

# PATTERN AND DETERMINANTS OF SKIN INJURIES IN PRETERM NEONATES ADMITTED TO SICK NEWBORN CARE UNIT IN A TERTIARY CARE HOSPITAL.

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## Abstract

**Objectives: Primary objective:** To estimate the proportion of skin injuries in preterm neonates admitted to the Sick Newborn Care Unit (SNCU)

**Secondary objective:** To describe the pattern of skin injuries and their predisposing factors in preterm neonates admitted to SNCU.

**Methods:** Hospital-based descriptive cross-sectional study done over 4 months between June 2021 and September 2021 in SNCU of Govt. Lady Goschen Hospital attached to Kasturba Medical College, Mangalore. The demographic information, clinical profile of eligible preterm neonates were documented and these neonates were examined daily until discharge from SNCU, and skin injuries along with their predisposing factors were documented in data capture sheets. The information obtained was analyzed using SPSS version 25.0.

**Results:** The proportion of preterm neonates with skin injuries during SNCU stay was 24.3% (n=35). Abrasion (n=12, 8.3%), followed by nasal septal skin damage (n=10, 6.9%) were the two most common injuries observed. Female neonates were affected thrice as much as males.

**Conclusion:** Skin injuries are common morbidities in preterm neonates admitted to SNCU. They can be trivial and self-limiting to severe ones that may prolong SNCU stay. Most are related to monitoring device use and therapeutic interventions in SNCU.

**Keywords:** Preterm, Prematurity, Injuries, Skin Injuries, Sick Newborn Care Unit

## Introduction

Neonatal illnesses and their management take a heavy toll on society in general and the health system in particular<sup>1</sup>. In India, every year approximately 30% of neonates that is about 7.5 million are born with a birth weight <2500 g and fall into the low birth weight category. This huge number constitutes 42% of the worldwide burden; most for any nation and 40% of these are premature<sup>2</sup>. An analysis of various causes of pediatric mortality in 2013 found prematurity and associated complications as an important cause of mortality and morbidity in newborns in our country<sup>3</sup>.

Prematurity or preterm birth, which is birth before 37 completed weeks of gestation, is one of the common reasons for neonatal admission, illness, and deaths in SNCUs in our country<sup>3</sup>. As intensive care facilities are increasingly being available, the mortality rate among preterm babies has reduced. However, aggressive management of these preemies heralds the use of various supportive drugs, monitoring devices, and therapeutic procedures, which increase morbidity<sup>4</sup>.

Skin injuries form an important group of morbidities that affect premature babies. There are multiple factors responsible for skin injuries in preterm babies. First, anatomically and physiologically, the lesser the gestational age more is the immaturity of the skin of these preemies owing to their very thin layer of stratum corneum, more so in babies with gestational age less than 32 weeks. In addition, skin being the largest exposed organ of the body is vulnerable to injury during birth, resuscitation, monitoring, treatment, and course of stay in hospital. In addition, skin is involved directly in one way or the other in many diagnostic, monitoring, and therapeutic

processes and procedures in newborns<sup>4</sup>. Preterm very low birth weight (birth weight less than 1500 g) and extremely low birth weight (birth weight less than 1000 g) babies have a prolonged length of stay in SNCUs owing to their other concurrent morbidities and are hence more prone to skin injuries.

Prevention of skin injuries in SNCUs is important for many reasons. Skin being a protective barrier of the body, if injured can introduce infection and lead to sepsis and its associated morbidity and mortality in this immunologically vulnerable group of neonates. Pain due to such injuries the neonates must endure en route to recovery and additional cost of their treatment adds to the burden of existing morbidities. Moreover, if skin injuries are severely deep enough to heal by scarring, they may have cosmetic implications in surviving babies, more so if injuries involve facial skin. To prevent or reduce the occurrence of such injuries in preemies, it is essential to know the proportion, pattern, and severity of injuries and their predisposing factors.<sup>(4-8)</sup>

