Incidence and factors associated with loss of skin grafts in burn patients

Diego A. Buitrago M.D. Donovan C. Sanchez M.D. Carlos E. Ramirez M.D. Héctor J. Meléndez M.D.

Santander, Colombia



Background: Skin grafts are therapeutic alternatives to treat second and thirddegree skin burns. Skin grafts are healthy tissues that are surgically removed from an area of the body and transplanted or attached to another. They are surgical procedures that are not exempt from complications and failures in integrating the grafted skin. In local literature, there is no report of the incidence or causes of skin graft loss. Methods: For 21 months, an observational, analytical, prospective study was carried out in which burned patients who were admitted to the University Hospital of Santander and were taken to management with skin grafts were included. Analysis of the cases in which there was a loss of skin grafts. Results: 203 patients were included in the study; we found an incidence of loss of skin grafts in burned patients of 11.3%, the risk factors identified were infection in the area of the skin grafts, the extent of burns greater than 25% of burned body surface area, the need for blood transfusions in the preoperative and immediate postoperative period, and as the last risk factor we find the need to graft special areas. Conclusion: The findings of the present study allow us to formulate strategies to optimize postoperative results and thus minimize the rate of skin graft loss in burned patients.

Keywords: Burns, Burns epidemiology, Skin grafts, loss of skin grafts, Skin grafts complications.

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The worldwide literature indicates that patients with deep second or third-degree burns benefit from early surgical management with skin grafts to reduce the morbidity associated with the presence of bloody areas and the days of hospital stay (1, 2).

Skin grafts are surgical procedures that could develop early or late complications and failures of its integration. Different causes of graft loss have been reported in international studies, including hematomas, infections, seromas, poor contact of the graft with the recipient bed, and other factors associated with the patient, such as diabetes mellitus, personal history of smoking, and malnutrition. (3,4,5,6,7).

In Bucaramanga, Colombia, we do not have statistics on the incidence of graft failure integration in burn patients, as well as nor have the factors associated with graft loss been identified once these procedures are performed on patients; Therefore, this study is proposed to carry out a prospective cohort in which the incidence of loss of skin grafts in patients who are victims of burns and the different failures that could lead to poor integration of both local and systemic grafts is identified.

Methods

An observational, analytical, prospective study was carried out at Hospital Universitario de Santander in patients who presented second and third-degree burns and who were managed with partial or fullthickness skin grafts. Patients with severe organic psychiatric or mental disorders were excluded, and those who did not agree to participate in the study once the purpose of the study had been explained. A convenience sampling with patients who met the inclusion and non-exclusion criteria was taken into account between January 31, 2018, and September 30, 2019, managing to follow up 90 days from the date of skin grafting. Some independent variables, such as age, sex, education level, socioeconomic status, place of residence, tobacco use, and pathological history, were evaluated.

For the analysis of the results, a tabulation was made in an Excel database; using the information

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	n	%
AGE		
<1 year	7	3,4
1-5 years	44	21,7
6-10 years	19	9,4
11-20 year	29	14,3
21-30 years	20	9,9
31-40 years	36	17,7
41-50 years	24	11,8
51-60 years	18	8,9
61-74 years	6	3,0
SEX		
Female	82	40,4
Male	121	59,6
SCHOOL LEVEL		
Analphabets	51	25,1
Elementary school complete	54	26,6
Elementary school incomplete	31	15,3
High School complete	24	11,8
High School incomplete	29	14,3
University	14	6,9
Social security		
Subsidiary	114	56,2
Contributive	36	17,7
Occupational disease	14	6,9
Car accident	9	4,4
No social security	6	3.0
Vinculated	20	9,9
Other	4	2,0

Table 1. Clinical and demographic characteristics. n=203.

collected; two people were designed to digitize the information to detect possible errors or inconsistencies in registration. Subsequently, the statistical program STATA version 15.0 (Stata Corporation, College Station, USA) was used. The univariate description of the variables was carried out through proportions, means, standard deviation, median and interquartile range, taking into account the nature of each one; also, for each of the variables. The multivariate analysis was carried out taking into account the construction of the logistic regression models proposed by Hosmer and Lemeshow, in which the variables with a level of significance in the bivariate analysis were included with p-value < 0.20 according to the Wald test or that generate significant changes (greater than 20%) in the outcome variable (graft loss), it was also decided to include the age and sex of the participants regardless of their significance.

