

Acute painful procedures pain in the preterm newborn in a neonatal unit

Procedimentos dolorosos agudos no recém-nascido pré-termo em uma unidade neonatal

Procedimientos dolorosos agudos en el recién nacido pre-término en una unidad neonatal

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ABSTRACT

Objective: to analyze the number of acute painful procedures and pain management in preterm newborn in a neonatal unit. **Method:** a cross-sectional and descriptive study was conducted in a neonatal unit of a public health institution. The newborns younger than 35 weeks were the participants in the survey. **Results:** seventeen preterm newborns were included. A total of 729 painful procedures were quantified. On average, 42.9 procedures per newborn were performed during the first 14 days of birth, and approximately three procedures performed per day service by child. The most common procedure was the hell-stick (23.9%). The predominant management was facilitated tucking (32.7%). The CPAP prongs insertion/reinsertion was the second most performed procedure. **Conclusions:** The present study showed that the management of pain in the preterm newborns in a neonatal unit is strongly neglected by the professionals.

Descriptors: Pain; Clinical Procedures; Pain management; Newborn.

RESUMO

Objetivo: analisar o número de procedimentos dolorosos agudos e manejo da dor em recém-nascidos pré-termo em uma unidade neonatal. **Método:** estudo descritivo, transversal. Teve como campo uma unidade neonatal de uma instituição pública de saúde. Os participantes da pesquisa foram recém-nascidos abaixo de 35 semanas. **Resultados:** foram incluídos 17 recém-nascidos. Foi quantificado um total de 729 procedimentos dolorosos. Em média foram realizados 42,9 procedimentos por recém-nascido durante os primeiros 14 dias de vida, sendo aproximadamente três procedimentos realizados por bebê no serviço diurno. Dentre os procedimentos, o mais frequente foi a punção de calcâneo (23,9%). O manejo predominante foi a contenção facilitada (32,7%). A (re)inserção de pronga foi o segundo procedimento mais realizado. **Conclusões:** O estudo permitiu apreender que o manejo da dor no recém-nascido pré-termo internado em uma unidade neonatal ainda é um desafio.

Descritores: Dor; procedimentos clínicos; manejo da dor; recém-nascido.

RESUMEN

Objetivo: analizar el número de procedimientos dolorosos agudos y manejo del dolor en recién nacidos prematuros en una unidad neonatal. **Método:** estudio descriptivo, transversal. Tuvo como campo una unidad neonatal de una institución pública de salud. Los participantes de la investigación fueron recién nacidos por debajo de 35 semanas. **Resultados:** se incluyeron 17 recién nacidos. Se cuantificó un total de 729 procedimientos dolorosos. En promedio se realizaron 42,9 procedimientos por recién nacido durante los primeros 14 días de vida, siendo acerca de tres procedimientos realizados por bebé en el servicio diurno. Entre los procedimientos, el más frecuente fue la punción de calcáneo (23,9%). El manejo predominante fue la contención facilitada (32,7%). La (re) inserción de prong fue el segundo procedimiento más realizado. **Conclusiones:** El estudio permitió aprehender que el manejo del dolor en el recién nacidos prematuros internado en una unidad neonatal se muestra fuertemente descuidado por el equipo.

Descriptores: Dolor; procedimientos clínicos; manejo del dolor; recién nacido.

INTRODUCTION

Newborns (NBs) admitted to neonatal intensive-care units (NICUs) are vulnerable to invasive and potentially painful procedures that are routinely performed at such units. These newborns are also exposed to risk for associated stress as a result of repeated procedures¹.

An observational study which involved 175 NBs and was conducted in a Dutch hospital found that the average number of painful procedures per NB per day was 11.4².

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It is noteworthy that until recently, it was erroneously thought that nociception was reduced in preterm newborns (PTNBs) due to immaturity of the central nervous system (CNS). In fact, it is now clear that skin receptors and perioral sensory nerves appear as early as the 7th week of gestation. In addition, CNS immaturity preferentially affects the descending inhibitory pathways that modulate spinal cord dorsal horn synapses, which do not appear until the 32nd week of gestation³.

It should be noted that painful procedures trigger a series of responses throughout the body, including facial expressions, changes in cortical activity and disruption of physiological stability⁴.

According to the American Academy of Pediatrics (2016), pain prevention and management in infants should be the goal of all health professionals, and family members should be given guidance on this subject⁵.

Over the past three decades, methods to reduce stress in babies at NICUs have been targeted by researchers. In their care-provision practice, neonatal nurses use therapies, such as non-nutritive sucking, skin-to-skin contact (kangaroo position held by the mother), massage, swaddling and positioning to minimize stress and promote optimal development⁶.

