

# The Role of Human Platelet-rich Plasma in Burn Injury Patients: A Single Center Study

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## ABSTRACT

**Introduction:** In recent years, platelet-rich plasma has been used in burn wound repair, plastic surgery, bone and tendon ligament injury repair and other treatment at home and abroad. In Platelet-Rich Plasma, the concentrated platelets of the patient's blood are used, which will lead to collagen production, production and regeneration of new cells in the damaged skin. Due to the many complications of burn wounds and response to treatment in a long period of time; It is possible that the PRP method is effective in the treatment of burn wounds and restores the skin with minimal scarring in a shorter period of time. Therefore, the aim of this study was the effect of human platelet-rich plasma on hospitalized burn patients. **Methods:** This is a clinical trial study that was conducted on burn patients admitted to Emam Khomeini Hospital in Ilam city in 2018. In this study, due to the fact that the time period was determined and all the patients who met the conditions for entering the study were treated after obtaining informed consent, the sample size formula was not used. Based on patient referrals and during a period of 6 months, 25 people suffered burns, according to the inclusion criteria; 20 people were included in the study. According to different wounds in patients; In each patient, routine treatment was used in one part of the wound and PRP in the other part of the wound in addition to the usual treatment. Then, they were compared in terms of the duration of epithelialized tissue formation in the burn site. **Results:** using PRP along with routine treatment compared to routine treatment alone, the time to create epithelialized tissue is reduced by about 29%. It was also shown that the variables of age, gender, weight, height, burn mechanism, percentage of burn, amount of platelets and white blood cells have no significant relationship ( $p < 0.05$ ) with the effect of PRP in the treatment of burn patients. **Conclusion:** The use of PRP along with the routine treatment of burn patients brought positive results, which can become a routine method in all burn departments if expanded, and widely reduce the length of hospitalization of patients and the amount of costs incurred by patients and Also, reducing the costs of the health system is effective.

**Keywords:** Burns, Centrifugation, Epithelialization, Platelet-Rich Plasma, PRP, Wounds

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## INTRODUCTION

The danger of burns always poses a threat to human life and leaves many disabled. Due to the increased mortality and length of disability associated with burn injuries worldwide, especially in developing countries, burn injuries are considered one of the major health problems(1). The body's general immune deficiency due to dysfunction of the humoral and cellular immune system, as well as the damage to the skin caused by burns and destruction of this tissue as the first defense barrier, make it more likely that the

patient will acquire hospital infections due to aggressive diagnostic and treatment processes. (2). A combination of factors may lead to burns, including economic status, race and ethnicity, age and gender, as well as the place of residence, intentionality, and other factors. (3). The concentration of platelets in platelet-rich plasma (PRP) is four to seven times greater than the concentration of platelets in normal blood (4). Among the many blood derivatives, platelet-rich plasma (PRP) is a crucial one. In addition to growth factors and other protein molecules, this substance contains bind-

ing molecules and chemokines that are involved in processes such as cell proliferation, differentiation, and regeneration. There is a direct relationship between the number of growth factors in PRP and its potential, such as its ability to cure (5,6). PRP has therapeutic potential due to these biological substances and factors. Grafted follicular units have demonstrated significant improvements in function following PRP hair transplant surgery. Several skin conditions have been treated with PRP, including rejuvenation of the skin, chronic wounds, and hair loss.

In wound healing, platelets play a crucial role. In response to the wound, they move to the site and begin coagulating. There are many growth factors and cytokines found in platelets that promote wound healing (8). Human skin wounds that do not heal can be successfully treated with platelet-derived growth factors (9). Prevention of infection at the wound site is one of the most significant principles of treatment for these people. The use of platelet-rich plasma in various therapeutic procedures is due to the fact that platelets contain vital growth factors, which can be used in the repair of tissues. Besides facilitating wound healing, they also contribute to it. In response to tissue damage, platelets help repair wounds and maintain hemostasis. To find out how human platelet-rich plasma affected burn patients admitted to Imam Khomeini Hospital in Ilam in 2018, this study was undertaken.

