THE EFFECT OF ULTRASOUND GUIDED PLATELET RICH PLASMA (PRP) INJECTION IN THE NON-SURGICAL TREATMENT OF PARTIAL SUPRASPINATUS TENDON TEAR

Mohamed Haroun Hassan Ibrahim 1, Mohamed Elgharib Abouelmaaty 2, Wael Ahmed Mohamed Nassar 1, Ahmed Mohamed Hussein 4, Allam Elsayed Allam 5
1,2,3,4,5 Radiology Department, Faculty of Medicine, Ain shams University, Egypt.

ABSTRACT

Aim of the work: A descriptive study to investigate the effect of ultrasound guided PRP injection in patients with partial tearing of supraspinatous muscle tendon.

Patients and methods: Fifteen patient with partial tear of supraspinatous tendon were included.

This was a prospective study that included patients with supraspinatous tendon partial tear due to either degenerative or traumatic which referred from the Orthopedic and Physiotherapy Departments at Ain Shams University Hospitals to the Interventional Radiology Unit for ultrasound guided tendon injection.

Platelets rich plasma injection are used to induce and provoke tendon healing and improve shoulder movements in such patients suffering from pain and inability to initiate shoulder abduction due to partial tear.

Results: The mean age of the selected patients was about 45 years old.

The most common cause of partial supraspinatous tear is tendon degeneration due to repetitive manual work for years and more common at dominant arm in 12 patients (80%), old age in 2 patients (13%) and overweight in 1 patient (7%).

The most frequent symptom is shoulder pain which represented the main symptom in the included fifteen patients (100%), while limited range of movement especially, arm elevation above head and behind back, was found in 13 patients (87%). As regard other symptoms, muscle weakness was noticed in 47% and crepitations were noticed in 34%.

Pain at the injection site was the most common complication and occurred in all patients (100%) which was improved by local anaesthesia before injection and analgesics (Paracetamol) after the procedure. Allergic reaction occurred in 2 patients (13%) in the form of erythema and itching which were self limiting. Skin discoloration was developed in a single patient (6%) and improved few days after. No infection nor any other complications had been reported.

Conclusion: Platelets rich plasma injection is an effective method for the clinical and radiological improvements of patients suffering chronic shoulder pain with inability to initiate abduction and protrusion of shoulder due to the partial tear of supraspinatous tendon resulting from tendon degeneration or traumatic causes; however, the procedure may be associated with minor self limiting complications.

Keywords: Platelets rich plasma (PRP); Ultrasound (US); Magnetic resonance imaging (MRI).

I. INTRODUCTION

Rotator cuff (RC) tears are the most common cause of shoulder disability with their prevalence ranging from 20 to 40% in the aging population. Degenerative changes and inflammation in the supraspinatous tendon is the most important causes of rotator cuff (RC) and shoulder pain. Muscular weakness and reduced mobility are common
symptoms. Such pain and dysfunction are refractory to usual treatments and have become a challenge for physicians as to date; there is no gold standard treatment [1].

The current treatment of RC partial tearing are mainly conservative. Subacromial injection of anaesthetics or corticosteroids is often used to treat patients with persistent symptoms after rehabilitative therapy and use of oral non-steroidal anti-inflammatory drugs (NSAIDs). Although NSAID treatment and injections of corticosteroids are known to alleviate inflammation and shoulder pain, serious gastrointestinal side-effects after prolonged oral NSAID administration as well as arthropathic changes and increased tendon fragility caused by repeated corticosteroid injections are important concerns[2].

The rotator cuff is limited in its ability to regenerate due to poor vascularization of the tendon tissue. Interest has increased in providing endogenous growth factors directly to the ligament and tendon injury site. Testing of platelet-rich plasma, the bioactive component of whole blood, is being conducted in various fields of medicine to aid in regeneration of tissue with poor healing potential[3].

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, patellar tendinopathy, Achilles tendinopathy and supraspinatoustendinopathy. [4].

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. 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[5].

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. The aim of the present study was to determine the effectiveness of PRP administration in patients with partial tearing of RC. [6].

Given that the suggested therapeutic effects of PRP cover the symptoms of RC disease, we considered whether PRP might be effective for treating RC disease. In this thesis, we try to study the therapeutic effects of PRP injection in patients suffering shoulder pain owing to partial supraspinatus tendon tear. We hypothesized that PRP injection at the site of a supraspinatus lesion would reduce pain and improve the range of motion of the shoulder significantly with healing of minor degrees of partial tear.[7].

II. PATIENTS AND METHODS:

Study place: Interventional radiology unit, AinShamsUniversityHospitals – Cairo – Egypt.

Samplesize: 15 patients.