There is a body of literature on the effectiveness of these interventions, and it suggests that they have positive effects on stress and a variety of outcomes for babies and parents^{7,8}.

However, studies show that, although NBs feel pain, the ability and approach of clinicians to assess and treat newborns' pain is inadequate and controversial⁹.

Given this scenario of frequent exposure to painful procedures to which PTNBs are submitted and their consequent short- and long-term repercussions, this study aimed to analyze the number of acute painful procedures and pain management in PTNBs in a neonatal unit.

METHOD

This cross-sectional observational study focused on the clinical care service of a public institution located in Rio de Janeiro, consisting of the Neonatal Intensive Care Unit (NICU), Conventional Intermediate Care Unit (UCINCO) and Kangaroo Intermediate Care Unit (UCINCA). Data were collected from June 27, 2016 to November 30, 2016, only in the day service (7:00 a.m. to 7:00 p.m.).

A proper instrument was used to account for painful procedures, which were chosen by talking to the nurse responsible for the routine of the sector and by considering the most common procedures in the first 14 days of PTNBs in an NICU⁹. This form contained the participant's identification, the day evaluated (from D1 to D14), the procedures performed and their frequency in the day service, and beside each procedure, there was a space for noting the respective management mentioned by the team.

The procedures included on the form were classified as very painful (venous puncture, arterial puncture, calcaneal puncture, orotracheal tube aspiration, orotracheal intubation, and peripheral insertion central catheter) and painful (upper airway aspiration, nasal prong re/insertion, gastric tube insertion and adhesive tape removal)⁹.

The procedure for removing adhesives was not initially on the form. Its inclusion occurred as a result of the team's suggestion when the project was presented. The removal of any type of adhesive material was quantified, whether for fixation of a gastric tube or an orotracheal tube, venous punctures, dressings or and any other instrument that came into direct contact with the PTNB's skin, and regardless of the type of adhesive material (adhesive tape, microporous tape, hydrococoid, transparent film, among others).

The form was completed at the end of the shift using questions that were asked by the researchers and addressed to the team members (nurses, nursing technicians, doctors and physiotherapists) about the procedures and their respective management performed during the day service. No questions failed to be answered as a result of the respondents' not recalling the information.

The study participants were the preterm newborns (PTNBs) of the aforementioned hospitalization units who were evaluated on their first 14 days of life and composed a convenience sample.

Exclusion criteria were: PTNBs over 35 weeks of gestational age (GA) and/or showing grade-III or grade-IV intracranial hemorrhage, genetic syndromes, nervous-system malformations, hypoxic-ischemic encephalopathy, sensory changes (hearing and visual impairment) and congenital TORCH infections (syphilis, toxoplasmosis, cytomegalovirus, rubella and herpes), which develop with central nervous system (CNS) disorders.

These exclusion criteria were due to the fact that this study was part of a broader investigation that aimed to evaluate the neurobehavior of PTNBs, so the above criteria were indicative of exclusion.

PTNBs that were born in another institution, those who were transferred to another sector of the hospital, another institution or discharged during the data collection period were also excluded.

The outcome variables were the acute painful procedures and the pain management performed by the neonatal unit's staff.

In turn, the exposure variables were: gestational age (GA), weight, gender and SNAPPE (Score for Neonatal Acute Physiology with Perinatal Extension, version II).

SNAPPE II assesses the patient within the first 12 hours of NICU admission by observing multiple physiological changes. SNAPPE II ranges from zero to 162, and the higher the score, the greater the NB's severity¹¹.

Regarding possible weaknesses, it is believed that the study may present a memory bias, since the instrument used to account for painful procedures was completed at the end of the shift with questions directed to the team.

The study had a convenience sample that was established by the time of data collection, which took place over a five-month period (from June to November 2016).

The database was created using Epi info, version 7.1.4.0, and data analysis was performed by SPSS, version 17.0 utilizing mean, median, percentile and standard deviation values. Categorical variables were analyzed using the chi-square test and continuous numerical variables by analyses of variance (ANOVAs).

All the participants' parents/legal guardians were informed about the study and, upon their agreement, they signed the Informed Consent Form to allow the inclusion of the NBs' data in the study. None of the parents/guardians refused to participate. The project was approved by the institution's Research Ethics Committee and has CAEE number 50675915.1.0000.5269.