## MATERIAL AND METHODS

### STUDY DESIGN

In 2018, Imam Khomeini Hospital in Ilam city conducted a clinical trial study on burn patients. Due to the fact that the time period was established and all patients who met the requirements for entering the study were treated after obtaining informed consent, the sample size formula was not used in this study. Twenty people were included in the study, based on the inclusion criteria, after suffering burns over a period of six months. In order to enter the study, the patient must be between the ages of 2 and 60, conscious, in the acute stage of the burn (48-72 hours after the accident), and without any hematological or coagulation disorders in the CBC, if chronic skin disease is not present, or if antiplatelet drugs are not used chronically. Anemia, WBC between 4 and 12 thousand, and patients who did not consent to participate in the study were exclusion criteria. There is no anemia, and white blood cells range from 4 to 12 thousand

### SELECTION OF VOLUNTEERS

By providing written consent, 20 burn patients hospitalized in the burn department of Imam Khomeini Hospital from 23/09/2018 to 20/03/2019 with the characteristics listed in Table 1 were randomly selected for this study.

### SAMPLING METHOD

Under sterile conditions, about 5 CC of blood were collected from the patient using a special PRP needle and kit, and the sample was immediately sent to a laboratory.

### SAMPLE CENTRIFUGE

In order to maintain the calibration of the UNIVERSAL centrifuge machine, a normal test tube of equal weight was placed in front of the patient's blood sample. Afterward, the centrifuge machine was set to 3200 rpm for 8 minutes and centrifuged.

### Separation

Under sterile conditions, the sample was gently separated and poured into a second test tube after 8 minutes using CC SAMPLER 1.

### PRP TRANSFER TO THE PATIENT'S BEDSIDE

A CC5 syringe was used to remove the sample from the tube immediately after PRP separation.

### Pouring samples takes place.

Routine treatment of one part of a burn wound was used, depending on the patient's burn wound. Furthermore, PRP was applied to another part in addition to routine treatment. Drop by drop, 2.5-3 CC of PRP is gently poured onto the target area once a day and allowed to dry for 15 minutes. PRP was used for 5 days.

### DRESSING

Once the desired area was dried, routine drugs were applied to the burn (vitamin A-D ointment).

### STATISTICAL ANALYSIS

The data were analyzed using SPSS V.22 software with descriptive statistics (percentage, mean, standard deviation), and inferential statistics (one-way analysis of variance, analysis of covariance, paired t-test).

### RESULTS

Hospitalized patients had an average age of 30.15 years. 65% of the patients in this study were males and 35% were females. PRP was effective in 26% of female patients and 31% of male patients, but the difference was not statistically significant.

Based on the results of this study, boiling water caused the highest rate of burns (45%). As far as burn location is concerned, the upper limb was most frequent with 40% of all burns. A study was conducted to determine the effect of PRP amount on the mechanism and location of burns. Flame burns and burns to the lower limbs had the highest response rates to PRP. And there was no significant difference in any of them ( $P > 0.05$ ).

When PRP was used in addition to the usual treatment, the average duration of epithelialization in the burn area was clearly shorter than when only the usual treatment was used. In table number 2, you will find additional information.

The average platelet count of the patients was 188.5, which is lower than the normal platelet counts of the healthy population due to the stress caused by burns. Patients' platelets did not make a difference in the effect of PRP. The average number of white blood cells in the patients was 11.58. This is higher than the average of the healthy population. Stress and inflammation in the patient's body cause these symptoms.

The number of white blood cells in the patients did not make a difference in the effect of PRP. The average length of hospitalization for patients was 10.5 days.

According to Table 3, the duration of epithelialized tissue formation in the burn area has been clearly reduced in people who were treated with PRP in addition to routine treatment.



