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Surgical Management of Thermal Injury: Narrative Review

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Abstract

Extensive burn care advanced over the past few decades to the point where burn victims can now often live. The goal of treating a severely burned patient nowadays is to help them return to their communities, families, and places of employment as fully participating members of society, rather than only preserving their life and ability to function. Burns are a common and difficult critical care issue. Specialized hospitals prioritize achieving optimal functional recovery, infection prevention, and patient stabilization. Over the past few decades, researches on burns have attracted a lot of attention. A number of significant discoveries have improved patient stability and reduced mortality, particularly in the case of younger patients and those with intermediate-degree burns. The presence of dead tissue over a burn wound hinders the healing process and serves as a breeding ground for bacteria. Consequently, clearing the eschar as soon as possible and getting a clean wound bed as soon as possible, can be regarded as the main objective to initiate the process of wound healing, either through autografting or spontaneous epithelization. This review article provides a comprehensive overview of the surgical management of thermal injuries. The article also discusses the importance of early surgical intervention, including debridement, skin grafting, and other surgical techniques. Additionally, it explores the latest advancements in surgical management and the potential future directions in this field. Overall, this review aims to provide a valuable

CC License CC-BY-NC-SA 4.0	resource for healthcare professionals involved in the care of patients with thermal injuries. ***Keywords: burn, thermal burn, thermal injury, surgery for burns***

Introduction:

Burns are among the most common ailments that individuals present to the emergency. While there is a significant risk of morbidity and death with burns, particularly large ones, individuals with extensive burns need to have their airway, breathing, and circulation aggressively managed. The emphasis has been on intensive fluid resuscitation and early endotracheal intubation of patients with actual or imminent airway impairment; nevertheless, it seems that the pendulum may have swung a little too far in the extreme direction [1]. Stabilization of breathing and airway, intravenous fluid administration, pain management, and local wound care are priorities in emergency resuscitation. Pregnant women and children are examples of special groups that need for extra concern in treatment. For some individuals, a referral to expert burn care is required in order to enhance long-term results [2].

Most people consider burns to be injuries to the skin brought on by extreme heat. In a broader sense, burns are the outcome of severe injuries to the skin or other tissues, usually brought on by heat or other brief exposures. Burns happen when heat, electrical discharge, friction, chemicals, or radiation kill part or all of the cells in the skin or other tissues [3]. Hand burns occur at a disproportionate rate in relation to their distribution over the body's surface area, It frequently affects young people who are primarily male and are victims of accidents that happen at home or at work, Functional outcome is therefore crucial for ensuring future productivity, According to estimates, functional loss of the hands accounts for 57% of total loss of function of individual [4].

Inhalation injury is an independent risk factor in burn mortality, increases the chance of dying by 20%. About 500,000 Americans suffer from acute heat injuries that need medical attention every year, accounting for 40,000 hospital admissions and 3,275 fatalities. It is calculated that concurrent inhalation injuries account for 10–20% of inpatient burn admissions in the united state. A multidisciplinary strategy including burn units, trauma teams, anesthesiologists, pulmonologists, and otolaryngologists is necessary for the acute therapy of thermal airway injury, these cooperative efforts have resulted in notable advancements in the outcome over[5]Thermal inhalation injuries account for more than 5% of patients hospitalized to a burn intensive care unit, and they are closely linked to death. While survival is still a crucial criterion, notable developments in the treatment of thermal injury have made functional results following a burn a more pertinent performance indicator. There is still a vacuum in our understanding of burn recovery and survivability regarding the functional impact of thermal inhalation injury on the airway [6].

In early surgical burn management, increasing use of primary or delayed skin grafting aids in the prompt restoration of skin integrity, lower risk of major complications, and improved emotional condition of the patients. lowering the patient's treatment's financial burden [7]. One of surgical technique was the application of tangential excision and grafting. In order to expose healthy tissue, tiny layers of burned skin must be excised one after the other. The wound must then be closed with a skin transplant [8].

A study done in Saudi Arabia from January 2018 to June 2018 on 166 participants, in order to create a standard proposal questionnaire was used to discuss skin burns. Age, gender, qualification, site of damage, length of time from injury, afflicted areas, percentage of body surface area burned, this study resulted, among Saudi Arabia, skin burns are widespread and more common among women)80%(but male only)20%(. The majority of skin burns happen at home (88%) and hot water is the main cause (96%), especially on hands (82%), most common reasons of thermal injury is scald and flame injury (46.4), thermal injury most common in age of 24-25 years old, The majority of patients were burned in a rage of 0-10% total body surface area (TBSA) which is about (62.0%), a total of 16 participants who received early excision and grafting were satisfied, whereas 10 participants who received delayed excision and grafting were not. Only a small percentage of burns require skin grafting; the majority are treated with topical treatments. The Saudi populace is comparatively more accepting of the results of skin burn treatments. The current study may assist medical professionals in evaluating burn victims' dermatological quality of life in order to deliver far better patient care [9].

