

Original Research Article

The reliability of use of combined homograft and autograft in management of major burns

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ABSTRACT

Background: The aim of the study to present the reliability of application of intermingled skin homograft and autograft in major deep burn cases in comparison with using homograft only. Early excision and skin graft closure of major burns is a life-saving procedure that reduces morbidity and mortality of severe burns. Patients suffering major burns lack adequate donor site skin graft to resurface burn wounds so they need another substitutes for coverage as homograft.

Methods: This cohort prospective study was conducted at Menoufia University Hospitals from January 2017 to January 2019 and with follow up 6 months. The population of the study was 54 patients with major deep burns. After stabilization they were divided into 2 groups, the first underwent homograft and the second underwent combined homograft and autograft. They vary between children and adults. Follow up done over 6 months regarding rejection, need of another graft and mortality

Results: Our study was undergone on 54 patients; 30 patients homograft (55.5%) and 24 patients combined grafts (44.5%). Forty eight patients survived, and six patients died (12.5%), with a mean age 26.3 years (range, 1-50). There was statistically significant difference between 2 groups regarding rejection time, need of another graft, percentage of rejected area and mortality.

Conclusions: Combined homografts and autografts is considered gold standard in management of major burns with lack of adequate autograft. It is superior to use of homograft only regarding morbidity, mortality and need for another graft.

Keywords: Allograft, Autograft, Graft expansion, Major burn, Rejection

INTRODUCTION

Major burns are generally life-threatening, devastating injuries if not treated properly. Significant amounts of water, electrolytes, and proteins are lost from the burn wound. The importance of fluid resuscitation was recognized as early in 1930.¹

Advances in fluid resuscitation, critical care, nutrition and antimicrobial therapy, coupled with early aggressive

wound management, have steadily reduced the mortality rate in major burns. The percentage burn producing a 50% mortality (LD50) has increased from 49 to 98% TBSA (total body surface area) in the 0±14 age group, and 46 to 70% TBSA in the 15±44 age group since the 1940s.²

Early excision and skin graft closure of major partial and full-thickness burns is a life-saving operative procedure that reduces the morbidity and the mortality of severe burns.³

Patients suffering major burns more than 40% TBSA lack adequate skin graft donor site to resurface burn wounds; hence, severe burns still continue to pose problems of insufficient autologous skin cover. The donation of organs, especially skin, is not acceptable in our community; therefore, we do not have skin bank facilities from skin allografts that can be processed, stored, or distributed.⁴

We also do not have the facilities and infrastructure in our country, for cultured keratinocytes, which can be used as skin graft substitutes. At present, the only temporary skin substitute that we can use as an allograft is the skin of burn patients' close relatives as living skin graft donors, particularly mothers and fathers for burn injuries in children and aunts, wives, and brothers for adult burn patients. Skin allografts readily vascularize and provide robust tissue coverage when freshly harvested and are applied on clean excised wounds until the inevitable rejection, if left in place more than 2 weeks.⁵

Intermingled skin autograft with an allograft abolishes the painful and ulcerative phase of skin allograft rejection by the smooth and continuous epithelialization of the auto graft keratinocytes when used to resurface the denuded areas left behind rejected allografts. This surgical technique also eliminates the skin allograft excision and replacement with a skin autograft without brisk bleeding.⁶

Skin allograft coverage inhibits water, electrolytes, proteins, and energy loss from the burn wound as a long-standing skin substitute. It also reduces the wound pain and acting as a barrier to the invasion of microorganisms. Temporary allograft coverage gives autograft donor areas the opportunity to heal between multiple skin graft harvesting and act as a biological dressing for maintaining the burn wound bed integrity.⁷

To the best of our knowledge, there are no studies comparing between homograft and intermingled graft regarding rejection time, surface area and mortality.

In this study, we aim to present the reliability of application of intermingled skin allograft and autograft in the treatment of deep burn cases in comparison with using allograft only.

METHODS

This cohort prospective study was conducted at Burn Unit of Department of Plastic, Reconstruction Surgery Menoufia University Hospitals from January 2017 to January 2019 and follow up period of about 6 months. The patient population of the study consisted of 54 patients suffering from major deep burns more than 20% of TBSA. They were admitted primarily to Burn Unit at Menoufia University Hospitals. Patients were divided into 2 groups, the first group underwent homograft and the second group underwent combined homograft and

auto graft for management of their burn. The age of the patients vary between children and adults and all of them had deep dermal to full thickness burns in variable body areas.

