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Effects of respiratory physiotherapy interventions on pulmonary mechanics of newborns: a protocol for a systematic review

Adriele de Morais Nunes ,[1]
Ana Tereza do Nascimento Sales Figueiredo Fernandes,[2]
Adynna Tévina de Castro Silva,[3] Mayara Fabiana Pereira Costa,[1]
Karolinne Souza Monteiro,[1] Silvana Alves Pereira [1,3]

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[1]Postgraduate program in Rehabilitation Sciences, Universidade Federal do Rio Grande do Norte, Santa Cruz, RN, Brazil
[2]Departamento de Fisioterapia, Universidade Estadual da Paraiba, Campina Grande, PB, Brazil
[3]Maternidade Escola Januario Cicco - Ebserh, Universidade Federal do Rio Grande do Norte, Natal, RN, Brazil

Correspondence to
Dr Silvana Alves Pereira; silvana.alves@ufrn.br

ABSTRACT

Introduction Although respiratory physiotherapy techniques may reduce respiratory load in newborns, manual contact with the ribcage may interfere with pulmonary mechanics. Therefore, this systematic review aims to evaluate the effects of conventional and non-conventional respiratory physiotherapies on pulmonary mechanics of newborns.

Methods and analysis We will search PubMed, LILACS, SciELO, ScienceDirect, Cochrane Central and Web of Science databases. Searches will be conducted from September 2022. We will include randomised clinical trials reporting thoracoabdominal synchrony, lung volumes and capacities, respiratory discomfort and pain in newborns aged between 1 hour and 28 days and admitted to neonatal intensive care units. We will exclude studies not fully available or incomplete and studies conducted with newborns presenting structural alterations. Two independent researchers will perform the study selection, data extraction and quality assessment. After consensus, one reviewer will proceed with the process. We will include studies published in English or Portuguese, without publication date restriction. An overview of the included studies and extracted information will be reported and the quality of studies will be assessed. A meta-analysis will be conducted if data regarding between-group comparisons are available.

Ethics and dissemination Ethics approval is not required for this systematic review. Results will be presented in journals and national and international conferences, and findings will be shared on social media using accessible language.

PROSPERO registration number CRD42021266729.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This systematic review protocol was prepared according to international recommendations.
⇒ Study inclusion and quality will be assessed independently by two reviewers.
⇒ Including studies published only in English and Portuguese may limit the results.
⇒ The study findings will provide comprehensive information for future randomised controlled trials about the influence of respiratory physiotherapy on pulmonary mechanics of newborns.

INTRODUCTION

Newborns present unique physiological and anatomical characteristics, such as fewer alveoli, more cartilaginous and horizontal ribs and greater airway resistance and ribcage compliance. Therefore, this population is more susceptible to muscle fatigue, requiring ventilatory support, hospitalisation and respiratory physiotherapy.[1–3]

Respiratory physiotherapy uses techniques to improve respiratory function, facilitate gas exchange, prevent and treat pulmonary complications and improve ventilation–perfusion, mucociliary clearance and secretion removal.[3] These techniques can be conventional or non-conventional, depending on the initial contact with the ribcage.[4] Conventional techniques are usually older than non-conventional techniques, and the contact with the ribcage does not always consider pulmonary mechanics. In contrast, non-conventional techniques are usually employed according to anatomical and physiological differences of each age group.[4–6]

Although conventional and non-conventional physiotherapy are commonly used in neonatal intensive care units to improve secretion mobilisation and thoracoabdominal repercussion,[5–12] the effects on pulmonary mechanics of newborns are still nuclear. Therefore, this systematic review aims to evaluate the effects of conventional and non-conventional respiratory physiotherapies, respiratory pattern, pulmonary

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mechanics and pain in newborns and identify protocols for respiratory physiotherapy used in this population.

METHODS AND ANALYSIS

Registration

This protocol followed the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P)[13] and was registered in the International Prospective Register of Systematic Reviews (PROSPERO) in August 2021.

