


RESEARCH

Medical adhesive-related skin injuries in the neonatology department of a teaching hospital

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Abstract

Background: Medical adhesives are used to affix components to the skin. They are part of procedures performed by medical specialties because of their participation as constituents of different products, such as tapes, dressings, and electrodes.

Aim: This study aims to assess the prevalence of, and factors associated with, the development of medical adhesive-related skin injuries (MARSIs) in patients treated with medical tapes in the neonatology department of a large teaching hospital in Brazil.

Study Design: Cohort study.

Methods: All premature newborns (gestational age from 28 to <37 weeks) admitted in the neonatal intensive care unit of a teaching hospital, from March to August 2019, were followed up. Neonate skin condition was assessed based on the Neonatal Skin Condition Scale (NSCS). Data analyses were conducted in R software.

Results: In total, 46 premature newborns were included in the study; 552 evaluations were performed—mean of 11.7 per patient. Most neonates ($n = 41$; 89.1%) used adhesive tapes, either paper tape ($n = 37$; 80.4%) or transparent film dressing ($n = 34$; 73.9%). Newborns' face and head were the most affected body regions ($n = 125$; 50.2%). Eight patients had MARSIs (19.5% of patients who used tape). NSCS scores (P value < .001) and the adopted warming system (P value = .01302) were associated with the occurrence of MARSIs. Incubators seem to be a protective factor for MARSIs (OR = 0.048; IC95% = 0.0008-0.75; P value = .013).

Conclusion: Adhesive tapes in premature newborns should be considered a risk factor for injuries. Although NSCS showed mild-to-moderate impairment and lesion severity was low, this event is relatively frequent in neonatal units.

Relevance to Clinical Practice: Awareness of the risk associated with adhesive tape application and removal in newborns allow health services to better address the problem by enforcing good practices, elaborating better protocols, qualifying the health care professionals, and potentially selecting softer tapes for neonates.

KEYWORDS

infant, newborn, skin, surgical tape, wounds and injuries

1 | INTRODUCTION

Medical adhesives are used to affix external components to the skin. They are part of procedures performed by all medical specialties because they are constituents of different products such as tapes, dressings, and electrodes.¹⁻³ Medical adhesive tapes are a basis that acts as a carrier for an adhesive. They are used to provide securement for patients with critical and non-critical devices and for products attached to the skin, as well as to improve skin protection and healing. However, tape application and removal trauma is prevalent and under-reported. Medical tapes are associated with risk of infection, skin injury, delayed healing, decreased quality of life, increased treatment costs, and pain. Preventing newborns from feeling pain is essential because repeated exposure to pain can cause neurodevelopmental impairment, mainly in premature newborns who are more exposed to invasive procedures.^{1,4-8}

A medical adhesive-related skin injury (MARS) is a skin abnormality complication that persists for more than 30 minutes after tape removal.^{1,3,9} *Skin stripping*, which happens when the epidermis is removed as a result of tape application and removal and leaves the skin bare and injured, is one of the most common MARS types.^{2,4,5,9} *Skin tears* are a MARS type featured by the separation of skin layers; it is caused by mechanical injury resulting from tape application, removal or friction in patients with fragile skin (e. g. older people and newborns).^{2,4,9} *Tension blisters* can happen when the tape is excessively stretched and ends up pulling epidermal skin layers.^{2,4,9} Dermatitis is another common MARS that happens when irritants are trapped between the skin and the adhesive.^{4,9}

The skin of newborns is 40% to 60% thinner than that of adults. Skin maturation is a dynamic process that starts during embryogenesis, and barrier development increases because of gestational age (GA).¹⁰⁻¹³ Premature newborns have fragile skin barriers because of oedematous capillary dermis, small collagen fibrils, wide spaces between skin structures, as well as incomplete maturation and thickness of the *stratum corneum*.^{1,2,4,10-13} The skin of premature newborns remains under development; therefore, the impaired barrier function makes it more susceptible to permeability increase. This condition can cause water loss and electrolyte and temperature disturbances.¹⁴ The risk of newborns' skin to develop chemical irritation, local or systemic infections,¹⁵ and several types of skin injuries¹⁶ is greater as a result of the aforementioned features.

