

## Review Article

# Burns within the South African context

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### ABSTRACT

Burn injuries are a major cause of morbidity and mortality worldwide, with significant physical and psychological sequelae. The application of trauma resuscitation principles can substantially reduce the impact of these injuries. In South Africa, their incidence is closely linked to socioeconomic factors and their management requires a coordinated multidisciplinary approach.

**Keywords:** Burns, South Africa, Socioeconomic, Trauma, Hypermetabolism

### INTRODUCTION

Burn injuries are a major cause of morbidity and mortality worldwide, but when basic principles of initial trauma resuscitation are applied, the burn's impact may be greatly minimized.<sup>1</sup> Burn injuries pose an immense challenge to even the most equipped and well-staffed healthcare centres.<sup>1</sup> Survivors often develop permanent deformities with the need for ongoing health care, including rehabilitative services.<sup>1</sup>

Burn injuries represent a crucial public health challenge in South Africa, with a complex interplay of socioeconomic factors, including healthcare access, that contributes to their prevalence and outcomes.<sup>2</sup> Over 3000 patients annually require hospitalization for burn injuries in the country, indicating an urgent need for improved burn care and treatment protocols.<sup>3</sup>

The socioeconomic landscape of South Africa significantly influences burn injury patterns, with higher rates and greater likelihood of mortality in children and the elderly, marginalized communities, individuals with underlying chronic illnesses (such as epilepsy) and migrant groups.<sup>3,4</sup> The electricity crisis in South Africa, better known as loadshedding, has left many households

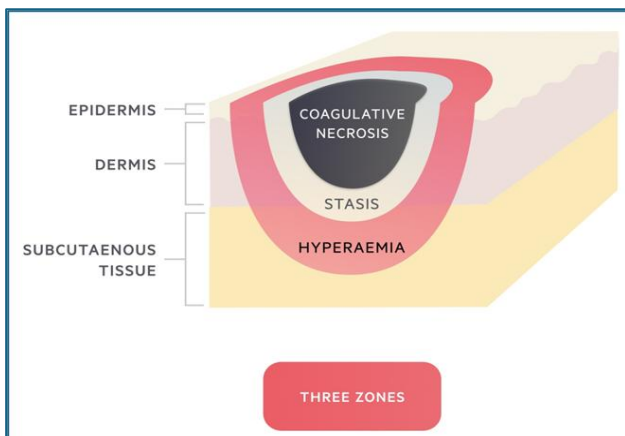
in the dark, and many had to rely on burning coal and wood for energy.<sup>5</sup> This reliance on unsafe energy sources has exacerbated the risk of burn injuries in vulnerable communities.<sup>5</sup> The illegal electricity connections have become rampant, in fact they form the main energy supply in many informal settlements.<sup>6</sup> This has numerous ramifications as they result in serious electrocution injuries to perpetrators and community members, and further deepen the financial constraints involved in the provision of electricity.<sup>6</sup>

The magnitude of paediatric trauma, particularly burns, is on the rise.<sup>7,8</sup> This population is served by either general practitioners, general surgeons, paediatric surgeons or plastic surgeons. However, approximately 30% of surgical trainees indicated having no adequate exposure to burn care in their training.<sup>9,10</sup> This gap in training is further compounded by the scarcity of resources and equipment.<sup>8-10</sup> Therefore, this overview will serve as a guide and a reference in the management of burns in our setting.

