DOI: 10.1590/1809-2950/18020126042019

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ORIGINAL RESEARCH

Chest physical therapy does not alter acute physiological parameters or pain levels in preterm infants with respiratory distress syndrome in intensive care unit

Fisioterapia respiratória não altera agudamente os parâmetros fisiológicos ou os níveis de dor em prematuros com síndrome do desconforto respiratório internados em unidade de terapia intensiva

Fisioterapia respiratoria no altera de manera aguda los parámetros fisiológicos o los niveles de dolor en recién nacidos prematuros con síndrome de dificultad respiratoria internados en unidad de cuidados intensivos

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ABSTRACT | Objective: to evaluate the occurrence of acute adverse physiological alterations and the presence of pain in premature newborns with respiratory distress syndrome in a neonatal intensive care unit after chest physical therapy. Methods: a cross-sectional study evaluating 30 preterm neonates in three moments: Moment one (M1), before physical therapy, Moment two (M2), immediately after physical therapy, and Moment three (M3), 15 minutes after. Physiological alterations were considered as variations in heart rate (HR), respiratory rate (RR), peripheral oxygen saturation (SpO_2), and body temperature. The presence of pain was assessed by the scales neonatal infant pain scale and neonatal facial coding system. Results: A statistically significant increase occurred in HR in M2 when comparing the three moments, but with return to baseline values 15 minutes after physical therapy. Other physiological variables (RR, SpO_2, and temperature) and pain evaluation did not present significant alterations. Conclusion: physiological and behavioral parameters remained stable after chest physical therapy, with slight alterations immediately after the procedure, but with return to baseline values, indicating that physical therapy has not sharply altered vital signs and pain levels of neonates.

Keywords | Pain; Newborn; Premature; Respiratory Distress Syndrome; Physical Therapy Specialty.

RESUMO | Objetivo: avaliar a ocorrência de alterações fisiológicas adversas agudas e a presença de dor em recém-nascidos prematuros com síndrome do desconforto respiratório internados em uma unidade de terapia intensiva neonatal após a fisioterapia respiratória. Métodos: estudo transversal que avaliou 30 neonatos prematuros em três momentos, sendo eles Momento um (M1), antes da fisioterapia, Momento dois (M2), imediatamente após a fisioterapia, e Momento três (M3), 15 minutos após. Consideraram-se alterações fisiológicas as variações da frequência cardíaca (FC), da frequência respiratória (FR), da saturação periférica de oxigênio (SpO_2) e da temperatura corporal. A presença

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Finance source: none – Conflict of interest: nothing to declare – Presentation: 14/06/2018 – Accepted for publication: 28/09/2019 – Approved by the Ethics Committee on Human Beings: Opinion No. 1,113,757 (UFCSPA) and Opinion No. 1,070,198 (Santa Casa de Misericordia Hospital).

de dor foi avaliada pelas escalas *neonatal infant pain scale e neonatal facial coding system.* Resultados: houve aumento estatisticamente significativo na FC no M2 quando comparados os três momentos, porém com retorno aos valores basais 15 minutos após a fisioterapia. Outras variáveis fisiológicas (FR, SpO_2 e temperatura) e a avaliação da dor não apresentaram alterações significativas. Conclusão: parâmetros fisiológicos e comportamentais permaneceram estáveis após a realização da fisioterapia respiratória, com discretas alterações imediatamente após o procedimento, mas com retorno aos valores basais, indicando que a fisioterapia respiratória não alterou agudamente os sinais vitais e os níveis de dor dos neonatos.

Descritores | Dor; Recém-Nascido; Prematuro; Síndrome do Desconforto Respiratório; Modalidades de Fisioterapia.

RESUMEN | Objetivo: evaluar cambios fisiológicos adversos agudos y la presencia de dolor en bebés prematuros con síndrome de dificultad respiratoria internados en una unidad de cuidados intensivos neonatales después de fisioterapia respiratoria. Métodos: este fue un estudio transversal que evaluó a 30 recién nacidos prematuros en tres momentos: Momento Uno (M1), antes de la fisioterapia, Momento Dos (M2), inmediatamente después de la fisioterapia, y Momento Tres (M3), 15 minutos después. Los cambios fisiológicos incluyeron cambios en la frecuencia cardíaca (FC), en la frecuencia respiratoria (FR), en la saturación periférica de oxígeno (SpO_2) y en la temperatura corporal. La presencia de dolor se evaluó mediante la escalas *neonatal infant pain scale y neonatal facial coding system*. Resultados: hubo un aumento estadísticamente significativo en la FC en el M2, pero con retorno al valor inicial 15 minutos después de la fisioterapia. Otras variables fisiológicas (FR, SpO_2 y temperatura) y la evaluación del dolor no presentaron cambios significativos. Conclusión: los parámetros fisiológicos y de comportamiento se mantuvieron estables después de la fisioterapia respiratoria, con ligeros cambios inmediatamente después del procedimiento, pero con retorno a los valores basales, lo que indica que la fisioterapia respiratoria no alteró de manera aguda los signos vitales y los niveles de dolor en los recién nacidos.