What is known about this topic

- Safe and proper care provided to the skin of premature newborns is essential to avoid skin injuries.
- The skin of premature newborns is more fragile and, therefore, more susceptible to injuries caused by adhesive tape fixation and removal.
- Dermatitis and oedema/erythema are the most common lesions.
- Injury prevalence significantly changes in different care-giving units, and it is associated with younger gestational age.

What this paper adds

- The importance of acknowledging the local configuration of the unit and the magnitude of the skin lesion issue for clinical practices.
- The high prevalence of skin injuries among patients who use adhesive tape.
- Face and head are the most often affected regions, and they should receive special attention based on preventive measures.
- Health services and professionals must make strong efforts to apply good practices like using scales to assess skin conditions and choosing more gentle tapes for this population.

GA, birth weight, length of stay, and medical devices such as endotracheal tube, gastric tube, venous access, and nasal catheter are risk factors for skin injuries. The prevalence of skin injury in neonatology ranges from 9.2% to 43.1%; many of these cases are only reported at advanced stage.¹⁶ Regions presenting soft tissue, such as face, the nasal region, and the chest/abdomen region, are the most common anatomical areas. Areas over bone prominences are often around the occipital bone. A single newborn can suffer with more than one skin injury type.¹⁶ Premature newborns with adhesives and medical devices are susceptible to skin

injuries, although they frequently need them in order to be treated. However, many studies conducted with premature newborns have grouped the skin injury types, a fact that makes it difficult to know more about MARSIs in this population.¹⁶ Newborns need adhesives at the time to fix endotracheal tubes, gastric tubes, nasal catheters, venous access and the thermometer, as well as electrodes and wound dressing.¹⁷

Premature newborns can develop MARSIs or skin damages after a single adhesive removal event. These injuries can get contaminated and cause harmful effects on patients and increase the costs with treatment.^{11,18,19} The rational use of adhesive tapes and neonatal warming systems is essential to minimize skin-barrier issues. To the best of our knowledge, there is no study on the occurrence of MARSIs in premature newborns. The aims of the current study were to evaluate the prevalence of, and factors related to, MARSIs in patients from the neonatology department, who were exposed to medical tapes and followed up in a big teaching hospital in Brazil.

2 | DESIGN AND METHODS

A single-centre prospective cohort study was conducted in the neonatology sector of a big teaching hospital in Brazil that assists women with high-risk pregnancy who live in urban and rural counties. The neonatal unit of this hospital has 30 beds and an occupancy rate of 85.9%. Mean hospital length stay reaches 18 days, and the hospital admits ~36 babies a month. All premature newborns—GA between 28 and 36 weeks and 6 days at birth—who were admitted in the hospital from March to August 2019, were included in the study. Parents of participants in the study have signed the consent form. Exclusion criteria comprised pre-existing skin injuries at birth, such as neonatal bullous epidermolysis.

2.1 | Outcome measures

The skin condition of newborns was assessed based on the Neonatal Skin Condition Scale (NSCS), which was translated and validated into Brazilian Portuguese in 2012.²⁰ Assessors were asked to evaluate skin condition by using this scale in order to assess the following parameters: dryness, erythema, and rupture/injury. All three subscales were summed, reaching a score that ranged from 3 to 9. The higher the score value, the greater the skin compromise.

2.2 | Data collection and analysis

Injury identification in patients and patients' skin assessments were performed by three undergraduate nursing students who were attending internship in nursing in the neonatology department of the herein assessed hospital. Data collection training was provided in two steps. The instrument was presented to the students in the first step. Subsequently, each student assessed 10 patients (they all assessed the same ones), who were randomly chosen. This procedure aimed at identifying

analysis' consistency. MARSIs were herein understood as a skin abnormality that persisted for more than 30 minutes after tape removal.

