Pain assessment of preterm newborns in peripheral venipuncture and diaper changes

Avaliação da dor do recém-nascido pré-termo submetido a punção venosa periférica e a troca de fraldas

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ABSTRACT

BACKGROUND AND OBJECTIVES: Pain and stress are the main factors stimulating behavioral, physiological, and hormonal changes in preterm newborns (PTNB) admitted to a Neonatal Intensive Care Unit (NICU); therefore, the systematic multidimensional assessment of pain at the bedside becomes an essential tool for reducing the impact of brain stimulation, as it guides the appropriate treatment. The objectives of this study were to assess the pain at the bedside of PTNB submitted to peripheral venipuncture or diaper change and to describe the measures for pain relief.
METHODS: Longitudinal study, with a prospective cohort of 25 PTNB, carried out in an NICU in the city of Rio de Janeiro. Pain assessment at the bedside was performed at three different times, using the Neonatal Infant Pain Scale (NIPS) and Premature Infant Pain Profile (PIPP), when subjected to peripheral venipuncture for infusion therapy and diaper changes. The scores of the scales were analyzed using the Chi-square test.
RESULTS: In the puncture group, there was pain and increased intensity. In the diaper group, three PTNB showed pain at the third assessment. During peripheral venipuncture, the non-pharmacological measures were used: oral 25% glucose, non-nutritive suction and a combination of the two.
CONCLUSION: Assessing pain at the bedside using scales helps nursing professionals in pain prevention and treatment, avoiding altered responses of newborns in the face of procedures.

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RESUMO

JUSTIFICATIVA E OBJETIVOS: A dor e o estresse são os principais fatores de estímulo às alterações comportamentais, fisiológicas e hormonais dos recém-nascidos pré-termos (RNPT) internados na Unidade de Terapia Intensiva Neonatal (UTIN); portanto, a avaliação multidimensional sistemática da dor se torna uma ferramenta imprescindível para a redução do impacto da estimulação cerebral, visto que direciona para o adequado tratamento. Os objetivos deste estudo foram avaliar a dor à beira do leito de RNPT submetidos à punção venosa periférica ou à troca de fraldas e descrever as medidas para o alívio da dor.
MÉTODOS: Estudo longitudinal, com uma coorte prospectiva de 25 RNPT, realizado em uma UTIN no município do Rio de Janeiro. Foi realizada avaliação da dor à beira do leito em três momentos distintos, com a *Neonatal Infant Pain Scale* (NIPS) e *Premature Infant Pain Profile* (PIPP), quando submetidos à punção venosa periférica para terapia infusional e troca de fraldas. As pontuações das escalas foram analisadas através do teste Qui-quadrado.
RESULTADOS: No grupo punção, houve presença de dor e aumento da intensidade. No grupo fralda, três RNPT mostraram presença de dor na terceira avaliação. Durante a punção venosa periférica, foram utilizadas as medidas não farmacológicas; glicose oral a 25%, sucção não nutritiva e a combinação das duas.
CONCLUSÃO: A avaliação da dor à beira do leito por meio de escalas auxilia os profissionais de enfermagem na prevenção e tratamento da dor, evitando respostas alteradas do recém-nascido diante de procedimentos.
Descritores: Dor, Enfermagem neonatal, Fraldas infantis, Punções, Recém-Nascido Prematuro.

INTRODUCTION

Pain and stress are the most common factors that may stimulate behavioral, physiological and hormonal alterations in preterm newborns (PTNB) hospitalized in the Neonatal Intensive Care Unit (NICU)[1,2]. Neonatal pain prevention must be a goal for all carers, because, taking into account the higher brain plasticity, especially in preterm, the repeated exposure to pain has several consequences in the short and long term for the newborn (NB) development[3].

The first 14 days of hospitalization at the NICU correspond to the period in which PTNB undergo a greater number of diagnostic and therapeutic procedures in order to monitor their health status[4]. Stress and pain may be associated with routine care, such as changing diapers, and frequent invasive procedures, such as peripheral venipuncture[5].

Changing diapers, although being a painless procedure, may generate responses to pain in the NB who is being submitted to other painful procedures, presenting an altered response to pain[6] called allodynia[7]. That happens because the repeated occurrence of pain may alter the PTNB brain development in relation to the behavioral and cognitive functions[6].

Another alteration, known as hyperalgesia, an exaggerated response to a painful stimuli[7], results from numerous medic procedures that involve needle puncture and are ubiquitous in contemporary health care when diagnosing, treating and monitoring medic conditions[8]. Due to the frequency in which venipuncture is performed in the NICU, it's necessary to evaluate and treat the behavioral and physiological responses of the NB submitted to such procedure[9].