A study conducted in UK in 2008 stated that certain referral criteria to take into account not just the anatomical location and TBSA of burned tissue, but also the etiology, comorbidities, and skill set of the referring facility, have been defined in the UK. This has been made possible in large part by telemedicine, which may also be useful in the follow-up care of burn victims. early excision reduces mortality, morbidity, hospital stay duration, time missed from work, and expense by removing dead and devitalized tissue, Future developments in the

management of inhalational injuries are necessary to minimize the burden of scarring, secure earlier definitive, higher-quality skin cover [10].

Types of Surgical Management of Thermal Injury:

A) Escharotomy: Tissue edema that developed during the acute phase of burn resuscitation in the first 48 hours following injury exacerbates the increasing interstitial pressures experienced by the tissues within any body structure that the burn eschar has circumferentially surrounded especially the fingers, extremities, abdomen, chest, or neck. An initial reduction in venous outflow is observed as the interstitial pressure rises, which is followed by a decrease in arterial inflow. Within hours, this state will frequently result in malfunction, ischemia, or necrosis within or distal to that body structure. Nerve and muscle loss in the limbs might result in a permanent functional disability or even necessitate amputation. The constricting tissue is released during an escharotomy, enabling the organs and tissues of the body to continue functioning normally and having normal perfusion [11]. It's technique, regarding the location of the incisions, eschar is split into two categories: those that are made in mid-medial or mid-lateral lines along the limb's long axis, through the dermis, or down to deep fascia. Care must be taken to prevent harm to any significant underlying tissues, especially nerves [12].
B) Early excision and grafting: All devitalized tissues were eliminated during early excision, which reduced expenses, length of hospital stay, bacterial colonization, mortality, and morbidity. The use of blood derivatives, fluid resuscitation, anesthetic, and critical care have all improved, making this kind of surgery safer. Proponents of early excision of burn wounds want to reduce the host inflammatory response in order to improve systemic inflammation response syndrome and avoid organ damage [13]. This is a surgical operation that removes the eschar from the burn area and covers the exposed wound with skin substitutes, autografts, or allografts. Preventing or controlling infection, preserving all viable tissue, maintaining shape and function, promptly closing all wounds, returning to rehabilitative therapy as soon as possible. All of these requirements are met by early excision and grafting [14].
The technique of surgical excision of the burn wound, fascial excision and tangential excision, fascial excision entails removing the burned tissue, including the skin's entire thickness and subcutaneous fat, down to the investing fascia layer. Electrocautery makes it simple to do facial excision while minimizing blood loss. It also makes it simple to identify blood vessels and coagulate or ligate them. Tangential preserves as much of the underlying healthy tissue as possible while removing necrotic tissue. This is the recommended treatment for minor burns since it is more attractive and preserves body shapes better than a fascial excision. Tangential excision involves gradually removing layers of eschar until a layer of live, bleeding tissue that can sustain a skin graft is found [15].
C) Debridement: It involves the use of mechanical or sharp procedures such as curing, scraping, rongeuring, or cutting to remove loose, devitalized, necrotic and contaminated tissue, foreign substances, and other material on the wound. The amount of tissue eliminated determines the degree of debridement, not the amount of tissue made visible during the debridement procedure [16].
Option of debridement is autolytic debridement, the safest as damaged tissue only is removed, the most used, simple, but take much time. The second option is biological debridement: Larval treatment is typically used in the UK for this. The larvae are placed on the necrotic tissue in two different ways: loose and allowed to roam freely, or enclosed in a net bag. It could be necessary to prepare the hard eschar in advance by applying a hydrocolloid or hydrogel to the tissue for a few days in order to soften it. Then, using a sterile blade, score the softened eschar to allow the maggots and their enzymes to enter. A proteolytic enzyme secreted by the maggots dissolves dead tissue, which is then consumed and rids the site of bacteria and illness. It is believed that altering the pH of the wound will speed up healing. This is a quick method; however some people may refuse these treatments because they can't bear the idea of having maggots on their body. The third one is enzymatic debridement, used when no option for surgical debridement [17].