Palabras clave | Dolor; Recién Nacido; Prematuro; Síndrome de Dificultad Respiratoria; Modalidades de Fisioterapia.

INTRODUCTION

Respiratory distress syndrome (RDS) is characterized by deficiency in the production of pulmonary surfactant and consequent respiratory insufficiency[1-4]. The pathophysiology of the disease is directly associated with the immaturity of the respiratory system in preterm newborns (PTNB), due to insufficient production of pulmonary surfactant at birth[5,6]. RDS normally reaches newborns (NB) with a gestational age of less than 35 weeks[7], being considered the main cause of mortality in PTNB, leading to death about 50% of those who receive the clinical diagnosis[2,8]. Morbidity is also high, because about 30% of survivors develop chronic hypoxemia, remaining dependent on oxygen therapy after the 36th week of life[9-12].

Several therapies are routinely adopted in the treatment of RDS, such as ventilatory support with positive pressure, oxygen therapy to improve the oxygen supply to the tissues, (prophylactic or therapeutic) replacement of pulmonary surfactant, and nitric oxide inhalation, to improve oxygenation and reduce inflammation[3,6,7,13-16]. Chest physical therapy has also been used as adjuvant therapy in neonates with RDS, especially under mechanical ventilation, which still has inconclusive effects[17]. Additionally, the application of physical therapeutic techniques may be related to the emergence of pain, alterations in the physiological variables of premature NB and to a high risk of hypoxemia, even if transient, or even from neurological and cerebral damage[17, 20-22].

Although the inconsistency of the findings in the literature makes it difficult to clearly indicate physical therapeutic procedures in this context[23], chest physical therapy is commonly integrated with clinical management in preterm infants admitted to neonatal intensive care units (ICU) as a prevention therapy for pulmonary complications[21,24].

The clinical management of newborns with RDS is also associated with long periods of hospitalization, during which they suffer, daily, around 5 to 15 clinical, surgical or therapeutic procedures that cause great stress and are the potential cause of the pain[25,26]. In clinical practice, the presence of pain and behavioral indicators of pain has been routinely evaluated in the ICU, with the objective of verifying more accurately its occurrence, including after the procedures of chest physical therapy[27].

Few studies have evaluated the acute effect of chest physical therapy procedures as well as the influence of pain on the stability and clinical evolution of newborns with RDS. We hypothesize that chest physical therapy is not associated with acute adverse effects or increased pain levels in neonates. Thus, the aim of this study was to evaluate the occurrence of acute adverse physiological alterations and the presence of pain in preterm NB with RDS admitted to a neonatal ICU after chest physical therapy.

METHODOLOGY

This cross-sectional analytical study was developed at the neonatal ICU in Maternity Mário Totta, at Santa Casa de Misericordia Hospital Complex of Porto Alegre.

Preterm neonates with a confirmed clinical diagnosis of RDS, with prescription of chest physical therapy, admitted to the ICU were included. All parents or guardians of the sample components were invited to participate in this study and granted their consent by signing the informed consent form, as required by resolution CNS No. 466/2012.

We excluded NB with congenital malformations, who were using invasive (IMV) or non-invasive (NIMV) mechanical ventilation, thoracic drains, with surgical incision, with diagnosis of pulmonary hypertension, grade III or IV intracranial hemorrhage, with cardiac malformation or with any type of central nervous system injury.

After inclusion of the patients in the study, demographic and clinical information were collected, such as the use of analgesia, use of surfactants, previous use of invasive and/or non-invasive ventilatory support, gestational age (weeks), current age (months), birth weight (g), length at birth (cm), sex and ethnicity. The following parameters were considered as acute physiological alterations: heart rate (beats per minute), respiratory rate (respiratory incursions per minute), peripheral oxygen saturation (% SpO_2) and temperature (°C). The parameters were evaluated at the bedside, before the routine physical therapeutic protocol performed by local professionals (Moment one – M1), immediately after the end (Moment two – M2), and 15 minutes after the end of the service (Moment three – M3).

Heart rate (HR) and SpO_2 were obtained using a transcutaneous monitor (Marquette Hellige Medical Systems Eagle 1000®). The respiratory rate (RR) was measured with the aid of a stopwatch (TIMEX®), followed by quantification of the thoracic-abdominal movements for 60 seconds, repeated twice. Temperature (T) was measured with an axillary digital thermometer (TechLine®). In the three aforementioned moments, the presence of (intercostal, subcostal and suprasternal) retractions and nose wing beat were inspected, being classified as absent (A) or present (P).

