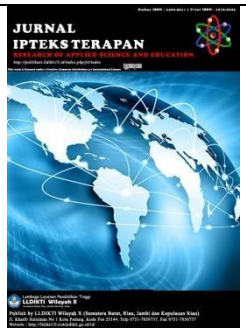

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RISK FACTORS OF MEDICAL DEVICE-RELATED PRESSURE INJURY IN CHILDREN IN THE INTENSIVE UNIT: A SYSTEMATIC REVIEW

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Abstract

Around 30% of hospital-acquired pressure injuries are caused by the use of medical devices. Children who are treated in intensive care units are at risk for medical device-related pressure injuries (MDRPI). This incident needs to be prevented considering the impact it has, namely prolonging hospitalization, increasing pain, increasing treatment costs, and requiring further care after discharge from the hospital. This review aims to identify risk factors that contribute to MDRPI in children who are in intensive care. A systematic review was carried out through a search strategy on an electronic database. A total of eight articles were selected and quality was assessed using the JBI critical appraisal guidelines. The face is the most frequently affected location for pressure injuries (54.5%), followed by the occiput (18.2%). Factors that contribute to MDRPI in children treated in the intensive care unit are the length of stay in the hospital, age of the respondent, knowledge of the nurse, attitude of the nurse, work experience of the nurse in the intensive care unit, leakage of the NIV mask, duration of device use, and gestational age. It is expected that nurses can carry out accurate risk assessments and apply appropriate interventions to prevent MDRPI events.

Keywords: Pressure Injury, Medical Device, Pediatric Intensive Care.

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INTRODUCTION

Medical devices are commonly used by patients in hospitals . The medical device itself will generate pressure impacting moisture and heat between the device and the skin which can change the microclimate of the skin. Often the device must be secured so tightly, the material used to secure the device (e.g. tape, straps) can make it difficult to examine the skin underneath. All of these factors contribute to the risk of developing a medical device-related pressure injury (Black et al., 2017) . Medical device-related pressure injury (MDRPI) is local or focal damage to the skin and underlying tissues due to interaction with devices or objects that come into direct or indirect contact with the skin or are implanted under the skin. MDRPI is different from compression injuries caused by immobilization (Gefen et al., 2020).

The impact of pressure injuries can extend the length of stay, increase the patient's pain, reduce the patient's motor function, and increase the cost of care and the need for further care after the patient is discharged from the hospital. Padula and Delarmente (2019) measured acute care costs attributable to hospital-acquired pressure injuries across the United States and found figures to exceed $26.8 billion and approximately 59% of these costs were due to grades 3 and 4 pressure injuries. Nearly 30% of pressure injuries occurred in hospitals caused by the use of medical devices. The risk of patients who use medical devices is 2.4 times greater for pressure injuries than those who do not(Black et al., 2017). A systematic review that included 29 articles found that the estimated incidence of pressure injuries due to the use of medical devices was 12% (adults 14%, children 9%) and the prevalence was 10% (adults 11%, children 8%). Medical devices that often cause pressure injuries include oxygenation equipment, cervical collar and cervical immobilization equipment, tubing, splints, intravenous catheters, pulse oximetry, restraints/casts, stockings, and braces (Jackson et al., 2020).

Medical devices are the leading cause of pressure injuries in children. In the Pediatric Intensive Care Unit (PICU) room, life-saving cannot be done without the use of medical devices. Therefore, hospitals must plan efforts to prevent pressure injuries related to this medical device(Nie, 2022). Data from Boston Children's Hospital stated that 30 children out of 674 pediatric patients who received heart surgery between May 2011 and June 2012, experienced pressure injuries related to medical devices (70%) and related immobilization (30%). The overall incidence of pressure-related injuries was 4.4%, of which 3.1% were device-related and 1.3% were immobilization related. Some levels of pressure injuries are grade 1 (40%), grade 2 (26.7%), and mucous membrane injuries (26.7%) (Kulik et al., 2018).

Knowledge of health care providers about the factors that contribute to MDRPI is expected to reduce the incidence of MDRPI so that the adverse effects do not occur on patients and their families. The purpose of writing this systematic review is to review medical device-related pressure injuries that occur in children and the specific factors that contribute to these pressure injuries.

