Assessment and Management of Major Burns: A Case Presentation

Annelise Gallien and Steven F. Morris, MD, MSc, FRCSC
Dalhousie University Medical School – Division of Plastic Surgery, July 2006

Introduction
A major burn is defined as a burn covering ≥ 25% of total body surface area. However, there are similar features to the treatment of any burn injury[1]. This case presentation will illustrate the key elements of assessment and management of major burns.

Case
MB is a 53 year old man who was transferred to the burn unit by life flight. He was burning brush in his backyard and threw a can of gasoline in the fire which resulted in an explosion. He suffered burn injuries to his anterior chest, abdomen, arms, hands and face (Fig.1 & 2). He dropped to the ground and rolled to extinguish the fire. He then took off all of his clothing and stood in the shower until the fire department took him to the local emergency department. MB suffers from MS but has no other medical conditions. He has no known allergies.

Figure 1: Burn to shoulder

Figure 2: Burn to forearm & hand

Pathophysiology of Burns
Burn injuries result in both local and systemic responses[2].

Local response
Burns have 3 zones (Fig.3):

1- zone of coagulation (ischemia): point of maximum damage, irreversible tissue loss due to coagulation of constituent proteins

2- zone of stasis (edema): decreased tissue perfusion, tissue potentially salvageable. Goal is to increase tissue perfusion in order to prevent deterioration to coagulation.

3- zone of hyperemia: outermost zone where tissue perfusion is increased. This tissue will recover unless there is prolonged severe hypoperfusion.

Systemic response

The release of cytokines and inflammatory mediators at the site of injury will cause systemic effects once the burn covers about 30% of total body surface area (Fig.4).

1- CVS: increased capillary permeability leading to loss of intravascular proteins and fluids. Peripheral and splanchnic vasoconstriction occurs and myocardial contractility is decreased. All these factors result in systemic hypotension and end-organ hypoperfusion.

2- Respiratory: inflammatory mediators cause bronchoconstriction which may progress to ARDS.

3- Metabolic: basal metabolic rate is increase up to threefold. Coupled with splanchnic vasoconstriction, early and aggressive enteral feeding is necessary to maintain gut integrity.

4- Immunologic: non-specific downregulation of both cell-mediated and humoral pathways.

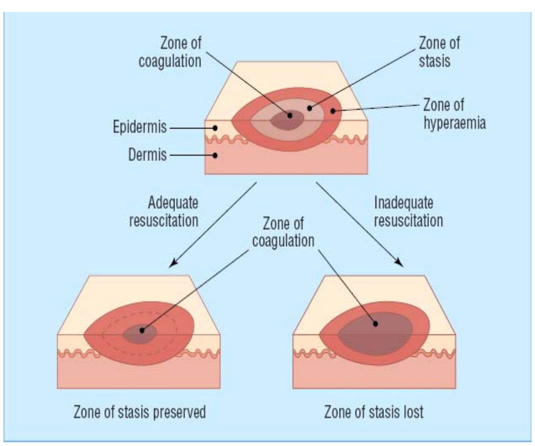

Figure 3: Jackson's burn zones in local response to burn injury. Adapted from Hettiaratchy, S. et al. BMJ 2004;328:1427

Case continued

Upon arrival at the local hospital he was found to have significant airway edema and soot in his oropharynx. He was intubated with a 7.5 endotracheal tube. He had burns to 40% of total body surface area. Fluid resuscitation was initiated at 800 cc/hr according to the Parkland formula.

Parkland Formula:

- 4cc / kg / % BSA burned (2nd and 3rd degree)

Calculation in this patient:

- 4 cc X 40% X 80 kg = 12 800 cc in first 24 hrs
- 50% (6 400 cc) given in first 8 hours, therefore 800 cc/hr

Analgesia and sedation was achieved with fentanyl and versed. He received tetanus toxoid due to the extent of his burn injuries. Initial investigations included C-spine x-rays and CXR, CBC, lytes, ABG, carboxyhemoglobin and ECG. He was subsequently transferred to the burn unit via life flight.

