

Early Excision and Skin Graft versus Delayed Skin Grafting for Patients with Deep Thermal Burn Up to 15% of the Body Surface Area: A Prospective Comparative Study

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ABSTRACT

Background: The innovation of early burn surgery takes very long time to be well established may be due to improper explanations of burn pathophysiology and unpredicted complications of such surgery [1]. Janzekovic work in the 1970s early allows early surgery of burns to achieve greater acceptance through tangential excision [2]. Delayed skin grafting technique include its relative selectivity and the fact that it is not based on diagnosis, usually involves less surgical intervention, and is simple to practice [3].

Objective: The outcomes of the two modalities of deep thermal burn management up to 15% of the body surface area were compared.

Patients and Methods: A prospective study was performed on 30 patients with recent burn who were divided into two groups; group of early surgery: 15 patients were operated using early excision and skin grafts and group of delayed surgery: 15 patients were operated using delayed skin grafts. Patients were evaluated during preoperative period for (fever, WBCs count, hemoglobin level, albumin level, blood and plasma transfusion), intraoperative blood transfusion and post-operative (graft take, numbers of the operations, functional deformity, psychotherapy drug needs, nosocomial infection, weight deficit and hospital stays).

Results: It was found that the incidence of fever and transfusion requirements were significantly higher in group of delayed surgery. There were no significant difference regarding intraoperative blood transfusion and graft take. As regarding the numbers of operations, the functional deformity, the need for psychotherapy drugs, the incidence of nosocomial infection, the incidence of weight loss and hospital stay were significantly less in group of early surgery.

Conclusion: Early excision and skin grafting in patients with thermal burn up to 15% of body surface area was associated with decreasing incidence of fever, nosocomial infection, decrease transfusion requirements, improve functional outcome, decrease rate of burn associated major psychological stress, decrease incidence of weight loss, decrease numbers of operations and decrease hospital stay.

Key Words: *Early excision and grafting – Delayed skin grafting – Burn eschar – Primary burn surgery – Surgical management of burn.*

INTRODUCTION

Burn injury has a major local and systemic effects; it is the most complicated traumatic event, affecting multiple organs beyond the skin [4].

Deep burn is a surgical problem that soon or later will necessitates skin grafting; there are two known surgical modalities for management. In the traditional one a conservative plane is followed through frequent dressing until the separation of the eschar and the formation of granulation tissue, after which skin grafting of the of raw areas can be applied [2]. The first modality depends on the biological response to injury so consumes more time for the wound to be appropriate for the skin grafting. In this chronic process patients will be more susceptible to burn complications. In the second modality, eschar tissue is excised during the first days post burn and auto grafted simultaneously when the patient becomes stable [2].

Burn depth assessment is the most important determinant for early surgical management of burn eschar and prognosis of secondary burn deformities. Burns is classified into superficial dermal burns which heal by epithelialization with minimal scarring and deep burns requiring surgical management. Clinical evaluation is the applicable method to diagnose the depth of a burn wound although this is accurate in only 60-75% of the cases [5].

Burn surgery requires cooperation from the whole burn team, treatment of massive burns is considered a major surgery, and it should be only attempted in major tertiary hospital facilities. Even

though burn wound excision and grafting may seem as a simple and easy surgical procedure, a profound understanding of the burn pathophysiology, dynamics of wounds, critical care, and wound healing is necessary to perform successful operations. Preparation for surgery is based on three main principles: Anesthetic evaluation, preparation of patients and preparation of the operating room [6].

So in our study we aimed to compare the outcomes of early excision and skin grafting versus delayed skin grafting for patients with deep thermal burns up to 15% of the body surface area.

PATIENTS AND METHODS

This was a prospective study being performed on 30 patients with recent burn, were treated as inpatients in El-Hylmia Armed Forces Hospital Burn Unit and the Burn Unit of Assuit University Hospital from October 2016 to October 2017. The inclusions criteria were patients with average age between 10 and 30 years with thermal burn up to 15% of the body surface area, the exclusion criteria were patients with inhalation injury, electrical burn, chemical burn, radiation burn preexistent chronic illness and preexistent psychological illness.

