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ORIGINAL ARTICLE

Outcomes of ketorolac versus depomedrol infiltrations for subacromial impingement syndrome: a randomized controlled trial

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Abstract

Purpose Local subacromial infiltration with steroids is a common method of treatment of subacromial impingement syndrome. However, the use of steroids has concerns like tendon rupture, articular cartilage changes and infections. Local NSAIDs infiltration has recently been tried in literature. This study compares the effect of subacromial injections of ketorolac with steroids.

Methods A randomized controlled study was planned with 35 patients in each group. Patients in group-1 were infiltrated with subacromial ketorolac (60 mg with 2% lignocaine) and in group-2 with a steroid (methylprednisolone-40 mg with 2% lignocaine). A similar rehabilitation protocol was followed, and clinical outcomes were analyzed using visual analog scale (VAS) for pain and shoulder pain and disability score (SPADI) and range of motion at one-month and three-months follow-up.

Results Total data of 67 patients were analyzed, as three patients were lost to follow-up. In group 1, mean VAS improved from 7.9 ± 0.95 to 3.19 ± 0.81 ($p < 0.001$) and SPADI improved from 61.41 ± 11.86 to 28.91 ± 9.06 ($p < 0.001$) at three months, respectively. In group 2, mean VAS improved from 8.05 ± 0.94 to 2.9 ± 0.64 ($p < 0.001$) and SPADI improved from 63.45 ± 9.64 to 25.32 ± 6.87 ($p < 0.001$) at three months, respectively. However, there were no differences in functional outcomes between the groups ($p = 0.21$ for VAS, $p = 0.16$ for SPADI).

Conclusion Subacromial ketorolac infiltration has an equivalent outcome as that of steroid infiltration. Ketorolac could be considered as a reasonable alternative to steroids in cases where it is contraindicated.

Keywords Shoulder pain · Subacromial impingement · Subacromial injection · Steroid injections · Nonsteroidal anti-inflammatory drugs · Ketorolac

Introduction

Subacromial impingement syndrome (SAIS) is the most common disorder of shoulder joint [1]. It accounts for 44–65% of all cases of shoulder pain in a routine outpatient department visit [2]. Symptoms occur secondary to subacromial bursitis and tendonitis of the rotator cuff. It usually results from constant irritation and subsequent inflammation of rotator cuff tendons and bursa against the coracoacromial arch [3]. Treatment can be broadly categorized into operative and non-operative methods. Non-operative treatment options for impingement syndrome include rest, ice, physical therapy, ultrasonic therapies, transcutaneous electrical nerve stimulation therapy, corticosteroid injections and nonsteroidal anti-inflammatory drugs (NSAIDs) [4]. Operative management aims at decompression of the subacromial space and is commonly done arthroscopically.

Corticosteroid infiltration in subacromial space is an effective modality when other conservative treatments fail [5, 6]. Though the exact mechanism of its action is not completely understood, the anti-inflammatory property is considered to be the main action. Corticosteroids have shown an association with complications like tendon rupture, subcutaneous atrophy, articular cartilage changes and

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systemic effects like osteoporosis [7–9]. These side effects limit the use of corticosteroids despite their efficacy. As the anti-inflammatory property is the main action of NSAIDs, it is proposed that this class of drugs may also provide symptomatic relief on local infiltration. These drugs are not known to be associated with the side-effects of corticosteroid administration. Ketorolac is an NSAID that acts by inhibiting prostaglandin, thereby reducing inflammation [10–12]. Our study aims at comparing short-term outcomes of ketorolac and corticosteroids in subacromial infiltration for impingement syndrome.

Materials and methods

This was a randomized controlled trial, recruiting patients from May 2018 to January 2019. The study was approved by the institutional review board. All patients with a clinical diagnosis of subacromial impingement syndrome were included. The clinical diagnosis was made in the presence of shoulder pain on active or passive shoulder abduction, tenderness on palpation of the acromion, positive Neer's sign, positive Hawkins–Kennedy test and a painful-arc test [13]. All patients were screened with a plain radiograph of shoulder to rule out any traumatic pathology or glenohumeral arthritis. Patients with degenerative glenohumeral arthritis, adhesive capsulitis, any fracture around the shoulder, signs of a major rotator cuff tear, history of allergy to NSAIDs, uncontrolled diabetes mellitus, pregnancy or breastfeeding status or any signs of local infection were excluded from the study, as shown in the flow diagram (Fig. 1). Stiff shoulders, with an active range of motion less than 50% of the normal motion, were also excluded. Written informed consent was obtained from all patients before inclusion in the study.

