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Determination of the Incidence of Medical Device-related Pressure Injury in Pediatric Intensive Care Unit: A Single-center Study

Çocuk Yoğun Bakım Ünitesinde Tıbbi Alet Kaynaklı Basınç Yaralanma İnsidansının Belirlenmesi: Tek Merkezli Bir Çalışma

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Abstract

Introduction: To determine the incidence of pressure injuries caused by medical devices in the pediatric intensive care unit.

Methods: It is a prospective study of observational analytical type. Strengthening the Reporting of Observational Studies in Epidemiology guide was used in the study. It was conducted with 117 children in the pediatric intensive care unit of a gynecology and pediatrics hospital in the Southeastern Anatolia Region of Turkey between 01.01.2023 and 30.06.2023. In the study, data were collected using the information form together with the Braden and Braden Q scale. Data were analyzed with SPSS 25.0 statistical analysis program.

Results: It was determined that 53% of the children included in the study were male, 24.8% were hospitalized due to neurological diseases, 55.6% had chronic diseases and 74% were fed enterally. It was determined that the average age of the children was 37.46±40.98 (months), the average body weight was 15291.45±17364 (g), and the average height was 83.06±23.85 (cm). In the study, pressure injuries caused by medical devices occurred in 26.5% of the children, 35.7% of these pressure injuries caused by medical devices were 1st degree, 17.6% were Ungraded Wounds (Mucosa), 48.5% of the children were injured. It was observed that 2 injuries occurred in 100,000 children and 44.4% of the children had 5 or more medical devices. It was determined that the average number of days for injuries caused by medical devices was 38.63±41.91 days, the frequency of injuries per 1000 patient days was 14.98, and the rate of injuries caused by medical devices was 5.9%.

Conclusion: The study showed that a high rate of pressure injuries occurred due to medical devices. Appropriate care should be planned for children admitted to pediatric intensive care units by assessing the risk of injury caused by medical devices.

Keywords: Pediatric intensive care unit, pressure injuries, medical device-induced pressure injury, wound incidence

Öz

Giriş: Çocuk yoğun bakım ünitesinde oluşan tıbbi alet kaynaklı basınç yaralanması insidansını belirlemektir.

Yöntemler: Gözlemsel analitik tipte prospektif bir çalışmadır. Çalışmada *Strengthening the Reporting of Observational Studies in Epidemiology* kılavuzu kullanıldı. Türkiye'nin Güneydoğu Anadolu Bölgesi'nde bir kadın doğum ve çocuk hastalıkları hastanesinin çocuk yoğun bakım ünitesinde 01.01.2023-30.06.2023 tarihleri arasında 117 çocuk ile yapıldı. Çalışmada veriler Braden ve Braden Q Ölçeği ile birlikte bilgi formu kullanılarak toplandı. Veriler SPSS 25.0 istatistiksel analiz programı ile çözümlendi.

Bulgular: Çalışmaya alınan çocukların %53'ünün erkek olduğu, %24,8'inin nörolojik hastalıklar nedeniyle yattığı, %55,6'sının kronik hastalığı bulunduğu ve %74'ünün enteral yolla beslendiği belirlendi. Çocukların yaş ortalamasının 37,46±40,98 (ay), vücut ağırlık ortalamasının 15291,45±17364 (gr), boy uzunluğu ortalamasının 83,06±23,85 (cm) olduğu saptandı. Çalışmada çocukların %26,5'inde tıbbi alet kaynaklı basınç yaralanması oluştuğu, bu oluşan tıbbi alet kaynaklı basınç yaralanmaların %35,7'sinin 1. derece olduğu, %17,6'sının derecelendirilmeyen yara (mukozada), çocukların %48,5'inde 2 tane yaralanma oluştuğu ve çocukların %44,4'ünde 5 ve üstü tıbbi alet takılı olduğu görüldü. Tıbbi alet kaynaklı yaralanmanın oluşma gün ortalamasının 38,63±41,91 gün olduğu, 1000 hasta günü başına yara görülme sıklığının 14,98 ve tıbbi alet sayısının yaralanma oluşmasının oranı %5,9 olduğu belirlendi.

Sonuç: Çalışmada yüksek oranda tıbbi alet kaynaklı basınç yaralanmalarının oluştuğu görüldü. Çocuk yoğun bakım ünitelerine yatırılan çocuklara tıbbi alet kaynaklı yaralanma risk değerlendirmesi yapılarak uygun bakım planlanmalıdır.

