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RESEARCH ARTICLE

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Ultrasound-guided platelet-rich plasma injection versus steroids injection for pain relief in partial rotator cuff tears

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ABSTRACT

Background: Platelet-rich plasma injection has become an effective treatment for partial rotator cuff tears. This study evaluates the efficacy of PRP versus steroids injection in pain relief for partial rotator cuff tears.
Study design: Prospective clinical trial.
Setting: Alexandria Main University Hospital.
Patients and methods: Sixty patients with symptomatic partial RCTs undergoing US-guided subacromial injection were randomly allocated into two equal groups: either steroids or PRP. Pain score, shoulder function, failure rate after injection, and complications were recorded.
Results: VAS score was significantly lower in the steroid group at week 2 follow-up than the PRP group (p 0.001). However, it was shorter, extended for 8 weeks in steroid in comparison to 4 months in PRP group. There was an insignificant difference among groups in the simple shoulder test at 2 and 4 weeks follow-up, and the test was significantly higher in PRP group at 6, 8, 12 weeks, and 4 month follow-up (P = 0.049, 0.001, 0.001, 0.001). Pain did not improve in six patients in steroid group and one patient in PRP group. Pain on injection was reported by six patients in the steroid group and 13 patients in PRP group (p = 0.052). Elevated blood sugar was significantly higher in the steroid group after the injection (p 0.001).
Conclusion: Subacromial PRP injection may have a prolonged analgesic effect and superior shoulder functional improvement than steroids in patients with partial RCTs.

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KEYWORDS
Platelet-Rich plasma; rotator cuff tears; steroids

1. Introduction

Rotator cuff (RC) tears are regarded as a common shoulder condition among the general population that frequently affect the elderly and cause discomfort and dysfunction [1,2]. Several factors are predisposing to the development of such tears. Old age, obesity, acute injury, genetic factors, and metabolic status are among these causes [3,4]. These variables make the muscles hypovascular and degenerate. Consequently, partial- and full-thickness tears as well as prolonged inflammatory alterations, fatty infiltration, and muscular degeneration are often seen [5,6]. The diagnosis is confirmed by clinical examination and the available imaging modalities [7,8]. Besides magnetic resonance imaging (MRI), ultrasonography (US) is frequently utilised to diagnose rotator cuff tears, since it offers a quick and precise diagnosis [9,10]. Non-steroidal anti-inflammatory drugs (NSAIDS) and physical exercise are the first line of management in cases of partial tears. Therapeutic injections should be tried prior to surgical interventions [11]. Platelet-rich plasma (PRP) injection is a common modality for treating a variety of tendon problems. PRP is the cellular portion of the plasma that is produced by centrifuging whole blood. It contains a variety of growth factors important for tissue regeneration [12,13]. Despite the growing use of PRP in the treatment of various tendon injuries, only a small number of studies have examined its effectiveness in partial rotator cuff tears [14,15]. In this prospective randomised controlled study, it is hypothesized that subacromial PRP injection may not be inferior than corticosteroid injection to improve the clinical and functional outcomes in patients with painful partial rotator cuff injuries.

2. Patients and methods

The present study was approved by the Institutional Review Board (No. 00012098), and an informed written consent was obtained from each patient. The trial was registered in the Clinical Trials.gov PRS Registry prior to patient enrollment (NCT05317624; date of registration: 19 July 2021). This trial was conducted in the period between August 2021 and November 2022. The trial adhered to the principles of the Declaration of Helsinki and complied with CONSORT for reporting randomized

