Deep Partial Scald Burn in a Neonate: A Case Report of the First Documented Domestic Neonatal Burn

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No previous publication about domestic neonatal burns exists in the literature. The authors have treated a 16-day-old baby boy for deep partial-thickness scalds that happened at home. The case report is followed by a literature review and discussion of the data previously published on neonatal burns. Special considerations to domestic neonatal burns are highlighted. A 16-day-old baby boy presented to our emergency room secondary to an 18% TBSA scald burn by hot tea. The patient was resuscitated and admitted to the pediatric intensive care unit. Topical wound care, although started with fusidic acid ointment, was changed to fuacel Ag Hydrofiber dressing once the final depth assessment was performed. The child’s wounds, although deep at some areas, healed by day 11 without the need for skin grafting. Neonatal burns have been previously described as iatrogenic injuries caused by various thermal sources. Part of the challenge in managing burns is due to their extremely thin skin. Possibility of the burn being inflicted should always be raised for such young victims. Burn wounds are tetanus-prone wounds; however, no previous recommendation regarding tetanus immunoglobulin administration exists for neonatal burns. Aquacel Ag’s efficacy in the management of pediatric partial-thickness burns has been documented extensively and from our limited experience, it seems appropriate for managing neonatal burns. Although neonatal burns need some special considerations during treatment, the cornerstones of pediatric burn management still apply. The role of tetanus immunoglobulin still needs to be studied. (J Burn Care Res 2011;32:000–000)

Pediatric patients form a large group among burn victims. These patients require specialized burn care and attention. At the extreme end of the spectrum are neonatal burns. Description of such burns in the literature is rare and limited to a few case reports and two small case series. Furthermore, all such cases describe iatrogenic burns occurring within the hospital setting. We describe the first case of domestic neonatal burn (ie, burn occurring within the household) in the literature and follow it with a discussion and literature review of neonatal burn management.

CASE REPORT

A 16-day-old newborn male, a product of full-term normal vaginal delivery, was brought to the emergency room by his family <30 minutes from sustaining a scald burn by hot tea. The father was drinking tea in a cup with the patient sitting on his lap. The handle of the cup broke off and tea spilled over the baby. Review of maternal, obstetric, and neonatal histories was unremarkable apart from reduced motion at the left hip, which was further confirmed to be congenital hip dislocation.

On examination, we found the child to be awake, alert, and in pain. Vital signs were within acceptable norms for his age. Burn assessment by two plastic surgeons with the aid of Lund and Browder burn assessment chart showed TBSA burned to be 18%. Depth assessment showed that most burns were of superficial partial thickness. Affected areas were half of the face, scalp, and neck, plus the right side of the chest and upper abdomen along with the right upper limb (Figures 1 and 2).

Immediate peripheral intravenous access was established, and resuscitation according to the Parkland formula was initiated with 5% dextrose in half-strength normal saline. Foley urinary catheter was used as a monitoring tool for adequacy of resuscitation, and an output of 1.5 to 2 ml/kg/hr was considered satisfactory. The child was then admitted to the pediatric intensive care unit for observation and

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treatment under the joint care of the plastic surgeon and the intensivist.

Topical burn dressing was provided by fusidic acid to the face using the open dressing technique in conjunction with Bactigras and gauze to the rest of the body. Fusidic acid was applied to the face four times a day and kept exposed. Dressing changes to other burned areas was performed once a day.

Observation of urine output during the first 5 hours of resuscitation demonstrated polyuria (7 ml/kg/hr), and volume of resuscitation was tapered until 1.5 to 2 ml/kg/hr urine output was achieved. By 16 hours postburn, the child was noted to show good oral intake of formula milk, and IV fluids were reduced to maintenance needs only. Serum electrolytes and renal function parameters were all within normal after 24 hours. IV fluids were stopped all together by the second day of admission.

Analgesic control was provided to the patient from admission time in the form of regular rectal paracetamol in conjunction with intravenous fentanyl administered by the intensivist. We found the combination to keep the child calm and pain-free, without any visible opioid-related side effects.

Temperature control was ensured in the pediatric intensive care unit by placing the child under a neonatal warmer, with skin temperature probes providing feedback control. Burn wound reassessment was formally performed on day 4 postburn, and we noted that burns were deeper than initially suspected (Figure 3). The upper limb and chest in particular were showing areas of deep to full-thickness burns but in a patchy island-like pattern. Aquacel Ag dressing (Aquacel® Ag Hydrofiber®, ConvaTec Professional Services, Skillman, NJ) was applied over the burns, excluding the face and neck. On the subsequent day, the child was transferred to the pediatric ward, as his general condition was stable.

On postoperative day 8, dressing change was performed to all nonadherent sheets of Aquacel Ag. Burns to the right upper arm were not exposed, as the dressing material was stuck to the underlying bed. Burn wound assessment showed healing of most of the burns, and the deeper residual raw areas were estimated at 2 to 3% TBSA (Figure 4).

