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ORIGINAL ARTICLE

OPTIMIZING MANAGEMENT TACTICS WHEN PATIENTS WITH HYPERTENSION RECEIVE BURN TRAUMA

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Abstract

Burn trauma is a severe form of injury that initiates complex local and systemic inflammatory responses, frequently resulting in significant hemodynamic instability, metabolic disturbances, and multiorgan dysfunction. In patients with pre-existing hypertension, burn injury presents additional therapeutic challenges because chronic vascular remodeling, endothelial dysfunction, impaired cardiovascular reserve, and associated comorbidities may substantially influence clinical outcomes. The coexistence of hypertension and burn trauma requires individualized management strategies that simultaneously address tissue perfusion, blood pressure regulation, fluid resuscitation, renal protection, cardiovascular stability, infection prevention, and wound healing. This study aimed to evaluate current management tactics for hypertensive patients following burn trauma and identify clinical factors associated with improved prognosis. The findings indicate that early multidisciplinary intervention, careful hemodynamic monitoring, individualized fluid therapy, optimized antihypertensive treatment, and comprehensive critical care significantly reduce complications and improve recovery. Tailored treatment protocols should therefore be incorporated into modern burn management to optimize outcomes in patients with chronic hypertension.

Keywords: burn trauma, hypertension, fluid resuscitation, cardiovascular complications, critical care, blood pressure management, burn injury, wound healing, renal protection, intensive care.

1. Introduction

Burn injuries remain among the most complex forms of traumatic injury encountered in emergency and critical care medicine. Beyond local tissue destruction, extensive burns initiate profound systemic inflammatory responses characterized by increased vascular permeability, massive fluid shifts, cytokine release, endothelial dysfunction, hypermetabolism, immune dysregulation, and progressive organ dysfunction. The severity of these systemic alterations increases with total body surface area burned, depth of injury, inhalation trauma, age, and pre-existing chronic diseases.

Hypertension is one of the most prevalent chronic cardiovascular disorders worldwide and frequently coexists with diabetes mellitus, obesity, chronic kidney disease, coronary artery disease, and cerebrovascular disease. As the global population ages, an increasing proportion of burn patients present with established hypertension before injury. These individuals require specialized therapeutic approaches because chronic cardiovascular adaptations significantly modify physiological responses

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to severe burns.
Persistent hypertension produces structural remodeling of the arterial wall, reduced vascular compliance, endothelial dysfunction, increased oxidative stress, and impairment of microcirculatory regulation. Consequently, hypertensive patients demonstrate reduced cardiovascular adaptability during periods of acute physiological stress. Following burn injury, these abnormalities may compromise tissue perfusion despite apparently adequate systemic blood pressure, thereby increasing susceptibility to organ dysfunction.
The early post-burn period is characterized by substantial intravascular fluid loss resulting from increased capillary permeability. Appropriate fluid resuscitation remains the cornerstone of burn management. However, patients with chronic hypertension often exhibit altered autoregulatory mechanisms requiring individualized resuscitation strategies. Excessive fluid administration increases the risk of pulmonary edema, abdominal compartment syndrome, and cardiac decompensation, whereas inadequate resuscitation may lead to renal ischemia, shock, and multiple organ failure.
Cardiovascular complications constitute another major concern in hypertensive burn patients. Increased sympathetic activation, inflammatory mediators, pain, anxiety, and circulating catecholamines frequently produce significant blood pressure fluctuations, myocardial oxygen imbalance, tachyarrhythmias, and worsening of pre-existing cardiovascular disease. Continuous cardiovascular monitoring therefore becomes an essential component of comprehensive burn care.
Renal dysfunction represents a common complication following severe burns, particularly among patients with hypertension and underlying vascular disease. Reduced renal perfusion, hypovolemia, rhabdomyolysis, sepsis, nephrotoxic medications, and systemic inflammation may contribute to acute kidney injury, significantly increasing mortality. Early preservation of renal perfusion through individualized hemodynamic optimization remains fundamental for improving clinical outcomes.
Modern burn management extends beyond emergency stabilization to include infection prevention, nutritional support, metabolic regulation, pain control, early wound excision, skin grafting, rehabilitation, and psychological care. For hypertensive patients, optimization of chronic antihypertensive therapy during the acute phase must be carefully balanced against evolving hemodynamic conditions to prevent hypotension while maintaining adequate organ perfusion.
Recent advances in critical care monitoring, bedside ultrasonography, hemodynamic assessment, biomarker-guided therapy, and multidisciplinary treatment protocols have significantly improved survival following severe burn injury. Nevertheless, evidence specifically addressing management strategies for hypertensive burn patients remains relatively limited.
The present study aimed to evaluate modern management tactics for patients with hypertension who sustain burn trauma by assessing hemodynamic changes, cardiovascular complications, renal function, therapeutic interventions, and clinical outcomes while emphasizing individualized approaches capable of improving survival and functional recovery.

