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Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old (Review)

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Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old.
Cochrane Database of Systematic Reviews 2012, Issue 2. Art. No.: CD004873.
DOI: 10.1002/14651858.CD004873.pub4.

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TABLE OF CONTENTS

[Intervention Review]

Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old

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Editorial group: Cochrane Acute Respiratory Infections Group
Publication status and date: Edited (no change to conclusions), comment added to review, published in Issue 12, 2012.

Citation: Roqué i Figuls M, Giné-Garriga M, Granados Rugeles C, Perrotta C. Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old. *Cochrane Database of Systematic Reviews* 2012, Issue 2. Art. No.: CD004873. DOI: 10.1002/14651858.CD004873.pub4.

ABSTRACT

Background

This is an update of the original Cochrane review published in 2005 and updated in 2007. Acute bronchiolitis is the leading cause of medical emergencies during winter in children younger than two years of age. Chest physiotherapy is thought to assist infants in the clearance of secretions and to decrease ventilatory effort.

Objectives

The main objective was to determine the efficacy of chest physiotherapy in infants aged less than 24 months old with acute bronchiolitis. A secondary objective was to determine the efficacy of different techniques of chest physiotherapy (for example, vibration and percussion and passive forced exhalation).

Search methods

We searched the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2011, Issue 4) which contains the Cochrane Acute Respiratory Infections Group's Specialised Register, MEDLINE (1966 to November week 3, 2011), MEDLINE in-process and other non-indexed citations (8 December 2011), EMBASE.com (1990 to December 2011), CINAHL (1982 to December 2011), LILACS (1985 to December 2011) and Web of Science (1985 to December 2011).

Selection criteria

Randomised controlled trials (RCTs) in which chest physiotherapy was compared against no intervention or against another type of physiotherapy in bronchiolitis patients younger than 24 months of age.

Data collection and analysis

Two review authors independently extracted data. Primary outcomes were respiratory parameters and improvement in severity of disease. Secondary outcomes were length of hospital stay, duration of oxygen supplementation and the use of bronchodilators and steroids. No pooling of data was possible.

Main results

Nine clinical trials including 891 participants were included comparing physiotherapy with no intervention. Five trials (246 participants) evaluated vibration and percussion techniques and four trials (645 participants) evaluated passive expiratory techniques. We observed no significant differences in the severity of disease (eight trials, 867 participants). Results were negative for both types of physiotherapy. We observed no differences between groups in respiratory parameters (two trials, 118 participants), oxygen requirements (one trial, 50 participants), length of stay (five trials, 222 participants) or severe side effects (two trials, 595 participants). Differences in mild transient adverse effects (vomiting and respiratory instability) have been observed (one trial, 496 participants).

Authors' conclusions

Since the last publication of this review new good-quality evidence has appeared, strengthening the conclusions of the review. Chest physiotherapy does not improve the severity of the disease, respiratory parameters, or reduce length of hospital stay or oxygen requirements in hospitalised infants with acute bronchiolitis not on mechanical ventilation. Chest physiotherapy modalities (vibration and percussion or passive expiratory techniques) have shown equally negative results.

PLAIN LANGUAGE SUMMARY

Chest physiotherapy for acute bronchiolitis in children younger than two years of age

Acute bronchiolitis is a frequent viral respiratory infection in children younger than two years of age. Most children have a mild disease and do not require hospitalisation. Those who do need to be hospitalised sometimes have difficulty clearing phlegm (thick mucous respiratory secretions caused by the infection). It has been proposed that chest physiotherapy may assist in the clearance of the respiratory secretions and improve breathing. This review has not found any evidence that chest physiotherapy has a clinical benefit in infants with acute bronchiolitis.

In the nine trials identified, which included 891 participants, chest physiotherapy has not shown to reduce the length of disease, improve the clinical scores or reduce the hospital stay in comparison with no treatment. In one trial, a physiotherapy technique based on progressive expiration that avoids occlusion of the airway combined with salbutamol provided transient relief in children with moderate bronchiolitis.The included trials did not report any severe adverse events, although one of the trials reported a higher number of transient episodes of vomiting and respiratory instability after physiotherapy. The conclusions are robust although they are based on a small number of trials, because the results are consistent across the trials and consistent with a large trial with a low risk of bias.

