Burn Care

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Bruna Arcoverde Abbott, Maykon Martins de Souza, Renato da Silva Freitas, Ana Luisa Bettega, and Carl Ivan Schulman

38.1 Introduction

Burn injury is a serious health problem that can affect any social group and age range, producing countless victims worldwide. In Brazil, burn is the second largest cause of death in children, and is most prevalent at the extremes of age. The major causes of severe burn injury in younger patients are liquid scalds. Flame burns are more common in adult patients and also responsible for most deaths.

In the last decades, there was a dramatic improvement in mortality after massive burns, which is associated with better resuscitation, improvements in wound coverage by early excision and grafting, better support of the hypermetabolic response, early nutritional support, more appropriate control of infection, and improved treatment of inhalation injuries.

There are six causal categories of burns: fire, scald, contact, chemical, electrical, and radiation. Flame, scald, and contact burns cause cellular damage by the transfer of energy that induces coagulative necrosis, while chemical and electrical burns cause direct damage to cellular membranes. The skin acts like a barrier, but after the source of burn is removed, the response of local tissues can lead to further injury. The necrotic area of the burn is termed the "zone of coagulation," and the surrounding area (that has a moderate degree of injury that initially causes a decrease in

B. A. Abbott · M. M. de Souza · A. L. Bettega (✉)
Iwan Collaço Trauma Research Group, Department of Surgery, Hospital do Trabalhador Trauma Center, Federal University of Parana, Curitiba, Brazil

R. da Silva Freitas
Division of Plastic Surgery, Department of Surgery, Hospital do Trabalhador Trauma Center, Federal University of Parana, Curitiba, Brazil

C. I. Schulman
Division of Trauma Surgery & Critical Care, DeWitt Daughtry Family Department of Surgery, Miller School of Medicine, University of Miami, Miami, FL, USA

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tissue perfusion) is the "zone of stasis." The "zone of hyperemia" is formed as a result of vasodilation from inflammation surrounding the burn wound and contains viable tissue.

38.2 Inflammatory Response

Significant burn can lead to hypermetabolic response and massive release of inflammatory mediators in the wound. The hypermetabolism is mediated by increases in circulation levels of catabolic hormones (catecholamines, cortisol, and glucagon) and is associated with alterations in blood serum glucose, hyperdynamic cardiovascular response, increased energy expenditure, loss of lean body mass and body weight, accelerated breakdown of glycogen and protein, lipolysis, and immune depression. Many mediators have been proposed to explain the changes in vascular permeability such as catecholamines, histamine, bradykinin, vasoactive amines, leukotrienes, and activated complement. Also, aggregated platelets release serotonin that improves the formation of edema. Another important mediator is thromboxane A2, which is a potent vasoconstrictor leading to platelet aggregation and contributing to expansion of the zone of stasis.

Major burn injury results in multiple organ dysfunction, including cardiac and pulmonary effects, decrease in renal blood flow and fall in glomerular filtration rate, hepatic steatosis due to increased peripheral lipolysis, and generalized impairment in host defenses that leads to increased susceptibility to infections. All burn-related metabolic responses last more than 2 years post-burn.

38.3 Initial Care

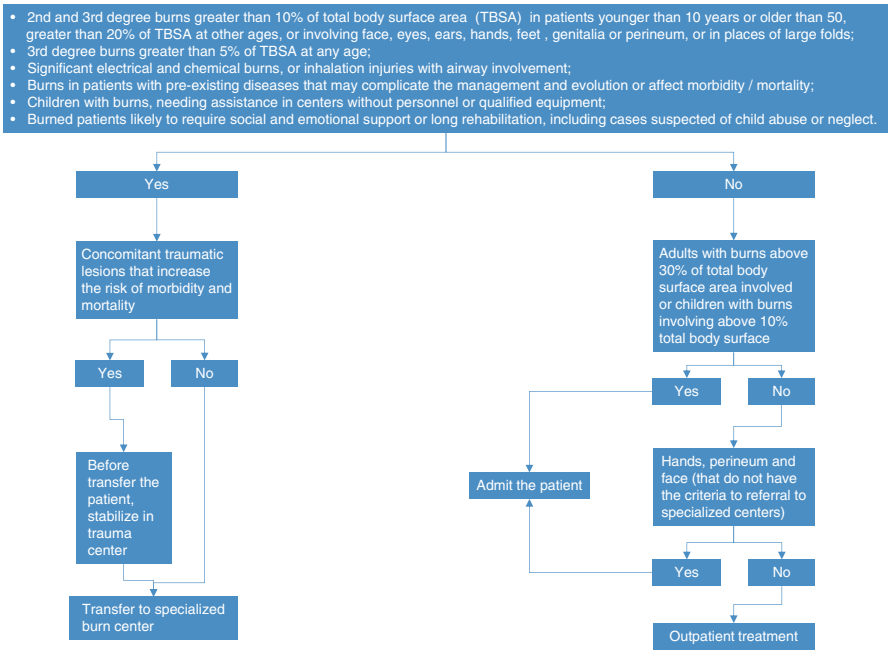
Since every burn victim should be considered as a trauma victim, the initial assessment should be fast and objective following clear rules observing basically the following parameters: age of the patient, affected site of the body, burn body surface area and identifying the causative agent of the lesion, other associated traumas, comorbidities, social conditions, and depth of burns.

