Rational Surgical Methods of Deep Burns Treatment in Older Patients

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ABSTRACT

OBJECTIVES: We describe our experience with surgical treatment of elderly (aged >60 years) patients with deep burns. Available data have indicated that the best results can be achieved with a single-stage autologous skin grafting to close all wounds in one step for limited deep burns. For extensive burns, the best results are achieved with delayed autologous skin grafting performed in 1 to 2 stages. Use of early surgical intervention methods for deep burns in elderly patients substantially reduces the recovery time of skin integrity, the frequency of burn disease complications, and mortality.

MATERIALS AND METHODS: We examined the results of comprehensive treatment of 69 patients seen in the combustiology department of the Samarkand City Medical Association from 2019 to 2023. Inclusion criteria included presence of deep burns of III-B to IV degree and age 60 years or older. All 69 patients had a Baux index exceeding 60 units.

RESULTS: Elderly patients who received surgical debridement followed by autodermoplasty for treatment of deep burns had average skin recovery period after injury of 30.6 ± 2.0 days. Rate of autodermotransplant graft lysis among patients was 20.3%. Better outcomes were achieved with simultaneous autodermoplasty than with delayed autodermoplasty (11.8% vs 23.1%). The average postoperative mortality rate among patients with thermal injuries was 8.7%; mortality was 6.9% in patients with a Baux index of 60 to 80 but reached 11.1% in patients with more severe trauma.

CONCLUSIONS: The application of surgical debridement methods in elderly patients significantly reduced the recovery time of skin surface, frequency of burn disease complications, and mortality rates. Simultaneous autodermoplasty with closure of all wounds in one stage is effective for limited deep burns. Delayed autodermoplasty performed in 1 to 2 stages can yield better outcomes for elderly patients with extensive burns.

KEY WORDS: *Autologous skin grafting, Autologous skin transplant, Surgical necrectomy, Wound defect closure*

INTRODUCTION

The number of people aged 60 years and older, including those over aged 80 years, continues to increase. Older people and young children are both high-risk groups for thermal injury.[1-3]

The severity of injuries in older patients (aged >60 years) is determined not only by the area and depth of burn wounds but also by comorbidities and age-related degeneration of all organs and systems.[4,5,6] Burn injuries typically exacerbate existing chronic diseases, which can substantially worsen patient conditions and can lead to complications, thereby deteriorating treatment outcomes.[7-9]

In patients older than 60 years, the use of active surgical treatment methods is limited.[10,11] The main limiting factors are the high risk of surgical intervention and the presence of severe comorbid conditions.

MATERIALS AND METHODS

We investigated clinical results and treatment of 69 older patients seen in the combustiology department of the Samarkand City Medical Association from 2019 to 2023. Inclusion criteria included age 60 years and older and

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presence of deep burns of III-B to IV degree. All 69 patients had a Baux index (BI) that exceeded 60 units.

We divided patients into 3 groups based on the clinical course and severity of thermal injury. The first group comprised 29 patients (42.1%) with a BI of 61 to 80 units, indicating a relatively favorable prognosis. The second group included 27 patients (39.1%) with a BI of 81 to 100 units, indicating unclear prognosis. The third group consisted of 13 patients (18.8%) with an unfavorable prognosis (BI >100 units). The average BI was 85.14 ± 15.97 units.

The study group included 39 men (56.9%) and 30 women (43.1%). Among total patients, 48.6% had sustained thermal injuries from flames. Thermal injuries from hot liquids also constituted a large etiological share in this age group, accounting for 39.4%. Other less frequent etiologies were contact burns (5.5%), burns from hot oil (3.7%), and electrothermal injuries (2.8%).

The total burn area in patients ranged from 0.5% to 70% of body surface, with an average of 16.7 ± 13.1%. All burn degrees were considered in the total assessment area (I, II, III-A, B, and IV degrees). Only 21 patients (30.4%) had limited burns of less than 10% of total body surface area. Thirteen patients (18.8%) had extensive burns covering more than one-third of total body surface area.

Among patients with smaller areas of deep burns (up to 3% and 7% of total body surface area), scalds from hot water were the most common etiology (55% and 50%, respectively). In contrast, among patients with more extensive burns, flames were the primary etiological factor. Deep contact burns did not exceed 6% of body surface area, and deep electrical burns reached up to 9% of body surface area.

