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Review Article

Initial management of burn patients in non-specialized centers: a comprehensive approach to stabilization and referral

Héctor Cisneros Pérez[1]*, Mario Hernandez Mancillas[1], Rafael Delgado Duarte[1], Claudia Guadalupe López Galaviz[1], Cesar del Río Robles[2], Alondra Guadalupe Romero Ibarra[2]

[1]Department of General Surgery, Hospital del Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado Zacatecas, Zacatecas, México
[2]Department of Emergency, Hospital del Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado Zacatecas, Zacatecas, México

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***Correspondence:**
Dr. Héctor Cisneros Pérez,
E-mail: dr.hector.cisneros.perez@gmail.com

ABSTRACT

The initial management of burn patients in non-specialized healthcare facilities is a critical determinant of clinical outcomes, requiring prompt and systematic intervention to mitigate complications and optimize recovery. Given the pathophysiological complexity of burn injuries—encompassing thermal, chemical, and electrical etiologies—early assessment and stabilization are paramount to prevent secondary systemic insults such as hypovolemic shock, infection, and multi-organ dysfunction. This article delineates evidence-based protocols for primary evaluation, fluid resuscitation, wound care, and analgesia in resource-limited settings, emphasizing the importance of early referral to specialized burn units when indicated. By integrating principles of trauma care with burn-specific interventions, healthcare providers in non-specialized centers can significantly influence morbidity and mortality rates, bridging the gap between initial presentation and definitive treatment.

Keywords: Burn injury, Initial stabilization, Non-specialized center, Fluid resuscitation, Wound management, Trauma care, Emergency medicine, Referral protocol

INTRODUCTION

Burn injuries represent a significant global health burden, with outcomes heavily dependent on the timeliness and efficacy of initial medical intervention. In non-specialized healthcare centers, where access to burn care expertise may be limited, the prioritization of evidence-based, systematic approaches to patient stabilization is essential to reduce preventable complications. The acute phase of burn management demands a thorough understanding of burn pathophysiology, including the interplay between local tissue damage and systemic inflammatory responses, which can precipitate hypovolemia, electrolyte imbalances, and compromised airway integrity.[1,2]

The absence of specialized burn units in many clinical settings underscores the necessity for primary care providers to adeptly execute foundational interventions—ranging from accurate burn surface area estimation using the Rule of Nines to the initiation of crystalloid-based fluid resuscitation per the Parkland formula. Furthermore, the prevention of wound contamination, judicious use of analgesics, and timely identification of inhalation injuries are critical components of initial care that can significantly alter patient trajectories. This article aims to provide a structured framework for the initial management of burn patients in non-specialized environments, addressing both technical and decision-making challenges while reinforcing the imperative for interdisciplinary collaboration and expedited referral when warranted. By equipping frontline providers with standardized protocols,

the continuum of burn care can be optimized even in settings with limited resources.[2,3]

CLINICAL CONSIDERATIONS FOR THE INITIAL MANAGEMENT OF BURN PATIENTS IN NON-SPECIALIZED CENTERS

The initial management of burn injuries in non-specialized healthcare facilities requires a systematic and physiologically guided approach to mitigate complications and optimize patient outcomes. Given the complex pathophysiology of burn trauma—characterized by localized tissue necrosis, systemic inflammatory response syndrome (SIRS), and potential multi-organ dysfunction—early clinical interventions must prioritize hemodynamic stabilization, airway security, and wound preservation.[3]

PRIMARY ASSESSMENT AND TRIAGE

The initial evaluation follows advanced trauma life support (ATLS) principles, with immediate attention to airway, breathing, and circulation (ABCs). Inhalation injury, a critical determinant of morbidity, should be suspected in patients with facial burns, singed nasal hair, hoarseness, or carbonaceous sputum. Early endotracheal intubation may be warranted in cases of progressive upper airway edema or compromised ventilation. Concurrently, circumferential full-thickness burns to the chest or extremities may impair respiratory mechanics or perfusion, necessitating emergent escharotomy to restore physiological function.[3]

Hemodynamic instability, secondary to capillary leakage and intravascular volume depletion, mandates aggressive fluid resuscitation guided by the Parkland formula with half administered in the first eight hours post-injury.

$$Parkland\ formula = 4\ ml \times \%\ total\ body\ surface\ area\ [TBSA] \times weight\ [kg]$$

Crystalloids, typically lactated Ringer's solution, remain the cornerstone of initial volume replacement, though frequent reassessment of urine output (target: 0.5–1 ml/kg/hours in adults) and hemodynamic parameters is essential to prevent under- or over-resuscitation.[4]