Also all of the patients were underwent escharectomy and then coverage with homograft or combined homograft and auto graft. The patients had different percentages of burn but all of them were more than 20% of TBSA with limited donor site availability for auto graft. The cause of the burn varied from scald, direct flame or chemical burn which occurred accidentally with no evidence of child abuse, suicidal or homicidal attempts for all patients.

Inclusion criteria include major burn patient more than 20%, limited donor site availability for autograft, deep dermal to full thickness burns that will take long time or will not heal conservatively and patients will get benefit from early escharectomy and coverage.

Exclusion criteria include minor burn less than 20% of TBSA, available donor site of auto graft for coverage of all burn area, superficial burn which heal conservatory without graft, critically ill patients not tolerate anesthesia and operation, and patients who refuse operation.

All patients admitted to burn ICU or burn unit according to burn percentage, presence or absence of inhalational injury, presence or absence of comorbidities.

All of them were received primary resuscitation treatment with analgesics, fluids, anti-stress measures and dressing with silver sulphadiazine ointment. Full lab investigations were done as base line investigations to the patients including Complete blood picture, prothrombin time, blood grouping, Na, K, urea, creatinine, AST, ALT, serum albumin, fasting and postprandial blood sugar and Virology of HCV, HBV, HIV was done to all patients and ECG for adult patients. After stabilization they were prepared for escharectomy (early excision of burn eschars) after 48 to 72 hours of injury.

Patient preparation (pre-operative preparation)

Another full laboratory investigation done 2 days from injury including: Complete blood picture, prothrombin time, blood grouping, Na, K, urea, creatinine, AST, ALT, serum albumin. Virology of HCV, HBV, HIV and 2 units of packed RBCS prepared for all recipient patients to compensate blood loss during operation if needed.

Donor's preparation (pre-operative preparation)

Source of homograft donors varied from one of the first degree relatives in the most of the patients or excised skin from other patients underwent abdominoplasty or breast reduction with excision of excess skin. All of donors signed consent for skin donation. They underwent routine preoperative investigations including: Complete blood picture, prothrombin time, blood grouping, Na, K, urea,

creatinine, AST, ALT, serum albumin and ECG for adult patient. In addition to washing the donor area with Dettol and shaving skin of both thighs night before operation. All of the donors checked for virology of HCV, HBV, HIV viral infection to avoid disease transmission between donor and recipient.

All of the patients and donors were evaluated generally and locally before operation and anesthesia consultation was carried out for both donor and recipient patients.

Intraoperative preparation and operative procedure

Antibiotic prophylaxis: Antibiotic was given to all recipient and donor patients before operation as 1gm of third generation cephalosporin direct intravenous route half hour preoperatively.

For donor: Homograft harvesting from donor person:

- Spinal or general anesthesia.
- Scrubbing donor site with betadine and toweling.
- Putting lubricant ointment at donor site.
- Harvesting split thickness graft from donor site (thigh) using humby knife. Thigh is the preferred donor site.
- Hemostasis (saline with adrenaline packs).
- Bulky dressing applied to donor site.
- Meshing of homograft taken skin with meshing application ratio 3-1.

Time interval between harvesting graft from donor and its application to recipient was variable in our study varied between 8 days (in case of harvesting from skin of breast reduction or abdominoplasty) to the same day.

In case of delayed application homograft, it is stored by:

- Wrapping with vaseline gauze.
- Cover with sterile dressing.

Operative procedure of burn patients: (Figure 1 and 2)

- General anesthesia.
- Sterilization (scrapping with betadine) of burn area.
- Tangential excision technique (escharectomy) with humpy knife till well bleeding surface obtained.
- Hemostasis with saline and adrenaline packs.
- In case of group A:
 - Application of meshed homograft sheets covering all or most of raw area present.
 - Fixation of homograft sheets with staples.
 - Application of vascular gauze over grafts then bulky dressing was applied.
- In case of group B patient:
 - Harvesting auto graft sheets from available donor sites of the patients mostly from thigh using humpy knife.

- Hemostasis of the donor site with bulky dressing.
- Meshing of the auto graft sheets with mesher ratio 3-1.
- Application of combined homograft and auto graft in parallel manner covering raw area present.
- Fixation of all graft sheets with staples.
- Wrapping with vaseline gauze.
- Bulky dressing applied.
- Splinting of joints was usually done with slap to maintain posture and prevent contracture.

Postoperative care

- The patient was transferred to ward and vital signs obtained.
- Normal diet allowed after complete recovery.
- Post-operative complete blood picture done to determine if the blood transfusion needed or not.
- Good antibiotic coverage to avoid infection.
- Dexamethasone (corticosteroid) given to decrease immune reaction against grafts delaying rejection.
- First dressing on graft usually done after 3-5 days unless excess soaking or high fever in these cases dressing done earlier.

