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ACUTE RENAL FAILURE IN A CHILD WITH 5% CHEMICAL *BURNS- A CASE REPORT*

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Abstract

Burn injuries are major cause of morbidity and mortality in children. In India, one-fourth of the total burn cases occur in paediatric age group with scald burns and thermal burns being the common types of injury. The difference in the physiology of fluid and electrolyte handling, energy requirement and body proportions in children dictate that the paediatric burn management should be taken with a different perspective than for adults. Multisystem manifestations are commonly seen in cases with extensive burns. Acute renal failure is one of the major complications of burns and it carries high mortality rate. Most renal failures occur either immediately after the injury or as a late consequence of sepsis. The lowest percentage of chemical burns resulting in renal failure reported is above 10% of TBSA. We hereby present a case where renal failure was seen in a case with merely 5% of total body surface area associated with acute renal failure requiring haemodialysis.

Keywords – Chemical burns, Paediatric burns, Renal failure

Introduction:

Burn-related injuries are a major cause of morbidity and mortality in children ranking third among injury-related deaths in children aged 1 to 9 years. In India, paediatric burns account for 17–25% of total burn admissions.(1) The cause of burn injury varies with scald injuries being most common type of thermal injury under the age of 5, accounting for 65% of the cases, while thermal injury is seen in older children, accounting for 56% of the cases. (2) Chemical burns seen more commonly in adults occurring at industrial environment, are unusual in paediatric population and they occur as a result of domestic accident.

Chemical burn injury not only results in local damage from the inciting injury, but in many cases results in multisystem injury. Acute renal failure is one of the major complications of burns and it is accompanied by a high mortality rate. Most renal failures occur either immediately after the injury or at a later period when sepsis develops. Causes for renal failure include- 1) Hypovolemia and fluid shift 2) Myocardial depressant factor, tumour necrosis factor and/or oxygen free radicals, causes a reduction of renal

flow and is followed by tubular necrosis 3) Elevated levels of stress hormones- catecholamines, angiotensin II, aldosterone, and vasopressin cause vasoconstriction and fluid retention as well as alteration of renal blood flow 4) Inflammatory mediators, including cytokines (TNF, IL-1, etc.), eicosanoids (prostaglandins [PGs], thromboxane, leukotrienes), and platelet-aggregating (activating) factor (PAF) increase vascular permeability and to induce tissue damage, development of disseminated intravascular coagulation, in which microthrombi are formed in the capillaries of the glomeruli and renal tubule. (3)

Management of burns differs greatly in children than in adults. Children have nearly three times the body surface area (BSA) to body mass ratio of adults. Fluid losses are proportionately higher in children than in adults. The peculiarities in the physiology of fluid and electrolyte handling, the uniqueness of the energy requirement and the differences in the various body proportions in children dictate that the paediatric burn management should be taken with a different perspective than for adults. (1) The lowest percentage of chemical burns resulting in renal failure reported is above 10% of TBSA (4). We hereby present a case where renal failure was seen in a case with merely 5 % of TBSA.

Case Report:

An 8 years old male child, moderately built and nourished presented with alleged history of chemical burns due to accidental spillage of unknown chemical by his friend while playing at school with sustained burns over lateral aspect of right arm (antero-lateral aspect) with right shoulder and axilla i.e. 5 % of the total body surface area (TBSA) as per Lund and Browder's chart. On the day of burns, he was admitted in a local hospital, received IV fluids and antibiotics and underwent cleaning of burn areas followed by dressings. Next day, he developed vomiting (non- bilious, non- blood tinged) with fever (mild, intermittent, not associated with chills and rigors) and pain in abdomen (diffuse). He also had increased thirst and decreased appetite. He was referred to our centre for further management.

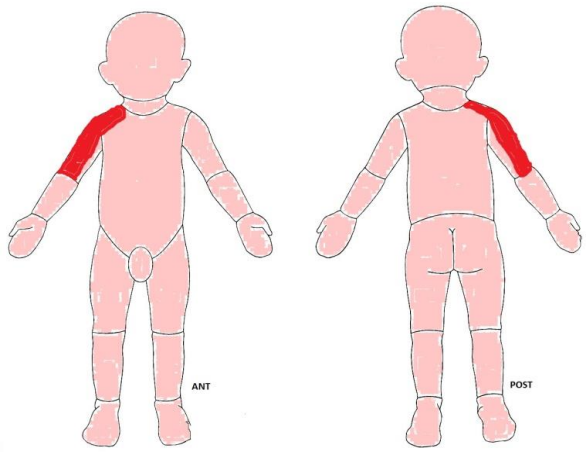

Figure 1- The extent of skin involvement

On admission, he had blood pressure of 90/60 mmHg with pulse 80 BPM,Spo2 was 100%. He was afebrile with second degree deep to third degree chemical burns over right arm (antero-lateral aspect) with right shoulder and axilla showing brownish-black coloured eschar. He was admitted in paediatric ICU and treatment was started. His investigations on admission showed –

1) **Haemoglobin – 10.7 % g/dl**
2) **Total Leucocyte Count- 10,700 cells/mm3**
3) **Serum Urea – 159 mg/dL**
4) **Serum Creatinine – 6.63 mg/dL**
5) **Serum Bicarbonate- 13 mEq/L**

Rest all blood investigations were found to be in normal limits.

