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Case Report

Thermal Trauma in Newborns. Case Report

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Abstract

Introduction: Burn injuries or thermal trauma should not be considered as accidents, but a series of unfortunate events which is one of the most common traumatic injuries in children. Regardless of the etiology, these are complicated wounds that require a complex management and are associated with high mortality rates.

Clinical Case: Female newborn admitted to a second level hospital due to bowel obstruction. During her hospital stay she suffer a series of adverse events which ended up in a burn by direct fire when the light bulb used to warm her suddenly burst, twenty three percent of her TBSA was burnt.

Discussion: These adverse events increase their complexity by affecting a population group as susceptible as pediatrics, since their size, total body surface area, temperature regulation, skin thickness, metabolic rate, and psychological and developmental characteristics differ widely from their adult counterparts.

Conclusion: Our main goal is to emphasize the importance of preventing these unfortunate events in a multidisciplinary way, since an adequate hospital infrastructure in charge of the care of the newborn is required to have radiant heat cribs and functional incubators.

Keywords: *Burns; Newborn; Fire; Poverty*

Introduction

Burn injuries or thermal trauma should not be considered as accidents, but a series of unfortunate events which is one of the most common traumatic injuries in children with a high mortality rate (fifth leading cause of childhood injury across the world) [1]. Burn inju-

ries have nonidentical etiologies, therefore they can be caused by friction, thermal extremes (hot or cold), radiation, chemical or electrical discharges, but most burn injuries are derived from thermal heat, this heat comes from hot liquids, solids, or fire [2].

Although information on burn epidemiology is essential for resource and prevention, the accessible data are variable and inconsistent. Burn injuries frequency varies from 25.6% to 33.3% in various studies and still dwindling in high-income nations, due to the enormous progress over the last 50 years in burn prevention, enabling the focus to shift from survival to quality of life [6]; yet the prevalence of burn injuries remains high elsewhere, with 90% of burns occurring in low and middle-income areas, due to burns being linked to poverty, yet there has been little significant change in either incidence or the outcomes int the lowest socio-economic regions. In a retrospective chart review study, it was shown that increasing poverty led to a decreased odd of flame burn but increase odds of scald burn ($p < 0.0001$), as well as an increase in population density led to decrease flame burn, but increased scald odds ($p = 0.0085$) [3]. The WHO estimates that eleven million burn injuries of all types occur annually worldwide, 180,000of which are fatal. Regardless of the etiology, these are complicated wounds that require a complex management and are associated with high mortality rates [4].

Currently in Mexico, the Dynamic Health Systems Information System has reported that in 2023, of the 969,761 patients received in the emergency department, 101,655 corresponded to pediatrics, in addition to 88,498 were due to unfortunate events, poisoning and violence, which include pediatric burn injuries. The injuries reported that same year were 105,237, of which 1,447 corresponded to injuries caused by fire, flame, hot substance/vapor, as reported in national statistics [5].

The state of Puebla received a total of 56,620 patients in the emergency department, of which 3,671 were in the pediatric service and 4,074 had accidents, poisoning and violence as the main etiology in each patient, as well as 5,838 injury events were individualized and 112 were injuries by fire, flame, hot substance/steam [5].

It has long been recognized in public health literature that pediatric burns are preventable, irrespective of the country or culture in which they occur. There is little to no debate that the best approach for reducing pediatric burns is prevention. Burn prevention programs have been shown to be effective, yet we lack the necessary tools to target specific social risk factors to further reduce burn incidence when formulating prevention strategies [7].

Children are prone to full depth burn penetration and considerable scarring because of their thinner skin anatomy requiring less heat or shorter exposure times to produce severe injury [3]. Children under 5 years old, commonly present with scald burns, while flame burns are seen more often as age increases. The exact incidence of newborn burns is unknown [8].

Newborns differ from older children and adults on numerous counts. Because of their smaller size, thinner skin, larger surface area to weight ratio, larger evaporative fluid losses, immaturity of renal and immune systems, and nonidentical resuscitative requirements due to their large maintenance fluid requirements per kg body weight [9].

Since newborns have an increased body surface area (BSA) to body mass ratio, even short delays in resuscitation have resulted in hypovolemia and longer lengths of stay, acute renal failure, and increased mortality [13]; yet, over resuscitation (more than 6 mL/kg/TBSA burn in >24 hrs) can lead to prolonged intubation, longer, and increased mortality [10].

To start fluid resuscitation, transfer decisions, further management, or state the most likely prognosis, it is necessary to determinate the percentage of total body surface area (TBSA) involved in a burn, there is a variety of methods to use, such as the patient palm method, the rule of nines, and Lund and Browder (LB) chart. The patient palm method can lead to overestimations and fluid overload of 10% to 20%, as area of the palmar surface of the adult hand corresponds to 0.78% of the TBSA. The “rules of nine” method is also reported to overestimate fluid resuscitation, especially in people with high body mass index. To overcome this, a “rule of five” for people under 80 kilograms and a “rule of eight” for infants weighing under ten kilograms have been proposed [11].

The LB chart (Figure 1) is considered the most accurate of these three methods and is used for estimation for TBSA of burns in children. The BSA varies with age, as the child ages, the BSA for the head decreases, while the BSA percentage for the legs increases. Superficial burns are not incorporated int the calculation of the TBSA. Infants and young children have thinner dermis in comparison to adults, so the extent of the burn may not be apparent at first presentation, thus reevaluation after 48 hours is needed [12].

