

# Pain and cardiorespiratory responses of children during physiotherapy after heart surgery

*Dor e respostas cardiorrespiratórias durante a fisioterapia de crianças no pós-operatório de cirurgia cardíaca*

Adriana Sanches Garcia Araujo<sup>1</sup>; Jyrson Guilherme Klamt<sup>1</sup>, MD, PhD; Walter Villela de Andrade Vicente<sup>1</sup>, MD, PhD; Luis Vicente Garcia<sup>1</sup>, MD, PhD

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## Abstract

**Objective:** The aim of the present study was to determine the occurrence of pain and changes in blood pressure, heart rate, respiratory rate, and arterial oxygen saturation associated with physiotherapy in children undergoing cardiac surgery.

**Methods:** Eighteen extubated children were assessed for the presence of pain using the face, legs, activity, cry, consolability scale, and blood pressure, heart rate, respiratory rate and arterial oxygen saturation were simultaneously recorded. The physiological parameters were measured at the following time periods: immediately before physiotherapy, five and 10 minutes after the beginning of physiotherapy, and five minutes after its end. Pain was assessed immediately before physiotherapy, ten minutes after the beginning of physiotherapy and five minutes after its end. Pain and physiological changes were assessed by the Friedman test and the correlation between the physiological parameters and the pain scores was assessed by the Spearman test.

**Results:** Pain increased during physiotherapy and decreased significantly after it compared to pre-physiotherapy scores. Systolic blood pressure and heart rate increased significantly after 10 minutes of the beginning of physiotherapy. Arterial oxygen saturation tended to decrease during physiotherapy and to increase after it, although without significance. The correlation between

pain scores and the physiological variables was significant only for systolic blood pressure and heart rate ten minutes after the beginning of physiotherapy.

**Conclusion:** Manipulation after the beginning of physiotherapy seems to be accompanied by significant pain and by important associated cardiovascular changes. Apparent analgesia and improved respiratory function were observed after respiratory physiotherapy.

**Descriptors:** Physical therapy (Specialty). Pain, Postoperative. Heart defects, Congenital. Thoracic surgery. Pediatrics.

## Resumo

**Objetivo:** O objetivo desse estudo foi avaliar as ocorrências de dor e as alterações na pressão arterial, frequência cardíaca, frequência respiratória, saturação arterial de oxigênio associadas à fisioterapia em crianças no pós-operatório de cirurgia cardíaca.

**Métodos:** Em dezoito crianças entubadas, foram avaliadas a dor pela escala face, pernas, atividade, choro e consolabilidade e registradas simultaneamente as pressão arterial, frequência cardíaca, frequência respiratória e saturação arterial de oxigênio. Os parâmetros fisiológicos foram medidos nos momentos: imediatamente antes, após cinco e dez minutos do início da fisioterapia,

<sup>1</sup>Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo (HC-FMRP-USP), Ribeirão Preto, SP, Brazil

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Correspondence address:  
Jyrson Guilherme Klamt

Hospital das Clínicas da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo  
Av. dos Bandeirantes, 3900 - Monte Alegre (Campus da USP)  
Ribeirão Preto, SP, Brazil - Zip code: 14048-900  
E-mail: jgklamt@fmrp.usp.br

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Abbreviations, acronyms & symbols	
BP	Blood pressure
HR	Heart rate
RR	Respiratory rate
SpO <sub>2</sub>	Arterial oxygen saturation
PICU	Pediatric Intensive Care Unit
DBP	Diastolic blood pressure
r <sub>s</sub>	Spearman correlation coefficient

ao término e após cinco minutos do término da fisioterapia. A dor foi avaliada imediatamente antes, dez minutos do início da e após cinco minutos do término da fisioterapia. A dor e as alterações fisiológicas foram analisadas pelo teste de Friedman e a correlação entre os parâmetros fisiológicos e os escores de dor foi analisada pelo teste de Spearman.

## INTRODUCTION

Pain after pediatric cardiac surgery can be intense if not adequately controlled and may increase due to patient manipulation, coughing and systematically applied physiotherapy procedures<sup>[1-3]</sup>. The intensification of pain may be associated with hemodynamic responses (acute increases in blood pressure and heart rate), superficial respiration and hypoxia (low SpO<sub>2</sub>)<sup>[1,4]</sup>.

The efficacy of respiratory physiotherapy in the postoperative routine in the intensive care unit has been well established regarding the respiratory, cardiovascular and psychological rehabilitation of children undergoing cardiac surgery with cardiopulmonary bypass<sup>[1,5,6]</sup>. However, few reports are available on the intensity of pain and the associated physiological changes during maneuvers of physiotherapy in this clinical situation<sup>[1,6,7]</sup>. Thus, this question was considered in the present observational study.