Added the fact that only 60% of venipunctures are effective in a single try, the NB ends up being more exposed to painful stimuli due to the several tries before reaching success[10,11]. Moreover, the device used for peripheral punctures needs to be changed in a shorter period and multiple punctures are necessary along the treatment[9,12]. This situation could be minimized by choosing a device with a longer stay, such as the peripherally inserted central catheter (PICC) or the umbilical catheter[13,14].

The nursing team must consider the systematic multidimensional assessment of pain as the fifth vital sign and it must be measured at the bedside with validated and appropriate instruments[15], becoming essential to reduce the impact of brain stimulation, since it guides the adequate treatment[9]. Scales that encompass the different response parameters of preterm are the most indicated, such as the multidimensional Neonatal Infant Pain Scale (NIPS) and Premature Infant Pain Profile (PIPP)[16].

The objectives of the present study were to evaluate bedside pain in NB undergoing peripheral venipuncture or diaper changes and to describe pain relief measures.

METHODS

Longitudinal study with a prospective cohort of PTNB, carried out at a NICU in the city of Rio de Janeiro, reference for the care of pregnant women and NBs at risk, from May to July 2010.

Inclusion criteria were gestational age between 28 and 36 weeks, with need for infusion therapy by peripheral needle catheter, umbilical catheterization or PICC. Exclusion criteria were an Apgar score of less than seven at the 5th minute of life, chromosomal abnormalities or malformations of the central nervous system, grade III and/or IV intraventricular hemorrhage, and mothers that are drug users, including alcohol, marijuana, cocaine, opioid, and their derivatives.

The sample was obtained by convenience and its size was based on an estimate of hospitalizations per year. During the study period, 89 NB were hospitalized, with 25 meeting the selection criteria. The PTNB were separated into two groups: puncture group (PG) and diaper group (DG), considering the frequency of pain exposure before the prescribed infusion therapy device. The PG was using a venous needle catheter with a permanence time around 72 to 96h. The PG was using an umbilical catheter, which has a duration of permanence of up to 14 days if inserted in the first hours of life, or the PICC, which has no specific duration of permanence in the literature[15]. Therefore, using the needle catheter was considered to result in a higher frequency of pain exposure and the use of one of the central intravenous devices, a lower frequency of pain exposure. The diaper changing procedure was chosen because it generates stress to the NB at the NICU[7].

Each PTNB was assessed at three different times within an interval of up to 15 days and according to the need to obtain peripheral venous access and diaper change, making it impossible to standardize the assessment times. The first assessment occurred from the moment of admission up to 24 h of hospitalization. The second assessment occurred between the 2nd and 13th day of hospitalization, and the third assessment occurred between the 6 and 14th day.

The PTNB who had infusion therapy suspended and the device removed before the established interval were lost, and three PTNB were excluded at the time of the third assessment of the PG.

All PTNB who participated in the study remained at rest for at least 30 minutes, without any kind of stimulation before the evaluations, which occurred during the daytime because it was the period of greatest activity in the unit.

The NIPS and PIPP were used as instruments to assess pain at the bedside. The NIPS was used to assess the presence or absence of pain and the PIPP to assess pain intensity.

NIPS has five behavioral indicators, namely: facial expression, crying, arm and leg movement, sleep/alert state, and a physiological indicator, which is the breathing pattern. Score ranges from zero, one, and two points, according to each indicator. Zero is the minimum score and seven the maximum, and the presence of pain is characterized by the sum of four points or more[17].

PIPP is divided into two stages of observation, the first occurs 15 seconds before the procedure, and the baseline heart rate and oxygen saturation, gestational age and alertness are checked and recorded. The second stage occurs through observation for 30 seconds after the procedure, identifying the behavioral indicators: frowning forehead, squeezed eyes and nasolabial fold, as well as the physiological ones, such as maximum heart rate and minimum oxygen saturation. Zero is the minimum score and 21 the maximum. Pain presence is considered at a score between 7 and 11, and severe pain above 12[18].

The presence of pain when the needle was introduced was evaluated in the PG, breaking the barrier of the skin of PTNB in the first attempt of peripheral venipuncture, whether successful or not. In the DG the moment when the wet diaper was changed for the clean diaper with attachment of the bilateral self-adhesive tapes was considered.

