



Ultra-Early versus Early Excision and Grafting for Thermal Burns up to 60% Total Body Surface Area; A Historical Cohort Study

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► ABSTRACT

Objective: To compare the outcome of patients with up to 60% total body surface area (TBSA) thermal burns undergoing ultra-early and early excision and grafting.

Methods: This historical cohort study was performed in two referral burn centers of Shiraz during a 1-year period from 2015 to 2016. We included those patients with thermal burns up to 60% TBSA who underwent ultra-early (48-72 hours) and early (7-10 days) excision and grafting. We excluded those who were hemodynamically unstable and those with electrical burns. The outcome of patients was determined by graft success, operation duration, blood loss, hospital length of stay and mortality rate.

Results: We included a total number of 107 patients with mean age of 32.1±11.6 years. There were 65 (60.7%) men and 42 (39.3%) women among the patients. Both study groups were comparable regarding the baseline characteristics. Ultra-early excision and grafting was associated with more, higher graft success rate ($p=0.048$), lower infection rate ($p=0.037$), shorter hospital length of stay ($p=0.044$) and lower mortality rate ($p=0.027$).

Conclusion: Ultra-early excision and grafting in patients with thermal burns covering less than 60% TBSA was associated with higher graft success rate, shorter hospital length of stay, lower infection rate and lower mortality rate when compared to early surgery.

Keywords: Ultra-early; Excision; Grafting; Thermal burns; Outcome.

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Introduction

Burns are considered a common healthcare problem associated with social and economic burden. According to the Human Development Reports 2015, the burn associated mortality rate

was 57:106 and 249:291 (women:men) per 1000 in high and low/middle income countries, respectively [1]. The epidemiological studies have demonstrated that the burn associated mortality and morbidity are higher in populations with lower socioeconomic status [2,3]. In Iran, it has been reported that burns

are placed at 13th position in the list of disease burden among all the disease and injuries [4]. More recent epidemiological studies have demonstrated that burns accounts for over 163,000 (41%) of about 400,000 injury cases [5].

Surgical procedures are performed in burn patients with the aim of prevention or control of infection, debridement of the necrotic tissue, preservation of the viable tissue, wound closure, accessing the rehabilitation, minimizing the morbidity and reducing the mortality [6]. Several lines of evidence suggest that early excision and grafting defined as surgery within 14 days of the burn is associated with better outcome and fulfilling more of these aims [7-10]. However, the early excision and grafting is limited by several factors such as anemia, resuscitation, malnutrition, unstable hemodynamics and unavailability of the skin graft. According to these limitations, the early excision and grafting is not considered the standard of care. We applied and ultra-early excision and grafting (48-72 hours of injury) in burn patients according to the hypothesis that this approach would minimize the morbidity and mortality. In the current study we report the results of ultra-early and early excision and grafting in patients with thermal burns up to 60% TBSA.

Materials and Methods

Study Population

This historical cohort study was conducted during a 1-year period from March 2015 to March 2016 in Ghotbeddin and Amir Al-Momenin hospitals, both tertiary referral burns and plastic surgery healthcare centers affiliated with Shiraz University of Medical Sciences. We included all the patients with thermal burns up to 60% of TBSA undergoing ultra-early and early excision and grafting in our center during the study period. All the included patients were hemodynamically stable, had no associated comorbidities, and none had associated injury such as trauma. We included patients with ASA I and II classes. Hemodynamically unstable patients, those with associated injuries, patients with chronic illness, those with facial burns, electrical, chemical, radiation and respiratory burns and those with impaired laboratory findings were excluded from the study. The study protocol was approved by the institutional review board (IRB) and medical ethics committee of Shiraz University of Medical Sciences. As this was retrospective analysis of the patients' information, no informed written consents were required.

