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PLATELET RICH PLASMA AS A NOVEL TREATMENT FOR CARPAL TUNNEL SYNDROME

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Received: 2 October 2018
Accepted: 26 December 2018

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ABSTRACT

Background: Carpal tunnel syndrome (CTS) is the most common peripheral entrapment neuropathy. Platelet-rich plasma (PRP) therapy is a simple, low cost and minimally invasive method that contains a natural concentrate of autologous growth factors. It was found that PRP has therapeutic effects on many neuropathies which synergizes nerve regeneration, but its effects on carpal tunnel syndrome are unclear. The aim of wok is to evaluate the effectiveness of PRP injections in carpal tunnel syndrome clinically and electrophysiologically.

Subjects & Methods: We performed this clinical trial study on 18 patients with idiopathic mild to moderate carpal tunnel syndrome who received single injection of PRP into the carpal tunnel. Nerve conduction studies (NCS) were carried out, Visual Analogue Scale (VAS) and the Boston Carpal Tunnel Questionnaire (BCTQ) were administered to patients immediately before treatment, one and three months after treatment.

Results: PRP injection showed significant improvement of patients as regard VAS, symptom severity scale (SSS) and functional status scale (FSS) of BCTQ after one and three months of injection. Also, we found that PRP injection showed significant difference in distal motor and sensory latency, amplitude of compound muscle action potential (CMAP) and sensory nerve action potential (SNAP) and sensory conduction velocity of the median nerve after one and three months of injection

Conclusion: local injection of the PRP proved to be available safe choice therapy for carpal tunnel syndrome. Key words: carpal tunnel syndrome; platelet-rich plasma; nerve conduction studies

INTRODUCTION

Carpal tunnel syndrome **(**CTS) is characterized by compression of the median nerve in the carpal tunnel [1]. Pain, tingling, numbness and loss of muscle strength are common symptoms of CTS which affect the performance of daily activities such as feeding, dressing, undressing, hygiene and writing, also it affects work productivity and quality of life [2].

Nerve conduction study (NCS) is a medical diagnostic test which commonly used in daily clinical practice to confirm clinical diagnosis of carpal tunnel syndrome [3].

Although many conservative managements of CTS are available, the effectiveness of these methods is insignificant or only persist for a short duration [1].

Platelet rich plasma (PRP) is a concentrated plasma which contains roughly 3-5 times the number of platelets found in whole blood. PRP contains a 3 to 5 fold increase in growth factor concentrations [4], These growth factors play variety of roles in tissue regeneration and healing [5].

In the last years, PRP has received considerable attention for its therapeutic effects. PRP has been widely used as a safe and novel treatment in dentistry, orthopedics, ophthalmology, neurosurgery, and cosmetic surgery. Recently, increasing evidence has revealed the beneficial effects of PRP on axon regeneration and neurological recovery [1].

In this study, we aimed to evaluate the effectiveness of PRP injections in treatment of CTS clinicaly and electrophysiologically.

SUBJECTS & METHODS

Patients and outcome measures

We performed this clinical trial study in the Rheumatology and Rehabilitation outpatient clinics at Zagazig University Hospitals, after review and approval by the Institutional Review Board (IRB) Committee, on 18 adult patients (2 males and 16 females) (from 25y to 50y) with idiopathic mild to moderate carpal tunnel syndrome diagnosed according to American Association of the Electrodiagnostic Medicine (AAEM) criteria [6].

We exclude patients with thrombocytopenia, severe anemia, local infection, NSAID use (less than 48 hours prior to injection), secondary causes of CTS (malignancy, pregnancy, rheumatological diseases, diabetes), past history of corticosteroid injection in the same wrist and patients with severe or very severe CTS.

All patients gave their informed consent prior to their inclusion.

Full history taking and clinical assessment including sensory and motor examination and provocative tests for CTS were done for all patients.

Nerve conduction studies (NCS) were carried out, Visual Analogue Scale (VAS) and BCTQ were administered to patients immediately before treatment, one and three months after treatment.

Nerve conduction studies (NCS)

Nerve conduction study was performed in NCS unit at Rheumatology & Rehabilitation department, Faculty of Medicine, Zagazig University using (NIHON KOHDEN) electromyography equipment. The normative values taken in our laboratory for median distal motor latency was $\leq$ 4.2 and median sensory distal latency ≤ 3.5 [7].

Boston Carpal Tunnel Questionnaire (BCTQ)[8].

