ORIGINAL ARTICLE

Impact of type of delivery on thoracoabdominal mobility of newborns

Open acess

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Abstract

Introduction: In newborns delivered by cesarean section, there is less chest compression and little amount of fluid is drained by gravity, which temporarily reduces thoracoabdominal mobility.

Objetive: The objective of this study is to evaluate the impact of the type of delivery on newborns Thoracoabdominal Mobility.

Methods: This is a cross-sectional study with newborns of gestational age between 37 and 41 weeks, of both sexes, with up to 72 hours of life, breathing in ambient air and born by normal delivery or cesarean section. The Thoracoabdominal Mobility was evaluated by videogrammetry using MATLAB Software and considered, in metric units (cm2), as the difference between the highest and lowest thoracoabdominal expansibility for each respiratory cycle.

Results: Twenty-six infants were included, 11 were male and 50% were born by cesarean section. The mean gestational age was 39 ± 0,9 and 28 ± 18 hours of life. The mobility, difference between greater and lesser expansion, of the thoracic area in vaginal and cesarean delivery was 6 ± 3 cm2 and 7 ± 5 cm2 and the abdominal area was 29 ± 22 cm2 and 21 ± 14 cm2, respectively. This difference was not statistically significant between the two types of delivery for the thoracic area, but was statistically different for the abdominal area (p= 0.01). And the higher the respiratory rate, the lower the abdominal mobility (r= -0.57, p= 0.02).

Conclusion: The data indicate that the type of delivery seems to influence abdominal mobility and respiratory rate. In the studied sample, newborns with cesarean section presented lower abdominal mobility.

Keywords: respiratory mechanics, photogrammetry, newborn, labor obstetric.

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INTRODUCTION

To sustain life, at birth the lungs undergo a rapid transition from an organ filled with fluid unable to perform sufficient exchange for an air-filled organ that is capable of performing all gas exchange[1].

However, several mechanisms work together to reduce and eliminate the amount of pulmonary fluid. In this transition, most of the fluid is eliminated through the upper airways and oral cavity, and the remainder through the process of labor and passage through the vaginal canal. The residual fluid, which is in the lungs, is absorbed through the pulmonary capillaries[2].

In the cesarean birth newborns, there is less thoracic compression and little fluid is drained by gravity, thus maintaining large volumes of fluid, interstitial and alveolar, in the first hours of life, transiently decreasing thoracoabdominal mobility[3].

It is estimated that the non-absorption of this fluid during cesarean delivery can lead to respiratory discomfort and cause a change in thoracoabdominal mobility, with increased energy expenditure and progressive clinical worsening. However, many of these studies are limited to retrospective data, which may compromise the assessment of progression of discomfort and respiratory mobility[4-6].

In a newborn with respiratory distress, alteration of thoracoabdominal mobility is a commonly perceived finding[7]. Often, this respiratory discomfort is evaluated through the number of respiratory incursions and the quality of thoracic expandability, the lower the thoracoabdominal mobility and the greater the respiratory rate, the worse the clinical condition of the newborn[5,7]. However, in clinical practice, noninvasive methods capable of quantifying respiratory evolution are preferable and also more reliable when compared to the subjective evaluation of the quality of thoracic expandability[8-10].

Considering that cesarean delivery can be a difficult factor in the respiratory evolution of newborns and that thoracoabdominal mobility is directly related to the clinical condition of the newborn, the present study aims to evaluate the impact of the type of delivery on the thoracic and abdominal mobility in newborns (NBs).

METHODS

This is a cross-sectional, pragmatic study aimed at evaluating the influence of the type of delivery on the thoracoabdominal mobility of term newborns. The research was made in a University Hospital and approved by the Ethics and Research Comittee of the Faculdade de Ciências da Saúde do Trairi of the Universidade Federal do Rio Grande do Norte (FACISA/UFRN) - nº 851.215, following the norms that regulate the research in humans contained in the resolution 466/2012 of the National Health Council.

The recruitment of the sample was non-probabilistic and for convenience conducted between January and November 2015, from the admissions of the Hospital Universitário Ana Bezerra (Santa Cruz – RN).

The sample consisted of newborns with gestational age between 37 and 41 weeks, of both sexes, with up to 72 hours of life. All were breathing in ambient air and were in the inactive alert stage (stage 4 of the Brazelton scale). Newborns with congenital malformation, genetic syndrome, heart failure, respiratory diseases or who had been fed in less than 30 minutes were not included in the study, being excluded from the analysis of the videos those that evolved to stage 5 or 6 of the Brazelton scale, during the evaluation.