## METHODS

The study was approved by the Research Ethics Committee of the University Hospital, Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo (Faculty of Medicine of Ribeirão Preto, University of São Paulo). Eighteen children aged 1 month to 2 years who had undergone cardiac surgery and with an indication of postoperative physiotherapy were studied. The persons legally responsible for the children signed written informed consent to participate. Exclusion criteria were: sedated, intubated, hemodynamically unstable children, children with neurological, psychological or motor retardation, with previous pneumopathy such as bronchial asthma, bronchiectasis, and cystic fibrosis, and children who had suffered cardiac arrest during surgery and

**Resultados:** A dor aumentou e reduziu significativamente durante e após, respectivamente, a fisioterapia, em relação aos valores pré-fisioterapia. A pressão arterial sistólica e a frequência cardíaca aumentaram significativamente após 10 minutos do início da fisioterapia. Houve tendência de redução da saturação arterial de oxigênio durante a fisioterapia e elevação após, porém, sem significância. A correlação entre os escores de dor foi significativa apenas para pressão arterial sistólica e frequência cardíaca durante a fisioterapia.

**Conclusão:** A manipulação durante a fisioterapia parece ser acompanhada de dor significativa e associada às alterações importantes da pressão arterial e frequência cardíaca. Uma aparente analgesia e melhora da função respiratória foi observada após a fisioterapia respiratória.

**Descritores:** Fisioterapia (Especialidade). Dor pós-Operatória. Cardiopatias congênitas. Cirurgia torácica. Criança.

who presented important respiratory discomfort. Data were collected in the Pediatric Intensive Care Unit (PICU) of the University Hospital, Faculdade de Medicina de Ribeirão Preto, during the period from January to November 2004.

The physiological variables systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and arterial oxygen saturation (SpO<sub>2</sub>) were measured using a multiparameter monitor (Dixtal®). Respiratory rate (RR) was determined according to the number of thoracic expansions. The pain scale used was the FLACC: Face, Legs, Activity, Cry, Consolability, with a maximum score of 10 points<sup>[8]</sup>.

Routine physiotherapy (chest wall vibration, expiratory flow maneuvers, directed cough, autogenic drainage, and postural drainage) was applied by the cardiorespiratory physiotherapist in charge according to individual necessities. The physiological variables were recorded immediately before the beginning of physiotherapy (Pre time), 5 (Time 5) and 10 (Time 10) minutes after the beginning of physiotherapy, at the end of physiotherapy (Time E), and 5 minutes after the end of physiotherapy (Post 5 Time). The pain scores were recorded at the Pre, 10 and Post 5 Times.

Data were statistically assessed by the nonparametric Friedman test and the correlation between the physiological variables and the pain scale was calculated using the Spearman correlation coefficient (r<sub>s</sub>). The level of significance was set at 5% (P<0.05).

## RESULTS

Eighteen children (11 girls and 7 boys) aged 1 to 24 months (mean±SD: 12.5±10.3) and weighing 3.2 to 16.5 kg (mean±SD: 9.8±6.1) were studied. The diagnoses of the congenital heart diseases are listed in Table 1.

Table 1. Diagnosis of congenital heart diseases.

Diagnosis	n
Atrial septal defect (ASD)	1
Ventricular septal defect (VSD)	1
Patent ductus arteriosus (PDA)	5
ASD, VSD, PDA	1
VSD, PDA	4
Pulmonary atresia, ASD, VSD, PDA	1
Total atrioventricular canal	1
Aortic coarctation	1
Tricuspid atresia, right ventricular hypoplasia, ASD, VSD	2
Transposition of the great vessels, IAC	1
Total	18

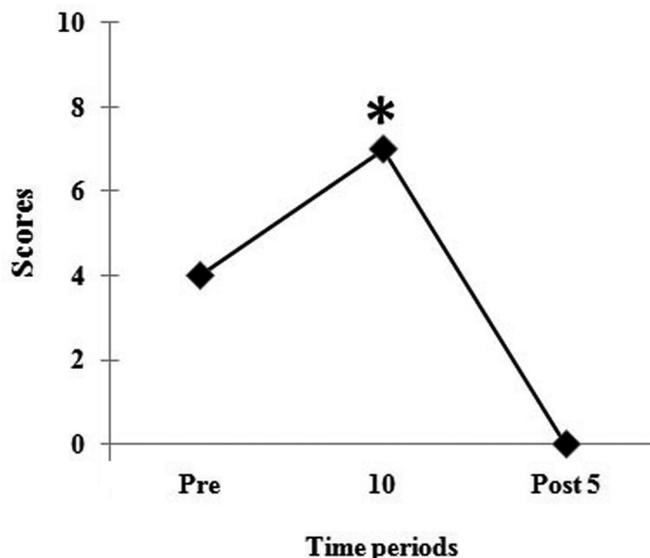


Fig. 1 – Pain during physiotherapy assessed by FLACC scale in 18 children after cardiac surgery. Data represent the median. \*Significantly different compared to Pre Time

There was a significant increase in pain scores on the FLACC scale during physiotherapy, followed by a reduction after the procedure compared to Pre Time values (Figure 1). SBP and HR increased significantly at Time period 10, whereas DBP and SpO<sub>2</sub> did not change. After physiotherapy, SBP and HR returned to the initial values and SpO<sub>2</sub> tended to increase (Figure 2). A significant positive correlation was observed at Time 10 (during physiotherapy) between pain scores and SAP ( $r=0.49$ ;  $P=0.042$ ) and between pain and HR ( $r=0.48$ ;  $P=0.041$ ).

