Original Article

Pain relief in premature neonates during upper airway aspiration comparing positions

Alívio da dor em neonatos prematuros durante a aspiração de vias aéreas superiores comparando posicionamentos

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ABSTRACT | INTRODUCTION: Premature newborns have survived long periods of time in neonatal intensive care units. In these patients, the pain, the result of intrusive interventions, is a concern of multidisciplinary teams. **OBJECTIVE:** To identify the best intervention for pain relief during the suction of the upper airway, nest positioning with containment in swaddling. **METHODS:** The Before and After type of study was conducted in preterm infants with less than 32 weeks at birth, who required aspiration of the airways in the first week of life. In the Before Group, patients were placed in the nest, and in the After Group, they remained contained in swaddling. The design of the studio allows patients to have their own controls and participate in the study more than once, according to the need for suction. The study was approved by the Human Research Ethics Committee. RESULTS: 22 premature newborns participated who were submitted to 100 procedures for suction of the upper airway. According to the dependent statistical analysis, it will be found that the individuals who usually score the pain at the time they place themselves in the score, when they are contained, by the Neonatal Pain Scale (p=0.001) and the Profile of Premature Infant Pain (p=0.01). Less variation in heart rate was observed in patients in the containment group. **CONCLUSION:** The pain is present in the suction of the upper airway. Heart rate varies in a smaller percentage in the containment group. The patients of containment did not obtain a positive pain score.

KEYWORDS: Pain. Facilitated tucking. Neonatology. Neonatal Intensive Care Units.

RESUMO | INTRODUÇÃO: Os recém-nascidos prematuros frequentemente passam por longos períodos internados em unidades de terapia intensiva neonatal. Nesses pacientes, a dor, resultado das intervenções intrusivas é motivo de preocupação das equipes multidisciplinares. **OBJETIVO:** Identificar a melhor intervenção para alívio da dor durante a aspiração de vias aéreas superiores, comparando posicionamento no ninho com contenção em cueiro. **MÉTODO:** Foi realizado um estudo do tipo Antes e Depois em recém-nascidos prematuros com menos de 32 semanas de idade gestacional ao nascimento e que necessitassem de aspiração de vias aéreas na primeira semana de vida. No Grupo Antes, os pacientes foram posicionados no ninho, e no Grupo Depois, permaneciam contidos com cueiro. O desenho do estudo permitiu que os pacientes fossem controles deles mesmos e participassem do estudo mais de uma vez, conforme a necessidade de aspiração. O estudo teve aprovação do Comitê de Ética em Pesquisa com Seres Humanos. **RESULTADOS:** Participaram 22 recém-nascidos prematuros que foram submetidos a 100 procedimentos de aspiração do trato respiratório. Conforme análise estatística dependente constatou-se que os indivíduos que haviam pontuado dor no momento em que estavam posicionados no ninho, passaram a não pontuar quando contidos, pela *Neonatal Infant Pain Scale* (p=0,001) e *Premature Infant Pain Profile* (p=0,01). Observou-se uma menor variação da frequência cardíaca no grupo contenção. **CONCLUSÃO:** A dor está presente na aspiração de secreções das vias aéreas. A frequência cardíaca variou percentualmente menos no grupo contenção. Os pacientes posicionados em contenção passaram a não pontuar escore positivo para dor.

PALAVRAS-CHAVE: Dor. Contenção facilitada. Neonatologia. Unidades de Terapia Intensiva Neonatal.

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Introduction

The vast majority of newborns admitted to a neonatal intensive care unit (NICU) to stabilize lung function, require respiratory physiotherapy and airway aspiration. These procedures can be an important cause of pain and changes in physiological parameters[1]. Airway aspiration is the most frequent painful procedure, accounting for 23% of those performed with newborns in the NICU[2].

However, despite the large number of invasive procedures performed in these units, there is a contradiction between the use of analgesia and the frequency of painful procedures[3]. Several non-pharmacological therapies have been proposed to control and modulate pain and discomfort in this population, with proven effects, although the physiological mechanisms are not completely understood[4].

