Research

Investigation of the prevalence of skin injuries in hospitalized newborns and main reports: an observational, cross-sectional, and monocentric pilot study

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Biagio Nicolosi[1], Eustachio Parente,[2], Irene Marilli[3], Prisco Ranieri[4], Mirco Gregorini[5], Daniele Ciofi[6].

[1] RN, Wound Clinical Nurse Specialist, Complex Injury and Burn Center, Departmental Management of Health Professions, Meyer Children's Hospital IRCCS, Florence, Italy.
[2] RN, MSc, Departmental Management of Health Professions, Meyer Children's Hospital IRCCS, Florence, Italy.
[3] RN, University of Florence, Florence, Italy.
[4] RN, Pediatric Intensive Care Unit, Meyer Children's Hospital IRCCS, Florence, Italy.
[5] RN, MSc, Head of Departmental Management of Health Professions, Meyer Children's Hospital IRCCS, Florence, Italy.
[6] RN, MSN, PhD, Research Manager, Department Health Professions, Meyer Children's Hospital IRCCS, Florence, Italy.

Abstract

The skin of newborns has important physiological and anatomical differences compared to adults, as well as other pediatric age groups. It is thin, with less hair, a poorly developed stratum corneum, reduced cohesion between the dermis and epidermis, weaker intercellular junctions, neutral pH and labile to any stimulus.The objective of this pilot study is to provide initial data relating to the phenomenon of injuries in the NICU. The study was observational, cross-sectional, monocentric and involved the analysis of a pilot cohort in a time window identified a priori. Of the 24 newborns hospitalized on the index day, only 11 newborns were enrolled, due to failure to provide consent from the parents or the absence of the newborn at the time of the survey. Of the 11 newborns present in the ward, 9 were admitted to the NICU (81.82%) and of these 7 presented injuries (77.78%); the other 2 were in the SNICU and only 2 had an injury (50%). Of these, 8 had lesions, with a prevalence of 72%; 5 had MASDs (62%), while the other 3 had PUs (38%). The prevalence of PUs was 27.27%, while that of MASD was 45.45%. From the analysis of Fisher's test, we did not highlight any statistically significant association between the appearance of lesions and the use of a specific device. The study results have described that the injuries are the result of the combination of different factors. Is fundamental investigate more these aspects and increase the windows observation.

Keywords: Pressure Ulcers, Injuries Prevalence, Newborn, Moisture Associated Skin Damage, Neonatal Intensive Care Unit

Background

The skin is the largest organ of the human body, entirely covers and protects the organism. It carries out biological functions necessary for survival: 1) protects the organism from microorganisms, trauma, radiation, injuries, etc.; 2) contributes to the immune response against pathogens; 3) participates in thermoregulation; 4) prevents dehydration, maintaining a hydroelectric balance.[1]

The skin of newborns has important physiological and anatomical differences compared to adults, as well as other pediatric age groups. It is thin, with less hair, a poorly developed stratum corneum, reduced cohesion between the dermis and epidermis, weaker intercellular junctions, neutral pH and labile to any stimulus. Furthermore, the dispersion of water via the trans epidermal route is greater; the sebaceous activity is minimal; therefore, the tendency is towards dehydration of the skin surface, and the adipose tissue is small.[2]

The head is proportionally larger than other areas of the body, in fact the occipital and temporal surfaces are the areas most exposed to the risk of pressure ulcers (PUs – Pressure Ulcers).[2]

Other different types of lesions are also identified: Medical Device Related Pressure Ulcers (MDRPUs), Moisture Associated Skin Damages (MASD), Medical Adhesive-Related Skin Injuries (MARSI)[3,4,5] and friction injuries (FIs).[6,7]

Lesions represent a significant problem worldwide and their prevalence remains too high, pediatric studies report a prevalence between 1.6% and 13.4% and there is variability in the count of PUs due to devices.[8]

Overall, the incidence of PUs in the neonatal population admitted to Neonatal Intensive Care Units (NICUs) is between 3.7% and 16%. In Spain, only 1 study addressed this outcome and reported a cumulative incidence of 31.7%.[2] Incidence rates of PUs ranging from 3.7% to 19% have been reported in NICUs and Surgical Intensive Care Units (SICUs)[9], although some investigations reported rates of 28%.[2] Other previous studies have identified prevalence rates of between 12% and 26% in the neonatal population.[10,11] In another more recent study, the overall prevalence ranged from 0.47% to 31.2% and the cumulative incidence ranged from 3.7% to 27%.[12]