The questionnaire comprises two scales, a symptom severity scale and a functional status scale. The symptom severity scale has 11 questions scored from 1 point (mildest) to 5 points (most severe). The similarly functional status scale has 8 questions scored from 1 point (no difficulty with activity) to 5 points (cannot perform the activity at all). Lower scores on the BCTQ indicate lesser symptom severity and better functional status of the patient.

PRP preparation

The whole blood of 10 ml was taken from each patient. The blood is collected on citrated tube with the mixing rate was 9:1 in volume and mixing by inversion. The tubes was centrifuged (first centrifugation). The rotation speed and time was 704g (3000 rpm × 3 minutes), which was the minimum for separating red blood cells (RBCs) from plasma. The tubes were then taken out from the centrifuge and arranged on a holder and the plasma was collected by syringes and transferred to another sterile tube without anticoagulant and was centrifuged (second centrifugation). The second centrifugation was performed on plasma tube at 4000rpm (1252g) for 15 minutes, which is the fastest speed of the machine and considered to be the realistic time as a daily practice. The supernatant platelet poor plasma (PPP) was removed leaving 2 ml of PRP on sediment (platelet pellet), and suspend the platelet pellets by gently shaking the tube. PRP activated by addition of 200 ul of 0.025 calcium chloride (CaCl2). [9]

PRP injection

A 25-gauge needle was slowly inserted 1 cm proximal to the distal wrist-flexion crease just on the ulnar side of the palmaris longus tendon. The injection was stopped if the patient experienced pain. 2 mL of PRP was injected into the carpal tunnel. Resting was recommended for the injected wrist for 24 hours. Non-steroidal inflammatory drug use was restricted because of the possibility of platelet function inhibition.

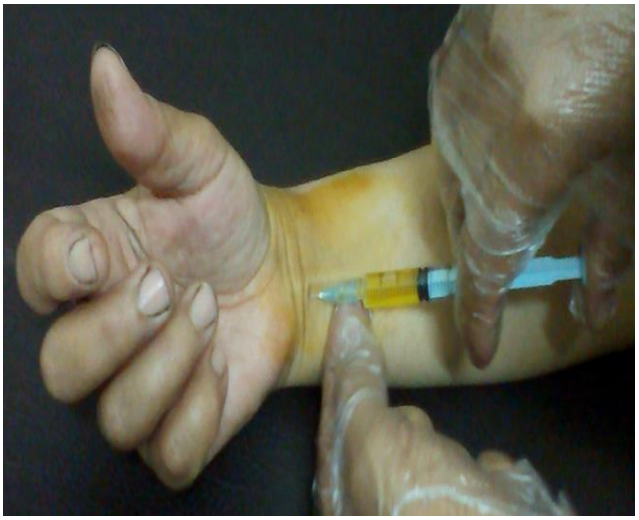

Figure (2): Local PRP injection

Statistical analysis

All data were collected, tabulated and statistically analyzed using SPSS 20.0 for windows (SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as the mean ± SD & median (range), and qualitative data were expressed as (number) & (percentage). Continuous data were checked for normality by using Shapiro Walk test. Friedman's test was used to compare between more than two dependent groups of non-normally distributed variables. Repeated measure anova test was used to compare between more than two dependent groups of normally distributed variables. Percent of categorical variables were compared using Chi-square test or Fisher's exact test when appropriate. All tests were two sided. p-value <0.05 was considered statistically significant and p-value ≥0.05 was considered statistically insignificant (NS).

Results

This study was carried out on 18 adult patients (2 males and 16 females) with idiopathic mild to moderate (3 mild and 15 moderate) carpal tunnel syndrome. Their age ranged from 25 to 50 years (38.5± 8) and the duration of disease ranged from 3 months to 36 months (14± 9).

We found statistically significant difference in Visual Analogue Scale (VAS), symptom severity scale (SSS), functional status scale (FSS) after one and three months of PRP injection. (p<0.05). [Table 1,2]. Also we reported significant difference in distal latency, amplitude and conduction velocity in the motor and sensory nerve conduction studies (NCS) of the median nerve after one and three months of injection [Table 3, 4].

Table 1 Comparison of Visual Analogue Scale (VAS) before injection, at one month and three months after PRP injection.

VAS	Intervention time			Friedman Test	P
	Before treatment	After one month of treatment	After Three months of treatment		
$\overline{X}$ ±SD	7.05± 1.39	2.1± 2.6	3.4± 2.09	-	0.0001 (HS)

Table 2 Comparison of symptoms severity scale (SSS) and functional status scale (FSS) before treatment, at one month and three months after PRP injection.

