

Severe Burn: Prognostic Factors, Management, and Current Updates in Skin Coverage

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ABSTRACT

Severe burns pose significant health, social, and economic challenges worldwide, with affected populations spanning all age groups but particularly vulnerable among children, older adults, and socioeconomically disadvantaged communities. This review examines the epidemiology, key prognostic factors, and advancements in the management of severe burns. It highlights the importance of early assessment of injury severity, including total body surface area and inhalation injury, to guide treatment strategies. Current management approaches emphasize multidisciplinary care, immediate resuscitation, early wound excision, and novel skin coverage techniques, such as tissue-engineered skin substitutes and bioengineered dermal templates. Advances in reconstructive options aim to improve functional and aesthetic outcomes, especially for extensive burns. Understanding these factors and innovations emphasizes the ongoing need for research to optimize long-term recovery and reduce burn-related morbidity and mortality.

KEYWORDS severe burns, epidemiology, prognostic factors, burn management, skin substitutes, reconstructive surgery, burn outcomes

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INTRODUCTION

Severe burns disproportionately affect several demographic groups, with risk and outcomes varying by age, sex, socioeconomic status, and race/ethnicity. Young children, particularly those under 5 years of age, represent a major at-risk group for both incidence and severity of burns, with scald injuries being especially prevalent in this population.[1-6] Middle-aged adults, especially men aged 30–59, are also highly represented among severe burn cases, with flame and explosion injuries being the most common etiologies in this group.[1-2][4][7] Males consistently have higher rates of severe burns across all age groups.[2][4][7] Older adults (≥65 years) are at increased risk for severe burns, particularly scalds and full-thickness injuries, and experience higher rates of hospital admission and mortality compared to

younger adults.[1][8] Advanced age is a well-established risk factor for both burn severity and poor outcomes, including increased mortality.[1-2][7-8]

Socioeconomic disadvantage is strongly associated with both increased incidence and severity of burns, particularly in pediatric populations, as demonstrated by higher burn severity in children from areas with high deprivation indices.[1][6] Racial and ethnic minority children in the United States are more likely to experience accidental burns, inhalational injuries, and require more surgical interventions and reconstructive procedures than their non-minority counterparts.[9] Globally, the burden of severe burns is greatest in low- and middle-income countries, where up to 90% of burns occur and mortality rates are highest.[1] Prognostic Factors, Management, and Current Updates



Figure 1. Third-degree burn of the chest and left upper extremity (post amputation)



Figure 2. Deep second-degree burns to lower extremities

Prognostic factors in severe burns include total body surface area (TBSA) burned, depth of burn (partial- vs. full-thickness), age, presence of inhalation injury, comorbidities, and the presence of associated trauma or infection. Increasing TBSA, advanced age, and inhalation injury are the most

significant predictors of mortality and morbidity. Early identification of patients with poor prognosis is essential for guiding management and goals of care discussions, including early involvement of palliative care when appropriate.[1-4]



Figure 3 Superficial second-degree burn with epifast placement

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Management strategies for severe burns are multidisciplinary and begin with initial resuscitation, typically guided by formulas such as the Parkland formula for fluid resuscitation, with close monitoring to avoid both under- and over-resuscitation. Early excision of devitalized tissue and rapid wound coverage are critical to reduce the risk of infection, sepsis, and hypermetabolic complications. Nutritional

support, early enteral feeding, and infection control are also central to care. The use of topical antimicrobials is tailored to wound depth and location; for example, silver sulfadiazine is generally avoided for superficial wounds due to impaired reepithelialization, while modern dressings that maintain a moist environment and minimize dressing changes are preferred.[1][4]



Figure 4 Deep second-degree burns, tangential excision is performed, followed by harvesting and application of a meshed partial-thickness skin graft.



Figure 5 Silver patch cover for mixed second-degree burns



Figure 6 Deep second-degree burn on the chest, neck and right upper extremity. Local excision was performed and partial-thickness mesh skin grafts were harvested and applied.



Figure 7 Epifast allografts in thigh, superficial second-degree burn treatment

For skin coverage, the gold standard remains autologous split-thickness or full-thickness skin grafts. Full-thickness grafts provide superior functional and cosmetic outcomes but are limited by donor site availability. Split-thickness grafts are more commonly used, especially for larger wounds, and can be meshed to expand coverage, though this results in a characteristic mesh pattern and increased risk of contracture. For extensive burns (>60% TBSA), donor site limitations necessitate the use of widely meshed autografts in combination with temporary coverage using allografts, xenografts, or dermal substitutes. These temporary coverings reduce fluid loss and infection risk until definitive autologous coverage is possible.[1][5][6]

Recent advances in skin coverage include the development and increasing use of tissue-engineered dermal templates and skin substitutes, which can provide a scaffold for neodermis formation and reduce scarring and contracture. Cultured epithelial autografts and spray-on cell techniques are being used with moderate success, though fragility and lack of dermal components remain limitations. Dermal analogs and bioengineered skin substitutes are increasingly incorporated into staged reconstruction, particularly for patients with limited donor sites, and may improve long-term functional and cosmetic outcomes. However, these approaches often require subsequent autografting for definitive closure.[1][5][6]

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Long-term outcomes in severe burns are heavily influenced by the quality of initial wound closure and the prevention of contractures. A significant proportion of patients require reconstructive procedures for contractures, particularly in functionally and cosmetically sensitive areas such as the

hands, arms, head, and neck. Scar quality is generally worse in patients with more extensive burns, and ongoing research is focused on optimizing both acute and reconstructive strategies to improve these outcomes.[3]

Aspect	Details
High-Risk Populations	Children (<5 years), older adults (≥65 years), socioeconomically disadvantaged groups
Common Causes	Scalds, flames, explosions, electrical injuries
Prognostic Factors	Total body surface area (TBSA), burn depth, inhalation injury, age, comorbidities
Initial Management	Fluid resuscitation (e.g., Parkland formula), airway management, wound stabilization
Wound Coverage Techniques	Autografts (split-thickness and full-thickness), skin substitutes, tissue-engineered products
Innovative Treatments	Dermal templates, cultured epithelial autografts, spray-on skin
Complications	Infection, sepsis, contractures, scarring, functional impairment
Outcome Factors	Severity of injury, quality of initial care, age, presence of inhalation injury
Long-term Goals	Reduce morbidity, improve functional and cosmetic outcomes, minimize scarring and contracture

CONCLUSION

Severe burns remain a significant global health challenge, disproportionately affecting vulnerable populations such as young children, older adults, and socioeconomically disadvantaged groups. The prognosis of burn patients relies heavily on factors like the extent and depth of injury, age, and inhalation involvement, underscoring the importance of early, multidisciplinary management. Advances in skin coverage techniques, including tissue-engineered skin substitutes and bioengineered dermal templates, are promising developments aimed at improving functional and cosmetic outcomes, especially in cases with limited donor sites. Continued research and innovation are essential to optimize acute treatment protocols and long-term reconstructive strategies, ultimately aiming to reduce morbidity, improve quality of life, and decrease mortality associated with severe burns worldwide.

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