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Maintenance of behavioral status for the initiation of oral feeding in preterm infants with bronchopulmonary dysplasia

Manutenção do estado comportamental para início da alimentação oral de prematuro com displasia broncopulmonar

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ABSTRACT

Purpose: To characterize the level of consciousness and maintenance of alertness in very low birth weight premature newborns with and without bronchopulmonary dysplasia during the assessment of readiness for oral feeding. **Methods:** This observational, analytical, cross-sectional study collected data from the medical records of preterm newborns with gestational age at birth < 30 weeks and birth weight < 1500 g, with and without a diagnosis of bronchopulmonary dysplasia. The variables collected were date of birth, Apgar, weight and gestational age at birth, medical diagnosis(es), corrected gestational age, current weight, and data from the Preterm Oral Feeding Readiness Scale. Descriptive and inferential statistics were used for data analysis, with descriptions of measures of central tendency and dispersion with absolute and relative values. **Results:** The groups with and without bronchopulmonary dysplasia differed significantly regarding 1-minute Apgar, gestational age, birth weight, weight at evaluation, and maintenance of alertness. Moreover, the study group had a higher corrected gestational age than the control group. **Conclusion:** Preterm newborns diagnosed with bronchopulmonary dysplasia had a higher frequency of alertness at the beginning of the evaluation and its maintenance at the end of the assessment compared with the control group, which may be associated with the fact that the group with bronchopulmonary dysplasia had a higher corrected gestational age.

Keywords: Premature newborn; Infant, very low birth weight; Bronchopulmonary dysplasia; State of consciousness; Feeding behavior; Sucking behavior

RESUMO

Objetivo: caracterizar o estado de consciência e manutenção do estado de alerta entre os recém-nascidos prematuros de muito baixo peso com e sem displasia broncopulmonar, durante a avaliação da prontidão para alimentação por via oral. **Métodos:** estudo observacional, analítico e transversal com base na coleta de dados nos prontuários de recém-nascidos prematuros com idade gestacional ao nascer inferior a 30 semanas e peso abaixo de 1500 gramas, com e sem o diagnóstico de displasia broncopulmonar. As variáveis coletadas foram: data de nascimento, Índice de Apgar, peso e idade gestacional ao nascer, diagnóstico(s) médico(s), idade gestacional corrigida e peso atual, assim como os dados do Instrumento de Avaliação da Prontidão do Prematuro para Início da Alimentação Oral. Para análise dos dados, foi utilizada estatística descritiva e inferencial, com descrição das medidas de tendência central e dispersão com valores absolutos e relativos. **Resultados:** verificou-se diferença entre os grupos com e sem displasia broncopulmonar, no que se refere às seguintes variáveis: Índice de Apgar no primeiro minuto, idade gestacional, peso ao nascimento e na avaliação e manutenção do estado de alerta. Observou-se ainda que o grupo experimental apresentou idade gestacional corrigida maior em comparação ao grupo-controle. **Conclusão:** os recém-nascidos pré-termo com diagnóstico de displasia broncopulmonar apresentaram frequência maior de estado de consciência no início da avaliação, assim como na manutenção do estado de alerta ao final do manuseio, quando comparados ao grupo-controle, o que pode estar associado ao fato de o grupo com displasia apresentar idade gestacional corrigida maior.

Palavras-chave: Recém-nascido prematuro; Recém-nascido de muito baixo peso; Displasia broncopulmonar; Estado de consciência; Comportamento alimentar; Comportamento de sucção

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INTRODUCTION

The World Health Organization (WHO) defines prematurity as births that occur before completing 37 weeks of gestation[1], classifying them into three categories based on gestational age (GA): extreme prematurity (< 28 weeks), severe prematurity (28 to < 32 weeks), and moderate to late prematurity (32 to < 37 weeks)[1]. Birth weight is another way to classify newborns (NB): extremely low birth weight (< 1000 g), very low birth weight (< 1500 g), and low birth weight (< 2500 g)[2].