Procedures for Data Collection

Data collection was performed in the bath room, with the newborns on a fixed bench, with a distance of 120 cm from the floor, routinely used for general care of the newborn. In order to capture the videos, the methodology adapted from the study by Ricieri and Rosário Filho8, presented in the study by Oliveira *et al.*[10], Gomes *et al.*[11] and Guerra *et al.*[12] was used. The newborns were placed supine on a support bed with the surface coated with a black, hypoallergenic and disposable EVA sheet of approximately 50 cm in length and 0.2 mm in thickness. (Figure 1). After positioning, adhesive markers were allocated to the following points: (1) anterior-superior iliac spines; (2) the level of the anterior axillary line and (3) the xiphoid process displaced laterally. These references served as an anchor for the geometric delimitation of the thoracic and abdominal compartment in the images acquired during the videogram, as shown in Figure 1.

Acquisition of Videos

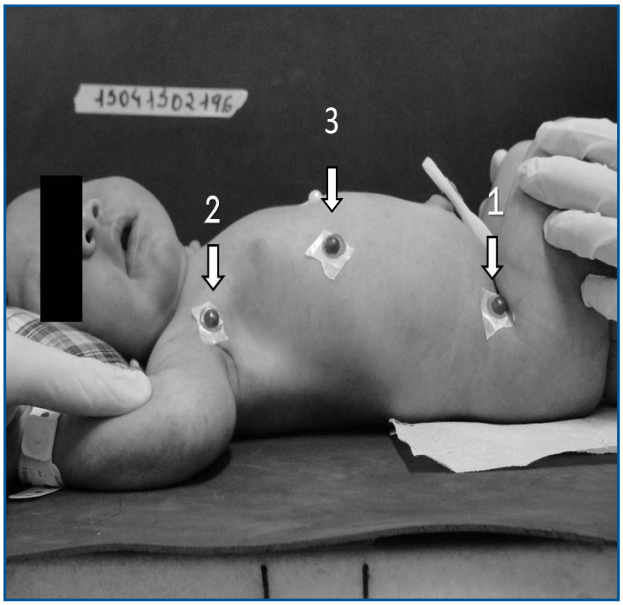

Figure 1: Positioning of the newborn during the experiment, allocation of the adhesive markers and delimitation of the thoracic and abdominal compartment at the time of the analysis of the images, Santa Cruz, Rio Grande do Norte, Brazil, 2016.

Source: Authors

To capture the videos, the digital camera (Sony Cyber-shot DSC-H20® 10.1 Megapixels), fixed by a tripod with height of 120 cm and positioned within a distance of 30 cm of the newborn was used. After adjusting the markers, the newborn was filmed for 120 seconds. The capture time of 120 seconds was determined to guarantee analysis of the respiratory cycle in 1 minute, since the newborns have frequent pauses in respiration.

Interpretation of Videos

The videos were treated by the MATLAB Software and the mobility was considered in metric units (cm^2), as the difference of the greater and lesser expansibility to the thoracic and abdominal area[10].

Data Analysis

Statistical data were analyzed in the SPSS 20 program. For the normality test, the Shapiro-wilk, t-student test was used to evaluate the means of thoracoabdominal mobility between the two types of delivery and the Spearman rank correlation test, for to evaluate the correlation of birth rates with the individual characteristics of the newborns; significance to the results for $p<0.05$.

RESULTS

Of the 26 newborns included, 18 were male and 50% were born cesarean. The descriptive data of the sample and the homogeneity between the groups are shown in Table 1. In this analysis only the respiratory rate was different between the groups ($p = 0.03$). Newborns undergoing cesarean delivery had a higher respiratory rate when compared to normal delivery (Table 1).

The mobility, difference between the greatest and lowest expansibility, of the thoracic area in vaginal and cesarean deliveries was 6 ± 3 cm2 and 7 ± 5 cm2 and the abdominal area was 29 ± 22 cm2 and 21 ± 14 cm2, respectively. This difference was not statistically significant between the two types of delivery for the thoracic area, but was statistically different for the abdominal area ($p = 0.01$). Figure 2 presents this analysis.

The correlation of mobility with birth weight, Apgar scores, length, respiratory rate and hours of life did not present significant difference, except for abdominal mobility with respiratory rate. In this analysis it was verified that, the higher the respiratory rate, the lower the abdominal mobility. Table 2 presents this result.