**Table 1.** demographic and clinical data of the patients

| Patient Code | Age (year) | Gender | Height (cm) | Weight (Kg) | Burn mechanism | Platelet *10 <sup>3</sup> | Burn percentage | Burning Site | WBC*10 <sup>3</sup> | Hospitalization (Day) |
|--------------|------------|--------|-------------|-------------|----------------|---------------------------|-----------------|--------------|---------------------|-----------------------|
| A            | 28         | Male   | 171         | 76          | fire flame     | 152                       | 13%             | Trunk        | 13.3                | 17                    |
| B            | 10         | Female | 138         | 31          | Boiling water  | 213                       | 10%             | Lower Limb   | 12.9                | 10                    |
| C            | 19         | Male   | 173         | 70          | Boiling water  | 128                       | 12%             | Upper Limb   | 9.6                 | 11                    |
| D            | 56         | Female | 158         | 63          | Boiling water  | 126                       | 14%             | Trunk        | 8.1                 | 12                    |
| E            | 6          | Male   | 124         | 22          | Boiling water  | 153                       | 25%             | Lower Limb   | 9.2                 | 7                     |
| F            | 35         | Male   | 180         | 82          | Electrocution  | 160                       | 10%             | Upper Limb   | 14.7                | 10                    |
| G            | 33         | Male   | 186         | 87          | Electrocution  | 142                       | 9%              | Upper Limb   | 13.8                | 8                     |
| H            | 10         | Male   | 136         | 29          | fire flame     | 248                       | 15%             | Lower Limb   | 10.2                | 14                    |
| I            | 24         | Female | 164         | 59          | fire flame     | 211                       | 10%             | Trunk        | 10.4                | 6                     |
| J            | 40         | Male   | 174         | 77          | fire flame     | 227                       | 13%             | Upper Limb   | 9.8                 | 8                     |
| K            | 34         | Male   | 172         | 79          | Electrocution  | 191                       | 8%              | Upper Limb   | 11.1                | 16                    |
| L            | 5          | Female | 113         | 19          | Boiling water  | 188                       | 15%             | Upper Limb   | 8.9                 | 6                     |
| M            | 53         | Female | 161         | 67          | Boiling water  | 271                       | 17%             | Lower Limb   | 10.3                | 12                    |
| N            | 26         | Female | 167         | 70          | Boiling water  | 196                       | 18%             | Lower Limb   | 7.9                 | 11                    |
| O            | 42         | Male   | 175         | 81          | fire flame     | 103                       | 20%             | Trunk        | 12.4                | 12                    |
| P            | 12         | Male   | 146         | 40          | Boiling water  | 212                       | 5%              | Upper Limb   | 9.9                 | 7                     |
| Q            | 49         | Male   | 181         | 85          | fire flame     | 203                       | 7%              | Lower Limb   | 10                  | 8                     |
| R            | 35         | Male   | 177         | 70          | fire flame     | 251                       | 8%              | Upper Limb   | 11.3                | 9                     |
| S            | 36         | Male   | 177         | 75          | fire flame     | 148                       | 15%             | Trunk        | 9.6                 | 10                    |
| T            | 50         | Female | 166         | 70          | Boiling water  | 247                       | 25%             | Trunk        | 7.9                 | 16                    |

**Table 2.** The average duration of the formation of variable epithelialized tissue the mechanism and location of the burn and the effect of PRP on them

| variable        | percent         | Mean the duration of the creation of epithelialized tissue with PRP | Mean the duration of the creation of epithelialized tissue without PRP | Response rate to PRP |     |
|-----------------|-----------------|---|--|----------------------|-----|
| Burn mech-anism | boiling water   | 45%   | 6.55   | 9.11                 | 28% |
|                 | flames          | 40%   | 6.00   | 9.25                 | 35% |
|                 | electric shocks | 15%   | 8.33   | 9.66                 | 14% |
| burn site       | upper limb      | 40%   | 6.25   | 8.12                 | 23% |
|                 | lower limbs     | 30%   | 6.00   | 9.50                 | 37% |
|                 | trunk           | 30%   | 7.66   | 10.50                | 27% |

PRP was used in addition to routine treatment in Table 3 to create epithelialized tissue for an average of 6.6 days in areas where epithelialized tissue was created. This was compared to 9.25 days in areas where only routine treatment was used. The results indicate a 29% reduction in the duration of epithelialization when PRP is applied to these wounds, which is statistically significant (p = 0.000). In terms of the variables of age, sex, height, weight, burn percentage, burn mechanism, burn site, platelet, and white blood cell count, the p-value was greater than 0.05, which negates the possibility that there is a significant relationship between these variables and the effect of PRP.

**DISCUSSION**

For the treatment of acute and chronic wounds, there are many different treatment methods that are available today. It is very crit-

ical to reduce the length of time that these patients spend in hospital burn departments. This is due to the complications, difficulty of proper treatment, and high cost of treating burn wounds. The development of novel treatment methods in recent years has resulted in a number of advantages and disadvantages. A-D ointment is used in hospitals for daily wound washing and dressing and to monitor the wound for healing and epithelialization. For several years, antibiotics were popular in burn departments; however, they are still used in some hospitals today. Several reliable sources consider them useless and even point to disadvantages, such as the rise of resistance. As a result of the fact that our proposed PRP therapy is autologous, the preparation cost is low, and no acute side effects have been reported, it can be applied to burn patients without any risk. Hospitalized burn patients were studied to determine the ef-



