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ORIGINAL

Platelet lysate in the treatment of burn patients, evaluation of its antimicrobial effect

Lisado de plaquetas en el tratamiento del paciente quemado, evaluación de su efecto antimicrobiano

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ABSTRACT

Introduction: platelets can interact directly with viruses, bacteria, fungi and protozoa through proteins with direct microbicidal properties that can generate an antimicrobial effect in burns.
Objective: to characterize the antimicrobial effect of platelet lysate in the treatment of burn patients.
Method: observational, descriptive, prospective longitudinal study in patients with type A and AB dermal burns, with less than 5 % of the body surface burned. Platelet concentrate production was performed using internationally established methods. Microbiological study was performed before and after the cures with platelet lysate and bacterial growth was evaluated in two subsequent cultures.
Results: the mean age of the patients is 52 years and type AB burns represented 75 % of the total, being more frequent in upper and lower limbs. Staphylococcus aureus and pseudomona aeruginosa were the predominant germs that grew in the burns. After the first treatment with platelet lysate, a gradual decrease in positivity to germs was observed, until in the third treatment, no more bacterial growth was observed.
Conclusions: platelet lysate has a positive antimicrobial effect, by decreasing the growth of germs isolated during the treatment of dermal burns.

Keywords: Dermal Burns; Antimicrobial Effect; Platelet Lysate.

RESUMEN

Introducción: las plaquetas pueden interactuar directamente con virus, bacterias, hongos y protozoos mediante proteínas con propiedades microbicidas directas que pueden generar un efecto antimicrobiano en las quemaduras.
Objetivo: caracterizar el efecto antimicrobiano del lisado de plaquetas en el tratamiento del paciente quemado.
Método: estudio observacional, descriptivo, de corte longitudinal prospectivo en pacientes con quemaduras dérmicas tipo A y AB, con menos de un 5 % de la superficie corporal quemada. La producción del concentrado de plaquetas se realizó por los métodos establecidos internacionalmente. Se realizó el estudio microbiológico antes y después de las curas con el lisado plaquetario y se evaluó en dos cultivos posteriores el crecimiento bacteriano.
Resultados: la edad media de los pacientes es de 52 años y las quemaduras tipo AB representaron el 75 %

del total, siendo más frecuentes en miembros superiores e inferiores. Los gérmenes estafilococo aureus y la pseudomona aeruginosa fueron los predominantes que crecieron en las quemaduras. Después de la primera cura con el lisado plaquetario se observa una disminución paulatina en la positividad a los gérmenes, hasta que en la tercera cura ya no se observó crecimiento bacteriano.
Conclusiones: el lisado plaquetario tiene un efecto antimicrobiano positivo, al disminuir el crecimiento de los gérmenes aislados durante la cura de quemaduras dérmicas.

Palabras clave: Quemaduras Dérmicas; Efecto Antimicrobiano; Lisado Plaquetario.

INTRODUCTION

Burns are injuries to living tissue caused by various agents that cause alterations ranging from erythema to destruction of the dermal and subdermal structures.[1,2] Burns are one of the most serious and disabling accidents and are one of the most devastating conditions encountered in medicine. The World Health Organization (WHO) estimates that 322 000 people die each year from burns.[1,2]

The healing of burns is not a quick process and can lead to tissue damage that affects the biomechanics and psychosocial aspects of the burn patient. Burns are treated with silver sulfadiazine and administered topically, which has a broad antimicrobial spectrum. However, for it to work correctly, the wound site must be treated daily, and pseudo scars can often form, where bacteria proliferate and prevent complete epithelialization. Furthermore, it should not be used in patients allergic to sulfonamides, pregnant women, or infants under 2 months of age. Another medication used, nitrofurazone, has a high rate of allergic reactions and can cause kidney damage in the elderly, as it is water-soluble (causing frequent bleeding that can delay healing).[3,4]

Since the 1980s, platelets have been used in regenerative medicine, positively affecting epithelialization, healing, and tissue generation. The main components of platelet lysate include platelet-derived growth factor, globular transforming factor, platelet factor 4, interleukin 1, epidermal growth factor (EGF), and other growth factors.[5,6] These molecules, among others, promote the local regeneration environment, stimulating cell proliferation, migration, differentiation, and angiogenesis. Platelets can interact directly with viruses, bacteria, fungi, and protozoa through proteins with direct microbicidal properties that significantly defend against pathogenic microorganisms. Among these are peptides called thrombocidins, which have antibacterial and antifungal activity.[7,8]

Objective

Characterize the antimicrobial effect of platelet lysate in the treatment of burn patients.

