EDITORIAL

Pediatric Burns—Time to Collaborate Together

Mullai Baalaaji

Keywords: Burns, Pediatric trauma, Pediatric intensive care.
Indian Journal of Critical Care Medicine (2023): 10.5005/jp-journals-10071-24604

Burns are one of the leading causes of morbidity and disability in children globally and ranks as the fifth most common cause of nonfatal childhood injuries.[1,2] Global burns registry (GBR) data reveal that children account for almost half of burn injuries worldwide and among the pediatric burn victims, more than 60% is contributed by children aged 1–5 years.[3] Global burns registry data also highlights the fact that over 50% of children sustain major burns defined as involvement of ≥15% total body surface area; however, the specialized pediatric emergency and critical care services required to cater to the needs of these children are scarce. The rates of mortality in pediatric burns is over seven times higher in the low and middle-income countries compared with high-income countries, reflecting the disparity in care capacity. This makes it important to understand the burden of burns in children in our context, their critical care requirements and outcome predictors. The authors Yashaswini et al. have described the clinical profile of pediatric burns in their retrospective cohort study, which would add to the existing epidemiologic data on burns in children in our country.[4]

Management of pediatric burns involves multidisciplinary team involving pediatricians, pediatric intensivists, plastic surgeons, anesthesiologists, and supporting staff. Children with burns involving large body surface area (BSA), inhalational injuries, electrical injuries, children with cardiorespiratory compromise are frequently admitted to intensive care units. Specialized pediatric burn centers are far and few, many of such children get managed in burns intensive care unit (ICU) or pediatric ICUs. The clinicians involved in caring for such children should have a working knowledge of the common issues faced in our setup.

Assessment of burns depth and BSA involved is crucial to understand and predict the course of burns victims, and commonly, Lund and Browder charts are utilized for this purpose. At times, the initial assessment may be falsely misleading and may evolve to a higher BSA and more deeper burns during further assessment. Increased vascular permeability following burns results in fluid shifts to interstitial compartment and resultant intravascular volume depletion. This is compounded by systemic inflammatory response syndrome (SIRS), decreased vascular resistance and myocardial depression in a few patients. Children have a larger BSA to body mass ratio, and greater burn-related fluid losses and insensible fluid losses. This makes them vulnerable to hypovolemia and resultant tissue damage, increased burn depth, multiorgan failure whenever there are delays to initiation of fluid resuscitation in children.[5] Various formulae have been proposed to guide in the fluid management and the commonly employed are Cincinnati formula which was developed by Shriners Hospitals for Children in Cincinnati that is based on Parkland formula and Galveston formula.[6] There has not been any head to head comparisons of the various proposed formulae and so, there is heterogeneity in the clinical practices among various centers. It is however, important to understand that all such formulae help us in the initial rate of fluid resuscitation in the burns injured child and further fluid rate needs to be titrated to the physiological needs, achieving adequate perfusion to the tissues, at the same time not resulting in tissue edema.

Pediatric Intensive Care Unit, Kovai Medical Center and Hospital, Coimbatore, Tamil Nadu, India

Corresponding Author: Mullai Baalaaji, Pediatric Intensive Care Unit, Kovai Medical Center and Hospital, Coimbatore, Tamil Nadu, India, Phone: +91 9855050822, e-mail: drmullaibaalaaji@gmail.com

How to cite this article: Baalaaji M. Pediatric Burns—Time to Collaborate Together. Indian J Crit Care Med 2023;27(12):873–875.

Source of support: Nil

Conflict of interest: None

It has been long realized that excessive fluid administration results in fluid creep, and causes abdominal compartment syndrome, increased burn depth, tissue edema and leads to prolonged need for respiratory support, ICU stay.[7–9] Physiological variables conventionally used to titrate fluid requirements in other children are altered by burns per se—tachycardia from SIRS, hypermetabolic state, pain and anxiety, tissue edema due to altered vascular permeability make such variables less reliable and less accurate to guide fluid therapy. Urine output was the end point that is frequently used in various published studies; however, there is a lot of heterogeneity in the target values. Invasive hemodynamic parameters, serum albumin level, biochemical parameters, such as base excess, lactate clearance are other monitoring variables that have been historically employed.[10] Each of these endpoints have their limitations, and a "composite targeted bundle" rather than a single parameter is likely to be more practical and helpful at the bedside to decide on fluid resuscitation in these children. The authors in the current study have also used urine output targets to titrate initial fluid therapy. They could not demonstrate any relation between fluid overload at 24, 48, and 72 hours and burns outcomes in their cohort.[4]