The present study was carried out following the declaration of Helsinki, which establishes the ethical principles for medical research in human beings, thus developing a body of principles and criteria for action in research. In addition, the corresponding national regulations were observed

	n	%
Boiling liquids	59	29,1
Boiling oil	25	12,3
Petrol	25	12,3
High voltage electricity	16	7,9
Low voltage electricity	6	3,0
Flame	33	16,3
Friction	13	6,4
Gas	1	0,5
Other	25	12,3

Table 2. Burn mechanism.

according to resolution 8430 of October 4, 1993, of the Ministry of Health. Article 11 classifies research without risk, minimal risk, and risk greater than the minimum. This research is classified as non-risk; no modification is made to the biological, physiological, psychological, or social variables of the individuals participating in the study; the information was obtained through an instrument of the electronic medical record of each subject with established selection criteria, without performing intervention other than that ordered by the Plastic Surgery service in patients, it is treated for this reason in secondary information. Permission was obtained from Hospital Universitario de Santander to access the medical records.

The research protocol was presented to the Scientific Research Ethics Committee of Universidad Industrial de Santander (CEINCI-UIS), and its development was approved before the start of the study, in a meeting held on December 15, 2017, according to the record. in the act No. 29.

For the processing of personal data, the data required for the investigation was stored in an Excel database; only the principal investigator has access and is managed under the provisions of Statutory Law No. 1581 of 2012 of the Congress of the Republic and Decree 1377 of 2013, guaranteeing the privacy and confidentiality of personal information.

Results

In this study, 203 patients who underwent deep second or third-degree burns required skin grafts from January 1, 2018, to September 30, 2019, were included. 121 patients (59.6%) were men, and 82 patients (40.4%) were women, with a male-female ratio of 1.48:1.

The average age were from 4 months to 74 years, most patients were under 10 years (n=70, 34.4%), and patients from 1 to 5 years old were the most affected. (n=44 21.7%), followed by the age group between 31 and 40 years old (n=36, 17.7%). Regarding the level of education, most of the patients had completed primary school (n=54, 26.6%), and

	n	%
Diabetes	3	1,5
Epilepsy	4	2,0
High blood pressure	2	1,0
Asthma	2	1,0
Cardiac arrhythmia	1	0,5
Anxiety disorder	1	0,5
Psychoactive substances abuse	4	2,0
Vitiligo	1	0,5
Pregnancy	1	0,5
Non-Hodgkin lymphoma	1	0,5
Cigarrette	5	2,5

 Table 3. Pathological history.

only a tiny population attended higher education (n=14, 6.9%). Most of the patients included in the study were subscribed to Colombia's subsidized regime of the social security system (n=114, 56.2%). See Table 1.

Burns from boiling liquids (29.06%), direct flame (16.2%), and petrol (16.2%) were the main burn mechanisms found in the study. See table 2.

The depth of the burn was distributed in 141 patients with second-degree burns (69.4%), followed by combined second and third-degree burns in 45 patients (22.1%), and finally, third-degree burns in 17 patients (8, 4%).

The burned body surface area (BSA) expressed as the percentage of burned body surface area (BSA) was calculated by institutional protocol according to the rule of 9 and adjusted for children according to the conversion factor. The study participants had commitments from 1% of (BSA) to 70% (BSA), finding that 87 patients (42.9%) had burns from 6 to 15% SCQ, 65 patients (32%) had burns less than 5% (BSA), 36 patients (17.7%) had burns from 16 to 25% (BSA) and 15 patients (7.4%) had burns greater than 25% (BSA)

Among the important antecedents, the main ones were smoking history use in 5 patients, epilepsy, and use of psychoactive substances in 4 patients, and diabetes mellitus in 3 patients. See Table 3.

The body areas most required management with grafts were the extremities, 79 skin grafts on the upper extremity (arms and forearms), and 78 skin grafts on the lower extremity (thighs and legs). See table 4.