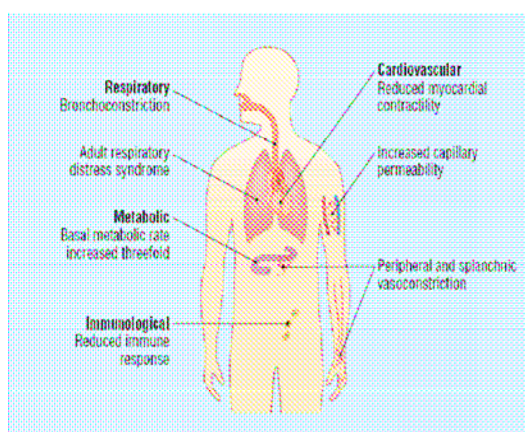

Figure 4: Systemic response to major burns. Adapted from Hettiaratchy, S. et al. BMJ 2004;328:1428

Initial Management of a major burn

1- ABCs according to ATLS protocol, with particular emphasis on assessment of airway and breathing[1]. Suspected inhalation injury requires immediate intubation prior to transfer due to impending airway edema. A burn eschar encircling the chest may also cause respiratory failure by restricting chest expansion. In this case an emergency escharotomy is indicated (procedure described later). Finally, CO poisoning requires treatment with 100% O_2 which displaces CO from bound proteins 6 times faster then atmospheric O_2.

2- Assess burn size using Wallace rule of nines (Fig. 5) or the Lund and Browder chart (Fig. 6). Lund and Browder chart is more accurate (assessment of burn depth later as sometimes difficult to determine initially)

3- Establish IV access with 2 large bore IVs and catheterize patients. Calculate fluid requirements using the Parkland formula:

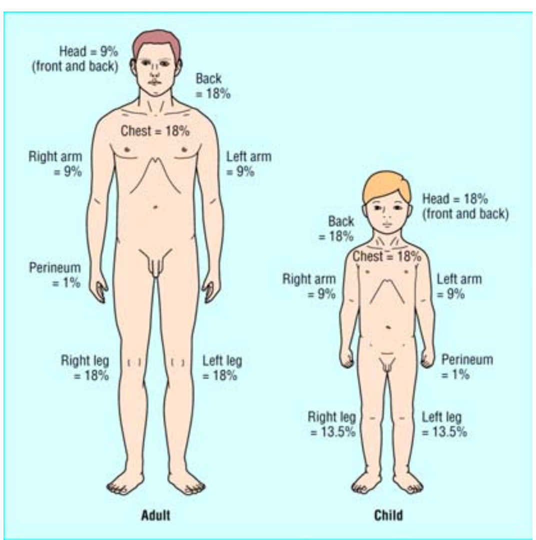

Figure 5: Wallace rule of nines. Adapted from Hettiaratchy, S. et al. BMJ 2004;329:101

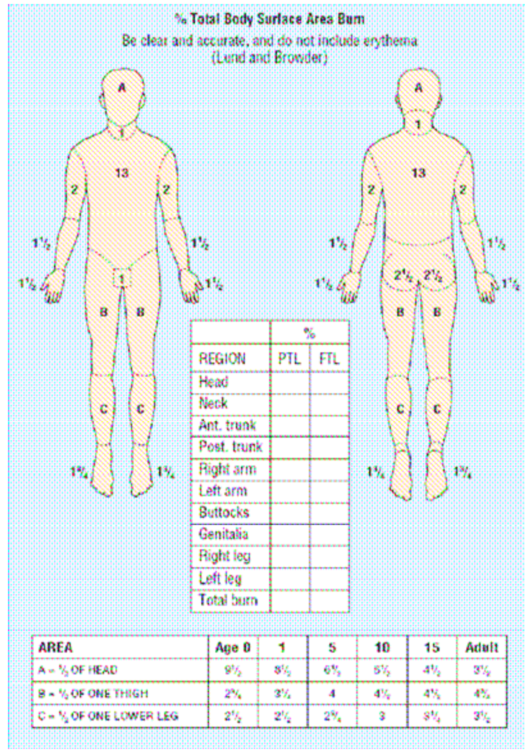

Figure 6: Lund and Browder chart. Adapted from Hettiaratchy, S. et al. BMJ 2004;329:101

- ❖ Total fluid requirements (crystalloid) in first 24 h = 4 ml X (total burn surface area %) X BW (kg)
- ❖ 50% given in first 8 hours, 50% given in next 16 hours
- ❖ Goal is to achieve urine output of 0.5-1.0 ml/kg/hour in adults. Fluids can be titrated accordingly.
- ❖ At the end of 24 hours, colloid infusion is begun at a rate of 0.5 ml X burn area X BW (kg) and a maintenance crystalloid (usually D5W/half NS) is continued at a rate of 1.5 ml X burn area X BW (kg).

