Introduction

Burn injuries are the principal reason accounting for emergency department admissions. Based on 2002 data reported by the Bureau of National Health Insurance (Taiwan), 178,975 burn patients, i.e., 0.8% of the total Taiwanese population, were registered for medical treatment. According to one epidemiologic survey of burn injuries in Taiwan, the overall mortality rate of burn injuries and incidence of catastrophic and hospitalized burns showed a decreasing trend, and the incidence of ambulatory burns showed an increasing trend1. Advances in medical progress and modern burn care have contributed to these changes over the last two decades, and these include the advent of topical treatment, improved resuscitation, modern hemodynamic monitoring, adequate nutritional support, and early tangential excision and grafting.

Advances in medical care and longevity have resulted in an increase in the elderly population, and burn injurie in this subset of the population are becoming more prevalent. Elderly patients over 65 years of age constitute between 13% and 20% of admissions to burn units, but have the highest death rate among the overall burn population. Among the number of burn deaths in 2002, the elderly group accounted for 30.3% of the all-age population in Taiwan. The risk of death from a major burn is associated with increased burn size, increased age, the presence of a full-thickness burn, the presence of inhalation injury, and female gender. Management of elderly burn patients remains a difficult challenge for clinicians from clinical, rehabilitative, social and ethical perspectives. Concerning the unique physiologic and metabolic changes in geriatric patients, it is imperative that a well-organized, protocol-driven approach to provide for proper medical care be considered. The current article will review the management of ongoing effective health prevention procedures, which necessitates focusing on both prevention and damage limitation with the aim of a reduction in thermal events in the elderly. [International Journal of Gerontology 2008; 2(3): 91–97]

Key Words: aged, burns, fluid therapy, mortality, resuscitation
Epidemiology of Elderly Burn Patients

Flame is the main cause of burn injury. Other causes, in order, include scalds, thermal contact, inhalation, hot fat and immersion. The majority of elderly burns occur at home, most commonly in the kitchen followed by the bathroom and living room. The majority of burns in the elderly is caused by carelessness and they are probably preventable.

Sensory and cognitive impairment in later life and preexisting medical conditions may lead to a decreased ability of the elderly to identify the severity of the situation as well as a reduced capacity to escape from harm. This, in turn, may increase vulnerability more than predicted, resulting in larger burn size, deeper burns and an increased risk of inhalation injury.

Elderly burn patients suffer from greater morbidity and mortality than younger patients with similar burn size as a result of the risk factors prevalent in the elderly, including premorbid conditions (e.g., diabetes, cardiovascular diseases), decreased pulmonary reserve, protein-energy malnutrition, unintentional weight loss, decreased lean body mass, impaired response to infection and sepsis, thinner skin, poorer microcirculation, and increased susceptibility to infection.

Fluid Resuscitation for Elderly Burn Patients

Most clinicians resuscitate patients with burns greater than 15% of total body surface area (TBSA) in adults and 10% of TBSA in children. Fluid resuscitation can be critical to the development of decreased tissue perfusion, multiple organ failure, sepsis, and mortality; hence, predicted fluid resuscitation constitutes a critical component of the early care of the burn patient. There are several fluid resuscitation formulae available for the burn patient during the initial period of volume resuscitation (Table 1). The Parkland formula is the favorite of most surgeons and emergency physicians. Mean arterial pressure (MAP) and adequate urine output (UOP) are the most reliable measures of adequate tissue perfusion. To ensure adequate fluid resuscitation, it is the goal to maintain MAP above 60 mmHg and an UOP of 0.5–1.0 mL/kg/hr or 30 mL/hr. For burn patients with myoglobinuria, osmotic diuresis with mannitol may be required to achieve an UOP of 100 mL/hr. In addition, larger volumes of resuscitation fluid were also identified as a risk factor for injury complications and death. Underresuscitation of a burn patient can lead to a downward spiral of unnecessary complications, including hypovolemic shock, renal failure, and the conversion of partial-thickness wounds to full-thickness wounds. A patient with both a large, deep burn and a profound inhalation injury, or a patient in whom resuscitation has been delayed, may require significantly more fluid than predicted by the Parkland formula to maintain MAP and UOP. In addition, in elderly patients, more fluid is required to resuscitate the same burn size than expected to avoid hypovolemia, and the reason is likely to be the decreased skin turgor which decreases the resistance to fluid accumulation or edema production.