Anahtar Kelimeler: Çocuk Yoğun bakım ünitesi, basınç yaralanmaları, tıbbi alet kaynaklı basınç yaralanması, yara insidans

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Introduction

With scientific progress and technological innovations, the role of technology in the treatment and care of patients has increased. The use of technology in treatment and care services causes some problems as well as benefits. One of these problems is medical-device related pressure injuries (MDRPI) and accordingly, the disruption of skin integrity.[1] MDRPI is defined as localized injuries to the skin or subcutaneous tissues, including the mucosa, caused by intense/continuous pressure exerted on the skin/mucosa by medical instruments used for diagnosis and treatment purposes. The most important difference between a pressure injury (PI) and a MDRPI is that the force exerted by an instrument strapped or taped to the body, not by body weight, plays a significant role in the development of a MDRPI.[2-5] While medical instruments alone can cause skin-damaging pressure, they can also alter the microclimate of the skin by creating heat and moisture between the equipment and the skin, which can increase the risk of skin deterioration. In the first large-scale study emphasizing the importance of MDRPI, the incidence and prevalence of pressure injuries were examined by following 2.178 adult patients over an eight-month period.[6] As a result of the study, it was reported that the rate of hospital-acquired pressure injuries was 5.4% and 34.5% of these injuries developed in association with medical instruments. It was also stated that if a patient had a medical instrument, the likelihood of developing any type of PI would be 2.4 times higher. The first integrative study examining the factors associated with MDRPI in hospitalized children was conducted by Murray et al.[1] in 2013. The study included 32 articles with evidence levels ranging from IV to VII and a total of 2,745 sick children. A total of 18 medical devices causing pressure injuries were identified and 138 pressure injuries caused by medical devices were mentioned.[1] In 2016, the National Pressure Ulcer Advisory Panel defined MDRPIs as those resulting from the use of medical instruments for diagnostic or therapeutic purposes and as PIs in which the shape of the injured part was consistent with the medical instruments.[2] In 2017 position paper, the Wound, Ostomy and Continence Nurses' Society has stated that medical instruments can cause PIs in all age groups, primarily in acute intensive care settings, and in long-term care settings and home care. It has made a number of recommendations, including the identification of risk factors as the basis for the development of risk assessment tools, best practices, quality improvement interventions, and safe materials, and the conduct of research to prevent the occurrence of MDRPI in all health care settings.[7,8] In February 2019, an international group of medical, clinical and bioengineering experts agreed that medical instruments or non-medical objects that came into contact with or compressed the skin could cause cellular and tissue-level disruption, based on their evidence-based reviews of the etiology, assessment, prevention and management of MDRPI. In their statement, the instruments most commonly associated with MDRPI and the biomechanical causes of the risks they posed were identified and discussed. They also assessed which bioengineering designs and technologies could be used to prevent MDRPI, how to alleviate the frictional force on tissues and how to optimize the microclimate.[3]

MDRPIs are a significant problem in the pediatric population. In studies evaluating the incidence and risk factors of pressure injuries in hospitalized infants and children, it has been reported that all PIs are largely related to the use of medical instruments, and the incidence of MDRPI varied between 7% and 36.2%. [3,4,9-15] In studies conducted in Turkey, it has been reported that the prevalence of MDRPI in pediatric age groups ranged between 6.8% and 21%. [9,12]

The types and numbers of medical instruments frequently used in pediatric clinics vary according to the patient population, which creates variability in instrument-related risk. Data monitoring for MDRPI may contribute to more effective evaluation of strategies to prevent such adverse events and to the improvements in care. Today, research carried out to determine trends in the prevalence and incidence of MDRPI is becoming more important. The incidence study on pediatric MDRPI shows the likelihood of occurrence of MDRPI, helps to identify its causes and provides a more accurate understanding of the quality of care for hospitalized patients. The use of MDRPI rate per 1000 device-days for each device type is a reliable measure that reveals the true extent of the causes as it also addresses the time factor. The aim of this study was to examine the incidence of MDRPIs in a pediatric intensive care unit (PICU) and to determine the relationship between the medical instruments used and MDRPIs, the factors causing this health problem and the risk situations.

