

# Neonatal Burn Injuries Managed in a Neonatal Intensive Care Unit of a Tertiary Hospital in North-Central Nigeria

## Abstract

**Introduction:** Neonatal burn injuries are rare in clinical practice. This explains the many case reports of such injuries. This is a report of our experience in the management of neonatal burn injuries in our centre. **Materials and Methods:** This is a retrospective study of neonatal burn injuries that were managed over an eight year period (2014–2022). The information that was retrieved from the case notes included the socio-demographic data, birth weight, weight at admission, type of injury, total burn surface area (TBSA), depth of burn injury, type of treatment, length of hospital stay and outcome of care. The data were then entered into the SPSS version 25 (IBM Corp., United States) software and analysed. **Results:** We managed 11 neonates, five males and six females with a male:female (M: F) ratio of 1:1.2. Their age ranged from zero to 25 days with a median (IQR) of 2 (1–15) days. Eight (72.7%) of them were one to two days old and eight (72.7%) were admitted as out born. Majority (81.8%) of the mothers were primiparous women. Nine (81.8%) of the injuries were as a result of hot water bath. Most (66.6%) of these baths were done by the grandmothers or mothers of the babies. The total burn surface area (TBSA) ranged from 1% to 62%, with a median (IQR) of 11 (7.5–19.0). None of the babies had skin grafting. The length of stay (LOS) ranged from six days to 25 days with a median (IQR) of 11.0 (7.0–16.0) days. Only one baby died giving a hospital mortality rate of 9.1%. **Conclusions:** The commonest cause of neonatal burn injury in this series is scald injuries from hot water bath. Providing education about safe bathing to caregivers should be included in routine antenatal and postnatal instructions in order to prevent burns.

**Keywords:** Burn injury, hot water bath, neonate, scald

## Introduction

Burn injuries are preventable thermal injury to the skin and other organs. It is a major cause of trauma globally and this occur in all age groups.<sup>[1]</sup> Majority of these injuries occur mainly in low- and middle-income countries with higher prevalence in adults and older children. Burn injuries that occur during the neonatal period of life are rare<sup>[2–8]</sup> These neonates are vulnerable to injuries generally because they solely depend on adults for their protection and survival.

The vulnerability of neonates sustaining burn injury is compounded by the fact that they have a thinner skin with smaller size and a larger surface to weight ratio.<sup>[9]</sup> An important feature of the skin of the infant especially the neonate, is that all layers are thinner and fragile compared to that of an older child or adult,<sup>[10]</sup> and this is worse in the pre-term babies.<sup>[11]</sup> For this reason the

neonate is prone to full thickness burns for injury that normally would have been partial thickness for an older child or adult.<sup>[10]</sup>

Most articles from Nigeria that looked at burn injuries in children usually group these injuries into the various paediatric age groups.<sup>[12–15]</sup> An online search for articles on neonatal burn injuries in Nigeria yielded only one full length article<sup>[16]</sup> and four case reports.<sup>[17–20]</sup> The outcome of this search was not surprising as such injuries are not common and so the data generated are usually included along with other paediatric burns. The aim of this article was to review our experience in the management of neonatal burn injuries in our centre over an eight year period and to identify factors that lead to such injuries and the factors that influence the outcome of management.

## Materials and Methods

This was a retrospective study of neonates with burn injuries that were managed in

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the Special Baby Care Unit (SCBU) of the Department of Paediatrics, Jos University Teaching Hospital, Jos Nigeria from 2014 - 2022. It is a policy to admit all neonates that require in-patient treatment into the SCBU of the hospital. For those with surgical pathology they are managed jointly by the neonatology team and the paediatric surgery team or the plastic surgery teams as the case may be.

All the affected neonates were managed as in-patients; they had detailed history taken, physical examination done with the assessment including assessment of the total burn surface area (TBSA) using the Lund and Browder chart and the necessary investigations done. Intravenous fluids were administered based on the TBSA that is used to calculate the volume of fluid required. For resuscitation the Parkland formula was used to calculate the fluid requirement and additional maintenance fluid calculated using the Holliday-Segar method (100 ml for each of the first 10kg). In addition to the fluid therapy anti-tetanus prophylaxis for babies whose mothers did not have or completed anti-tetanus immunisation and analgesia were administered. The wounds were cleansed with warm normal saline and topical application of antibiotic impregnated paraffin gauze. The dressing was occlusive for burn injuries involving the limbs and trunk except those involving the perineum, the head and neck were open dressing was used. The babies were breast fed as soon as possible usually within 48 hours for babies who needed resuscitation and on admission for those that were stable. This is to provide calorie as well as fluid to the affected babies. There was no need for skin cover for any of the babies as conservative management was applied to all the injuries.