During the data collection period, 117 NBs were admitted, of whom 94 were excluded. Of these, 42 (44.7%) were excluded due to central-nervous-system (CNS) malformation; 36 (38.3%) to showing a longer GA than 35 weeks; 10 (10.6%) to genetic syndromes and six (6.4%) to coming from other units. Of the 23 NBs included, six were lost during the study, three due to transfers, two to clinical instability, and one to the development of Grade-IV Intracranial Hemorrhage (ICH).

Exclusion due to clinical instability and grade-IV ICH occurred because these newborns could not be submitted to neurobehavioral evaluation, since the main project to which the present investigation is linked evaluated these NBs' neurobehavior.

RESULTS

Among the 17 PTNBs, 12 (70.6%) were males and five (29.4%) were females. The PTNBs' GA ranged from a minimum of 25 weeks to a maximum of 34 weeks (mean = 32 weeks). Their weight ranged from 640g to 2,620g, with a mean of 1,636.4g (SD = 499.5). The mean Score for Neonatal Acute Physiology with Perinatal Extension (SNAPPE, version II) was 14.6 (SD = 9.1), as shown in Table 1.

TABLE 1: Procedures performed in the first 14 days according to gestational age. Rio de Janeiro, Brazil (n = 17)

Gestational Age (n)	Painful Procedures* n (Mean)	Very Painful Procedures** n (Mean)	Total Number of Procedures n (Mean)
≤ 32 weeks (3)	204 (68)	72 (24)	276 (92)
> 32 weeks (14)	227 (16.2)	226 (16.1)	453 (32.3)
Total (17)	431 (25.3)	298 (17.5)	729 (42.9)

*Painful Procedures (upper-airway aspiration, re/insertion of nasal prongs, gastric tube insertion and removal of adhesives); **Very Painful Procedures (venous puncture, arterial puncture, calcaneal puncture, orotracheal tube aspiration, orotracheal intubation and peripherally inserted central catheter).

SNAPPE II assesses the patient within the first 12 hours of NICU admission by observing multiple physiological changes. SNAPPE II ranges from zero to 162, and the higher the score, the greater the NB's severity¹⁰.

A total of 729 procedures were recorded. 42.9 procedures were performed per PTNB during the first 14 days after birth, totaling approximately three (3.063) procedures being performed per PTNB during the day service.

It was identified that the lower the PTNBs' GA, the greater the number of procedures performed in the first 14 days. In PTNBs with up to 32 weeks of gestational age, a mean of 92 (SD = 1.4) painful procedures were performed during the first 14 days, whereas NBs with gestational age greater than 32 weeks had a mean of 32.3 procedures (SD = 11.8). (Table 1).

However, for each PTNB with gestational age less than 32 weeks, a mean of 16.7 managements were performed over the first 14 days, while for infants with gestational age greater than 32 weeks, a mean of 5 managements occurred.

Among the procedures, the most frequent was calcaneal puncture (23.9%), followed by prong re/insertion (20.2%), gastric tube insertion (17.1%), upper airway aspiration (12, 8%), adhesive removal (8.6%), orotracheal tube aspiration (5.2%), venous puncture (5.1%), arterial puncture (4.5%) and peripheral insertion central catheter passage (2.1%). The least frequent procedure was orotracheal intubation (0.5%).

Of the 729 procedures performed, only 124 received some type of management (one or more). The remaining 605 procedures received no management. The predominant form of management was facilitated restraint, with a total of 53 (32.7%) (Table 2). Of the 37 venous puncture procedures, 16 (43.2%) had more than one management performed. Of these 16 cases, 12 (75%) had the association of non-nutritive sucking with sweetened solution.

TABLE 2: Pain Management for Each Type of Painful Procedure and Total Number of Procedures that did not Receive Any Management. Rio de Janeiro, Brazil (n = 17)

Procedure	Restraint n (%)	NNS* n (%)	Sweetened Solution n (%)	Fentanyl n (%)	Total of Management Procedures n	Procedure Without Management n
Venous Puncture	6 (13.6)	19 (43.2)	19 (43.2)	-	44	14
Calcaneal Puncture	8 (26.7)	7 (23.3)	15 (50)	-	30	156
Arterial Puncture	9 (39.1)	7 (30.4)	9 (39.1)	-	25	17
UAA* Aspiration	10 (62.5)	5 (31.25)	1 (6.25)	-	16	77
PICC*	-	-	-	15 (100)	15	-
NGT/OGT*	3 (25)	4 (33.3)	5 (41.7)	-	12	115
Prong Re/Insertion	10 (100)	-	-	-	10	135
Adhesive Tape Removal	3 (60)	1 (20)	1 (20)	-	5	59
OTT* Aspiration	4 (80)	1 (20)	-	-	5	29
OTI*	-	-	-	1 (100)	1	3
Total	53 (32.5)	44 (27)	50 (30.7)	16 (9.8)	163 (100%)	605

*NNS (Non-Nutritive Sucking); OGT (Orogastric Tube); NGT (Nasogastric Tube); UAA (Upper Airways); OTT (Orotracheal tube); PICC (Peripheral Insertion Central Catheter); OTI (oro-tracheal intubation).