4- Give analgesia (IV morphine)

5- Base line investigations (CBC, UA, BUN, creatinine, CXR, electrolytes, ECG, cross-match, ABG, carboxyhemoglobin)

6- Tetanus prophylaxis

7- Cleanse, débribe and dress wound (cling film preferred as it protects wound, reduces heat and does not alter the wound appearance)

8- Perform secondary survey

9- Arrange safe transfer to specialist burn facility

Case continued

Upon arrival to the burn unit, a more detailed assessment of his burn injuries was undertaken. He suffered second and third degree burns to 40% of total body surface area. The burn injury was circumferential in the right arm, forearm and wrist. He was taken to the OR shortly thereafter for escharotomy of the left upper limb (Fig. 7 & 8).

Figure 7: Escharotomy

Figure 8: Escharotomy

Assessment of Burn Depth

Estimation of burn depth can be difficult[3]. Accurate assessment is important for planning treatment, however it is not necessary to calculate fluid requirements. Most burns are a mixture of different depths. A burn is a dynamic wound and its depth will change depending on the effectiveness of resuscitation (Table 1).

Escharotomies

Full thickness burns result in an eschar that is inelastic and may become restrictive to the underlying structures[4]. During fluid resuscitation, intracellular and interstitial edema progresses which results in rising pressure under an unyielding eschar. Both full-thickness and extensive partial-thickness circumferential extremity burns are most likely to impede peripheral blood flow. During an escharotomy, only the tissue extending to the subcutaneous fat is released, not any underlying fascia. This differentiates the procedure from a fasciotomy. Incisions are made along the midlateral or medial aspects of the limbs avoiding any underlying structures (Fig. 9). Escharotomies are best done with electrocautery as they tend to bleed. They are then packed with Kaltostat alginate dressings and dressed with the burn.

Surgery

Superficial burn wounds should heal by regeneration within 2 weeks. Deeper burns will not reepithelialise spontaneously and should have epithelial cover within 3 weeks to minimize scarring[5]. The ideal covering of a burn is a split thickness skin autograft from unburnt areas. Donor sites should ideally be harvested from adjacent skin to improve color match. If donor sites

Table 1: Burn Depths

Nomenclature	Traditional Nomenclature	Depth	Clinical Features
Superficial	First degree	Epidermis	Painful, blancheable
Superficial-Dermal	Second degree	Into superficial dermis	Painful, blisters, blanchable, hair follicles present
Deep-Dermal	Second degree	Into deep dermis	+/- pain, does not blanch, some hair follicles present
Full thickness	Third/Fourth degree	Extends to subcutaneous tissue	Painless, black eschar, no hair follicles

are sparse due to large burns or if the wound bed is likely to bleed profusely, the graft is perforated with a mesher to allow expansion. This improves graft take but will leave permanent unsightly scars (Fig. 10). Unmeshed skin graft should be used for the face and hands.

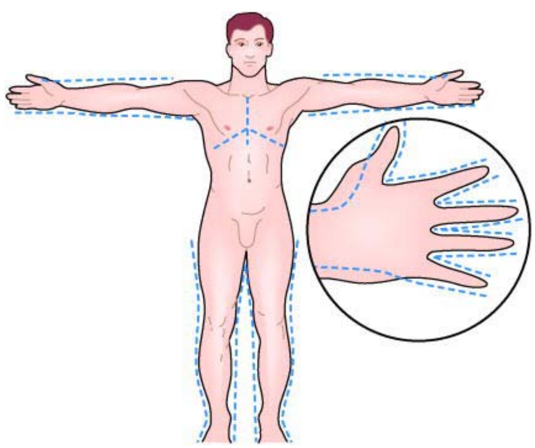

Figure 9: Preferred sites of escharotomy incisions. Adapted from Townsend CM et al: Sabiston Textbook of Surgery, 17th ed.

Case Conclusion

On day 5 post burn injuries, MB is still intubated and he developed Staph aureus pneumonia. He will go back to the OR within the next few days for skin grafting.

Figure 10: Meshed skin grafting

References

1. Hettiaratchy, S. and Papini R. Initial management of a major burn: I-overview. BMJ 2004;328:1555-1557.
2. Hettiaratchy S and Dziewulski P. Pathophysiology and types of burns. BMJ 2004;328:1427-1429.
3. Hettiaratchy S and Papini R. Initial management of a major burn: II-assessment and resuscitation. BMJ 2004;329:101-103.
4. Roberts: Clinical Procedures in Emergency Medicine, 4th edition. Saunders 2004. pp 770-771.
5. Papini,R. Management of burn injuries of various depths. BMJ 2004;329-158:160.
6. Townsend C.M.: Sabiston Textbook of Surgery, 17th edition, Saunders 2004. Chapter 22. p.578.