Many older patients have 1 or more comorbidity. In our study, we only accounted for clinically significant diseases that could affect patient outcomes and treatment strategies. Overall, serious comorbidities were noted in 51 patients (73.9%). As expected, cardiovascular diseases were the most frequent: 56% of patients examined had ischemic heart disease and 20.2% had arterial hypertension, corresponding to average rates for this age group. Circulatory disorders included cases of acute cerebrovascular accidents in medical history (21.1%) and the consequences of chronic cerebrovascular insufficiency (1.8%). In addition, 14.7% of older burn patients had respiratory diseases, 22.9% had diabetes mellitus, and 20.2% had digestive diseases. Isolated comorbidities included chronic alcoholism (2.8%), kidney diseases (0.9%), and malignant neoplasms (0.9%).

Treatment in our patients included surgical debridement. Based on the timing, we classified surgical debridement as early or delayed among our patients. Early surgical debridement was performed in the first week after the thermal injury, provided there were no inflammatory processes in the wound area. Delayed surgical debridement was performed between 8 and 42 days after the injury.

RESULTS AND DISCUSSION

In our study group, an approximately equal number of older men and women had thermal injuries, which may seem somewhat surprising at first glance. It is well known that almost all types of injuries, including burns, occur more frequently in men. However, we found no correlation between sex and the frequency of thermal injuries among our older patients.

Patients received early surgical debridement at a mean of 6.1 ± 0.2 days. Patients received delayed surgical debridement at a mean of 9.7 ± 0.7 days. Twenty-two patients (31.9%) had early surgical debridement, and 47 patients (68.1%) had delayed surgical debridement. In 18 patients (26.1%), surgical debridement was performed more than 14 days after injury for the following reasons: (1) need for prolonged preoperative preparation due to the severe general condition of the patient, (2) deepening of III-A degree burns, and (3) late hospital admission (9-40 days postinjury).

In patients with extremely severe thermal injury, with a BI exceeding 100 units, general and local conditions allowed for early surgical debridement in only 2 cases. Among those with less severe thermal injuries, with a BI of 81 to 100 units, early surgical debridement was performed in 22.2% of patients. Conversely, for elderly patients with a BI ranging from 60 to 80 units, we were able to utilize the benefits of so-called active surgical tactics (early debridement) in approximately half of the cases (48.3%).

The average area of necrotic tissue removal during necrectomy was 11.7 ± 0.7% of total body surface area, which did not differ between patients with early versus delayed surgical debridement (12.1 ± 0.5% vs 10.8 ± 1.2% body surface area, respectively). However, among burn patients with a BI exceeding 80 units, we had to remove necrotic tissues over a larger area (Table 1).

After fascial necrectomy, patients received simultaneous autodermoplasty. In our study, 17 patients (24.6%) received simultaneous autodermoplasty. Perforated skin grafts were used in all cases. In general, patients with limited deep burns had favorable conditions for simultaneous autodermoplasty. Delayed autodermoplasty was performed in 52 patients (75.4%) within 1 to 10 days after surgical necrectomy (average of 4.1 ± 1.9 days later).

The possibility of simultaneous radical excision of necrotic tissues and, consequently, performing simultaneous

autodermoplasty was not dependent on the timing of debridement. Simultaneous autodermoplasty was achieved in 36.4% of patients with early and in 19.1% of patients with delayed surgical debridement ($\chi^2 = 0.122$). Typically, patients predominantly had limited deep burns, with burn area of IIIb-IV degree exceeding 7% of body surface in only 2 patients (2.9%) undergoing simultaneous autodermoplasty.

Delayed autodermoplasty after early surgical debridement was performed in 14 patients (63.6%) on average 2.9 days later. In 1 patient, autodermoplasty was delayed for 32 days because of medical reasons (severe prolonged pneumonia, sequelae of a previous stroke). In addition, in 2 patients with delayed surgical debridement, autodermoplasty was delayed by 2 weeks (17 and 22 days) after necrotic tissue excision because of development of secondary necrosis and sluggish wound healing in the context of diabetes mellitus.

On average, timing of autodermoplasty after injury in patients undergoing surgical necrectomy was at 13.4 ± 0.9 days (Table 2). Depending on the type of debridement (early or delayed), closure times with skin grafts differed approximately 2-fold, with respective averages of 8.4 ± 0.5 and 16.1 ± 1.2 days ($P < .001$). Although these figures are somewhat conditional, considering both simultaneous and delayed autodermoplasty, they unequivocally highlight the advantages of early necrectomy in reducing the recovery time of skin coverage.

