



## Systematic review

# Peri-operative chest physiotherapy for paediatric cardiac patients: a systematic review and meta-analysis

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**Background** Chest physiotherapy (CPT) is implemented before and after congenital heart disease (CHD) surgery in paediatrics to prevent and treat postoperative pulmonary complications (PPC). Currently, there are no systematic reviews or meta-analyses on the efficacy of CPT in this population.

**Objective** To conduct a systematic review and meta-analysis to determine whether peri-operative CPT is safe and effective for paediatric patients with CHD.

**Data sources** A literature search was conducted on PEDro, MEDLINE, CINAHL, Informit, The Cochrane Library and Scopus in March and April 2016.

**Eligibility criteria** English peer-reviewed articles that utilised CPT before or after cardiac surgery for paediatric CHD. Systematic reviews were excluded.

**Data extraction and synthesis** Completed by two independent researchers using the Crowe Critical Appraisal Tool. Data were collated using a piloted data extraction tool. Mix Version 2.0.1.4 was used for meta-analysis, and data were extracted using an odds ratio (with a random effects model).

**Results** Eleven studies met the inclusion criteria for the systematic review. Variable results were found regarding the effect of CPT on peripheral oxygen saturation and pain. Meta-analysis showed that CPT did not prevent pneumonia (odds ratio (OR) 2.01; 95% confidence interval (CI) 0.80 to 5.05;  $P=0.13$ ), and did not prevent or treat atelectasis (OR 1.27; 95% CI 0.18 to 8.87;  $P=0.81$ ).

**Limitations** There was a lack of high-quality studies. The included studies were comprised of heterogeneous treatment, limiting external validity.

**Conclusion** Active therapies such as mobilisation, deep breathing and incentive spirometry were more effective than passive treatment. Percussion led to oxygen desaturation, and percussion, vibration and suctioning increased the risk of developing atelectasis.

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**Introduction**

Congenital heart disease (CHD) is a broad term used to describe a range of conditions present at birth which affect the heart, heart valves and/or great blood vessels [1,2]. In Australia, 2000 infants are born with CHD each year, with the condition being the highest cause of death for infants

aged less than 1 year [1,3–5]. Up to 50% of children with CHD require heart surgery [1,6,7].

Cardiac surgery is a lifesaving treatment for CHD. However, it has complications such as reduced pulmonary and cardiac function [8]. Factors such as anaesthesia, positioning, time on mechanical ventilation, cardiopulmonary bypass and length of stay in the intensive care unit (ICU) can lead to atelectasis, sputum retention, pneumonia and muscle atrophy [6,9–13]. Although few studies have been conducted on the effects of prolonged mechanical ventilation in infants,

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current evidence suggests that there is a high rate of serious co-morbidities and significantly higher risk of mortality in adult patients [14]. As such, effective chest physiotherapy (CPT) protocols are required to prevent and treat postoperative complications.

A 2012 Cochrane review of adults undergoing cardiac surgery found that pre-operative exercise therapy reduced postoperative pulmonary complications (PPC) such as atelectasis and pneumonia, reduced hospital length of stay, and increased the 6-minute walk test distance; no adverse reactions were documented [15]. The immediate effects of CPT have yet to be synthesised in recent literature.

A review of the effects of peri-operative CPT for cardiac patients was published in 2011, and reported positive outcomes of CPT for improving recovery after paediatric cardiac surgery [16]. However, recommendations were based on research in adult populations as well as general surgery; therefore, a true synthesis of the effect of CPT for paediatrics with CHD was not provided.

The aim of this systematic review and meta-analysis was to determine whether peri-operative CPT is both safe and effective in the immediate and long term for paediatric cardiac patients with CHD, compared with receiving no physiotherapy or receiving postoperative physiotherapy alone.

## Methods

### *Protocol and registration*

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) approach was used to conduct a comprehensive and objective systematic review [17]. The proposed review protocol was submitted to PROSPERO (Registration No. CRD42015024768).

### *Eligibility criteria*

Articles were included if they met all of the following inclusion criteria:

- Age <18 years.
- Received CPT before and/or after open or closed cardiac surgery for correction of CHD.
- CPT was defined as any ventilatory or secretion removal technique, and used physiotherapy-related outcomes.
- The physiotherapeutic protocols and procedures were documented clearly.
- The article was peer reviewed.
- The study design was prospective, retrospective, experimental or observational.
- The article was published in English.

Systematic or literature reviews, editorials, letters to the editor, presentations or comments were not included. The

search limits implemented are available in Appendix A in supplementary material.

### *Search strategy*

Databases that were searched included PEDro, MEDLINE, Scopus, CINAHL, The Cochrane Library and Informit. To ensure inclusion of all eligible literature, the search strategy was formulated with the divisional librarian at James Cook University [18].

The literature search included Boolean phrases combining search terms outlined in Appendix A in supplementary material. The key phrases were: 'physiotherapy', 'rehabilitation', 'preoperative', 'postoperative', 'paediatric' and 'heart surgery'. The title, abstract and keywords were screened to determine whether the article met the inclusion criteria. The reference lists of appropriate articles were examined, and literature citing was completed by the primary researcher (AB). The authors of articles that did not meet full inclusion criteria due to lack of specificity of physiotherapeutic treatment were contacted in an attempt to allow article inclusion. Full-text assessment was subsequently completed and the secondary author (AJ) confirmed article inclusion.

### *Data collection and analysis*

A data extraction sheet was formulated by the primary researcher (AB) to minimise selection bias during data extraction, and was piloted prior to application in the systematic review. The Crowe Critical Appraisal Tool (CCAT) was used to provide an overall indication of the quality of the studies, regardless of study design [19,20].

The aim of this review was to determine both the immediate and long-term effects of CPT. As such, data terms in the form of outcome measures which represented both timeframes were selected [20]. The data terms which were selected are outlined in Appendix A in supplementary material.

### *Meta-analysis*

The meta-analysis inclusion criteria were as follows:

- Articles included a control and an intervention group.
- Two or more articles included similar sample group characteristics, treatment provided and outcomes assessed.
- Statistical outcomes were provided in the results.

The meta-analysis was conducted using Mix Version 2.0.1.4 [21], an add-in for Microsoft Excel Version 2010. Data from the articles were extracted, and an odds ratio (OR) measure was used (no difference between the treatment and control groups equal to 1) with a 95% confidence interval (CI). A random effects model was chosen as it was unlikely that the populations used in the articles could be considered homogenous. The weighting used was an inverse variance with  $\tau^2$ , and the estimator for  $\tau^2$  used the DerSimonian–Lairs

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