Overresuscitation of a burn can also lead to potentially deleterious effects, including compartment syndromes involving the extremity or abdomen, pulmonary edema, congestive heart failure, acute respiratory distress syndrome, prolonged periods of ventilation, and increased mortality. These elderly patients may have underlying disease, lower cardiac output and impaired renal function, and may, therefore, be less tolerant of

<table>
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<th>Table 1. Common fluid resuscitation formulae</th>
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<td><strong>Formula</strong></td>
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<td>Parkland</td>
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<td>American Burn Association formula</td>
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fluid overload. Thus, infusion of large crystalloid volumes should be done with extreme care in elderly patients.

According to the study of Hagstrom et al.7 in 2003, there were substantial numbers of burn patients who were inappropriately fluid resuscitated. Only 23% of patients fell within the accepted range using the American Burn Association formula. They even found that 33% of the patients had a TBSA with a more than 50% discrepancy between the burn unit and emergency department calculations7.

Fluid formulae are merely guidelines and should be adjusted according to the patient’s overall conditions and comorbidity, especially in elderly burn patients. Continuous monitoring and reliance on objective clinical outcomes must dictate the patient management. In fact, relying on fluid formulae alone can lead to insufficient resuscitation, especially in patients with excessively deep burns with muscle necrosis, inhalation injury and delay in resuscitation13. Early invasive hemodynamic monitoring, such as central venous pressure monitoring, arterial thermodilution14 and use of a continuous cardiac output monitor, may be beneficial for the management of elderly patients with premorbid status or severe burns. With assistance of these novel invasive monitoring instruments, the participating clinician might have a more accurate judgment in continuous fluid administration, and more precise determination for the need of additional vasopressors to support the circulation15.

Wound Management for Elderly Burn Patients

Meticulous burn wound care is extremely important for optimal prognosis, especially in elderly patients. On consideration of significant changes in the skin aging process, decreased epidermal turnover, decreased skin appendages, thinning of the dermis, decreased dermal vasculature, decreased collagen and matrix and decreased fibroblasts and macrophages may account for decreases in the healing rate of a partial-thickness burn16–18.

Aggressive, early excision (24–72 hours post-burn) of deeply burned tissues and early skin grafting provides a greater likelihood of a return of function and decrease in infections and shorter hospital stay19, although survival has not always been improved for these patients20. A conservative approach for surgical intervention is not warranted. However, thinner skin grafts are necessary because of the thinner skin, and a longer healing time is expected21,22.

Pain control is often a forgotten topic in the management of burn wound care. In consideration of the elevation of deleterious catecholamine levels associated with pain, it is paramount to provide adequate and proper pain control and/or sedation. The geriatric burn patient is often undertreated for pain. The most likely reasons may be due to the prevalent misconception of having less pain with age and the consideration of decreased clearance of prescribed analgesics by clinicians23.

Inhalation Injury in Elderly Burn Patients

Associated inhalation injury, present in approximately one-third of burn patients treated at burn centers, must be taken into consideration. It is often suggested by singed nasal hairs, fire in a closed space, carbonaceous sputum, or a carboxyhemoglobin level >15%. A number of studies have demonstrated an increased incidence of nosocomial infection, length of stay and cost of hospital care among burn patients who sustained inhalation injury24. Inhalation injury increases mortality by a maximum of 20% in relation to one’s age and the extent of the burn25.

Inhalation injury tends to be more prevalent in elderly patients26. It is probably because they are generally less mobile and lack a protective mechanism from structural fires compared with the younger group. The presence of inhalation injury, burn size and age are significant independent determinants of mortality following burn injury, and inhalation injury is the most significant predictor of mortality (Table 2)27. Therefore, inhalation injury is an important comorbidity factor in geriatric patients resulting in more dismal prognosis. The same aggressive approach as used for inhalation injury in the younger patient applies to the elderly.

| Table 2. Independent predictors of mortality in the study of Suzuki et al.27 |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                                  | Odds ratio  (95% confidence interval) |
| Inhaling injury                  | 2.58 (2.03–3.29) |
| Full-thickness burn size         | 1.10 (1.09–1.11) |
| Partial-thickness burn size      | 1.06 (1.06–1.07) |
| Age                             | 1.05 (1.05–1.06) |

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but keeping a lower threshold of early ventilator support due to decreased lung reserve and earlier fatigue may be advisable.

**Nutritional Support of Elderly Burn Patients**

Given the pronounced metabolic response elicited by extensive burn injuries, extensive nutritional support to meet the increased energy expenditure is essential for the survival of burn patients. Early continuous internal nutritional support via nasogastric tube feeding is the preferred supplementary route for providing the extensive calorie requirement to the acutely injured burn patient, and it statistically significantly diminishes the frequency of sepsis complications\(^{28,29}\) and is effective in the prevention of stress hemorrhage in the upper gastrointestinal tract of these patients\(^{30}\). The feeding diet is formulated on basal energy expenditure with incremental energy input determined by body weight and burn size.