Inclusion criteria: Patients of any age with clinically and radiologically (US and/or MRI) evident partial RC tear (degenerative or traumatic) with no or little response to conservative management over the 3 months prior to the study. Only patients having supraspinatus tendinosis or a tendon partial-thickness tear of less than 1 cm will be included.

Both sexes were included.

Exclusion criteria: Patients were excluded if they had prior surgery on their shoulder or history of other noticeable pathology in RC or steroid injection during the recent 6 weeks and consumption of NSAID or antiplatelet agents over the 2 weeks prior to this study or patients using aspirin with their doctor's recommendation, they could not stop using it during the period of our treatment or patients with complete tear or partial thickness tear more than 1cm or patients known to have other hindering co-morbidities e.g. patients with organ failure (heart failure, respiratory failure, etc.) together with unstable, uncooperative and psychic patients.

Toolsused: a high frequency linear broadband transducer with a frequency of 6 to minimum of 12 MHz assessment over the RC region with Doppler options (color and power) - MRI (Philips, closed, 1.5 Tesla) and
shoulder coil - Local area sterilization by povidone iodine - Local anaesthesia by superficial lidocaine injection - 10 ml syringes - Blood containing kit - Blood centrifuge Machine.

III. TECHNIQUE

B-Mode real-time ultrasound was performed using GE MINDRAY DC-60 Exp™ ultrasound system with a 6–12 MHz linear array transducer is used with topical gel application. RC tendon abnormalities are described as follows: normal, tendinosis, partial-thickness tear, or full-thickness tear. When a rotator cuff tear is detected on sonographic examination, its type (full- or partial-thickness), location (name of involved tendon; tear in a critical zone or intra-substance) and size is recorded. For the purpose of this study, only patients having supraspinatus tendinosis or a tendon partial-thickness tear of less than 1 cm will be included.

Twenty milliliters of blood was obtained from patients via venipuncture from the unaffected arm.

PRP preparation is obtained using JINELAB ® centrifuge system. This device comprises a microprocessor-controlled centrifuge and two syringe pumps. Twenty milliliters of the patient’s blood is obtained and mixed with 3 mL of anticoagulant dextrose citrate. The blood sample is centrifuged at 2000 rpm (soft spin) to separate erythrocytes from the plasma. The whole blood is separated into three layers. The supernatant layer of plasma and buffy coat were separated and subjected to centrifugation at 3000 rotation per minute (hard spin). In the final end product, the upper two thirds of the tube will be containing platelet-poor plasma which is removed, and the lower one third will be PRP enhanced with a superficial buffy coat which will be used for injection.

Using a sterile technique with a sterile probe cover, real-time US guidance is provided. A sterile field is set up and maintained throughout the procedure.

The lesion is localized under ultrasound and the target area is then adjusted according to the site of maximal tenderness.

A 3-gauge needle is used to anaesthetize the area over supraspinatus tendon with 5 mL of 0.5% lidocaine.

After centrifugation, 3 mL of the PRP is obtained via the disposable kit and is infiltrated, within 30-60 minutes after preparation, into the lesion of the supraspinatus tendon under ultrasound guidance. If it is difficult to inject the PRP into the site of the tear directly, it can be infiltrated around the lesion.

Duration of the study: About 20 minutes.

The approach is through subacromial subdeltoid bursa injection, using one of the following techniques:

Transverse approach: It allows good needle visualisation from the start, and is often comfortable for the patient. If the patient is able to extend the shoulder slightly, it facilitates humeral head exposure and bursa visualization.

Lateral approach: It is an alternative technique if the patient is unable to easily extended the shoulder. The bursa has more dependent regions and one of these areas is distal to the grater tuberosity. Here, a characteristic ‘tear drop’ sign can often be found where the bursa is more distended. This approach is used if the patient is more anxious, and are better in lying in supine position.

PRP injections are performed in the affected supraspinatus tendon twice at a four-week interval between injections.

Patients’ upper limb was advised to be immobilized for 3 days. NSAIDs are prohibited for 2 days and use acetaminophen instead in case of shoulder pain during this 2 day period.

Until the first follow-up appointment at two weeks after the first injection, patients were recommended relative rest and allowed to continue usual activities of daily living. However, overhead activity and rounded shoulder posture were prohibited. Passive range of motion exercise and Codman pendulum exercise for the shoulder were started on the first post-injection day. Active range of motion and light resistive exercises for strengthening the rotator cuff were allowed only if the pain had significantly subsided and movement was possible with less discomfort. [8]
IV. RESULTS

This study was conducted trying to evaluate the effectiveness of ultrasound guided PRP administration in patients with partial tearing of supraspinatus muscle tendon and patients suffering supraspinatoustendinosis.