Materials and Methods

Research Type

It is an observational analytic type prospective study. The study was performed according to the Strengthening the Reporting of Observational Studies in Epidemiology guideline used in observational studies.[16]

Study Population and Sample

The sample of the study consisted of children hospitalized in the PICU of a maternity and child hospital located in the Southeastern Anatolia Region of Turkey between 01.01.2023

and 30.06.2023 (for 6 months). During the specified period, 142 children were hospitalized in the PICU; however, 3 of these children were excluded from the study because they had PI when they arrived at the unit, 2 due to having skin diseases, and 20 due to being hospitalized daily. The study was conducted with 117 children who were hospitalized in the PICU and met the inclusion criteria.

Children between the ages of 1 month and 18 years, who did not have any skin problems, who had at least one medical device, and whose parents gave written and verbal consent were included in the study. Day cases and those with skin diseases were not included in the study.

Data Collection

The data of the study were collected by the researcher, who was working as a nurse in the PICU, by using the Braden Q scale, Braden risk assessment scale, information form including clinical and socio-demographic information of the children and MDRPI staging form.

Braden Q Scale

Curley et al.[10] developed the Braden Q scale by adapting the Braden scale for adults to children. They added tissue perfusion and oxygenation items to the Braden scale. The scale is an assessment tool used to evaluate the risk of pressure ulcer development in children aged 28 days to 5 years. Each item in the scale is scored from 1 to 4. For the interpretation of the scores obtained from the scale, 16-23 points are considered as moderate risk for PI development, 13-15 points as serious risk, 10-12 points as high risk, and 9 and lower points as very high risk.[10] The Turkish validity and reliability study of the scale was conducted by Güneş and Törüner[17] and the Cronbach alpha value of the scale was found to be 0.80.

Braden Risk Assessment Scale

It was developed by Braden et al. in 1987. The scale consists of 6 subscales: Sensory perception, skin moisture, activity, mobility, friction and shear, and nutritional status. It was adapted to the Turkish population by Oğuz and Olgun[18] and then for the second time by Pınar and Oğuz.[19] The total score of the scale ranges from 6 to 23; 12 points and below are considered very risky, 13-14 points are considered moderately risky and 15-16 points are considered low risky. In the present study, risk assessment of children over 5 years of age was performed with the Braden scale.[18,19]

Information Form

It was composed of 17 questions formed by reviewing the literature including information on gender, body weight, height and clinical characteristics etc. of the children.[10,13,18,19]

MDRPI Staging Form

The form was developed by the investigators according to the staging form accepted by the National PI Advisory Panel.[2] Skin pressure injuries were staged using the MDRPI staging system. For mucosal injuries, the staging system for skin pressure injuries was not applied, and they were considered as "mucosal membrane pressure injury".

Statistical Analysis

The data obtained in the study were uploaded to the SPSS 25.0 program and analyzed. Frequency, percentage, mean, minimum, maximum and standard deviation analyses were performed. In addition, MDRPI per 1000 patient days was calculated using the formula (number of wounds formed/ total number of hospitalization days * 1000).

Ethical Dimension of the Study

Before starting the study, ethics committee approval was obtained from the Ethics Committee of a Kilis 7 Aralık University with the decision numbered 2021/11-6 and research permission was obtained from the provincial health directorate to which the hospital was affiliated. Written and verbal consents were obtained from the families of the children for inclusion in the study. The study was conducted in accordance with the Declaration of Helsinki.

Results

Demographic and clinical characteristics of the pediatric patients evaluated in this study are summarized in Table 1. It was observed that 53% of the children participating in the study were male, neurological diseases (24.8%), cardiovascular problems (19.7%) and respiratory system disorders (17.1%) were found to be prominent among the reasons for hospitalization, and the presence of chronic diseases was determined in 55.6%. When the nutritional status was analyzed, it was observed that most of the children (74.5%) were fed with enteral nutrition. The mean age of the children was 37.46±40.98 months, the mean body weight was 15291.45±17364 g and the mean height was 83.06±23.85 cm. The mean values for the vital signs of the children were as follows: heart rate 119.66±20.63 min, respiratory rate 28.81±6.43 min, systolic blood pressure 102.72±12.63 mmHg and diastolic blood pressure 61.09±12.57 mmHg. The mean oxygen saturation, hemoglobin and serum albumin values of the children included in the study were 98.56±1.90%, 10.71±1.09 g/dL and 34.3±3.67 mg/dL, respectively. The mean Braden Q scale score was 10.36±1.90, the mean Braden scale score was 10.77±2.46 and the mean duration of hospitalization was 31.94±37.55 days (Table 1).