Use of colloids such as human albumin (HA) in burns resuscitation is another frequently debated concept, despite the fact that they have been recommended in most of the resuscitation protocols, especially in those with larger BSA involvement. It has been demonstrated that there is an immediate increase in the capillary permeability in the burned skin due to inflammatory response that persists beyond 48 hours, and administration of colloids could not limit this burn tissue edema formation.[11] A similar, albeit less severe and transient increase in capillary permeability has been demonstrated in the unburned soft tissues after burns greater than 25% BSA, and colloid resuscitation is able to limit the fluid flux into the interstitium of the unburned soft tissues. Colloids, especially HA has been employed historically in two different contexts – as an immediate resuscitation fluid and as a responsive rescue fluid in either those who fail resuscitation with crystalloids or those who require larger volumes of crystalloids than expected from the conventional resuscitation formulae . Use of HA has been associated with lesser resuscitation volumes and also noted to have increased end organ perfusion in those who failed initial resuscitation with crystalloids.[12] A recent prospective multicenter study of resuscitation practices in adult burn victims has concluded that the use of HA is associated with larger and deeper burns and more severe organ dysfunction at presentation. Albumin supplementation was initiated when crystalloid infusion requirements are above expected targets and there was improvement in the in-to-out ratio.[13] The authors in the current study have notably used HA in hemodynamically unstable children beyond 24 hours, and the use of albumin was a independent predictor of mortality in their study cohort. As elucidated by the authors, this association might still be a reflection of the sickness of the subset of children who received HA beyond 24 hours as the study design precludes drawing direct conclusions between HA use and mortality. There is still a equipoise existing in the timing of initiation, volumes of HA required in pediatric burns resuscitation and more evidence is awaited.

Another important challenge in managing burns is infection, and in the current study, there was a preponderance of gram-negative infection, *Pseudomonas* being the commonest isolate. Impaired epithelial barrier, increased vascular permeability, altered immune responses, need for invasive devices in management of burns make these children at risk of infection. Diagnosis of infection is by itself challenging as clinical parameters of SIRS overlap with those resulting from burns itself, and more objective laboratory markers such as procalcitonin, tissue cultures are frequently resorted to aid in diagnosis.[14] Burn wounds are typically sterile to begin with and get frequently colonized in due course. Mere colonization is not evidence of infection and deeper tissue invasion and other signs of infection need to be demonstrated. Apart from burns tissue, other sources of infection such as respiratory, blood stream, and urinary tract also need to be evaluated in a child suspected with sepsis. It is also essential to have a local data on the sources of sepsis and causative organisms to aid in early appropriate antimicrobial management.

Wound management in burns has also seen lot of advances in recent years. Early wound excision is indicated for all full thickness and deep partial thickness burns to remove the devitalized tissue. Wound dressing and dedicated nursing care is essential to promote wound healing. Involvement of larger surface areas of burns would necessitate multiple re-explorations for excision, temporary closure and final grafting. A close liaison of the critical care team with the surgical team is required to facilitate better wound care in these patients.

Nutrition is a vital part of management in burns injured children and enteral nutrition provides better preservation of intestinal mucosal integrity and allows a better regulation of inflammatory cytokine responses. Hypermetabolic response observed following burns necessitates increased calories and protein requirements and the same need to be individualized and met.[15]

Predictors of burns mortality has consistently shown that BSA involvement is an important factor, higher the BSA involved, higher is the mortality.[16] The authors in the current study have additionally reported that higher organ dysfunction scores at admission is an independent predictor of mortality, and could be studied further in burns risk prediction models for children prospectively in future studies. Judicious fluid resuscitation, early wound excision, wound nursing care, enteral nutrition, infection control practices put together play a vital role in the acute care of the burns injured children and would translate into improved clinical outcomes. Similar data from the units managing pediatric burns and a local burns registry would further our understanding of the unique problems faced in our setup and help us improve acute care delivered to these children.