Randomization was done with block method [14] dividing all the patients into two groups. Group-1 received injection ketorolac 60 mg, with 5 ml, 2% lignocaine and group-2 received injection methyl-prednisolone 40 mg, with 5 ml, 2% lignocaine.

Technique of injection

Subacromial injections were given under sterile conditions using the postero-lateral approach [15]. The posterior-lateral aspect of the acromion was identified by palpation. The needle was angled approximately 30° anterior to the coronal plane, 2 cm below the angle of the acromion, to the depth of approximately 3 cm. After negative aspiration for blood, a mixture of steroid/ NSAIDs + lignocaine was infiltrated. All patients followed similar post-intervention rehabilitation protocol including rotator cuff strengthening exercises, capsular stretching exercises and shoulder range of motion exercises [16].

Injection protocol

All patients were followed-up after four weeks. In case of persistent symptoms, the injections were repeated. Maximum three injections at four weeks interval were given before patients were advised surgery.

Outcome measurement

Outcome assessment was done at one month and three months to compare with pre-injection status. Aim of the study was to study short-term functional outcomes. Following parameters were studied:

- Visual analog scale for pain (VAS) 0–10 scale.
- Shoulder Pain and Disability Index (SPADI).
- Range of movement (ROM).
    - Flexion abduction: Supine with thorax stabilized.
    - Internal rotation/external rotation—Supine with the shoulder and elbow abducted 90°. The forearm is midway between pronation/supination with the entire humerus supported by the table.
    - ROM assessment for internal rotation was made in sitting position with trunk stabilized. Results were classified as
        - 0—Hand reaches behind the trunk to the opposite scapula or 5 cm beneath it in full internal rotation. The wrist is not laterally deviated.
        - 1—Hand almost reaches opposite scapula, 6–15 cm beneath it.
        - 2—Hand reaches the opposite iliac crest.
        - 3—Hand reaches buttock.
        - 4—Subject cannot move hand behind the trunk.

Shoulder pain and stiffness are principal complaints in cases of shoulder impingement syndrome. VAS score is a universally accepted subjective measure of pain, and SPADI score is a validated and commonly used tool that covers all aspects of the functional assessment.

Sample size

Sample size calculations were done considering the differences in VAS scores and SPADI using "a priori" power analysis [17]. The power of study $(1-\beta)$ was set at 80% and α at 0.05. The minimum clinically significant difference in VAS score was 2 points with a standard deviation of 2 points between subjects [18]. The minimum clinically significant difference in SPADI is 15 points, and the standard difference