D) Allograft: In burn centers, allograft skin has been utilized extensively for wound care. When autograft is not immediately accessible, it can not only offer the best temporary wound coverage for significant burns when functioning as a biologic dressing but further ready the wound bed for permanent autografting. For a long time, patients with severe burns have received allograft as the usual skin substitute for temporary skin coverage. Due to allograft's adaptability and accessibility, severe burns can now be treated promptly [18]. It's technique is Sandwich Grafting Method, Allograft skin can be applied as an overlay over postage stamp-sized autografts or broadly meshed autografts. This method, also known as sandwich grafting, uses an allograft to act as a biologic dressing to shield the wound bed between extensively meshed autograft segments. Furthermore, as a

result of the gradual rejection process, the allograft would gradually separate from the wound, enabling the underlying autograft to finish the epithelialization process [19].

Infection of thermal injury:

Infection of thermal injury is the main reason for the importance of speed in thermal management. Invasive infection is now the chief reason for death and morbidity after burn injury, with it being responsible for 51% of the deaths. The importance of prevention, surveillance, and sampling for infections in this immunocompromised group has been well established. Origin of contamination is staphylococcus aureus and is the most common pathogenic bacteria found in burn sites, a recent study revealed that the pseudomonas and Acinetobacter are two of the most common multi resistant pathogens that cause infection-related deaths nowadays [20]. In patients with severe burns, the breakdown of the epidermal barrier due to heat and the simultaneous suppression of humoral immune responses and host cellular and systemic responses are important variables that lead to infectious consequences. The surface of a burn wound, whether it be deep partial-thickness or full-thickness, is a protein-rich environment made up of avascular necrotic tissue, or eschar, which creates an ideal setting for the colonization and growth of microorganisms. While toxic compounds generated by eschar tissue impede local host immune responses, the avascularity of the eschar hinders the migration of host immune cells and limits the administration of systemically administered antimicrobial drugs to the area [21].

Classification of thermal injury:

A system that takes into account the necessity for surgical intervention has replaced the conventional technique of classifying burns as first, second, third, or fourth degree. superficial: only affect the skin's outermost layer. They are uncomfortable, dry, red, and blanch when pressure is applied; they do not blister. The erythema and soreness go away over the course of the next two to three days, and by day four, the damaged epithelium is peeling off of the freshly healed epidermis. These kinds of wounds usually heal completely in six days. This is the typical course of sunburn, no need for surgical management [22].

Partial-thickness: involve the epidermis and portions of the dermis classified into superficial partial thickness and deep partial thickness. superficial partial thickness, within 24 hours, blisters develop between the epidermis and dermis from these burns. When pressure is applied, they bleed, blush, and hurt. Deep partial thickness: These burns are distinct from superficial partial-thickness burns in that they penetrate deeper into the dermis, hair follicles and glandular tissue are harmed by deep burns. They only hurt when pressure is applied, nearly always blister, can be wet or waxy dry, and vary in color from spotty, cheesy white to red [23].

Full-thickness: All layers of the dermis are destroyed by these burns, which also frequently damage the subcutaneous tissue beneath. Full-thickness burns are typically treated with anesthetic or hypoesthetic. Skin can appear burnt and black, leathery gray, or waxy white [24].
Extension to Deep Tissues: Fourth-degree burns are severe burns that can be fatal, extending below the skin's surface into the soft tissue beneath it. These burns can affect the bone or muscles, and demand surgical intervention [23].

Thermal airway management:

When the upper airway is directly exposed to hazardous fumes and superheated gases, edema development happens. Determining whether and when the patient needs their airway protected, preferably by endotracheal intubation, is one of the most important considerations. When a patient exhibits evident enlargement of the oropharynx, abundant carbonaceous sputum, or respiratory difficulty, it is obvious that the patient has to be intubated [25]. Patients exhibiting symptoms of thermal inhalation injury ought to get a comprehensive multidisciplinary assessment of their airways, encompassing an early otolaryngologic evaluation. When combined with targeted medical therapy aimed at components of mucosal airway inflammation (local corticosteroids and systemic azithromycin), new early endoscopic approaches (scar lysis, mucosal reconstitution with autologous grafting over an endoluminal stent) may have the potential to limit chronic cicatricial complications [5].

Conclusion:

Severe burns are a major cause of morbidity and death globally, but their effects can be mitigated with the help of education, burn prevention initiatives, basic first aid, and specialized burn services. Therapy will be guided by a comprehensive evaluation that is essential to rule out other injuries and determine the degree and depth of the burn. Burn patients require substantial continuous medical and psychological care
In order to increase the likelihood that the use of allografts will result in a positive outcome, we recommend starting educational programs to increase doctors' awareness of the significance of early surgical excision of deep burns in order to prevent the subsequent morbidity resulting from pitfalls in the early management of burns, the use of allografts improved the overall life expectancy of patients who were primarily burned.

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