

BURN INJURIES

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1. Core Definition and Etiology

Burn injuries constitute a pervasive form of physical trauma resulting from the damage caused to body tissues--most commonly the skin--by exposure to energy sources such as intense heat, electricity, corrosive chemicals, friction, or various forms of radiation, including intense **ultraviolet radiation**. The gravity of the injury is determined by several critical factors: the depth of tissue penetration, the total body surface area (TBSA) affected, and the anatomical location of the burn, particularly involvement of the face, hands, feet, or perineum. Functionally, a burn injury is characterized not only by the immediate physical destruction of cellular structures, leading to necrosis and immediate inflammation, but also by profound and dangerous systemic responses, including massive fluid loss, elevated risk of overwhelming infection, and severe metabolic disruption, which collectively can precipitate life-threatening complications such as hypovolemic shock and multisystem organ failure. Furthermore, the experience of sustaining a severe burn is intrinsically linked to extreme psychological distress, encompassing **excruciating pain** and significant **mental trauma**, often necessitating specialized psychological intervention and long-term support long after the physical wounds have ostensibly healed.

The spectrum of etiologies responsible for burns is broad and varied, demanding tailored immediate responses. Thermal sources--including direct contact with open flame, immersion in scalding liquids, or exposure to intense dry heat without flame--represent the most common cause globally. Chemical burns, which are typically sustained in industrial or laboratory settings, result from strong acids or bases reacting destructively with tissue proteins and lipids. Electrical burns, while often presenting with minimal visible surface damage, are particularly treacherous because they utilize the body's internal resistance to generate heat, causing extensive deep tissue necrosis along neurological and vascular pathways. Radiation burns, such as those resulting from acute solar exposure or medical radiotherapy overdose, represent cellular damage caused by localized energy absorption. Regardless of the specific mechanism, the resulting cascade of tissue damage initiates a massive, sustained inflammatory response that serves as the central driver of the pathophysiology and subsequent arduous recovery process experienced by the burn victim.

2. Classification of Burn Severity (Degrees)

The standard clinical classification system, essential for accurate triage and prognosis, categorizes burn injuries primarily based on the depth of penetration into the various layers of the skin. Historically, these were described using degrees (first, second, third), a nomenclature that remains widely understood, though contemporary traumatology often utilizes the more precise surgical

terminology of partial-thickness versus full-thickness involvement. Understanding this classification is paramount for determining the necessity of specialized burn center care versus general wound management.

First-degree burns are the most superficial injury type, confined strictly to the epidermis, the outermost layer of the skin. They are clinically characterized by localized redness (erythema), mild swelling, and tenderness, but crucially, they do not result in blistering, as the epidermal barrier remains intact. These burns heal rapidly, usually within three to seven days, without any resulting scarring or the need for advanced medical intervention, demonstrating complete resolution as the damaged cells are sloughed off. A common and recognizable example of this type of injury is a mild, non-blistering sunburn resulting from prolonged exposure to solar radiation.

Second-degree burns, known clinically as partial-thickness burns, are considerably more severe as they extend **beyond the skin layer** and penetrate into the underlying dermis. These are clinically subdivided based on the depth of dermal damage. Superficial partial-thickness burns are exceptionally painful due to intact nerve endings and classically present with characteristic fluid-filled blisters, profuse weeping, and a bright pink or red appearance; these typically heal within two to three weeks with appropriate care and usually result in only minimal, if any, scarring. Deep partial-thickness burns extend significantly deeper into the reticular dermis, damaging hair follicles and sweat glands. Paradoxically, these are often less painful than superficial second-degree burns due to partial destruction of nerve endings, appearing blotchy, mottled white, or dull red. These deeper injuries frequently require surgical intervention, such as specialized enzymatic debridement or early skin grafting, to prevent excessive scarring, functional contractures, and prolonged healing times.

Third-degree burns represent a critical, full-thickness injury where the damage is complete, extending through the entire epidermis and dermis, reaching **deep into the subcutaneous layer**. In these catastrophic injuries, vital structures like connective tissues, nerves, and blood vessels are often destroyed. The skin lacks sensation (is anesthetic) because nerve endings have been obliterated; it appears leathery, firm, and often white, brown, or charred black (eschar). Because all epithelial elements necessary for spontaneous regeneration are destroyed, these wounds cannot heal without intervention. Extensive third-degree burns demand immediate, aggressive fluid resuscitation to counteract burn shock and necessitate extensive surgical excision of the necrotic tissue followed by permanent wound closure using skin autografts or complex dermal substitutes.