2. Materials and Methods

This prospective observational study was conducted between January 2023 and April 2025 at specialized burn centers and intensive care units. The primary objective was to evaluate optimal management strategies for patients with pre-existing hypertension who sustained moderate to severe burn injuries and to identify clinical factors influencing treatment outcomes and survival.
A total of 210 adult patients with thermal burn injuries were enrolled in the investigation. Among them, 106 patients had a documented history of primary hypertension before injury (Hypertension Group), while 104 patients without hypertension served as the comparison group. Burn severity ranged from 15% to 60% of total body surface area (TBSA), and all participants required inpatient treatment.
Patients younger than 18 years, individuals with terminal malignancy, severe chronic liver disease, advanced heart failure unrelated to hypertension, or incomplete clinical documentation were excluded from the study.
Comprehensive clinical assessment was performed immediately after hospital admission. Patient characteristics including age, sex, body mass index, smoking history, diabetes mellitus, chronic kidney disease, coronary artery disease, antihypertensive medication use, duration of hypertension, and previous cardiovascular events were documented.
Burn injury evaluation included determination of total body surface area involvement using the Lund-Browder chart, burn depth classification, anatomical location, presence of inhalation injury,

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mechanism of injury, and revised Baux score for mortality prediction.
Hemodynamic monitoring consisted of continuous measurement of heart rate, arterial blood pressure, oxygen saturation, urine output, central venous pressure when indicated, and serial assessment of tissue perfusion. Mean arterial pressure was maintained according to individualized clinical targets to ensure adequate renal and systemic perfusion.
Laboratory investigations included complete blood count, serum creatinine, blood urea nitrogen, serum electrolytes, arterial blood gases, lactate, glucose, albumin, liver function tests, coagulation profile, C-reactive protein, procalcitonin, creatine kinase, cardiac troponin, and blood cultures when infection was suspected.
Fluid resuscitation was initiated according to accepted burn management protocols and subsequently individualized using dynamic hemodynamic parameters, urine output, serum lactate clearance, and bedside clinical assessment. Particular attention was paid to avoiding excessive fluid administration in hypertensive patients with impaired cardiovascular reserve.
Renal function was monitored daily using estimated glomerular filtration rate, urine output, serum creatinine, and electrolyte measurements. Acute kidney injury was diagnosed according to internationally recognized criteria.
Antihypertensive therapy was adjusted individually based on hemodynamic status. Medications producing excessive hypotension during early shock resuscitation were temporarily withheld, whereas long-term cardiovascular treatment was gradually reintroduced after stabilization. Beta-blockers, calcium channel blockers, angiotensin-converting enzyme inhibitors, and angiotensin receptor blockers were prescribed according to current cardiovascular recommendations and individual patient tolerance.

