

# Importance of pre- and postoperative physiotherapy in pediatric cardiac surgery

## *Importância da fisioterapia no pré e pós-operatório de cirurgia cardíaca pediátrica*

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RBCCV 44205-1106

### *Abstract*

**Lung complications during postoperative of pediatric heart surgery are frequently highlighting atelectasis and pneumonia. Physiotherapy has an important role in the treatment of these complications. We reviewed and update the physiotherapy performance in the preoperative and in the postoperative lung complication of pediatric cardiac surgery. We noted efficacy of physiotherapy treatment through different specific techniques and the need for development of new studies.**

**Descriptors: Physical Therapy (Specialty). Thoracic Surgery. Atelectasis. Pneumonia.**

### *Resumo*

**Complicações no pós-operatório de cirurgia cardíaca pediátrica são freqüentes, destacando-se a atelectasia e a pneumonia. A fisioterapia contribui significativamente no tratamento destas complicações. Desta forma, este estudo buscou agrupar e atualizar os conhecimentos da atuação fisioterapêutica no pré-operatório e nas complicações pulmonares do pós-operatório de cirurgia cardíaca pediátrica. Observou-se a eficácia do tratamento fisioterapêutico por meio de diferentes técnicas específicas e a necessidade do desenvolvimento de novas pesquisas.**

**Descritores: Fisioterapia (Especialidade). Cirurgia Torácica. Atelectasia. Pneumonia.**

## INTRODUCTION

Congenital heart diseases affect about 8 to 10 children per 1000 live births and it is estimated the occurrence of 28,846 new cases per year in Brazil, where, on average, 23,077 surgical procedures are needed per year [1].

The most common congenital heart diseases in the study of Miyague et al. [2] were acyanotic anomalies such as

ventricular septal defect (30.5%), atrial septal defect (19.1%), patent ductus arteriosus (17%), pulmonary valve stenosis (11.3%) and aortic coarctation (6.3%), while the most common cyanotic anomalies were tetralogy of Fallot (6.9%), transposition of great vessels (4.1%), tricuspid atresia (2.3%) and total anomalous pulmonary veins drainage (2%).

Children with congenital heart disease often develop changes in respiratory mechanics [3]. In addition, heart

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Article received on February 10<sup>th</sup>, 2009

Article accepted on August 31<sup>st</sup>, 2009

surgery associated with cardiopulmonary bypass (CPB) also leads to a number of respiratory complications [4]. Thus, physiotherapy in pre- and postoperative period have as main objectives the pulmonary reexpansion, airway clearance and guidance for those responsible concerning prevention of these complications [5].

This review aimed to update knowledge regarding the role of physiotherapy in the preoperative and postoperative pediatric cardiac surgery in the prevention of pulmonary complications.

#### PULMONARY COMPLICATIONS IN PEDIATRIC CARDIAC SURGERY

Pulmonary complications of postoperative pediatric cardiac surgery observed in the study of Felcar et al. [5] were: atelectasis, pneumonia, pleural effusion, pneumothorax, chylothorax, pulmonary hypertension, pulmonary hemorrhage and diaphragmatic paralysis, whereas the first two aforementioned complications are the more common ones.

Atelectasis, defined as collapse of a certain region of the lung parenchyma [6] is the most common complication in the postoperative period of cardiac surgery [7], by worsening oxygenation, decreasing pulmonary compliance, leading to inhibition of cough and pulmonary clearance and may lead to respiratory failure and increase pulmonary vascular resistance [8].

Heart surgeries associated with CPB have as adverse effect the increased capillary permeability that causes edema, which results in decreased lung compliance and gas exchange [9], in addition to lead to airway obstruction, atelectasis, decreased functional residual capacity and, therefore, hypoxemia [4].

Stayer et al. [3] assessed the changes in resistance and dynamic pulmonary compliance in 106 children aged less than one year, with congenital heart disease who underwent cardiac surgery with CPB. These variables were measured on two occasions: before the surgical incision with ten minutes of mechanical ventilation and after disconnection of CPB and sternal closure. The authors found that newborns and patients with increased pulmonary blood flow presented preoperatively decreased lung compliance and increased respiratory resistance, whereas after surgery the latter parameter has improved. On the other hand, the infants with normal pulmonary blood flow in the preoperative had decreased lung compliance and developed in the postoperative deterioration of dynamic compliance, however, the pulmonary resistance was not affected. This study showed that heart surgery can alter the respiratory mechanics in newborns and infants.

In a retrospective study of Nina et al. [9] which assessed the risk score adjusted for surgery in congenital heart

disease (RACHS-1) in 145 patients, it was observed a mortality rate of 17.2%, whereas 66% occurred in patients with congenital heart diseases. There was a higher mortality (60%) in the highest risk group, or that is, patients undergoing longer duration of CPB and myocardial ischemia.

Among the most common causes of death it can be highlighted the low cardiac output syndrome (48%), followed by lung infections (11%).

Pneumonia is one of the frequent causes of nosocomial infection in the postoperative period of heart surgery and is considered a major cause of morbidity and mortality in this population [10,11]. Tan et al. [12] found that 21.5% of 311 children with congenital heart disease who underwent surgical correction acquired nosocomial pneumonia.