## Materials and methods

This hospital-based descriptive cross-sectional study was carried out over 4 months from June 2021 to September 2021 in SNCU of Govt. Lady Goschen Hospital attached to Kasturba Medical College, Mangalore. Approval to conduct the study was taken from the Institute Ethics Committee and Medical Superintendent of the hospital. Written, informed consent was taken from parent/s of the preterm neonates to be enrolled in the study. All neonates born before 37 completed weeks of gestation and admitted to SNCU during the study period were included in the study. Preterm neonates with congenital skin disorders and those with pre-existing skin injuries referred from other hospitals were excluded from the study. Preterm neonates whose parent/s did not consent to participate were excluded from the study. All preterm neonates meeting the inclusion criteria were examined clinically for skin injuries and subcutaneous manifestations daily until discharge from SNCU. A data extraction sheet was prepared by filling the pre-designed proforma containing three sections. Section I documented the socio-demographic details of the neonates namely gestational age, sex, birth weight, place, and mode of delivery. Section II documented the clinical features of neonates at presentation until discharge from SNCU including the need for resuscitation at birth. Section III documented the nature of skin injuries occurring in neonates overtime during their stay in SNCU, as well as information on various monitoring devices, therapeutic interventions used in these neonates. All neonatal skin injuries, whether pressure-induced, thermal injuries, drug or fluid extravasation induced, monitoring or therapeutic device or procedure-induced injuries on the skin and associated subcutaneous manifestations were referred to as "skin injury" in the study. Data was entered and analyzed by using statistical software Statistical Package for Social Sciences (SPSS) Version 25.0. Descriptive statistics like to mean, proportions, and standard deviation were used for expressing the results. The association of socio-demographic characteristics with clinical presentation and outcome was analyzed by using the Chi-square test and *P*-value <0.05 was considered statistically significant.

## Results

The baseline characteristics of admitted preterm neonates are displayed in Table I. During the 4-month study period, 144 neonates were admitted to the SNCU (mean birthweight 1540± 400 gms [range 600–2750gms]; gestational age ranged between 25 completed weeks to 36 weeks 6 days; 65 male, 79 female). All babies were inborn. The majority of neonates were delivered by Lower Segment Caesarean Section (n=112, 77.8%) and the rest by vaginal route (n=32, 22.2%). Resuscitation at birth was required in a little more than one-third of babies (n =49, 34%) in the form of Bag and mask ventilation (n= 21, 14.6%) and Bag and tube ventilation (n=28, 19.4%). When the duration of stay of babies in SNCU was analyzed, it was seen that the majority of babies spent 7 to 14 days in SNCU (n=75, 52.1%).

Thirty-five neonates (24.3%; 9 male, 26 female; the mean birth weight of 1,467±345.3 gms) exhibited some kind of skin injury during SNCU stay. Nineteen babies had one skin injury during the period of hospitalization and fifteen babies had two injuries each. Table II shows the types and frequency of various skin injuries in preterm neonates in our study. Abrasion (n=12) of skin was the most common type of skin injury followed by nasal septal skin injury (n=10) due to n CPAP use. Most skin injuries were noted on lower limbs (n=13, 9%).

The majority of preterm neonates with skin injuries were in the gestational age group of 32-33 6/7 weeks (n=15, 42.9%). Most neonates with skin injuries were in the weight range of 1500 to 2499 gms (n=22, 62.9%). Female preterm neonates (n=26, 74.3%) experienced more skin injuries compared to male preterm neonates (n=09, 25.7%), with a *p*-value of 0.008 which was significant. Babies delivered by Lower Segment Caesarean Section (n=25, 71.4%) had more skin injuries compared to those delivered by vaginal route (n=10, 28.6, *p*-value 0.299). Most babies who had skin injuries had a length of stay between 7- 14 days (Mean duration 8.25±5.1 days) in the SNCU. Table III compares the baseline characteristics in preterm babies with and without skin injuries.

Of the various systemic morbidities in our preterm neonates, respiratory distress syndrome was the most prevalent followed by sepsis, necrotizing enterocolitis, hypoxic-ischemic encephalopathy, and patent ductus arteriosus. The vital signs of all neonates were monitored using monitoring devices as displayed in Table IV. The various therapeutic interventions used were infant feeding tubes, central lines, intravenous calcium, and nCPAP (nCPAP) along with others. Skin injuries were associated with many of these factors.

## Discussion

Advances in medical knowledge and technology plus improved perinatal and neonatal care over the past several years have resulted in increased survival of premature neonates worldwide<sup>9,10</sup>. Premature babies by their anatomic and physiologic immaturity need intensive care management. This intensive care consisting of the application of various monitoring devices, therapeutic procedures, and resuscitative efforts brings along a series of unavoidable, inadvertent, and potential injury risks to the newborns<sup>4</sup>. One iatrogenic event occurs in one out of three to five newborn babies admitted to SNCU<sup>11</sup>. The data of such events and skin injuries in preterm neonates is limited<sup>10</sup>.