The presence of pain was measured at the bedside, in the aforementioned moments, through the application of two scales, validated and translated into Portuguese: the neonatal Infant Pain Scale (Nips)[25,26], consisting of six parameters (facial expression, cry, breathing pattern, arm movement, leg movements, and alertness level), whose scores ranged from zero to seven, considering the presence of pain when the sum of the scale was equal to or greater than four points. The scale neonatal facial coding system (NFCS)[28,29], in turn, verified the presence of acute pain by observing the facial expressions of NB, from seven facial movements, considering the presence of pain when three or more facial movements were detected in a consistent manner.

All assessments occurred in the morning shift, performed by students of the physical therapy course (AB Tavares, L Treichel and CC Ling), trained to verify the physiological and behavioral parameters and to apply the pain scales. The session attendance protocol was always performed by the same physical therapist, who was trained to execute it: the patient was positioned in the right and left lateral decubitus for the application of the thoracic vibration technique associated with passive manual expiratory therapy and then in dorsal decubitus for the application of the diaphragmatic stimulation technique. When necessary, after mobilizations, the upper airway secretions were aspirated. At the end of the session, the NB was positioned appropriately in the bed. The average duration of the care protocol was 15 minutes.

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 20.0. Data normality was verified by the Shapiro-Wilk test, and data were presented as mean and standard deviation for scalar data, percentage frequency for categorical data of sample description, and absolute percentage and frequency (n). Cochran's Q test was applied to analyze the effect of the intervention on the inspected parameters. Physiological data and pain scales were tested by repeated measures variance analysis with *post-hoc* by Bonferroni and

McNemar's test, respectively. The significance level used was 5% for all variables.

RESULTS

The sample consisted of 30 patients, 26 (86.7%) of whom were Caucasian. Regarding clinical characteristics, only 3 patients (10%) had received some analgesia until the time of evaluation, but not among the analyses performed. All NB received one or more doses of pulmonary surfactant, prophylactic or therapeutic, until the beginning of data collection, but did not receive any during the application of this protocol. Table 1 shows the use of IMV and/or VMNI as well as other patient characteristics.

Table 1. Characterization of patients included in the sample

Variables	n=30
Male sex n (%)	15 (50)
Duration of IMV (days)	28 (93.3)
Duration of NIMV (days)	27 (90)
Gestational age (weeks)*	30.2±3
Current age (months)*	1.5±0.9
Length at birth (cm)*	36.2±3.3
Birth weight (g)**	990.5 (790.5–1365)

* Data presented on average±standard deviation; ** Data presented as median (P25–P75); n: number of patients; IMV: invasive mechanical ventilation; NIMV: noninvasive mechanical ventilation; cm: centimeters; g: grams.

Regarding the evaluation of physiological parameters, physical therapy caused an increase in HR immediately after the protocol, but with return to baseline values after 15 minutes. Thus, despite the acute increase in stress caused by the protocol, there was a return to the basal state of NB (Table 2).

Table 2. Physiological parameters in the three evaluated moments

	M1	M2	M3	p
RR (ripm)	54.27±9.01	56.10±12.43	54.37±10.13	0.374
SpO_2 (%)	97.73±2.45	98.27±1.8	97.53±2.9	0.212
T (°C)	36.46±0.87	36.55±0.29	36.55±0.3	0.627
HR (bpm)	151±16.49	156.57±19.16	150.07±17.78	0.006

Data presented as mean±standard deviation; M1: Moment one; M2: Moment two; M3: Moment three; RR: Respiratory rate; SpO_2: peripheral saturation of O_2; T: Temperature; HR: heart rate; ripm: respiratory incursions per minute; bpm: beats per minute.

No significant alterations were found in RR, body temperature and SpO_2, nor immediately 15 minutes after the chest physical therapy protocol, indicating they were not associated with stress or destabilization of NB (Table 2).

As to the signs of respiratory distress through inspection, the presence of retractions and nose wing beat was higher in M2 than in the baseline (M1), although without statistical significance. In M3, a reduction occurred in the presence of these findings, returning to baseline values (Table 3).

Table 3. Parameters inspected at the three evaluated moments

	M1	M2	M3	p M1×M2	p M1×M3
Intercostal retractions	70.0%	76.7%	66.7%	1.000	1.000
Subcostal retractions	76.7%	86.7%	80%	1.000	1.000
Suprasternal retractions	43.3%	60.0%	53.3%	0.453	0.453
Nose wing beat	3.3%	16.7%	3.3%	1.000	1.000
Pain (NIPS)	3.3%	10.0%	3.3%	0.500	1.000
Pain (NFCS)	3.3%	13.3%	0%	0.250	1.000

Data presented in percentage frequency (%) Refer to the presence of the symptom; M1 Moment one; M2 Moment two; M3 Moment three; NIPS: neonatal infant Pain Scale ; NFCS: neonatal facial coding system.