METHOD

Study design. Universe and sample

A prospective, descriptive, observational, longitudinal study was conducted to characterize the antimicrobial effect of platelet lysate on skin burns in patients attending the emergency department of the Plastic Surgery and Burn Unit at the Miguel Enríquez Clinical Surgical Teaching Hospital from 2022 to 2024.

The study population consisted of patients with type A and AB dermal burns covering less than 5 % of the body surface area. Patients treated with corticosteroids or immunosuppressants with uncontrolled chronic diseases, tumors, or active infections were excluded. Patients will be included using a non-randomized sampling technique at the researcher's convenience.

Procedures

Obtaining platelet lysate

Platelet concentrate was produced using internationally established methods. Platelet-rich plasma was separated from whole blood by gentle centrifugation (2750 rpm x 4 to 5 minutes at 22°C) and then subjected to rapid centrifugation at higher speeds (3750 rpm x 10 minutes at 22°C) to obtain the platelet concentrate. The platelets in the form of platelet concentrate will be frozen at -30°C and then thawed minutes before implantation to obtain a homogeneous lysate rich in growth factors from platelets.

Microbiological study

Samples were collected following the general procedure for sampling secretions: the lesion was exposed, washed, and sampled using a sterile cotton swab, which was then placed in a sterile tube and transferred to the laboratory.

Isolation and identification were then carried out. Microbiological culture is carried out on agar blood and

MacConkey agar culture plates; the plates are incubated at 35°C for 24 hours. After incubation, the plates are read for differential characteristics in the colonies, and the isolated microorganisms are identified—current techniques and procedures were carried out in these studies.

Variables to be studied

- *Demographic:* age, gender, skin color, occupation.
- *Clinics:* personal medical history, toxic habits, etiology, location, and depth of the burn.
- *Microbiological*: type of bacteria, identified germ, culture result.

Information gathering

The source of information is primary, as it was collected directly from patients through a survey and imaging studies. The information was obtained by applying the data collection form to each patient seen in consultation and selected for the study. The principal investigator was responsible for completing the documentation throughout the study, ensuring the highest quality and accuracy in the collection of information.

Ethical considerations

This study will be conducted using the ethical principles for medical research involving human subjects, as outlined in the latest update of the Declaration of Helsinki (Seoul, Korea, October 2008).

Each patient will be given a detailed and careful explanation of the procedure and the risks, benefits, possible complications, and discomfort that may arise. This will be recorded in an informed consent form prepared for this purpose, including the voluntariness principle. The confidentiality of the information was guaranteed, as required by the ethical principles adopted in the study, and it will be safeguarded and used only for research or teaching purposes. The researchers undertake to publish the results of this research to disseminate the new scientific knowledge acquired.

RESULTS

Table 1 shows the results of the clinical and demographic variables of the 20 patients included in the study.

Table 1. Clinical and demographic variables in the patients studied

Variable		n (%)
Age		52,3 (31-58)
Age range	20-30	6 (30,0)
	31-40	3 (15,0)
	41-50	5 (25,0)
	51-60	6 (30,0)
Female		7 (35,0)
Skin color	White	6 (30,0)
	Mestizo	9 (45,0)
	Black	5 (25,0)
Etiology of physical burns	Friction	3 (15,0)
	Direct fire	4 (20,0)
	Boiling water	13 (65,0)
Depth of burns	A	2 (10,0)
	AB	15 (75,0)
	A/AB	3 (15,0)

As can be seen, the average age is 52, with a predominance of males aged between 51 and 60. Physical burns caused by boiling water were the most prevalent, and AB burns accounted for 75 % of the total.

Figure 1 shows the location of the burns on the body, according to six prominent regions in the patients.