### PATHOPHYSIOLOGY

The pathophysiology of burn injuries involves both local and systemic responses which determine principles of management and patient outcome.<sup>11</sup>

Local tissue response to burn injury was described by Jackson in 1947 when he annotated the three zones of burn, namely zones of coagulation, stasis and hyperaemia.<sup>11</sup> The zone of coagulation happens centrally at the area of maximum injury, where there is irreversible tissue destruction.<sup>11</sup> The subsequent zone, as one moves from the centre, is called a zone of stasis. This is an area which is potentially salvageable with adequate fluid resuscitation.<sup>11</sup> Fluid therapy with crystalloids increases intravascular volume with subsequent improvement in tissue perfusion, which in turn will reverse and prevent further damage from the burn injury.<sup>11</sup> However, delays in burn management will convert this zone into an area of irreversible tissue injury (zone of coagulation).<sup>11</sup> A zone of hyperaemia refers to the most peripheral zone where there is still good tissue perfusion.<sup>11</sup> Recovery is expected in this region unless there is infection or prolonged period of hypoperfusion (Figure 1).<sup>11</sup>



**Figure 1: Jacksonian zones of local tissue burn injury.**<sup>12</sup>

Burn injuries simultaneously induce a response that affects nearly all organ systems.<sup>11</sup> Systemic response is triggered by the release of cytokines and other inflammatory mediators when they reach the cardiovascular, respiratory, gastrointestinal, renal, immunological and metabolic systems.<sup>11</sup> Cardiovascular effects are manifested with an increase in capillary permeability and subsequent leakage of proteins and fluids from the intravascular space into the interstitium.<sup>11</sup> This results in systemic hypotension, tissue hypoperfusion and hypovolaemic shock.<sup>11</sup> Respiratory effects include bronchospasm and, in severe forms, acute respiratory distress syndrome.<sup>11</sup> Burns cause impairment of intestinal motility and absorption, splanchnic vasoconstriction, and disruption of mucosal barrier with bacterial translocation.<sup>13</sup> Burns also increase basal metabolic rate and induce a catabolic state with a resultant decline in immune functions.<sup>11</sup>

### HYPERMETABOLISM OF BURNS

Severe burns can predispose to a hypermetabolic state which can remain long after the initial injury.<sup>14</sup> This

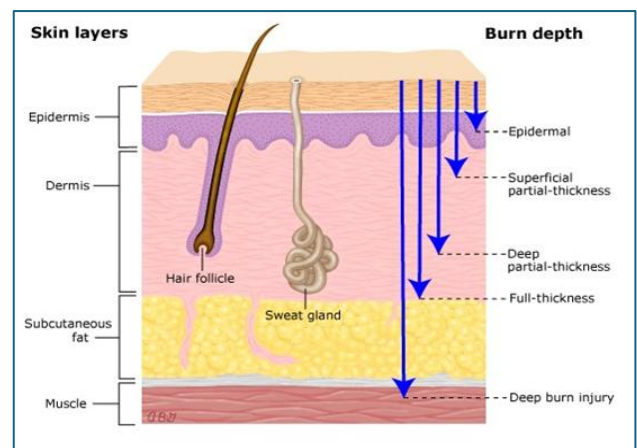
response is characterized by an increased resting energy expenditure, elevated cardiac work, and significant degradation of muscle, bone and adipose tissue.<sup>14</sup> During this state, patients are at risk of insulin resistance, multiorgan failure and sepsis due to a diminished immune system.<sup>14</sup> Medications that may counteract hypermetabolic response include: insulin, metformin, propranolol, recombinant human growth hormones, and oxandrolone.<sup>14</sup>

### CLASSIFICATIONS

A burn injury results from biochemical destruction to the skin or underlying tissues due to heat, radiation, electricity or chemical contact.<sup>15</sup> Thermal burns are by far the most common, accounting for over 80% of burn injuries requiring hospital admission.<sup>15</sup> Thermal burn may be caused by hot liquids (scalds), hot solids (contact burns), flames or steam.<sup>15</sup>

#### Burn wound depth

The historical classification of burn injuries as first, second, third or fourth degree has largely been replaced by the current system that takes into consideration burns surgical management.<sup>15</sup> Burns are now classified as superficial, superficial partial thickness, deep partial thickness, and full thickness.<sup>15</sup> However, in fourth degree burns the terminology still remains unchanged, describing burn injuries that extend beyond the skin surface to involve subcutaneous tissues as well as blood vessels, nerves, muscles, and bones (Figure 2).<sup>15</sup>