Eligibility criteria

Types of studies

We will include randomised controlled trials published in full. Studies not fully available or incomplete will be excluded.

Types of participants

We will include studies performed with newborns of both sexes, aged between 1 hour and 28 days, and admitted to neonatal intensive care units. We will exclude studies conducted with animals or newborns presenting structural alterations (eg, chest wall deformities, abdominal pathologies and cardiac diseases).

Types of interventions

We will include studies comparing conventional (vibration or vibrocompression, percussion and postural drainage) with non-conventional physiotherapy techniques (assisted autogenic drainage, increased expiratory flow, prolonged slow expiration and thoracoabdominal rebalancing).[4 6] All techniques are described as follows.

Vibrocompression and vibropercussion: bronchial hygiene manoeuvres with thixotropic effects caused by the propagation of mechanic waves on the chest wall. These waves allow secretion mobilisation and facilitate its elimination.[4]

Postural drainage: bronchial hygiene manoeuvre that uses gravity to drain pulmonary secretion to the centre of the bronchial tree.[4]

Assisted autogenic drainage: the flow generated during the manoeuvre is altered and reaches the small airways and pulmonary periphery, interfering with the depuration process.[4]

Increased expiratory flow: bronchial hygiene manoeuvre consisting of changes in thoracoabdominal movements promoted by the hands of the therapist with the newborn positioned supine. The technique is applied during the expiratory phase to increase the expiratory flow of the newborn.[4]

Prolonged slow expiration: bronchial hygiene manoeuvre that consists of prolonging spontaneous breathing by manually pressing the chest and abdomen during expiration. The manual pressure must be applied continuously and synchronously in both regions to stimulate the expiratory flow and mobilise secretions.[14 15]

Thoracoabdominal rebalancing: the technique consists of manual support on different points of the thoracoabdominal region (eg, floating ribs and sternum) to assist ribcage movement and mobilization of the thorax.[10]

Types of outcome measures

Primary outcomes

1. Lung compliance and airway resistance: variables assessed in the mechanical ventilator using the following formulas: $C_{dyn} = VT/PIPEEP$; $C_{stat} = VT/P_{plateau} - PEEP$; $C_{raw} = PI - P_{plateau}/\text{inspiratory flow}$ C_{dyn}, dynamic compliance; VT, tidal volume; PI, inspiratory pressure; PEEP, Positive End Expiratory Pressure; C_{stat}, static compliance Craw, airway resistance; $P_{plateau}$, Plateau Pressure.
2. Lung volumes and capacities: pneumotachograph coupled to a flow transducer.
3. Thoracoabdominal synchrony: observation of the evaluator, Silverman Andersen Respiratory Severity Score and methods for assessing thoracoabdominal movement (eg, plethysmography and biophotogrammery).

Secondary outcomes

1. Respiratory distress: the instruments used to assess respiratory distress will not be limited, but dichotomous answers (eg, yes or no) will be considered during data extraction.
2. Pain: the instruments used to assess pain will not be limited, but dichotomous answers (eg, yes or no) will be considered during data extraction.
3. Heart rate: monitored using multiparametric monitors.
4. Respiratory rate: respiratory rate (newborns under mechanical ventilation) and respiratory incursions within 1 min assessed visually or using multiparametric monitors.
5. Peripheral oxygen saturation: monitored using multiparametric monitors.

Information sources

Search strategy

Searches will be conducted from September 2022 using PubMed, LILACS, SciELO, ScienceDirect, Cochrane Central and Web of Science databases. The reference list of all included studies and relevant systematic reviews identified in the search will be screened for additional eligible studies. Finally, experts in the field will be asked for further eligible studies.