On day 11 of admission, dressing change was performed once more, and we found that all visible burns were fully healed. We still could not assess the right upper arm, as the Aquacel Ag was still adherent to it, and therefore we assumed that the area has not still healed. Repeated laboratory works (blood count and electrolytes) were all within normal limits, and the patient was discharged home with outpatient clinic follow-up.

Patient was seen in the clinic on day 13 postburn, and the Aquacel Ag was detached from the right arm.
The area had fully healed by this point. Patient was seen again on day 18 postburn, and no adverse events were noted (Figures 5 and 6). Long-term follow-up visits were scheduled to start follow-up the patient for future adverse scarring.

DISCUSSION

Thermal injury in the pediatric population is extremely common. Children younger than 1 year are less likely to get burned compared with older children. Neonates, in particular, are the rarest victims of burns, and the majority of such burns occur iatrogenically within intensive care units. Mechanisms of neonatal burns have ranged from scald burns while bathing, contact burn from heating bottles in incubators, electrocautery pads, and even radiant heat during indirect laryngoscopy. Individual reports and case series have documented burn victims as young as 1 day old and several premature babies. The patient in this study is the first reported victim of neonatal burns occurring in a domestic setting.

Neonates form a particular subset of pediatric patients due to their immature immunity and extremely thin skin. The depth of burns in neonates is more than what is typical of a similar injury in an older child, and this makes accurate assessment of burn depth at presentation challenging.

Inflicted burns in children constitute 4.2 to 20% of all pediatric burns. A recent review has shown an inverse relation between patient age and the incidence of abuse, where inflicted burns were more common in patients younger than 2 years. Because neonates are not ambulatory, child abuse—or neglect—is a scenario that should be considered when assessing such burn victims. With regard to our patient, cross-interviewing of the mother and father separately reassured us that the injury was accidental. The patterns of the burns were not suggestive of inflicted injuries either.

Age has routinely been used as a predictor of mortality among burn patients; however, its role in the very young burn victim is less clear cut. A single center review of mortality among pediatric patients showed that all deaths occurred in patients younger than 3 years, with an overall mortality risk of 0.87%. Barrow compared the mortality of patients younger than 1 year and those aged between 3 and 12 years and found it to be 9.9% and 4.9%, respectively. In contrast to Barrow’s findings, Jeffery and Byron found mortality in patients between 2 and 5 years of age almost twice as high as the mortality for burn patients younger than 1 year. The quoted figures were 2.1% vs 1.3% for the infants. Similar findings were mentioned by Sheridan’s review of 1,223 patients in a single burn center. Interestingly, not a single death
was reported in the patient group younger than 4 years, whereas patients older than 4 years had a mortality rate of 10.9%.13

A study of 12,902 children younger than 16 years through the National Burn Repository (NBR) initially found the mortality rate of children younger than 4 years to be 1.4% and not statistically different from mortality of older children. However, when the data were adjusted to match TBSA among the two groups, patients younger than 4 years showed double the mortality risk compared with the older children. Within that group, the subset of patients from 0 to 1.9 years had a 2.7 odds ratio compared with patients older than 4 years.14

Although the results are conflicting, this is not to be unexpected when assessing burn mortality. The great diversity in patient profiles, comorbidities, burn mechanism, treatment methods, center of treatment, TBSA, and burn depth among many other variables makes it difficult to assess a single predictor of mortality. The largest of the studies quoted above, which actively adjusted TBSA, found that patients younger than 2 years are clearly at a higher risk or mortality compared with older patients, and this is in line with common wisdom. Reviewing the 12 previously reported neonatal burns showed no mortality in any of them.4-7

Resuscitation of pediatric patients, especially those younger than 2 years, necessitates the use of a dextrose-containing solution, as their liver glycogen stores are incapable of maintaining adequate blood sugar levels.10 The amount of fluid calculated by the Parkland formula is too little to maintain the intravascular volume alone, and maintenance fluids should be added to the calculation based on body weight. Our chosen fluid for resuscitation was 5% dextrose in 0.45% NaCl, due to its dextrose and sodium contents as well as its tonicity. An alternative method would have been to run the maintenance needs in the form of 5% dextrose in 0.22% NaCl through one line and provide the Parkland’s formula resuscitation in the form of lactated Ringer’s through another line. Previous reports on neonatal burns do not give a detailed account of the choice of intravenous fluids used for resuscitation or the subsequent electrolyte response.

Urine output is an accurate method to assess the adequacy of resuscitation in the majority of burn patients. Children having an average urine output of 1 ml/kg/hr are likely to have adequate organ perfusion. When managing infants, a higher urine output of 1.5 ml/kg/hr should be aimed at, while neonates should exhibit a urine output of 1.5 to 2 ml/kg/hr, which is the target output we sought with our patient.