Researchers developed the data collection instrument to gather data from medical records and clinical observation about the response and explanatory variables, as well as clinical and sociodemographic data, such as sex, date of birth, date of hospitalization discharge, and treatment used in the lesions (Appendix S1). Injury occurrence, injury type, infection occurrence, type of tape used, tape application region, and heating device type used will be expressed in occurrence rate. Lesion severity was assessed based on the Three-Item Severity (TIS) score is applied to assess erythema (R, redness), oedema (O), and abrasion (S, scratch) intensity. Total score was measured through the intensity of the three items, which ranged from zero to three, wherein 0 = absent; 1 = mild; 2 = moderate; and 3 = severe. The most representative injury was selected and described as R-O-S (eg, as 1-0-1, total 2). The TIS score ranged from 0 to 9. This scale was developed to assess atopic dermatitis. This tool was adopted to get more detailed information on lesions in this group of patients because of lack of instruments to assess skin lesion severity in newborns.^{21,22} Researchers accounted for doing the assessment on alternate days and for identifying eligible patients before the evaluation sessions.

The difference between explanatory variables linked to response variables was analysed through the chi-square test, or Fisher's exact test was adopted for categorical variables. Student's *t* test or the Kruskal-Wallis test was used for continuous variables, depending on data normality, which was evaluated through the Shapiro-Wilk test. All analyses were conducted in R software.²³ After admission and inclusion criteria identification, the attending health professionals informed the parents about the research and provided them with the patient information sheet. Parents signed the informed consent form after reading the information sheet and having the opportunity to ask any questions. Parents signed two copies of the consent form: they kept one and the researchers took the other. Assessments were made at the institution itself. Researchers answered a questionnaire about the patient's skin condition during the assessment session. All parents agreed to participate in the survey.

3 | ETHICAL ISSUES

The study was conducted based on the ethical principles of the Declaration of Helsinki and on CNS Resolution N. 466/2012. Collected personal data remained confidential and under possession and coordination of the researcher in chief. Results will be disclosed in aggregate because it does not allow individual identification. Risks for patients and caregivers include discomfort in providing some data and fear that the provided information can be made public. These factors were minimized by interviewers' training and by ensuring data confidentiality. Research benefits include scientific knowledge on the topic and potential improvement in patient caregiving in the country, both at local and public health levels. The study was approved by the ethics committee of Universidade Federal de Minas Gerais (CAAE 08047819.6.0000.5149).

4 | RESULTS

In total, 112 patients were admitted in the hospital from March 27 to August 9, 2019. All newborns with GA between 28 and 36 weeks and 6 days were included in the study. The final sample encompassed 46 patients. One patient was excluded from the analysis because he did not meet the inclusion criteria. Mean GA was 32.1 weeks (standard deviation [SD] = 3.2) [224.5 days (SD = 22.4)]. Mean weight at birth was 1679 g (SD = 600)—54% of patients were male. Mean hospital length of stay was 31.3 days (SD = 28.2). In total, 80% (37 individuals) of the sample used incubators, 4.3% (two individuals) used radiant heat cradles, and 12.8% (six individuals) of the it used cots (no warming system). Data of one neonate were not reported because of follow-up loss. Six patients died while the study was still in course, and data collected until the date of their death was included in the study (Appendix S2).

4.1 | Medical adhesive-related skin injuries

In total, 552 assessments were made during the study—11.7 per patient, on average. MARSIs are listed in Table 1. Almost all patients used more than one tape, in more than one region. Most tapes were attached to their faces and heads (50.2%, $n = 125$) in order to affix endotracheal tube, gastric tube, venous access, nasal catheter, and eye protector for phototherapy. In total, eight patients had MARSi

TABLE 1 Medical adhesive-related skin injuries in a teaching hospital of Brazil, 2020

Variable	n (%) or mean (SD)
Use of adhesive tapes during inpatient care	
Yes	41 (89.1)
No	5 (10.9)
Tape attachment location	
Head and face	125 (50.2)
Limbs	68 (27.3)
Torso	56 (22.5)
Type of adhesive used	
Paper tapes	37 (80.4)
Transparent film dressing	34 (73.9)
Adhesive elastic bandage	24 (52.1)
Common adhesive plaster	1 (2.2)
Patients that used adhesive tape with MARSi	
Yes	8 (19.5)
No	33 (80.5)
Average number of MARSi per patient	0.23 (0.60)
Average number of MARSi per patient that used any kind of tape	0.25 (0.63)

Abbreviations: MARSi, medical adhesive-related skin injury; SD, standard deviation.

