Influence of skin protector in reading pulse oximetry in neonates

Influência do uso de proteção de pele na leitura da oximetria de pulso do neonato

Influencia del uso de protección cutánea en la lectura de oximetría de pulso del recién nacido

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Abstract

Objective: To verify the influence of using a hydrocolloid patch as a skin protector on reading oxygen saturation in newborns.
Methods: Observational study, carried out in a neonatal unit of a municipal hospital in São Paulo. Data collection was carried out by the researcher using an instrument organized by Recap® software on neonatal characteristics and the measurement of oxygen saturation carried out by a Dixtal® Model DX 2022 monitor and an extra-thin hydrocolloid plate. Data analysis was performed using descriptive statistics and the use of non-parametric Kruskal-Wallis tests, considering the probability of type I error or less than 5%.
Results: The sample consisted of 56 oxygen saturation values measured in 14 newborns with and without the use of a hydrocolloid patch to protect the skin. The average value of the oximetry reading in the right lower limb with a hydrocolloid plate was 98% (±1.73) and 97.65 (±2.46) at five and ten minutes, respectively. The value without the hydrocolloid patch was 98.2% (±1.57) and 97.8% (±1.59) at five and ten minutes respectively. It was found that there is no statistically significant difference in oxygen saturation readings (H= 0.4368, p=0.932).
Conclusion: The use of the hydrocolloid patch as a covering on the newborn's skin did not interfere with the reading of oxygen saturation in the studied sample

Keywords
Pediatric nursing; Oximetry; Skin; Infant newborn; Nursing care; Neonatal nursing

Resumo

Objetivo: Verificar a influência do uso de placa de hidrocolóide como protetor de pele na leitura da saturação de oxigênio do recém-nascido.
Métodos: Estudo observacional, realizado em uma unidade neonatal de um hospital municipal de São Paulo. A coleta de dados foi realizada pela pesquisadora por meio de instrumento organizado software Recap® sobre as características neonatais e a medida da saturação de oxigênio realizada por um monitor Dixtal® Modelo DX 2022 e uma placa de hidrocolóide extrafino. A Análise dos dados foi por meio de estatística descritiva e uso de testes não paramétricos de Kruskal-Wallis, sendo considerada probabilidade de erro tipo I ou inferior a 5%.
Resultados: A amostra foi de 56 valores de saturação de oxigênio medida em 14 recém-nascidos com e sem uso de placa de hidrocolóide para proteger a pele. O valor médio da leitura da oximetria em membro inferior direito com placa de hidrocolóide foi de 98% (±1,73) e 97,65 (±2,46) aos cinco e dez minutos, respectivamente. O valor sem a placa de hidrocolóide foi de 98,2% (±1,57) e 97,8% (±1,59) aos cinco e dez minutos respectivamente. Verificou-se que não existe diferença estatisticamente significante nas leituras da saturação de oxigênio (H= 0,4368, p=0,932).
Conclusão: O uso da placa de hidrocolóide como cobertura na pele do recém-nascido não interferiu na leitura da saturação de oxigênio na amostra estudada.

Descritores
Enfermagem pediátrica; Oximetria de pulso; Pele; Recém-nascido; Cuidados de enfermagem; Enfermagem neonatal

