

Advanced Management in Burn Patients

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ABSTRACT

This review highlights the comprehensive, multidisciplinary approach necessary for the management of burn patients, emphasizing initial stabilization, surgical intervention, critical care, and rehabilitation. Key aspects include prompt airway management, fluid resuscitation guided by established formulas, early wound assessment, and timely surgical procedures such as debridement and skin grafting. Critical care measures focus on organ support, infection prevention, and pain management, while long-term rehabilitation aims to restore function and minimize scarring. Despite advancements, burn injuries remain associated with significant complications, including infections, hypertrophic scarring, chronic pain, psychological difficulties, and heterotopic ossification. Addressing these challenges requires coordinated, individualized care strategies to optimize healing, prevent secondary complications, and improve the long-term quality of life for burn survivors.

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INTRODUCTION

Advanced management of burn patients is multidisciplinary and encompasses initial stabilization, resuscitation, wound care, surgical intervention, and ongoing critical care, with the approach tailored to burn severity, extent, and associated injuries.[1-5]

Initial Stabilization and Assessment:

Major burns require prompt airway, breathing, and circulation assessment. Airway compromise is a particular concern in patients with facial burns or suspected inhalation injury; early intubation is recommended if there are signs of airway involvement (e.g., facial burns, singed nasal hairs, soot in the oropharynx, respiratory distress).[1][4][6] Immediate removal of constrictive jewelry is advised to prevent vascular compromise due to swelling.[6]

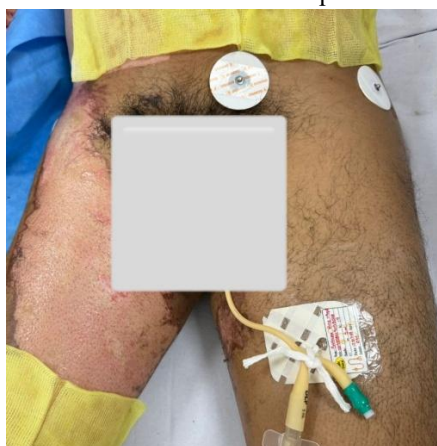


Figure 1. Superficial and deep second-degree burn. Covered with furacinated gauze.

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Fluid Resuscitation:

Large burns (>10% TBSA in adults, >5% in children) necessitate intravenous fluid resuscitation to prevent burn shock. The Parkland formula ($4 \text{ mL} \times \text{body weight (kg)} \times \text{TBSA (\%)} \times 4 \text{ mL} \times \text{body weight (kg)} \times \text{TBSA (\%)} \times 4 \text{ mL}$) is commonly used to guide initial fluid administration, with half given in the first 8 hours and the remainder over the next 16 hours. Fluid requirements should be titrated to urine output and hemodynamic parameters to avoid complications of overresuscitation, such as compartment syndrome and pulmonary edema.[1][4-5][7]

Wound Care:

Early wound assessment is critical to determine burn depth and extent. For partial-thickness burns, closed dressing techniques are preferred, with topical agents such as petrolatum, honey, or aloe shown to improve healing times.[4][6] Deep burns require early surgical debridement and coverage to minimize infection risk and promote healing. Advanced wound closure techniques include autografting, use of skin substitutes, and staged excision, with the goal of dermal preservation to optimize functional and cosmetic outcomes.[2-5][8]



Figure 2. Mixed burn Epifast plus furcinated gauze



Figure 3. Mechanical lavage and escharectomy in a patient with a third-degree burn.

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Surgical Management:

Early excision of devitalized tissue and wound closure are standard for deep and extensive burns. Techniques include tangential excision, autografting, and use of dermal scaffolds or cellular/tissue-based products. The choice of technique

depends on burn depth, available donor sites, and patient comorbidities. Multimodal approaches combining skin grafts, flap repair, and adjuncts such as negative-pressure wound therapy are often required for complex wounds.[2-4][8]



Figure 4. Deep second-degree burn on the right waist of a male patient with a mesh graft.