3. Results

Patients with pre-existing hypertension demonstrated significantly greater cardiovascular instability during the first seventy-two hours following burn injury compared with normotensive individuals. Blood pressure fluctuations, episodes of transient hypotension during fluid resuscitation, and reactive hypertension during the hypermetabolic phase were observed more frequently in this population.
Despite receiving similar burn management protocols, hypertensive patients required more individualized fluid administration. Excessive crystalloid infusion resulted in pulmonary congestion and peripheral edema more frequently among patients with chronic cardiovascular disease, whereas inadequate resuscitation was associated with reduced urine output and deterioration of renal function.
Laboratory investigations demonstrated higher inflammatory marker concentrations among hypertensive patients during the acute phase. C-reactive protein, procalcitonin, leukocyte count, and serum lactate remained elevated for longer periods, reflecting more pronounced systemic inflammatory activation following burn trauma.
Acute kidney injury occurred more frequently in patients with hypertension, particularly among those with diabetes mellitus or pre-existing chronic kidney disease. Progressive elevation of serum creatinine and blood urea nitrogen was accompanied by declining urine output and electrolyte disturbances, requiring intensified nephrological management.
Cardiovascular complications including atrial fibrillation, ventricular arrhythmias, myocardial ischemia, and acute heart failure occurred with greater frequency among hypertensive patients. Individuals with poorly controlled hypertension before injury exhibited the highest incidence of cardiac complications during hospitalization.
Wound healing progressed more slowly in hypertensive patients. Delayed granulation tissue formation, prolonged epithelialization, and increased frequency of wound infection were associated with impaired microvascular circulation and chronic endothelial dysfunction.
Patients receiving individualized blood pressure management together with continuous hemodynamic monitoring demonstrated superior clinical outcomes compared with those managed using conventional fixed treatment protocols. Maintenance of adequate organ perfusion while avoiding excessive blood pressure fluctuations significantly reduced renal complications and improved wound healing.
Early multidisciplinary collaboration involving burn surgeons, intensivists, cardiologists, nephrologists, nutrition specialists, physiotherapists, and infectious disease physicians contributed to lower complication rates and shorter hospitalization.

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Overall mortality remained higher among hypertensive patients with extensive burns, particularly when burn injury exceeded forty percent of total body surface area or when inhalation injury and sepsis developed simultaneously.

4. Discussion

The present investigation demonstrates that chronic hypertension substantially influences physiological responses following severe burn injury. Long-standing vascular remodeling, endothelial dysfunction, impaired arterial compliance, and reduced cardiovascular reserve limit the body's ability to compensate for profound hemodynamic disturbances occurring after thermal trauma.

One of the most important findings is the necessity for individualized fluid resuscitation. Traditional burn resuscitation formulas provide valuable initial guidance; however, hypertensive patients often require dynamic adjustment based on real-time assessment of tissue perfusion, cardiac performance, urine output, serum lactate, and bedside ultrasonography. Personalized fluid therapy minimizes complications associated with both under-resuscitation and fluid overload.

Blood pressure management during burn treatment presents a unique clinical challenge. Excessive reduction of arterial pressure may compromise renal and tissue perfusion, whereas persistent hypertension increases myocardial workload, bleeding risk, and vascular complications. Continuous hemodynamic monitoring therefore represents a cornerstone of optimal management.

The increased incidence of acute kidney injury observed in hypertensive burn patients highlights the interaction between chronic vascular disease and burn-induced systemic inflammation. Preservation of renal perfusion, avoidance of nephrotoxic medications, early recognition of electrolyte disturbances, and timely nephrological consultation are essential for preventing progression to severe renal dysfunction.

Cardiovascular monitoring remains equally important because burn-induced catecholamine release, inflammatory activation, hypovolemia, and metabolic stress increase susceptibility to myocardial ischemia and cardiac rhythm disturbances. Early identification and treatment of these complications significantly improve patient survival.

The slower wound healing observed among hypertensive patients may result from chronic microvascular dysfunction, impaired tissue oxygen delivery, and prolonged inflammatory activation. Comprehensive nutritional support, glycemic optimization, infection control, and early surgical wound management contribute to improved tissue regeneration.

Future research should investigate precision hemodynamic monitoring, artificial intelligence-assisted fluid management, biomarker-guided cardiovascular support, and personalized therapeutic algorithms specifically designed for burn patients with chronic cardiovascular diseases.

5. Conclusion

Pre-existing hypertension significantly complicates the clinical management of patients with burn trauma by increasing the risk of cardiovascular instability, acute kidney injury, delayed wound healing, infectious complications, and prolonged hospitalization.

Successful management requires individualized fluid resuscitation, careful blood pressure regulation, continuous cardiovascular and renal monitoring, early surgical wound care, nutritional optimization, and multidisciplinary collaboration. Personalized treatment strategies provide better physiological stabilization than standardized protocols alone.

Implementation of comprehensive management algorithms integrating burn surgery, intensive care, cardiology, nephrology, and rehabilitation can substantially improve survival, reduce complications, preserve organ function, and enhance long-term recovery in hypertensive patients experiencing burn trauma.

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