Recognizing pain in premature newborns is still a challenge, even though they are frequently exposed to painful procedures. The difficulty in assessing pain in this population consists of the fact that they express it in a subtle way, this reaction also being dependent, among other factors, on the gestational age, the sensitivity of the instrument used, the knowledge to interpret the assessment tools and the perception of pain that the caregiver has.

Thus, in non-verbal patients, such as premature, there is a need to use instruments to assess pain in real time and accurately, in order to protect them from damage and propose a form of relief[5]. This fact is a matter of concern for multidisciplinary care teams, as, in addition to ethical issues, it is known that pain sensitizes immature neural pathways, and can bring neurological repercussions, such as changes in behavior, attention and learning.

In this context, understanding that pain prevention and treatment are fundamental rights, regardless of neurological understanding and maturation, the physiotherapist's concern at the NICU emerges in providing quality care to the premature, aiming beyond bronchial clearance and path permeability. Comfort, through non-pharmacological measures. The study is relevant since the Ministry of Health itself recommends humanized care measures for the premature, thus, the objective of the study was to identify the best intervention for pain relief during upper airway aspiration, comparing nest position with containment in swaddling clothes.

Method

The research project was submitted for evaluation by the institution's Human Research Ethics Committee, and was approved under number 706.623 (CAAE 19182613.5.0000.0096). The Free and Informed Consent Term, mandatory for research on human beings, was used (Resolution No. 466 of 12/12/2012), which was signed by the parents.

The study was of the Before and After type, carried out in the Neonatal Intensive Care Unit of a public university hospital, from March 2014 to May 2015.

Data collection was performed in the first week of life and the newborns who met the following. Inclusion criteria were part of the study: gestational age between 24 to 32 weeks assessed by early fetal ultrasound, with chronological age between the second and seventh day of life, having the presence of secretion on pulmonary auscultation evaluated by the doctor indicating the need for respiratory physiotherapy and upper airway aspiration, at least twice a day, regardless of being in room air or under invasive or non-invasive ventilatory support. Exclusion criteria were: Presence of any genetic syndromes and congenital malformations of the head, neck or central nervous system; critically ill patients, Snappe II greater than 70, transfer or death before the first data collection, born during periods of research break, such as the researcher's vacation, extended holidays.

Convenience sampling was used and considering the inclusion and exclusion criteria, the study population consisted of 22 premature newborns, and the study design determined that patients were in control of themselves, and participated in the study several times during the first week of life, according to

your clinical needs for physiotherapy and secretion aspiration. All participants received the procedures in the morning and in the afternoon, after a period of at least 1 hour and 30 minutes without receiving other interventions, such as changing diapers, collecting blood, handling the team. Totaling 100 physiotherapy procedures followed by aspiration. The newborns who participated in the study received respiratory physiotherapy and respiratory tract aspiration with the adoption of postural measures, and were divided into two groups: Before, called Nest and After, Contention.

During the procedure of respiratory physiotherapy and aspiration of the respiratory tract, in the morning, the newborns were positioned in the nest, group Before or Nest. They remained supine inside the nest, in semiflexion of lower limbs, inside the incubator, according to the positioning pattern used in the unit. The nest is made by folded swaddling clothes and placed around the newborn.

In the second service, in the afternoon, they were positioned in the nest and also with restraint by means of swaddling clothes, group After, or Contention. Containment restricts the movement of the newborn, but does not prevent it from moving spontaneously, with the presence of movements of the upper and lower limbs being noticeable to the examiner. The newborns were restrained, keeping the chest uncovered so that it was possible to check the respiratory rate. (FIGURE 1)

Figure 1. Before and After Group

BEFORE AFTER

Pain responses were assessed using the Neonatal Infant Pain Scale (NIPS)[7] and Premature Infant Pain Profile (PIPP)[8]. The evaluator of the pain scales was the member of the nursing team responsible for the newborn at the time of collection, or in the impossibility of this, he was the member of the physiotherapy team. To carry out this study, the nursing and physiotherapy team working during the collection period was trained by the researcher, with aspects of pain manifestation in premature newborns being presented, how to recognize pain and how to assess it, and the NIPS and PIPP scales[9].