The data indicate that the type of delivery seems to

Table 1: Characteristics of the population studied (n=26), Santa Cruz, Rio Grande do Norte, Brazil, 2016.

Variables	Birth type		
	Normal	Cesarean	p
NB (n)	13	13	-
Sex			
Male	7	11	0.15-(x^2)
Female	6	2	0.34 (x^2)
GA (wks)	39 ±0,62	39±1.04	0.32 (t)
Weight (grams)	3152±5.23	3369±5.20	0.16 (t)
Apgar 1 min	7±1.92	7±1.05	0.4 (t)
Apgar 5 min	8±1.05	9±0.55	0.69 (t)
CP (cm)	34±1.82	34±2.15	0.55 (t)
Len. (cm)	48±1.74	49±1.90	0.36 (t)
RF (ipm)	48±11.88	57±9.98	0.03*(t)
Hours of life	28±19	29±17	0.52 (t)

Legend: NB: new-born; n: number of individuals; GA: gestational age; wks: weeks; min: minutes; CP: Cephalic perimeter; cm: centimeters; Len.: Length; RF: Respiratory Frequency; ipm: incursions per minute; *p<0.05; p: probability of significance used t-student (t) and chi-square tests (x2).

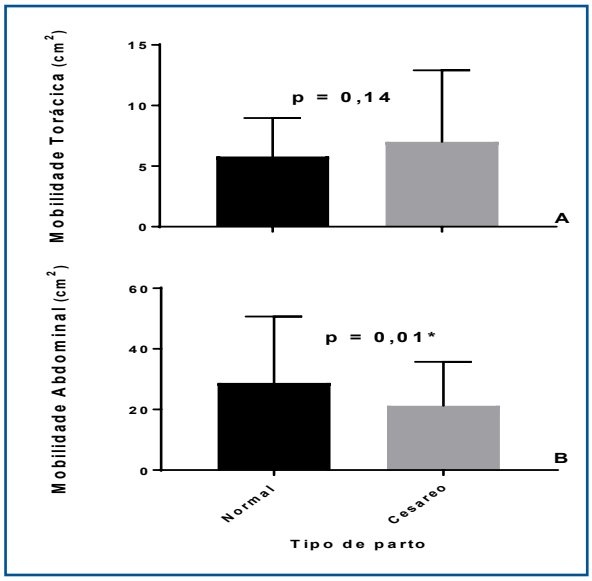

Figure 2: Graphical representation of the values of Thoracic Mobility (A) and Abdominal Mobility (B) for vaginal (normal) and cesarean delivery of the 26 newborns studied. p <0.05 = statistical significance factor. Santa Cruz, Rio Grande do Norte, Brazil, 2016.

Table 2: Correlations between thoracoabdominal mobility and the variables studied in the 26 newborns.

Variables of the 26 infants studied	Mobility Thoracic		Mobility Abdominal	
	r	p	r	p
Weight	0.21	0.29	0.08	0.69
Length	0.88	0.67	0.23	0.25
Apgar 1st minute	0.47	0.81	0.33	0.09
Apgar 5st minute	-0.03	0.98	0.15	0.44
Respiratory Frequency	-0.85	0.67	-0.57	0.02*
Hours of Life	-0.24	0.23	-0.17	0.39

Legend: r: Pearson's correlation; p: probability of significance; *p<0.05. Correlation is significant when p≤0.05.

DISCUSSION

influence abdominal mobility and respiratory rate. In the sample studied, cesarean births presented lower abdominal mobility.

Studies investigating the types of cesarean deliveries and normal deliveries of second-line pregnant women demonstrate that cesarean delivery neonates more frequently required neonatal intensive care because they had a higher occurrence of transient tachypnea, non-specific respiratory dysfunction and sepsis[11-13]. A retrospective study, with more than 3,000 elective cesareans performed with a gestational age greater than or equal to 37 weeks, shows that cesarean delivery with elective progression, even in the full-term period, increases the risk of respiratory morbidity[13].

Infants born by cesarean delivery with elective progression had a higher prevalence of neonatal transient tachypnea when compared to newborns by cesarean section with spontaneous progression (12.3%), which may justify our results[14].

This study includes newborns coming from a school hospital that encourages cesarean delivery only with the pregnant woman already in spontaneous progression, an important peculiarity for interpretation of our results.