Based on these values, patient was diagnosed with acute renal failure secondary to 5% second degree deep- third degree chemical burns which is unusual. After initial stabilization, he underwent emergency debridement and tangential excision of eschar (Esharectomy) over right arm (antero-lateral aspect), right shoulder and axilla on the next day of admission. Only minimal surgical intervention was undertaken at first stage considering his renal status. The child was treated with IV fluids resuscitation and analgesics, IV antibiotics, nutrition, antipyretics along with regular dressings. He underwent 4 sittings of haemodialysis over 2 - 6th day of admission. Patient's general condition improved gradually. His blood urea levels came down to 117 and serum creatinine levels were 4.76 on day 7 of admission. He underwent debridement and split thickness skin grafting over right arm (antero-lateral aspect), right shoulder and axilla on 7th day of admission. Post-operative course

was uneventful with satisfactory healing of grafted post-burn raw areas.

Figure 2- Pre-operative burn wounds

Figure 3 -Post operative grafted, healed wound

Discussion:

Burn injuries are major cause of morbidity and mortality in children. In India, one-fourth of the total burn cases occur in paediatric age group with scald burns and thermal burns being the common types of injury(1). Chemical burns seen more commonly in adults occurring at industrial environment, are unusual in paediatric population and they occur as a result of domestic accident.

The exact causative chemical could not be traced, but based on the clinical findings and considering that it was a colourful cleansing agent for floor was thought to be a phenolic compound, which is used as a disinfectant and insecticide, has erosive effects on epidermal and epithelial tissues in the body. Macroscopically, corrosive lesions such as red-to-brown-colored epithelium and edematous thickening of walls were seen in the skin. Significant absorption may result in systemic toxicity.Phenol is both water- and lipidsoluble, is readily absorbed through the skin and widely distributed. Other manifestations of phenol toxicity include CNS depression, seizures, hypotension, cardiac dysrhythmias, hypothermia, metabolic acidosis, methemoglobinemia, and direct renal injury leading to excretion of the carbolic acid metabolite and may be accompanied by acute renal failure requiring hemodialysis (5,6, 7, 9)

Renal dysfunction is primarily a result of decreased perfusion secondary to multi-factorial causes of hypotension including significant evaporative fluid loss and decreased circulating volume, SIRS, along with development of septic shock in the setting of decrease barrier function. Increased levels of catecholamines and inflammatory mediators result in vasoconstriction of the renal vasculature, further aggravated by myoglobinuria. A secondary effect of renal dysfunction is altered metabolism and elimination of several drugs used in treatment (2, 8). Severity of renal failure may vary with degree of skin exposure and time interval to intervention also with the type of chemical involved. Early complications in form of metabolic acidosis and acute renal failure required hemodialysis. Phenol-induced acute renal failure may result from excretion of unconjugated phenol damaging the glomeruli and renal tubules, renal ischemia, formation of casts due to haemoglobin. Profound acidosis results from renal excretion of base during the initial respiratory alkalosis, the acidic nature of phenol and disturbed carbohydrate metabolism due to functional defects in enzyme.(10,11)

The difference in the physiology of fluid and electrolyte handling, energy requirement and body proportions in children dictate that the paediatric burn management should be taken with a different perspective than for adults. Appreciating the major differences between burn management in children and adults is important. Children have nearly three times the body surface area (BSA) to body mass ratio of adults. Fluid losses are proportionately higher in

children than in adults. Consequently, children have relatively greater fluid resuscitation requirements and more evaporative water loss than adults. The large BSA to body mass ratio of the child also predisposes the child to hypothermia, which must be aggressively avoided. Children have thinner layers of skin and insulating subcutaneous tissue than adults. As a result, they lose more heat and water than adults do, and they lose it more rapidly than adults. In very young children, temperature regulation is partially based on non-shivering thermogenesis, which further increases metabolic rate, oxygen consumption, and lactate production.

The goals of initial patient management include preservation of overall homeostasis while appreciating the physiologic challenges that the burn injury poses to the body (2). Initial efforts are focused on resuscitation, maintaining hemodynamic stability, and airway management. Intermediate efforts are focused on managing the multi-organ failure that results from systemic inflammatory mediators that result in diffuse capillary leak and surgical therapy. Finally, efforts shift to issues with chronic wound healing, pain management, restoration of functional capabilities, and rehabilitation. After stabilization of the critical care issues in the burn injured child, attention is directed toward burn wound management. Often the burn reconstruction is completed in separate phases, depending on severity of burn and donor tissue availability. The use of early excision and skin grafting allows initial acute coverage of burns, reduce necrotic and infected tissue, leads to decreased hospital lengths of stay, a significant reduction in mortality.(2) The concept of early removal of burn eschar and immediate wound closure has gained widespread acceptance. Evidence suggests that early eschar removal is effective in decreasing morbidity and improving the mortality rate. The goal is to excise the wound within the first week of injury. (1).

In the current case report, the patient presented with acute renal failure due to accidental chemical burns with merely 5% of TBSA involved. There are few case reports where adult patients with chemical burns leading to systemic side effects have been mentioned. Paediatric case reports are fewer with hardly any mention of correlation if any between percentage of skin exposure and severity of systemic side effects. Lin and Yang mentioned that 40% BSA exposure in adults can lead to systemic intoxication and multiple organ failure, in our case report, exposure < 10% total body surface area was found to result in acute renal failure. This likely reflects the greater body surface area to weight ratio in children. Hence paediatric chemical burns cases warrants aggressive resuscitation and respective care with prior anticipation of systemic complications. (4, 12) The prognosis for survival in children and adolescents is quite good. The most important factor that has lead to improvement in prognosis is the prompt identification, excision, and effective wound closure.

Conclusion:

Burn injury in children continues to be a major epidemiologic problem. Care for these particularly vulnerable patients requires a sound understanding of the multisystem pathophysiological effects of burn injury on virtually every organ system. Appreciation of the major differences in the physiology of fluid and electrolyte handling, energy requirement and body proportions between children and adults is of utmost importance (2) Early prediction of the complications of chemical burns considering the sensitivity in paediatric population and respective strategical changes in the therapy is the key for better outcome.

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