The patients were divided into two groups; group of early surgery: 15 patients were operated using early excision of burn eschar and skin grafts that underwent surgery within 5 days of burn insult, at El-Hymia Armed Forces Hospital Burn Unit. (Fig. 1) and group of delayed surgery: 15 patients were operated using delayed skin grafts, at Burn Unit of Assuit University Hospital (Fig. 2).

Patients were followed for assessment of general status and vital signs were observed with special monitoring of daily fever chart including the occurrence of fever and its duration. Detection of the signs of local burn wound infection and nosocomial infection through clinical daily evaluations and investigatory results of WBCs count that was performed every three days. Special consideration was taken for the investigatory results that detect hypoalbuminaemia and anemia through follow-up of albumin and hemoglobin levels every three days so we calculated the of Plasma and Blood Units that were needed during the study period. After correction of general condition that was reached when hemoglobin level was above 10gm%, albumin level was above 30g/L and patient temperature chart was not raised above 38c preoperative surgical fitness consultation was done.

Dating of surgery was important to be well documented in patients follow-up sheet; in early surgery group operation was done during the first five days of burn, for delayed surgery group timing of the operation was variable according to general condition of the patients and biological progress in burn wound and formation of healthy granulation tissue.

Early surgery group patient's intraoperative assessment of deep burn eschar was challenging to avoid overestimation of burn wound percent and underestimation of burn depth. Tangential excision was performed using Watson knife and for the eschar that included the hands and the face versa jet was used, till reaching vascularized bed (Fig. 1B). In delayed surgery group reassessment of the raw area percent was mandatory, get riding of the granulation tissue and application of adrenaline soaked gauze to minimize bleeding.

Assessment of donor site availability was performed to cover the raw areas and then splinting the grafted areas that crossing the joints, dressing the donor by Vaseline soaked gauze, surgical betadine soaked gauze. Detection of the need for intraoperative blood transfusion by surgeon and anesthesiologist was estimated in units. First post-operative dressing of the graft was done at the 4th day after coverage, followed by assessment of the graft was regarding take and signs of seroma, hematoma or infection.

Assessment of function of the joints was done with the help of physiotherapist for early functional deformity and late contractures (Figs. 1D,2B,C) hospital stay was accurately calculated in days.

RESULTS

The baseline characteristics of the patients are summarized in Table (1). There was no significant difference between two study groups regarding the demographic information as well as baseline clinical characteristics. The baseline characteristics of the wounds were comparable between the study groups.

We found that the incidence of pre-operative fever was significantly higher in group of delayed surgery than group of early surgery (5.13 ± 1.36 vs. 1.2 ± 1.57 ; $p < 0.0001$) and the pre-operative WBCS count was higher in delayed surgery group than early surgery group (16.27 ± 3.63 vs. 8.33 ± 3.11 ; $p < 0.0001$).

The incidence of anemia during pre-operative time was higher in delayed surgery group than early surgery group patients (9.33 ± 1.66 vs. $11.99 \pm$

1.57: $p < 0.0001$). The incidence of hypoalbuminaemia was higher in delayed surgery group than early surgery group (27.2 ± 6.22 vs. 34.4 ± 4.24 : $p < 0.0009$). The transfusion requirements both blood and plasma were significantly higher in delayed surgery group than early surgery group (1.6 ± 1.24 vs. 0.067 ± 0.26 : $p = 0.0001$) (4.87 ± 4.19 vs. 0.33 ± 0.9 : $p = 0.0003$) respectively.

There were no significant difference between both groups regarding intraoperative blood transfusion and graft take. The functional deformity, the need of psychotherapy drugs, nosocomial infections, weight loss, the numbers of operations and hospital stay were significantly higher in delayed surgery group than early surgery group and summarized in Table (2).



Fig. (1): A male patient 15-year old with history of deep flame burn including chest: (A) Photo taken at the 3rd day post burn shows deep burn (B) Intraoperative photo shows excision of burn eschar that follows the direction of arrows (C) Post-operative photo at the 10th day after burn shows well taken graft. (D) Late post-operative photo shows good functional outcome.