Data were collected from medical records such as gender weight, gestational age, Snappe II (Score for Neonatal Acute Physiology with Perinatal Extension-II)[10] and Apgar score. Physiological parameters, respiratory rate, heart rate, peripheral oxygen saturation by pulse oximetry and pain assessment by NIPS and PIPP scores were recorded. These parameters were recorded in three moments, namely: at the end of physiotherapy and immediately before the aspiration procedure (T1), immediately after the end of the procedure (T2) and five minutes after the end of the procedure (T3). In the last 5 minutes, between moments T2 and T3, the patient was not touched by any professional.

Considering the relational hypothesis, the Nest or Containment intervention variables were positioned as independent variables and as NIPS and PIPP scores as dependent variables. All data were recorded in the collection instrument, entered in an Excel spreadsheet, checked and exported to the Statistic Statsoft® program. Initially, descriptive statistics were performed, with measures of central tendency and dispersion for continuous variables and absolute and relative frequency for categorical variables. Inferential statistics was performed according to the study groups and research objectives. Mc Nemar's test was performed for dependent analysis of categorical variables and Fisher's exact test was performed for independent analyzes. To analyze the continuous variables of dependent samples, the Student T Test was performed for dependent samples. For all tests, a significance level of 5% was considered.

Results

During the data collection, 76 premature newborns were born with before 32 weeks of gestation. Of which 43 were excluded, 20 for not having an indication to receive two daily physiotherapy consultations, 8 for transfer before the first data collection, 7 for death in the first hours of life, 4 for being critically ill, 3 born with malformations, and 1 for parents not agreeing to participate. Of the 33 who met the inclusion criteria, 11 were born during periods of pause in the research.

The 22 premature newborns participating in the study had a mean gestational age of 28.4 (± 2.34) weeks and a median birth weight of 1025.45 grams (ranging from 510.0 - 2230.0 grams), being thus distributed by weight category: 50% (11 patients) between 500 and 1000 grams, 27.3% (6 patients) between 1001 and 1500 grams and 22.7% (5 patients) above 1501grams. Twelve patients (55%) were male while 10 (45%) were female. Most (75%) of newborns had an Apgar score in the fifth minute greater than or equal to seven points, and had a SNAPPE-II score with a median of 23.2 ranging from 5 to 62 points, thus showing that cases in which the score was higher did not participate in the research because they indicated greater severity.

The physiotherapy and respiratory tract aspiration procedures were held after patients underwent clinical evaluation with auscultation by the physician and the researching physiotherapist, and with the presence of secretion, the patients were included in the study. The median days of life at the time of collection was 4 days ranging from 2 to 7, with 10 newborns having 2 days of life. Among these, 5 weighed less than 1500g.

Of the 100 procedures collected, 4% were in room air, and 96% received supplemental oxygen, thus being offered: catheter 12%, continuous positive airway pressure (CPAP) 48%, invasive mechanical ventilation 36%, with no statistically significant difference between cases who scored and did not score pain using the NIPS and PIPP scales. (p = 0.54 Fisher's exact test).

The first assessment of pain scores performed at T1, immediately after physical therapy, in the nest group there was only once that the newborn scored pain and in the containment group in 3 procedures, patients scored pain, using NIPS and PIPP scores. Due to the insufficient number of cases with pain, it was not possible to perform statistical tests.

Table 1 shows the presence of pain at the evaluated moments, T1, T2 and T3, using the NIPS and PIPP scale in the Nest and Containment groups.

The comparison of results between Nest and Containment groups, using the NIPS and PIPP scale according to gestational age, at time T2, immediately after aspiration, is described in Table 2.