Assessment of the homograft take and survival was done by clinical examination on regular follow up dressing and outpatient clinic visits.

The assessment was done at first dressing and after one week, one month and six months of operation.

Follow up

After the first dressing with good graft taken every other day, dressing until exposure of the wound was possible. With wound exposure and improvement of general condition patients were discharged with outpatient clinic follow up on regular basis. If there is any sign of considerable graft rejection, infection and graft loss, the patient is kept in the hospital and prepared for another session of homograft or auto graft if possible (Figure 3 and 4).

Statistical methodology

The collected data were organized, tabulated and statistically analyzed using SPSS software (Statistical Package for the Social Sciences, version 21, SPSS Inc. USA). Data were described using mean and standard deviation (SD) and frequencies according to the type of the data (quantitative or categorical respectively). Chi-square and fisher exact test were used for comparison of qualitative variables. We used one way ANOVA test to compare between means of categorical and numerical data. Significance level (P-value) was adopted, i.e.

p<0.05 for interpretation of results of tests of significance.

RESULTS

Our study was undergone on 54 patients; 30 patients homograft (55.5%) and 24 patients combined grafts (44.5%).

Forty eight patients survived, and six patients died (12.5%). Of fifty four patients, thirty four were male (70%) and 14 patients were female (30%), with a mean age of 26.3 years (range, 1-50). We depend mainly on parents on taking homograft and only two cases that we use excess skin after abdominoplasty operation.

The mean age of the patients among homograft patients, combined grafts were 27.8±12.9; 19.68±8.3 respectively

with (p=0.11). The percentage of burn area of homograft patients and combined grafts were 43.8±13.6; 48.8±14.1 respectively with (p=0.19). Graft rejection starts earlier among homograft patients (10.48±3.8), while starts later among combined grafts (17.8±4.7) with high significance ((p≤0.001). Percentage of grafts rejection among homograft patients and combined graft were 54.28±9.2; 31.088±7.1 with high significance ((p≤0.001) (Table 1; Figure 1).

Need for another sessions of debridement and another grafts were significantly high among homograft patients (17 patients; 56.6%), while low in combined grafts (5 patients; 20.8%) with (p=0.008). Hospital stay among homograft patients and combined graft were 34.18±5.53; 19.98±2.8 with high significant p≤0.001. No significant correlation between type of graft and incidence of mortality (p=0.45).

Table 1: Demographics of patients received homograft and combined homograft and autografts.

	Homograft	Combined	P value
Number	30	24	
Age (mean±sd)	27.8±12.9	19.68±8.3	0.11
Sex- M (%)	21 (70%)	13 (54.1%)	0.18
Percentage of burn (mean±sd)	43.8±13.6	48.8±14.1	0.19
Cause of burn (%)	N (%)	N (%)	0.237
Chemicals	3 (10)	0 (0.0)	
Direct	3 (10)	4 (17)	
Scald	24 (80)	20 (83)	
Source of graft- donor (%)	26 (86.6%)	22 (91.6%)	0.45
Start of graft rejection (mean±sd)	10.48±3.8	17.8±4.7	<0.001
Percentage of rejection area (mean±sd)	54.28±9.2	31.088±7.1	<0.001
Need for another sessions- Need (%)	17 (56.6%)	5 (20.8%)	0.008
Hospital stay (mean±sd)	34.18±5.53	19.98±2.8	<0.001
Mortality (%)	4 (13.3%)	2 (8.3%)	0.448

Table 2: Comparison between need of another session and other variables.

	Need of Another session	No need for Another session	P value
Number	22	32	
Age (mean±sd)	31.8±11.6	18.9±8.6	<0.001
Sex- M (%)	14 (63.3%)	20 (62.5%)	0.58
Percentage of burn (mean±sd)	54.9±11.6	38.5±11.2	<0.001
Cause of burn (%)	N (%)	N (%)	0.53
Chemicals	2 (9)	1 (3)	
Direct	2 (9)	5 (15.6)	
Scald	18 (82)	26 (81.4)	
Source of graft- donor (%)	19 (86.3%)	19 (90.6%)	0.472
Start of graft rejection (mean±sd)	11.3±4.3	14.7±5.6	0.021
Percentage of rejection area (mean±sd)	51.4±12.3	38.8±13.36	0.001
Hospital stay (mean±sd)	32.9±8.2	24.2±6.5	<0.001
Mortality (%)	3 (13.5%)	0 (0.0)	0.117

Table 3: Correlation between mortality and other variables.