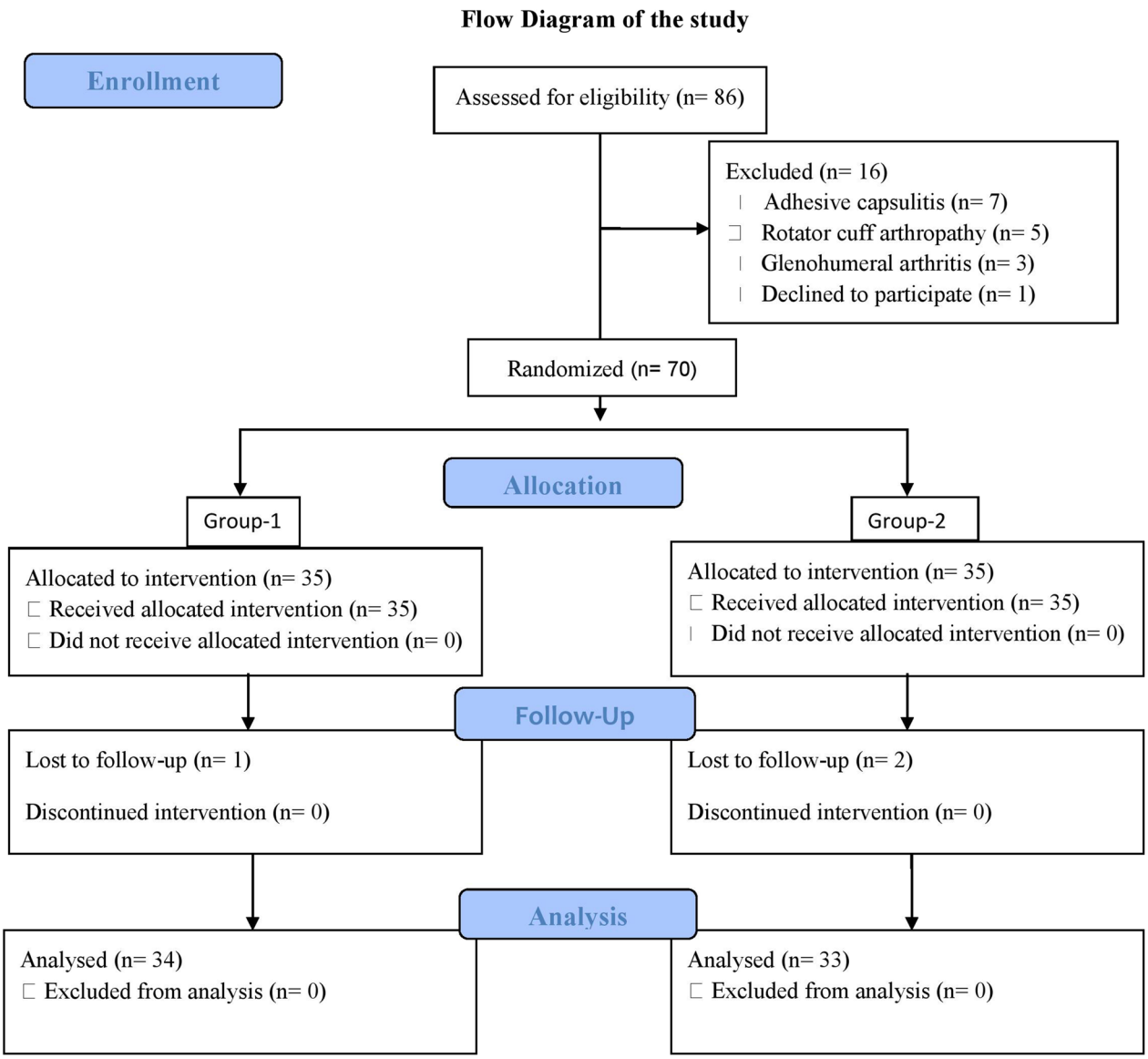

Fig. 1 Figure showing flow diagram of the study

was assumed to be 15 points. The minimum sample size for the VAS score was 28 in each group, and SPADI was 21. Assuming a 25% dropout rate, the minimum sample size was calculated to be 35 in each group.

Statistical analysis

Statistical analysis was done using SPSS 23.0 software (SPSS Inc, Chicago,IL, USA. Continuous variables were expressed as mean ± standard deviation (SD) as the data were found to be normally distributed. Categorical variables presented as absolute numbers. Pre- and post-treatment data of VAS and SPADI were compared using paired sample *t*-test.

Results

A total of 70 patients meeting inclusion and exclusion criteria were enrolled for the study (35 patients in group 1 and 35 patients in group 2). Three patients were lost to follow-up (one patient in group-1 and two patients in group-2), and the data of 67 patients were analyzed. The demographic data of these patients are presented in Table 1.

Both groups showed improvement in clinical and functional parameters after the injections (Table-2). VAS improved from 7.9 ± 0.95 to 3.19 ± 0.81 in group 1 ($p < 0.001$) and from 8.05 ± 0.94 to 2.9 ± 0.64 in group 2 ($p < 0.001$) at three months, respectively. SPADI improved from 61.41 ± 11.86 to 28.91 ± 9.06 in group-1 ($p < 0.001$)

Table 1 Table showing demographic data of the patients

	Group 1	Group 2
Total number	34	33
Age	51.57 ± 13.22	52.7 ± 11.81
Male/female	14/20	10/23
Mean duration of symptoms	4.86 ± 1.3	5.28 ± 1.1
Side involved (right/left)	24/10	21/12

and 63.45 ± 9.64 to 25.32 ± 6.87 in group-2 ($p < 0.001$) at three months, respectively. Two patients in group 1 and one in group 2 needed repeat infiltration at four weeks follow-up because of the persistence of symptoms. Two of them (one from each group) showed resolution of symptoms after the second infiltration and one patient from group 1 needed arthroscopic subacromial decompression. No crossover was allowed between the two groups. No local or systematic adverse events were noted in either group.

There was no statistically significant difference in the VAS score between two groups at one month ($p = 0.13$) and three months ($p = 0.21$). Similarly, no significant difference was noted for SPADI at one month ($p = 0.12$) and three months ($p = 0.16$), and shoulder range of motion (Table 2).