Table 3 shows the areas of agreement by NIPS and PIPP scores. In the NIPS assessment, newborns who scored pain in the nest, when they were placed in contention for the 16 (32%), 10 (62.5%) started not to score more pain. According to the PIPP score, when individuals who scored pain were placed in restraint, of the 26 (52%), 10 (38.5%) started to score no more pain.

As for the percentage variation of physiological data between T1 / T2 moments, heart rate in the Nest group varied 5.9 (-7.9 - 81.9) and in the Containment 1.3 group (-13.8 - 36.5), according to the Mann-Whitney statistical test (p <0.001). The other physiological data collected were respiratory rate and peripheral oxygen saturation, with no statistically significant difference, and are shown in Table 4.

Table 1. Presence of pain by the nips and pipp score in the ninho and contention groups, in moments T1 - T2 - T3

Moment	Nest (n=50)	Facilitated Tucking (n=50)	p
T1	1 (2%)	3 (6%)	*
T2	16 (32%)	11 (22%)	<0,001
T3	4 (8%)	2 (4%)	*
T1	1 (2%)	3 (6%)	*
T2	26 (52%)	22 (44%)	0,01
T3	2 (4%)	0 (0%)	*

NOTE: Statistical test: Mc Nemar test; * no p value, due to an insufficient number of cases with pain.

Table 2. Presence of post-aspiration pain by the nips and pipp score immediately after aspiration, time T2

		Nest			Facilitated Tucking			
		Pain	No pain	p	Pain	No pain	p	p*
NIPS		n=16 32,0%	n=34 68,0%		n=11 22,0%	n=39 78,0%		
	AG (week)	29,1±2,3	27,2±1,9	0,008	29,4±1,9	27,2±2,1	<0,001	0,72
PIPP		n=26 52,0%	n=24 48,0%		n=22 44,0%	n=28 56,0%		
	AG (week)	27,6±2,4	28,1±1,9	0,46	27,4±2,6	28,1±1,8	0,28	0,78

LEGEND: p * between groups with pain: p-value between groups that scored pain; NIPS: Neonatal Infant Pain Scale; PIPP: Premature Infant Pain Profile; GA: gestational age; without: weeks.

NOTE: Statistical tests: Student's t-test for dependent samples

Table 3. Comparison of responses at moment T2

			FACILITATED TUCKING			
			NO PAIN	PAIN	TOTAL	P
NIPS	NEST	NO PAIN	29 (85,3%)	5 (14,7%)	34 (68,0%)	
		PAIN	10 (62,5%)	6 (37,5%)	16 (32,0%)	<0,001
		TOTAL	39 (78,0%)	11 (22,0%)	50 (100,0%)	
PIPP		NO PAIN	18 (75,0%)	6 (25,0%)	24 (48,0%)	
		PAIN	10 (38,5%)	16 (61,5%)	26 (52,0%)	0,001
		TOTAL	28 (56,0%)	22 (44,0%)	50 (100,0%)	

NOTE: Mc Nemar statistical test

Table 4. Percentage variation of the physiological data of the ninho and contention groups, between moments T1 / T2 and T2 / T3

MOMENTS	PHYSIOLOGI-CAL DATA	NEST GROUP MEDIAN (MIN-MAX)		Facilitated Tucking GROUP MEDIAN (MIN-MAX)		p
Δ T1/T2	HR	5,9	(-7,9 –81,9)	1,3	(-13,8 – 36,5)	0,001
	RR	0	(-31,9137,9)	1,82	(-34,5 – 87,5)	0,83
	SAT O_2	-2,0	(-27,0 – 45,9)	-2,0	(-16,8 – 18,7)	0,39
Δ T2/T3	HR	-5,22	(-32,6 – 8,7)	-3,61	(-20,9 – 23,6)	0,31
	RR	0	(-39,6 – 56,4)	-3,85	(-30,0- 60,0)	0,58
	Sat O_2	3,1	(-4,2 – 38,6)	2,1	(-6,1 – 20,2)	0,54

