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Ultrasound guided platelet-rich plasma injection for the treatment of rotator cuff tendinopathy

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Abstract

Background:

Degenerative changes and inflammation in the rotator cuff (RC) are the most important causes of shoulder pain. The aim of the present study was to determine the effectiveness of platelet-rich plasma (PRP) in patients with chronic RC tendinopathy.

Materials and Methods:

This study was an open-label study performed at Kashani Hospital between April 2012 and June 2014. Patients with a <1 cm partial tearing of the bursal side of RC with no or little response to conservative management were included. PRP injection was done using ultrasonography guide via posterior subacromial approach. Demographic data were obtained in all patient before the study, and shoulder function was evaluated using Constant shoulder score (CSS) before and 3 months after PRP injection.

Results:

A total number of 17 patients were enrolled. The mean of CSS before and after intervention was 37.05 ± 11.03 and 61.76 ± 14.75, respectively ($P < 0.001$). There was no statistically significant correlation between the pain score before the study and the improvement in CSS ($P = 0.45$, $r = 0.03$). Significant relation was observed between the individuals' age and improvement of CSS ($P = 0.02$, $r = -0.49$). There was no significant difference in CSS improvement between genders ($P = 0.23$).

Conclusion:

Single injection of PRP is effective to reduce pain and improve range of motion in patients with bursal side partial tearing of RC who failed to respond to conservative treatments.

Keywords: Constant shoulder score, platelet-rich plasma, rotator cuff, tendinopathy

INTRODUCTION

Degenerative changes and inflammation in the rotator cuff (RC) are the most important causes of shoulder pain,[1,2] and in about 30% of patients with painful arc, there is a pathology in RC structure. Muscular weakness and reduced mobility are common symptoms.[3]

RC pain and dysfunction are refractory to usual treatments and have become a challenge for physicians as to date; there is no gold standard treatment.

The current treatment of RC partial tearing is mainly conservative and focuses on causing the presumed inflammatory process to stop using nonsteroid anti-inflammatory drugs (NSAIDs), physical therapy, corticosteroid injection, relative immobilization, and compression.[4]

Recently, new evidences have emerged on the effectiveness of platelet-rich plasma injection (PRP) in the treatment of tendinopathies such as lateral epicondyle extensor tendinopathy,[5,6,7] patellar tendinopathy, [8] and Achilles tendinopathy,[9,10] although it still remains controversial issue.

PRP is an autologous concentration of platelets obtained by whole blood centrifugation with specific protocol. The supernatant includes several growth factors such as platelet-derived growth factors (PDGFs) alpha, beta, transforming growth factors (TGF) beta 1 and beta 2, vascular endothelial growth factor (VEGF), and epithelial growth factor (EGF) which can play role in tendon healing.[11,12] For instance, PDGF plays a role in cell differentiation and neovascularization, TGF stimulates tendon differentiation and formation of collagen, EGF induces fibroblast proliferation, and VEGF stimulates neovascularization. During recent years, clinicians tend to use PRP in tendinopathies more due to the lower risk of complications such as gastrointestinal problems and tendon tearing occurring with this method in comparison to other conservative methods.[13] The aim of the present study was to determine the effectiveness of PRP administration in patients with partial tearing of RC.

MATERIALS AND METHODS

Participants and setting

This study was a prospective, open-label study performed at Kashani Teaching Hospital, a Tertiary Referral Center in Isfahan, Iran. Eligible patients were enrolled in the study over a period of 2 years and 3 months, from April 2012 to June 2014. Patients with a <1 cm partial tearing of the bursal side of RC were included in this study. Partial tearing was defined as disruption in RC not involving the full thickness of the tendon. We included individuals aged between 18 and 70 years with no or little response to conservative management over the 3 months prior to the study. Patients were excluded if they had prior surgery on their shoulder or history of other noticeable pathology in RC, steroid injection during the recent 6 weeks, consumption of NSAID, or antiplatelet agents over the 2 weeks prior to this study, and also patients using aspirin were excluded if according to their doctor's recommendation they could not stop using it during the period of our treatment.