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clinical trials. Sixty patients were studied. Inclusion criteria were patients with symptomatic partial RC tears of both sexes, between the ages of 20 and 70 years scheduled for a sub-acromial injection procedure. Patient refusal, age lower than 20 years, infection at the site of injection, previous surgery on the shoulder joint area, presence of other related pathologies in the shoulder area, and contraindications to the use of platelet concentrate or steroids injection were all exclusion criteria. This prospective, randomized, controlled, clinical study was conducted at Alexandria Main University Hospital, pain clinic. Patients were diagnosed clinically by positive tests for rotator cuff pain (supraspinatus weakness, lift-off test, drop shoulder test, and Hornblower's sign) for more than 3 months [16-19]. Diagnosis was confirmed radiologically through MRI and US. Pain was evaluated using the Visual Analogue Scale (VAS) [20]. Functional assessment of the shoulder joint was performed using the simple shoulder assessment test. The Simple Shoulder Test is a questionnaire that consists of 12 items for assessing the functional activities of the shoulder joint. These questions are designed to measure the degree of difficulty of various daily living activities requiring upper-extremity use [21]. The total score is calculated by dividing the number of (yes) scored items by the total completed items and multiplying by 100, resulting in a final percentage of: 0% = maximal disability; 20–40% = crippled; 40–60% = severe disability; 60–80% = moderate disability; 100% = no disability.

Patients were randomly divided into two groups using the closed envelope method via a simple randomization sheet:

2.1. Steroid group

Thirty patients received subacromial injection of 1 ml methylprednisolone +1 ml 0.5% bupivacaine +2.5 ml normal saline.

2.2. PRP group

Thirty patients received subacromial injection of 3 ml PRP + 0.5 ml of PRP activator (10% calcium gluconate) +1 ml 0.5% bupivacaine (Figure 1). The primary outcome was to evaluate the efficacy of ultrasound-guided platelet-rich plasma injection versus ultrasound-guided steroids injection in relieving partial rotator cuff tear pain, which was assessed using the VAS score, and secondary outcomes were to assess the shoulder function using the simple shoulder assessment test, to determine the rate of recurrent tears, and to record any complications.

PRP was prepared according to a double-centrifugation technique and the resulting 3 ml of leukocyte-free platelet-rich plasma concentrate were used for injection [22]. The injection of the shoulder joint was done using a high frequency linear probe (Sonosite, Inc. S.E. Bothwell W.A.). The transducer was applied in the coronal plane at the shoulder joint area to identify the subacromian bursa via the posterior approach. The subacromial-subdeltoid bursa was visualized as an anechoic linear structure, and with movement of the transducer, the supraspinatous tendon was identified at the shoulder joint area. The point of injection was the lateral subacromial space below the lateral border of the acromion while directing the needle from the lateral side of the probe in an in-plane technique to above the footprint of