**Table 3.** Duration of epithelialization at the burn site (days)

| Patient Code | Standard Treatment | Standard Treatment + PRP |
|--------------|--------------------|--------------------------|
| A            | 15                 | 11                       |
| B            | 9                  | 6                        |
| C            | 10                 | 6                        |
| D            | 10                 | 6                        |
| E            | 7                  | 4                        |
| F            | 9                  | 8                        |
| G            | 6                  | 5                        |
| H            | 13                 | 8                        |
| I            | 5                  | 3                        |
| J            | 7                  | 5                        |
| K            | 14                 | 12                       |
| L            | 5                  | 5                        |
| M            | 11                 | 8                        |
| N            | 10                 | 6                        |
| O            | 10                 | 7                        |
| P            | 6                  | 4                        |
| Q            | 7                  | 4                        |
| R            | 8                  | 5                        |
| S            | 9                  | 5                        |
| T            | 14                 | 12                       |

fect of human platelet-rich plasma.

In our study, we found that the average duration of epithelialization was shorter when PRP was used alongside routine treatment than when only routine treatment was used. This was statistically significant. A review study by Huang et al (10) found that topical PRP treatment on burn wounds could improve healing rates compared with topical sulfadiazine silver and normal saline. PRP treatment, as compared with other treatments, can also shorten healing time, reduce pain, and decrease scar hyperplasia, which is consistent with our study.

Also, the results of studies by Knighton et al (11), and Ganio et al (12) have shown improvement in the epithelialization of chronic lower limb wounds. Kazakos investigated PRP gel in the management of acute wounds, including friction burns. They found that PRP is an effective aid in the management of acute wounds (13). In a study of five pigs, Henderson showed that autologous platelet gel (platelet-rich plasma concentrate) affected wound healing by inducing a severe inflammatory response (14).

According to Kao et al (15) in 2021, PRP was superior to conventional dressings and placebo when applied to burn wounds. Thus, PRP may be considered a treatment option for burn patients in the clinical setting.

According to Mahdavi and Falahi (16), after PRP stimulation of the skin, cells multiply and exfoliation accelerates, scars are prevented and excess tissue is prevented, so it is suitable to heal burn wounds to a satisfactory degree. This method of treatment is con-

**Table 4.** Duration and standard deviation of epithelialized tissue creation with PRP, without PRP and difference in time of epithelialized tissue creation

| Variable   | N  | M±SD      | 95%Confidence interval of the difference |       | t    | df | sig   |
|--|----|-----------|--|-------|------|----|-------|
|  |    |           | lower                                    | upper |      |    |       |
| The duration of the creation of epithelialized tissue with PRP                 | 20 | 6.60±2.64 | -  | -     | -    | -  | 0.000 |
| The duration of epithelialization without PRP                                  | 20 | 9.25±3.00 | -  | -     | -    | -  | 0.000 |
| The duration of the creation of epithelialized tissue with PRP and without PRP |    | 2.65±1.22 | 3.22                                     | 2.07  | 9.66 | 19 | 0.000 |

\* Paired Samples Test

sidered safe and provides quick treatment results due to its limited side effects. It is imperative that the patient's condition is monitored carefully and the doctor supervises this method of controlling and healing burn wounds.

Hospitalization averaged 10.5 days because all wounds should be healed and epithelialized tissue should be formed under all burned areas before patients are discharged. The findings of the two studies were not compared.

### LIMITATIONS

We limited our study to 2nd-degree burn patients since PRP probably has less effect on 3rd and 4th-degree burn patients due to more severe tissue destruction. Additionally, more severe burn patients (3rd and 4th degree) were often referred to burn centers with better equipment, so it was not possible for us to study PRP in these patients, which is why our study was conducted on a limited number of hospitalized patients within a set timeframe.

### CONCLUSION

Both PRP and routine burn treatment had positive results. This could make it a routine treatment in all burn departments if it is expanded. It can reduce the length of hospitalization and the number of costs incurred by patients. As a result, the health system's costs can be reduced. For the treatment of burn wounds, more research is needed on the use of platelet-rich plasma and evaluating long-term clinical outcomes.

### ETHICAL CONSIDERATION

This study was approved by the Ethics Committee of Ilam University of Medical Sciences, Ilam, Iran (Code IR.MEDILAM.REC.1397.015). The study was conducted with the informed con-



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### CONFLICT OF INTERESTS

There are no conflicts of interest in terms of the present manuscript.

### ABBREVIATIONS

PRP; platelet-rich plasma.

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