To fulfil the aim of the study, fifteen patients with age ranging between 27 and 63 years old were included and suffering supraspinatous partial tear and/or tendinosis.

Comparing clinical examination and ultrasound studies before and after the procedure. Then, documented, calculated and analyzed using suitable statistical analysis.

Statistical Analysis: Appropriate descriptive and inferential statistical tests were used.

Statistical Package: Statistical analyses and graphing were done.

Following ultrasound guided PRP injection, patients were assessed clinically by using the Shoulder Pain and Disability Index (SPADI) scoring system (Table 1) and radiologically by using ultrasound measuring supraspinatus tendon thickness and tear gap which were evaluated at 0, 2, 4, 8 and 12 weeks. Such study showed evident noticeable changes when comparing the SPADI scoring system pre and post-injection. There were higher statistically significant pain and disability score and percentage improvement, however the radiological improvement shows lower statistically significant difference between baseline tendon thickness and its follow-up at 4, 8, and 12 weeks while there was improvement of size of gap and statistically significant decrease in tendon thickness found at 24 weeks with P value = 0.046.

The study was done after approval of ethical board of Ain Shams university and an informed written consent was taken from each participant in the study.

Demographic criteria of the studied patient as regard age, sex (Table 2):

This study was conducted on 15 cases with age ranged from 27 to 63 years and with mean ± SD of 25.46. They were 6 females (40%) and 9 males (60%). The majority of the cases (11 cases) had right-sided affection, 8 of which were right-sided dominant, and the other (4 cases) cases were left-sided affected, 3 of them were left-sided dominance.

Risk factors (Table 3):

The most common risk factor of supraspinatoustendinosis and partial tear were repetitive lifting and overhead activities (80%) especially in old age (67%) and overweight (60%). Traumatic injury are much less and accounted for only (20%) of cases.

Symptoms (Table 4):

Shoulder Pain represented the main symptom in the included fifteen patients (100%), while limited range of movement especially, arm elevation above head and behind back, was found in 13 patients (87%). As regards other symptoms, muscle weakness was noticed in 47% and crepitations were noticed in 34%.

The reported side effects (Table 5):

Pain at the injection site was the most common complication and occurred in all patients (100%) which was improved by local anaesthesia before injection and analgesics (Paracetamol) after the procedure. Allergic reaction occurred in 2 patients (13%) in the form of erythema and itching which were self limiting. Skin discoloration was developed in a single patient (6%) and improved few days after. No infection nor any other complication had been reported.
### Table (2) Demographic criteria of the studied patient as regard age, sex

<table>
<thead>
<tr>
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<th>Number</th>
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<td><strong>Sex</strong></td>
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<td>60 %</td>
</tr>
<tr>
<td>Female</td>
<td>6</td>
<td>40 %</td>
</tr>
<tr>
<td><strong>Age</strong></td>
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<td></td>
</tr>
<tr>
<td>&lt;30y</td>
<td>3</td>
<td>20 %</td>
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<tr>
<td>30-50y</td>
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<td>20 %</td>
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<tr>
<td>&gt;50y</td>
<td>9</td>
<td>60 %</td>
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### Table (3) Risk factors (usually multifactorial)

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<td>Old age</td>
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<tr>
<td>Overweight</td>
<td>9</td>
<td>60 %</td>
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<tr>
<td>Repetitive lifting or overhead activities</td>
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<td>80 %</td>
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<tr>
<td>Traumatic</td>
<td>3</td>
<td>20 %</td>
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### Table (4) Symptoms

<table>
<thead>
<tr>
<th>Symptoms</th>
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<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Pain</td>
<td>15</td>
<td>100%</td>
</tr>
<tr>
<td>Limited range of movement</td>
<td>13</td>
<td>87 %</td>
</tr>
<tr>
<td>Muscle weakness</td>
<td>7</td>
<td>47 %</td>
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<tr>
<td>Crepitation</td>
<td>5</td>
<td>34 %</td>
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### Table (5) The reported side effects

<table>
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</thead>
<tbody>
<tr>
<td>Pain</td>
<td>15</td>
<td>100%</td>
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</tbody>
</table>
OUTCOME MEASURES

SPADI score (Graph 1)

For the whole study group members, an analysis of SPADI scores was done prior to the procedure and then at 4, 8 and 12 weeks after the injection. Data of fifteen patients had been recorded and analyzed. The total scoring difference between pre-injection and post-injection shows that there was a statistically significant decrease in the SPADI score at the different points of follow-up (P < 0.01)

Based on the previous results, a statistically significant improvement of the total scores and their percentages should be concluded. They showed a remarkable drop from a mean value after injection, completing its descending way. The P value of < 0.001 suggested high statistical significance.