Each pain assessment occurred at three moments. Baseline - immediately 15s before the procedure, used as the initial part of the

PIPP, with observed and recorded gestational age, behavioral status, heart rate and baseline oxygen saturation. Time 1 - when the procedure was performed, use of NIPS. Time 2 - post-procedure, in which the NB was observed for 30 seconds. According to the PIPP, the time to maintain the eyebrow protruding, squeezed eyes and nasolabial sulcus was observed, in addition, the maximum heart rate and minimum oxygen saturation were obtained. After the application of the bedside scales in the described times, the total scores were calculated and the pain relief measures used and the number of attempts to repeat the punctures, if the first attempt was not successful, were recorded.

To extract data on the characterization of PTNB in the medical records, a form was used. Data regarding clinical characteristics and the number of procedures performed in the 24 hours prior to the evaluation, such as control of possible biases, were extracted.

The research was approved by the Research Ethics Committee of the Municipal Health and Civil Defense Secretariat of Rio de Janeiro (CEP SMSDC-RJ), under Opinion no. 85A/2010, respecting all ethical principles determined by the National Health Council. All caregivers signed the Free and Informed Consent Term (FICT).

Statistical analysis

The data collected were double entered into the Microsoft Office Excel software. The characterization of the sample, the number of attempts to repeat the procedure, and the pain relief measures used were analyzed descriptively for each group. The categorization of the NIPS and PIPP scales scores was analyzed using the Chi-square test. The procedures performed in the 24 h prior to assessments were analyzed by the Fisher's Exact test. A 5% significance level was adopted.

The measure of association calculated was the relative risk (RR), and those with a score of absent pain were considered non-exposed and those who presented a score referring to the presence of pain, regardless of intensity, were considered exposed.

RESULTS

Fifteen PTNB were allocated to the PG and 10 to the DG. The variables related to the characterization of PTNB are shown in table 1. Table 2 presents the categorization of pain obtained by scoring the scales used on each day of assessment of PTNB. In the first assessment (time of admission until 24 h of hospitalization), when NIPS was used, the PTNB who used the needle catheter for infusion therapy had a 3.3 times higher RR of feeling pain when compared to the DG, who used the device of longer permanence time. When assessed by PIPP, the RR of experiencing pain was 4.6 times higher.

In the second assessment (2nd and 13th day of hospitalization), using the NIPS, PTNB using the needle catheter for infusion therapy had 8.6 times higher risk of experiencing pain when compared to the DG using the long permanence catheter. At the third assessment (day 6 and day 14), the RR of the PTNB who used the needle catheter to experience pain was 3 times higher compared to the DG.

The study observed that the number of PTNB in the PG who scored severe pain increased from the first to the 3rd assessment - 1st assessment: 1 PTNB; 2nd assessment: 4 PTNBs; 3rd assessment: 7 PTNB. In the DG, 3 PTNB scored presence of pain at the third assessment (between day 6 and 14).

Pain assessment in the study considered the first attempt of peripheral venipuncture. The number of attempts (from the first puncture until the success of the puncture) was counted. The mean number of peripheral venipuncture attempts per PTNB in the PG was 1.4 in the first assessment (min. 1; max. 5), 2.2 in the second assessment (min, 1; max. 11) and 2.6 in the third assessment (min. 1; max. 7), suggesting a reduction in pain threshold by increasing local sensitivity.

Table 3 shows the pain relief measures used at the time of the procedure by nursing professionals and the number of procedures performed in the 24 h prior to the assessment. Only PTNB who underwent peripheral venipuncture received some type of non-pharmacological pain relief measure.

Table 1. Description of variables related to the characterization of PTNB in both groups. Rio de Janeiro, RJ

Variables	PG			DG		
	n	%	μ±SD	n	%	μ±SD
Gender						
Male	05	33.3		05	50	
Female	10	66.7		05	50	
Birth weight (g)			1822.3±445			1181.5±483
< 1.000	-	-		05	50	
1.001 to 1.499	03	20		03	30	
1.500 to 2.499	11	73.3		02	20	
≥ 2.500	01	6.7		-	-	
Gestational age at birth (weeks)			33.6±1.6			
<30	01	6.7		02	20	
30 to 34	10	66.7		06	60	
35 to 36	04	26.6		02	20	
Total	15	100		10	100	

PG = puncture group; DG = diaper group, μ = mean; SD = standard deviation.