It was detected that a total of 941 medical devices were used in pediatric patients hospitalized in PICU. When the distribution of these devices was analyzed, it was seen that pulse oximetry probe (POP), blood pressure cuff and infusion pump were used in all of the children and the ratio was 12.4% for each of them in the total devices used. These devices were followed by electrocardiography (ECG) electrodes (12.2%), nasogastric catheter (NGS) (11.8%), and foley catheters (10.3%). Endotracheal tube (ETT) and intravenous catheters were used at similar rates (7.2%). These devices were followed by central venous catheters 5.4%, tracheostomy tubes 3.6%, nasal oxygen cannulas 1.8%, continuous positive airway pressure (CPAP) masks and heating devices 1% each, hemodialysis catheters 0.7% and gastrostomy tubes 0.6%, respectively (Table 2).

It was determined that 26.5% of pediatric patients treated in the PICU had MDRPI. When the number of MDRPIs was analyzed, it was found that 38.6% of the children had one MDRPI, 48.4% had two MDRPIs, 6.5% had three MDRPIs and 6.5% had four MDRPIs and the total number of MDRPIs was 56. Of these 56 MDRPIs, 35.7% were classified as grade 1, 39.2% as grade 2 and 7.1% as grade 3. The rate of ungraded PIs that developed in the mucosa was found to be 18.0%. When the number of medical instruments used in each child was analyzed, it was determined that 12.8% had two, 18.9% had three, 23.9% had four, and 44.4% had five or more medical instruments. The mean number of days of MDRPI development was 38.63±41.91 days and the incidence of injuries per 1000 patient days was 14.98. In addition, the ratio of the number of wounds according to the number of medical devices was determined as 5.9% (Table 3).

When Table 4 was analyzed, it was observed that the most common causes of grade 1 MDRPI were POP, ECG electrodes, similarly NGS and tension cuff, respectively. Grade 2 injuries

Table 1. Distribution of socio-demographic and clinical characteristics of pediatric patients (n=117)

Characteristics		**n**	**%**
Sex	Female	55	47.0
	Male	62	53.0
Diagnosis at hospitalization	Neurological diseases	29	24.8
	Cardiovascular	23	19.7
	Respiratory system	20	17.1
	Nervous system	19	16.2
	Metabolic diseases	16	13.7
	Emergency cases	10	8.5
Presence of chronic diseases	Yes	65	55.6
	No	52	44.4
Nutritional status	Oral	20	17.0
	Enteral	87	74.5
	Parenteral	10	8.5
		Mean ± SD	**Min-max**
Age (month)		37.46±40.98	2.0-185.0
Body weight (gram)		15291.45±17364	3000.0-90000.0
Height (cm)		83.06±23.85	54.0-164.0
Heart rate (min)		119.66±20.63	67.0-158.0
Respiratory rate (min)		28.81±6.43	20.0-60.0
Systolic blood pressure (mmHg)		102.72±12.63	78.0-139.0
Diastolic blood pressure (mmHg)		61.09±12.57	34.0-97.0
Saturation level (%)		98.56±1.90	92.0-100.0
Hemoglobin value (gr/dL)		10.71±1.09	6.90-13.8
Serum albumin value (mg/dL)		34.3±3.67	28.42-43.24
Braden Q scale score		10.36±1.90	7.0-15.0
Braden scale score		10.77±2.46	8.0-19.0
Hospitalization day		31.94±37.55	5.00-210.0

SD: Standard deviation

Table 2. Distribution of medical instruments used for children (n=117)

Medical devices used	n	%
Pulse oximeter probe	117	12.4
Tension cuff	117	12.4
Infusion pump	117	12.4
Electrocardiography electrode	115	12.2
Nasogastric catheter	111	11.8
Foley catheter	97	10.3
ETT tube	67	7.2
IV catheter	67	7.2
Central venous catheter	50	5.4
Tracheostomy tube	33	3.6
Nasal oxygen cannula	17	1.8
CPAP mask	10	1.0
Heating device	10	1.0
Hemodialysis catheter	7	0.7
Gastrostomy tube	6	0.6
Total*	941	100.0

*: There are children who used more than one tool, IV: Intravenous, ETT: Endotracheal tube, CPAP: Continuous positive airway pressure

were caused by ETT tube application, NGS and POP in equal rates, ECG electrodes and central venous catheter applications in similar rates, respectively. Grade 3 injuries were lower in number and were equally associated with NGS, POP and ECG electrodes. The causes of MDRPI that could not be evaluated due to the absence of mucosal injury were NGS, EET tube and nasal oxygen cannula, respectively.