With the evolution of technology and perinatal care in the last two decades, the survival rate of very low birth weight NBs is increasingly higher. However, morbidities related to prematurity continue to be a major concern for neonatology[3].

Brazil recorded a reduction in the prematurity rate from 2012 to 2019, going from 10.87% to 9.95%. Nonetheless, this group requires more meticulous attention, given NBs' inversely proportional relationship between their GA, birth weight, and the risk of vulnerability[2,4].

The lower the GA and birth weight, the greater the chances of the NB having developmental complications. The most prevalent morbidities among extremely low birth weight NBs include respiratory problems[5], with bronchopulmonary dysplasia (BPD) being one of the main outcomes of prematurity[6].

BPD is characterized as a chronic lung disease, resulting from multiple factors that affect the preterm NBs' immaturity, mainly of their lungs. This condition results in reduced lung development, affecting both the airways and the pulmonary vessels, which, in turn, restricts respiratory capacity to varying degrees[7,8].

A study[9] documented that BPD global occurrence rates vary widely, ranging from 10% to 89%. These variations were observed in different regions of the world, including rates of 10% to 73% in Europe, 18% to 89% in North America, 18% to 82% in Asia, and 30% to 62% in Oceania.

Studies indicate that BPD can pose challenges that go beyond pulmonary issues, impacting NBs in several ways. One study, for instance, revealed that BPD is associated with delays in neuropsychomotor development during the first year of life[10]. In addition, it can result in a prolonged transition to oral feeding and passivity regarding feeding incidents, including difficulties coordinating sucking, swallowing, and breathing. Another aspect observed was a reduced state of consciousness[11].

The latter can be classified as alert, light sleep, and deep sleep, playing a significant role in oral feeding[12,13]. Thus, it is essential to be attentive to the state of alertness during stimulation, not as a new recommendation, but as a reinforcement of its importance already recognized in clinical practice. NBs' state of alertness can favor more effective breastfeeding[14].

This justifies the need for this research, whose purpose is to support the clinical work of speech-language-hearing pathologists in identifying the babies' signs of maturity and readiness to start oral feeding. Thus, we sought to understand how babies' behavioral state during breastfeeding can interfere with their ability to feed orally. It was hypothesized that premature infants who developed BPD may face challenges in maintaining alertness during breastfeeding.

Therefore, this study aimed to characterize the state of consciousness and maintenance of alertness among very low birth weight premature NBs with and without BPD, during the assessment of readiness for oral feeding.

METHODS

This is an observational, analytical, cross-sectional study, conducted in the neonatal intensive care unit (NICU) of the Januário Cicco Maternity School of the Federal University of Rio Grande do Norte (MEJEC/-UFRN), Natal, Brazil, between 2020 and 2021. The research was approved by UFRN's Research Ethics Committee (CEP/UFRN) under approval number 3,311,874, and the parents/guardians authorized their children's participation by signing an informed consent form, in accordance with Resolution 466/2012, which establishes the guidelines and standards that regulate human research.

The variables were collected from electronic medical records of preterm NBs of both sexes with GA at birth of less than 30 weeks and weight below 1500 grams, with and without a diagnosis of BPD. The following data were selected: date of birth, Apgar score, birth weight, GA, medical diagnosis(es), corrected GA, current weight, and data from the Preterm Oral Feeding Readiness Scale (POFRAS)[12] with analysis of the state of consciousness (alert, light sleep, or deep sleep) and maintenance of alertness (yes and no/partially).

The eligible sample for participation in the study was stratified into a study group (SG) and a control group (CG). The SG inclusion criteria were as follows: being born with a GA of less than 30 weeks and a birth weight of less than 1500 grams; being diagnosed with BPD; having a medical and speech-language-hearing prescription to initiate oral feeding. Preterm infants with neurological involvement, syndromes, and craniofacial anomalies were excluded. The CG criteria were being born preterm (with a GA at birth of less than 30 weeks and a weight below 1500 grams), without a diagnosis of BPD, having clinical stability, and having a medical and speech-language-hearing prescription to initiate oral feeding. For every infant in the SG, a CG participant was selected from the entire eligible sample with the variables that most closely resembled the SG, considering similar GA and birth weight.