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RESEARCH METHODS

A. Design

The design of this study was a systematic review with the research question "what are the risk factors that contribute to the occurrence of medical device-related pressure injury in children who are treated in the intensive care unit?"

B. Search Strategy

Research questions then generate keywords or main topics which are included in 4 electronic databases, namely ProQuest, Scopus, ScienceDirect, and Sage journal. The keywords used are (Medical Device Related Pressure Injury OR Medical Device Related Pressure Ulcer OR Device-related pressure injury) AND (Associated factors OR Risk factors) AND (Pediatric Intensive Care Unit OR Pediatric patients OR Critical illness children). The inclusion criteria used in the literature search strategy were articles with a sample of children aged 0-18 years, in English, and the last 10 years of publication (2012 until now). Meanwhile, the exclusion criteria were articles that were in the type of literature review or systematic review and could not be accessed in full text.

C. Data Extraction

Data extraction is carried out independently by the author by conducting a critical appraisal of the article using JBI critical appraisal tools. The initial search for articles was carried out by entering keywords in 4 predetermined databases and found 26,046 articles. Besides that, the writer also did a hand search through identification from the reference list of relevant articles and obtained 12 articles. Articles were then filtered according to inclusion criteria, namely the year of publication in the last 10 years, and using English, a total of 286 articles were obtained. Then the writer looked at the titles and abstracts one by one and removed the irrelevant articles to produce 69 articles. Furthermore, from these 69 articles, it turned out that there were 11 articles without full text, which in the end left 58 articles. Of the 58 articles read, it turned out that there were still several things that led to the exclusion of the articles, namely non-child samples (17 articles), articles not focused on MDRPI risk factors (32 articles), and articles that were a type of review (9 articles). In the end, the author got 8 articles that deserved to be criticized to determine their quality.

RESULTS AND DISCUSSION

Pressure injuries associated with medical devices are injuries that occur as a result of using a device designed or used for diagnostic or therapeutic purposes, generally occurring according to the pattern or shape of the device. The most common locations for injuries are the face and head. Nurses should be able to carry out accurate risk assessments and implement appropriate interventions to prevent MDRPI events in neonates, infants, and children. According to pressure injury prevention guidelines, things that can be done are skin assessment, repositioning the device, and using dressings to reduce friction between the skin and the device.

A. Instruments for assessing pressure injuries associated with medical devices

Of the 8 articles that were reviewed, not all articles assessed the MDRPI incident. However, it can be

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concluded that the incidence of MDRPI in neonates is assessed using the Neonatal Skin Risk Assessment Scale (NSRAS), while for infants and children using the Braden Q scale or the Braden QD scale. All the tools used have been declared valid and reliable. Quoted by Curley et al., (2018) *Braden QD scale* is acceptable for assessing the incidence of MDRPI in children. The Braden QD scale can promote patient safety, improve the quality of care, and effectively use resources for pediatric inpatients in hospitals (Chamblee et al., 2018). Meanwhile, the NSRAS was developed in 1997 by Barbara Huffines and Cynthia Logsdon in the United States based on the Braden scale for the adult population but using factors that are more specific for pressure injuries in neonates.(Huffines & Logsdon, 1997). Analysis of the psychometric properties of the Portuguese version of the NSRAS shows adequate factors for assessing the risk of pressure injuries in premature infants and neonates, therefore the NSRAS is very good to use as a research instrument(Martins & Curado, 2017).

The risk assessment of pressure injuries in the hospital is very important to do. Dweekat et al., (2023) recently developed an integrated system of multifaceted machine-learning models to predict if and when hospital-acquired pressure injuries occur, it's called Genetic Algorithm with Cost-Sensitive Support Vector Machine (GA-CS-SVM). This model helps to prioritize who has the highest risk and when that risk will be highest. This is expected to help prioritize at-risk patients, allocate targeted resources, and aid with better medical staff planning to provide interventions to those patients.