BURN WOUND EVALUATION AND IMMEDIATE CARE

Accurate determination of burn depth (superficial, partial-thickness, full-thickness) and extent (via Rule of Nines or Lund-Browder charts) informs prognosis and referral decisions. Superficial burns typically require only analgesic support and topical emollients, whereas deeper injuries demand meticulous aseptic handling to prevent infection. Non-adherent dressings (e.g., petrolatum-impregnated gauze) and antimicrobial agents (e.g., silver sulfadiazine for partial-thickness burns) may be employed, though escharotomy or surgical debridement should be deferred to specialized centers.[5]

PAIN MANAGEMENT AND ADJUNCTIVE THERAPIES

Burn-induced nociceptive and neuropathic pain necessitates multimodal analgesia, combining opioids (e.g., intravenous morphine) with non-opioid adjuncts (e.g., acetaminophen, NSAIDs). Sedation may be required for procedural interventions; though hemodynamic monitoring is crucial to avoid respiratory depression. Additionally, tetanus prophylaxis must be administered if immunization status is uncertain, given the high risk of *Clostridium tetani* infection in devitalized tissue.[6]

INFECTION PREVENTION AND SYSTEMIC COMPLICATIONS

Burn wounds are inherently susceptible to bacterial colonization, with *Pseudomonas aeruginosa* and *Staphylococcus aureus* being common pathogens. Systemic antibiotics should not be administered prophylactically but reserved for confirmed infections due to the risk of antimicrobial resistance. Instead, emphasis should be placed on sterile wound care, elevation of affected limbs to reduce edema, and early nutritional support to counteract hypermetabolic catabolism.[6]

INDICATIONS FOR REFERRAL TO A BURN CENTER

While initial stabilization is feasible in non-specialized settings, certain clinical scenarios necessitate expedited transfer to a burn unit. These include burns involving >10% TBSA in children or elderly patients, >20% TBSA in adults, full-thickness burns >5% TBSA, and injuries affecting critical areas (face, hands, feet, perineum, or major joints). Electrical and chemical burns, as well as those complicated by inhalation injury or comorbid trauma, also warrant specialized care.[6]

The initial management of burn patients in non-specialized centers hinges on rapid assessment, judicious fluid resuscitation, infection control, and timely referral. By adhering to structured protocols, frontline providers can significantly influence survival and functional recovery, bridging the gap between emergency intervention and definitive burn care.[7]

ADVANCED MANAGEMENT OF CRITICAL BURN PATIENTS IN NON-SPECIALIZED CENTERS: BEYOND INITIAL STABILIZATION

The management of critically ill burn patients in non-specialized healthcare facilities extends beyond initial resuscitation, requiring a nuanced understanding of evolving pathophysiology, metabolic derangements, and organ-specific complications. While definitive burn care remains the domain of specialized units, prolonged

stabilization and monitoring may be necessary prior to transfer, particularly in resource-limited settings where delays are inevitable.[7]

HEMODYNAMIC AND RESPIRATORY OPTIMIZATION

Following initial fluid resuscitation, hemodynamic monitoring must transition from volume replacement to dynamic assessment of end-organ perfusion. Burn shock, characterized by a hyperdynamic circulatory state with increased cardiac output and systemic vascular resistance, necessitates judicious fluid titration to avoid complications such as pulmonary edema or abdominal compartment syndrome. Invasive hemodynamic monitoring (e.g., central venous pressure, arterial lines) may be employed where available, though clinical indicators—urine output, mentation, and lactate clearance—remain fundamental.[8]

Mechanical ventilation strategies must account for potential acute respiratory distress syndrome (ARDS) secondary to inhalation injury or systemic inflammation. Lung-protective ventilation (tidal volumes 6–8 mL/kg ideal body weight, plateau pressures <30 cm H_2O) should be prioritized, with cautious use of positive end-expiratory pressure (PEEP) to mitigate atelectasis without exacerbating fluid-induced pulmonary congestion. Frequent arterial blood gas analysis ensures adequate oxygenation (PaO_2 >60 mmHg) and ventilation ($PaCO_2$ 35–45 mmHg), while bronchoscopy may be considered if particulate aspiration or airway sloughing is suspected.[8]

METABOLIC AND NUTRITIONAL SUPPORT

The hypermetabolic response to severe burns manifests within 48–72 hours, marked by catabolism, insulin resistance, and profound protein wasting. Early enteral nutrition (initiated within 24 hours) is critical to attenuate muscle breakdown and support immune function. High-protein, high-calorie formulations should be administered, with careful monitoring for ileus or feeding intolerance. Supplemental glutamine, antioxidants, and trace minerals may modulate oxidative stress, though evidence remains context-dependent.[8]