Table 2. Categorization of PTNB pain scores in both groups according to the NIPS and PIPP scales in the three assessments. Rio de Janeiro, RJ

Pain scales	1st Assessment				2nd Assessment				3rd Assessment*			
	PG n	DG n	p-value**	RR	PG n	DG n	p-value**	RR	PG n	DG n	p-value**	RR
NIPS			0,091	3,3			< 0,001	8,6			<0,001	0
Absent	05	08			02	09			00	10		
Present	10	02			13	01			12	00		
PIPP			0,097	4,6			< 0,001	0			<0,001	3,0
Absent	08	09			02	10			01	07		
Present	06	01			09	00			04	03		
Intense	01	00			04	00			07	00		
Total	15	10			15	10			12	10		

*At the third assessment, the Puncture Group lost three PTNB (n=12) **Chi-square test; RR = relative risk; PG = Puncture Group; DG = Diaper Group; NIPS = Neonatal Infant Pain Scale; PIPP = Premature Infant Pain Profile.

Table 3. Distribution of pain relief measures used, and procedures registered in the 24 hours before each assessment in both groups. Rio de Janeiro, RJ

Variables	1st Assessment			2nd Assessment			3rd Assessment*		
	PG n	DG n	p-value **	PG n	DG n	p-value**	PG n	DG n	p-value**
Non pharmacologic measures			-			-			-
Oral 25% glucose	11			08			08		
Non-nutritive sucking (NNS)	01			03			01		
Oral 25% glucose + NNS	03			04			03		
None		10			10			10	
Registered procedures									
Ventilatory support			0.023			0.565			0.2
Nasal CPAP	10	04		04	04		00	04	
Mechanic ventilation	01	06		01	04		01	04	
Nasal oxygen catheter	00	00		00	00		01	00	
None	04	00	-	10	02	-	10	02	-
Orotracheal Intubation	01	06	0.006	00	00	-	00	01	1
None	14	04	-	15	10	-	12	09	-
Reinstallation of CPAP nasal prong	10	04	0.241	04	04	0.667	00	04	0.029 -
None	05	06	-	11	06	-	12	06	
Blood collection/venipuncture	06	01	0.179	01	01	1	00	00	-
None	09	09	-	14	09	-	12	10	-
PICC insertion	00	01	0.4	00	02	0.4	00	03	0.078
None	15	09	-	15	08	-	12	07	
Total	15	10		15	10		12	10	

*At the third assessment, the Puncture Group lost three PTNB (n=12); CPAP = Continuous Positive Airway Pressure; **Fisher's Exact test; PICC = Peripherally Inserted Central Catheter; NNS = non-nutritive sucking; PG = Puncture Group; DG = Diaper Group.

Regarding the procedures registered in the 24 h prior to each assessment, PTNB in the DP were those most often submitted to ventilatory support (p=0.023) and orotracheal intubation (p=0.006) at the first assessment. At the third assessment, the DG presented reinstallation of CPAP (Continuous Positive Airway Pressure) nasal prong (p=0.029).

DISCUSSION

The present study has shown that the number of PTNB with presence and intensity of pain was increasingly higher from the second day of hospitalization on during the peripheral venipuncture. The PTNB which were submitted to diaper change presented pain in the first and third evaluations. Some hypotheses may be used to justify the pain intensity increase in the PTNB of the PG, even with the use of pain relief measures, such as the number of repeated peripheral venous punctures before reaching success and the non-standardized use of non-pharmacological measures. As for the DG, a suggested hypothesis is that the NB had lower gestational weight and less age, as well as higher need for procedures in the previous 24h.

In an epidemiological study developed in France, the frequency of venipuncture and the intensity of pain for bedside puncture in a period of 14 days were determined. A total of 1887 peripheral

venipunctures were recorded in 495 NB with a mean gestational age of 33 weeks. A total of 1164 (61.4%) punctures were effectively performed on the first attempt, 343 (18.2%) on the second attempt, 188 (10.0%) on the third attempt, and 192 (10.2%) with 4 or more attempts. Specifically for pharmacological infusion 735 (39%) punctures were counted in total, with a mean of 4.1 punctures per preterm (min. 1; max. 17). Pain was assessed in 94.8% of PTNB, with the higher number of attempts required for the procedure to be effective and the absence of parents during venipuncture being pointed out as factors associated with high scores[11].

In this study, oral 25% glucose, NNS and the combination of the two pain relief measures were the most used strategies by nursing professionals who performed peripheral venipuncture. Sweetened solutions during venipuncture decrease crying time, attenuate facial mimicry, and reduce the physiological response to pain compared to distilled water and NNS itself. Among the various sweetened solutions for clinical use in NB, the 25% or 30% glucose solution should be at a dose of 0.5 mL for PTNB, administered on the anterior part of the tongue about two minutes before venipuncture[19].