	Mortality	Survived	P value
Number	6	48	
Age (mean±sd)	30±11.5	19±8.5	0.01
Sex- M (%)	2 (33.3%)	32 (66.7%)	0.17
Percentage.of.burn (mean±sd)	55.6±12	35.2±10	0.02
Cause of burn (%)	N (%)	N (%)	0.03
Chemicals	1 (16.5)	2 (4)	
Direct	4 (66.7)	7 (14.5)	
Scald	1 (16.5)	9 (18.7)	
Source of graft- Donor (%)	3 (50%)	43 (89.5%)	0.472
Start of graft rejection (mean±sd)	9.5±4.3	13.7±5.3	0.05
Percentage of rejection area (mean±sd)	52.3±11.3	40.8±13.36	0.04
Hospital stay (mean±sd)	29.9±8.2	27.2±6.5	0.54
Type: Homograft (%)	4 (66.6%)	26 (54%)	0.45
Type: Combined (%)	2 (33.3%)	22 (46%)	
Need for another session- Need (%)	3 (50%)	32 (66.6%)	0.117

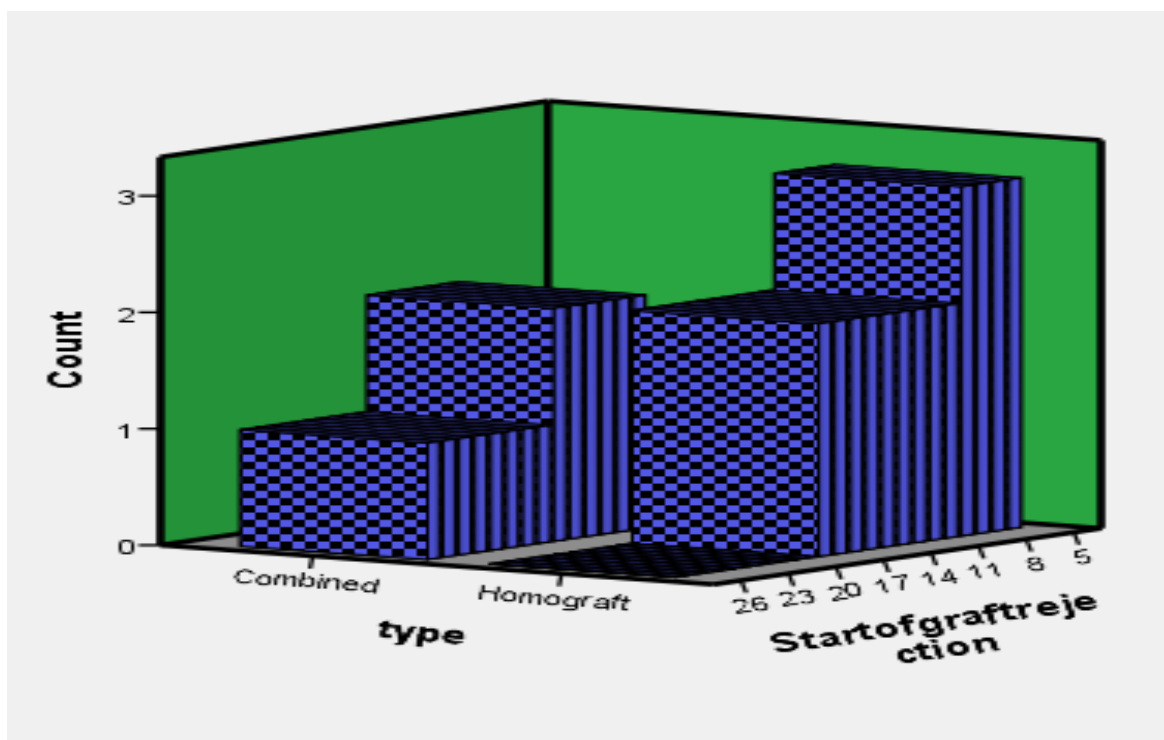


Figure 1: Relation between type of graft and start of rejection.

Interestingly, we found significant correlation between need of another session of graft with percentage of burn area as it was 54.9±11.6 among patients need another session versus 38.5±11.2 that do not need another session (p<0.001). Because of early start of graft rejection and high percentage of rejected area, those patients need another session (p=0.02, 0.001 respectively) (Table 2).

Regarding mortality, it was high among old age patients (p=0.01), direct flames as a cause of burn (p=0.03) and high percentage of burn area (p=0.02) (Table 3).