DISCUSSION

This study recorded a total of 729 painful procedures, with a mean of approximately three procedures performed per NB during the day service.

A study conducted on 89 preterm infants in a university hospital in São Paulo state identified that each NB was exposed to a mean of 75.1 painful procedures during the first 14 days, resulting in a daily mean of 5.4 procedures per preterm infant¹². That study used a table with 13 more procedures than those used in this investigation. In addition, the procedures performed at the night service and a larger number of participants were also quantified. Therefore, the reduced number of procedures predetermined for quantification, the limited data collection that occurred only in the day service and the small sample size can justify the smaller number of daily procedures performed by NB in this study.

The collection of painful procedures showed limits, as the information was recalled. The form with the number of procedures performed during the shift was completed at the end of the day, thus requiring the professionals to remember the procedures that they had performed on the PTNB included in the study. This may also have been a contributing factor to a lower figure as compared to the number of painful procedures.

Orotracheal intubation was the least frequent procedure. However, the counting of painful procedures began from the PTNBs' admission to the neonatal units, which excluded the intubations performed at the Obstetric Center.

Calcaneal puncture is still the method of choice for blood sampling in most neonatal units, and it represents the most common painful event among all the procedures performed on newborns¹³.

The widespread use of calcaneal puncture on newborns is mainly associated with their limited arteriovenous structure, which restricts the use of venous puncture. Performing a calcaneal puncture is an easy procedure that can be performed by a nurse alone, and it is a common situation in many neonatal wards¹⁴.

In addition, the frequency of calcaneal punctures is justified because it is a procedure performed to identify the NB's glycemic dosage, and this is one of the tests frequently performed in neonatal units. One resource to reduce excessive calcaneal puncturing is effective communication by the entire multidisciplinary team for when venous or arterial collection is required for other tests, the same blood sample should be used to perform the glycemic test as well.

In order to decrease the frequency of this procedure in neonatal units, the use of devices that can perform various analyses (pH, PaO₂, PaCO₂, electrolytes, calcium, bilirubin, lactate) from a single small blood sample is proposed, thus reducing the number of calcaneal punctures required for laboratory testing. In addition, it is also indicated that peripheral arterial or central venous catheters should be placed in patients who need more than 3-4 punctures per day. These procedures should be performed with adequate analgesia¹⁵.

Although the calcaneal puncture was the most frequent procedure, only 10.3% had some type of management. This information may show that pain management regarding routine procedures in neonatal units is still undervalued.

A recent meta-analysis showed that glucose is an acceptable alternative to sucrose, as it decreases Premature Infant Pain Profile (PIPP) scores and crying periods associated with venous puncture and calcaneal puncture¹⁶.

Another effective way is to combine methods aimed at pain relief during acute painful procedures. A prospective randomized study of 102 newborns found that for infants who received sucking + breast milk + restraint and sucking + breast milk during calcaneal-puncture procedures, the chances of moderate to severe pain were 87.4% and 95.7% lower than those of babies receiving routine care, respectively¹⁷.

Prong (re)insertion is noteworthy because it was the second most often performed procedure. In contrast, in only 10 of 147 procedures was there any management, and the only management performed for such procedure was facilitated restraint.

It is important to understand the proper way to perform facilitated restraint so as to tuck the NB during the painful procedure and not just restrain his/her movements to facilitate it.

Changing the NB's position, nestling and swaddling him/her, maintaining a flexed position and postural support with manual restraint have been recommended to facilitate the organization and autoregulation of neonates during acute pain¹⁸. The NB should be swaddled before the painful procedure by using a blanket or a swaddling cloth, wrapping him/her while keeping his/her lower limbs flexed, aligning on the midline of the flexed upper limbs and placing his/her hand close to his/her mouth¹⁹.

In addition to facilitated restraint, there are several non-pharmacological techniques that can be used to relieve newborns' pain, such as non-nutritive sucking, the kangaroo position, maternal lap, the presence of a nest, breastfeeding, music therapy and olfactory stimulation. Integrating these interventions into the clinical routine will alleviate neonatal distress and provide greater satisfaction to parents and the clinical staff²⁰.

