



## ORIGINAL ARTICLE

# Cerebral blood flow assessment of preterm infants during respiratory therapy with the expiratory flow increase technique



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### KEYWORDS

Newborn;  
Preterm;  
Physical therapy modalities;  
Blood flow velocity;  
Transcranial Doppler ultrasonography

### Abstract

**Objective:** To assess the impact of respiratory therapy with the expiratory flow increase technique on cerebral hemodynamics of premature newborns.

**Methods:** This is an intervention study, which included 40 preterm infants ( $\leq 34$  weeks) aged 8–15 days of life, clinically stable in ambient air or oxygen catheter use. Children with heart defects, diagnosis of brain lesion and/or those using vasoactive drugs were excluded. Ultrasonographic assessments with transcranial Doppler flowmetry were performed before, during and after the increase in expiratory flow session, which lasted 5min. Cerebral blood flow velocity and resistance and pulsatility indices in the pericallosal artery were assessed.

**Results:** Respiratory physical therapy did not significantly alter flow velocity at the systolic peak ( $p=0.50$ ), the end diastolic flow velocity ( $p=0.17$ ), the mean flow velocity ( $p=0.07$ ), the resistance index ( $p=0.41$ ) and the pulsatility index ( $p=0.67$ ) over time.

**Conclusions:** The expiratory flow increase technique did not affect cerebral blood flow in clinically-stable preterm infants.

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**PALAVRAS-CHAVE**

Recém-nascido;  
 Prematuro;  
 Modalidades de  
 fisioterapia;  
 Velocidade do fluxo  
 sanguíneo;  
 Ultrassonografia  
 Doppler  
 transcraniana

## Avaliação do fluxo sanguíneo cerebral de recém-nascidos prematuros durante a fisioterapia respiratória com a técnica do aumento do fluxo expiratório

**Resumo**

**Objetivo:** Avaliar a repercussão da fisioterapia respiratória com a técnica de aumento do fluxo expiratório sobre a hemodinâmica cerebral de recém-nascidos prematuros.

**Métodos:** Estudo de intervenção no qual foram incluídos 40 neonatos prematuros ( $\leq 34$  semanas) com 8–15 dias de vida, clinicamente estáveis em ar ambiente ou em uso de cateter de oxigênio. Foram excluídas crianças com malformações cardíacas, diagnóstico de lesão cerebral e/ou em uso de drogas vasoativas. Exames de ultrassonografia com avaliação por dopplerfluxometria cerebral foram feitos antes, durante e depois da sessão de aumento do fluxo expiratório, que durou cinco minutos. Foram avaliadas as velocidades de fluxo sanguíneo cerebral e os índices de resistência e pulsatilidade na artéria pericalosa.

**Resultados:** A fisioterapia respiratória não alterou significativamente a velocidade de fluxo no pico sistólico ( $p=0,50$ ), a velocidade de fluxo diastólico final ( $p=0,17$ ), a velocidade média de fluxo ( $p=0,07$ ), o índice de resistência ( $p=0,41$ ) e o índice de pulsatilidade ( $p=0,67$ ) ao longo do tempo.

**Conclusões:** A manobra de aumento do fluxo expiratório não afetou o fluxo sanguíneo cerebral em recém-nascidos prematuros clinicamente estáveis.

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**Introduction**

The control of cerebral blood flow (CBF) involves complex neural and metabolic mechanisms, which are still immature in preterm newborns (PTNB).<sup>1</sup> Therefore, these children show a failure in the autoregulation of the CBF, which is directly dependent on blood pressure and has a pattern known as pressure passive. The immaturity of cerebral blood flow control occurs mainly in newborns with gestational age up to 34 weeks, when the germinal matrix begins to involute.<sup>2</sup> The subependymal matrix, which is located in the area adjacent to the lateral ventricles, is the site of proliferation of neuronal and glial cells,<sup>2,3</sup> and is highly vascularized by irregular vessels with few structural support on its walls.<sup>2,4</sup>

Due to clinical reasons, newborns in intensive care are more likely to have CBF fluctuations, which increases the risk of hemorrhagic and ischemic cerebrovascular lesions, such as peri-intraventricular hemorrhage (PIVH) and periventricular leukomalacia (PVL), respectively. These neurological diseases may cause permanent motor sequelae of varying degrees, depending on the lesion extent, as well as cognitive, behavioral and intellectual disorders.<sup>1,3-5</sup>

CBF alterations are commonly associated with upper airway obstruction, severe respiratory diseases, apnea, hypoxia, hypercapnia, hypocapnia, ventilation with intermittent positive pressure, asynchrony with the ventilator, tracheal aspiration and expansion of circulating volume, as well as care routine, such as diaper changing and repositioning of the endotracheal tube, excessive manipulation and agitated sleep.<sup>6-8</sup> As observed, the vast majority of situations that are known to cause significant alterations in CBF in preterm newborns is related to respiratory disorders resulting from pulmonary immaturity, leading to the need for increased hospital stay and ventilatory support and,

consequently, increased risk of complications associated with mechanical ventilation and increased morbidity and mortality.

In this context, respiratory physiotherapy has become necessary and a routine in most neonatal intensive care units (NICU) worldwide.<sup>9</sup> The main objectives of respiratory physiotherapy are the prevention and treatment of bronchial obstruction due to accumulation of secretion, which contributes to reducing its deleterious effects, such as hyperinflation, atelectasis, changes in the ventilation-perfusion and increased respiratory effort.<sup>10,11</sup>

Few studies have investigated the influence of respiratory physiotherapy on brain injuries in preterm newborns regarding CBF alterations.<sup>12-15</sup> To date, no study quantitatively described the pattern of brain hemodynamic behavior in this population before, during and after respiratory physiotherapy maneuvers are performed.

The objective of this study was to assess the influence of physiotherapy on the CBF in clinically-stable preterm newborns.

**Method**

This is an intervention study, carried out in intensive care and neonatal intermediate care units at Hospital da Mulher Prof. Dr. José Aristodemo Pinotti, Centro de Atenção Integral à Saúde da Mulher (Caism) of Universidade Estadual de Campinas (Unicamp), from October 2013 to June 2014. The sample consisted of clinically-stable preterm newborns with gestational age  $\leq 34$  weeks, between 8 and 15 days of postnatal age, spontaneously breathing room air or receiving oxygen with the aid of a nasal cannula and with no contraindications for respiratory physiotherapy and the supine position. In our service, all

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