Orcid

Mullai Baalaaji https://orcid.org/0000-0003-1746-1586

References

1. World Health Organization. Burns. World Health Organization (2018). Available online at: https://www.who.int/news-room/fact-sheets/detail/burns. (accessed November 8, 2023).
2. Smolle C, Cambiaso-Daniel J, Forbes AA, et al. Recent trends in burn epidemiology worldwide: A systematic review. Burns 2017;43(2):249–257. DOI: 10.1016/j.burns.2016.08.013.
3. Jordan KC, Di Gennaro JL, von Saint André-von Arnim A and Stewart BT . Global trends in pediatric burn injuries and care capacity from the World Health Organization Global Burn Registry. Front Pediatr 2022;10:954995. DOI: 10.3389/fped.2022.954995.
4. Yashaswini K, Lalitha AV, Kanna GSN, Kujur AR, Michael Raj JA. Clinical profile of children with burns in a tertiary care hospital. Indian J Crit Care Med 2023;27(12):934–938.
5. Sharma RK, Parashar A. Special considerations in paediatric burn patients. Indian J Plast Surg 2010;43:S43–50. DOI: 10.4103/0970-0358.70719.
6. Carvajal HF. A physiologic approach to fluid therapy in severely burned children. Surg Gynecol Obstet 1980;150:379–384. PMID: 7355364.
7. Pruitt BA Jr. Protection from excessive resuscitation: Pushing the pendulum back. J Trauma 2000;49(3):567–568. DOI: 10.1097/00005373-200009000-00030.
8. Romanowski KS, Palmieri TL. Pediatric burn resuscitation: Past, present, and future. Burns Trauma 2017;5:26. DOI: 10.1186/s41038-017-0091-y.
9. Nagpal A, Clingenpeel MM, Thakkar RK, Fabia R, Lutmer J. Positive cumulative fluid balance at 72 h is associated with adverse outcomes following acute pediatric thermal injury. Burns 2018;44:1308–1316. DOI: 10.1016/j.burns.2018.01.018.
10. Stutchfield C, Davies A, Young A. Fluid resuscitation in paediatric burns: How do we get it right? A systematic review of the evidence. Arch Dis Child 2019;104(3):280–285. DOI: 10.1136/archdischild-2017-314504.
11. Cartotto R, Greenlagh D. Colloids in acute burn resuscitation. Crit Care Clinics 2016;32(4):507–523. DOI: 10.1016/j.ccc.2016.06.002.
12. Comish P, Walsh M, Castillo-Angeles M, Kuhlenschmidt K, Carlson D, Arnoldo B, Kubasiak et al. Adoption of rescue colloid during burn resuscitation decreases fluid administered and restores end-organ perfusion. Burns 2021;47(8):1844–1850. DOI: 10.1016/j.burns.2021.02.005.
13. Greenhalgh DG, Cartotto R, Taylor SL, Fine JR, Lewis GM, Smith Jr DJ, et al. Burn resuscitation practices in North America: Results of the acute burn resuscitation multicenter prospective trial (ABRUPT). Ann Surg 2023;277(3):512–519. DOI: 10.1097/SLA.0000000000005166.

14. Kundes M, Kement M. Value of procalcitonin levels as a predictive biomarker for sepsis in pediatric patients with burn injuries. Niger J Clin Pract 2019;22:881–884. DOI: 10.4103/njcp.njcp_311_18.
15. Bul C. Nutrition treatment in pediatric burns patients. Clin Sci Nutr 2020;2(2):53–67. DOI: 10.5152/ClinSciNutr.2021.978.
16. Dhopte A, Bamal R, Tiwari VK. A prospective analysis of risk factors for pediatric burn mortality at a tertiary burn center in North India. Burns Trauma 2017;5:30. DOI: 10.1186/s41038-017-0095-7.