DISCUSSION

The present prospective cohort study showed a sharp increase in pain during the physiotherapy maneuvers in children extubated in the PICU after cardiac surgery with car-

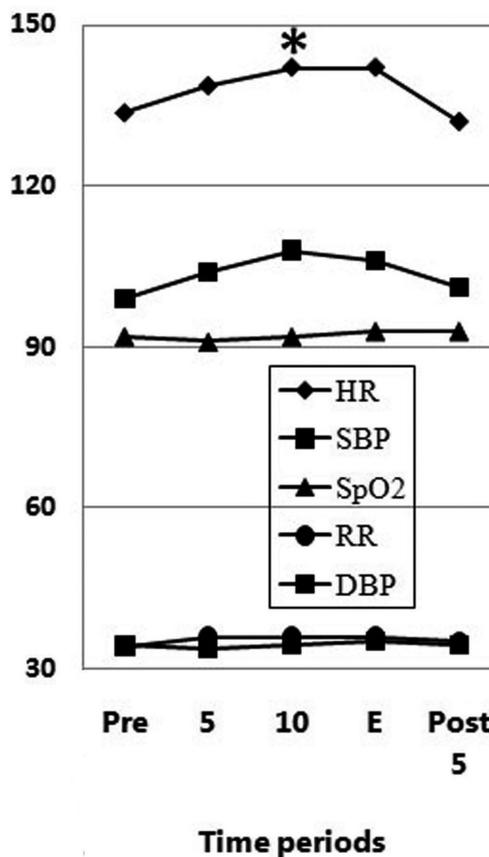


Fig. 2 – Changes SBP, DBP, H, SpO<sub>2</sub>, and RR during physiotherapy in 18 children after cardiac surgery. Data represent mean. \*Significantly different from Pre Time

diopulmonary bypass, which was correlated with increased SBP and HR. After physiotherapy, the scores obtained on the FLACC scale showed values that corresponded to the absence of pain, indicating an apparent analgesic effect of physiotherapy. The discrete increase in SpO<sub>2</sub> after physiotherapy may indicate improved oxygenation. DBP and RR did not change during physiotherapy.

The hemodynamic responses produced by physiotherapy, although they were within the physiological variation for the respective ages, may have been a consequence of the pain or discomfort felt by the patients during respiratory physiotherapy, although changes in the regulatory mechanisms present in the postoperative period after cardiac surgery may also have contributed. Indeed, some vagal suppression was demonstrated, while the sympathetic system operated on a normal scale<sup>[9]</sup>. This imbalanced interaction of the neuroveg-

etative nervous system may explain the tendency to a greater hemodynamic response to movement and aspiration and the higher incidence of tachycardia during the postoperative period<sup>[9]</sup>. On the other hand, the relative stability of BP, HR, RR and SpO<sub>2</sub> during the physiotherapy procedures may indicate the quality of analgesia administered and may have been a factor for the correlation with marginal significance between the hemodynamic variables and pain<sup>[10]</sup>. In contrast to this paradigm, children who are intubated and sedated during the postoperative period frequently show hemodynamic instability and episodes of bradycardia during manipulation, caused by vagal hyperactivity due to intense stimulation<sup>[5]</sup>.

Respiratory physiotherapy is essential for cardiorespiratory rehabilitation during the postoperative period of cardiac surgery and should be started as soon as hemodynamic stability occurs<sup>[1,11]</sup>. Manipulation, compression maneuvers and coughing during physiotherapy may intensify pain or discomfort, in agreement with the increase in pain scores. Surprisingly, however, apparent analgesia was detected immediately after the end of physiotherapy. We have no explanation for this finding and we can only propose that the pattern of somatosensory stimulation and affective care may possibly activate mechanisms of endogenous control of pain<sup>[12]</sup>. The determination of the consistency of this finding requires future investigation.

In conclusion, respiratory physiotherapy after cardiac surgery causes pain associated with tolerable increased systolic blood pressure and heart rate in children. However, the pain may be followed by apparent analgesia.

Authors' roles & responsibilities	
ASG	Coauthor
JGK	Corresponding author
WVAV	Coauthor
LVG	Coauthor

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