The following information were retrieved from the case notes; they were age on admission (baby and mother), gestational age, sex, type of gestation, maternal parity, place of birth, birth weight, weight at admission, type of injury, total burn surface area (TBSA), depth of burn injury, type of treatment, length of hospital stay and outcome of care. This information was entered into a proforma prepared for the study. The data were then entered into the SPSS version 25 (IBM Corp., United States) software and analysed. The categorical data were presented as frequency tables to display the characteristics of the neonates managed. While continuous variables were described using median  $\pm$  interquartile range (IQR) for skewed dataset and mean  $\pm$  standard deviation (SD) for normally distributed data.

To publish this data an ethical approval was obtained from the Health Research Ethics Committee of the Jos University Teaching Hospital, with a reference number JUTH/DCS/REC/127/XXXI/310.

## Results

Over an eight year period a total of 11 neonates were managed for burn injuries. Five of them were males and six females with a male: female (M: F) ratio of 1:1.2. Their

age range was from zero to 25 days with an average of  $6.55 \pm 8.12$  days. Eight (72.7%) of them were one to two days old. Their weight on admission was between 1400g to 3600g with a mean of  $2718.2 \pm 764.0$ g. The weight gain at the time of discharge/death ranged from 100g to 1100g with the highest gain of 1100g occurring in the twins who had the smallest weight on admission. The characteristics of the neonates is as shown on [Table 1].

### Place of delivery, gestation and parity of mothers

Eight (72.7%) out of the 11 neonates that were admitted were out born babies i.e. they were not delivered in our facility. There were two sets of twins with the rest as singletons who accounted for 63.6% of those admitted. Six (55.5%) of the babies were term babies and the rest (45.5%) were pre-term babies. Majority (81.8%) of the mothers of the babies were primiparous women and only two were multiparous women, one of whom had a parity of nine.

### Aetiology, mechanism, total burn surface area, depth and location of burn injury

Nine (81.8%) of the burn injuries were as a result of bathing with hot water. Most (66.6%) of these bathing was carried by the grandmothers and mothers of the babies as shown on [Table 1]. The total burns surface area (TBSA) ranged from 1% to 62% with a mean of  $17.7 \pm 18.4\%$  and a median (IQR) of 11(7.5 – 19.0). The injuries were mainly superficial partial thickness burns and only one deep partial thickness burns which also had the highest TBSA. Almost all parts of the body were involved ranging from a single region to multiple regions of the body as shown in Figures 1–3.

### Treatment, length of stay and outcome

All the babies were managed by dressings of the limbs and trunk, while open dressings for the perineum, head and neck. None of the babies had skin grafting. The length of stay (LOS) in the hospital ranged from six days to 25 days with a median (IQR) of 11.0 (7.0 – 16.0). Only one baby (with TBSA of 62%) died giving a hospital mortality of 9.1%. The baby was a day-old pre-term singleton out born female who sustained scald injury following bathing by the grandmother.

## Discussion

Burn injuries in children are common in children. However these injuries are rare and are accidental amongst neonates.<sup>[2,6,16,21-28]</sup> The neonates are a complex and vulnerable age groups that are usually exposed to preventable environmental factors that are often implicated as the cause of their injuries.<sup>[9,24]</sup> These neonates have immature immunity, a thin and fragile skin, and a large body surface. The thin skin is more marked in the pre-term babies.<sup>[11]</sup> The neonatal burn injuries do occur within and outside the hospital as seen in our series. It has been reported that more of the hospital burn injuries in neonates are commoner in the developed countries, while domestic