The timing of autodermoplasty did not significantly differ among patients with varying severity of thermal injury. For example, the difference between patients with BI within 60 to 80 units and those with BI over 80 units in terms of this indicator was 1 to 2 days ($P > .05$).

Overall, among burn patients with similar severity of thermal injury, difference in timing of wound closure with autodermotransplant can reach up to 15 days. The choice of timing for surgical debridement and subsequent autodermoplasty was determined by factors such as the patient's admission time to the hospital, their condition, and presence of comorbidities and complications. For example, in patients with BI over 80 units undergoing primary surgical debridement with simultaneous autodermoplasty, wounds closed with transplants in 6.3 ± 0.2 days; however, in patients with delayed surgical debridement and subsequent autodermoplasty, closure occurred in 17.0 ± 0.8 days (Table 3). Similar operations were conducted within these timeframes for patients with BI over 100 units.

Autodermoplasty was performed on average over an area of 9.8 ± 0.2% of total body surface area (Table 4). Average area of autodermoplasty did not significantly differ between the early and delayed surgical debridement groups. In all cases, efforts were made to maximize coverage of deep skin defects with autografts, resulting in significant differences in autodermoplasty area among subgroups with different

TABLE 1. Average Area of Necrectomy During Early and Delayed Surgical Debridement in Older Burn Patients (Aged >60 Years) With Different Severity of Thermal Injury

Group	Area of Necrectomy, % body surface area		
	ESD (n = 22)	DSD (n = 47)	Average (n = 69)
Baux index 60-80 units (n = 29)	7.3 ± 0.6	7.1 ± 0.7	7.2 ± 0.5
Baux index >81-100 units (n = 27)	13.0 ± 0.7	12.6 ± 2.4	12.9 ± 1.5
Baux index >100 units (n = 13)	15.1 ± 0.8	14.2 ± 2.2	14.7 ± 1.4
Total patients (n = 69)	12.1 ± 0.5	10.8 ± 1.2	11.7 ± 0.7

Abbreviations: DSD, delayed surgical debridement; ESD, early surgical debridement

TABLE 2. Average Timing of Autodermoplasty After Injury With Primary and Delayed Surgical Debridement in Older Burn Patients (Aged >60 Years)

Group	ADP Timing, days		
	ESD (n = 22)	DSD (n = 47)	Average
Baux index 60-80 units (n = 29)	7.7 ± 1.4	15.7 ± 0.9	12.9 ± 1.1
Baux index >81-100 units (n = 27)	9.8 ± 1.6	15.5 ± 1.5	13.7 ± 1.8
Baux index >100 units (n = 13)	10.2 ± 2.3	17.9 ± 1.3	15.5 ± 1.7
Total patients (n = 69)	8.4 ± 0.5	16.1 ± 1.2	13.4 ± 0.9

Abbreviations: ADP, autodermoplasty; DSD, delayed surgical debridement; ESD, early surgical debridement

severity of thermal injury. According to the extent of debridement, autodermoplasty was performed on different areas in patients with BI of 60 to 80 units and in those with BI over 100 units, covering areas of 7.6 ± 0.5% and 12.6 ± 1.3% of total body surface area, respectively.

Among our patients, autodermoplasty was used to close all deep defects in 1 stage for 53 patients (76.8%) and in 2 stages for 16 patients (23.2%). In patients who underwent early surgical debridement (n = 22), 31 autodermoplasty procedures were performed: a single successful procedure for 16 patients, 2-stage procedures for 3 patients, repeated procedures due to graft lysis for 4 patients, and 3 procedures in 1 patient (2-stage autodermoplasty followed by repeat autograft due to graft lysis).

Among burn patients with delayed surgical debridement (n = 47), 51 autodermoplasty procedures were performed: a single successful procedure for 34 patients, 2-stage autografts for 4 patients, and repeat operations because of graft lysis after a single procedure (n = 3) or after a 2-stage procedure (n = 1).

The average time for skin recovery after trauma with surgical necrectomy averaged 30.6 ± 2.0 days, with 28.4 ± 1.7 days for early surgical debridement group and 32.2 ± 1.6 days for delayed surgical debridement group (average difference of 4 days; $P < .05$). These indicators also significantly differed between groups of patients with BI less than 80 and BI more than 100.

Longer skin recovery times in patients with extensive and deep burns were because of both staged autodermoplasty and local complications, as well as epithelialization rates of IIIA degree burns, which healed within 21 to 28 days. In patients with early surgical debridement with simultaneous autodermoplasty, the average skin recovery time was 19.6 ± 1.9 days, allowing for a reduction in treatment duration by 3 to 8 days compared with the results shown in the delayed surgical debridement group.