Resumen

Objetivo: Verificar la influencia del uso de un parche hidrocoloide como protector cutáneo en la lectura de la saturación de oxígeno en recién nacidos.
Métodos: Estudio observacional, realizado en una unidad neonatal de un hospital municipal de São Paulo. La recolección de datos fue realizada por el investigador mediante un instrumento organizado por el software Recap® sobre las características neonatales y la medición de la saturación de oxígeno realizada por un monitor Dixtal® Modelo DX 2022 y una placa de hidrocoloide extrafina. El análisis de los datos se realizó mediante estadística descriptiva y el uso de pruebas no paramétricas de Kruskal-Wallis, considerando la probabilidad de error tipo I o inferior al 5%.
Resultados: La muestra estuvo compuesta por 56 valores de saturación de oxígeno medidos en 14 recién nacidos con y sin uso de parche hidrocoloide para proteger la piel. El valor promedio de la lectura de oximetría en miembro inferior derecho con placa de hidrocoloide fue de 98% (±1,73) y 97,65 (±2,46) a los cinco y diez minutos, respectivamente. El valor sin parche de hidrocoloide fue de 98,2% (±1,57) y 97,8% (±1,59) a los cinco y diez minutos respectivamente. Se encontró que no existe diferencia estadísticamente significativa en las lecturas de saturación de oxígeno (H= 0,4368, p=0,932).
Conclusión: El uso del parche hidrocoloide como cobertura sobre la piel del recién nacido no interfirió en la lectura de la saturación de oxígeno en la muestra estudiada.

Descriptores
Enfermería pediátrica; Oximetría; Piel; Recién nacido; Atención de enfermería; Enfermería neonatal

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Introduction

In recent decades, developments in neonatal care have determined the survival of newborns with increasingly younger gestational ages. This results from the development of modern ventilatory support techniques, associated with the increasing availability of new drugs in the treatment of neonatal complications, improvements in the quality of prenatal, labor, and birth care, and greater training of health professionals in the management of these children.[1]

The survival of these newborns (NB), especially maintaining the integrity of their skin, has been a challenge for nurses because procedures and interventions that frequently disrupt the integrity of the skin are used in the Neonatal Intensive Care Units (NICU) or intermediate care units. In neonates, this fragile protective barrier is often connected to devices, monitors, life support equipment, intravenous catheters, and other instruments that require adhesives. They have been reported to be responsible for more than 70% of pressure injuries in neonates, causing trauma to the epidermis and increasing the likelihood of infection.[1,2]

The skin barrier is vital for NB and its functioning is reduced due to immaturity at this stage.Thus, optimized skin care is important and can minimize the morbidity and mortality associated with this problem in the neonatal period.[2,3]

Continuous monitoring of arterial oxygen saturation by pulse oximetry (SpO_2) is the main method to guide respiratory and oxygen support in neonates during postnatal stabilization and after admission to the NICU.[4] It is a non-invasive method that provides continuous measurement of hemoglobin oxygen (O_2) saturation through a sensor. It uses light beams that pass through the blood and measure the amount of O_2 in hemoglobin. Such a sensor must be positioned in regions that allow measurement, preferably in peripheral regions, such as the ends of the hands and feet, earlobes, etc.[5,6] However, its use has been associated with the occurrence of skin lesions in newborns.[7-9]

To reduce the direct and frequent contact of any device with the fragile and sensitive skin of NB, some neonatology services have used skin protectors such as hydrocolloid patches. Hydrocolloid patches on the skin form a gel when in contact with exudate. They are hydrophilic and keeps the environment moist, acting in the prevention and treatment of non-infected open wounds.[10] Its use in neonatology has been indicated to prevent skin injuries, mainly linked to pressure or burn ulcers.[11] Adopting such a practice does not provide a reliable indication of benefits and possible repercussions on O_2 saturation readings in NBs, although exact and reliable oximetry values are important for the treatment and monitoring of hospitalized neonates. Thus, interference in the reading of O_2 saturation can make its result less accurate.

Evidence was not found in the literature ensuring that the application of the hydrocolloid patch on the skin of newborns, does not interfere with the reading of O_2 saturation parameters. Therefore, the objective of this study was to verify the influence of using a hydrocolloid patch as a skin protector on O_2 saturation readings in newborns.

Methods

An observational, analytical and quantitative approach study was carried out in the neonatal unit of a municipal hospital in São Paulo. It consisted of twenty beds; five of them were of intensive care. In this unit, internships are carried out by undergraduate students in the health area of a public educational institution. The sample was composed of the O_2 saturation values obtained in newborns using a hydrocolloid patch and without the skin protector.