The POFRAS was performed when preterm NBs achieved clinical stability and medical clearance to begin oral feeding, which occurred around 30 weeks of corrected GA in this study. The assessment took place approximately 30 to 15 minutes before feeding time, with the NB preferably alert. Clinical stability refers to the absence of need for invasive mechanical ventilation, minimal or no supplemental oxygen, and heart rate and blood pressure maintained within normal ranges.

They were assessed with non-nutritive sucking, which, along with other aspects such as GA and behavioral state, can indicate maturity for the transition to oral feeding[15]. The speech-language-hearing pathologist positioned the preterm NB in lateral decubitus inside the incubator and, with a gloved little finger introduced into the preterm NB's oral cavity, observed and noted their first signs of sucking and state of consciousness. After observing all points of the instrument, which took approximately 2 minutes, the NB's state of consciousness was rechecked and noted.

The assessment was interrupted upon any sign of an incident or discomfort by the child, such as a drop in saturation, an increase in respiratory rate, or inconsolable crying.

They were assessed by two speech-language-hearing pathologists from the institution with prior experience in applying the research instruments and following the institutional guidelines[15].

Data analysis

Data analysis used descriptive and inferential statistics, describing measures of central tendency and dispersion with absolute and relative values. The data were tabulated in an Excel® spreadsheet, and the Statistical Package for the Social Sciences (SPSS), version 20.0, was used for statistical analysis. The Kolmogorov-Smirnov test was used to verify the normal distribution among the variables, and then Pearson's chi-square test was used to compare categorical variables between groups. Student's t-test and the Mann-Whitney test were used for quantitative variables, depending on the normal distribution, based on a significance level of $p < 0.05$.

RESULTS

The sample had 48 preterm NBs (24 in SG and 24 in CG). In the assessment of readiness for oral feeding, they had a corrected GA between 30 and 37 weeks. The research participants were characterized according to sex, 1 and 5-minute Apgar scores, and age and weight at birth and at the assessment. The groups with and without BPD differed in 1-minute Apgar scores, as well as GA and weight at birth and at the assessment. The data are presented in Table 1.

When cleared to start oral feeding, preterm NBs with BPD differed ($p = <0.001$) in corrected GA from those without BPD, being higher than the latter. The maintenance of alertness after the POFRAS assessment also differed between them ($p = 0.039$); preterm NBs with BPD had greater maintenance than those without BPD. The POFRAS assessment results are presented in Table 2.

DISCUSSION

The assessment of the state of consciousness found a higher percentage of alertness and its maintenance in NBs with BPD. These findings could be justified by the NICU's hyper-stimulating environment. Several studies show that a super-stimulating environment can negatively influence NBs' development, interrupting the regulation of the baby's physiological and behavioral states[16-18]. Other factors can also affect the baby's sensory systems, such as physical and emotional separation from parents and interrupted sleep patterns[19].

The higher corrected GA of newborns with BPD than of the CG may have also influenced the difference in maintenance of alertness. Preterm NBs are only released for assessment of feeding readiness when clinically stable and with sufficient indicators of maturity for it. Hence, those with BPD have several respiratory manifestations that can delay their development and release for oral feeding[10]. The findings of the present research confirm those of other studies[11,20] that found similar results with corrected GA of 35 to 36 weeks in the assessment of feeding readiness of preterm infants with BPD.

The various manifestations of preterm infants with BPD, such as low birth weight, low GA, and mechanical ventilation, can lead to prolonged NICU stays, suggesting that a longer stay in intensive care may lead to more frequent behavioral changes[21]. A study that investigated the influence of behavioral state on the sucking patterns of preterm NBs concluded that the stimulation of non-nutritive sucking helped them maintain alertness, changing to a sleep state at the end of nutritive sucking[22]. This study's speech-language-hearing field advocates non-nutritive sucking stimulation at a time close to that of the unit's usual diet to favor the maturation of the functions of the oral sensorimotor system. Hence, the clinical routine may have led NBs with BPD to present greater reactivity at feeding time.