Area	Birth-1 y.	1–4 y.	5–9 y.	10–14 y.	15 y.	Adult	2°	3°	TBSA %
Head	19	17	13	11	9	7			
Neck	2	2	2	2	2	2			
Ant. Trunk	13	13	13	13	13	13			
Post. Trunk	13	13	13	13	13	13			
R. Buttock	2.5	2.5	2.5	2.5	2.5	2.5			
L. Buttock	2.5	2.5	2.5	2.5	2.5	2.5			
Genitalia	1	1	1	1	1	1			
R.U. Arm	4	4	4	4	4	4			
L.U. Arm	4	4	4	4	4	4			
R.L. Arm	3	3	3	3	3	3			
L.L. Arm	3	3	3	3	3	3			
R. Hand	2.5	2.5	2.5	2.5	2.5	2.5			
L. Hand	2.5	2.5	2.5	2.5	2.5	2.5			
R. Thigh	5.5	6.5	8	8.5	9	9.5			
L. Thigh	5.5	6.5	8	8.5	9	9.5			
R. Leg	5	5	5.5	6	6.5	7			
L. Leg	5	5	5.5	6	6.5	7			
R. Foot	3.5	3.5	3.5	3.5	3.5	3.5			
L. Foot	3.5	3.5	3.5	3.5	3.5	3.5			
						TOTAL			

Figure 1: *Modified Lund Browder chart. Source: Shah, A. R., & Liao, L. F. (2017). Pediatric burn care: unique considerations in management. Clinics in plastic surgery, 44(3), 603-610.*

The mechanism of burn injury should also be noted and considered when estimating the child's total trauma burden. Burns that occur in enclosed spaces, such as house fires, may have an associated inhalation injury. Children burned in motor vehicle collisions or other blunt trauma mechanisms can have associated brain, thoracic, abdominal, and/or extremity injuries, even though, it is a small percentage of all burn injuries [8].

Clinical Case

We present the case of a 7-day-old full-term female newborn admitted to a second level General Hospital in Puebla due to bowel obstruction, secondary to ileal stenosis. During her stay at the hospital, she was the victim of an unfortunate events that lead to our patient being burnt by direct fire when the light bulb used to warm her suddenly burst, twenty three percent of her TBSA was burnt (Figure 2).

Figure 2: *Female neonate with 23% TBSA burn by direct fire, the patient sustained mixed second and third degree burns to her face, arm, torso, and thig at the time of admission.*

The physical examination showed mixed second and third degree burns on head and neck, the right side of her body trunk, right arm and forearm, her hand's dorsal region involving her fifth finger, and right thigh, 13% of these burns were superficial dermal thickness with patches of deep dermal second degree, while the remaining 10% were third degree burns. After the light bulb burst occurred, she was immediately removed from the fire and transferred via helicopter to the Burn Unit of Puebla's Health Services (Hospital del Niño Poblano), where she was initially treated, the management was not registered (Figure 3).

On admission to the intensive care unit, ventilatory support was required via orotracheal intubation for four days. Pseudoanalgesia with long-term morphine and dexmedetomidine. Inotropic and vasopressor support with dobutamine and dopamine for four days. IV fluids from 180 ml/kg/day up to 230 ml/kg/day, considering the increased insensible losses during the acute phase of the metabolic response. Broad spectrum antibiotic management with Meropenem and Vancomycin for 14 days to treat the bowel perforation.

The newborn underwent an exploratory laparotomy to perform a Y ileostomy due to ileal stenosis, 60 cm past the ileocecal valve. The patient's burns were conventionally treated by the pediatric plastic surgery service using enzymatic and surgical debridement, and cultured keratinocyte wound dressings from day twelve of her admission (Figure 3), improving epithelial migration from rough areas, leaving no residues.

Figure 3: *Burn improvement 14 days (left column), 3 months (middle column), and 6 months (right column) after the debridement and hydrocolloid wound dressings application.*

By the 69th day of hospital admission, it was decided our patient would be discharged, she remains under hospital ambulatory treatment.

Discussion

These unfortunate events increase their complexity by affecting a population group as susceptible as pediatrics, since their size, total body surface area, temperature regulation, skin thickness, metabolic rate, and psychological and developmental characteristics differ widely from their adult counterparts [14,15].

The foundation of the complexity in the management of pediatric burns consists in the interruption of the three key functions of the skin: regulation of heat loss, maintenance of body fluids and barrier to infections, in addition the body adopts a hypermetabolic state characterized by altered hemodynamic, catabolic, and immune system responses making them more labile to complications such as shock in its different modalities (hypovolemic, distributive, and cardiogenic) [16].

Thus, an adequate monitoring ultrasonography It is fundamental when caring for critical patients in a non-invasive way, recognizing their clinical status allowed to quickly identify life-threatening injuries and resolve them immediately, as well as the adequate response to water restitution and/or where appropriate the need to use inotropes in whom there is no longer response to volume adequately to reduce mortality in pediatric patients who, together with the medical management plan and appropriate surgical care, significantly reduce the stay in the emergency departments without increasing complications [16].

Conclusion

Our main goal is to emphasize the importance of preventing these unfortunate events in a multidisciplinary way, since an adequate hospital infrastructure in charge of the care of the newborn is required to have radiant heat cribs and functional incubators in addition a special group made up of doctors and nurses responsible for appropriate and close surveillance for adequate pediatric care, otherwise, it's likely these unfortunate events will never decrease (Figure 4).

Figure 4: *Pictures taken after patient's full recovery (left and middle side). Crib where the patient was being warmed with a lightbulb, after the fire (right side).*

Conflict of Interest

Authors reclaim to have no conflict of interest in this article.

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