Children in general and neonates in particular are prone to develop hypothermia. This is due to the large BSA in relation to body weight, increased metabolic needs, low energy reserves, and underdeveloped shivering response.15 Burned children are at increased risk of hypothermia due to the loss of the skin barrier and periods of prolonged exposure during dressing changes. Efforts should be made to prevent hypothermia by administering warmed IV fluids, by the use of heating blankets or lights as indicated, and by keeping the patient in a thermoneutral room temperature of 32°C.15,16 Patient exposure should be kept to the minimum required. Failing to prevent hypothermia in the acute burn setting can lead to electrolyte imbalances and cellular changes.18

Pain control is a major part of the management of pediatric burns. A 2003 survey of pain control practices in pediatric burn victims in North America has shown a positive change compared with older data. Opioid use has become more widespread. The use of psychotropic medications as adjuncts to analgesics during wound care has also become common. Proper pain assessment is of paramount importance and is a difficult challenge, especially in the younger child. Underestimation of pain can result in providing lesser than needed amounts of analgesics. Proper pain assessment can be aided by combining methods of assessment such as feedback from the parents, pain scores, and clinical observation.20,21

Another aspect that is not detailed in previous series and case reports on neonatal burns is tetanus vaccination status. In Saudi Arabia, tetanus vaccination is provided through the DTaP (Diphtheria, Tetanus, Pertussis) vaccine, with the first dose given at 2 months of age. For that, all neonates would be considered at risk of tetanus infection. The exception would be children born to mothers who have been vaccinated by tetanus toxoid within 5 to 10 years from delivery. Maternal antibodies secondary to immunization can cross the placenta and provide protection to the neonate, thus reducing neonatal morbidity and mortality.22,24

Neonatal tetanus in particular is associated with mortality rates as high as 100%.22 This explains the fact that 40% of all reported tetanus-caused deaths occurred in the neonatal age group.24 Neonates that survive infection with tetanus may end up with permanent residual neurological deficit.25 If a nonvaccinated individual is exposed to Clostridium tetani spores, the only method of adequate immunization is by administering Tetanus Immune Globulin (TIG). Tetanus toxoid administration fails to provide immediate protection during the current exposure, as se-
logical immunity only starts to develop by day 4 after administration of the toxoid.  

Necrotic and hypoperfused burn tissue is an ideal media for the growth of C. tetani spores due to their obligatory anaerobic nature. A review of pediatric burns in Nigeria—a high-risk nation for tetany due to lack of widespread immunization—showed an 8.3% incidence of tetanus among pediatric burn victims.  

When combining the high-risk wound of our patient with the lack of immunity against C. tetani, we retrospectively feel that administering TIG to the patient would have been more appropriate.

Topical antimicrobials are vital to proper burn wound management. Silver sulfadiazine has long been the standard choice at our institute and most regional hospitals we are familiar with. Drawbacks of silver sulfadiazine cream is the loss of silver delivering capability after 12 hours of application, the creation of pseudoeschars, risk of methemoglobinemia, hemolysis, argyria, and bone marrow suppression in the pediatric population.  

The manufacturer contra-indicates the use of silver sulfadiazine in neonates. Despite that, silver sulfadiazine seems to have been used effectively without any significant side effects in the treatment of neonatal burns. Another silver impregnated dressing that was used to treat partial-thickness neonatal burns was Acticoat® (Smith & Nephew, London, United Kingdom) with acceptable results. We chose not to use Flamazine cream due to its contraindication in neonates and because we realized that assessing burn depth in such a young child might be a challenging task, especially if a pseudoeschar was to form.

Aquadel Ag is a silver impregnated Hydrofiber dressing that has been shown to be less painful, reduce hospital stay, carry less risk for wound infection, and less frequent dressing changes. Its effectiveness against a broad range of antimicrobial agents has been proven by in vitro tests. Aquacel Ag was compared with silver sulfadiazine in the pediatric group and found to be superior in several studies. Because of its superiority and safer profile, we chose to use Aquacel Ag as our dressing of choice once the final depth of the burns was confirmed on day 4 postburn. Its effectiveness was demonstrated by the rapid healing that we noted and the absence of wound infection.

As for various topical burn treatments in neonates, we reviewed the manufacturers’ recommendations for some of the more common topical burn wound treatments. The products that we reviewed were Fucidin® (Leo Pharma Inc., Thornhill, Ontario, Canada), Sulfamylon® (UDL labs, Rockford, IL), Silver sulfadiazine and Acticoat® (Smith & Nephew, Hull, United Kingdom), Silvercel™ (Systagenix Wound Management, MA), and Aquacel Ag® (ConvaTec Professional Services, NJ).

The only product that has information/guidance related to neonates was silver sulfadiazine, where the manufacturer clearly mentions that their product is contraindicated in the first months of life due to risk of hemolysis caused by the sulfa group. Although Sulfamylon also contains the sulfa group, the manufacturer only warns against its use in G6PD-deficient patients but does not relate the contraindication to age. All other products did not have any information related to its use on neonates.

CONCLUSION

Neonatal burns are extremely rare and extremely challenging to the burn surgeon. Special considerations must be taken into account when dealing with such patients. Although all previous cases were reported within the setting of a hospital, neonatal burns can unfortunately occur within the home, making sure that the injury is not inflicted should be an integral part of the management. Adequate resuscitation, close monitoring, topical wound care, and debridement and skin grafting—when indicated—remain the cornerstone of treatment. The role of prophylactic tetanus immunoglobulin in these patients is yet to be described.

REFERENCES