Table 2 Table showing clinical and functional outcome parameters

	Group 1	Group 2	*p*-value
VAS			
Before injection	7.9 ± 0.95	8.05 ± 0.94	0.625
At 1 month	3.14 ± 0.79	2.8 ± 0.6	0.131
At 3 months	3.19 ± 0.81	2.9 ± 0.64	0.213
SPADI			
Before injection	61.41 ± 11.86	63.45 ± 9.64	0.549
At 1 month	27.96 ±7.67	24.37 ±6.58	0.116
At 3 months	28.91 ± 9.06	25.32 ± 6.87	0.162
Range of motion			
Flexion			
Before injection	135.7 ± 16.4	137.8 ± 14.4	0.809
At 1 month	162.1 ± 18.3	164.7 ± 16.2	0.450
At 3 months	166.7 ± 17.2	163.8 ± 15.9	0.882
Abduction			
Before injection	82.8 ± 12.7	85.3 ± 13.7	0.604
At 1 month	151.7 ± 16.2	153.3 ± 13.1	0.515
At 3 months	152.6 ± 15.9	151.5 ± 13.9	0.850
Internal rotation			
Before injection	2.9 ± 0.9	2.8 ± 0.9	0.901
At 1 month	2.0 ± 1.1	1.9 ± 0.9	0.471
At 3 months	1.9 ± 0.8	1.7 ± 0.8	0.725
External rotation			
Before injection	50.1 ± 12.3	52.7 ± 12.1	0.414
At 1 month	72.3 ± 13.4	74.8 ± 11.7	0.707
At 3 months	72.4 ±10.4	73.9 ± 9.8	0.680

Discussion

Conservative therapy is the preferred treatment of SAIS in initial stages. Dorrestijn et al. [19], in a systematic review of randomized controlled trials, found no difference in pain and shoulder function between conservatively and surgically treated patients. Local inflammation and edema in subacromial space lead to SAIS [20]. Alleviation of the inflammatory process is the aim of treatment [21]. The use of local corticosteroid infiltration for treatment of SAIS is well established in the literature [5, 11, 20]. Systemic NSAIDs are commonly used in impingement syndrome. In a systematic review by Cochrane collaboration [22], three high-quality trials comparing subacromial steroid injection with systemic NSAIDs found no significant difference in pain and range of motion at 4 to 6-week follow-up. Systemic NSAIDs may have deleterious side-effects, particularly renal and gastrointestinal. Local infiltration of NSAIDS is beneficial as it is free from these systemic side effects.

Although most evidence supports the beneficial effects of corticosteroids, they are also associated with potentially serious side effects like tendon rupture [7, 9, 20] and tendon atrophy [8, 20]. Corticosteroids have a negative effect on future surgery, and corticosteroid injections prior to surgery are associated with decreased suture pull-out strength, weaker tendon repair and increased rate of failure [23]. Intra-articular steroid administration also has a detrimental effect on articular cartilage [24]. Sepsis is a known complication of intraarticular steroid injections [25]. Patients with diabetes mellitus have a risk of post-injection hyperglycemia and infection with steroid injections [25, 26] and were therefore excluded from the study. The recommended frequency of corticosteroid infiltration is limited to a maximum of three injections. These were repeated after a minimum duration of 4 weeks, and patients were followed-up for 12 weeks so that any symptomatic relief from these injections can be evaluated.

Local injection of NSAIDs is not known to be associated with any significant changes in cartilages or soft tissues [27, 28]. As both NSAIDs and corticosteroids function by decreasing local inflammation, NSAIDs are proposed to be a viable alternative for local infiltration. Lornoxicam or tenoxicam, relatively weaker NSAIDs than ketorolac, have been used for subacromial injections in SAIS with variable success [29–31]. Kyong et al. [32] conducted a randomized controlled trial to compare the effects of subacromial injection of triamcinolone versus ketorolac in SAIS in 32 patients. They found better efficacy of ketorolac in terms of improvement in the UCLA shoulder score at 4 weeks follow-up. A similar study conducted by Taheri et al. [10] comparing

either ketorolac or methyl-prednisolone injections also found comparable outcomes in the two groups. Compared to these studies, we had a relatively longer follow-up (12 weeks) and larger sample size. A minimum follow-up of 12-weeks is also needed to assess the effect of repeat doses of steroid or ketorolac. We found out that there were no significant differences between two comparable groups in pain, functional outcomes or need for repeated injections. Infiltration of NSAIDs showed equivalent efficacy as compared to corticosteroid in terms of VAS and SPADI.

This study has a few limitations. The diagnosis of SAIS was clinical. We did not see evidence of radiological improvement in patients after injections. We did not use an image or ultrasound-guided injections, which are considered better methods for infiltration.

Conclusion

In this study, ketorolac had equivalent results as compared to corticosteroids, when used in subacromial infiltrations. Though methylprednisolone showed slightly better clinical outcomes, the difference between them was statistically insignificant ($p > 0.05$). With the risk of potential side effects of corticosteroids, ketorolac could be considered as a viable alternative in the treatment of SAIS.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Informed consent Informed consent was taken from all individual participants included in the study.

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