Complications were noted in 9 of 69 patients (13.0%), with pneumonia observed in all cases of complications. Frequencies of other complications ranged from 1.4% to 4.3%. A nearly 2-fold increase in complication rates was observed in patients with more severe thermal trauma (BI > 100 units), which was expected. However, no significant difference in complication rates was found between the early and delayed surgical debridement groups. It is noteworthy that none of the 8 patients with limited (<10% body surface) deep burns who underwent early surgical debridement with simultaneous autodermoplasty experienced burn disease complications.

Six of 69 patients (8.7%) in our study had fatal outcomes after surgical necrectomy. Pneumonia was the immediate cause of death in 3 patients. In 1 patient, acute heart failure as a result of acute myocardial infarction was the immediate cause of death, and pulmonary embolism was the cause of death in 2 patients. Thus, early surgical necrectomy,

TABLE 3. Average Timing of Immediate and Delayed Autodermoplasty After Trauma in Older Burn Patients (Aged >60 Years)

Group	ADP Timing, days			
	ESD (n = 22)		DSD (n=47)	
	Simultaneous ADP (n = 8)	Delayed ADP (n = 14)	Simultaneous ADP (n = 9)	Delayed ADP (n = 38)
Baux index 60-80 units (n = 29)	5.5 ± 1.6	10.1 ± 2.0	10.9 ± 1.7	20.2 ± 0.6
Baux index >81-100 units (n = 27)	6.3 ± 1.2	11.0 ± 1.4	15.6 ± 1.5	17.0 ± 0.8
Baux index >100 units (n = 13)	6.9 ± 1.7	12.2 ± 1.5	15.0 ± 1.9	17.3 ± 2.1

Abbreviations: ADP, autodermoplasty; DSD, delayed surgical debridement; ESD, early surgical debridement

TABLE 4. Average Area of Autodermoplasty During Debridement in Older Burn Patients (Aged >60 Years)

Group	ADP Area,* % body surface area		
	ESD, n=22	DSD, n=47	Total
Baux index 60-80 units (n = 29)	6.7 ± 0.9	7.9 ± 0.7	7.6 ± 0.5
Baux index >81-100 units (n = 27)	13.2 ± 1.6	11.7 ± 0.9	12.8 ± 0.8
Baux index >100 units (n = 13)	14.3 ± 2.6	12.4 ± 1.1	12.6 ± 1.3
Total patients (n = 69)	9.8 ± 0.4	9.9 ± 0.3	9.8 ± 0.2

Abbreviations: ADP, autodermoplasty; DSD, delayed surgical debridement; ESD, early surgical debridement

*If staged ADP was performed, the area of the first stage was taken into account.

TABLE 5. Autodermotransplant Graft Lysis in Older Burn Patients (Aged >60 Years)

Group	No. (%)			
	Lysis <10%	Lysis 10% to 50%	Lysis >50%	Total
Baux index 60-80 units (n = 29)	2 (6.9)	2 (6.9)		4 (13.8)
Baux index >81-100 units (n = 27)	3 (11.1)	2 (7.4)	1 (3.7)	6 (22.2)
Baux index >100 units (n = 13)	2 (15.4)	1 (7.7)	1 (7.7)	4 (30.8)
Total patients (n = 69)	7 (10.1)	5 (7.2)	2 (2.9)	14 (20.3)

in contrast to concerns among some specialists, did not significantly worsen mortality rates in our older patients.

Graft lysis in older patients with burn injuries occurred in 14 patients (20.3%) who underwent surgical necrectomy with subsequent autodermoplasty. In groups with different levels of severity of thermal trauma, the frequency of graft lysis varied from 13.8% (BI of 60-80 units) to 30.8% (BI of >100 units). However, among our 69 patients, differences were not significant ($P > .05$) (Table 5). The fact that this complication occurred in 30.8% of patients with severe thermal trauma (BI > 100 units) was likely because of the patient's severe condition and use of a higher perforation ratio of flaps (1:4, 1:6).

Two patients (2.9% of all lysis cases) had total and subtotal graft lysis rejection. Partial rejection (up to 50%) of the transplanted autologous skin was more frequent and observed in 12 patients (17.3% of all lysis cases).

During simultaneous autodermoplasty, where skin grafts were placed on the excised burn wound, the frequency of graft lysis was 11.8% (2 of 17 autodermoplasty procedures). However, with delayed grafting onto granulating wounds, this rate doubled to 23.1% (12 of 52 cases).