The patient should be removed from the source of the burn to stop burning process, and clothing and jewelry should be immediately removed. Then, the patient should be placed on sterile or clean sheets; cold water and ice are not recommended since they can harm by inducing hypothermia.

Regarding the depth of the lesion, they can be classified as follows: first degree which comprises only the epidermis, second degree reaching also partially the dermis, and third degree in which injuries have spread to the entire thickness of the dermis. To calculate the burn surface area, the patient's own hand rule, which represents approximately 1% of the body area, or the "rule of nines," can be used.

After the classification of the patient through the parameters described above, a coordinated order of steps is required to perform a correct risk stratification which will allow evaluating if hospitalization or outpatient treatment is needed or

if the patient needs to be transferred to a specialized burn care center. For that, we elaborate the following practical and objective algorithm:



It is important to evaluate the airway once airway obstruction due to inhalation injury or edema can be present and indicate immediate treatment with intubation. Arterial blood gas and carboxyhemoglobin levels should be obtained when inhalation injury is suspected. Noninvasive measurement of blood pressure may be difficult in patients with burned extremities, so an arterial line may be necessary to monitor the blood pressure during transfer or resuscitation. The insertion of a femoral arterial line may be more appropriate.

The best intravenous access can be obtained with short large-bore peripheral catheters through unburned skin. Other options are central venous lines or intraosseous access. Lactated Ringer's solution without dextrose is the fluid of choice except in children less than 2 years of age. Infants should receive some 5% dextrose in intravenous solutions to prevent hypoglycemia because they have limited glycogen stores. The initial rate can be rapidly estimated by multiplying the estimated total body surface area (TBSA) burned by the weight in kilograms, which is divided by 4 to get an hourly rate for the first 8 hours (Parkland formula). Children have a larger body surface area relative to their weight compared to adults and generally have grater fluid needs during resuscitation. The Galveston formula for children based on body surface area uses 5000 ml/m^2 TBSA burned for resuscitation + 1500 ml/m^2 TBSA for maintenance in the first 24 hours. Over-resuscitation can be prevented by monitoring urine output, which should be maintained at 0.5 ml/kg/h in adults and 1.0 ml/kg/h in children.

38.4 Chemical Burns

In chemical burns, it is necessary to prompt treatment to minimize tissue damage and the area should be copiously irrigated with water. Attempts at neutralization of either acidic or basic solutions can result in heat production and extend the injury. Chemical burns are typically deeper than that appears.

38.5 Electrical Injuries

They may be mostly internal, affecting nerves, blood vessels, and muscle, and sparing skin, except at the contact point of the electrical current. Electrical injuries require vigorous intravenous resuscitation (urine output maintained at greater than 1 ml/kg/h) and attention to myoglobinuria from muscle damage. If necessary, administration of mannitol to increase renal tubular flow and bicarbonate to alkalize the urine can be considered.

Important burns in extremities may lead to generalized edema that impedes venous outflow and will have a tourniquet effect on the arterial inflow to the distal beds. The release of a burn eschar is performed by making lateral and medial incisions on the affected extremity using the electrocautery to release the obstruction to blood flow.

38.6 Wound Care

Once the extent and depth of the wounds have been assessed and the wounds have been thoroughly cleaned and debrided, the management phase begins. The choice of dressing should be individualized. First-degree burns require no dressing and can be treated with lotion to keep the skin moist. Second-degree burns can be treated with an antibiotic ointment and covered with gauze under elastic wraps. Alternatively, the wounds can be covered with a temporary biologic or synthetic covering to close the wound, including biological materials such as allograft skin, porcine xenograft skin, human amniotic membranes, and synthetic materials and silver-impregnated dressings.

38.7 Surgical Treatment

Most surgeons practice early excision and skin graft due to benefit over serial debridements in terms of survival, blood loss, and length of hospitalization. After the excision, the wound must be covered with autograft skin or another covering. The recommendation is to perform the excision immediately after stabilization of the patient, and once blood loss diminishes, the operation can be performed the first day after injury.

Skin graft loss after an operation is typically due to the presence of infection, fluid collection under the graft, shearing forces that disrupt the adhered graft, or an inadequate excision of the wound bed.

38.8 Control of Infection

The topical antibiotics can be salves or soaks. Salves are generally applied once or twice a day directly to the wound with dressings placed over them, and include 8.5% mafenide acetate, 1% silver sulfadiazine, polymyxin B, neomycin, bacitracin, and mupirocin. Soaks with antimicrobial solutions are generally poured into dressings on the wound, and include 0.5% silver nitrate solution, 0.025% sodium hypochlorite, 5% acetic acid, and 5% mafenide acetate solution.

Besides, perioperative systemic antimicrobials are useful in decreasing sepsis in the burn wound. Choosing the antimicrobial is important to cover *S. aureus* and *Pseudomonas* sp. that are prevalent in wounds.

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