Newborns with a gestational age older than 30 weeks were the inclusion criteria. The exclusion criteria were as follows: NB with a history of heart problems, aimed to eliminate possible physiological influences on the saturation level obtained and the presence of an intravenous catheter in the lower limbs, as this was the standardized location for placing the oximeter sensors.

The sample calculation was carried out considering the population of annual live births in the hospital field of this research, an error of 2.0%; in a population deviation of 370 newborns, based on the Ruegger, Burcher, Mieth study[12] and a confidence level of 95%. Thus, the minimum sample size was calculated based on the oxygen saturation values measured in 13 newborns.

The final sample composition was 56 O_2 saturation values obtained in 14 newborns. The variables studied were as follows: O_2 saturation values in NB (%), weight (g), gestational age (weeks), skin color (white, black, or brown), sex (male or female), mode of delivery (normal, cesarean section, or forceps), morbidities, Apgar score (0-10), type of accommodation (incubator or common crib), use of phototherapy (yes or no), and use of respiratory assistance (yes or no).

A pulse oximetry monitor was installed to obtain the data; a Dixtal® (Model DX 2022) monitor was used, powered by the electrical network (100-240 VAC) and an internal rechargeable battery; the video screen presented the saturation and pulse values, and the plethysmographic curve. The sensor was fixed to the right (RLL) and left lower limbs (LLL) of the NB, with and without hydrocolloid patch, respectively.

The hydrocolloid patch used for the collection was the same as that used in the service (CASEX®); extra-thin hydrocolloid dressings (10x10 cm) were individually packaged; the patches were cut in a rectangular shape proportional to the size and weight of the NB wrap around the dorsum of the right foot.

The O_2 saturation values were read 10 min after attaching the sensors to the NB, waiting for the plethysmographic waves to stabilize. The reading of values was started 5 and 10 min after wave stabilization. The data obtained were analyzed using the Assistat Program, descriptive and inferential statistics, mean, median, and standard deviation; the Kruskal-Wallis test was applied to analyze data variance.

The study followed the principles of the National Health Council according to resolution 466/2012 and was approved by the Ethics and Research Committee of researcher institution (number 1,953,507). The participants' agreement was formalized by the signature of the person responsible for the newborns after the free and informed consent form was accepted.

Results

Half of the mothers of newborns in whom peripheral O_2 saturation was assessed had complications during pregnancy The complications presented were as follows: premature labor (25.0%), congenital infections (toxoplasmosis and congenital syphilis - 25.0%), specific hypertensive disease of pregnancy (25.0%), bleeding (12.5%), and urinary tract infection (12.5%). During childbirth, 86.0% of these mothers had no complications. However, cord circling was observed in one NB and hypothermia in another. Of the total number of newborns, 50.0% were female and 50.0% were male. They had white (93.0%) or brown (7.2%) skin and were born vaginally (64.0%) and by cesarean section (35.7%) with more frequent accommodation in an incubator (50.0%) and common (42.8%) and heated (7.2%) cribs in the neonatal unit (Table 1).

Table 1. Profile of newborns

Variables	f(%)
Sex	
Masculine	7(50)
Feminine	7(50)
Skin color	
White	13(93)
Brown	1(7)
Black	0(0)
Delivery route	
Cesarean section	5(35)
Vaginal	9(64)
Type of accommodation	
Incubator	7(50)
Common crib	6(43)
Heated crib	1(7)
Apgar (1 min) $\bar{x}$(±SD)*	7.1(±1.79)
Apgar (5 min) $\bar{x}$(±SD)	8.7(±1.13)
Birth weight (g) $\bar{x}$(±SD)	2,603(±937)
Current weight (g) $\bar{x}$(±SD)	2,557(±768)
Morbidities	
Prematurity	11(78)
Others	5(35)
Breathing problems	4(28)
Neurological problems	2(14)
Metabolic problems	2(14)
Infections	2(14)
Jaundice	1(7)
Gestational ages (week) $\bar{x}$(±SD)	36.3 (±3)