Existing data suggests IAD is a common problem in healthcare settings. Studies have estimated that it has: 1) prevalence (i.e. proportion of patients with IAD at a defined point in time) of 5.6%-50%[13,14]; 2) incidence (i.e. proportion of patients who develop IAD over time) of 3.4%–25%.[15,16,17] The wide variations in reported prevalence and incidence of IAD are likely to have a number of causes including differences in care setting and prevalence of incontinence, and the lack of widely accepted clinical criteria for the diagnosis of IAD. Epidemiological studies of IAD must report prevalence and incidence rates in relation to the proportion of the population that is incontinent.[14]

Clinical practice guidelines for the prevention and treatment of pressure ulcers that specifically address the needs of the pediatric and neonatal population are needed.[18] Epidemiological studies on neonatal lesions are scarce,[1,2,18,19,20] although several studies also report a higher prevalence of lesions in this population compared to older children, precisely because of the skin fragility that affects them. characterizes.[1]

The objective of this pilot study is to provide initial data relating to the phenomenon of injuries in the NICU, in anticipation of subsequent broader investigations.

Methods

The objective of the study was to obtain updated epidemiological indicators and the prevalence of lesions in the hospitalized neonatal population. The study was observational, cross-sectional, monocentric and involved the analysis of a pilot cohort in a time window identified a priori. The cohort was represented by the entire neonatal population present within the NICU investigated in the identified window period, chosen randomly by the Promoting Center. The data collection took place in a timely manner through a data collection form (CRF), filled out after obtaining informed consent from the parents, a brief analysis of the newborn's medical record and observation of the skin. The variables investigated were: 1) presence/absence of skin lesions (PUs, MASD, FIs); 2) sociodemographic data; 3) risk factors; 4) preventive measure; 5) characteristics of the lesions.

Infants (<30 days of age, due to neonatal age) admitted to the NICU on the index day and for

whom informed consent was obtained were included in the study.

During data analysis, correlations were made with respect to the type of lesions on the basis of statistical significance (Fisher's exact < 0.05).

To carry out the study, approval was requested and obtained from the Regional Ethics Committee for Clinical Trials of the Tuscany Region, Pediatric Ethics Committee section (register number 270/2022).

Results

Of the 24 newborns hospitalized on the index day, only 11 newborns were enrolled, due to failure to provide consent from the parents or the absence of the newborn at the time of the survey.

Of the 11 newborns present in the ward, 9 were admitted to the NICU (81.82%) and of these 7 presented injuries (77.78%); the other 2 were in the SNICU and only 2 had an injury (50%).

Of these, 8 had lesions, with a prevalence of 72%; 5 had MASDs (62%), while the other 3 had PUs (38%). The prevalence of PUs was 27.27%, while that of MASD was 45.45%.

Of the 5 newborns who reported MASDs, 3 were hospitalized for respiratory diseases (60%), one had congenital malformations (20%), the other a disease affecting the nervous system (20%).

The 3 children who had PUs were hospitalized for diseases affecting the respiratory system (33.33%), the infectious respiratory system (33.33%) and the nervous system (33.33%).

The average length of hospitalization of the sample of newborns present was 9.45 days, while that of the 8 newborns with lesions was 8.8 days. For newborns with MASDs the average number of days of hospitalization was 8.2 days; for those with PUs instead of 10 days.

Below is the summary table of the frequencies and averages calculated (Table 1).

Variables	**Average**
Days of life	15
Gestational age	40
Length hospitalization	9.45
Variables	**Type**
Setting	NICU
Gender	M
Diagnosis	Respiratory, Infection
Type of mattress	Standard hospital mattress
Nutrition	Enteral
Variables	**Frequency**
Oxygen	4 (36.36)
Orogastric tube	1 (9.09)
Nasogastric tube	5 (45.45)
Urinary catheter	1 (9.09)
ECMO	0
Central venous catheter	1 (9.09)
Peripheral venous catheter	6 (54.55)
Not invasive ventilation	0
Invasive ventilation	0
Cushion	3 (27.27)
Postural change	11 (100)
Pulse oximeter	11 (100)
AGHO	0
Barrier product	5 (45.45)
PUs	3 (27.27)
MASDs	5 (45.45)
FIs	0

Table 1. Frequencies and averages of the sample.