Study Protocol

The medical charts of the included patients were reviewed for demographic information (age, gender), thermal burn characteristics (mechanism of injury, total surface body area, burn grade), intraoperative variables (duration, blood loss) and outcome

(hospital length of stay, mortality). Ultra-early excision and skin autografting was performed 48-72 hours of injury while early excision and grafting was performed between 7-10 days of injury. At the time of surgery, a power dermatome was used to perform thorough surgical excision of all devitalized tissue and tissue specimens were collected for cultures. Split thickness skin grafts were harvested from unaffected areas, especially the lower limbs and abdomen. All excised wounds were reconstructed with intermediate thickness (0.012-0.015 inch). The skin grafts were applied on the wound beds and secured in place with staples. The skin grafts were covered with non-adherent Sofratulles and bulky absorbent dressings. Dressings were maintained until the 5th postoperative day in early excision and grafting group while it was opened at 3rd postoperative day in ultra-early excision and grafting group. In order to avoid the development of shearing forces on the grafted wounds, patients were kept on strict bed rest. On day 5, the dressings were removed and the wounds were inspected macroscopically to establish the graft take pattern. Graft take was measured as the percentage of grafted surface area where the graft had taken in relation to the burn wound bed.

Statistical Analysis

All the statistical analyses were performed by the statistical package for social sciences (SPSS Inc., Chicago, Illinois, USA) version 16.0. Data are presented as mean±SD and proportions as appropriate. Parametric data with normal distribution was compared between groups using independent t-test while those without normal distribution was compared using Mann Whitney U-test. Proportions were compared using chi-square test. A 2-sided *p*-value of less than 0.05 was considered statistically significant.

Results

Overall we included a total number of 107 patients with thermal burns up to 60% TBSA who underwent ultra-early and early excision and grafting in our center during the study period. The mean age of the patients was 32.1±11.6 (ranging from 3 to 76) years. There were 65 (60.7%) men and 42 (39.3%) women among the patients. Most of the patients had deep second degree burn (59.8%) and the mean percentage of TBSA burned was 36.9±5.8 (ranging from 12 to 60) percent. The baseline characteristics of the patients in two study groups are summarized in Table 1. There was no significant difference between two study groups regarding the baseline characteristics.

The operation duration was comparable between two study groups (Table 2). Those who underwent ultra-early excision and grafting had significantly higher graft success rate when compared to early grafting group (*p*=0.048). The infection rate was

Table 1. Baseline characteristics of 107 patients with thermal burns up to 60% total body surface area included in the current study.

	Ultra-early group (n=56)	Early group (n=51)	p value
Age (years)	32.3±10.6	31.8±9.6	0.188
Sex			
Men (%)	33 (58.9%)	32 (62.8%)	0.215
Women (%)	23 (41.1%)	19 (37.2%)	
Burn depth			
2 nd degree (%)	32 (57.2%)	32 (62.8%)	0.093
3 rd degree (%)	24 (42.8%)	19 (37.2%)	
Percentage TBSA^a burned	36.7±8.4	37.2±7.2	0.179
Percentage TBSA grafted	15.8±6.7	17.1±4.9	0.075

^aTBSA: Total body surface area

Table 2. Intraoperative characteristics and outcome of 107 patients with thermal burns up to 60% total body surface area undergoing ultra-early or early excision and grafting.

	Ultra-early group (n=56)	Early group (n=51)	p value
Intraoperative bleeding (mL)	386.7±75.6	353.4±66.7	0.177
Operation duration (min)	46.8±10.3	50.7±11.4	0.098
Graft success rate (%)	91.5±3.1	85.3±2.8	0.048
Infection (%)	7 (12.5%)	10 (19.6%)	0.037
Hospital length of stay (days)	14.3±2.8	19.1±3.8	0.044
ICU length of stay (days)	8.4±5.4	9.6±4.1	0.062
Mortality rate (%)	1 (1.78%)	4 (7.84%)	0.027

TBSA: Total body surface area

significantly lower in ultra-early group ($p=0.037$) while the hospital length of stay was significantly shorter in ultra-early group ($p=0.044$). Ultra-early excision and grafting was associated with lower mortality rate ($p=0.027$) when compared to early excision and grafting. The study outcomes are summarized in Table 2.