Our study aimed to estimate the proportion and pattern of skin injuries and related factors in preterm neonates admitted to SNCU. According to our results, 24.3% (n=35) of admitted preterm neonates developed skin injuries during their stay in SNCU. This was less compared to a study done by Abkenar MH et al where the incidence of skin injuries was 34.2%<sup>12</sup>. In addition, our incidence was comparable to many previous studies on skin injuries where the incidence varied from 12.7% to 31%<sup>10, 12-15</sup>. However, all these studies included both term and preterm neonates admitted to SNCU whereas our study included only preterm neonates. Most preterm neonates with skin injuries in our study were early to moderate preterm (28 w to 33w 6/7 days, n=25, 71.4% of skin injuries); with birth weight between 1000 gms to 2499 gms (n=33, 94.2% of skin injuries) and had an average length of stay in SNCU between 7 to 14 days (n=20, 57.1% of skin injuries). This pattern of baseline characteristics reinforces the fact that lower gestational age, low birth weight, and a longer duration of stay in intensive care units increase the risk of skin injuries in neonates<sup>12,14,16</sup>. The skin of preterm neonates being anatomically and physiologically being more fragile, as well as their prolonged stay in SNCU compounded with diagnostic and therapeutic procedures exposure, could pose more risk for above skin injuries. All these were consistent with the results of our study.

Abrasion of skin especially over the pressure points on lower limbs were the most common skin injuries encountered in our study (n=12, 8.3%). Most of these injuries were minor, erythematous, and symmetrical, located on the knees, and were related to the friction of these pressure points with mattresses used on radiant warmers as well as due to prone positioning of care. Metzker et al described similar injuries in their review<sup>9</sup>.

In the last four decades, nasal skin and septal injury secondary to the use of nCPAP (nCPAP) devices have been described with varying degrees of incidence and severity<sup>4</sup>. In our present study, we came across preterm neonates with nasal skin injuries (n= 10, 6.9%). Inappropriate sizes of prongs and masks, inappropriate size of the head-securing device, prolonged nasal CPAP usage due to respiratory morbidities could be the possible reasons for this type of injury.

Pulse oximeters and multichannel monitors are essential non-invasive devices used for continuous monitoring of vital signs of sick neonates. Application of probes of these monitoring devices can lead to injuries at the site of application as encountered in our study. Nine babies (n=9, 6.2%) developed erythema and pressure-induced injuries due to the tight application of probes on the feet and hands of babies. Similar injuries have been reported in babies less than 30 weeks gestation<sup>4, 17-21</sup>. Use of appropriate device-specific probes, more frequent checking of probe sensor application site, and tying the probe snug but not overly tight can reduce the incidence of such injuries.

Adhesive-related injuries occur due to the phenomenon of epidermal stripping wherein there is a separation of the superficial epidermis from the underlying dermis partly or completely. This phenomenon occurs when the adhesives used for fixing intravenous lines, various tubes and probes, and electrodes of monitoring devices are removed and applied repeatedly. In the present study, we came across adhesive-induced injuries in preterm neonates (n=8, 5.6%) especially around the perioral region where adhesives were used to secure endotracheal tubes and infant feeding tubes. Similar injuries were seen in a study conducted by Csoma et al<sup>10</sup>.

Injuries of skin and surrounding tissues can also occur due to the extravasation of intravenously administered fluids and medications. These injuries can occur with increased frequency in preterm neonates owing to their fragile nature of veins and longer duration of intravenous fluids and parenteral nutrition. This is compounded by the use of drugs like intravenous calcium, vasopressors, and sodium bicarbonate usage in sick preterm neonates as part of their therapeutic management<sup>4, 21-27</sup>. In our study, we encountered extravasation injuries in a few babies (n=6, 4.2%); a similar incidence of extravasation injuries were seen in a study done by Csoma et al<sup>10</sup> and Wilkins et al<sup>21</sup>. One baby had extravasation of blood component packed red blood cell during transfusion. Meticulous monitoring of intravenous line sites for early signs of extravasation might alleviate this problem to a certain extent.

In our study, we came across one case of decubitus ulcer on the scalp following prolonged mechanical ventilation, which was very much on the lesser side when compared to similar injuries in a study by Csoma et al<sup>10</sup>. Frequent position change and meticulous observation might reduce their incidence. A bruise at the site of arterial blood gas analysis and venepuncture sites were seen in five babies (n=5, 3.5%). Abscess at the site of intravenous cannulation was observed in one baby in our study. Meticulous hand hygiene and aseptic precautions while inserting and maintaining an intravenous line might reduce this type of complication.

