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WHAT'S NEW IN INTENSIVE CARE

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Ten tips for managing critically ill burn patients: follow the RASTAFARI!

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Critically ill burned patients experience intensive injury associated with severe cardiovascular, immune, and metabolic disturbances. Management of severely burned patients remains challenging for many intensivists who only rarely face burn injuries. Together with pain and anesthetic management a multidisciplinary approach is needed in which anesthesiologists, intensivists, and surgeons play a central role. A critically ill burned patient could be defined as a burn patient with occurrence of organ dysfunction and/or requiring organ support. Adult patients with a total body surface area (TBSA) greater than 20 %, children with a TBSA greater than 10 %, or patients with inhalation injury are at most risk of developing organ dysfunction. Although specialized care is mandatory, all intensivists have already faced, or will, a patient with severe burn injury in its initial management before transferring the patient to a burn center. In this way, key factors of initial burn care should be known by all intensivists. Well-powered and designed randomized controlled trials are lacking for most strategies or treatments in burn care and most recommendations are based on observational data and/or expert opinions. However, many strategies remain controversial with clinical and pathophysiological questions being unanswered.

Although evidence-based strategies to improve outcome are lacking, prognosis of critically ill burn patients has much improved over the last 20 years thanks to refined critical care and surgical techniques [1]. In this short paper, we detail the key points of initial (0–48 h) critical care burn management (Fig. 1). Improvement in initial management is likely to improve survival and functional outcome, based on evidence from the specialized literature but also from translation of non-burn critical care literature.

1. Estimation of the burned body surface area (%TBSA) can be difficult, especially in the prehospital setting: the "rule of nine" overestimates burns when TBSA is less than 40 % and tends to underestimate the larger burns. Although the prehospital assessment could remain gross it has to be reasonably accurate. In this way the use the "serial halvings" method is a pragmatic tool in the prehospital setting [2] (based on the estimation of the burn covering more than half of the visible area when viewing the front or back of the patient, and whether the burn covers more than the

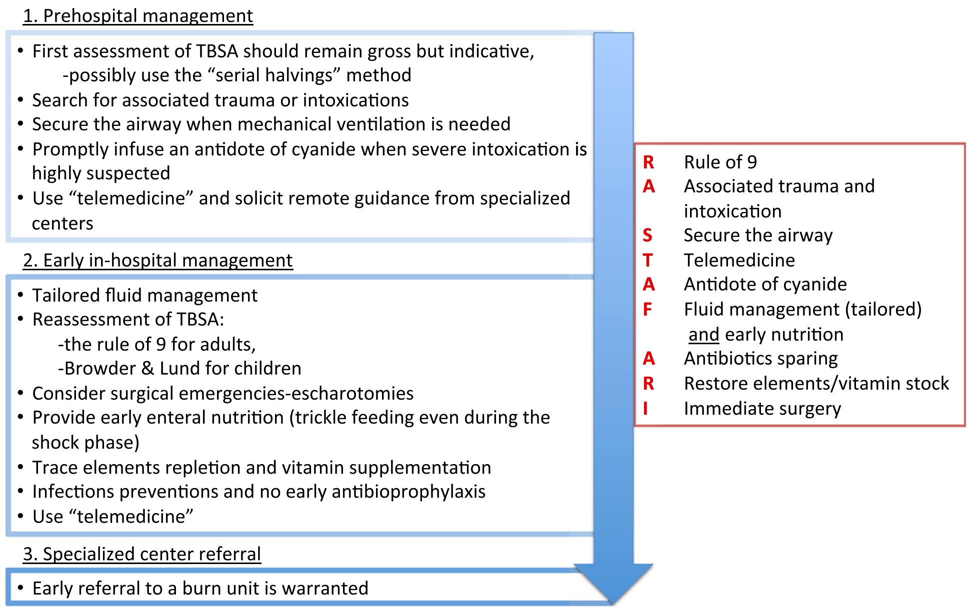

Fig. 1 The ten tips of early burn care summarized under the mnemonic of RASTAFARI, with the timeline for interventions. *MV* mechanical ventilation

remaining half, etc.). In this way, interaction with specialists is helpful and remote guidance of TBSA estimation and treatment can be guided through pictures or live video data of burn areas sent using smartphones for telemedicine to specialized centers.