Regarding the length of hospital stay, the shortest time was 14 days, up to 178 days in a patient with burns of 70% of (BSA), with an average hospital stay from admission to Hospital Universitario de Santander until discharge was 37.5 days, an average of 27.6 days between the burn and the performance of skin grafts, and an average of 11.8 days between the

Arm-Forearm	79
Thigh-Legs	78
Hands	56
Feet	41
Head and neck	35
Chest	31
Abdomen	17
Back	12
Buttocks	8
Genitals	5
Breast	5

Table 4. Grafted body areas.

day of the surgical intervention for skin grafts and hospital discharge.

256 skin grafts were performed in the 203 patients included in the study; 31 of the patients required more than one intervention; the main reason was the need to graft other areas than those operated on in the first surgery, followed by having to perform new skin grafts due to partial loss of the grafts. When performing the analysis of skin graft losses, there was a total loss of 29 grafts; none of the losses was 100% of the grafted area; in 1 patient, a loss of >50% of the graft was observed. In 11 patients there was loss of 20-50% and in 13 patients 10-20% of the graft was lost; 4 patients with graft loss were treated by second healing; the incidence of 11.3% of loss of skin grafts in this study was reported.

When performing the analysis of the explanatory and confounding variables, within the cases of graft loss, 11 patients clinically documented infection of the grafted area, 8 patients required blood transfusion in the preoperative or immediate postoperative period, 8 patients presented burns greater than 25%(BSA), 5 patients were grafted in special areas of the body (face, hands, feet, genitals, flexion areas), no risk factor related to loss of skin grafts was found in 5 patients. No patient found no significant pathological history was found, such as diabetes mellitus, nor a history of smoking.

The multivariate analysis found that in some patients, up to 2 risk factors for skin graft loss were combined; this is how in 4 patients with loss of skin grafts, we found the association between infection and blood transfusion requirement in the preoperative period or immediate postoperative, In 2 patients, the infection of the grafted area was associated with a burn greater than 25% (BSA), and finally, in 1 patient, an association of infection in the grafted area with the need for blood transfusion was found. No significant relationship was found between patient age or sex with loss of skin grafts in burn patients. See table 5.

	OR	95%IC	р
Grafted area infection	2,16	1,06-4,42	0,02
Blood transfusion	2,34	1,05-5,41	0,02
Burn >25% BSA	2,34	1,05.5,41	0,04
Special area affected	1,59	0,53-4,71	0,05
Grafted area infection + Blood transfusion	4,96	1,7-14,47	0,02
Grafted area infection +>25% BSA	4,76	1,05-21,5	0,02
Blood transfusion + 25% BSA	3,17	0,35-28,6	0,04
Age			
0-10 years	1,33	0,97-2,45	0,43
11-20 years	1,79	0,23-4,32	0,64
21-30 years	1,04	0,92-2,72	0,56
31-40 years	0,7	0,57-0,82	0,40
41-50 years	0,98	0,88-1,99	<0,01
51-60 years	1,42	0,32-2,82	0,48
61-74 years	1,5	0,42-3,22	0,56
Sex			
Male	1,88	0,75-2,33	0,47
Female	1,35	0,65-1,89	0,56

Table 5. Multivariate analysis of risk factors for graft loss in burn patients.

Discussion

The present study shows the sociodemographic characteristics of patients admitted to the Burn Unit at Hospital Universitario de Santander from January 1, 2018, to September 30, 2019, and who required surgical management to treat skin burns using skin grafts. During the study period, 203 patients were treated, and 256 partial skin grafts were done, 31 of which required more than one intervention.

A male: female ratio of 1.48:1 was found, coinciding with previous studies carried out at the local level, Ramírez-Blanco 2017 (8), with a greater relationship towards the male sex 1.39: 1 to the female sex; in other latitudes, we found a greater commitment

of the male sex, male: female 3.8 : 1, Pegg 2004 (9) and 3.1:1, Duke 2008 (10).

The primary causative agent of burns found in this study was boiling liquids 29.6%, coinciding with national and international studies, Berrocal 1998 (11), Polo 1979 (12), Song 2005 (13), Chien 2003 (14). and with local studies such as that of Ramírez Blanco 2017 (8). The second etiological agent in our patients was direct flames 16.3%, followed by gasoline and boiling oil, 12.3%.