In the study, 23.0% of NGS-induced injuries were determined as grade 1, 30.8% as grade 2, 7.7% as grade 3 and 38.5% as ungradable wound mucosa. Of the ETT tube-induced injuries, 30.0% were ungradable wound mucosa, 60% were grade 2 and 10% were grade 3. Of the POP-induced injuries, 50% were grade 1, 40% were grade 2 and 10% were grade 3. Of the injuries caused by ECG electrodes, 71.4% were grade 1 and 28.6% were grade 2. Of the injuries caused by tracheostomy cannula, 50% were grade 1 and 50% were grade 2. In both types of central venous catheter and CPAP mask injuries, 50% were grade 1 and 50% were grade 2. All of the injuries caused by nasal oxygen cannula were found to be ungradable wound mucosa and all of the injuries caused by gastrostomy tube were found to be grade 3. 100% of the Foley catheter injuries were grade 2 (Table 4).

Table 3. Medical-device related pressure injuries in children (n=117)

Medical-device related pressure injuries		n	%
Presence of medical-device related pressure injuries	Yes	31	26.5
	No	86	73.5
The number of wounds in children with medical-device related pressure injuries	1 wound	12	38.6
	2 wounds	15	48.4
	3 wounds	2	6.5
	4 wounds	2	6.5
	Total	**31**	**100.0**
The degree of medical-device related pressure injuries*	1. grade	20	35.7
	2. grade	22	39.2
	3. grade	4	7.1
	Non-graded Wound in mucosa	10	18.0
	Total	**56**	**100.0**
The number of medical devices used	2	15	12.8
	3	22	18.9
	4	28	23.9
	5 and above	52	44.4
	Total	117	100.0
	Mean ± SD	**Min-max**	
Day of the development of medical-device related pressure injuries	38.63±41.91	3.00-180.0	
Incidence of wound development per 1000 patient days	14.98 (56/3.736*1000)		
The ratio of wound number according to the number of medical devices	5.9 (56/941)		

*: More than one MDRPI were observed, MDRPI: Medical-device related pressure injuries, SD: Standard deviation

Table 4. The cause and degree of medical-device related pressure injuries in children (n=117)

Medical device used	1. grade		2. grade		3. grade		Non-graded Wound in mucosa		Total	
	n	%	n	%	n	%	n	%	n	%
Nasogastric catheter	3	23.0	4	30.80	1	7.70	5	38.5	13	100.0
ETT tube	0		6	60.00	1	10.0	3	30.0	10	100.0
Pulse oximeter probe	5	50.0	4	40.00	1	10.0			10	100.0
Electrocardiography electrode	5	71.4	2	28.6	0				7	100.0
Tracheostomy tube	2	50.0	2	50.0	0				4	100.0
Tension cuff	3	75.0	1	25.0	0				4	100.0
Central venous catheter	1	50.0	1	50.0	0				2	100.0
Nasal oxygen cannula			0		0		2	100	2	100.0
CPAP mask	1	50.0	1	50.0	0				2	100.0
Gastrostomy tube	0		0		1	100.0			1	100.0
Foley catheter	0		1	100.00	0				1	100.0
Total	20	35.7	22	39.2	4	7.1	10	18.0	56	100.0

CPAP: Continuous positive airway pressure, ETT: Endotracheal tube

Discussion

In the study conducted to determine the incidence of MDRPI in PICU, patients who met the inclusion criteria were observed by the researcher for 6 months between 01.01.2023 and 30.06.2023 and the data obtained were analyzed and discussed.