BACKGROUND

Description of the condition

Acute bronchiolitis is the leading cause of Emergency Department visits during winter in children younger than two years of age. It results in high utilisation of healthcare resources, being an increasing burden on outpatient practices, Emergency Departments and hospitals (Carroll 2008). It also results in significant morbidity for infants. Infant mortality rates vary depending upon the population. The incidence of bronchiolitis-associated death was reported to be 2 per 10,000 live births in the USA in the 1990s (Holman 2003) and 1.82 per 100,000 in the UK in 2000 (Panickar 2005).

Criteria for diagnosing acute bronchiolitis vary greatly. Most doctors agree that the case definition for an episode of acute bronchiolitis should include children aged 24 months or younger who have a first episode of acute wheezing accompanied by physical findings of viral infection (for example, coryza, cough and fever) (González 2001; Videla 1998; Wainwright 2003). The most prevalent virus identified with the disease is respiratory syncytial virus (RSV).

Most cases of acute bronchiolitis are mild and can be treated on an outpatient basis; 1% to 3% (depending on the severity of the disease) will require hospitalisation (Mc Millan 1994). Risk factors associated with the need for hospitalisation are young age, premature birth, chronic lung disease, congenital heart disease and a deficient immune system (Wallis 1999). In low-income countries the most frequent risk factors associated with hospitalisation and severe disease include living in a low-income family, malnourishment, low birthweight, age of the mother, mother's education level, being bottle-fed and premature birth (Spencer 1996).

Description of the intervention

The standard treatment of acute bronchiolitis is to ensure adequate oxygenation, fluid intake and feeding of the infant (AAP 2006; SIGN 2006). Pharmacological strategies considered in acute bronchiolitis include bronchodilators, antibiotics and steroids but their effectiveness remains quite uncertain and current guidelines do not recommend their use (AAP 2006; SIGN 2006). There is no evidence to support the use of glucocorticoids or antibiotics (Fernandes 2010; Spurling 2011) and although there is some evidence that bronchodilators, nebulised hypertonic saline, epinephrine and heliox therapy may have some benefit improving clinical scores (Gadomski 2010; Hartling 2011; Liet 2010; Umoren 2011; Zhang 2011), this benefit must be weighed against the lack of benefit in reducing duration or severity of illness, costs and adverse effects.

Chest physiotherapy has been proposed to assist in the clearance of tracheo-bronchial secretions. The main goal is to clear the airway obstruction, reduce airway resistance, enhance gas exchange and reduce the work of breathing. Different techniques are used in paediatric patients: chest percussion, vibration in postural drainage positions, chest shaking, directed coughing and slow passive forced exhalation to trigger coughing and help to move secretions. Specific measures are recommended to prevent spreading of the disease during the procedure, such as cohort segregation, hand washing and wearing gowns, masks, gloves and goggles (Hall 1981). As a drawback of chest physiotherapy it has been claimed that it might cause distress to the infant and concerns have arisen about the safety of the procedure, especially in relation to rib fractures in patients at risk (Beeby 1998; Chalumeau 2002).

Why it is important to do this review

The publication of this review prompted the recommendation that chest physiotherapy based on vibration and percussion not be applied routinely in hospital settings (AAP 2006; BGT 2005; SIGN 2006) and we called for further research to be done in this area. Nevertheless, clinical practice in several countries is not aligned with these recommendations. In France, passive forced exhalation techniques are recommended by a consensus panel both for inpatient and outpatient cases (Beauvois 2001; Consensus 2001) with extremely high implementation in outpatient settings (David 2010; Halna 2005; Touzet 2007). Other countries also report using chest physiotherapy in outpatient and inpatient settings, although it is not clear which techniques are applied. A 2007 survey of cases treated in primary care or hospitals in Spain identified that 7.3% of infants received physiotherapy (González 2010a). A 2006 survey of Swiss paediatricians identified that 4.0% of them reported always prescribing chest physiotherapy for outpatients and 14.4% reported always prescribing chest physiotherapy for inpatients (Barben 2008). Parents' expectation and demand for chest physiotherapy in clinical daily practice may explain its widespread use (Sanchez 2007).

In line with recommendations for further research, new clinical trials have been conducted since the last publication of this review. This updated review aims to integrate the most current evidence in light of the existing gap between clinical practice and evidence and the possibility of a differential effect of chest physiotherapy depending on the technique used.

OBJECTIVES

1. The main objective of this review was to determine the efficacy of chest physiotherapy in infants aged less than 24 months with acute bronchiolitis.
2. A secondary objective was to determine the efficacy of different techniques of chest physiotherapy (vibration and percussion and passive forced exhalation).