Two other studies[15,16] demonstrate, by retrospective models, that cesarean delivery is a complicate in the transition from the fetus to the extra uterine life in which it reflects the respiratory adaptation.

In our sample, although we presented a model algorithm (MATLAB) to quantify the thoracoabdominal mobility, we did not show this variation for the thoracic area. We believe that this result comes down to the parturition process pertinent to the hospital profile. In addition, our mean gestational age for cesarean delivery was 39 weeks, which allows for pulmonary maturation, since the condition of late cesarean delivery, performed at 39 weeks, decreases admissions of newborns due to respiratory complications[17].

Several other studies[15-18] have shown that the incidence of respiratory dysfunction is inversely proportional to gestational age. However, these researches have concluded their hypotheses, based on retroactive or subjective data, which may compromise their interpretation.

In our study we present a clear and objective model of evaluation of the thoracic and abdominal mobility in newborns. This method was previously used to infer respiratory mechanical behaviors of relevant clinical utility for respiratory physiotherapy[10-12], and in all the studies have presented numerical results on the variation of the movement of the thorax and the abdomen.

The method is objective and configured within a mathematical sequence in MATLAB software, which demonstrates objectivity and accuracy in the analysis of the results. It has been shown to be a useful resource in the evaluation of patients who do not voluntarily control the synergy of muscle work during respiration[12].

The use of photogrammetry for the analysis of respiratory movement allows establishing evidence related to thoracic and abdominal kinetics, this information can be used to infer respiratory mechanical behavior even in patients who do not voluntarily control respiration, as in newborns[8-12].

However, some limitations should be considered. We present a cross-sectional study without a group of cesarean deliveries with elective progression, absence of the thoracic perimeter and we lost 25% of our sample during the interpretation phase of the images. We would need to longitudinally follow a larger group of newborns with cesarean deliveries with elective progression (without the parturition process) and with gestational age different from those included in this study.

Although it is essential to the adaptations described as limitations in this study, the evaluation of the thoracic and abdominal mobility by MATLAB in the different types of delivery was effective in newborns. Demonstrating efficiency in the quantification of changes in respiratory mechanics, which can serve as an objective and practical tool for the use of the different professionals of a care team, besides being an evaluation method of low cost and easy applicability.

The data indicate that the type of delivery seems

CONCLUSION

to influence abdominal mobility. In the sample studied, cesarean births presented lower abdominal mobility.

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Resumo

Introdução: Nos recém-nascidos de parto cesáreo, ocorre menor compressão torácica e pouca quantidade de líquido é drenada por ação da gravidade, o que diminui, transitoriamente, a mobilidade toracoabdominal.

Objetivo: O objetivo do estudo é avaliar o impacto do tipo de parto na mobilidade torácica e abdominal em recém-nascidos.

Método: Trata-se de um estudo transversal com recém-nascidos de idade gestacional entre 37 a 41 semanas, de ambos os sexos, com até 72 horas de vida, respirando em ar ambiente e nascidos de parto normal ou parto cesáreo. A mobilidade torácica e abdominal foram avaliadas pela videogrametria por meio do Software MATLAB e considerada, em unidades métricas (cm2), como a diferença da maior e menor expansibilidade toracoabdominal para cada ciclo respiratório.

Resultados: Foram inclusos 26 recém-nascidos 11 do sexo masculino e 50% nascidos de parto cesáreo. A idade gestacional média foi de 39 ± 0,9 sem e tinham 28 ± 18 horas de vida. A mobilidade, diferença entre a maior e menor expansibilidade, da área torácica no parto vaginal e cesáreo foi 6 ± 3 cm2 e 7 ± 5 cm2 e da área abdominal foi de 29±22 cm2 e 21± 14 cm2, respectivamente. Esta diferença não foi estatisticamente significante entre os dois tipos de parto para a área torácica, mas mostrou-se diferente estatisticamente para a área abdominal (p = 0,01). E para os recém-nascidos de parto cesáreo, quanto maior a frequência respiratória, menor a mobilidade abdominal (r = -0,57; p = 0,02).

Conclusão: Os dados indicam que o tipo de parto parece influenciar a mobilidade abdominal e a frequência respiratória. Na amostra estudada os recém-nascidos de parto cesáreo apresentaram menor mobilidade abdominal.

Palavras-chave: mecânica respiratória, fotogrametria, recém-nascido, trabalho de parto.