The injury-related devices were: 1) oxygen: 100% of infants receiving oxygen therapy had at least one injury; 2) nasogastric tube: out of 5 newborns, 4 (80%) had at least one lesion; of these, 3 (75%) had respiratory diseases and MASDs; 3) type of mattress: out of 8 newborns with hospital mattresses, 6 had lesions (75%), of which 4 (67%) had MASDs, while 2 (33%) PUs; 4) pulse oximeter: although all newborns were subject to frequent changes (1 time every 3 hours), 3 had PUs (1 newborn had no other devices). From the analysis of Fisher's test, we did not highlight any statistically significant association between the appearance of lesions and the use of a specific device (Table 2).

Device	Fisher's exact	P Value
For Oxygen	.72	1.00
Nasogastric tube	.42	0.54
Orogastric tube	.72	1.00
Urinary catheter	.72	1.00
Peripheral venous catheter	.42	0.54
Central venous catheter	.72	1.00
Barrier Product	.12	0.18

Table 2. Analysis of Fisher's exact between PUs and devices

Discussions

The growing medicalization of neonatal care has led to a progressive increase in related complications, including lesions of different etiologies. Wound care strategies in newborns, including the choice of dressings, are currently based on a combination of experience and preferences of professionals, as there is a lack of availability of guidelines and consensus.[21] This highlights the urgent need to focus on specific research and interventions aimed at reducing the incidence of these lesions in pediatric and neonatal patients, taking into account the complications that this population may present.

Visscher M. (2014) indicates that the prevalence of PUs varies between 1.6% and 13.4% and that there is a notable predominance of MDRPUs.[8] In this regard, Fujii K. (2010) distinguishes the factors of risk into two categories: extrinsic risk factors, which are primarily related to the use of clinical devices, and intrinsic factors, which include physical and physiological characteristics of the newborn.[22] Furthermore, it reports that devices contribute between 50% and 70 % of cases of pressure ulcers in neonatal settings.[22]

Patients who develop PUs frequently have multiple risk factors and comorbidities.[23,24] In most cases, a PU forms at an anatomical location where there is a bony prominence beneath the skin. When an individual spends prolonged periods of time in a bed or chair, pressure and shear forces caused by gravity act on the skin over the bony prominences. These compress, stretch and shear tissues, deforming the cells and extracellular matrix (ECM) components and obstructing vascular and lymphatic flow. The compression, which is always combined with shear, causes local ischaemia by occluding the microvascular network of capillaries in skin and deeper tissue.[25]

Pressures required to cause local ischaemia depend on the magnitude of the shear and the individual's vascular functionality (cardiovascular system health).[26,27,28] Inflammatory changes initially occur in tissues directly exposed to sustained force and deformation.[29,30] In the context of DRPUs, this has been demonstrated through cell-scale computational modelling, which shows that external forces associated with use of medical devices can cause deformation-inflicted cell damage almost immediately.[31]

The magnitude and duration of the deformation will determine the extent of cell and tissue damage and subsequent inflammation, as well as the degree of ischaemia.

Also, the friction distorts tissue resulting in shear forces, which cause skin and subdermal damage, leading to pressure ulceration. Friction-related PUs often develop in patients who are partially mobile or repetitive involuntary movement.[32] In these fragile cases, inadvertent damage from friction burn is frequently observed.[33,34] The patient, who may already be compromised because of their skin morphology and/or involuntary repetitive movements, or have reduced tissue tolerance, may exert pressure and frictional forces that can cause skin damage.[35] High frictional forces can cause

delamination of skin and skin tears, particularly in older people and those with less mechanical strength in the dermo- epidermal junction.[35]

Frictional forces acting on the skin are affected by the local microclimate, with increased skin hydration, increasing the coefficient of friction by 26–43%.[36] Use of prophylactic dressings to prevent pressure ulceration has been shown to reduce the coefficient of friction, when compared with moist skin on bed linen, thereby reducing the risk of pressure ulceration.[37]