The main age group affected was those under 10 years of age, 34.4%, and most of these were preschool patients, which leads us to conclude that home accidents with boiling liquids in preschool children cause most burns. Therefore, it is necessary to improve domestic accident prevention campaigns. We found second-degree burns do not have a good healing process if early debridement and management of bloody areas with partial skin grafts is not performed. Superficial and intermediate seconddegree burns remain as injuries that can be managed conservatively and, depending on the time of evolution, determine the need for surgical management to cover bloody areas.

An incidence of skin graft loss in burn patients of 11.3% was found, slightly lower than evidenced in other studies such as described by Park in 2013 (15), where the loss of skin grafts was reported in burn patients at 15.1%.

In the present study, 100% loss of skin grafts was not found; on the contrary, partial losses were found, coinciding with findings found by Park in 2013 (15), Flowers in 1970 (6), Nosanov in 2017 (4). and Jewell in 2007 (5).

The primary risk factors found for graft loss were the presence of infection in the grafted area (OR 2.16 (1.06 - 4.42)), coinciding with Park's findings in 2013 (15) in contrast to Jewell's study in 2007 (5); the need for blood transfusion in the preoperative and immediate postoperative period appears as the second risk factor (OR 2.34 (1.05-5.41)), a finding not reported in previous studies, followed by a percentage of body surface area burned greater than 25% (OR 2.34 (1.05-5.41)), a finding also found by Park in his 2013 study (18), and as the fourth and last risk factor associated with loss of skin grafts in our study population was the involvement of a special area with an OR of 1.59 (0.53 - 4.71).

In this study, no relationship was found between the loss of skin grafts in burn patients and a history of diabetes mellitus or smoking, risk factors described in other studies (6). The age and sex of the patients were also not risk factors related to loss of skin grafts in burned patients.

By combining risk factors, we found that patients in whom infection of the grafted area associated with the need for transfusion was documented had a higher risk of skin graft loss OR of 4.96 (1.7 - 14.47) and the presence of infection of the grafted area with a (BSA) greater than 25% present an increased risk of loss of skin grafts with an OR of 4.76 (1.05 - 21.5).

Finally, analyzing hospital stay, we found in this study that the average hospital stay from the moment of admission to Hospital Universitario de Santander until discharge was 37.5 days, the average number of days between the burn and the of skin grafts was 27.6 days, and between the day of the surgical intervention for skin grafts and hospital discharge it was 11.8 days, this coincides with the findings in the world literature and emphasizes the importance of campaigns prevention of burns because hospital stay and recovery times are long, generating high costs for both patients and health systems.

Conclusions

Burn injuries represent a public health problem worldwide; they are one of the most severe injuries an individual can experience since they have high physical, psychological, emotional, and economic repercussions.

Deep second-degree and third-degree burns require optimal management with skin grafts or flaps to cover residual bloody areas. Classically, partial skin grafts have been the best option for optimal management of burns that require skin coverage; this procedure carried out in expert hands has low failure rates and adequate future results.

In the present study, we found an incidence of loss of skin grafts in burn patients of 11.3%, slightly lower than that reported in the world literature, which is approximately 15.1%. Likewise, we found that the risk factors for loss of skin grafts in burned patients identified in our study were infection in skin grafts, the extent of burns greater than 25% of BSA, and the need for blood transfusions in the preoperative and immediate postoperative period. As the last risk factor, we need to graft special areas such as the face, neck, hands, feet, and genitals.

Likewise, it was possible to characterize sociodemographically the population of patients with burns who undergo skin grafts.

The foundations are laid to carry out a predictive model for the loss of skin grafts and

formulate strategies that optimize postoperative results and thus minimize the rate of skin grafts in burned patients.

Adequate pre-surgical preparation and adequate operative planning can lead us to optimize surgery times, thus reducing bleeding and the risk of infections in patients who will undergo partial skin grafts.

Public health campaigns aimed at preventing domestic accidents, especially in terms of burns, would greatly reduce the incidence of burns in the population of Santander and northeastern Colombia and, therefore, would also reduce the need for surgical management of the injuries in burn patients.

Conflicts of interest

No conflicts of interests.

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Diego A. Buitrago Aesthetic and Reconstructive Plastic Surgery Department Universidad Industrial de Santander Hospital Universitario de Santander Santander, Colombia