* $\bar{x}$(±SD): mean±standard deviation

The mean gestational age was 36.3±3 weeks and the median was 34.6 weeks. Birth weight had a mean value of 2,603±937 g and a median of 2,295 g; current weight had a mean value of 2,557±768 g and a median of 2.18 g. The Apgar scores were 7.1 (1 min) and 8.7 (5 min) and the medians were 7.5 (1 min) and 9.0 (5 min). Table 1 shows the most frequent morbidities in newborns: prematurity (78.6%) followed by respiratory problems (28.6%). Table 2 shows the oxygen satura-

tion values obtained after reading with and without a skin protector.

Regarding the influence of the pulse oximetry reading, the mean values with the hydrocolloid patch were 98.0±1.73 and 97.6±2.46% (5 and 10 min, respectively) (Table 2). The reading values without hydrocolloid patch were 98.2±1.57 and 97.8±1.59% (5 and 10 min, respectively). Figure 1 presents Oxygen Saturation values and the differences between using and not using a skin protector (Kruskal-Wallis test).

Table 2. Oxygen saturation values obtained with and without hydrocolloid patch at different times

$SatO_2$ Readings	Mean values (%)	Standard Deviations
5 min		
With patch (RLL)*	98.00	±1.73
Without patch (LLL)**	98.28	±1.57
10 min		
With patch (RLL)	97.64	±2.46
Without patch (LLL)	97.85	±1.59

*RLL: right lower limb; ** LLL: left lower limb

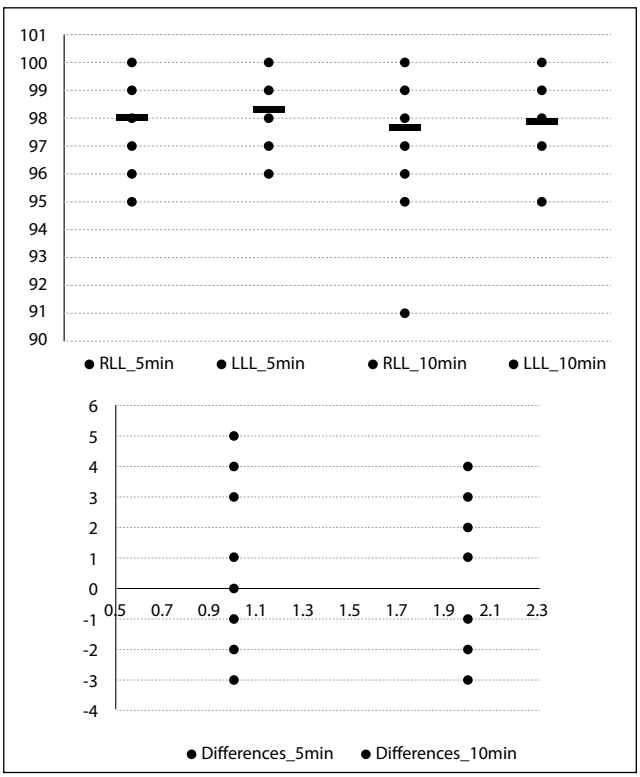

Figure 1. Oxygen Saturation Values and differences between using or not using a skin protector.

When analyzing the difference between oxygen saturation readings with and without a hydrocolloid patch, the difference was not statistically significant at the 5% probability level (H=0.4368; p=0.932).

Discussion

Analysis of the values obtained with and without the hydrocolloid patch simultaneously did not show significant interference in the reading of oxygen saturation values.