The presence of malnutrition and involuntary weight loss has been shown to be a major risk factor for increased infections, impaired wound healing, and mortality. Protein-energy malnutrition and involuntary weight loss are a common problem in the elderly population\(^{31}\). The goal of nutritional support must not be maintenance alone but rather replacement therapy, especially of micronutrients, as preexisting deficiency states are common\(^{22}\).

**Prognosis of Elderly Burn Patients**

Percentage TBSA burn, inhalation injury and age all have been shown to be independent predictors of mortality and prognosis in burn victims\(^{2,32–35}\). However, the recent studies of Pomahac et al. revealed that modern burn care allows survival in many patients aged over 80 years with less than 60% TBSA burns, without significant other comorbidities\(^{36}\).

Krob et al., in 1991, showed that general trauma scores perform poorly when used to attempt to prognosticate burn injuries\(^{37}\). There are many scoring systems designed for quantification of severity of burns and prediction of mortality of burn patients. TBSA and burn index (burn size of third degree × 1 + burn size of second degree × 1/2) are very easy to use, but they evaluate only the severity of burns\(^{38}\). The prediction of burn mortality using the Baux Score (age +%TBSA, e.g., 50 years +20% burn = 70% mortality) is obviously quite variable depending on associated medical factors, and it does not provide reliable correlations with actual mortality in very old patients\(^{39–41}\). The predictive formula of Ryan et al.\(^{2}\) applies three objective clinical criteria at the time of admission, including age over 60 years, more than 40% of TBSA, and inhalation injury. Their simple method predicts 0.3%, 3%, 33% or approximately 90% mortality, depending on whether zero, one, two or three risk factors are present, respectively\(^{2}\). However, the limitations of the formula of Ryan et al. become apparent when a 100% TBSA burn victim without the other two factors (age, inhalation) would have only a 3% risk of death\(^{2,3}\). The Prognostic Burn Index, which is calculated by summation of burn index and age, is a convenient index of prognosis, but also has limitations in elderly patients and in patients with severe underlying illness\(^{42}\).

The Abbreviated Burn Severity Index (ABSI), published by Tobiasen et al. in 1982, is a more recent index based on five variables: age, sex, full-thickness burn, TBSA burned, and inhalation injury (Tables 3 and 4)\(^{43}\).
ABSI is more accurate and specific in describing outcomes for the victims of burn injury, and it was also found to be a good indicator of survival when used in a study of burns in octogenarians, although the ABSI does not take coexisting morbid conditions into account. Concerning the vulnerability of elderly burn patients, ABSI seems to be superior in predicting outcome in the geriatric population following thermal injury.39,43,44

Rehabilitation of Elderly Burn Patients

The subsequent problem of secondary scarring and constrictive wounds are encountered after the acute stage. Significant degradation in quality of life and social functionality would be expected. The long-term disability is much greater in elderly burn patients. Approximately 50% of elderly patients with a major burn return to a home environment within the first year compared with nearly 90% of younger adults.45–47 Hence, the importance of aggressive rehabilitation to avoid early loss of function or strength cannot be overemphasized. The geriatric patient is capable of resistance exercise for muscle strength and should not be managed conservatively.48

Prevention Strategies for Elderly Burn Patients

The best management for burn injury is prevention. Given that the majority of these injuries are preventable, it is important to focus on effective burn prevention strategies in addition to improved burn treatment. Approximately 30% of elderly patients are the victims of self-neglect, and injuries are, therefore, preventable. In addition, at least 10% are the victims of elder abuse.49 Burn prevention campaigns and educational programs for the elderly should focus on reducing flame and scald burns that occur in the home, preferably using television, news and poster media.50 Optimal and safe living environments for a growing older population are necessary for injury prevention.

Conclusion

Given the increasing population of people over the age of 65, geriatric thermal injury still remains a challenge from clinical, rehabilitative, social and ethical perspectives. Recent literature reveals the present limitations for improvement of survival rates and prognosis in elderly burn patients, despite advances in the care of patients with major burns. Concerning the unique physiologic and metabolic changes in geriatric patients, it is imperative that a well-organized, protocol-driven approach to provide for proper medical care be considered. Furthermore, ongoing effective health prevention programs also necessitate focusing on both prevention and damage limitation with the aim of a reduction in burn events.

References


