies applied to the acromioclavicular joint (ACJ) and the subacromial area. In the long-term they found significantly successful outcomes with both procedures, compared to baseline values, there was no statistically significant difference in the outcomes at 0, 1, 4, 12, and 24 weeks follow-up visits between the two group [25].

Our study showed statistically significant difference between studied groups as regard rescue analgesic. This decrease was found to be greater in corticosteroid treatment group compared with PRF treatment group. This may be explained by the significant effect of intra-articular the corticosteroid injection on pain, which is in agreement with **Eyigor *et al.*** [7] study .

The strengths of our study are that it compares the efficacy of PRF applied to the suprascapular nerve and intra-articular corticosteroid injection in patients with shoulder pain and this concept wasn't discussed previously except in limited studies, it was a randomized and single-blinded study, and the patients were evaluated through multiple dimensions in 6 months follow up period.

The limitation of our study, is that we did not use ultrasound guided technique in this study due to lack of suitable device in our place of work at start of the study. We also had limited number of causes of shoulder pain among our participants.

CONCLUSION

Pulsed radiofrequency applied to the suprascapular nerve and intra-articular injection of triamcinolone acetonide are statistically significant in improvement of chronic shoulder pain with better improvement with intra-articular injection of triamcinolone acetonide.

There is a statistically significant difference between studied groups as regard VAS in (first and third months), and OSS in (first, third and sixth months) with better improvement in triamcinolone acetonide treatment group compared with PRF treatment group.

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