Med Intensiva. 2016;40(1):46–48

medicina intensiva

www.elsevier.es/medintensiva

SPECIAL ARTICLE

Update in the management of critically ill burned patients

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Received 11 October 2015; accepted 22 October 2015
Available online 30 December 2015

KEYWORDS
Trauma;
Burns;
Resuscitation;
Shock;
Management

Abstract The management of critically ill burn patients is challenging. These patients have to be managed in specialized centers, where the expertise of physicians and nursing personnel guarantees the best treatment. Mortality of burn patients has improved over the past decades due to a better understanding of burn shock pathophysiology, optimal surgical management, infection control and nutritional support. Indeed, a more aggressive resuscitation, early excision and grafting, the judicious use of topical antibiotics, and the provision of an adequate calorie and protein intake are key to attain best survival results. General advances in critical care have also to be implemented, including protective ventilation, glycemic control, selective decontamination of the digestive tract, and implementation of sedation protocols.

PALABRAS CLAVE
Trauma;
Quemadura;
Reanimación;
Shock;
Tratamiento

Actualización sobre el tratamiento de enfermos quemados críticos

Resumen El manejo de enfermos quemados críticos supone un gran reto para el clínico. Estos pacientes han de ser tratados en centros especializados, donde la experiencia del personal médico y de enfermería garantiza el mejor tratamiento. El pronóstico de los enfermos quemados ha mejorado durante las últimas décadas debido a una mejor comprensión de la fisiopatología del shock y a un mejor tratamiento quirúrgico, de la infección y soporte nutricional. La reanimación intensiva, el tratamiento quirúrgico más puntual, el uso juicioso del tratamiento tópico antimicrobiano y el aporte de la cantidad de nutrientes necesaria son aspectos clave

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para conseguir los mejores resultados. También han de implementarse los avances generales en la medicina intensiva, como son la ventilación mecánica protectora, el control de la glucemia, la descontaminación digestiva selectiva y el uso de protocolos de sedación.

The management of critically ill burn patients is challenging. These patients have to be managed in specialized centers, where the expertise of physicians and nursing personnel guarantees the best treatment. Mortality of burn patients has improved over the past decades due to a better understanding of burn shock pathophysiology, optimal surgical management, infection control and nutritional support.[1] Indeed, a more aggressive resuscitation, early excision and grafting, the judicious use of topical antibiotics, and the provision of an adequate calorie and protein intake are key to attain best survival results. General advances in critical care have also to be implemented, including protective ventilation, glycemic control, selective decontamination of the digestive tract, and implementation of sedation protocols.

Editors of *Medicina Intensiva* have made the keen decision to support the publication of a series of five review articles updating current management of critically ill burned patients, covering areas such as initial treatment, resuscitation, infection control, surgery and current guidelines and evidence-based burn care.

The framework for an appropriate comprehension of current burn care has to include basic knowledge on advances on the physiological bases of resuscitation, as will be discussed in detail in the present series. Burn patients develop shock immediately after trauma.[2–5] Shock is characterized by severe tissue hypoperfusion. Despite the presence of shock, blood pressure is often not low due to intense vasoconstriction of the cardiovascular system. The intense systemic catecholamine surge increases blood pressure (increased afterload) that compromises cardiac function. Hypovolemia is determined by intracellular fluid shifts and loss of plasma volume due to the release of inflammatory mediators and subsequent increased capillary permeability. Understanding that the major cardiovascular disturbance in burn shock is hypovolemia is crucial for the success of resuscitation.[6–8] We have shown that 90% of patients admitted to the Burn ICU are successfully resuscitated following this principle, only by the administration of crystalloids and, in some cases, colloids in the form of albumin.[8]

It is important to note that immediately after trauma there is decreased cardiac output and a marker increase in systemic vascular resistance (*ebb* phase) that evolves over the first 72 h of resuscitation toward a state of systemic vasodilation and increased cardiac output.[5] Thus the typical vasodilatory state characteristic of distributive shock ensues only 2–3 days after resuscitation is initiated, being the initial state characterized by hypovolemic shock. Low cardiac output is the combined result of decreased plasma volume (low preload), increased afterload, and decreased contractility.

Patients with burns of more than 20% total body surface area (TBSA) need resuscitation. However we have found that elderly patients with burns as small as 10% TBSA are admitted to the floor without resuscitation only to require days later ICU admission because of hypotension and renal failure. Thus, the need for resuscitation in the context of significant intravascular fluid deficit should not be ignored even for small burns, particularly in the elderly. Under-resuscitation leads to persistent tissue hypoxia, metabolic acidosis, shock and renal failure. The risk of over resuscitation, leading to excessive edema formation and limb, abdominal and orbital compartment syndromes, has recently been pointed out.

The pathophysiology of the burn injured gravitates around the open wound, which perpetuates the state of hypercatabolism, immunodeficiency and risk of infection.[9,10] Thus advances that allow burn wound closure in a short period of time are needed, as will be reviewed in the current series. The standard surgical treatment rests on only two principles: removal of burned skin and coverage of the burn wound in the shorter period of time possible. Delayed burn wound closure is associated with increased risk of infection, higher mortality and worse esthetic and functional results. Split-thickness skin autografts are used for burn wound closure. Normal skin is taken from unaffected areas (donor site) and used to cover the excised wound. However, closure takes time, and donor sites may not be available to cover the burn wound in cases of extensive burns. In these cases, autografts from the patients keratinocytes obtained from a small biopsy can be used with reasonable success,[11–13] but cell expansion takes 3–4 weeks before keratinocytes are ready to use. Thus, advances to obtain permanent coverage in a short period of time are needed.

Cell based therapies using progenitor cells is a new option aimed at improving time to healing. Mesenchymal stem cells (MSC) from the bone marrow have been successfully used to treat burns experimentally and in human subjects.[14–16] However, the use of autologous (from the same patient) MSC as a therapy for burns is also associated with a delay of several weeks required for cell isolation and expansion in culture. However, allogeneic (from a different individual) MSC, already expanded and ready to use, will circumvent the problem of the time required for cell expansion before use, and can be available for treatment in the early stages after injury.[17,18]

These series are completed by discussion on initial treatment, infection control and evidence-based burn care. Indeed, knowledge on the initial management of burn injury is pertinent for any critical care physician. Early management principles are only related to airway management (consider intubation in cases with facial burns, burns in an enclosed space, or large burns), and initiation of fluid resuscitation. Consideration of these principles suffices to keep the patient alive until the patient is taken to a specialized center. Infection control by the use of bacteriological surveillance cultures, use of selective digestive

decontamination to prevent secondary endogenous infections,[19,20] and early antibiotic treatment when infection is suspected, is crucial in later stages after injury, as most patients who do not survive die in the context of multiorgan failure associated with sepsis. Finally, burn care has been traditionally based on expert opinion and evidence based guidelines and clinical trials were lacking. However, over the past years many clinical trials in this area and well designed evidence-based practice guidelines have been published, and burn care recommendations do not rest any longer only in expert opinion but in higher levels of evidence.[21]

Conflict of interest

The authors declare no conflict of interest.

Financing

Funded by FIS PI 12/02989 and co-funded by FEDER funds.

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