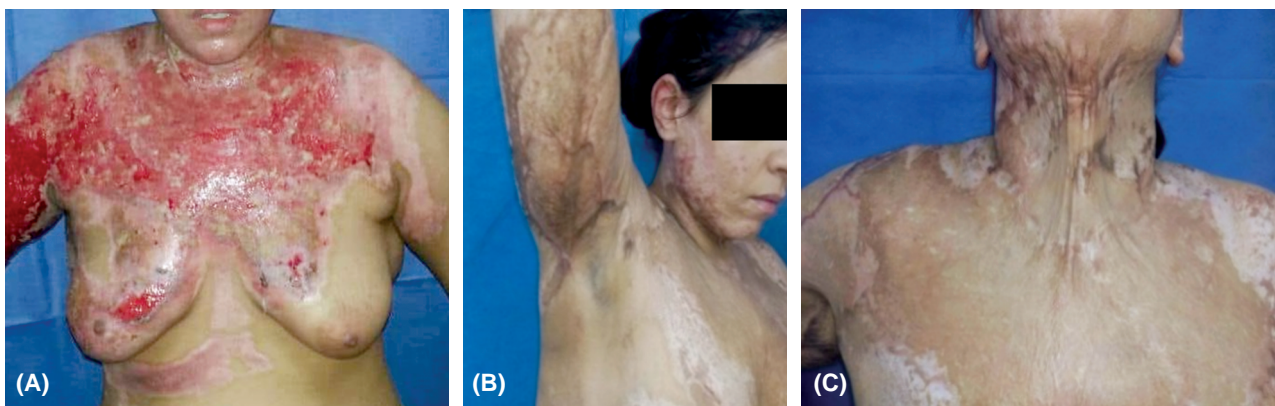


Fig. (2): A female patient 18-year old with post burn raw area: (A) Photo was taken at the 25th day of burn show clean granulation tissue that was ready for graft (B, C) Delayed post-operative photo show contracture RT axilla and neck.

Table (1): Baseline characteristics of 30 patients with burns who underwent early excision and grafting or delayed grafting. (Surgery surface area is the percent of the burn that necessitates skin graft).

	Group of early surgery (n=15)		Group of delayed surgery (n=15)	
Age in years: (Mean ± S.D)	21.47±6.85		21.53±6.65	
Sex:	No.	%	No.	%
Male	11	73.3	13	86.7
Female	4	26.7	2	13.3
Surgery surface area	5.4±2.95		7±3.87	

Table (2): One year outcomes of 30 patients who underwent early excision skin graft or delayed skin graft.

	Time point	Group of early surgery	Group of delayed surgery	p-value
Functional deformity	After 6 months	0.07±0.26	0.53±0.52	0.0048
Nosocomial infection	During the course of admission	0±0	0.27±0.46	0.00
Weight deficit	At time of discharge	0.33±1.29	4±3.68	0.0011
Number of operations	During the course of complete coverage	1.07±0.26	0.63±1.6	0.0055
Psychotherapy drugs administration	During the course of admission	0.07±0.26	1.4±0.58	<0.0001
Hospital stay in days	At time of discharge	8.4±5.23	32.87±7.84	<0.0001

DISCUSSION

For long time there was multiple limitations of early surgical management of deep burn may be due to lack of knowledge about pathophysiology of burn, role of infection and innovation of skin graft surgery wasn't well established to allow wide wound coverage. Janzekovic in the 1970s was the first to describe tangential excision of burn eschar which achieved greater acceptance with early excision [2].

Treatment of deep dermal burns includes early excision and grafting is the approach to remove necrotic and inflamed tissues and rapidly promotes physiologic wound closure. Excision of burn eschar that acts as culture for bacterial infection exposes a viable bed for skin grafting. Grafting prevents fluid loss, reduces the inflammatory and metabolic response, and protects the wound from exposure

to infectious organisms [7]. Many advantages are associated with early excision approach including: Reduction of patient hospital stay, bacterial colonization of the wound, decrease the pain that's associated with the burned portion by early grafting, promoting quicker healing of the wound and decreased hospital costs [8].

Leaving wound for the biological cascades for the burned wound is associated with prolonged hospital stays and joint contractures and hypertrophic scars due to the prolonged process of wound healing, increased hospital costs, more painful dressing changes and increased psychological stress [9].

In our study the patients all had up to 15% total body surface area burns. They were otherwise healthy, so mortality was not considered as a factor.