LEGEND: Δ T1 / T2: Variation in percentage between Time 1 and Time 2
Δ T2 / T3: Percentage variation between Time 2 and Time 3
HR: Heart Rate; RR: respiratory rate; Sat O2: Peripheral oxygen saturation by pulse oximetry; Min: minimum; Max: maximum
NOTE: Mann-Whitney statistical test

Discussion

The study design aimed to evaluate the daily pain response during aspiration of upper airway secretion, allowing the same neonate to participate more than once, with the response of each procedure being observed for statistical analysis, and the newborns -births were their own controls. Comparing the response of the premature infant positioned in the nest, during physiotherapy and aspiration of secretions with himself positioned in the nest and with containment by means of swaddling clothes. The secretion aspiration procedure performed by physiotherapists, among other professionals, was chosen to be studied. It is important to highlight that they were performed due to the patient's needs, evaluated by pulmonary auscultation performed by the intensive care physician and the physiotherapist before the service and not to meet the needs of the study.

The clinical need justified assistance before the 72 hours recommended in the literature to avoid peri-intraventricular hemorrhages[11]. As for the Snappe II severity score, scores vary from 0 to 162, where higher values indicate greater severity and greater risk of mortality[12], and the study participants obtained a maximum of 62 points. It is noteworthy that in the present study, newborns had a lower average gestational age compared to another study[13]. The literature shows results of different gestational ages, and slightly higher, making comparisons difficult.

Among the contextual factors that influence the response to painful stimuli, gestational age is identified as the main influencing factor, given that facial expression tends to increase with gestational age[8]. Premature newborns have more subtle responses to pain, often making it difficult for the evaluator to perceive these responses[9].

The intrusive procedures are painful and the result of pain scores at moments T1, T2 and T3, pointed to the presence of pain in the event of aspiration of secretions, in both groups surveyed, with a significant difference between the groups Nest and Contention, when evaluated NIPS and PIPP scores. Corroborating with a study that evaluated the presence of pain in procedures in an NICU such as venipuncture, intubation and airway aspiration[14]. Another study that evaluated the aspiration of secretions with different scales also found the presence of severe pain immediately after the procedure[15].

It is known that pain is present in many procedures during admission to the NICU and that its control has long-term benefits[15]. Due to the subjective character of pain, to carry out the assessment in the neonatal population, there are factors that can interfere in the perception and, especially in the observation of the responses presented, among these are gestational age, birth weight, and the evaluator[16]. Procedural-related pain should be assessed by the multi-professional team, as well as the use of more than one scale, as there is no gold standard in the assessment. The team, after being trained and familiarized, must choose among the validated scales which adapt to the clinical profile of the patients[17].

When assessing the team's difficulty in interpreting responses presented by PTNBs, another study agrees with the findings and states that neonates younger than 28 weeks exposed to nociceptive stimuli have less intense facial responses when compared to those older than 32 weeks of gestational age. These physiological differences were explained by the greater immaturity at birth and the number of painful procedures experienced during hospitalization[18].

Among the various pain scales are NIPS and PIPP. The NIPS scale, which is composed of five behavioral and one physiological indicator, considers that the newborn presents pain when four or more points are assigned[7,19]. PIPP is composed of seven indicators, namely, gestational age, sleep-wake indicators, facial expression and physiological changes[8,20,21]. The total score ranges from zero to 21 points in premature newborns and indicates pain above six points. In general, the scales are not very specific for the very premature, born with less than 27 weeks. PIPP was developed considering this age group, as it includes gestational age in the assessment[22].