3. Physical Pathophysiology and Systemic Response

The primary clinical concern following severe burn injury is the acute systemic pathophysiological response, which dictates short-term survival. The destruction of the microcirculation and the integrity of the capillary endothelium at the site of injury leads to a massive and rapid shift of

plasma proteins and accompanying intravascular fluid into the interstitial spaces. This process creates generalized systemic edema and profound intravascular volume depletion--a condition termed burn shock. This dangerous hemodynamic instability occurs rapidly in burns covering more than 20% TBSA and is the leading cause of early mortality if not immediately addressed through meticulously calculated, aggressive intravenous fluid resuscitation protocols.

Beyond the acute volume deficit, severe burns trigger a protracted state of hypermetabolism, one of the most challenging aspects of long-term care. This hypermetabolic state is characterized by drastically elevated basal metabolic rate (up to twice normal), increased oxygen consumption, heightened core body temperature, and accelerated catabolism of protein and fat stores. This state is initiated and sustained by the massive release of stress hormones (catecholamines, cortisol) and inflammatory mediators, leading to rapid muscle wasting, severe weight loss, nutritional depletion, and profound immunosuppression. This sustained catabolic state significantly impedes wound healing, increases susceptibility to infection--the foremost cause of late mortality--and prolongs recovery, demanding intensive, high-calorie nutritional support and targeted pharmacological interventions to mitigate energy expenditure.

4. Psychological Sequelae and Post-Traumatic Stress

The long-term psychological and emotional consequences of **burn injuries** are frequently as severe and enduring as the initial physical damage. Victims endure overwhelming, intense physical pain during the acute phase, which is compounded by the existential threat and shock of the injury event itself. The subsequent recovery process is characterized by protracted hospitalizations, repeated, agonizing debridement and grafting procedures, the pain associated with aggressive physical therapy, the reality of permanent disfigurement, and potential long-term functional impairment. All these factors contribute synergistically to severe and debilitating psychological distress.

A critical and highly prevalent psychological outcome is the development of **Post-Traumatic Stress Disorder (PTSD)**. Clinical data unequivocally demonstrates that **more than physical recovery and cosmetic repair, most burn sufferers go through some form of post traumatic stress therapy**. Symptoms include persistent intrusive memories, emotionally charged flashbacks of the accident or painful medical procedures, avoidance behaviors related to triggers (e.g., heat, specific smells, loud noises), and chronic states of hypervigilance and anxiety. The resulting trauma is often categorized as complex, involving a superposition of the original life-threatening event, the subsequent intense medical trauma, chronic pain management struggles, and the profound, identity-altering changes to body image and social presentation.

Challenges related to body image disturbance, social stigma, and functional reintegration pose paramount hurdles to achieving full recovery. Visible, extensive scarring, contractures that impair

movement, and the perception of being visibly "different" can precipitate debilitating depression, profound anxiety disorders, and crippling social isolation. Effective and successful rehabilitation, therefore, must seamlessly integrate robust mental health care from the outset. This typically involves modalities such as Cognitive Behavioral Therapy (CBT), specialized group therapy focused on shared experiences, comprehensive family support and psychoeducation, and vocational rehabilitation aimed at restoring the patient's capacity to engage confidently and productively in daily life and work environments.

5. Modern Treatment and Rehabilitation Protocols

The contemporary management of severe burn injuries mandates a highly specialized, coordinated multidisciplinary approach involving acute trauma care, complex surgical intervention, stringent infection control, and comprehensive long-term physical and psychological rehabilitation. Acute management priorities include stabilization of the airway--a critical concern in potential inhalation injuries--meticulous fluid resuscitation guided by standardized formulas (e.g., the Parkland formula) to maintain hemodynamic stability, and immediate initiation of infection prophylaxis and wound care. The gold standard for surgical intervention involves early excision of all non-viable tissue (eschar) followed immediately by permanent wound closure, typically achieved through autografting, where skin is harvested from the patient's remaining healthy areas. This strategy minimizes the risk of sepsis and significantly shortens the duration of hospitalization.

The rehabilitation phase is necessarily protracted and absolutely critical for achieving maximal physical function and acceptable cosmetic outcomes. This involves intensive, daily physical and occupational therapy aimed specifically at preventing disabling joint contractures, restoring full range of motion, and maximizing hand and digit functionality. Furthermore, the application of custom-fitted pressure garments, sometimes required for months or years post-injury, is essential for modulating the process of scar formation, reducing the risk of hypertrophic and keloid scarring. Reconstructive surgery is often a continuous process, spanning multiple procedures over many years, playing a vital role in correcting functional deficits caused by scar tightness and enhancing aesthetic appearance to facilitate social reintegration.

Further Reading

[Burn Injury Classification and Treatment \(Wikipedia\)](#)

[World Health Organization \(WHO\) Fact Sheet on Burns](#)

[UpToDate: Initial Evaluation and Management of Thermal Burns](#)