Discussion

The concept of the current study was obtained by the fact that early surgery is associated with lower rate of infection and faster recovery in thermal burns covering less than 50-60% of TBSA [7,9,11,12]. Early excision and grafting is defined as performing the operation within 14 days of the injury. We postulated that ultra-early (48-72 hours) excision and grafting would be associated with better outcome compared to early procedure (7-10 days) as it would provide body surface coverage in early phase and thus avoid further complications and shorten hospital length of stay. The results of the current study clearly demonstrated that ultra-early excision and grafting in thermal burns covering less than 60% TBSA is associated with higher graft success rate, lower infections rate, shorter hospital length of stay and lower mortality rate compared to early surgery. The only disadvantage was the larger amount of intraoperative bleeding. This point should be taken into consideration that this surgical timing needs precise patient selection. Only hemodynamically stable patients who have been successfully resuscitated could tolerate the ultra-early procedure.

To the best of our knowledge, this is the first report of ultra-early excision and grafting in the literature. However, some authors have pointed out the beneficial effects of ultra-early surgery in burn patients [7,9,10]. Technically, early excision and grafting decreases bacteremia and inflammatory mediators (by early removal of the burned skin and simultaneous wound coverage), thus decreasing the chances of sepsis and multi-organ failure and death as indicated by some studies [13,14]. Recently Ayaz *et al.*, [7] compared early excision and delayed grafting closure in 54 patients with less than 15% TBSA burns. They found that the graft success rate was significantly higher in those who underwent early excision and grafting when compared to delayed grafting group (96.88% vs. 92.88%; $p=0.033$). However, the length of hospital stay, itching and scar scores were comparable between two study groups after 6 months of follow-up [7]. Puri *et al.*, [9] also demonstrated that early excision and grafting (within 5 days of injury) was associated with more intraoperative bleeding and lower graft success rate compared to delayed grafting (after 3 weeks of injury).

They also found that early excision and grafting decreases the hospital stay [9].

We found that ultra-early surgery is associated with higher graft success rate contrary to their findings. Intraoperative blood loss, however, was higher in both studies in those undergoing early excision and grafting [7,9]. Blood loss is an important disadvantage of tangential skin grafting [15,16]. Several strategies have been applied in

order to minimize the intraoperative blood loss and subsequent complications such as hypothermia [17]. These techniques include subcutaneous infiltration of vasoconstrictive agents, tourniquets, aerosolized delivery of fibrinogen thrombin sprays, and others have been shown to decrease blood loss [18,19]. In our center, we use diluted epinephrine solution (1:10,000) in both donor and recipient sites to minimize the amount of intraoperative bleeding.

Early excision of the burn eschar has been termed as one of the most significant advances in modern burn care [20]. Delayed wound closure leads to extensive wound colonization with increased likelihood of burn wound sepsis, multi-organ failure, and death [21,22]. We found that those undergoing ultra-early excision and grafting had significantly lower rates of infections compared to early surgery. This is contrary to the results of Puri *et al.*, [9] who found comparable infection rates between early and late groups. Our results are however, in line with some previous reports regarding the infection rate [7,10]. One of the other advantages of this method is early removal of the dressing which decreases the rate of infection and increases the graft success rate. In early method we remove the dressing in 5 days while it can be removed in 3 days when using ultra-early

excision and grafting. this also decreases the hospital length of stay.

We note some limitations to our study. First, this was retrospective study dealing with patients' medical charts. This might lead to selection bias. Future randomized clinical trials are required to shed light on the issue. Second, we included limited number of patients. That was because our retrospective review and our restricted inclusion and exclusion criteria limited the number of patients. Larger prospective studies are currently underway. And finally we did not take into consideration some factors such as anemia which may serve as a confounder. To the best of our knowledge, this is among the few studies addressing the role of very early excision and grafting in management of patients with thermal burns.

In conclusion, ultra-early excision and grafting in patients with thermal burns covering less than 60% TBSA was associated with higher graft success rate, shorter hospital length of stay, lower infection rate and lower mortality rate when compared to early surgery. Further prospective studies are required to support these facts.

Conflict of Interest: None declared.

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