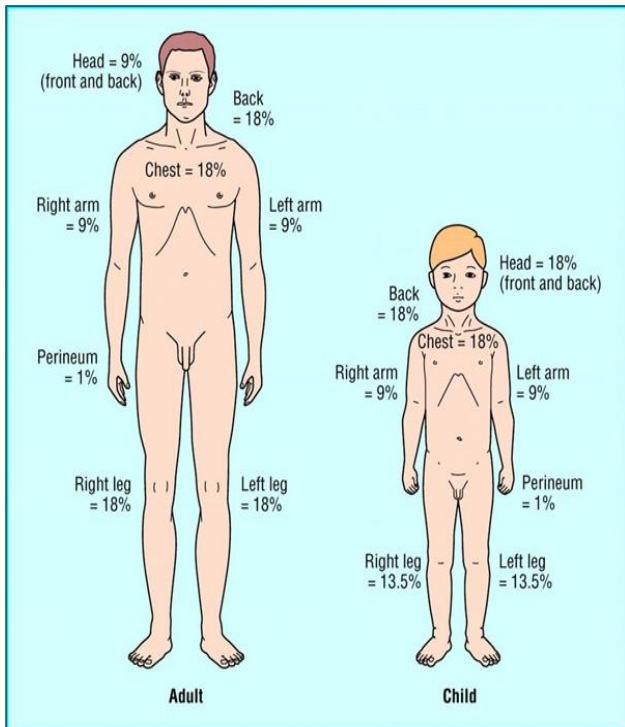


**Figure 2: Classification of burns based on depth of injury.**<sup>16</sup>

#### Burn wound extent

An accurate determination of the burn size is critical in guiding fluid therapy as well as in deciding when to transfer a patient to a specialist burns centre.<sup>15</sup> The extent of burns is estimated and expressed as the total percentage of body surface area (i.e. TBSA) using Wallace's rule of nine, especially in adults, and the Lund

and Bowder chart for the paediatric population. Superficial (first-degree) burns are not included in the TBSA calculation (Figure 3).<sup>15</sup>



**Figure 3: Wallace's rule of nine to estimate total body surface area of burns.**<sup>17</sup>

## PROGNOSTIC SCORING SYSTEMS

Improvements in survival rates post burn injuries have been seen with a steady rise over the last few decades.<sup>18,19</sup> The use of prognostic scores assists healthcare facilities, particularly intensive care units, in evaluating the need for higher levels of care in order to optimally use resources in the burn care.<sup>18,19</sup> These scoring systems aim to use established variables in determining the likelihood of mortality in a patient.<sup>18,19</sup> The patient's age, total body surface area of burn and the presence of inhalational injury form the base of burn prognostication, and these variables are also factored in the revised Baux score which was proposed in 2010 by Osler and has become widely accepted in burns care centres across the globe.<sup>18,19</sup>

Formula for the calculation of the revised Baux score.<sup>19</sup>

$$\text{rBaux score} = \text{age (years)} + \text{burned area (\%)} + (17 \times I)$$

In which: I=1 if the patient suffered inhalation injury; I=0 if patients did not suffer inhalation injury.

A higher Baux score signifies increased chances of complications and death, with a score of above 140 being considered non-survivable.

## MANAGEMENT

Initial management follows the same principles of care as those for trauma injury: prioritizing the ABCs (airway, breathing, and circulation). However, the first step is to stop the burning process and remove burning items from skin contact. A basic history is essential if it is possible to obtain (AMPLE: allergies, medication, past medical history, last oral intake, events of the injury).<sup>20</sup>