B. Medical devices that pose a risk of pressure injury to children

Based on a review of 8 articles, the data obtained from medical devices that most often cause pressure injuries in children are oxygen tubes, which are 37%, oxygen masks 27%, intravenous catheters 17.6%, endotracheal tubes (ETT) 13%, oropharyngeal tube (OGT) by 12%, nasogastric tube (NGT) by 11%, non-invasive ventilation (NIV) mask by 7.2%, and oxygen saturation probe or pulse oximetry by 6%. These results are in line with researchGaletto et al., (2021)in 93 adult patients in the ICU of a hospital in Brazil where the medical devices at risk for causing MDRPI were ETT (50%), NGT (44.1%), and urinary catheter (28.6%). Often these devices must be secured with a tight fixation that creates pressure. Special attention is needed to check the condition of the skin under the device and choose a safe material to fix it (Black et al., 2017). Pressure injuries due to attached medical devices occur because the equipment is usually tied or affixed to the body and creates a force that can damage the underlying and surrounding tissues, or it could also be pinched soft tissue due to pressure (Worsley et al., 2016).

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C. Factors contributing to MDRPI

Based on the summary of the eight articles above, it can be seen that the factors that contribute to MDRPI in children treated in intensive care units are the length of stay in the hospital, age of respondents, knowledge of nurses, attitudes of nurses, work experience of nurses in intensive care, leakage of NIV masks, duration of device wear, gestational age/gestational age, and preterm infants increase the risk of MDRPI events.

Previous research stated that the longer the hospital stay, the more pressure injuries would increase, and vice versa, pressure injuries would prolong the hospital stay by 2-5 times.(Anthony et al., 2004). However, this is different from research fromMarufu et al., (2021) who stated that there was no relationship between the length of stay and the incidence of pressure injuries, where he obtained the average length of stay for infants and children in hospitals in England in June and July 2022 was 11 days with an incidence of pressure injuries of 3.4% and medical devices are associated with an increased pressure injury risk score. The age of the respondent also affects the incidence of pressure injuries, in neonates and premature babies their skin characteristics are very delicate and immature coupled with various medical devices that are installed to increase the risk of pressure injuries. This is supported by researchVisscher & Taylor (2014) involving 741 NICU patients, where the number of pressure injuries related to devices was almost 80% of the total number of pressure injuries and 90% occurred in premature infants and the time for healing of pressure injuries was longer in premature infants than full-term infants.

Nurse knowledge is also related to the prevention of MDRPI in patients in the intensive care unit. Research results from Zhang et al., (2021)stated that there was a positive and significant relationship between the knowledge, attitudes, and actions of nurses towards MDRPI prevention practices in hospitals in Gansu province, West China. The study findings also reveal that the knowledge score of nurses in tertiary hospitals is higher than scores in other hospitals and the knowledge scores and practice scores of nurses with a bachelor's degree are higher than other nurses. One of the medical devices that contribute to the incidence of pressure injuries in children is the Non-invasive ventilation (NIV) mask. Research results from Lauderbaugh et al., (2019) mention leak in the NIV is considered to be the most significant thing affecting pressure injuries in 255 subjects who use it in a hospital in San Diego, California. Meanwhile, according to research by Erbay Dallı et al., (2022) in Turkish Hospital, factors that contribute to the incidence of pressure injuries related to medical devices in adult patients treated in the ICU are a history of cardiovascular disease, use of vasopressors, length of stay, and use of mechanical ventilation.

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To prevent pressure injuries related to medical devices, early detection strategies and efforts to recognize the risks of MDRPI are needed(Visscher & Taylor, 2014). Nurses need to recognize the risks of MDRPI so that negative impacts do not occur such as increased length of stay, increased patient pain, decreased patient motor function, increased cost of care, and the need for further care after the patient is discharged from the hospital (Padula and Delarmente, 2019).

CONCLUSION

Pressure injuries associated with medical devices are injuries that occur as a result of using a device designed or used for diagnostic or therapeutic purposes, generally occurring according to the pattern or shape of the device. The most common locations for injuries are the face and head. Nurses should be able to carry out accurate risk assessments and implement appropriate interventions to prevent MDRPI events in neonates, infants, and children. According to pressure injury prevention guidelines, things that can be done are skin assessment, repositioning the device, and using dressings to reduce friction between the skin and the device.

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