Non-nutritive sucking, oral sucrose and facilitated restraint appear to be the most promising non-pharmacological interventions for pain relief during nasal Continuous Positive Airway Pressure (CPAP) use. A randomized controlled study involving 30 PTNBs showed that when nasal CPAP is installed, 100% of PTNBs experience pain; however, when they are offered non-nutritive sucking, PTNBs respond to the stimulus without showing a score that is indicative of pain, according to the Neonatal Pain Scale (NIPS)²¹.

A meta-analysis of 57 studies, including more than 4,730 infants whose gestational ages ranged from 25 to 44 weeks, found that sucrose was safe and effective in reducing the procedural pain of a single event. Maximum reductions in physiological and behavioral pain indicators were observed when sucrose was administered 2 minutes before a painful stimulus, and the effects lasted 4 minutes²².

The combination of non-nutritive sucking and glucose has been shown to be effective in reducing the proportion of crying time after simple painful procedures and, in some cases, it reduces the behavioral and physiological indicators of pain²³.

Adhesives are often used in neonatal units, but their removal, besides being potentially painful, can trigger skin lesions in PTNBs. An NB's skin has some peculiarities in relation to that of an adult, such as: it is thinner (40 to 60%), less hairy, with less cohesion between the epidermis and the dermis, and the ratio between body surface area and weight is five times that of an adult²⁴.

Skin damage is common in PTNBs who are hospitalized and as early as the first month of life, and approximately 80% of such infants have suffered a skin lesion. The use of adhesives in NICUs to fix devices, such as a venous catheter, an endotracheal tube and others, can strongly adhere to the skin and even tear the superficial layers or the entire epidermis when removed. A minimal amount of adhesive tape should be used, placing soft-material protective pads between these tapes and the skin²⁵.

Although the population in this study was more susceptible to skin injury, and consequently with more exposure to pain, the removal of adhesives had only five managements for a total of 63 procedures performed during this data collection period.

In order to prevent skin lesions in NBs, the use of adhesives should be limited and discriminated. Their removal should be performed carefully by using saline-moistened gauze, thus enabling atraumatic removal²⁶.

Adequate pain management for removing adhesives is of utmost importance, and it should be understood that it is a procedure usually performed in neonatal units that submits newborns to a painful process.

It is important to point out that the inclusion of the adhesive removal procedure in the study instrument was due to the very team members' suggestion because they considered it a painful procedure. However, only 6.3% had some type of management, which indicates a gap between the knowledge of the painful process caused to the NB by the procedure and the initiative to perform pain management. Professionals who routinely perform invasive procedures may have their sensitivity diminished through cognitive restructuring, thus becoming more skeptical of children's subjective pain responses^{27,28}.

It is necessary to understand how the environment can influence professionals' care practice by encouraging them, or not, to apply their knowledge in the clinical setting and to pursue quality care provision.

At this point, organizational culture will be an important variable to consider in analyzing the engagement of these professionals. Organizational culture means the values, beliefs, customs and norms shared by the members of an organization, and it can be classified into several types, such as a culture that is oriented to hierarchy, innovation or tasks, among others²⁹.

At the institution where the study was conducted, a clinical pain protocol had already been implemented, and the entire multidisciplinary team working at the unit had been trained on assessment for the use of a pain scale, since the Neonatal Infant Pain Scale (NIPS) had been instituted in the sector as a daily instrument to assess all hospitalized newborns and appropriate pain management procedures. However, that capacitation took place in 2015, and since then, the team has been renewed, and professionals have been replaced by others who have not been fully trained, which indicates the need for constant capacitation of the whole staff so that knowledge and its application in practice can be continuous.

CONCLUSION

This study has enabled us to understand that, despite the number of acute painful procedures performed on PTNBs during their first 14 days of hospitalization in a neonatal unit, pain management is still a challenge.

It is expected that this study will not only encourage reflection on professionals' performance in painful procedures, but that it will also lead to an attitudinal change regarding the performance of management aiming at preventing and relieving the pain of such newborns already weakened by their underlying disorder and the stressful ICU environment.

A path for such change can also result from the implementation of pain assessment and treatment protocols in neonatal units, as well as from public health policy formulations aimed at training, enhancing and encouraging institutions and professionals to adopt actions in the clinical setting that can minimize the impact of pain on hospitalized neonates.

It is also worth pointing out the need to explore this topic more thoroughly through scientific research in order to contribute to the improvement of care-provision and practice in neonatal units.

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