Platelet-rich plasma preparation and injection

PRP preparation was done in Kashani Laboratory using ROOYA GEN® (Arya Mabna Tashkhis Co., Tehran, Iran). In this system, 35 mL of the patient's blood was obtained and mixed with 5 mL of anticoagulant, dextrose citrate. Then, a blood sample was centrifuged at 1600 rotate per minute (rpm) for 12 min, and the supernatant was centrifuged again at 3600 rpm for 7 min. PRP was injected within 30 min to 1 h after preparation (resting time) by one of the authors using ultrasonography guide via posterior subacromial approach. Patients' upper limb was immobilized for 3 days and was advised not to use NSAIDs for 2 days. They were advised to use acetaminophen in case of shoulder pain during this 2 day period.

Measurements and outcomes

In this study, the diagnosis of RC tearing was based on magnetic resonance imaging. Demographic data on age and sex were recorded. Shoulder function was evaluated using Constant shoulder score (CSS) before and 3 months after PRP injection.

Sample size and statistical analyses

Sample size was calculated using statistical formula for the detection of at least 5 unit difference in CSS, considering $\alpha = 0.05$ and $\beta = 0.8$ to be 15.

Data analyses were performed using paired *t*-test, Student's *t*-test, McNemar test, and Wilcoxon Rank test on as needed basis. The protocol of this study was approved by Institutional Review Board at Isfahan University of Medical Sciences (grant no: 392388). Written informed consent was obtained from all patients at the beginning of the study.

RESULTS

During the period of study, a total number of 23 patients met the inclusion criteria. Four patients did not consent to participate in the research project, and two did not show up for the follow-up and were thus excluded from the study. Of the remaining 17 patients, 10 (58.8%) were male and 7 (41.2%) female with the mean age of 50.41 ± 11.62. Patients had been suffering from shoulder symptoms for a mean period of 9.17 ± 6.41 months. Complete blood count was done for whole blood and PRP. The mean platelet count for whole blood was 292.1 ± 36.3 × 10^3/μL, and four-fold increase was seen upon PRP with the mean platelet count of 1325 ± 121.2 × 10^3/μL in the final blood product.

The mean of CSS before and after intervention was 37.05 ± 11.03 and 61.76 ± 14.75, respectively. Kolmogorov–Smirnov test showed that CSS had normal distribution and paired *t*-test showed that the difference detected was statistically significant ($P < 0.001$).

Statistical analyses were performed, and different items were compared before and after the intervention, as shown in Table 1. The analysis showed that except sleep and sports activity other items changed significantly after PRP injection.

There was no statistically significant correlation between the pain score and the improvement in CSS ($P = 0.45$, $r = 0.03$). Significant relation was observed between the individuals' age and improvement of CSS ($P = 0.02$, $r = -0.49$). There was no significant difference in CSS improvement between genders ($P = 0.23$).

DISCUSSION

In this study, we found that PRP injection as treatment for RC injury significantly improves patients' activity and reduces pain in patients with extra-articular partial tearing of the tendon. Our data showed that PRP is effective in for treatment of these patients, and CSS showed an improvement in all parameters except two items including return to full work and sport.

There are few previous studies that have evaluated the effect of PRP injection in RC injury.

Kesikburun *et al*.[14] have evaluated the effect of a single injection of PRP in two groups of 20 patients with RC tear. They revealed that PRP is not significantly more effective than placebo on Western Ontario RC index (WORC), shoulder pain and disability index, 100-mm visual analog scale, and shoulder range of motion in a 1-year follow-up. They concluded that their study did not support the use of PRP for RC tendinopathy. In another randomized trial by Rha *et al*.[13] PRP injection and dry needling were used in two groups of 17 patients for the treatment of RC diseases. In this study, PRP injection and dry needling were performed twice with a four weeks interval between injections. They showed that PRP is more effective than dry needling in the treatment of both intra-articular and bursal surface tendinopathy. Both previous studies showed improvement in patients' signs and symptoms and a reduction in pain after PRP injection.

