NEONATAL BURN INJURIES: AN AGONY FOR THE NEWBORN AS WELL AS THE BURN CARE TEAM

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SUMMARY. This retrospective analysis of neonatal burn injuries was carried out at the Department of Plastic Surgery and Burn Care Centre, Pakistan Institute of Medical Sciences (PIMS), Islamabad, Pakistan. A total of 11 neonates who were aged less than 29 days were managed during the 2 year study period. Out of these, 72.7% (8) were male and 27.3% (3) were female. The mean age was 11.18±9.67days. The commonest underlying cause of burn insult was accidental direct contact with room heaters in 4 (36.3%) neonates. The TBSA burnt ranged from 3%-55%, with a mean of 18.72±17.13%. All the neonates (100%) presented during winter season. Among the body areas affected, the most common was face/head and neck (10). The commonest operative procedure undertaken among the neonates included early wound excision followed by resurfacing with split thickness autografts (5). There were three in-hospital mortalities (27.2%) in our series.

Keywords: neonatal burns, iatrogenic burns to neonates, burns from warming devices

Introduction

Though burns are common among children, there is scarcity of published literature regarding neonatal burn injuries in particular.[1,2] There are only a few published studies on neonatal burns.[3,4] The injury mechanisms reported include household accidents in developing societies and iatrogenic injuries in developed countries.[5-8] The exact incidence of neonatal burns is unknown, however in South Africa these account for 0.34% of burn injury admissions, while in Nigeria their annual share is 0.5- 2.5%.[3,4]

Neonates differ from older children and adults on many counts. Because of their smaller size, thinner skin, larger surface area to weight ratio, larger evaporative fluid losses, immaturity of renal and immune systems,[4] different resuscitative requirements due to their large maintenance fluid requirements per kg body weight, neonatal burns management poses challenging dilemmas. The management protocols for burns in older children have been established for a long time, however there are no clear guidelines concerning the care of neonatal burns victims.[6,8-13]

The present study was undertaken to determine the epidemiologic pattern and outcome of neonatal burns in our population, with a view to developing an actionable evidence base that could better guide preventive strategies and ensure better management of such unfortunate neonates in future.

Patients and methods

This retrospective analysis of neonatal burn injuries was carried out at the Department of Plastic Surgery and Burn Care Centre, Pakistan Institute of Medical Sciences (PIMS), Islamabad. The study encompassed a 2 year period from June 01, 2010 to May 31, 2012. The study included all burned neonates aged less than 29 days who presented during the study period.

Initial assessment and diagnosis was made by thorough history-taking, physical examination and necessary investigations. The age and gender of the neonates, type of burn injury, total body surface area (TBSA) burnt, surgical management instituted, and mortality were all recorded on a proforma.

All the neonates were admitted for indoor management. They were initially managed according to the standard ATLS protocol. Wound cleansing with warmed normal saline was performed, followed by application of topical antibiotics (fucidic acid for the face and silver sulphadiazine for other body parts) and aseptic dressings. Anti-tetanus prophylaxis and analgesia were instituted. Intravenous fluid resuscitation was used in all babies with over 5% TBSA burns. The calculation of fluid resuscitation requirement was based on body weight, %TBSA burned and additional paediatric maintenance allowance. The fluid used was 5% dextrose in lactated Ringer. The total fluid vol-

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ume for 24 hours was calculated by employing the formula 4 ml/ kg/ %TBSA + 1500 ml/m ^{2} BSA.[14] The calculated volume was broken into five time intervals of 4,4,4,6 and 6 hour blocks. The formula was used only to guide resuscitation for a target urine output of 1-2 ml/kg/ hr.[3,4,15] The urine output was constantly monitored and resuscitative readjustments made to prevent over or under infusion of fluid throughout the resuscitation period. Breastfeeding was encouraged from day 2 onwards for those on fluid resuscitation and from the outset for the other neonates. Transfusion of fresh frozen plasma and blood was done where indicated. Albumin was not used in resuscitation.

Early excision of deep burns and autografting were performed after resuscitating the babies. Each session of excision covered up to 10% TBSA. The Dermatome was set to harvest a split thickness skin graft of 0.1 mm from the lower limbs and buttocks. The autografts were meshed up to 1:3 expansion. Partial thickness burns were initially managed conservatively for spontaneous healing and, if burn wound progression showed full thickness skin loss, the wounds were then resurfaced with split thickness skin grafts. Neonates whose wounds dictated other surgical interventions, such as early ectropion release and grafting, were managed accordingly. A follow up of three months was done. *Figs. 1-11* show some of the included neonates.

Fig. 1 - The neonate sustained contact burns to the head, left upper limb, shoulder and upper back from an electric heater kept in the room for heating during winter.

Fig. 3 - The neonate sustained contact burns to face, head and neck from an electric heater kept in the room for heating.

Fig. 2 - The same neonate as in *Fig. 1* at two months follow up.

Fig. 4 - The same neonate as in *Fig. 3*, undergoing excisions and autografting, each session of 10% TBSA.