Critical Care and Supportive Measures:

Patients with major burns require intensive monitoring for organ dysfunction, infection, and metabolic derangements. Early enteral nutrition is essential to counteract hypermetabolism and support wound healing.[3-4][9] Pain

management should be multimodal, with both systemic and regional approaches; intravenous NSAIDs and acetaminophen are generally well tolerated.[1][6] Infection control, temperature regulation, and prevention of sepsis are ongoing priorities.[4-5]



Figure 5. Managing burn injury in the advanced stage. In the emergency room, a major burn injury



Figure 6. Electrical burn

Rehabilitation and Long-term Care:

Early mobilization, physical therapy, and scar management are key points to optimize and achieve a functional recovery and minimize long term disability. Multidisciplinary collaboration—including plastic surgery, critical care, nutrition, and rehabilitation—is essential throughout the continuum of care.[2-5][8-9]

Triage and Transfer:

Patients with burns involving critical areas (face, hands, feet, genitalia), inhalation injury, or large TBSA involvement should be managed in specialized burn centers due to the need for advanced interventions and multidisciplinary expertise.[1][3-4][6]

Management Aspect		Purpose/Goals
Initial Stabilization	Assess airway, breathing, and circulation; early intubation if airway compromise suspected; remove constrictive jewelry.	Ensure vital stability and prevent airway obstruction.
Fluid Resuscitation	Use Parkland formula ($4 \text{ mL} \times \text{body weight in kg} \times \text{TBSA}\%$); titrate based on urine output and hemodynamics.	Prevent burn shock and maintain organ perfusion.
Wound Assessment & Care	Determine burn depth; apply appropriate dressings; early debridement for deep burns; topical agents like petrolatum.	Promote healing, reduce infection risk.
Surgical Intervention	Early excision and grafting; autografts, skin substitutes, dermal scaffolds; multimodal wound closure techniques.	Facilitate wound closure, minimize scarring.
Critical Care & Support	Monitor organ function; provide enteral nutrition; manage pain with multimodal approaches; prevent sepsis.	Support vital functions, accelerate recovery.
Infection Control	Strict asepsis; prophylactic antibiotics in some cases; ongoing wound monitoring.	Reduce risk of infection and sepsis.
Temperature Regulation	Maintain normothermia via environmental controls and warming devices.	Prevent hypothermia, which impairs healing.
Rehabilitation	Early mobilization; physical and occupational therapy; scar management; psychological support.	Restore function and minimize long-term disabilities.

Long-term Care & Follow-up	Monitor for hypertrophic scars, contractures; provide ongoing physical therapy; psychological counseling.	Improve quality of life and functional outcomes.
Triage & Transfer	Send large TBSA burns, inhalation injuries, or burns on critical areas to specialized burn centers.	Ensure access to specialized multidisciplinary care.

Complications

The recovery period following burn injury is characterized by a high risk of both acute and chronic complications, many of which can significantly impact functional outcomes and long-term quality of life. The most common complications during this period include:

1. **Infection:** Burn wounds are highly susceptible to colonization and infection, which can progress to cellulitis, invasive wound infection, and sepsis. Nosocomial infections such as pneumonia and urinary tract infections are also prevalent due to the immunocompromised state induced by severe burns. Infection remains the leading cause of morbidity and mortality in burn patients, with risk factors including larger total body surface area involvement, full-thickness burns, and delayed wound closure.[1-3]
2. **Hypertrophic Scarring and Contractures:** Excessive scar formation and contracture development are common, particularly in areas over joints, leading to significant functional impairment. Nearly half of patients with severe burns develop contractures by discharge, necessitating ongoing rehabilitation and sometimes surgical intervention.[4-7]
3. **Chronic Pain and Neuropathic Pain:** Persistent pain, including neuropathic pain, is frequently reported and can be severe, affecting up to two-thirds of burn survivors. This pain is associated with increased psychological distress and reduced participation in social roles, and may persist for years post-injury.[5][8]
4. **Pruritus and Skin Changes:** Pruritus is a common and often debilitating sequela, along with other cutaneous complications such as folliculitis, pigmentary changes, and altered skin physiology. These issues can be chronic and impact quality of life.[5][7]
5. **Heterotopic Ossification:** Abnormal bone formation in soft tissues occurs in a notable proportion of patients, particularly those with extensive burns and prolonged immobilization, leading to pain and restricted mobility.[4-6]
6. **Deep Venous Thrombosis (DVT):** There is an elevated risk of DVT in the burn population, likely due to immobility, hypercoagulability, and vascular injury. Rates as high as 29% have been reported in specialized rehabilitation cohorts.[4]
7. **Peripheral Nerve Injury and Amputation:** Nerve injuries and, less commonly, amputations may occur due to direct thermal damage, compartment syndrome, or secondary to infection and vascular compromise.[5-6]
8. **Psychological and Psychiatric Complications:** High rates of mental health issues, including anxiety, depression, and post-traumatic stress disorder, are observed during recovery. These complications are closely linked to pain, disability, and social reintegration challenges.[4-6][8]
9. **Dysphagia:** Swallowing difficulties may arise, particularly in patients with facial or neck burns, or those requiring prolonged intubation.[5]
10. **Cardiovascular Complications:** Severe burns and inhalation injuries are associated with increased risk of cardiovascular events, which correlate with higher mortality.[3]

The prevalence and severity of these complications are strongly associated with burn size, depth, presence of inhalation injury, and length of hospital stay. Multidisciplinary management—including infection prevention, early excision and grafting, aggressive rehabilitation, pain control, and psychological support—is essential to mitigate these risks and optimize recovery.[1-6][8]

Complication	Description	Impact/Significance
Infection	Wound colonization, cellulitis, sepsis, pneumonia, urinary tract infections.	Leading cause of morbidity and mortality; delays healing.
Hypertrophic Scarring & Contractures	Excessive scar tissue formation and joint contractures, especially over joints.	Impairs function and causes cosmetic concerns.
Chronic Pain & Neuropathy	Persistent, sometimes severe pain, including neuropathic pain syndromes.	Reduces quality of life, mental health burden.
Pruritus & Skin Changes	Itching, pigmentation alterations, folliculitis, and skin dryness.	Chronic discomfort affecting daily activities.
Heterotopic Ossification	Abnormal bone formation in soft tissues, leading to pain and restricted movement.	Limits mobility, causes additional pain.
Deep Venous Thrombosis	Formation of blood clots in deep veins, elevated risk due to immobility and vascular injury.	Risk of pulmonary embolism; requires preventive measures.
Peripheral Nerve Injury & Amputation	Damage from thermal injury, compartment syndrome, or secondary complications.	Can lead to loss of limb function or necessity of amputation.

Psychological & Psychiatric Issues	Anxiety, depression, PTSD commonly observed during recovery.	Affects rehabilitation engagement and long-term mental health.
Dysphagia	Swallowing difficulties in facial/neck burns or after prolonged intubation.	Impairs nutrition, increases risk of aspiration.
Cardiovascular Complications	Increased risk of cardiac events, especially with severe burns and inhalation injury.	Higher mortality; requires monitoring and management.

CONCLUSION

In conclusion, the management of burn patients requires a comprehensive, multidisciplinary approach encompassing initial stabilization, timely surgical intervention, vigilant critical care, and ongoing rehabilitation. Early assessment and intervention are vital to prevent complications such as infections, airway compromise, and fluid imbalance, while tailored wound care and surgical procedures optimize healing outcomes. Despite advances in burn care, patients remain at significant risk for both acute and long-term complications—including infections, hypertrophic scarring, chronic pain, psychological issues, and heterotopic ossification—that can profoundly impact their recovery and quality of life. Effective management strategies focused on prevention, early intervention, and holistic rehabilitation are essential to improve survival rates, achieve optimal functional recovery and overall well being of burn survivors.

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