If a translucent material (interposed between the light-emitting diode and the photodetector sensor in a pulse oximeter) is more transparent for one of the two wavelengths used in the device, theoretically it will induce an error and the equipment will display a false reading. A study examined the difference between readings taken through skin protection coverings (Micropore 3M® and gauze) directly and it was not very different in direct method repeatability tests. Therefore, these differences were considered clinically insignificant. The results of the study suggest that the interposition of Micropore or gauze does not affect the accuracy of readings to a clinically significant level, and the findings of the present research agree with this study.[6]

Other authors also used Micropore for protection and did not identify significant differences between the values and saturation observed in neonates.[7] We emphasize that any adhesive applied to a newborn's skin favors the occurrence of injuries if it is not properly removed. A study was carried out on newborns who weighed less than 2 kg and were admitted to the NICU and randomly allocated into two groups; micropore was used in one group and hydrocolloid in another to prevent injuries caused by oximetry sensors. When removing the adhesives, the authors identified that both caused injuries, but the injury caused by the hydrocolloid patch was less frequent and statistically less intense significant (p<0.05), especially in premature newborns weighing less than 1 kg whose skin is gelatinous and very friable.[9]

A Brazilian study performed in 2013 showed that many professionals are still unaware of the importance and indication of hydrocolloid patches; they are very used in services although without scientific basis or certainty regarding its indication. Interestingly, research has shown that its use is much greater for treating skin lesions than for prevention.[13]

During data collection at the unit, the authors realized the importance of reading and trusting oxygen saturation data, which were presented in other studies.[4,14] They also realized the need to control this parameter to guide respiratory support and offer supplemental oxygen to newborns during the postnatal stabilization period and NICU admission. However, it was reported that a premature newborn suffered a burn caused by an oximeter sensor on the back of one foot and lost four toes.[8] This shows that investigations such as the present study are necessary to advance nursing practice and promote greater patient safety.

The use of adhesive labels directly on the skin was the main cause of skin lesions in newborns; nasal prongs for ventilatory support and oximeter sensor monitoring were the second most prevalent cause of injuries, accounting for 18.4% of cases.[10] The author of the study also highlighted that the injuries resulting from the oximeter sensor were not caused by the equipment, but by care in maintaining intact skin.

A recent study showed thermal burn injury secondary to prolonged pulse oximeter application. Several mechanisms have been investigated in pulse oximeter-associated burns, such as thermal burn which occurs due to overheating of the sensor in a faulty device or prolonged duration of exposure. Other causes include electrical (induced by current leakage into a damaged electrical sensor component) and chemical (caused by a topical reaction to the sterilizing agents contaminating the sensor contact area) burns. In addition, decreased peripheral perfusion and thinner skin, which occur in neonatal and elderly patients, contribute to developing burn injury.[15]

Sensor device and oximeter inspection must include preventive and routine maintenance to rule out injuries related to improper use of the sensor.

Moreover, other precautions can prevent pressure injuries, such as: changing the installation placement of the sensor frequently (at least every 2-4 h) to avoid prolonged contact with the skin; avoiding tightly wrapping flexible sensors with elastic adhesive tape around the fingertip on the hand or foot; and assessing the condition of the local skin can be effective in preventing such injuries. These simple maneuvers are often ignored and can have catastrophic consequences if not adopted.[15,16]

Considering that newborns' skin is sensitive, thin, and fragile, all devices should have protection to avoid pressure injuries to newborns' skin. Thus, the use of a protective plate would not be necessary as it can cause injury when removed and increase the cost of the service.[17]

The main objective of health-related research is to produce new knowledge to improve care and obtain healing and health. However, the real life of health services shows that the production of technology is not always committed to the absence of risk. Thus, investing in new technologies and forms of care is part of the professional ethical commitment of nurses in the search for quality, harm-free care for newborns and their families.

It is recommended that other studies be carried out, with the expansion of the sample, to allow a strong recommendation of this evidence.

Conclusion

The use of the hydrocolloid patch as a covering on the skin of newborns while using a pulse oximeter does not interfere with the oxygen saturation reading. The values obtained did not show a statistically significant difference to infer any change in value.

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Contributions

Rodrigues SC, Orsi KCSC, Avelar AFM, and Balieiro MMFG contributed to the design of the study, analysis, and interpretation of the data, writing of the manuscript, critical review of the content, and approval of the final version to be published.

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