#### PHYSIOTHERAPY IN PRE- AND POSTOPERATIVE PERIOD

Physiotherapy in the pre- and postoperative period is indicated in pediatric cardiac surgery in order to reduce the risk of pulmonary complications (retention of secretions, atelectasis and pneumonia) [5] as well as to treat such complications as it contributes to the appropriate ventilation and successful extubation [13].

In the preoperative, physiotherapy uses techniques of clearance, reexpansion, abdominal support and guidance on the importance and objectives of physiotherapy intervention for parents or escorts, or patients able to understand such guidance [5]. The techniques used by postoperative physiotherapy include vibration in the chest wall, percussion [5,14-16], compression [16], manual hyperinflation [5,16], reexpansion maneuver [6], positioning [5,14] postural drainage [5,6,14,15], cough stimulation [14,15], aspiration [5,14], breathing exercises [15], mobilization [5] and AEF (acceleration of expiratory flow) [17].

There are few current studies on the role of physiotherapy in the postoperative of pediatric cardiac surgery [5], especially those that approach the effectiveness of physiotherapy in the preoperative to prevent pulmonary complications after heart surgery.

Felcar et al. [5] performed a study with 141 children with congenital heart disease, aged varying between one day old to six years, randomly divided into two groups, whereas one of them received physiotherapy in the pre- and postoperative and the other only postoperatively. The study obtained statistically significant difference regarding the presence of pulmonary complications (pneumonia and atelectasis), being more frequent in the group undergoing physiotherapy only postoperatively. Moreover, when the presence of pulmonary complications was associated with other complications regarding the time of hospital stay, such as sepsis, pneumothorax, pleural effusion and others,

the group that received physiotherapy before and after surgery showed a lower risk of developing such complications. These findings demonstrate the importance of preventive action of physiotherapy preoperatively.

The study by Main et al. [15] compared the effectiveness of aspiration with the techniques of respiratory physiotherapy (manual vibration, percussion, compression, manual hyperinflation, positioning and postural drainage) in 83 participants with a mean age of 9 months. The respiratory parameters (expiratory tidal volume, resistance and lung compliance) were measured 15 minutes before treatment and after 30 minutes, and lasting for 60 minutes after the intervention in case there was no need for clinical intervention. The duration of physiotherapy was higher than the aspiration ( $8.5 \pm 3.5$  and  $5.6 \pm 2.7$  minutes, respectively). It was observed that physiotherapy tends to produce improvement in expiratory tidal volume, pulmonary compliance and pulmonary resistance.

According to Kavanagh [7], the treatment for atelectasis consists of physiotherapy, deep breathing, incentive spirometry. However, sometimes, atelectasis is difficult to reverse and it is necessary association with another method, as in the case report from Silva et al. [16], in which a child with congenital heart disease underwent heart surgery and developed this pulmonary complication after extubation in the postoperative period and the reversal of this presentation was achieved after the association of respiratory physiotherapy with inhalation of hypertonic saline solution with NaCl at 6%.

Chest radiographs and four physiotherapy sessions lasting 20 minutes were performed daily in this study, using maneuvers of pulmonary reexpansion and bronchial hygiene, bronchial postural drainage and tracheal aspiration. Immediately before and after physiotherapy inhalation of hypertonic saline solution with NaCl at 6% was associated. The authors found that this association was shown to be effective in this case [16].

Breathing exercises are indicated in cases of atelectasis due to thoracic or upper abdominal surgery, because they improve the respiratory efficiency, increase the diameter of the airways, which helps to dislodge secretions, preventing alveolar collapse, and facilitating the expansion of the lung and peripheral airways clearance [15].

Campos et al. [17] analyzed the effect of increased expiratory flow (IEF) in heart rate, respiratory rate and oxygen saturation in 48 children diagnosed with pneumonia. The variables were assessed before physiotherapy, in the first and fifth minutes after physiotherapy. The authors found a statistically significant increase in oxygen saturation and statistically significant reduction in cardiac and respiratory rate after intervention with IEF and concluded that this physiotherapeutic technique for bronchial hygiene is effective in improving lung function.

## FINAL CONSIDERATIONS

The occurrence of pulmonary complications in the postoperative of heart surgery is quite common, and the atelectasis and pneumonia are highlighted among them. Since the frequency of heart surgery in children with congenital heart disease is high, it is important to make use of effective means to prevent, reduce or treat such complications.

Physiotherapy included in the multidisciplinary team contributes significantly to the better prognosis of pediatric patients undergoing heart surgery, as it prevents and treats pulmonary complications by means of specific techniques such as vibration, percussion, compression, manual hyperinflation, reexpansion maneuver, positioning, postural drainage, cough stimulation, aspiration, breathing exercises, IEF and mobilization.

It was observed the effectiveness of physiotherapy in reducing the risk and/or treating pulmonary complications caused by surgical procedure in children with congenital heart disease. Thus, more research is needed to assess the physiotherapy in the pre- and postoperative of pediatric cardiac surgery, by comparing the different techniques used by the physiotherapist in order to minimize the frequent postoperative pulmonary complications.

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