Fig. 5 – The same baby as in *Figs. 3*, *4* at three months follow up. He presented with ectropion of the right eye which was corrected with release and grafting.

Fig. 7 - Scalds from hot vapours of boiling water.

Fig. 6 - Neonate with contact burns to face and forehead resulting from exposure to a heater kept in the room for warming purposes.

Fig. 8 - The neonate sustained scalds from hot vapours of boiling water.

Fig. 9 – One-day old neonate who sustained scalds from hot water used for bathing.

Statistical analysis

The data were subjected to statistical analysis using SPSS version 10 and various descriptive statistics were used to calculate frequencies, percentages, means and standard deviation. The numerical data such as age were expressed as Mean ± standard deviation, while the categorical data, such as the causes of burns, were expressed as frequency and percentages.

Results

A total of 11 neonates were included in the study. Out of these, 72.7% (8) were male and 27.3% (3) were female. The age ranged from 01 day to 28 days. The mean age was 11.18 ± 9.67 days. The underlying causes of burn injury included contact burns from room heaters in 4 (36.3%) neonates, scalds in 3 (27.2%) neonates, flame burns secondary to domestic accidents with leaked natural gas in 2 (18.1%) neonates, and flame burns secondary to accidents involving candles used as a source of light in 2 (18.1%) neonates.

The TBSA burnt ranged from 3%-55% with a mean of 18.72 ±17.13%. The lowest TBSA involved was found in a neonate with scald burns to the face, while the highest TBSA involved was found in a neonate injured by an accidental fall on a room heater. All the neonates (100%) presented in winter season.

Among the body areas affected, the most common was face/head and neck (10), followed by lower limbs/feet (4), upper limbs/hands (3), shoulder/back (2) and front of chest/abdomen (1).

The most common operative procedure undertaken among the neonates included early wound excision (performed within 3-7 days of injury) followed by resurfacing with split thickness autografts (5). The most common complication found at two months follow up was ectropion of the eye (4). There were three in-hospital mortalities (27.2%) in our series. All the neonates who died had associated inhalation injury, their TBSA burnt ranged from 30%-55% and they died during their first 24 hours of hospitalization.

Fig. 10 - This neonate suffered a flame burn injury due to a blast caused by a gas leak in the room.

Fig. 11 - This neonate was among a family cluster of three, sustaining flame burns as a result of household accidental leak of natural gas. He died after an hour of presentation.

Discussion

Our study reflects the high frequency of neonatal burn injuries in our country. To our knowledge, this is the first reported local series on neonatal burns and it shows the gravity of this largely preventable catastrophe which afflicts our newborn babies. Burn injuries constitute a significant cause of childhood morbidity and mortality throughout the world. However, in developed countries and affluent societies, improved standards of living have brought about a reduction in the number and severity of such horrendous cases as these.

The skin of the neonate is relatively thinner with less keratinization and fewer cell layers, and is thus less protective against noxious agents including thermal insults. Owing to these factors, neonates sustain full thickness burns from thermal insults which, in older children, may result in superficial or partial thickness burns.

In our study, contact burns from room heaters constituted the commonest cause of neonatal burns. Ugburo AO el al.[3] from Nigeria reported 21 neonatal burn injuries, all resulting from domestic accidents, with flame burns (13), scalds (6) and chemical burns (2). Cox SG et al.[4] from South Africa, in a review of 37 years, reported 86 neonates under 4 months of age, with scalds (45), flame burns (38) and 2 cases of burns due to primitive heating devices.

A variety of iatrogenic injury mechanisms have been reported from developed countries regarding causation of neonatal burns. Among these are warm baths,[5] devices employed for keeping babies warm, [6,16-20] topical disinfectants such as chlorhexidine and alcohol,[21,22] malfunctioning pulse oxymeters,[23] laryngoscopes,[24,25] phototherapy,[26] infra-red heating lamps,[27] alcohol lamps,[28] a defective transillumination device,[29,30] and a variety of monitoring devices such as temperature probes, and electrode jelly etc.[31]

The mean TBSA burned in our neonates was 18.72 ±17.13 %. The burn percentage of TBSA is variably reported in the published literature. Ugburo AO el al.[3] have reported a mean TBSA of 26.00 ± 5.53% in their series. Cox SG et al.[4] have reported a mean TBSA of 11.5%, with 62.7% of the neonates having had less than 10% TBSA involvement. Rimdeika R et al.[8] have reported one neonate with 20% TBSA burns and another with 14% TBSA involvement.

In our study, inhalation injuries were found among three neonates. Cox SG et al.[3] reported inhalation injuries in 12(14%). Ugburo AO el al.[4] reported inhalation injury in 8 (38%) neonates.

We undertook early wound excision followed by resurfacing with split thickness autografts in five of our neonates. Cox SG et al.[4] have reported early excision and delayed grafting in 27 neonates, delayed excision and grafting in 7 neonates, immediate tangential excision and grafting in 25 neonates. Rimdeika R et al.[8] have reported two neonates in whom they performed staged excisions of deep burns followed by resurfacing with autografting, using overlay allograft harvested from the twins' father to protect the autografts.