A detailed description of the search strategies is provided in the online supplemental material. The main terms, synonyms and relevant examples were identified and included in the search using the Boolean operator OR. Articles in English and Portuguese will be included with no publication date restriction. The search will be conducted in titles, abstracts and main body of the texts. To perform an up-to-date review, the search will be redone before submission and potential, new released and relevant articles will be incorporated.

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Study selection

The search results will be imported into the reference list management tool Mendeley (https://www.mendeley.com). Any duplicates will be identified and removed using Mendeley. Then, the reference list will be exported to the Rayyan QCRI systematic review web-based application (https://rayyan.qcri.org). We will record the selection process in sufficient detail to complete a PRISMA flow diagram.

Two review authors (AdMN and ATdCS) will independently screen the titles and abstracts of the remaining search results and code them as 'retrieve' (eligible or potentially eligible/unclear) or 'do not retrieve'. We will retrieve the full-text study reports of all potentially eligible studies, and two review authors (AdMN and ATdNSFF) will independently screen for inclusion and record the reasons for exclusion of ineligible studies. We will resolve any disagreement through discussion or, if required, we will consult a third review author (SAP). We will identify and exclude duplicates and collate multiple reports of the same study so that each study, rather than each report, is the unit of interest in the review.

Data extraction

We will extract data from all included studies using a prepiloted form. Two authors (AdMN and MFPC) will extract data, and two authors (KSM and SAP) will verify data accuracy and integrity. We will extract the following characteristics from included studies:

1. Participants: age, sex and geographical location.
2. Methods: study design, location, sample size and year.
3. Interventions: intervention, comparison, duration of intervention and method of delivery.
4. Outcomes: primary and secondary outcomes.
5. Limitations.

Quality assessment

Two reviewers (AdMN and ATdCS) will independently assess the risk of bias using the following domains of the PEDro scale: eligibility criteria, random allocation, concealed allocation, baseline comparability, blinding of participants, blinding of therapists, blinding of assessors, adequate follow-up, intention-to-treat analysis, between-group comparisons and measures of variability. The total scores of the scale range from 0 to 10, and risk of bias will be interpreted as high (0–3), moderate (5–7) or low (8–10).[16] Results will be presented in a table containing the name of authors and scores obtained on each item of the PEDro Scale.

Data analysis

The characteristics of interventions will be described and presented as mean and SD. A meta-analysis will be conducted using the Review Manager software (Copenhagen: The Nordic Cochrane Collaboration) if data regarding between-group comparisons are available.

The heterogeneity of studies will be assessed by quantifying the proportion of total variability of the estimates (I^2). I^2 ranges from 0% to 100%, in which 0% indicates lack of variability, >25% low variability, >50% moderate variability and >75% high variability. A significance level of $p < 0.10$ will be considered statistically significant for I^2. Effect sizes (Z value) will also be assessed, and $p < 0.05$ will be considered statistically significant.[17]

Certainty of evidence

Two authors (ATdNSFF and KSM) will independently assess the reliability of evidence using the Grading of Recommendations Assessment, Development and Evaluation.[18] Results will be presented in tables and classified into high, moderate, low or very low.

Study timeline

This review will be conducted in 8–12 months, contemplating all steps described above.

Patient and public involvement

None.

ETHICS AND DISSEMINATION

Ethics approval is not required for this systematic review. The findings from this review will be submitted for publication in a scientific journal and presentation at national and international conferences. Findings will also be shared on social media using accessible language.

Twitter Silvana Alves Pereira @PTPereiraSA

Contributors All authors contributed substantially to the study design, development of inclusion criteria and search strategies and read and approved the final version of the protocol. AdMN developed, designed and registered the protocol in the PROSPERO database. SAP, ATdNSFF, KSM, ATdCS and MFPC provided critical insights and reviewed the protocol.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Not applicable to our type of study.

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ORCID iDs
Adriele de Morais Nunes http://orcid.org/0000-0002-2802-4093
Silvana Alves Pereira http://orcid.org/0000-0002-6226-2837

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