It was determined that most of the children followed up in the study were male, the mean age was 3 years, the leading reason for hospitalization was neurological diseases, more than half of them had chronic diseases and the majority of them were enterally fed. Their clinical values were within normal ranges and they were found to be at risk according to the evaluation of Braden scales. It is reported that most of the children hospitalized in PICUs are under 5 years of age, those with chronic diseases have more severe disease course and neurological patients should be hospitalized to protect the brain. It is known that patients hospitalized in PICUs are at risk for pressure injuries due to their poor clinical status, the device they are attached to or their inability to move due to unconsciousness. We can say that the fact that the clinical values of the children in the study were within normal limits was due to the treatment in the clinic. Semerci et al.[12] conducted a descriptive and retrospective study on 6.350 children, using data obtained in PICUs, Neonatal Intensive Care Units (NICUs) and Pediatric Clinics and they found that the prevalence of PI was 2.25% in all patients and 6.04% in PICU patients. They reported that the majority of the children were boys mostly in the age range from 0 month to 12 months and a total of 143 pressure injuries occurred in 59 children. At the same time, it was reported that medical instrument-induced pressure injuries occurred in 21% of patients hospitalized in PICU.[12] In a study performed by Başbakkal et al.[9] medical instrument-induced pressure injuries were reported to have occurred in 96 patients. It was determined that the majority of the children included in the study were male, 56 medical instrument-induced pressure injuries occurred in 31 children and NG, ETT and POP mostly caused pressure injuries. Children hospitalized in the PICU are compatible with previous studies in terms of the occurrence of pressure injuries caused by medical instruments.

In the study, the incidence of injuries per 1000 patient days was 14.98 and the number of medical instruments was 5.9%. In a study by Başbakkal et al.[9], it was reported that the incidence of injuries was 43.4 per 1000 patient days and 6.8% of medical instruments caused pressure injuries. In a study by Shimura et al.[20], it was reported that the occurrence of pressure injuries caused by medical instruments was 4.6 per 1000 patient days. In another study conducted in the United States of America in 8 hospitals and with 625 children, they found that the occurrence of medical instrument-induced pressure injuries was in 7 days per 1000 patient days.[13] The difference in medical instrument-induced injuries per 1000 patient days in the studies may be thought to be due to the conditions of the patients followed in countries, regions and clinics.

In the study, it was determined that NG, ETT and POP were the first three instruments causing medical instrument-related injuries. It can be thought that NG, ETT and POP are the most commonly used medical devices in PICUs, and at the same time, the areas where these devices are attached are sensitive. It is estimated that MDRPI develops due to the sensitivity of the regions where the NG and ETT tubes are attached and it

is very difficult to prevent the pressure of these instruments attached there. Başbakkal et al.[9] found that NG, ETT and ECG electrode were the most common causes of pressure injuries caused by medical devices. Kim et al.[21] reported that the rate of pressure injuries related to medical instruments was 11.9% in a study on 184 pediatric patients in the PICU of a university hospital in Korea and 54.2% of these injuries were caused by intubation tubes, 37.5% by high-flow oxygen cannulas and 8.3% by saturation probes. In a 5-year study conducted nationwide in pediatric and NICUs, Ventilacion et al.[22] found that 50% of pressure injuries were caused by nasal intubation tubes. In our study and other studies conducted in the literature, it was observed that the instruments causing MDRPIs were similar.

These rates vary between 1% and 27% in PICUs and NICUs.[23,24] Kohr and Curley[23] found that the rate of pressure-related injuries in pediatric patients was 27.7% in a study conducted in Switzerland. In a study conducted by Pellegrino et al.[24] on 523 children in different hospitals in Brazil, they reported a hospital-acquired PI rate of 7.1%; 25% of pressure injuries were associated with medical devices and 94% were observed in children with medical devices. In a study conducted in Turkey, it was reported that the rate of medical device-related pressure injuries was 37.5%.[9] In the present study, the rate of medical device-related injuries was 26.5%. The high incidence of medical instrument-induced pressure injuries in children is thought to be due to the lower resistance of children's skin to pressure.

In a study by Başbakkal et al.[9] it was reported that 22.9% of children had 1st degree pressure injuries, 89.5% of children with injuries had 5 or more medical devices attached, and 33.3% of medical device-induced pressure injuries were caused by NGS. In another study, it was reported that 24% of medical device-induced pressure injuries in children were 1st degree and most injuries were caused by NGS.[25] In the study, it was observed that 50% of the medical instrument-induced pressure injuries in children were grade 1 and NG was the most common medical instrument causing pressure injuries. In our study and in the literature, it is seen that NG is the medical instrument that most frequently causes MDRPIs. Since there is no adipose tissue under the skin of the nose, it can be stated that even the smallest pressure can prevent circulation and cause injury.