DISCUSSION

Burn is one of the most common traumas worldwide and cases of major burn usually have high mortality rate. Burn causes pathological flux of energy within a tissue, resulting in the disruption of functional integrity.⁸ Regardless of the source of energy (thermal, chemical, electrical or radiation), the burn leads to a common pathway underlying the disruption of skin integrity. The skin is no longer able to function as a protective barrier to the environment. In addition to substantial pain and

distress, the skin damage also causes exposure to infection, increased evaporative heat loss, as well as loss of body fluids, protein and electrolytes.⁹

For major burns, the extensive breach in the epithelial layer may cause systemic physiological derangements, including leakage of intravascular fluids and proteins into the interstitium, hypovolemic shock and suppression of the immune system.¹⁰ Therefore, re-establishment of the skin barrier is crucial to normalize the victim's physiological state.¹¹

The approach to burn wound management varies according to total body surface area involved and the depth of burn. The superficial partial thickness burn may heal without skin grafting, but it requires application of topical antimicrobial therapy, wound dressing or skin substitute in a moist wound healing environment. The deep partial- and full-thickness burns, on the other hand, necessitate early tangential excision and autogenous skin grafting to decrease wound infection and mortality.⁸

The ultimate goal of burn treatment is to promote survival, rapid healing of the wounds, minimal scarring and abnormal pigmentation, with restored quality of life.¹²

The use of cadaveric skin allografts as biological coverage or skin substitute in burn management dates back to World War II and is currently being practiced in many major burn centers all over the world.¹³ Skin banks are also established to address the need for skin allografts in the respective centers. The benefits of using skin allograft in burns have been widely proven in the published literature¹⁴.

There is no skin bank in our country. In the countries in which there are skin banks and cadaver skin can be used, the amount of allograft needed to close the burn wound can be determined preoperatively. Thus, the use of unnecessary allograft and cost can be prevented.

There are another benefits of skin allograft application, such as decreased loss of water, electrolyte and protein. Skin allograft application also reduces pain and thus allows exercise and ambulation, and it decreases the incidence of contractures¹⁵. As the cadaveric skin bank is not available in Egypt and because the major burn usually affect low socioeconomic standard patients who can't afford for skin substitutes as Integra and Matriderm which are very expensive.

We consider the live sibling skin homograft as a very good skin substitute which is without any cost and depend on parents donation or from excised skin from operation like abdominoplasty or breast reduction in which the skin usually discarded.¹⁶ We can offer the live sibling skin homograft as integral part of management which help in early excision and coverage in cases of major burn who don't have enough donor site for

autograft. Skin from a live donor does not require complex preparation or preservation. It can be used immediately after harvesting and provides a ready source of skin substitute.¹⁷

The closer the donor is related to the patient the lesser the immunological rejection process.¹⁸ In this study we use skin homograft in comparable to combined graft in the management of burn wound in order to increase initial take and lessen time to start signs of rejection.

The skin allograft is known to be more susceptible to rejection than other tissue and organ allograft due to the skin's unique intrinsic immunological features, including high concentrations of Langerhan's and other dendritic cells as antigen presenting cells, and extracellular matrix glycoproteins that position the T cells for activation and effector functions.¹⁹

In our study we depend mainly on the parents as one of the important sources of homograft in many cases as we believe that this method has many advantages, and this agree with what Phipps and Clarke said in their study 1991. They feel that there are some specific advantages which derive from the use of skin from a parent, rather than from an unrelated donor: the allograft skin is freshly donated, avoiding the need for storage facilities or complex treatment and packaging, and presenting the skin at maximum viability.²⁰ We found also there is a considerable psychological benefit to the donor parent, who feels that he is making a significant contribution to his child's recovery.

Many of the patients in this study used combined graft heal conservatively without need for another graft session. However, patients received homograft only has high incidence of graft rejection and high percentage surface area of rejection. These results comply with Esmail et al study that conclude intermingled graft offer high power of expansion that reach 79%.¹¹

In this study, only six patients survived, and the forty eight patients survived. There is significant correlation between high mortality with old age patients, direct flame as a cause of burn and increase burn size. Our results coincide with Muller et al that evaluated the charts of 4094 patients retrospectively.²¹ Multivariate analysis of the individual prognostic factors showed that the determinants of death were increasing age and burn size, inhalation injury, and female sex. Narayan et al conducted a similar retrospective review of 1665 patients. They found that identifiable risk factors for death were an age greater than 60 years, a burn covering more than 40% TBSA, and inhalation injury.²²

CONCLUSION

At the end of this study, we want to recommend the use of combined graft as an important part of management of major burn cases with lack of donor site for autograft.

Combined graft is priceless and considered gold standard and not in need for special complicated methods for harvesting, preparation and preservation and in same time has great benefits. As it high power of expansion and less surface area of rejection with no need for another session of graft.

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Ethical approval: The study was approved by Menoufia University-Faculty of Medicine's ethics committee

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