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Review

Frequency, location and risk factors of neonatal skin injuries from mechanical forces of pressure, friction, shear and stripping: A systematic literature review

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ABSTRACT

Introduction: Recognition of neonatal skin injuries from mechanical forces and their risk factors are limited and vague.
Aim: To identify frequency, locations and risk factors for neonatal skin injuries from pressure, friction, shear and/or stripping.
Methods: Joanna Briggs Institute Systematic Review process was used to search and review articles from Ovid (MEDLINE), CINAHL, Scopus databases and Cochrane Library published from 1990 to 2017.
Results: Of the 1545 papers originally identified, 76 full text articles were examined, 21 studies met the inclusion criteria. Studies were more likely to identify skin injuries from various etiologies (n = 7), pressure (n = 4) and stripping (n = 4). Prevalence of neonatal skin injury ranged from 9.25 to 43.1%. Risk factors included medical devices, gestational age and weight.
Conclusion: Neonatal skin injuries from mechanical forces occur more frequently and differ in location from adults. Future studies need to identify modifiable risk factors and use consistent skin injury classifications applicable to neonates.

Introduction

Premature or sick neonates survive the neonatal period based on the assistance of multidisciplinary care and devices therefore are at risk for skin injuries. Historically research in this area has been limited but it is increasing and recent work suggests that risk factors for neonatal skin injury are decreased gestational age and medical devices (Gray, 2004; Schlüer, 2017). However neonatal skin has many structural differences compared to paediatric and adult populations including fragility, depth (between 0.9 and 1.2 mm thick compared to 2.1 mm in healthy adult skin) and weaker connections in the epidermal-dermal junction (Mathes and Williams, 2015); therefore potential for skin injury is high (Schlüer, 2017). These differences present distinctive challenges for injury prevention but may also suggest additional aetiologies for injury development; compared to paediatric and adult populations.

Skin injuries from pressure, friction or shear are most often classified as pressure injures, defined as "a localised damage to skin and underlying tissue over a bony prominence or related to a medical device" (Edsberg et al., 2016). Whilst the terminology of injury is focused on direct pressure, elements of shear and friction may also be involved and it is uncertain which forces work in isolation to form injuries. Additionally, epidermal stripping is an injury related to the force of adhesive removal with the bond between the adhesive and skin stronger than the layers of skin to each other (Lund, 2014). Epidermal stripping injuries, also known as medical adhesive related skin injuries (MARSI), are suggested to occur frequently in the neonatal population (McNichol et al., 2013).

Skin injuries from pressure, friction, shear and stripping; are reported to be common for hospitalised adults and paediatric patients with well understood locations and risks; but less is known

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for the neonatal population (Schlüer, 2017). Thus, the aim of this review is to explore frequency, locations and risk factors of neonatal skin injuries from these four mechanical forces, pressure, friction, shear and stripping.

Methods

Search string

A three-phase search-strategy was conducted guided by the Joanna Brigs Institute Systematic Review process (The Joanna Briggs Institute, 2014). Initial searches in Ovid (MEDLINE), CINAHL, Scopus and Cochrane Library databases were conducted to identify search terms (MeSH terms or subject headings) from the following: skin injury, pressure injury, pressure ulcer, epidermal stripping, skin stripping, skin tear, iatrogenic skin injury. Following which, keyword searches were also conducted and search strings were generated based on results (see Fig. 1). Searches in Ovid (MEDLINE), CINAHL, Scopus and Cochrane Library databases were restricted only by publication date (1990 current 2017).

Articles identified were imported into reference library, combined and searched for duplicates. Once duplicates were removed, the titles and abstracts were reviewed using the inclusion and exclusion criteria.

Study inclusion criteria

- Neonatal population (up to 44 weeks CGA or until discharge from a Neonatal unit)
- Human studies, published in English
- Definition or identification of skin injuries from pressure, friction, shear and/or stripping was determined based on the paper's own identification of the condition
- Observational (descriptive) and experimental studies for skin injuries from pressure, friction, shear and/or stripping
- Frequency of skin injury expressed as incidence or prevalence and/or locations of injury and/or risk factors for injury

Study exclusion criteria

- Case studies; case series; conference papers, posters or abstracts; reviews; periodicals; letters to the editor; textbooks; or thesis papers
- Skin injury identified as: surgical wound, dermatitis, venous/capillary punctures, burns (thermal or chemical), infection, birth/delivery complications, extravasation, skin diseases or dermatologic conditions (including epidermis bullosa, granuloma, erythema toxicum), congenital anomalies, birthmarks (port wine stain),
- Fetal injury, in vitro studies

Full text articles were retrieved for remaining studies and reference lists searched for additional articles. Full texts were scanned for inclusion and exclusion criteria and grouped into include, exclude by two authors (DA, KN) independently with reasons for exclusion documented. If agreement was not reached articles were reviewed by a third author (YK).

Data extraction

Authors then independently used a data extraction spreadsheet for included studies. The spreadsheet included: author(s), title, frequency (incidence or prevalence), anatomical location, and risk factors.

Results

The combined libraries identified 1536 articles, with 1021 remaining after duplicates removed and nine other articles were retrieved from other sources (references) (Fig. 2).

Next, titles and abstracts of a further 945 articles were excluded based on not meeting inclusion criteria. The full-text for 76 articles were reviewed. Studies conducted in paediatric intensive care units, with neonates identified in demographics but without subgroup analysis were also excluded from this study (n = 34). Other reasons for exclusion included: repeated sample for sub-analysis (n = 2), articles not available in English (n = 3), product evaluation (n = 5), skin injury frequency not provided (n = 5) and discussion papers and/or case studies (n = 6). A total of 55 studies were excluded with reasons documented resulting in 21 studies for review (see Tables 1 and 2).

Results of this review include studies from a variety of geographical settings and a combination of observational (n = 15) (August et al., 2014; Csoma et al., 2016; Fischer et al., 2010; Fujii et al., 2010; Huffines and Logsdon, 1997; Jatana et al., 2010; Ligi et al., 2010; Meszes et al., 2016; Nascimento et al., 2009; Nist et al., 2016; Schluer et al., 2012; Migoto et al., 2013; Visscher et al., 2013; Visscher and Taylor, 2014; Waterlow, 1997) or interventional studies (n = 6) (Chen et al., 2016; Collins et al., 2014; Günlemez et al., 2010; Newnam et al., 2015; Yong et al., 2005). Additionally, results reflect that previously neonatal skin injury from pressure, friction, shear and stripping were reported primarily as a group of various etiologies (n = 7) (August et al., 2014; Csoma

(A) infant* OR newborn* OR neonat* (MeSH term or subject heading)

(1) “skin trauma” OR “skin breakdown” OR “skin break”
(2) “skin injury" OR “skin injuries”

Following searched with *skin OR dermis OR epidermis (not always associated with skin)*
“pressure injury” OR “pressure injuries” **+1 , +2**
erythem* **+1, +2**
friction **+1, +2**

(3) "skin stripping" OR "skin tear" OR "epidermal stripping" OR "medical adhesive-related skin injury"

(4) "bed sore" OR "bed sores" OR bedsore* OR "decubitus ulcer" OR "decubitus ulcers" OR "pressure sore" OR "pressure sores" OR "pressure ulcer" OR "pressure ulcers" OR "deep tissue injury"

(5) "skin shearing" OR "skin-shearing" OR "shear force"

Fig. 1. Search string details.

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