2. Tailored fluid management: severely burned patients are constantly hypovolemic and dehydrated during the first 24 h. Balanced crystalloid solutions (e.g., Ringer's lactate or acetate) are the first-line fluid solutions. While severe hypovolemia with insufficient oxygen delivery to the tissues should be avoided, liberal fluid management also appears detrimental with an increase in risk of organ dysfunction, especially of abdominal compartmental syndrome. Therefore permissive hypovolemia in the absence of organ dysfunction is advised with fluid volume ranging from 2 to 4 ml/kg/%TBSA (the original Parkland formula): using the lower range is often sufficient to provide adequate organ perfusion. Likewise, targeting urine output of 0.5 ml/kg/h is a widely accepted expert consensus. On the other hand, low urine output or development of organ dysfunction or increased serum lactate or hemoglobin (greater than 18 g/dl) should lead to hemodynamic monitoring for fluid resuscitation tailoring, but maximization of cardiac output is not an objective. Systematically giving unnecessary IV fluid to fluid-responsive patients may indeed lead to fluid overload and risk of severe hypoxemia and acute compartment syndromes [3–6]. A strategy of permissive hypovolemia (i.e., a restrictive maintenance of sufficient circulating volume to prevent organ dysfunction) has been suggested to be safe in burn patients in a preliminary report [4].
3. Search for associated trauma or intoxications: the team should not be blinded by sometimes-impressive burns injury and always consider the possibility of blunt or penetrating trauma or intoxications (i.e., medications, drugs, alcohol).
4. Patients trapped in closed spaces with fire and having evidence of smoke exposure (e.g., soot in the oropharyngeal area, voice hoarseness) should be highly suspected of smoke inhalation injury and investigated for carbon monoxide and/or cyanide intoxication. Those patients presenting with an unstable condition should be given a cyanide antidote in the prehospital setting [7].
5. Endotracheal intubation should not be delayed for the most severe patients (TBSA greater than 40 % and/or massive smoke inhalation) as edema forms rapidly and reintubation can be impossible. A protective ventilation strategy with PEEP and low tidal volume should be applied.
6. Surgical emergencies–escharotomies: circular deep burns may cause compartment syndromes in limbs and trunk. Alteration of peripheral saturation and increase in creatine kinase (CK)/myoglobin plasma levels should lead to escharotomy but these measures have poor sensitivity and may lead to delay in performing the procedure. Measurements of muscular tissue pressure using pressure transducers provide an objective assessment of tissue pressure and should prompt one to perform an escharotomy when the pressure exceeds 30 mmHg [8].
7. Early enteral nutrition: cautious enteral gastric feeding as early as during the first 24 h is part of resuscitation and contributes to gastric ulcer prevention with initial energy target starting at 20–25 kcal/

kg/day (later use the Toronto equation or, even better, indirect calorimetry) [9].

8. Trace elements repletion and vitamin supplementation: burns greater than 20 % TBSA lose large amounts of antioxidant trace elements (zinc, copper, selenium) through the open wounds. Early replacement along with vitamins C and E reduces oxidative stress and may improve outcome [10].
9. Antibiotics and prevention of infection (catheters, pneumonia, skin): no antibiotics early on! Antibiotic therapy should be initiated when infection is highly suspected or proven and the strategy reassessed 48 h later. Systematic antibiotic prophylaxis during the initial 48 h should be discouraged. If antibiotics are to be initiated for proven sepsis, high doses should be infused owing to the risk of low serum concentration [11]. Burn patients carry a high risk of nosocomial sepsis. Apply best standard of care measures for prevention of nosocomial infections (i.e., ventilator-associated pneumonia, catheter-related infection, urinary tract and skin infections). Preferably insert the catheters in non-burn sites if available, ideally with ultrasound guidance [12].
10. Because burn care management can be challenging, interaction with specialists is helpful. In this way, remote guidance of local treatment can be guided through pictures of burn areas sent by telemedicine [13]. Early referral to a burn unit is warranted. Early excision of deep burn areas is a key factor in limiting the hypercatabolic phase of burn injury and probably in improving outcome. We recommend that non-specialized centers establish protocols for initial care with the reference burn center of the region.

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