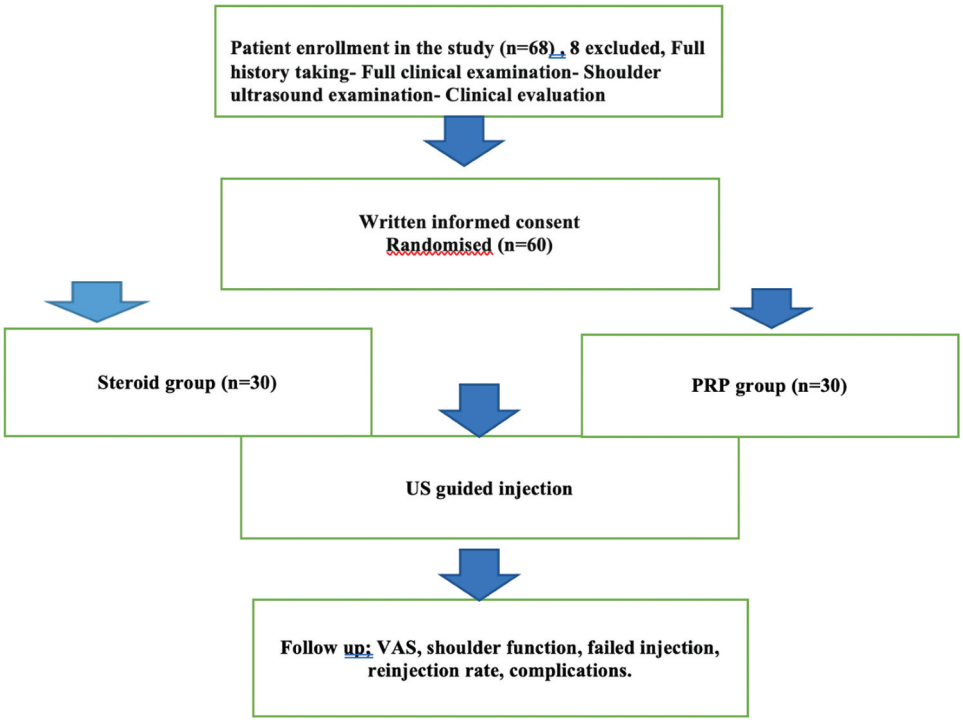

Figure 1. Flowchart for study methodology.

the supraspinatus tendon (Figure 2). Patients were advised to rest relatively with two days off work. Fourteen days after the injection, all patients were advised to attach themselves to a physical rehabilitation program to help improve strength and activity. NSAIDs were not allowed for the next 2 weeks after injection, and instead, acetaminophen was advised to be used in case of shoulder pain. The follow-up of patients was performed at 2, 4, 6, 8, and 12 weeks, and 4 months after the injection procedure.

3. Statistical analysis

A sample size of 30 patients in each study group was calculated using NCSS-PASS programme version 20 and approved to be sufficient by the Bio-statistic and information Department, Medical Research Institute, University of Alexandria. Statistical analysis was performed using IBM SPSS software package version 20.0. Qualitative data were described using numbers and percent. Quantitative data were described using means (±SD) for normally distributed data, range (minimum and maximum), median, and interquartile range (IQR). Categorical data were statistically analysed using the Chi-square ($\chi 2$) test or Fisher's exact test, as applicable. The significance of the achieved results was considered at the 5% level. Pain score, shoulder function using the simple shoulder assessment test, failure rate after injection, and post-injection complications were recorded.

4. Results

Sixty patients were included in the present study and divided into two groups (30 each): PRP and Steroid. There were no significant differences between the two groups in terms of patient demographics, comorbidities, or the laterality. ($p > 0.05$) (Table 1). The VAS score improved in the steroid group for 12 weeks after injection, while it continued to be lower than the basic score for four months after PRP injection. The VAS score was significantly lower in the steroid group than the PRP group at 2 weeks of follow-up ($p < 0.001$). It was significantly lower in PRP group at 12 weeks and 4 months follow-up ($p < 0.001$) (Figure 3). A simple shoulder test showed that there was significant improvement in should function for short period up to 6 weeks after injection in steroid group but the functionality declined significantly at 4 month in comparison to baseline values. The shoulder function test was significantly better in the PRP group than the steroid group at 6, 8, and 12 weeks and 4 months of follow-up ($P = 0.049$, <0.001, <0.001, <0.001 respectively) (Table 2). Pain did not improve in six patients in the steroid group and one patient in the PRP group. Pain on injection was described by six patients in the steroid group and 13 patients in the PRP group as moderate to severe ($p = 0.052$). Eleven patients in steroid group developed elevated blood glucose level after the injection, while none of the patients in PRP group developed elevated blood glucose level ($p < 0.001$) (Table 3).

5. Discussion

The present study is one of the few randomized studies that compare the analgesic and functional effects of PRP and steroid subacromial shoulder injection. Steroid and PRP injection improved pain due to rotator cuff tears in the form of reduced VAS scores in the two