**Table 1: Characteristics of the neonates with burn injuries**

Characteristics	Frequency (n = 11)	Percentage	95% Confidence Interval
Age of mothers			
Mean $\pm$ SD (years)	27.9 $\pm$ 6.0		23.9 – 32.0
Type of gestation			
Singleton	7	63.6	28.8 – 88.3
Multiple	4	36.4	11.7 – 71.2
Place of delivery			
Facility	3	27.3	7.2 – 64.6
Outside the facility	8	72.7	35.4 – 92.8
Parity of the mothers			
Primiparous	9	81.8	42.0 – 96.6
Multiparous	2	18.2	3.0 – 58.0
Age of patients at admission in days			
Median (IQR)	2 (1 -15)		
Gestational age at birth			
Pre-term	5	45.5	16.8 – 77.4
Term	6	55.5	22.6 – 83.2
Sex of the patients			
Male	5	45.5	16.8 – 77.4
Female	6	55.5	22.6 – 83.2
Place of injury			
Facility	3	27.3	7.2 – 64.6
Outside the facility	8	72.7	35.4 – 92.8
Birth weight of the patients			
Mean $\pm$ SD (g)	2718.2 $\pm$ 764.0		2205.0 – 3231.4
Weight on admission			
Mean $\pm$ SD (g)	2650.0 $\pm$ 697.9		2181.2 – 3118.2
Outcome of treatment			
Discharged	10	90.9	46.3 – 99.2
Died	1	9.1	0.9 – 53.7
Total body surface area affected (%)			
Median (IQR)	11.0 (7.5 – 19.0)		
Depth of burns			
Superficial partial burns	10	90.9	46.3 – 99.2
Deep partial Burns	1	9.1	0.9 – 53.7
Mechanism of burns			
Mother bathing	2	18.2	3.5 – 58.0
Grandmother bathing	4	36.4	11.7 – 71.2
Nurse/hospital staff bathing	2	18.2	3.5 – 58.0
Neighbour bathing	1	9.1	0.9 – 53.7
Radiant warmer related	2	18.2	3.5 – 58.0
Length of hospital stay (days)			
Median (IQR)	11.0 (7.0 – 16.0)		
Location of burns			
Single	2	18.2	0.9 – 53.7
Multiple	9	81.2	42.0 – 96.6

SD = Standard Deviation, IQR = interquartile range

injuries are commoner in the developing countries.<sup>[21]</sup> This is consistent with the findings in our study in which most of the injuries occurred outside the facility.

From the available literature most reports of neonatal burn injuries are mainly case reports. This supports the assertion that it is an uncommon condition. This is also the case in our environment as evidenced by the number of cases we recorded which is only 11 cases over a period

of eight years giving an average of 1.4 cases per year. This number is comparable to the report by Muntean *et al.*<sup>[21]</sup> who reported from Romania 13 cases over a period of seven years giving a rate of 1.8 cases/year. However, our report is far less than some other reports from within and outside Nigeria that reported cases ranging from 3.0cases/year to 9.2 cases/year.<sup>[16,22,26,29]</sup> The report by Uguro *et al.*<sup>[16]</sup> from Nigeria was a compilation from four centres compared to



Figure 1: Neonatal burn injury involving the anterior trunk perineum and feet at Presentation (A1 and B1) with good healing with treatment (A2 and B2)



Figure 2: Neonatal burn injury involving lower back and lower limbs, at presentations (A) and good healing (B) with treatment

our report which is from a single centre, which gives credit to the fact that this type of injury is not common in our environment.

Most (72.7%) of the patients sustained the injury outside the hospital and only three sustained the injury within the hospital setting. This was comparable to the findings by Ugboro *et al.*<sup>[16]</sup> where majority (90.5%) of the patients

sustained the injury outside the hospital. This finding is in contrast with the report by Muntean *et al.*<sup>[21]</sup> who reported that all their patients sustained the injuries in the hospital. All except two of our patients sustained scald injuries which in contrast with the report by Muntean *et al.*<sup>[21]</sup> where all their patients sustained their injuries as a result of a fire disaster in the hospital. Even though we reported a



**Figure 3: Neonatal burn injury involving the face**

combination of aetiological agents like other authors<sup>[16,22,29]</sup> some of the reports were mainly from flames or contact with heaters.<sup>[16,22]</sup> Like some previous reports<sup>[21,22]</sup> all our cases were accidental this was in contrast with the report by Ugburo *et al.*<sup>[16]</sup> where one of their patient who had the food deliberately mixed with an unspecified chemical. Several studies have alluded to the fact most cases of neonatal burn injuries were from accidents with various combination of aetiological agents. The causative agents were scald,<sup>[16,21,23-25]</sup> contact,<sup>[6,21,22]</sup> flame,<sup>[2,16]</sup> radiant heat<sup>[22,30]</sup> and chemicals.<sup>[16,27]</sup>