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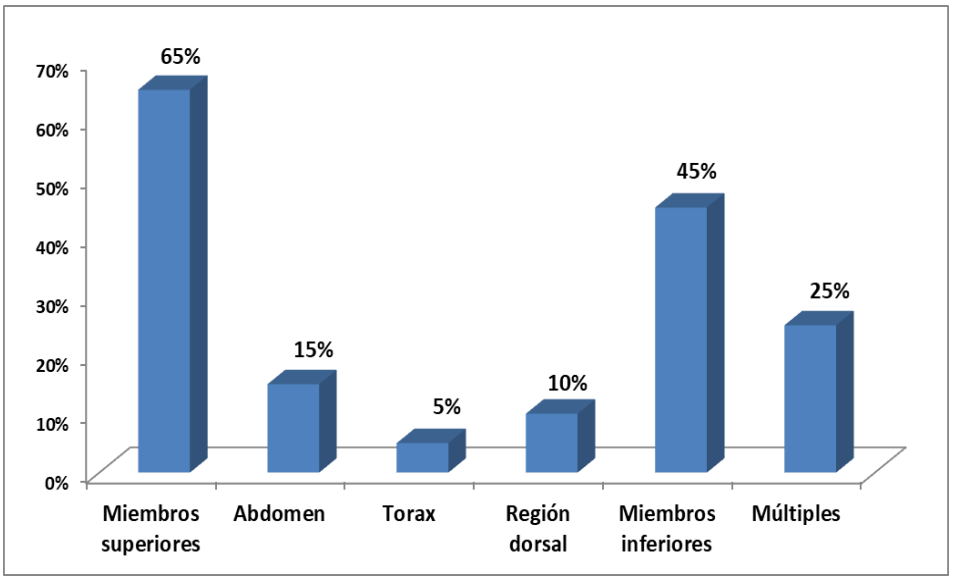

Figure 1. Location of burns on the body

As shown, burns on the upper and lower limbs were the most common, and the least affected area was the chest. It is important to note that 25 % of patients had multiple burns.

Figure 2 shows the germs isolated from the burns of the patients included in the study.

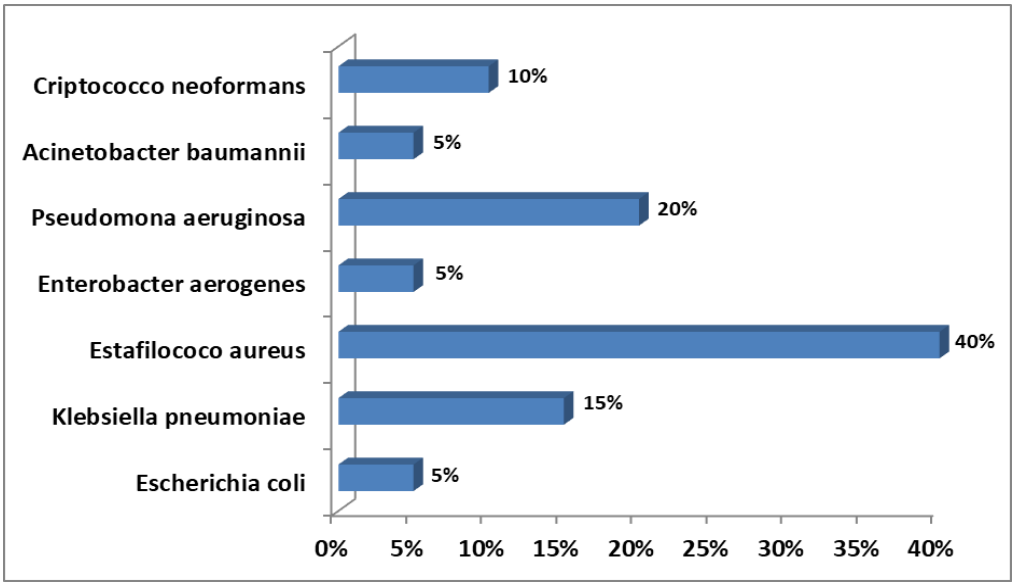

Figure 2. Germs isolated from the burns of the patients studied.

As can be seen, Staphylococcus aureus and Pseudomonas aeruginosa were the predominant germs that grew in the burns, while Cryptococcus neoformans and Escherichia coli were isolated less frequently.