Study Limitations

The study has some limitations. These limitations include the fact that the study was conducted in a certain hospital in a certain region, that health professionals working in the clinic were not investigated because only patients were examined in the study, and that other reasons other than medical devices were not addressed.

Conclusion

As a result of the study, it was observed that MDRPIs developed at a high rate in children. NGS, ETT tubes, POP and ECG electrodes, which are frequently used in PICUs, were found to be the most common causes of MDRPIs. The strength of the study is that it will be used as a source for future research on MDRPIs and will also be used to guide studies on the prevention of MDRPIs. In addition, another strength of the study is that it may lead to the establishment of guidelines and protocols for the prevention of injuries caused by medical devices used in PICUs and it reveals the importance of nursing care.

In order to prevent the development of MDRPI, it is firstly necessary to select the appropriate size of the instrument for the child, to fix the instrument correctly and to evaluate the fixation tension regularly, to prefer products that minimize tissue damage, and to follow the manufacturer's recommendations on the use and care of the instrument. However, it is critical to assess the skin and mucosa under and around the medical instrument to detect early signs of pressure. Regular repositioning of the medical instrument will help to reduce the shear force of the pressure at the interface of the skin and the instrument and redistribute the pressure. Emphasis should be given on using a prophylactic dressing under the instrument and discontinuing the use of the instrument as soon as possible to reduce the risk of MDRPI.

Priority should be given to the education of healthcare team members and patient relatives about the developmental potential of PI. Assessment of the child, interventions applied and ongoing care needs should be recorded. All healthcare team members should work together (as a team) for creating and implementing a care plan.

This article suggests that standardized, multicomponent interventions for MDRPI prevention (e.g., the use of risk assessment scales to assess the relocation and repositioning of the device, how often to assess the skin and mucosa under and around the medical device, what type of dressings to use between the medical device and the skin, etc.) should be tested in larger-sampled, randomized, controlled trials for children admitted to intensive care units.

Ethics

Ethics Committee Approval: ethics committee approval was obtained from the Ethics Committee of a Kilis 7 Aralık University with the decision numbered 2021/11-6 and research permission was obtained from the provincial health directorate to which the hospital was affiliated. The study was conducted in accordance with the Declaration of Helsinki.

Informed Consent: Written and verbal consents were obtained from the families of the children for inclusion in the study.

Authorship Contributions

Surgical and Medical Practices: Ş.Ç., Concept: E.E., A.B.C., Ş.Ç., Design: E.E., A.B.C., Data Collection or Processing: E.E., Ş.Ç., Analysis or Interpretation: E.E., Z.Ç., A.B.C., Ş.Ç., Literature Search: E.E., Z.Ç., Writing: E.E., Z.Ç., A.B.C.