Boston Carpal Tunnel Questionnaire (BCTQ)	Intervention time			Friedman Test	P
	Before treatment	After one month of treatment	After three months		
SSS $\overline{X}$ ±SD	3± 0.56	1.7± 0.94	1.93± 0.9	-	0.0001 (HS)
FSS $\overline{X}$ ±SD	2.3± 0.56	1.5± 0.66	1.64± 0.6	-	0.0001 (HS)

Table 3 Comparison of motor distal latency, amplitude and conduction velocity before treatment, at one month and three months after PRP injection.

Motor nerve conduction study	Intervention time			Repeated measure F Test	P
	Before treatment	After one month of treatment	After three months		
Distal latency (ms) $\overline{X}$ ±SD	4.8± 0.5	4.3± 0.65	4.5± 0.67	33	0.0001(HS)
Amplitude of CMAP (mv) $\overline{X}$ ±SD	6.2± 2.4	11.2± 7.8	11.5± 8	Friedman test	0.002(HS)

CMAP: compound muscle action potential

Table (4): Comparison of sensory distal latency, amplitude and conduction velocity before treatment, at one month and three months after PRP injection..

Sensory nerve conduction study	Intervention time			Repeated measure F Test	P
	Before treatment	After month of treatment	After three months		
Distal latency (ms) $\overline{X}$ ±SD	4.5± 0.5	3.9± 0.5	4± 0.56	21	0.0001 (HS)
Amplitude of SNAP (uv) $\overline{X}$ ±SD	14.8± 7	20.3± 6.2	19± 4.9	Friedman test	0.002 (HS)
Conduction velocity (m/s) $\overline{X}$ ±SD	40.9± 5.8	49± 7.7	49± 5.6	16	0.0001 (HS)

SNAP: sensory nerve action potential

DISCUSSION

In the last decade, PRP has received considerable attention for its effects on healing of musculoskeletal injuries. The idea of using PRP in the treatment of this peripheral entrapment neuropathy originated from the various experimental studies that had reported positive effects of PRP on regeneration of peripheral nerves [10].

PRP was considered to promote peripheral nerve regeneration through the autologous supply of growth factors, which stimulates schwann cell proliferation and increases the expression and secretion of nerve growth factor and glial cell line-derived neurotrophic factor.[11]

Our study demonstrated that PRP injections into the carpal tunnel relieved symptoms of patients, where the VAS was significantly reduced one and three months after injection when compared with the baseline [table 1]. These results go ahead with **Nikolaou et al. (2015)**[12], who demonstrated that single injection of PRP in 32 patients with mild to moderate CTS showed significant improvement in the VAS one and three months after injection.

Also, our findings are in agreement with **Malahias et al. (2017)** [13] who found significant improvement in VAS after one and three months of PRP injection in the treatment of CTS.

Moreover, our findings showed that the scores of SSS and FSS of BCTQ were significantly reduced (improved) one and three months after injection [table2].

These results agreed with **Uzun et al. (2016),**[14] who showed significant improvement in BCTQ three months after PRP injection in 20 patients with mild CTS.

Our findings agreed with **Wu et al. (2017)**[15], who found significant reduction in the VAS score and BCTQ score after one and three months of PRP injection in CTS.

Also, results of our study partially agreed with **Raeissadat et al. (2018)**[16], who showed significant improvement in the VAS and BCTQ after 10 weeks of single local injection of PRP with using wrist splint in treatment of 21 patients with mild and moderate idiopathic CTS.

Moreover our findings demonstrated that PRP injection showed significant improvement in distal motor and sensory latency, amplitude of compound muscle action potential (CMAP) and Sensory nerve action potential (SNAP) and sensory conduction velocity of the median nerve after one and three months of injection [table 3, 4].

Our results agreed with **Wu et al. (2017)** [15], who found that PRP injection in 30 patients with mild to moderate CTS showed significant improvement in distal motor latency (DML) and sensory nerve conduction velocity (SNCV) after one and three months of injection.

Also, results of our study partially agreed with **Raeissadat et al. (2018)**[16], who found significant reduction in latency of median SNAP in follow up of patients. But our findings are disagreed with this study as they found insignificant improvement in motor distal latency in follow up of patients 10 months after PRP injection.

This incompatibility between this results and our results may be contributed to that they injected 1 ml of PRP with follow up after 10 weeks, but we injected 2 ml of PRP in carpal tunnel with follow up of patients after one and three months of injection.

