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Systematic review

What is the role of the physiotherapist in paediatric intensive care units? A systematic review of the evidence for respiratory and rehabilitation interventions for mechanically ventilated patients

Ellie Hawkins, Anne Jones *

Discipline of Physiotherapy, School of Public Health, Tropical Medicine and Rehabilitation Sciences, James Cook University, Townsville, Australia

Abstract

Background Physiotherapy in intensive care units (ICU) has traditionally focussed on the respiratory management of mechanically ventilated patients. Gradually, focus has shifted to include rehabilitation in adult ICUs, though evidence of a similar shift in the paediatric ICU (PICU) is limited.

Objectives Review the evidence to determine the role of physiotherapists in the management of mechanically ventilated patients in PICU.

Data sources A search was conducted of: PEDro, CINAHL, Medline, PubMed and the Cochrane Library.

Eligibility criteria Studies involving PICU patients who received physiotherapy while invasively ventilated were included in this review. Those involving neonatal or adult ICU patients, or patients on non-invasive or long-term ventilation, were not included in the study.

Study appraisal All articles were critically appraised by two reviewers and results were analysed descriptively.

Results Six studies on chest physiotherapy (CPT) met the selection criteria. Results support the use of the expiratory flow increase technique and CPT, especially manual hyperinflation and vibrations, for secretion clearance. Evidence does not support the routine use of either CPT or suction alone. No studies investigating rehabilitation in PICU met selection criteria.

Limitations A lack of high level evidence was available to inform this review.

Conclusion Evidence indicates that CPT is still the focus of physiotherapy intervention in PICU for mechanically ventilated patients, and supports its use for secretion clearance in this setting.

PROSPERO register for systematic reviews (registration no. CRD42014009582).

Keywords: Intensive care; Pediatrics; Physical therapy specialty; Physical therapists; Ventilators; Mechanical

Introduction

Paediatric intensive care unit (PICU) admissions are usually due to acute medical illness, accidents, or life-threatening surgical conditions [1]; a high percentage of these patients require mechanical ventilation for more than 24 hours [2,3]. Resultant airway clearance compromise predisposes these patients to secondary complications such as respiratory infections and acute lobar atelectasis [4,5]. Evidence in adult populations also demonstrates that the long periods of immobility associated with mechanical ventilation often result in muscle atrophy and weakness [6]. As respiratory and function specialists, physiotherapists are an important part of the multi-disciplinary team in most intensive care units (ICU) in Australia and throughout the world [7,8]. Chest physiotherapy (CPT) is usually the main focus of treatment for physiotherapists in ICU, and forms part of the standard care for both adult and paediatric mechanically ventilated

* Corresponding author. Tel.: +61 747816280; fax: +61 747816868.
E-mail addresses: ellie.hawkins@my.jcu.edu.au (E. Hawkins), anne.jones@jcu.edu.au (A. Jones).

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patients [9,10]. The aims of CPT surround the removal of excess secretions, and in PICU usually involves positioning, percussions, vibrations, saline instillation, oropharyngeal or endotracheal suction, and manual hyperinflation [4,9,11]. However, overall the evidence base for physiotherapy in paediatric acute care is limited [12].

In recent years improvements in neonatal medicine has resulted in an increasing number of very premature infants surviving the neonatal period [3,13]. With this population at greater risk of morbidities, such as reduced lung function and developmental delay, the prevalence of chronic comorbidities among PICU and neonatal ICU (NICU) patients has increased [14–16]. As a result, focus has shifted to include rehabilitation as part of standard physiotherapy intervention in NICU's, as well as in adult intensive care units, for mechanically ventilated patients [9]. Documented benefits of early rehabilitation in adult ICU's include improved quality of life and function, and reduced length of stay [17,18]. In NICUs, initial evidence shows that infants receiving developmental care had significantly improved functional outcomes, compared to those infants who did not receive such care [19]. In contrast, a large gap exists in this area among the mechanically ventilated PICU population. The aim of this study was to determine the role of physiotherapists in the management of mechanically ventilated patients in the paediatric intensive care unit, with regards to both rehabilitation and respiratory management.

Method

Protocol and registration

A systematic review was conducted using a PRISMA approach in order to determine the research objective [20]. The review was registered on the PROSPERO register for systematic reviews (registration no. CRD42014009582).

Search strategy

Five databases were selected through James Cook University (JCU) to be used for searches: PEDro, CINAHL, MEDLINE, PubMed, and the Cochrane Library. A preliminary search of Google Scholar, JCU's One Search, and the five databases was conducted to determine the depth of the evidence base and inform the selection of search terms. The final search was conducted using keywords and MeSH terms, with or without truncation, as appropriate for the database. The search terms used can be seen in Appendix A. Articles yielded from the search were screened by title and abstract; those which met the selection criteria were obtained in full text and further screened for eligibility. Studies which met all inclusion and exclusion criteria following full text review were included in the study. Reference lists of full text articles were also screened to ensure a comprehensive search of potential evidence.

Inclusion and exclusion criteria

Studies were included in the review if the sample included invasively ventilated patients who were admitted to PICU, and receiving some form of physiotherapy intervention from a physiotherapist. Both qualitative and quantitative articles were included provided they were available in full text English. Article types which were excluded include: letters to the editor, editorials, comments, presentations, studies on animals or artificial models, and systematic or literature reviews. Studies were also excluded if the sample included adults (older than 18 years), patients admitted to an adult or neonatal ICU, patients on non-invasive ventilation or being discharged from ICU on mechanical ventilation, and those not receiving intervention from a physiotherapist. No restrictions were applied to the year published or methodological quality based on a critical appraisal tool score.

Data collection and analysis

Due to the variation in study protocols and data collected between studies, and so the lack of comparable quantitative data, outcomes were collected in a descriptive manner. Study specific terms regarding study characteristics and significant findings were used to answer the research question. These were collected in accordance with the research aims: demographics of the population, treatments performed and their protocols, adverse events, and the evidence behind interventions (see Table 1). Results were presented in tables to allow comparison of protocols and results, and highlight any similarities.

Risk of bias

To minimise the risk of selection bias, the eligibility of the studies for inclusion was agreed upon by two assessors based on the defined inclusion and exclusion criteria. The Crowe Critical Appraisal Tool (CCAT) was used to determine the methodological quality of all studies, including risk of bias within studies [21]; this was also completed independently

Table 1
Descriptive data using objective outcomes from individual studies.

PICO	Descriptive data/objective measures used
Population demographics	Number of participants, age (months and years), and primary and associated conditions
Treatments and protocols	Treatments performed *e.g.* manual hyperinflation, suction, vibrations, postural drainage *etc*. Treatment duration, number of techniques, passes of suction, cycles of treatment *etc*.
Evidence behind treatments	Significant effects on oxygenation, dead space, tidal volumes, peak expiratory flows/peak expiratory flow ratios, airway compliance, airway resistance, forces applied during manual techniques *e.g.* suction produced significant reductions in airway compliance.
Adverse events	Haemodynamic stability (heart rate, blood pressure), oxygenation (SpO_2)