Due to its complexity and multiple consequences throughout the preterm NB's life, BPD requires multidisciplinary management and early interventions, with approaches focused on providing better quality of life for the patient and their family[21,23]. Thus, various professionals working in cooperation managed them, which may have helped to maintain their state of alertness during the assessment of readiness for oral feeding. Speech-language-hearing pathologists stand out among the professionals working

Table 1. Characterization of the sample at birth and during evaluation

Variables	Groups		p-value
	With BPD (n = 24)	Without BPD (n= 24)	
Sex n(%)			
Males	15 (62.5)	12 (50.0)	0.383[PC]
Females	9 (37.5)	12 (50.0)	
At birth			
Gestational age (weeks)*	27 (IQR 26-28)	29 (IQR 28-30)	**0.001**[U]
Weight (grams)**	898.75 (±199.89)	1144.46 (±239.47)	**<0.001**[T]
APGAR 1*	5 (IQR 4-7)	7 (IQR 5-8)	**0.016**[U]
APGAR 5*	8 (IQR 7-9)	8.5 (IQR 8-9)	0.320[U]
During evaluation			
Corrected gestational age (weeks)*	35 (IQR 33.2-36.7)	32 (IQR 31-32.7)	**<0.001**[U]
Weight (grams)*	1446.50 (IQR 1325.25-1842.50)	1315.00 (IQR 1195.00-1438.00)	**0.017**[U]

*Values shown in median and interquartile range; **Values shown in mean and standard deviation; [PC] Pearson's chi-square test; [U] Mann-Whitney test; [T] Student's t-test
Caption: n(%) = absolute and relative values; BPD = bronchopulmonary dysplasia; IQR = interquartile range ($Q_1 - Q_3$)
Source: Research data

Table 2. Variables related to the assessment of the Preterm Oral Feeding Readiness Scale

Variables	With BPD (N = 24)	Without BPD (N = 24)	p-value
Corrected gestational age n(%)			
Less than or equal to 32	3 (12.5)	11 (45.8)	
Between 32 and 34	4 (16.7)	11 (45.8)	**<0.001**[PC]
34 or more	17 (70.8)	2 (8.3)	
Behavioral state n(%)			
Light sleep	4 (16.7)	8 (33.3)	0.182[PC]
Alert	20 (83.3)	16 (66.7)	
Maintenance of the alert state n(%)			
Yes	13 (54.2)	6 (25.0)	**0.039**[PC]
No	11 (45.8)	18 (75.0)	

[PC] Pearson's chi-square
Caption: n(%) = absolute and relative values; BPD = bronchopulmonary dysplasia
Source: Research data

in the NICU regarding aspects such as stimulating preterm NBs for oral feeding, promoting breastfeeding, and training to improve oral skills (e.g., coordination between sucking/swallowing/breathing and adequacy of oral functions) to enable their timely progress and hospital discharge[24].

This study also found that the group diagnosed with BPD had more male preterm NBs, confirming the findings in the literature, which show a higher rate of BPD diagnosis in male babies[25,26].

The GA, 1-minute Apgar score, and weight at birth of preterm NBs with BPD were lower than those of the CG, with differences between the groups. These findings reinforce the data found in other studies, in which BPD is often associated with perinatal factors, such as extreme and severe prematurity, low 1-minute Apgar scores, and low birth weight. They are considered risk factors for delayed neuropsychomotor development in the first year of life[10,21,25,26] and behavioral impairment[27].

The few NBs with BPD in the study proved to be a limitation. Therefore, further studies should include a larger study group to confirm the present findings. Studies with the population in question draw attention to the need for constant and effective public actions for prenatal care, NICU care, and post-hospital discharge follow-up to minimize disorders and sequelae resulting from BPD.

CONCLUSION

Preterm NBs diagnosed with BPD had a higher frequency of awareness at the beginning of the assessment and maintained alertness at the end of management than the CG. This may be because the group with BPD had a higher corrected GA, which favors better oral motor behavior and a greater ability to maintain alertness.

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