We observed burn wound infection timing and we used fever as clinical indicator for infection timing in both groups was ranged from (3-7) days in early surgery group 60% of patients passed to surgery without suffering pre-operative fever and 40% of patients suffered pre-operative fever ranged from (3-4) days at timing, in group of delayed surgery 100% of patients suffered pre-operative fever and ranged from (3-7) days at timing.

Pre-operative duration of fever was monitored during pre-operative time and showed significant difference between both groups, in early surgery group was ranged from (1-2) days and delayed surgery group duration ranged from (4-12) days.

For further confirmation about preoperative burn wound infection we monitored preoperative WBCs as investigatory indicator to fever, that showed significant difference between both groups with less counting to group that underwent early excision and skin grafting.

Xiao-Wu and colleagues his study was done on 157 children with acute burns he found that the incidence of significant wound bacterial or fungal contamination and invasive wound bacterial or fungal infection was decreased with early excision and grafting [10].

In our study early excision and grafting of burn wound was valuable in decreasing pre-operative fever in 60% of burned patients in comparison to delayed skin graft.

In our study there was significant difference between both groups regarding nosocomial infection that in early surgery group no cases were complicated with nosocomial infection and in

delayed surgery group 26.67% of cases were complicated with nosocomial infection.

Our result was consistent with the finding of M. Leseva et al., who worked on (5894) patients and found that early burn surgical management of burn wound was associated with decreasing incidence of nosocomial infection in burned patients [11].

In our study we found that there was significant difference between both groups regarding pre-operative hemoglobin level and in early surgery group (11.99 ± 1.57) in comparison to delayed surgery group patient (9.33 ± 1.66). Early surgery group underwent surgery before affection of general condition by burn insult, no recurrent dressing oozing, no frequent blood sample, less duration of exposure to erythroid inhibitory substances and decrease incidence of burn wound infection and nosocomial infection that share in anemia.

In our study there was significant difference between both group regarding units of blood transfusion that in early surgery group 6.67% of the cases required one unit blood transfusion in comparison to delayed surgery group 73.33% of the cases needs blood transfusion with range (1:4) units for correction of anemia.

In our study we found that intraoperative blood transfusion show no significant difference between both groups.

Khadjibayev et al., found that the blood transfusion requirements increased after 16 days, and explained his result that debridement of a granulating bed through curette of the bloody friable tissue was accompanied with more bleeding rather than debridement in a level of dry tissue as it is the case in early excision [12].

In our study we were found that there was significant difference between both groups regarding pre-operative albumin level with average level in early surgery group (34.4 ± 4.24) and delayed surgery group (27.2 ± 6.22).

The finding was consistent with joaquin Pérez et al., who found that serum albumin levels were associated with hospital stay, with greater to lesser serum albumin level found in: <21 days of LHS (length of hospital stay), 21-30 of LHS and >30 days of LHS, in that order [13].

In order to correct hypoalbuminemia frequent plasma transfusion was needed and in our study there was significant difference between both groups with less transfusion in early surgery group

average (0.33 ± 0.9) and delayed surgery group average (4.87 ± 4.19) plasma transfusion carry the same risk of the transfusion.

Regarding post-operative hemoglobin level, albumin level, plasma transfusion and blood transfusion there were no significant difference between both groups this may indicate that coverage of burn wound is the standard key for management of deep burn [12].

Regarding graft take there were no significant difference between both groups but in many other studies considered that results of graft take was better with patients underwent early excision and grafting, Saaq et al., considered that early excision and grafting showed significant result regarding graft take than that of delayed skin grafting [14].

With documented numbers of operations we found that there were significant differences between both groups with less number in early surgery group as many patients in delayed surgery group requires escharectomy for debridement of burn wound and grafting of burn raw area in stages.

In our study we found that early excision of burn wound was significantly decrease incidence of functional disability in group of early excision average (0.07 ± 0.26) and in group of delayed surgery (0.53 ± 0.52), early functional recovery may be more rapid in patients whose wounds have been successfully closed surgically because painless joint movement is facilitated, appropriate physical therapy is continued.

In our study we found that early excision and grafting decrease significantly the incidence of psychiatric disorder associated with burn this may referred to decrease of hospital stay, decrease time of pain, itching and dressing discomfort, decrease possibility of infection and associated bad odor and malaise and early functional recovery in comparison to delayed grafting patients.