Glycemic control presents a unique challenge, as stress-induced hyperglycemia exacerbates infection risk and impairs wound healing. While tight glucose control (target range 140–180 mg/dl) is ideal, hypoglycemia must be avoided due to its deleterious neurologic effects. Subcutaneous insulin protocols may suffice in stable patients, whereas intravenous infusions are preferable in those with erratic absorption or hemodynamic instability.[9]

INFECTION SURVEILLANCE AND ANTIMICROBIAL STEWARDSHIP

Sepsis remains the leading cause of late mortality in burn patients, necessitating vigilant surveillance for evolving infections. Clinical indicators—such as fever, leukocytosis, or worsening organ function—must be interpreted cautiously, as systemic inflammation alone can mimic infection. Procalcitonin and C-reactive protein trends may aid in distinguishing sepsis from sterile inflammation, though cultures (blood, wound, sputum) remain diagnostic cornerstones.[9]

Empiric antibiotics should be reserved for clear signs of invasive infection, with selection guided by local resistance patterns. Gram-positive coverage (e.g., vancomycin for methicillin-resistant *Staphylococcus aureus*) and antipseudomonal agents (e.g., piperacillin-tazobactam, cefepime) are common first-line choices, though antifungal therapy may be warranted in prolonged critical illness. Topical antimicrobials (e.g., mafenide acetate for cartilage-involving burns) should be used selectively to minimize systemic absorption and toxicity.[9]

RENAL AND COAGULATION CONSIDERATIONS

Acute kidney injury (AKI) complicates up to 30% of major burns, driven by hypovolemia, nephrotoxic medications, and rhabdomyolysis (particularly in electrical injuries). Continuous renal replacement therapy (CRRT) may be required for refractory acidosis or fluid overload, though its availability in non-specialized centers is often limited. Diuretics should be avoided in oliguric AKI unless hypervolemia is present, as they may exacerbate tubular injury.[9]

Coagulopathies—ranging from disseminated intravascular coagulation (DIC) to thrombocytopenia—are common in severe burns. Routine coagulation panels and platelet counts guide transfusion strategies, with cryoprecipitate or fresh frozen plasma administered for clinically significant bleeding. Venous thromboembolism (VTE) prophylaxis, via low-molecular-weight heparin or pneumatic compression devices, is imperative given the prothrombotic burn milieu.[10]

PSYCHOLOGICAL AND SUPPORTIVE CARE

The profound psychosocial impact of burn trauma necessitates early integration of anxiolytics, antidepressants, and non-pharmacologic support. Delirium, prevalent in critically ill burn patients, should be managed with antipsychotics (e.g., haloperidol) or dexmedetomidine, while avoiding benzodiazepines when possible due to delirium risk. Family engagement and clear communication about prognosis are essential to mitigate long-term post-traumatic stress.[10]

PRE-TRANSFER STABILIZATION

Prior to interfacility transfer, thorough documentation of interventions—including fluid totals, ventilator settings, and active medications—ensures continuity of care. Securing airway patency, ensuring hemodynamic stability, and optimizing analgesia are prerequisites for safe transport. Communication with the receiving burn center

facilitates anticipatory management, particularly for high-risk patients requiring emergent surgical intervention.[11]

The prolonged management of critical burn patients in non-specialized centers demands a multidisciplinary approach, balancing physiological support with pragmatic resource utilization. By addressing metabolic, infectious, and organ-specific sequelae, providers can mitigate secondary insults and bridge the gap to definitive care. While transfer remains the ultimate goal, meticulous critical care in the interim period profoundly influences survival and functional recovery.[11]

SURGICAL MANAGEMENT OF CRITICAL BURN PATIENTS IN NON-SPECIALIZED CENTERS: PRINCIPLES AND PRAGMATIC APPROACHES

The surgical management of critically ill burn patients in non-specialized facilities presents unique challenges that demand careful consideration of both physiological priorities and resource limitations. While definitive surgical interventions typically require transfer to specialized burn units, certain urgent procedures may be necessary during the initial stabilization phase to preserve life and limb function.[11]

The pathophysiology of major burns creates a complex surgical landscape where tissue perfusion, infection control, and metabolic demands must be carefully balanced against procedural risks.[11]

Early surgical intervention in burn care primarily focuses on two critical objectives: decompression of compartment syndromes through escharotomy and removal of non-viable tissue via debridement.[11]

Circumferential full-thickness burns, particularly those affecting the thorax or extremities, may require immediate escharotomy to restore adequate ventilation and peripheral circulation. This procedure involves linear incisions through the inelastic eschar down to viable tissue, typically performed at bedside under sterile conditions with adequate analgesia.[11]

The surgical team must possess thorough knowledge of anatomical compartments and fascial planes to effectively release constriction while avoiding iatrogenic injury to underlying neurovascular structures.[11]