Table 2 shows the results of the microbiological cultures performed during patient follow-up.

Table 2. Microbiological cultures

Isolated germ	Cultivation carried out n (%)		
	First	Second	Third
Escherichia coli	1 (5,0)	-	-
Klebsiella pneumoniae	3 (15,0)	1 (5,0)	-
Staphylococcus aureus	8 (40,0)	3 (15,0)	-
Enterobacter aerogenes	1 (5,0)	-	-
Pseudomonas aeruginosa	4 (20,0)	1(5,0)	-
Acinetobacter baumannii	1 (5,0)	-	-
Cryptococcus neoformans	2 (10,0)	-	-

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After the first culture, treatment with platelet lysate began, and a gradual decrease in germ positivity was observed as treatment progressed. In the second culture, only Klebsiella pneumoniae, Staphylococcus aureus, and Pseudomonas aeruginosa grew, although somewhat. In the third culture, there was no growth in any of the plates studied.

DISCUSSION

Previous results show epidemiological behavior similar to that found in this study, with a predominance of physical burns in men, with a male-to-female ratio of 3,4:1, in ages ranging from 50 to 60 years. The etiology depends on the work performed by the individual: in men, it is exposure to fire and electricity; however, in women, burns from boiling liquids are more frequent in their household activities.[9,10]

Ramírez-Blanco et al., in their review, found a high incidence of burns due to direct exposure to fire during work activities. They also highlight that exposure to hot liquids in domestic activities is the leading cause of burns in the home, with children and older people being the most affected population.[11] When analyzing the distribution according to skin color, we found a predominance of mixed-race patients, purely anecdotal data corresponding to the population treated at our institution. We found no association between skin color and a predisposition to suffer a particular type of burn.

Regarding the location of burns, it can be argued that the upper limbs are used extensively during work, so, logically, they would be one of the most affected areas, in addition to the fact that they are often used to help stop the action of the agent on the body during thermal injury. This is consistent with previous reports.[12,13]

Burns to the lower limbs, with less than 5 % of the body surface area burned, have increased significantly in our environment, where motorcycles are a common means of transportation, causing injuries in this area due to direct contact with hot metal exhaust pipes, as well as friction burns. This location is essential from the point of view of the evolution of the burn since the lower limbs, due to the blood stasis present in them, are more susceptible to the appearance of complications such as local infection and deepening, factors that negatively affect proper healing.[14]

Our research found that AB skin lesions predominate in the depth of burns. Suppose we start from the premise that our study aims to demonstrate the antimicrobial effect of platelet lysate in treating burn patients. In that case, these AB skin burns frequently describe the presence of local infections at the burn site, making them ideal for testing the effectiveness of our platelet lysate as an antimicrobial in the local healing of burn injuries. Other studies also report a high frequency of this type of injury.[15,16]

The main germs isolated in burns depend mainly on the type of injury and the microbiological map of the institution. However, many authors agree that staphylococci (early) and fungi (late) are common in isolates derived from burn cultures. In research based on the first sample taken for culture before local treatment with platelet lysate, we found Staphylococcus aureus to be the most frequent germ, as reported by some authors.[17,18] A study covering the years 2016-2022 found that the most frequently found germs were, in order of frequency, coagulase-negative Staphylococcus, Staphylococcus aureus, and Pseudomonas aeruginosa.[19]

The results of the present study show that bacterial growth decreases progressively after applying platelet lysate. This is primarily related to its efficacy as an antimicrobial and antifungal agent due to its interaction with viruses, bacteria, fungi, and protozoa through proteins with microbicidal properties. In addition, its use is very effective as an adjuvant and stimulant of the defense process due to the significant growth factors present in these platelets and others that exert regenerative and angiogenic actions. It is important to note that the mechanism that allows the antimicrobial function is not yet fully described.[20,21]

This study has limitations, including the small number of patients included and the lack of comparison of the effectiveness of platelet lysate with that of topical antimicrobials used according to protocol for healing burns.

CONCLUSIONS

Platelet lysate has a positive antimicrobial effect, reducing the growth of isolated germs during the healing of skin burns.

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CONFLICT OF INTEREST

None.

AUTHOR CONTRIBUTIONS

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