In our study we found that early excision and grafting significantly decrease weight loss complication in comparison to delayed skin grafting this mainly due to cessation the release of metabolically active substances, decrease incidence and duration of infection that raising the metabolic rate and early pain free movement, Pietsch et al., reported that early excision and skin grafting in children with massive burns show fewer metabolic complications and weight loss complication, but on this study was done on patients with larger burned areas [15].

In our study we found that there was significant decrease length of hospital stay with early excision and grafting with (8.4±5.23) days in comparison to (32.87±7.84) in delayed grafting cases.

There is many other studies prefer early excision and grafting to decrease hospital stay Burke et al., found that early excision is associated with decrease length of hospital stay [16].

REFERENCES

- 1- Liu H.F., Zhang F. and Lineaweaver W.C.: History and Advancement of Burn Treatments. *Annals of Plastic Surgery*, 78 (2): S2-S8, 2017.
- 2- Janžekovic Z.: A new concept in the early excision and immediate grafting of burns. *Journal of Trauma and Acute Care Surgery*, 10 (12): 1103-8, 1970.
- 3- Rosenberg L.: Enzymatic debridement of burn wounds. *Total Burn Care*, 2: 131, 2012.
- 4- Evers L.H., Bhavsar D. and Mailänder P.: The biology of burn injury. *Experimental Dermatology*, 19 (9): 777-83, 2010.
- 5- Devgan L., Bhat S., Aylward S. and Spence R.J.: Modalities for the assessment of burn wound depth. *Journal of Burns and Wounds*, 5, 2006.
- 6- Herndon D.N. and Barret-Nerin J.: Principles and practice of burn surgery: CRC Press, 2004.
- 7- Emery N.J.: Cognitive ornithology: The evolution of avian intelligence. *Philos Trans. R. Soc. Lond B. Biol. Sci.*, 361 (1465): 23-43, 2006.
- 8- Gray D.T., Pine R.W., Harnar T.J., Marvin J.A., Engrav L.H. and Heimbach D.M.: Early surgical excision versus conventional therapy in patients with 20 to 40 percent burns: A comparative study. *The American Journal of Surgery*, 144 (1): 76-80, 1982.
- 9- Ong Y.S., Samuel M. and Song C.: Meta-analysis of early excision of burns. *Burns*, 32 (2): 145-50, 2006.
- 10- Xiao-Wu W., Herndon D.N., Spies M., Sanford A.P., Wolf SE. Effects of delayed wound excision and grafting in severely burned children. *Archives of Surgery*, 137 (9): 1049-54, 2002.
- 11- Leseva M., Arguirova M., Nashev D., Zamfirova E. and Hadzhyiski O.: Nosocomial infections in burn patients: etiology, antimicrobial resistance, means to control. *Annals of burns and fire disasters*, 26 (1): 5, 2013.
- 12- Khadjibayev A., Fayazov A., Djabriyev D. and Kamilov U.: Surgical treatment of deep burns. *Annals of burns and fire disasters*, 21 (3): 150, 2008.
- 13- Pérez-Guisado J., De Haro-Padilla J.M., Rioja L.F., DeRosier L.C. and De La Torre J.I.: Serum albumin levels in burn people are associated to the total body surface burned and the length of hospital stay but not to the initiation of the oral/enteral nutrition. *International Journal of Burns and Trauma*, 3 (3): 159, 2013.
- 14- Saaq M., Zaib S. and Ahmad S.: Early excision and grafting versus delayed excision and grafting of deep thermal burns up to 40% total body surface area: A comparison of outcome. *Annals of burns and fire disasters*, 25 (3): 143, 2012.
- 15- Pietsch J.B., Netscher D.T., Nagaraj H.S. and Groff D.B.: Early excision of major burns in children: effect on morbidity and mortality. *Journal of Pediatric Surgery*, 20 (6): 754-7, 1985.
- 16- Burke J.F., May Jr. J.W., Albright N., Quinby W. and Russell P.: Temporary skin transplantation and immunosuppression for extensive burns. *New England Journal of Medicine*, 290 (5): 269-71, 1974.