Regarding the pain observed by NIPS and NFCS scales in the three moments, we observed the presence of pain from M1 to M2 in both scales, although the results obtained were not statistically significant. However, in M3, pain was not observed by the scales in any NB (Table 3).

DISCUSSION

Our study showed an increase in HR immediately after the physical therapy protocol, but with return to baseline values in the rest period. The other physiological and behavioral parameters remained stable after chest

physical therapy, suggesting that the latter did not cause acute adverse physiological alterations or pain in preterm NB with RDS admitted to a neonatal ICU.

Chest physical therapy techniques may be related to the emergence of pain and acute alterations in the physiological variables of PTNB[17,19]. In our study, a statistically significant increase was found in HR in M2 immediately after physical therapy but returned to normal values 15 minutes after the physical therapy protocol. The increase in HR may be associated with greater effort and oxygen consumption during chest physical therapy. Antunes et al.[30] conducted a randomized clinical trial to evaluate the physiological parameters and the presence of pain in preterm infants in the post-extubation period. Two physical therapy techniques were compared, the NB being allocated to the conventional physical therapy group (n=20) or the expiratory flow acceleration group (n=20), each lasting around 15 minutes. The authors found significant increase in HR, which persisted for up to 30 minutes only in the group that performed conventional physical therapy, suggesting that the maneuver of expiratory flow acceleration was less stressful to the NB.

Fox et al.[17] also evaluated the physiological alterations associated with chest physical therapy, such as RR, arterial blood gas, respiratory mechanics and functional residual capacity, of 13 NB with respiratory failure in three moments: shortly after physical therapy (M1), which consisted of thoracic vibration maneuvers, followed by pulmonary aspiration; after hyperventilation (M2); and 2 hours after physical therapy (M3). They found significant reduction in mean oxygen partial pressure and elevation of RR, especially after aspiration of secretions (M1), while functional residual capacity, pulmonary compliance and partial pressure of carbon dioxide did not show relevant changes[17].

In relation to RR, although we did not find statistical significance, there was a slight elevation of the values in M2, with return to initial values after 15 minutes. The behavior was similar for the SpO_2 and for body temperature. The return of the parameters to baseline-similar values suggests that the physical therapy protocol did not cause stress or respiratory failure in NB.

Similarly, a study conducted with 44 NB with RDS analyzed the hemodynamic variables before (2min) and after (5min) the physical therapeutic care and presented favorable results. The association of chest physical therapy and mobilization techniques proved to be effective in decreasing HR, systolic blood pressure and mean arterial pressure, but without significant effect on RR, SpO_2 and body temperature[31]. In our study, the SpO_2 and the body temperature of the neonates studied also did not present significant acute alterations after physical therapy at any time evaluated. Possibly, this was due to the fact that the sample consisted of clinically stable NB.

After verifying the presence of pain, we noticed that the score on the scales used was greater shortly after the end of the session (M2) in relation to the M1 and normalized to baseline values at the time of the last evaluation (M3), although without any statistical significance. Similarly, the presence of retractions and nose wings were present in a larger number of patients in M2, showing the acute stress produced immediately after physical therapy, but with improvement after the rest period.

In this study, only a small portion of the NB felt pain; however, it is necessary to emphasize that, although most of the patients in the sample did not score enough to corroborate the presence of pain in any of the scales, several signs of discomfort were present in the three phases analyzed, in greater or lesser quantity. Therefore, although no statistically significant variations indicated the presence of pain were found, we observed, in this study, that the physiological and behavioral parameters were influenced, to a lesser or greater degree, by physical therapeutic procedures. However, the return to the state prior to care indicates that chest physical therapy did not sharply increase the pain levels of neonates, providing them with further relief from discomfort.

As limitations of this study, we highlight the lack of a control group to confirm whether the findings were actually associated with the physical therapy protocol adopted, since the PTNB are very hemodynamically unstable and can remain in IMV and/or NIMV by prolonged time. Additionally, only NB with medical prescription of physical therapy were included in the analysis, which could be interpreted as a selection bias. However, all analyses were adequate to the design of the proposed study.

CONCLUSION

There was an increase in HR immediately after the chest physical therapy protocol, but with a return to baseline values 15 minutes after treatment. The other physiological and behavioral parameters remained stable after physical therapy, suggesting that the procedure did not adversely affect vital signs and pain levels in preterm NB with RDS admitted to a neonatal ICU. The production of randomized clinical trials with evaluation of physiological parameters and the effects of chest physical therapy on this population are still essential in order to contribute and improve the management of these preterm infants in the ICU.

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