## Conclusion

A significant proportion of preterm neonates admitted to SNCU develop skin injuries, some of which are avoidable and the rest unavoidable. A variety of skin injuries are seen in preterm neonates ranging from trivial injuries like abrasion to serious ones like extravasation and nasal septal skin injuries. Most injuries are related to the use of monitoring devices and therapeutic interventions in SNCU. Awareness of the treating team of SNCU about such injuries together with meticulous monitoring and early intervention might reduce the occurrence of a few of these injuries.

**Conflict of interest:** None

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Baseline characteristic	Number (n)	Percentage (%)
<b>Gestational age (Weeks)</b>		
< 28	09	6.2
28- 31 6/7	34	23.6
32-33 6/7	44	30.6
34-6 6/7	57	39.6
<b>Sex</b>		
Male	65	45.1
Female	79	54.9
<b>Birth weight (grams)</b>		
<1000	07	4.9
1000- 1499	49	34
1500-2499	85	59
≥2500	03	2.1
<b>Mode of delivery</b>		
Vaginal	032	22.2
Caesarean	112	77.8
<b>Resuscitation at birth</b>		
None	95	66
Bag and mask ventilation	21	14.6
Bag and tube ventilation	28	19.4

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27. Maggi JC,  
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Length of stay in SNCU		
< 1 day	07	4.9
1-6 days	48	33.3
7- 14 days	75	52.1
>14 days	14	9.7

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64:145–150.  
Angeles J,  
Gangrene in a  
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Pediatr 1982; 100:323–325

**Table I. Baseline characteristics of preterm neonates admitted in SNCU (n=144)**

**Table II. Pattern and frequency of skin injuries in admitted preterm neonates (N=35)**

Type of injury	Number*	Percentage
Abrasion	12	8.3
Bruise	5	3.5
Nasal skin injury post-CPAP	10	6.9
Extravasation injury	6	4.2
Probe/thermal injury	9	6.2
Pressure ulcer	1	0.7
Adhesive injury	8	5.6
Abscess	1	0.7

\*Multiple injuries included

**Table III. Baseline characteristics in preterm neonates with and without skin injuries.**

Baseline characteristic	Preterm neonates N (%)	Skin injury		p-value
		Present	Absent	
<b>Gestational age</b> <28 weeks 28- 31 6/7 weeks 32-33 6/7 weeks 34-36 6/7 weeks	09 (6.2) 34 (23.6) 44 (30.6) 57 (39.6)	02(5.7) 10(28.6) 15(42.9) 08(22.9)	07(6.4) 24(22) 29(26.6) 49(45)	0.109
<b>Weight</b> <1000 gms 1000-1499 gms 1500-2499 gms ≥2500 gms	07(4.9) 49(34) 85(59) 03(2.1)	02(5.7) 11(31.4) 22(62.9) 00(0.0)	05 (4.6) 38 (34.9) 63 (57.8) 03 (2.8)	0.744
<b>Sex</b> Male Female	65 (45.1) 79 (54.9)	09(25.7) 26(74.3)	56 (51.4) 53 (48.6)	0.008

<b>Mode of delivery</b> Vaginal LSCS	32(22.2) 112(77.8)	10(28.6) 25(71.4)	22(20.2) 87(79.8)	0.299
<b>Length of SNCU stay</b> <1 day 1-6 days 7-14 days >14 days	07(4.9) 48(33.3) 75(52.1) 14(9.7)	01(2.9) 04(11.4) 20(57.1) 10(28.6)	06(5.5) 44(40.4) 55(50.5) 04(3.7)	_____

**Table IV. Systemic morbidities, monitoring devices, and therapeutic interventions in the admitted preterm neonates and their relation to skin injuries.**

Parameter	Preterm neonates N (%)	Skin injury		P-value
		Present	Absent	
<b>Systemic morbidities</b>				
Patent ductus arteriosus	13(9)	03	10	0.914
Respiratory distress syndrome	128(88.9)	35	93	-----
Necrotising enterocolitis	23(16)	04	19	0.399
Hypoxic-ischemic encephalopathy	14(9.7)	03	11	0.792
Sepsis	52(36.1)	13	39	0.884
<b>Monitoring devices</b>				
Pulse oximeter probe	144(100)	35	109	-----
Multichannel monitor probe	84(58.3)	22	62	0.533
Temperature monitoring probe	144(100)	35	109	-----
<b>Therapeutic interventions</b>				
Central lines	107(74.3)	29	78	0.183
Inotropic support	86(59.7)	24	62	0.478
Intravenous calcium usage	144(100)	35	109	-----
Nasal CPAP ventilation	76(52.8)	22	54	0.220
Mechanical ventilation	32(22.2)	08	24	0.380
Infant feeding tubes	144(100)	35	109	-----
Resuscitation at birth	49(34)	12	37	0.995