(19.5% of patients who have used a tape). Five of them had one injury, one had two injuries, and one had three injuries, which represents 0.25 injuries per patient who have used medical adhesive tapes, on average. Data of two patients were not collected or included in the collection form. One of these patients is known to have had at least one injury. Oedema/erythema was observed in five patients, skin stripping was identified in one patient, dermatitis happened in one patient, and skin tear was observed in one patient—no tension blisters were observed. No patient had infection in the injury site (Appendix S3). None of the observed injuries was severe, and no specific treatment was necessary for their healing (TIS scores ranged from 0 to 6; there was no mild injury). NSCS scores ranged from 3 to 5 among patients—score 4 was the most frequent result (65.2%).

NSCS scores (P value $<.001$) and the warming system used (P value = .013) were the only variables associated with MARSi occurrence. Incubators seem to be a protective factor against MARSi (OR = 0.048; CI95% = 0.0008-0.75; P value = .013). Nevertheless, the sample was too small to have the present finding as conclusion. Sex, tape type, GA, weight at birth, and length of hospital stay were not significantly associated with MARSi occurrence in this study (Appendix S4). There were no associations between injury occurrence and have stopped using the device. It is so because the collected data were not the subject of investigation. Only adhesive fixation location was recorded in the data collection instrument.

5 | DISCUSSION

Based on the current results, 19.5% of premature newborn patients who have used tape had MARSi. None of the observed injuries was severe or needed specific treatment. Many studies have described the prevalence and incidence of MARSi in patients using adhesive tapes. Estimates of injuries caused by adhesive tapes present significant variation in the literature. Studies have found incidence rates ranging from 5.8% to 29.83% in different age groups presenting different clinical conditions.^{2,7,24} Noonan et al¹¹ conducted a cross-sectional study with children and infants admitted to a tertiary teaching hospital to assess skin integrity and care needs. They observed that 8% (20/253) of patients had skin peeling as a result of adhesive tape application and removal—many of these injuries were preventable.^{11,25} Habiballa²⁶ conducted a cross-sectional period-prevalence study in a neonatal intensive care unit (NICU) in the Irbid National University Hospital, Jordan. Skin injury prevalence in this population reached 26.6%; premature and underweight neonates with respiratory issues and dependent on mechanical ventilation were more susceptible to injuries. The skin of premature newborns is morphologically and functionally different. Their need of life support interventions increases their exposure to invasive procedures that require adhesive tape using. Thus, more attention should be given at the time to plan the skincare of this population.

Tape-related lesions in premature newborns can be caused by a single application and removal of adhesive tape, as well as by its incorrect application or removal and by the inappropriate selection of the

tape type for a particular region of patient's skin, purpose, or skin type.⁴ Health care services should identify patients at risk, use the appropriate tape type, monitor patients closely for skin damage, and avoid fixing tapes on the skin, whenever possible, in order to avoid MARSIs.⁵ Tape removal is suggested to be the major cause of skin injury in patients in NICUs; this risk is even greater in the first 2 weeks of life.¹⁰ Therefore, the present study showed the importance of adopting assessment tools for therapeutic planning. Protocols should be developed to prevent, in addition to assess and treat, injuries.