Premature newborns, with lower gestational ages, respond to painful stimuli acutely and with different physiological responses from those with higher gestational age[22]. The scales based on the observation of these behaviors present weakness in the assessment of the pain felt in this population[23]. In a systematic review to assess the reliability, validation, feasibility and clinical utility of PIPP, it was shown that this scale is a reliable measure to assess pain related to procedures in newborns[24]. Pain control in premature newborns improves their clinical stability and reduces complications[15]. There is evidence that the intervention can be beneficial for preterm infants, mitigating responses to pain related to procedures[25]. Containment in neonates performed by means of swaddling clothes or hands has low-cost benefits and effects on crying time and sleep quality. Because maintaining the flexed posture helps self-regulation[26]. Containment provided clinical stability and reduced pain scores in preterm infants[27]. Facilitated containment inhibits responses related to stress and physiological changes, reinforcing behavioral stabilization and can be used in routine intensive care procedures[28]. This result agrees with another controlled and randomized cross-sectional study in premature newborns evaluating the effect of facilitated containment, and there was a decrease in pain scores during endotracheal aspiration[29]. Evidence that restraint is beneficial, reducing the presence of pain in the studied group, which may be due to the inhibition of the active movement of contained newborns, promoting comfort and motor stability.

In a worldwide panorama, in Japan, a study showed that the containment performed at the painful moment acts as a protective factor of the neonatal nervous system: the therapeutic touch modified the changes in cerebral oxygenation, showing that the touch / containment has a protective effect on self-regulation of cerebral blood flow during pain exposure in newborns[30]. In Malaysia, another study evaluated containment with diapers in premature newborns as an alternative to suction, thus avoiding the use of pacifiers in that unit. The results of this study also show that restraint reduced pain in the studied neonates[31]. Non-pharmacological combinations during painful procedures facilitate the newborn's motor organization and sleep[28].

The preterm infants assessed maintained the physiological parameters observed within normal limits. Noteworthy was the heart rate that showed a smaller variation in the Containment group. This being a result that shows that the positioning in containment of neonates promotes clinical stability. It is known that changes in respiratory rate and heart rate are not specific to assess pain and cannot be used in isolation[32]. And that in the face of pain they behave with an increase in heart and respiratory rate and with a decrease in oxygen saturation.

In agreement with this study, another investigation in a tertiary care unit, evaluated the physiological responses to heel puncture by comparing non-nutritive suction with containment in premature newborns. There were no differences between the groups of painful and non-painful stimuli[28].

This research provided the studied unit, through the training of the team, with a moment of reflection regarding neonatal pain. Offering permanent education to the entire multidisciplinary team, aiming at the systematic evaluation of pain, proposing prior to the painful event non-pharmacological measures for prevention and relief, with the structuring of a protocol of non-pharmacological measures aimed at the premature according to the gestational age and painful event that will be submitted. Thus, enabling a standardization in care strategies, knowing that containment proved to be beneficial during aspiration.

Providing preterm infants with reduction of pain and discomfort, minimizing the damage resulting from this procedure, directly impacting the improvement of quality of life after hospitalization.

Final considerations

As limitations of this study we have the lack of control over the other painful events that the newborn received, as they depended on the clinical need. However, the times of collection of the research always occurred after a period in which the newborns did not receive other procedures and handling by the team. The application of pain scales was dependent on the evaluator group, with no gold standard available in the literature for comparison.

Non-pharmacological containment intervention at the time of aspiration of airway secretions provides pain relief when these data are assessed in a dependent manner. Because individuals started not to score positive pain scores when they were contained. The containment intervention using swaddling clothes shows interference in the heart rate, where the patients in the Contention Group showed less variation when compared to the Nest Group. The other physiological variables evaluated did not show any statistically significant variation. As both interventions are postural, it can be justification for not having significant differences between the results obtained.

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Author contributions

Andreazza MG participated in the conception, design, data collection, search and statistical analysis of the research data, interpretation of results and writing of the scientific article. Motter AA participated in the design, interpretation of results and writing of the article. Cat MNL participated in the design, statistical analysis and interpretation of the results. Da Silva RPGVC participated in the conception and design, guidance and review of the article.

Competing interests

No financial, legal or political conflicts involving third parties (government, companies and private foundations, etc.) have been declared for any aspect of the submitted work (including, but not limited to, grants and funding, participation in advisory council, study design, preparation of manuscript, statistical analysis, etc.).

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