The primary survey starts with airway assessment for inhalational injuries, which if present necessitates prompt intubation. Concerns with breathing can be in many forms with burn injuries. Open flames lead to low ambient levels of oxygen and severe hypoxaemia. Carbon monoxide poisoning from prolonged smoke exposure can also cause severe hypoxaemia. Administration of 100% oxygen will be first line treatment. Patients with extensive burns (TBSA>20%) need aggressive intravenous fluid resuscitation to prevent "burn shock." Several fluid administration formulae are proposed but the Parklands equation is the most widely used. It is used in estimating the number of crystalloids to be given in the first 24 hours after the burn injury. The patient should be protected against hypothermia; therefore, warmed intravenous fluids should be administered and warming devices (e.g. bear-hugger) applied.<sup>20</sup>

### Long-term care

Prolonged hospital stay is often expected in the case of burn injuries because wounds take several weeks to months for them to heal. During this period there are three main tasks to fulfil: 1) close the wound 2) manage hypermetabolic response 3) treat sepsis and multiple organ dysfunction.<sup>20</sup>

After giving an oral or intravenous analgesia, burn wounds should be washed with water and soap while the patient is at the emergency department. Debridement of loose hanging skin and blisters should be performed, and this will be followed by application of a topical ointment and dressings. If topical antibacterials are used, dressings should be changed daily or on alternate days. Few studies have shown that silver sulphadiazine discourages re-epithelialisation and therefore should not be used for superficial and superficial partial thickness burns. A preferred dressing is one that closes the wound, maintains moisture and falls off when the wound is healed, as it obviates the need for regular dressing changes which disrupts healing. Skin graft to cover a burn wound is recommended for full thickness burns and deep partial thickness burns which take more than 2-3 weeks to heal.<sup>20</sup>

A catabolic state (hypermetabolism of burns) develops in burns patient with more than 20% of TBSA in adults and 10% TBSA in children, and this leads to muscle wasting and often death if untreated. Nutritional support is crucial to maintain a positive nitrogen balance. Therefore,

placing a feeding tube and starting feeds early is highly advised.<sup>14,20</sup>

Sepsis is often seen with large burn wounds as the skin protective barrier is lost. In this case, an open wound is the main instigator along with the loss of immune proteins as they sip out of the intravascular space into the interstitial compartment. Unfortunately, prophylactic antibiotic use in burns is ineffective and never recommended. Close monitoring is required, looking out for a drop in platelet count, poor feeding, decrease in urine output, and metabolic derangement on blood gas analysis; all these parameters may indicate the presence of infection in burns paediatric patients. Therefore, in such cases early aggressive antimicrobial therapy is advocated for with broad spectrum antibiotics at the time when blood cultures are taken. This should be followed by culture specific antibiotics when culture results are out.<sup>20</sup>

When to refer a patient from a community health centre to a designated burns unit.<sup>21</sup>

**Table 1: When to refer a patient from a community health centre to a designated burns unit.**

| Variables                              |                                                                                                                 |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>Burn extent and depth</b>           | All full thickness burns. Partial thickness burns >15% adults, 10% children and the elderly                     |
| <b>High risk body areas</b>            | Face, hands, feet, major joints, genitalia, and perineum                                                        |
| <b>Special burns</b>                   | Electrical, chemical, or inhalation burns                                                                       |
| <b>Pre-existing medical conditions</b> | Epilepsy, diabetes, heart failure                                                                               |
| <b>Associated trauma</b>               | Burns with concomitant traumatic injuries                                                                       |
| <b>Non-accidental burns</b>            | Includes suspicion of child abuse, self-inflicted burns, or assault                                             |
| <b>Special needs</b>                   | Involving a child, patients with disabilities, or burns needing social services or rehabilitative intervention. |

## CONCLUSION

A patient with burns has a complex array of needs that require specialized expertise from various health disciplines. Success in managing a burns patient therefore lies in a coordinated and goal directed strategy which encompasses the nursing team, allied health professionals (including dietitians, occupational and physical therapists, social workers), and medical practitioners (including emergency medicine doctors, surgeons, intensivists). An improved coordination of care leads to better patient outcomes, with reduced morbidity and

mortality, and addresses the physical, psychological and social needs of the patient.

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