Early excision and grafting of deep burns considerably increase the survival of patients compared with conservative management and delayed grafting. As the interval between burn injury and operation prolongs, there is increased contamination of the wounds and a reduction in the patients' compensatory compliance. The excisions are performed under optimal elective conditions, once the resuscitation phase is complete. Published studies, concerning both young children and adults, have reported the superiority of early excision and grafting of deep burns.[4,9,32] While excision and grafting remains the golden standard of surgical care of deep burns, there are certain challenges among neonates in particular. The lower limbs, which constitute the second most common donor site (following the scalp) for autograft harvest, are proportionately smaller. As the majority of our neonates suffered afflictions to their head and neck region, we predominantly used the lower limbs/buttocks for autograft harvest. The skin of the neonates is very thin and difficult to mesh to considerable expansion ratios. Major burns require major excision and thus considerably increase the surgical stress for the neonate. The published literature has documented different solutions for these challenges. For instance, wound grafting using the Chinese 'postage stamp' skin graft snips or intermingled transplantation[33] or employing the modified Meek skin graft expansion technique with meshed allograft overlay (sandwich technique).[34-37] With allograft overlay the autograft can safely be expanded to 1:9 meshing ratio.

Our in-hospital mortality was 27.2%. All neonates who died had associated inhalation injury, their TBSA burnt ranged from 30%-55% and they died during their first 24 hours of hospitalization. Ugburo AO el al.[3] from Nigeria have reported 43.5% mortality among their neonates. All those had thermal injuries, and the underlying causes of death included inhalation injury in 34.8% neonates and septicemia in 8.7% neonates. Cox SG et al.[4] from South Africa have reported a mortality of 9.3% in their series. Four of their neonates died from the destructive nature of their burns, involving full thickness burns to the face and both hands. Four others died from bronchopneumonia. One neonate had an inhalation injury. All neonates had burns over 15% TBSA with fire as the predominant cause. Non-fatal morbidities included septicaemia in 10.5% and pneumonia in 12.8% neonates.

Neonatal burns deserve special attention, as these injuries often have long-term physical, psychosocial, and economic ramifications and all these are even more challenging in developing societies such as ours. We recommend that further local studies be carried out to confirm and improve

upon our results. Additionally, a local study may be designed to identify any association of neonatal burns with factors such as parental negligence, socioeconomic status of the household, education status of the parents and occupation of the parents. There is also a need to determine any neonatal abuse in the context of neonatal burn injuries. This will help to evolve an evidence base for prompting legislative reforms concerning neonatal protection and safeguarding. As burns management is a largely neglected area of plastic surgery, we recommend establishment of improved facilities for acute burn management as well as adequate rehabilitation of burn injury survivors. Dedicated and well trained professionals are needed to ensure proper surgical management of these unfortunate neonates during the acute phase as well as through the phase of their rehabilitation. We also need to develop national guidelines consistent with our local circumstances.

Conclusion

Neonatal burn injuries constitute an important cause of paediatric morbidity and mortality in our population. Contact burns from room heaters are the commonest form of these injuries, and the face is the most frequently affected body part. Neonatal burn injuries emanate from largely preventable causes. There is a need to educate the public and create awareness by instituting focused burn prevention strategies consistent with our local circumstances.

RÉSUMÉ. Cette analyse rétrospective de brûlures néonatales a été réalisée au Département de Chirurgie Plastique et Centre de soins aux brûlés, du « Pakistan Institute of Medical Sciences » (PIMS), Islamabad, Pakistan. Un total de 11 nouveau-nés qui étaient âgés de moins de 29 jours ont été gérés au cours de la période d'étude de 2 ans. Parmi eux, 72,7% (8) étaient des hommes et 27,3 % (3) étaient des femmes. L'âge moyen était de 11,18 ± 9,67 jours. La plus fréquente cause de blessures par brûlure était contact direct accidentel avec des appareils de chauffage en 4 (36,3%) des nouveau-nés. La SCT brûlée variait de 3 % à 55 % avec une moyenne de 18,72 ± 17,13%. Tous les nouveau-nés (100%) ont présenté au cours de la saison d'hiver. Parmi les parties du corps touchées, le plus commun était le visage / tête et le cou (10). L'intervention chirurgicale la plus fréquente parmi les nouveau-nés inclus l'excision précoce de la plaie suivie par le resurfaçage avec des autogreffes d'épaisseur mince (5). Il y avait trois cas de mortalité à l'hôpital (27,2%) dans notre série.

Mots-clés: brûlures néonatales, les brûlures iatrogènes aux nouveau-nés, brûlures de dispositifs de réchauffement

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Conflict of interest. The authors of this paper hereby declare that they have no conflict of interest. The authors do not have any financial or personal relationships with any persons or organizations that could bias their work.

Funding. There has been no funding involved.

This paper was accepted on 22 July 2013.