CONCLUSION

We conclude that single local injection of the PRP proved to be readily available & safe choice therapy for carpal tunnel syndrome. PRP therapy showed improvement clinically as regard the pain and function and electrophysiologically as regard sensory and motor NCS of the median nerve throughout follow up period (one and three months).

REFERENCES

1) **Zheng C, Zhu Q, Liu X, Huang X, He C, Jiang L et al;** Effect of platelet-rich plasma (PRP) concentration on proliferation, neurotrophic function and migration of Schwann cells in vitro. J Tissue Eng Regen Med., 2016;10(5):428-36

2) **Pekel N, Senol P, Yildiz D, Kilic A, Sener D, Seferoglu M, et al.:** The diagnostic efficacy of

clinical findings and electrophysiological studies in carpal tunnel syndrome. The European Research Journal, 2017; 3(1), 62-67.

3) **Herrera E, Sandoval M, Camargo D and Salvini T:** Motor and Sensory Nerve Conduction Are Affected Differently by Ice Peak, Ice Massage, and Cold Water Immersion. Physical Therapy, 2010; 90(4), pp.581-591
4) **Amy S, Wasterlain B, Hillary J, Braun B, Jason L and Dragoo, M:** Contents and Formulations of Platelet-Rich Plasma Oper Tech Orthop., 2012; 22:33-42
5) **Rendu F and Brohard-Bohn B:** The platelet release reaction: granules' constituents, secretion and functions. Platelets. 2001;12(5):261–273
6) **American Association of Electrodiagnostic Medicine (AAEM):** Literature review of the usefulness of nerve conduction studies and needle electromyography for the evaluation of patients with carpal tunnel syndrome. Muscle Nerve (supplement 8), 1999; S145-S167.
7) **Basiri K and Katirji B.:** Practical approach to electrodiagnosis of the carpal tunnel syndrome: A review. Advanced Biomedical Research 2015; 4:50
8) **Levine D, Simmons B, Koris M,Daltroy L, Hohl G, Fossel A, et al.:** A self-administered questionnaire for the assessment of severity of symptoms and functional status in carpal tunnel syndrome. J Bone Joint Surg Am 1993;75(11):1585–1592
9) **Dhurat R and Sukesh M:** Principles and Methodes of Preparation of Platelet-Rich Plasma: A Review and Author's Perspective. JCutan Aesthet Surg. 2014; 7(4):189-197.
10) **Sanchez M, Yoshioka T, Ortega M, Delgado D and Anitua E:** Ultrasound-guided platelet-rich plasma injections for the treatment of common peroneal nerve palsy associated with multiple ligament injuries of the knee. Knee surgery, sports traumatology, arthroscopy: official journal of the ESSKA, 2014; 22, 1084–1089
11) **Sabongi R, De Rizzo L, Fernandes M, Valente S, Gomes dos Santos J, Faloppa F et al.:** Nerve regeneration: is there an alternative to nervous graft? J Reconstr Microsurg, 2014;30:607–16.
12) **Nikolaou V, Malahias M, Johnson E and Babis G:** Single injection of platelet-rich plasma as a novel treatment of carpal tunnel syndrome. Neural Regeneration Research, 2015;10(11), p.1856
13) **Malahias M, Nikolaou V, Johnson E, Kaseta M, Kazas S and Babis G:** Platelet-rich plasma ultrasound-guided injection in the treatment of carpal tunnel syndrome: A placebo-controlled clinical study. Journal of Tissue Engineering and Regenerative Medicine, 2017;12(3), pp.e1480-e1488.
14) **Uzun H, Bitik O, Uzun Ö, Ersoy U and Aktaş E:** Platelet-rich plasma versus corticosteroid injections for carpal tunnel syndrome, Journal of Plastic Surgery and Hand Surgery, 2016; 51(5), pp.301-305
15) **Wu Y, Ho T, Chou Y, Ke M, Li T, Huang G et al.:** Six-months efficacy of platelet-rich plasma for carpal tunnel syndrome: A prospective randomized, single-blind controlled trial. Scientific Reports, 2017; 7(1).
16) **Raeissadat S, Karimzadeh A, Hashemi M and Bagherzadeh L:** Safety and efficacy of platelet-rich plasma in treatment of carpal tunnel syndrome; A randomized controlled trial. BMC Musculoskeletal Disorders, 2018; 19(1).

How to cite this article: **Atwa ET, Esh AMH, Abd El Al IT, Mohamad** YMA. Platelet rich plasma as a novel treatment for carpal tunnel syndrome. ZUMJ 2019; 25 (1); 110-115.