Excisional debridement of necrotic tissue represents another potentially life-saving intervention that may be initiated in non-specialized centers. The removal of devitalized tissue serves multiple purposes: reducing the inflammatory burden, decreasing bacterial colonization, and preparing the wound bed for eventual grafting. Surgical debridement should be approached methodically, with particular attention to maintaining hemostasis in these often coagulopathic patients. Tangential excision techniques, while ideal, may prove challenging in resource-limited settings, and thus sharp excision to viable tissue planes may represent a more pragmatic approach.[12]

The management of burn wounds with exposed critical structures - such as tendons, joints, or bones - requires particular surgical consideration. These wounds often necessitate temporary coverage with biological dressings or available skin substitutes to protect underlying structures while awaiting definitive reconstruction. The surgical team must carefully assess wound vascularity and potential for infection when determining the timing and extent of any excisional procedures.[12]

Electrical burns present unique surgical challenges due to their potential for deep tissue damage that often exceeds visible surface injury. These patients may require early fasciotomies to prevent compartment syndrome from progressive muscle necrosis, as well as careful monitoring for rhabdomyolysis and subsequent renal complications. Chemical burns similarly demand specialized surgical consideration, particularly in cases of ongoing tissue penetration, where copious irrigation and potentially radical debridement may be necessary to halt progressive injury.[12]

Anesthetic management for burn surgery in non-specialized centers requires particular attention to the patient's altered physiology. The hypermetabolic state, potential airway compromise, and altered pharmacokinetics of medications in burn patients all contribute to increased perioperative risk. Regional anesthesia techniques may be particularly valuable in this setting, when applicable, to avoid the challenges of general anesthesia in potentially difficult airways.[12]

While non-specialized centers may lack resources for definitive burn reconstruction, understanding the principles of wound bed preparation and temporary coverage techniques can significantly improve outcomes. The surgical team should focus on creating optimal conditions for eventual transfer and definitive care, while managing immediate threats to life or limb. This includes judicious use of available biological dressings, negative pressure wound therapy when available, and meticulous documentation of wound characteristics to facilitate continuity of care.[13]

Postoperative management following these interventions requires vigilant monitoring for complications including bleeding, infection, and graft failure. The systemic inflammatory response to surgical trauma in burn patients can be profound, necessitating careful fluid management and hemodynamic support. Nutritional optimization becomes particularly crucial in the postoperative period to support wound healing and immune function.[13]

The decision to perform surgical interventions in non-specialized centers must always weigh the potential benefits against the risks of delaying transfer. In cases where transfer to a burn center can be accomplished within

an appropriate timeframe, temporizing measures may be preferable to definitive procedures.

However, when faced with immediately life-threatening conditions or unavoidable delays in transfer, judicious surgical intervention can serve as a critical bridge to definitive care, preserving both life and function for severely burned patients.[13]

CONCLUSION

The initial management of burn patients in non-specialized healthcare settings represents a critical intervention point where timely, evidence-based decision-making can significantly alter clinical trajectories. Given the complex pathophysiology of burn injuries—encompassing not only localized tissue destruction but also systemic inflammatory cascades, hemodynamic instability, and metabolic derangements—the importance of structured, physiologically guided care cannot be overstated. While definitive treatment often requires specialized burn unit expertise, the foundational interventions performed during the golden hours following injury play a decisive role in mitigating complications such as hypovolemic shock, sepsis, and multi-organ dysfunction. Non-specialized centers must prioritize a systematic approach that integrates principles of trauma resuscitation with burn-specific considerations. This includes meticulous attention to airway security in the context of potential inhalation injury, aggressive but monitored fluid resuscitation to counteract capillary leakage, and judicious wound management to minimize infection risk. The early recognition of high-risk features—such as extensive total body surface area involvement, full-thickness burns, or concomitant trauma—should prompt immediate consultation with burn specialists and expedited transfer when feasible. Moreover, the management of burn patients in these settings extends beyond technical interventions, requiring an awareness of the psychosocial impact of burn trauma and the need for adequate analgesia and emotional support. The challenges posed by resource limitations further underscore the necessity for protocol-driven care, ensuring that even in the absence of specialized equipment or expertise, fundamental principles of burn management are consistently applied. The goal of initial burn care in non-specialized centers is not to replace definitive treatment but to stabilize the patient sufficiently to bridge the gap to higher levels of care. By adhering to evidence-based practices, maintaining a high index of suspicion for complications, and fostering effective communication with referral centers, healthcare providers in these settings can profoundly influence patient outcomes. The integration of continuous education and simulation-based training may further enhance preparedness, ensuring that even in resource-constrained environments, the standard of care remains uncompromised. In doing so, non-specialized facilities become vital links in the chain of survival for burn patients, optimizing recovery long before they reach specialized burn units.

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