In line with these studies, we found the effectiveness of single injection of PRP in patients with bursal side partial tearing of RC, and that the improvement lasts for 3 months after injection. Kesikburun *et al*. suggested that single injection of PRP is not more effective than exercise therapy; however, in this study, patients who failed to respond to conservative treatments such as physical therapy improved significantly with a single injection of PRP.

Our data also showed the effectiveness of PRP injection reduces by age. This may be due to the higher prevalence of other musculoskeletal problems in older patients, e.g., frozen shoulder, osteoarthritis (especially with osteophytes present) can also result in repetitive trauma that can lead to tendon injury and reduce PRP effect.

This study also demonstrates that the effectiveness of PRP is not related to the duration and severity of pain before injection.

The strength of this study was that we focused on the bursal side partial tearing of RC while previous studies did not separate the types of tears. We believe that intra-articular and bursal surface tearing of RC could be quite different in responding to PRP injection.

Recent studies have also argued the platelet count in PRP, and there is no consensus on this matter. Early studies in this field revealed that platelet count should be less than three times more than the whole blood for the optimal effect. However, recently studies do not support this idea and suggest that higher rate of platelet concentration–even more than 10 times–is effective and does not inhibit tendon healing.[4] In this study, platelet count in PRP was four times the whole blood, and we found it to be effective. Nevertheless, more studies in the field are needed to make a conclusion.

This study was an open-label study, and due to the novelty of the method, we were faced with a lack of cases and were unable to perform a randomized trial. To further evaluate the effectiveness of PRP in RC injury, we suggest randomized trials be performed. There are also several unclear aspects in the administration of PRP in RC tendinopathy that such as frequency of injection and the interval between injections. We found these issues a challenge in this study.

CONCLUSION

A single injection of PRP is effective to reduce pain and improve range of motion in patients with bursal

side partial tearing of RC, who failed to respond to conservative treatments.

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Conflicts of interest

There are no conflicts of interest.

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Figures and Tables

Table 1

Constant shoulder score before and after intervention among study patients

Constant shoulder score	Before intervention (%)	After intervention (%)	*P*
Pain¥			
Severe	10 (58.8)	0 (0)	<0.001*
Moderate	7 (41.2)	4 (23.5)	
Mild	0 (0)	11 (64.7)	
None	0 (0)	2 (11.8)	
Activity level€			
Unaffected sleep			
Yes	5 (29.4)	15 (88.2)	0.001*
No	12 (70.6)	2 (11.2)	
Full recreation			
Yes	0 (0)	1 (5.9)	0.98
No	17 (100)	16 (94.1)	
Full work			
Yes	0 (0)	2 (11.8)	0.50
No	17 (100)	15 (88.2)	
Arm positioning¥			
Up to waist	1 (5.9)	0 (0)	0.001*
Up to xiphoid	9 (52.9)	3 (17.6)	
Up to neck	6 (35.3)	3 (17.6)	
Up to top of head	1 (5.9)	7 (41.2)	
Above head	0 (0)	4 (23.5)	
Strength of abduction (pounds)¥			
0	0 (0)	0 (0)	0.001*
1-3	2 (11.8)	0 (0)	
4-6	4 (23.5)	0 (0)	
7-9	4 (23.5)	2 (11.8)	
10-12	6 (35.3)	7 (41.2)	
13-15	1 (5.9)	1 (5.9)	
15-18	0 (0)	5 (29.4)	
19-21	0 (0)	0 (0)	
22-24	0 (0)	1 (5.9)	
>24	0 (0)	1 (5.9)	
Forward flexion (°)¥			
31-60	0 (0)	0 (0)	0.009*
61-90	6 (35.3)	2 (11.8)	

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