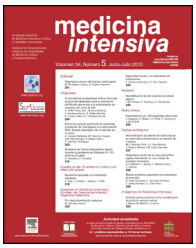
Med Intensiva. 2016;40(2):118–124

medicina intensiva

www.elsevier.es/medintensiva



SPECIAL ARTICLE

First resuscitation of critical burn patients: progresses and problems

M. Sánchez-Sánchez*, **A. García-de-Lorenzo**, **M.J. Asensio**

Hospital Universitario La Paz/Carlos III, Instituto de Investigación IdiPaz, Madrid, Spain

Received 22 July 2015; accepted 12 December 2015
Available online 9 February 2016

KEYWORDS
Fluid resuscitation;
Burn;
Colloids

Abstract Currently, the aim of the resuscitation of burn patients is to maintain end-organ perfusion with fluid intake as minimal as possible. To avoid excess intake, we can improve the estimation using computer methods. Parkland and Brooke are the commonly used formulas, and recently, a new, an easy formula is been used, i.e. the 'Rule of TEN'. Fluid resuscitation should be titrated to maintain the urine output of approximately 30–35 mL/h for an average-sized adult. The most commonly used fluids are crystalloid, but the phenomenon of creep flow has renewed interest in albumin. In severely burn patients, monitoring with transpulmonary thermodilution together with lactate, ScvO2 and intraabdominal pressures is a good option. Nurse-driven protocols or computer-based resuscitation algorithms reduce the dependence on clinical decision making and decrease fluid resuscitation intake. High-dose vitamin C, propranolol, the avoidance of excessive use of morphine and mechanical ventilation are other useful resources.

PALABRAS CLAVE
Fluidos de resucitación;
Quemados;
Coloides

Reanimación inicial de pacientes quemados críticos: progresos y problemas

Resumen El objetivo de la reanimación de los pacientes quemados es mantener la perfusión tisular con el menor aporte de fluidos posible. Para evitar un aporte excesivo podemos usar métodos de estimación computarizados. La fórmula de Parkland y la de Brooke son las más usadas y recientemente se ha propuesto una fórmula sencilla que es la «regla de los diez». Los fluidos de reanimación deben intentar mantener una diuresis de 30-35 ml/h. Los fluidos más usados son los cristaloides, pero el fenómeno del «fluid creep» ha renovado el interés por el uso de la albúmina. En pacientes quemados críticos, la monitorización con termodilución transpulmonar junto con lactato, $SvcO_2$ y presión intraabdominal es una buena opción. Protocolos de enfermería y algoritmos de reanimación informáticos reducen la dependencia de las decisiones

* Corresponding author.
E-mail address: manuelsanchezsa@gmail.com (M. Sánchez-Sánchez).

http://dx.doi.org/10.1016/j.medin.2015.12.001

de los clínicos y disminuyen el aporte requerido. Otras actuaciones útiles son: usar altas dosis de vitamina C, emplear propranolol y evitar el uso excesivo de morfina y de ventilación mecánica.

Introduction

Over the recent years, the improved survival rates in the critically burn patients are because of the development of resuscitation protocols together with early burn wound closure, improved respiratory and renal support, control of the hypermetabolic response and early enteral nutrition.

Emergency management follows the principles of the Advanced Trauma Life Support Guidelines for the assessment and stabilisation of airway, breathing, circulation, disability, exposure and environment control. Instantaneously, we must assess for the severity and extent of the burn.

The goal of the initial resuscitation of critically burn patients is to replace extracellular fluid losses to maintain end-organ perfusion and prevent burn shock. These patients have a much higher capillary leak than that in septic or trauma patients; thus, they require more aggressive fluid resuscitation. Furthermore, in critically burn patients, only partial compensation can be achieved by fluid resuscitation because of a generalised reduction in sodium ATPase activity and disruption of the cellular transmembrane ionic gradient.[1]

Clinically, this is manifested by hypovolaemia, haemoconcentration, oedema, reduced urine output and cardiovascular dysfunction.

Under-resuscitation can limit perfusion to potentially recoverable burns, grafted tissue, kidney and other organs that are not directly injured. Over-resuscitation is as deleterious as under-resuscitation. Excessive fluid administration can produce complications such as the conversion of superficial burns into deep burns; abdominal, extremity and orbital compartment syndromes; myocardial oedema; infectious complications; impaired gas exchange, prolonged mechanical ventilation, prolonged hospital stay and multiple organ dysfunction.[2]

Fluid resuscitation

All critically burn patients should receive formal fluid resuscitation. Delayed or insufficient fluid resuscitation increases mortality. Patients with inhalation injury, electrical burns and those in whom resuscitation was delayed have greater fluid requirement than others. Other factors that increase the fluid requirement are age, narcotic use and ventilator dependence.

Several studies have shown that many patients with major burns receive more fluid than that recommended by the Parkland formula.[3,4] Friedrich et al. found that fluid requirements of their current patients were double that of those before.[5] This phenomenon had been described by Pruitt, and it was named as 'fluid creep'.[6] To avoid fluid creep, patients should be given the least amount of fluid necessary to maintain adequate organ perfusion.[2] Fluid creep usually results from inaccuracies in calculating fluid requirement, from clinician inattention to reducing unnecessary fluid infusions, from the increased use of sedation and narcotic pain medication and from the excess administration of crystalloid. Finally, despite the growing awareness of fluid creep, Cartotto et al. confirmed that their patients were continuing to receive more fluid as expected.[7]

Fluid selection

The ideal burn resuscitation fluid is the one that effectively restores plasma volume, with no adverse effects. There are no level I or II publications to guide the choice of resuscitation fluid in the burn patient. The most commonly used fluids are *crystalloid solutions*. High-volume administration of normal saline can produce dilutional hyperchloraemic acidosis; to avoid it, we use Ringer Lactate (RL) solution. However, RL is not free of some adverse effects such as an increase in neutrophil activation. D-Lactate in RL solution containing a racemic mixture of the D-lactate and L-lactate isomers has been found to be responsible for the increased production of reactive oxygen species and acute respiratory distress syndrome. Another adverse effect that has been demonstrated is that dilution with crystalloids resulted in a hypercoagulable state.

Other balanced solutions have demonstrated effectiveness in burn patients. Thus, Gille et al. showed that Ringer's acetate solution in severe burn is associated with lower SOFA-scores than RL solution.[8]

Hypertonic sodium solutions have proven to increase the plasma osmolality and limit cellular oedema. Patients resuscitated with hypertonic sodium solutions required lower total volume than that of isotonic solutions in the initial 24 h, but after 48 h, cumulative fluid loads were similar. The use of hypertonic saline as a resuscitation fluid decreases the risk of abdominal compartment syndrome but does not appear to provide better outcomes than isotonic solutions and has been associated with increased rates of renal failure and death in one retrospective observational study.[9]

Colloids are more expensive, and in critically ill patients, do not improve survival when compared with crystalloids.[10] Some studies were unable to observe increase in multiple organ failure rates or direct association between died and fluid resuscitation in critically burn patients, whereas other studies found that colloid-resuscitated patients required less fluid than those who received crystalloid alone.[11] Thus, there is a great controversy about the use of colloids in burn patients, but the American Burn Association (ABA) accepted the addition of colloid-containing fluid following burn injury, particularly after the first 12–24 h post-burn, because it may decrease the overall fluid requirements. The