Boswell and Waker²⁷ compared two currently acceptable NICU adhesive methods (hydrocolloid dressing—Duoderm Extra Thin Spots and transparent film dressing—Tegaderm) used to secure nasogastric and orogastric tubes, and umbilical lines, in order to determine the method most effective and least likely to cause irritation or injury to neonatal skin, as well as the influence of silicone-based adhesive. Fifty-seven neonates in the mean GA group of 30.24 weeks were enrolled in the study. There were no significant and quantitative differences between scores and the chosen adhesive method. However, qualitative comments by health care professionals indicated more red marks on the neonate's face and nares when transparent film was used.

A randomized, grader-blinded, comparative study assessed the relative gentleness of silicone tape in comparison with paper tape in 24 healthy infants and children. The silicone tape caused much lower erythema response, discomfort was significantly lower, and keratin removal was significantly lesser in patients with silicone tape than in the ones with paper tape.¹⁰ Gentle adhesives, such as silicone tapes and hydrogel-backed electrodes, can help reducing MARSIs in premature newborns.²⁸

Based on the present study, using adhesive tape on the face is very frequent because it allows the adequate positioning of devices such as endotracheal tube, gastric tube, venous access, and nasal catheter. Accordingly, caregiving health care professionals should give special attention to this region by adopting measures to promote skin protection. Health professionals' knowledge about specificities of premature newborns' skin, injury mechanism, and prevention strategies can result in providing qualified care to these patients. Incorporating assessment scores to clinical practice can be an important resource to nurses at bedside. Currently, evaluating newborn's skin conditions is not a systematic practice in most neonatal units, and it makes early identification of MARSIs difficult. It is also important to avoid attaching adhesive tapes whenever possible; the team must have the power to adopt skin protection measures and to incorporate assessment methodologies aimed at enabling early identification and intervention of MARSIs.

6 | LIMITATIONS

One important limitation of the present study lies on the small sample size and on the relatively short follow-up time. Some of the performed tests were not powerful enough to detect differences between variables—the number of events was small, and therefore, there was

much imprecision. Skin condition seemed to be the most important factor associated with MARSIs occurrence, as expected. Interestingly, there was strong association between incubators and protection from MARSIs. The use of incubators was a protective factor for MARSIs development. Therefore, premature newborns shall be treated in heated and humidified incubators to avoid temperature fluctuations—skin injuries are linked to warm and humidified environments.²⁹ The number of MARSIs associated with adhesive tapes was relatively large in cases of preventable complications. The complexity of skincare in neonatology requires well-prepared professionals to work with lesion prevention in, and skincare of, newborns. This scenario was not considered a serious issue in the herein assessed institution because the observed injuries were not associated with adverse outcomes in patients.

7 | CONCLUSION

The use of adhesive tape in premature newborns should be considered a risk factor for injuries. Although the skin condition assessment score (NSCS) showed mild-to-moderate injuries and the severity of the observed lesions was low, this complication is relatively frequent event in neonatal units (19.5% prevalence). The skin evaluation should be performed periodically so that the treatment is timely in neonatal care units.

AUTHOR CONTRIBUTIONS

All authors contributed to the final manuscript.

DATA AVAILABILITY STATEMENT

Unidentifiable data are available upon request.

ETHICS STATEMENT

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and CNS Resolution No. 466/2012. The personal data collected will be kept confidential, under the coordination of the principal researcher. The dissemination of research results will be made in aggregate, not allowing individual identification. Risks for patients and caregivers include the discomfort of providing some data and the fear that information will be made public, which will be minimized by interviewer training and ensuring data confidentiality. The benefits of the research include scientific knowledge on the topic and potential improvement in patient care, both at the local and public health levels in the country. The evaluations took place at the institution itself. Those responsible for the patients were informed about the research and its objectives, the procedure, the anonymity of the data, and their freedom to interrupt data provision at any time. The consent form was read with the representative of the patient. If the responsible person allows the research, he or she signed the informed consent form in two copies, as well as the researcher. One copy was given to the patient representative and another stayed with the researcher. During the evaluations, the researchers answered a semi-structured questionnaire about the patient's skin condition. This study

was approved by the ethics committee of the Universidade Federal de Minas Gerais (CAAE 08047819.6.0000.5149). No material from other authors was used in the report.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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