Graph (1) displaying the difference in the SPADI score between time of injection and four points of follow-up visits

Tendon thickness (Graph 2)

The following table shows that there was no statistically significant difference found between baseline tendon thickness and its follow-up at 4, 8, and 12 weeks while only there was a statistically significant decrease in tendon thickness found at 24 weeks with P value = 0.041

The previous graph shows that the radiological progression regarding the tendon thickness appear obviously at the last follow-up visit after 24 weeks. So, clinical improvement precedes the radiological improvement.

Graph (2) displaying the difference in the tendon thickness in the follow-up visits

V. DISCUSSION

Characteristics of the study population and details of the procedure:

This study was conducted trying to evaluate the effectiveness of ultrasound guided PRP administration in patients with partial tearing of supraspinatus muscle tendon and patients suffering supraspinatoustendinosis. Fifteen
patients with age ranging between 27 and 63 years old were included and suffering supraspinatous partial tear and/or tendinosis.

Comparing clinical examination and ultrasound studies before and after the procedure. Then, documented, calculated and analyzed using suitable statistical analysis.

Following ultrasound guided PRP injection, patients were assessed clinically by using the Shoulder Pain and Disability Index (SPADI) scoring system and radiologically by using ultrasound measuring supraspinatus tendon thickness and tear gap which were evaluated at 0, 2, 4, 8 and 12 weeks. Such study showed evident noticeable changes when comparing the SPADI scoring system pre and post-injection. There were higher statistically significant pain and disability score and percentage improvement, however the radiological improvement shows lower statistically significant difference between baseline tendon thickness and its follow-up at 4, 8, and 12 weeks while there was improvement of size of gap and statistically significant decrease in tendon thickness found at 24 weeks with P value = 0.046.

Comparison between the current study results with other nearly similar studies:

Data of fifteen patients had been recorded and analyzed. The total scoring difference between pre-injection and post-injection shows that there was a statistically significant decrease in the SPADI score at the different points of follow-up (P < 0.01)

This agrees with Dong-Wook, et al., 2012, compared the effects of PRP injection with those of dry needling on shoulder pain and function in patients with rotator cuff disease, a study was designed at a University rehabilitation hospital using thirty-nine patients with a supraspinatus tendon lesion who met the inclusion criteria recruited between June 2010 and February 2011. Two dry needling procedures in the control group and two PRP injections in the experimental group were applied to the affected shoulder at four-week intervals using ultrasound guidance.

Results: The clinical effect of the PRP injection was superior to the dry needling from six weeks to six months after initial injection (P < 0.05). At six months the mean SPADI was 17.7 ± 3.7 in the platelet-rich plasma group versus 29.5 ± 3.8 in the dry needling group (P < 0.05). No severe adverse effects were observed in either group.

Conclusions: Autologous PRP injections lead to a progressive reduction in the pain and disability when compared to dry needling. This benefit is certainly still present at six months after treatment. These findings suggest that treatment with PRP is safe and useful for rotator cuff disease.

Based on the previous results, a statistically significant improvement of the total scores and their percentages should be concluded. They showed a remarkable drop from a mean value after injection, completing its descending way. The P value of < 0.001 suggested high statistical significance.

There were radiological progression regarding the tendon thickness appear obviously at the last follow-up visit after 24 weeks. So, clinical improvement precedes the radiological improvement.

Complications

In fact, PRP therapy, is actually a safe method since using the patient autologous plasma to accelerate and focus healing process.

Pain in the injected area: Some people who've undergone PRP therapy complain about an acute ache or soreness in the spot of the injection. Sometimes this pain is even felt deep inside the area, whether in the muscle or bone. Such pain could be improved by local anaesthesia before injection and analgesics (Paracetamol).

Infection: While a tremendous amount of precaution is taken when injecting a patient with a PRP serum–intense sterilization procedures are, in fact, followed closely for each treatment–sometimes an infection can break out in the injured area.

Allergic reaction: Some patients body will reject their own serum and react negatively to the treatment. This is rare, but it does happen and could present as skin redness, erythema and itching.

Skin Discoloration: Sometimes the color around the skin of a PRP injection will appear bruised. This could be normal, based upon history of bruising.
No improvement in injured area: While this is not necessarily a side-effect, we still need to mention that not all athletes respond to a PRP injection. Sometimes the original pain and soreness of the injury remains (it may even get worse), even after an extended rest period after the PRP therapy.

VI. CONCLUSION

Ultrasound guided autologous PRP injections lead to a progressive improvement in the pain and disability in patients suffering partial supraspinatus tendon tear. The procedure is a safe minimally invasive with no gross complications.

REFERENCES