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References

1. Murray JS, Noonan C, Quigley S, Curley MAQ. Medical Device-Related Hospital-Acquired Pressure Ulcers in Children: An Integrative Review. J Pediatr Nurs. 2013;28:585-95.
2. Edsberg LE, Black JM, Goldberg M, McNichol L, Moore L, et al. Revised National Pressure Ulcer Advisory Panel Pressure Injury Staging System: Revised Pressure Injury Staging System. J Wound Ostomy Continence Nurs. 2016;43:585-97.
3. Gefen A, Alves P, Ciprandi G, Coyer F, Milne CT, et al. Device-related pressure ulcers: SECURE prevention. J Wound Care. 2020;29(Sup2a):S1-52.
4. Şimşek E, Demir AS, Semerci R, Karadağ A. The incidence and prevalence of medical device-related pressure injuries in pediatric patients: Systematic review and meta-analysis. J Pediatr Nurs. 2023;72:e130-8.
5. Vasconcelos J de MB, Caliri MHL. Nursing actions before and after a protocol for preventing pressure injury in intensive care. Escola Anna Nery - Revista de Enfermagem. 2017;21.
6. Black JM, Cuddigan JE, Walko MA, Didier LA, Lander MJ, et al. Medical device related pressure ulcers in hospitalized patients. Int Wound J. 2010;7:358-65.
7. Kayser SA, VanGilder CA, Ayello EA, Lachenbruch C. Prevalence and Analysis of Medical Device-Related Pressure Injuries: Results from the International Pressure Ulcer Prevalence Survey. Adv Skin Wound Care. 2018;31:276-85.
8. Schmitt S, Andries MK, Ashmore PM, Brunette G, Judge K, et al. WOCN Society Position Paper: Avoidable Versus Unavoidable Pressure Ulcers/Injuries. J Wound Ostomy Continence Nurs. 2017;44:458-68.
9. Başbakkal Z, Yılmaz H, Gümüş M, Belli M, Erçelik Z. Medical device-related pressure injuries in paediatric patients: An incidence study in a children's hospital. J Clin Nurs. 2024;33:2633-9.
10. Curley MAQ, Razmus IS, Roberts KE, Wypij D. Predicting pressure ulcer risk in pediatric patients: the Braden Q scale. Nurs Res. 2003;52:22-33.
11. Marufu TC, Setchell B, Cutler E, Dring E, Wesley T, et al. Pressure injury and risk in the inpatient paediatric and neonatal populations: A single centre point-prevalence study. J Viab. 2021;30:231-6.
12. Semerci R, Umaç EH, Yılmaz D, Karadağ A. Analysis of the prevalence and risk factors of pressure injuries in the hospitalized pediatric population: A retrospective study. J Tissue Viability. 2023;32:333-8.
13. Stellar JJ, Hasbani N, Kulik L, Shelley S, Quigley S, et al. Medical Device-Related Pressure Injuries in Infants and Children: Findings and Implications of the Braden Qd Study. J Wound Ostomy Cont Nurs. 2019;46:S4-5.
14. Visscher M, King A, Nie M, Schaffer P, Taylor T, et al. A Quality-Improvement Collaborative Project to Reduce Pressure Ulcers in PICUs. Pediatrics. 2013;131:E1950-60.
15. Zhang H, Ma Y, Wang Q, Zhang X, Han L. Incidence and prevalence of pressure injuries in children patients: A systematic review and meta-analysis. J Tissue Viability. 2022;31:142-51.
16. Vandenbroucke JP, von Elm E, Altman DG, Gøtzsche PC, Mulrow CD, et al. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): explanation and elaboration. Int J Surg. 2014;12:1500-24.
17. Güneş NB, Törüner EK. Çocuk Hastalarda Braden Q Basınç Ülseri Değerlendirme Ölçeği'nin Türkçe Geçerlilik Ve Güvenirliği. Anadolu Hemşirelik ve Sağlık Bilimleri Dergisi. 2014;17:6-14.
18. Oğuz S, Olgun N. Braden ölçeği ile hastaların risklerinin belirlenmesi ve planlı hemşirelik bakımının bası yaralarının önlenmesindeki etkinliğinin saptanması. [İstanbul]: Marmara Üniversitesi; 1997.
19. Pınar R, Oğuz S. Norton ve Braden bası yarası değerlendirme ölçeklerinin yatağa bağımlı aynı hasta grubunda güvenirlik ve geçerliğinin sınanması.Kongre Kitabı Damla Matbaacılık Ltd. Şti; 1998.
20. Shimura T, Nakagami G, Ogawa R, Ono S, Takahashi T, Nagata M, et al. Incidence of and risk factors for self-load-related and medical device-related pressure injuries in critically ill patients: A prospective observational cohort study. Wound Repair Regen. 2022;30:453-67.
21. Kim HK, Kim Y, Son HM. Characteristics ınfluencing the occurrence of respiratory medical device-related pressure ulcers in the pediatric ıntensive care unit. Child Health Nurs Res. 2019;25:133-42.
22. Ventilacion IMC, Thruston IM, Lynch F, Durward A, Tibby S. Nasal Pressure Ulcers: A National Survey of Current Practice and Occurrence in Paediatric and Neonatal. Archives of Disease in Childhood. 2008;93:ps403.
23. Kohr LM, Curley MAQ. Small study finds 27.7% prevalence of pressure ulcers in paediatric hospitals in Switzerland, with many cases caused by external medical devices. Evid Based Nurs. 2010;13:58.
24. Pellegrino DM de S, Chacon JMF, Blanes L, Ferreira LM. Prevalence and incidence of pressure injuries in pediatric hospitals in the city of São Paulo, SP, Brazil. J Tissue Viability. 2017;26:241-5.
25. Widiati E, Nurhaeni N, Gayatri D. Medical-Device Related Pressure Injuries to Children in the Intensive Care Unit. Compr Child Adolesc Nurs. 2017;4(Suppl 1):69-77.