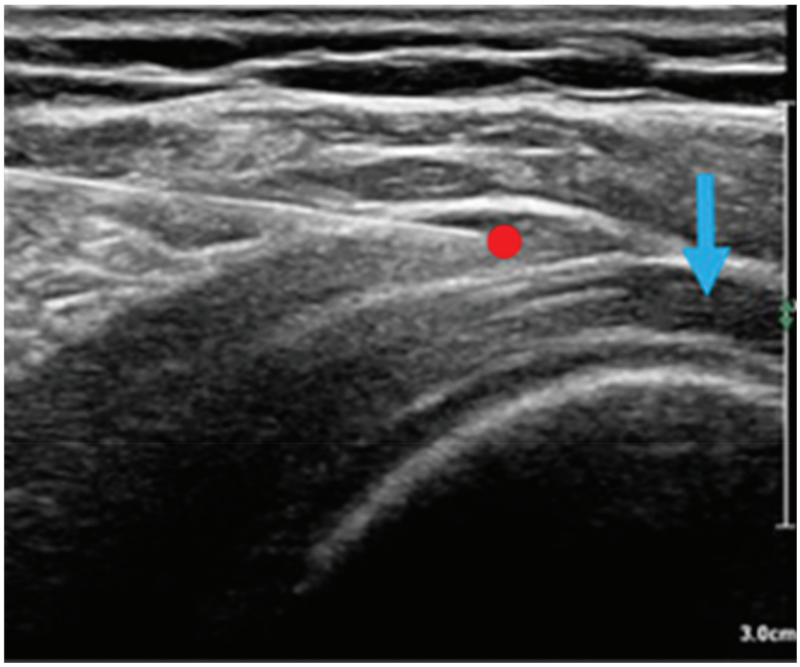

Figure 2. Ultrasound-guided sub acromial bursa injection. The blue arrow indicates the tendon tear and the red dot indicates the needle tip.

Table 1. Demographic characteristics, comorbid conditions and laterality.

Steroid group		PRP group	p-value
Number (n)	30	30	
Age	52.17 ± 12.49	53.77 ± 12.44	0.621
Sex M/F	14/16	12/18	0.602
Comrbidities;			
DM	8	11	0.405
HTN	10	12	0.592
Laterality (Rt:Lt)	18:12	16:14	0.602

Values are presented as mean ± SD or number (percentage). DM (diabetes mellitus), HTN (hypertension)

groups after injection during the follow-up period. PRP injection showed much prolonged analgesia than steroid injection demonstrated by better VAS scores in the PRP group at 12 weeks and 4 months after injection. Functional assessment demonstrated that both steroid and PRP injection improved shoulder function; however, PRP injection resulted in better simple shoulder assessment test at 8 and 12 weeks, and 4 months after injection. This may emphasize the prolonged improvement in function after PRP injection.

Vaquerizo V et al. [23] reported that platelet rich growth factors intratendinous injections showed superior and sustained pain relief and functional improvements in patients with chronic rotator cuff tendinopathy compared with corticosteroid injections. Follow-up contiued for one year after injection and the assessment was done using 3-patient assessment scale. Different injection modalities for rotator cuff tears have been reviewed and analysed by Edoardo Giovannetti de Sanctis et al. [24] PRP injections appeared to be superior in terms of shoulder function and pain reduction on the long run. Furthermore, Kim SJ et al. [25] recorded an improvement in the VAS score and shoulder joint function after PRP injection for partial rotator cuff tears. The anti-inflammatory effects and local growth factor release by PRP may promote tendon healing when coupled with activated platelets

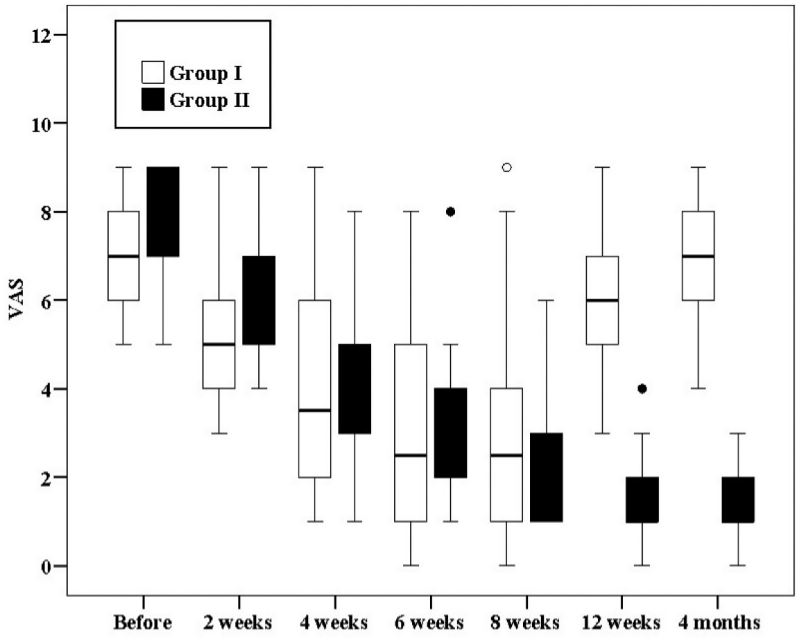

Figure 3. Comparison between both groups according to VAS score.