In older patients, after early surgical debridement, of 22 autodermoplasty cases, only 3 episodes of graft lysis were recorded (13.6%). Interestingly, this complication was slightly more frequent in patients with delayed autodermoplasty compared with those with simultaneous grafting (21.4% vs 12.5%). After delayed surgical debridement, 10 cases of graft lysis were observed among 47 patients (21.3%). Notably, patients undergoing simultaneous autodermoplasty had better outcomes, experiencing graft lysis more than twice as rarely as those with delayed skin grafting (11.1% vs 23.7%). Comparison of graft lysis rates between early and delayed surgical debridement (18.2% and 21.3%, respectively) did not reveal a significant difference.

When surgical debridement was followed by autodermoplasty for treatment of deep burns in older patients, the average skin recovery period after injury was 30.6 ± 2.0 days. The average frequency of autodermotransplant graft lysis was 20.3%. Notably, better outcomes were achieved with simultaneous autodermoplasty compared with delayed autodermoplasty (11.8% vs 23.1%). Complications were noted in 9 of 69 patients (13.0%), all of whom developed pneumonia. The average postoperative mortality rate among patients with thermal injuries was 8.7%, with mortality not exceeding 6.9% in patients with a BI of 60 to 80 units, but reaching 11.1% in patients with more severe trauma.

CONCLUSIONS

The application of surgical debridement methods in older patients significantly reduced the recovery time of skin surface, reduced the frequency of burn disease complications, and reduced mortality rates. The rational application of early surgical treatment methods in older patients should be conducted after appropriate preoperative preparations and stabilization of conditions are made. Simultaneous autodermoplasty with closure of all wounds in a single stage is effective for limited deep burns. Delayed autodermoplasty performed in 1 to 2 stages yielded good outcomes for extensive burns in older patients.

REFERENCES

1. Alekseev AA, Bobrovnikov AE. Analysis of the results of implementing innovative treatment technologies for burn patients in clinical practice. *Combustiology. Elektronnyj nauchno-prakticheskij zhurnal.* 2019;63-64.
2. Farinas AF, Bamba R, Pollins AC, Cardwell NL, Nanney LB, Thayer WP. Burn wounds in the young versus the aged patient display differential immunological responses. *Burns*. 2018;44(6):1475-1481. doi:10.1016/j.burns.2018.05.012
3. Church S, Rogers E, Rockwood K, Theou O. A scoping review of the Clinical Frailty Scale. *BMC Geriatr.* 2020;20(1):393. doi:10.1186/s12877-020-01801-7
4. Khadzhibaev AM, Fayazov AD, Sultanov BK. Early surgical debridement effectiveness in elderly patients. *Skoraya medicinskaya pomoshch*'. 2006;7(3):162-163.
5. Maxwell D, Rhee P, Drake M, Hodge J, Ingram W, Williams R. Development of the Burn Frailty Index: a prognostication index for elderly patients sustaining burn injuries. *Am J Surg.* 2019;218(1):87-94. doi:10.1016/j.amjsurg.2018.11.012
6. Jeschke MG, Shahrokhi S, Finnerty CC, Branski LK, Dibildox M; ABA Organization & Delivery of Burn Care Committee. Wound coverage technologies in burn care: established techniques. *J Burn Care Res.* 2018;39(3):313-318. doi:10.1097/BCR.0b013e3182920d29

7. Malahov SF. Main directions in the use of modern wound dressings for the treatment of extensive deep burns. *Voprosy nauki i obrazovaniya*. 2017;7(8):83-85.
8. Fayazov AD, Azhiniyazov RS. Features of burn disease progression in elderly patients. *Skoraya medicinskaya pomoshch'*. 2020;21(3):54-57.
9. Romanowski K, Curtis E, Barsun A, Palmieri T, Greenhalgh D, Sen S. The frailty tipping point: determining which patients are targets for intervention in a burn population. *Burns.* 2019;45(5):1051-1056. doi:10.1016/j.burns.2018.11.003
10. Atyasova ML. Features of treating deep burns in the elderly. *Current Issues in Surgery, Traumatology, and Intensive Care: Proceedings of the Regional Scientific and Practical Conference.* Saransk. 2011;149-151.
11. Thompson A, Gida S, Nassif Y, Hope C, Brooks A. The impact of frailty on trauma outcomes using the Clinical Frailty Scale. *Eur J Trauma Emerg Surg.* 2022;48(2):1271-1276. doi:10.1007/s00068-021-01627-x