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials (RCTs) evaluating chest physiotherapy in acute bronchiolitis.

Types of participants

Infants younger than 24 months of age with acute bronchiolitis as defined by the studies' authors, in all settings.

Types of interventions

We included trials that compared any type of chest physiotherapy (postural drainage, chest percussion, vibration, chest shaking, directed coughing or forced exhalation technique) versus standard care (excluding chest physiotherapy) or other drainage or breathing techniques.

Types of outcome measures

Primary outcomes

1. Change in the severity status of bronchiolitis
2. Time to recovery
3. Oxygen saturation levels
4. Transcutaneous carbon dioxide partial pressure (PCO_2)

Secondary outcomes

1. Duration of oxygen supplementation
2. Length of hospital stay
3. Use of bronchodilators and steroids
4. Parents' impression of physiotherapy benefit

We defined adverse events as any undesired outcome due to the intervention. For example, rib fractures, bradycardia, respiratory instability, vomiting or long-term neurological disabilities. All outcomes were taken into consideration. We described the method used to measure any adverse events.

Search methods for identification of studies

Electronic searches

In this 2011 update we searched the Cochrane Central Register of Controlled Trials (CENTRAL) 2011, Issue 4, part of *The Cochrane Library* www.thecochranelibrary.com (accessed 13 December 2011), which includes the Cochrane Acute Respiratory Infections Group's Specialised Register, MEDLINE (May 2006 to November week 3, 2011), MEDLINE in-process and other non-indexed citations (8 December 2011), EMBASE.com (December 2005 to December 2011), CINAHL (2006 to December 2011), LILACS (2006 to December 2011) and Web of Science (2006 to December 2011). See Appendix 1 for details of previous searches.

We used the following search strategy to search CENTRAL and MEDLINE. We did not combine the search strategy with a filter for identifying randomised trials as there were too few results. We adapted the search strategy to search MEDLINE in-process (Appendix 2); Embase.com (Appendix 3); CINAHL (Appendix 4); LILACS (Appendix 5) and Web of Science (Appendix 6).

1 exp Bronchiolitis/
2 bronchiolit*.tw.
3 exp Respiratory Syncytial Viruses/
4 Respiratory Syncytial Virus Infections/
5 (repiratory syncytial virus* or rsv).tw.
6 or/1-5
7 exp Physical Therapy Modalities/
8 (chest adj2 (physiotherap* or physical therap*)).tw.
9 Drainage, Postural/
10 (postural adj2 drainage*).tw.
11 Percussion/
12 (chest* adj3 percuss*).tw.
13 Vibration/
14 vibrat*.tw.
15 (chest* adj3 shak*).tw.
16 directed cough*.tw.
17 forced exhalation.tw.
18 forced expiration.tw.
19 Breathing Exercises/
20 breathing exercise*.tw.
21 or/7-20
22 6 and 21

Searching other resources

In the first publication of this review, we examined reference lists of general paediatric, infectious diseases, pneumatology and physiotherapy textbooks. We reviewed reference lists of all selected articles and recent review articles and also examined published abstracts from the Pediatric Academic Societies' Annual Meetings (US) (1999 to 2003). We handsearched the French journals *Journal Pédiatrie Puériculture* (1999 to May 2004) and *Archives de Pédiatrie* (1994 to 1997; 2000 to May 2004).

Data collection and analysis

Selection of studies

Three review authors (CG, MG, MR) independently screened the initial search of all the databases and references lists to identify citations which seemed relevant to this review. We obtained the full-text articles once pertinent abstracts or titles were identified. The three review authors (CG, MG, MR) independently decided on which trials to include using a standard form. There were no disagreements in relation to the included trials.

Data extraction and management

Two review authors (MR, MG) independently extracted the data. We used a standard form to extract the following data:

- characteristics of the study (design, method of randomisation, withdrawals, drop outs);
- participants (age, gender, low birth weight or normal weight, ambulatory or hospital patients, disease severity, nutritional status);
- intervention (type of chest physiotherapy, administration, co-interventions) and its comparator;
- outcomes (types of outcome measures, timing of outcomes, adverse effects); and
- results.

Assessment of risk of bias in included studies

Two review authors (MG, MR) independently assessed risk of bias for each study using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). We resolved any disagreement by discussion.

(1) Sequence generation (selection bias)

We described for each included study the methods used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups. We assessed the methods as:

- low risk of bias (any truly random process, e.g. random number table; computer random number generator);
- high risk of bias (any non random process, e.g. odd or even date of birth; hospital or clinic record number); or
- unclear risk of bias.