A study described the behavioral and physiological responses of 84 NB undergoing venipuncture, with and without the use of non-pharmacological measures for pain relief. It was evident that the lack of implementation of guidelines and protocols in health institutions for adequate pain management can even lead to not using these measures in procedures considered to be painful[9]. Although non-pharmacological intervention measures recommended in the literature were used in this study, there was no protocol for standardized use in the unit, generating individual actions related to the form of offering, dose, time of analgesia of the glucose solution and frequency of suctions required to provide analgesia.

Regarding the presence of pain in the DG, known to be a painless procedure, there is evidence that in this group the number of PTNB with extreme and very low weight was higher when compared to the PG, and they were more often submitted to ventilatory support procedures, orotracheal intubation and reinstallation of the CPAP nasal prong. No severity scores were verified in this study, but based on the characterization of PTNB, it can be considered that NBs in this group were more dependent on NICU technology.

A study that related pain and free cortisol of 32 PTNB under intensive care therapeutic procedures evidenced that invasive ventilation, to which PTNB are routinely submitted, triggered a predominance of moderate pain in 37.5%. In PTNB receiving CPAP, moderate or severe pain occurred in 9.4%. As for the puncture, PTNB presented moderate and intense pain in the same frequency, which was 31.3%. Regarding the purpose of the puncture, more than half occurred for the passage of PICC, so that 10 PTNB had moderate pain. Also, in relation to venipuncture, regarding the number of attempts, the NB submitted to a single venipuncture had moderate pain in 12.5% and severe pain in 9.4%[20].

The ventilatory support offered by invasive ventilation through tracheal intubation and non-invasive through nasal CPAP causes pain of different intensities in PTNB, with need for relief. A study that proposed an effective program for pain relief in the neonatal population, considering the promotion of health professionals' education with this objective, showed that NB on mechanical ventilation using a tracheal tube need analgesia and sedation[21] also with other measures for pain relief offered in specific procedures, such as venipuncture, calcaneal puncture, among others[4]. In pain caused by the installation and reinstallation of nasal CPAP prongs, all 20 PTNB who received NNS had absent pain scores measured by the NIPS[22]. One of the limitations of the study refers to the absence of registrations of the use of non-pharmacological measures in the procedures performed in the 24 hours prior to the evaluation, which would help in discussing the findings.

Although studies have related the number of painful procedures with memory of pain, in a study carried out with 36 30-week-old PTNB hospitalized at the NICU, it was found that, when changing diapers, the NBs had the lowest mean oxygen saturation and the highest scores on the Behavioral Indicators of Infant Pain (BIIP), NIPS and PIPP pain scales. On the fifth and last day of assessment, the highest mean for the change in heart rate was found. However, there was no correlation between previous experiences of pain during the 28 days of life and the variation in oxygen saturation, heart rate or BIIP, NIPS and PIPP scores, considering that the NB presented no allodynia[23].

Although allodynia was not identified in the previous study, the present study identified PTNB with pain when changing diapers. Changing diapers can be a stressful event, due to the frequency in which it's performed, demonstrating the need for interventions that can promote comfort and reduce stress[24].

In the pilot study of a randomized clinical trial conducted with 19 PTNB with a mean gestational age of 32 weeks and a mean birth weight of 1.732 g, skin-to-skin contact was evaluated regarding the reduction of stress during diaper changing through changes in skin conductance. To evaluate pain and stress, an Algesimeter conductance equipment was used, which identified a significant increase in conductance peaks before and during the diaper change procedure, with a reduction during and after. Fewer peaks were observed in those who were in skin-to-skin contact compared to those who remained in the incubator[25].

The decision about pain relief for PTNB must always be individualized. It's important to consider the presence of pain when the NB is submitted to painful procedures, such as catheter insertion, venous and arterial punctures, mechanical ventilation, besides those more severe scenarios in which they may need multiple procedures[26].

As another limitation of the study and a possible generator of bias, there was no registration in the medical record of the number of repeated attempts to achieve success in the procedures performed in the previous 24 hours.

CONCLUSION

This study showed that PTNB who underwent peripheral venipuncture with a needle catheter had a higher RR of pain when

compared to those in the DG, who used the device for a longer time. The PTNBs who underwent the painful procedure presented exacerbated pain response as the length of hospital stay increased, and those who underwent diaper changing showed painful response to the procedure.

AUTHORS' CONTRIBUTIONS

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Data Collection, Conceptualization, Resource Management, Project Management, Research, Methodology, Writing - Preparation of the original, Writing - Review and Editing, Supervision, Validation, Viewing
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Bruna Nunes Magesti
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Statistical Analysis, Writing - Review and Editing, Software

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