Table 2. Comparison within and between the two studied groups according to simple shoulder test at baseline and follow-up.

ASSES (%)	Steroid Group	P0	PRP Group	p0	P-value
Baseline	77.33 ± 11.28		78.83 ± 13.04		0.635
2 weeks	83.0 ± 11.26	<0.001	80.83 ± 11.53	0.465	0.245
4 weeks	83.0 ± 11.34	<0.001	84.50 ± 9.94	0.588	0.001
6 weeks	84.67 ± 11.14	<0.001	90.0 ± 9.47	0.049	<0.001
8 weeks	81.17 ± 11.87	0.211	93.33 ± 6.61	<0.001	<0.001
12 weeks	73.0 ± 11.42	0.045	96.50 ± 5.11	<0.001	<0.001
4 months	70.83 ± 11.60	<0.001	98.0 ± 4.07	<0.001	<0.001

SD: Standard deviation.
p: p value for comparing between the two studied groups in each period.
p_o: p value for Post Hoc test (adjusted Bonferroni) for ANOVA with repeated measures for comparison between before and each other period.
*: Statistically significant at $p \leq 0.05$.

Table 3. Comparison between the two studied groups according to failure rate after injection, and complications after injection.

	Steroid Group	PRP Group	P-value
Failure rate after injection %	20.0	3.3	0.103
Elevated blood sugar%	36.7	0.0	<0.001
Pain after injection%	20.0	43.3	0.052

[26]. On the other hand, the anti-inflammatory effects of corticosteroids include inhibition of neutrophil apoptosis, reduction arachidonic acid derivatives production through inhibition of phospholipase A2, promoting interleukin-10 and other anti-inflammatory genes, and reducing the buildup of leucocytes and macrophages [27]. However, the current study demonstrated that steroid injection may have a transient effect in cases of shoulder pain due to partial rotator cuff tears manifested by regression of the effect after 4 months follow-up. Debates exist regarding local steroid injection. Gialanella B. et al. [28] concluded that triamcinolone intraarticular injection improved symptoms of partial tears for 3 months, after which patients displayed recurrence of the symptoms. A systematic review discussed the ability of local steroid injections to improve rotator cuff tendinosis and concluded that they provided only minimal transient pain relief in a small number of patients [29]. PRP injection may have a longer effect through acceleration of the healing process by enhancing type I and type III collagen synthesis by the tendon cells, delivering a natural mixture of autologous growth factors. The current study demonstrated no major complications after injection. However, blood glucose levels in the steroid group were significantly higher than the PRP group after injection. Six patients in the steroid group and 13 patients in the PRP group developed moderate to severe pain after injection. The current study has several limitations. No blindness was applied, hence bias may occur. No radiological follow-up was done to patients after injection. Clinical assessment was the sole method used for follow up.

6. Conclusions

Subacromial PRP injection may provided a prolonged analgesic effect and superior shoulder functional improvement than steroids in patients with symptomatic partial rotator cuff tears.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This research involved only patient charts. An institutional permission was approved to the study prior to submission for publication.

Informed consent

Individual patient consent was taken prior to the procedure.

Authors' contributions

Dorreya M. Fikry: the principal investigator and senior author, revising the whole manuscript.

Tarek M. Sarhan: senior author, revising the whole manuscript.

Mohamed M. El Sawy: methodology section, PRP preparation.

Moutaz E. Elabbasy: data analysis, writing revision and figure formatting.

Radwa S. Raslan: scientific writing and data analysis and reference styling.

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