The scald injuries in our series were a result of bathing and only two of the bathing were done by the mothers and four by the grandmothers. The culture in our environment is that the more experienced mothers (commonly the grandmothers and aunts) are the ones that give the new-borns their first bath until the mother is strong or has learned to give such baths. The two mothers who were involved in bathing their babies were multiparous women. The commonest practice is to cool the water that has been heated to boiling point by adding cold water to a temperature that is determined by the person giving the bath. Sometimes this aspect of cooling is not carried out like in the traditional hot bath that is common in some parts of Northern Nigeria.<sup>[18]</sup> These traditional hot baths are given to the mothers and extended to the newborn through hot compress of the different parts of the body. These baths can lead to burns. Because most of the injuries were due to bathing with hot water several parts of the body can be affected. Sometimes the temperature of the water is not tolerable. This is a practice that can be prevented through health education during antenatal care or postnatally. It will be important to include older female family members such as grandmothers and aunties in such health talks because they are often the immediate caregivers of the neonates until the mothers are considered strong enough to care for their babies. Currently, information about bathing is included in routine care for every baby but the focus is to delay the first bath until after the 1<sup>st</sup> 24 hours of life for term babies and until small babies attain a weight of 2.5kg in order to prevent hypothermia which is a strong predictor of mortality in the first 24 hours.<sup>[31-33]</sup> This report has highlighted the risk of scalds, hence the need

to also include information about the peculiarities of the newborn that make them particularly vulnerable to burns as well as how to ensure that water for bathing is within recommended temperatures.

In our series we had a wide range (1% - 62%) in the TBSA with a median of 11% and a mean of 17.7%. The mean TBSA was comparable to a mean report of 18.7% by Saaiq *et al.*<sup>[22]</sup> in a case series of similar number of cases. The TBSA in our report was lower than that of Ugburo *et al.*<sup>[16]</sup> who reported a mean of 26% and that of Muntean *et al.*<sup>[21]</sup> who reported a mean of 47.5%. In all three reports, the sample size was small and there was a wide range in TBSA which was skewed to the left therefore mean values presented an exaggerated measure of central tendency.

Nearly all our patients sustained superficial partial thickness. This may be due to the fact that they were mostly accidental scald injuries from bathing in which the victims would have been rescued and so reducing the period of contact with the agent causing the injury. These neonates depend on adults and parents for protection as they cannot move away or protect themselves from the agent causing the injury. Considering the fact that the neonatal skin is thin and delicate they are prone to sustaining such injury.<sup>[23]</sup> Usually, the extent and depth of this type of injury depends on the temperature and the quantity of the fluid.<sup>[16]</sup> The possible accidental nature of the scald injuries must have explained the depth and the extent of the injuries. As attempts are usually made to rescue the baby as well as applying cold water to prevent further damage.

All the injuries were managed without surgical intervention unlike other reports where surgical interventions such as excision and skin grafting were carried out for a number of the patients.<sup>[16,21,22,25]</sup> The maximum length of stay of our patients was 25 days and all were discharged except one patient that died. The LOS in our series ( $12.5 \pm 6.3$  days) was less than that reported by Ugburo *et al.*<sup>[16]</sup> ( $17.33 \pm 3.87$  days) because the mean TBSA in this study ( $17.7 \pm 18.4\%$ ) was less than the TBSA they reported ( $29.37 \pm 4.61\%$ ). The longer the period of hospitalisation the higher will be the cost of care which is also dependent on the severity of the burn injury.<sup>[34]</sup> The only mortality we recorded was in a neonate who had a TBSA of 62% and for a neonate this is a very severe burn injury that poses a great challenge to the metabolic response of a neonate whose immunity is immature and cannot mount enough response for survival. Though the TBSA in this study ( $17.7 \pm 18.4\%$ ) was similar to that of Saaiq *et al.*<sup>[22]</sup> ( $18.72 \pm 17.13$ ), they had a high mortality of 27.2% compared to ours of 9.1%. This is due to varying aetiological factors and the associated inhalational injuries reported in their article.

## Conclusion

Neonatal burn injuries are uncommon in our environment. Our report shows that it is usually accidental and the

commonest cause is scald injuries from hot water bath. Most of them were superficial partial thickness burns and the outcome was good. All these burn injuries were preventable and might have been achieved through health education. Health talks about safe natal baths highlighting water temperature can be incorporated with the routine health talks during antenatal care or during pre-discharge education after births. Also, it is important to include older female caregivers in such education. It is better to prevent burn injuries than to treat one and it is better to be aggressive in the treatment to prevent complications that may arise.

#### Authors contribution

Simon J. Yiltok: Took part in the concept, design, clinical studies, definition of intellectual content, literature search, data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing and manuscript review.

Akintunde J. Akintayo. Took part in the concept, design, clinical studies, definition of intellectual content, literature, data acquisition, manuscript preparation, manuscript editing and manuscript review.

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Abdulquadir Idrisu. Took part in concept, clinical studies, literature search, data acquisition, manuscript editing.

#### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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#### Conflicts of interest

There are no conflicts of interest.

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