Attention should be paid to newborns, who are physiologically exposed to muscle weakness and poor muscle coordination, which limits mobility. These aspects compromise a newborn's ability to maintain natural and conscious body positions. This decreases mobility and can cause bony prominences to press against a support surface or medical device, increasing the risk of MDRPUs. Friction between the skin and a surface causes tangential deformation of the skin, causing shear forces and distortions of the subcutaneous tissue.[38,39]

Incontinence-Associated Dermatitis (IAD) describes the skin damage associated with exposure to urine or stool. It causes considerable discomfort and can be difficult, time consuming and expensive to treat.[40]

IAD is a type of irritant contact dermatitis (inflammation of the skin) found in patients with faecal and/or urinary incontinence.[41]

IAD is also known as perineal dermatitis, diaper rash and many other names and is included within a broader group of skin conditions that are referred to as moisture-associated skin damage (MASD). The term IAD is preferred as it distinguishes skin problems arising directly from contact with urine and/or faeces due to incontinence from other conditions and acknowledges that the condition may affect more than the perineal area and people of any age.[42]

In neonates with MASDs, was identified factors in relation, which was infectious respiratory disease (Respiratory Syncytial Virus), antibiotic therapy, peripheral venous catheter, the nasogastric tube, pulse oximeter e the application of barrier product.

With incontinence, water from urine and/or faeces is pulled into and held in the corneocytes. This overhydration causes swelling and disruption of the structure of the stratum corneum and leads to visible changes in the skin (e.g. maceration).[43] As a result of excessive hydration, irritants may more easily penetrate the stratum corneum to exacerbate inflammation. When skin is overhydrated, the epidermis is also more prone to injury from friction caused by contact with clothing, incontinence pads or bed linen.[44]

With exposure to urine and/or faeces, skin becomes more alkaline. This occurs because skin bacteria convert the substance urea (a product of protein metabolism found in urine) to ammonia which is alkaline. The increase in skin pH is likely to allow micro-organisms to thrive and increase the risk of skin infection. Faeces contain lipolytic (lipid-digesting) and proteolytic (protein-digesting) enzymes capable of damaging the stratum corneum. Clinical experience has demonstrated that liquid faeces are more damaging than formed faeces as liquid faeces tend to be highest in digestive enzymes.[45,46]

Enzymes can also act on urea to produce ammonia, further increasing the pH seen in urinary incontinence. Enzymes are more active at a higher pH, so the risk of skin damage is increased with alkaline changes. This may explain why the combination of urine and faeces observed in mixed incontinence is more irritating to the skin than either urine or stool alone.[47]

There is emerging interest in the possibility that certain medications (e.g. steroids or chemotherapeutic agents or their metabolites) that are excreted in urine or faeces may have a role in the development of IAD. In one study, antibiotic usage was found to be a statistically significant risk factor for IAD.[48] Poor or inappropriate management of incontinence may also contribute to the development of IAD. For example: a) prolonged exposure to urine and faeces due to infrequent change of incontinence products or limited cleansing; b) absorptive or incontinence containment devices may exacerbate overhydration by holding moisture against the skin surface,[49] especially if they have a plastic backing; c) thick occlusive skin protectant products may limit fluid uptake of absorbent incontinence products[50] causing overhydration of the stratum corneum; d) frequent skin cleansing with water and soap is detrimental to skin barrier function by damaging the corneocytes, removing lipids, increasing dryness and creating friction;[51] e) aggressive cleansing technique (e.g. using regular washcloths) can increase frictional forces and abrade the skin.[52]

In this study we tried to maximize the information obtained, despite the limitation of a single observation window. a statistical analysis

method was used to ensure the validity of the conclusions and to mitigate the impact of the single prevalence window. The limitation of the study, however, must be considered in the perspective of further investigations of prevalence and relationships between risk factors, in fact it represents a pilot window. The objective was to use the results obtained as a starting point for further investigations, hoping to expand the number of windows to delve deeper into what was found with respect to the multifactorial nature of lesions in newborns.

Conclusion

The limited availability of updated epidemiological indicators on the prevalence of skin lesions and the possible relationships with the various risk factors represents an obstacle to guaranteeing appropriate and safe care.

The study results have described that the injuries are the result of the combination of different factors. However, for a complete description of this phenomenon, is fundamental investigate more these aspects and increase the windows observation.

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