(2) Allocation concealment (selection bias)

We described for each included study the method used to conceal the allocation sequence in sufficient detail and determine whether

intervention allocation could have been foreseen in advance of, or during recruitment, or changed after assignment. We assessed the methods as:

- low risk of bias (e.g. telephone or central randomisation; consecutively numbered sealed opaque envelopes);
- high risk of bias (open random allocation; unsealed or non-opaque envelopes, alternation; date of birth); or
- unclear risk of bias.

(3) Blinding of outcome assessment (detection bias)

Blinding of study participants and personnel was not possible due to the characteristics of the interventions studied. We described for each included study all the methods used, if any, to blind outcome assessors from knowledge of which intervention a participant received. We also provided information on whether the intended blinding was effective. Where blinding was not possible, we assessed whether the lack of blinding was likely to have introduced bias. We assessed the methods as:

- adequate;
- high risk of bias; or
- unclear risk of bias.

(4) Incomplete outcome data (attrition bias through withdrawals, drop outs, protocol deviations)

We described for each included study and for each outcome or class of outcomes the completeness of data including attrition and exclusions from the analysis. We stated whether attrition and exclusions were reported, the numbers included in the analysis at each stage (compared with the total randomised participants), reasons for attrition or exclusion where reported and whether missing data were balanced across groups or were related to outcomes. We assessed whether each study was at risk for attrition bias:

- low risk of bias;
- high risk of bias; or
- unclear risk of bias.

(5) Selective reporting bias

We described for each included study how the possibility of selective outcome reporting bias was examined by us and what we found. We assessed the methods as:

- low risk of bias (where it is clear that all of the study's pre-specified outcomes and all expected outcomes of interest to the review have been reported);
- high risk of bias (where not all of the study's pre-specified outcomes have been reported; one or more reported primary outcomes were not pre-specified; outcomes of interest are reported incompletely and so cannot be used; study fails to include results of a key outcome that would have been expected to have been reported); or
- unclear risk of bias.

(6) Other sources of bias

We described for each included study any important concerns we have about other possible sources of bias, in particular about contamination. We assessed whether each study was free of other problems that could put it at risk of bias:

- low risk of bias;
- high risk of bias; or
- unclear risk of bias.

Measures of treatment effect

We estimated the effect of treatment by mean differences (MD) in continuous outcomes and risks ratios (RR) in dichotomous outcomes, with their corresponding confidence intervals (CI).

Unit of analysis issues

We would have assessed their data analysis in search of possible unit of analysis errors if any cluster-randomised trials had been included in the review. We would have combined them with individually randomised trials if no errors were observed. We did not expect to identify any cross-over randomised trial on this topic given the short course of bronchiolitis.

Dealing with missing data

We assessed the impact of missing data on the results from the risk of bias assessment, considering for each trial the magnitude of missing data and how it was dealt with. We tried to assess how many patients were excluded from the trials analysis, which treatment group they belonged to, what were the causes for excluding them and whether their exclusion was biased the trials results. If a quantitative analyses had been performed, the main analysis would be based on available data and a secondary intention-to-treat (ITT) sensitivity analysis would have been performed for dichotomous outcomes. The ITT sub-analysis would have used imputation assuming that all missing data corresponded to a negative outcome.

Assessment of heterogeneity

We would have assessed statistical heterogeneity with the I^2 statistic (Higgins 2003), considering values $I^2 \geq 50\%$ as a sign of moderate to high heterogeneity if the trials included had been similar enough to perform a quantitative analysis.

Assessment of reporting biases

We did not explore publication bias and other reporting biases statistically or graphically due to the lack of statistical data in the included studies.

Data synthesis

We did not perform a meta-analysis due to clinical heterogeneity and statistical considerations. We described the individual results with the effect measures described in the original trials. If the included trials had been similar enough to combine them, a statistical pooling of effect measures would have been performed under a random-effects model, applying the inverse-variance method.

Subgroup analysis and investigation of heterogeneity

We did not plan or perform any subgroup analyses.

Sensitivity analysis

We did not plan or perform any sensitivity analyses.

RESULTS

Description of studies

Results of the search

In this 2011 update we retrieved 120 records from the databases searched, as well as one relevant record identified in Google searches.

Six trials met the inclusion criteria, although we later excluded one, as it was a controlled clinical trial (Pupin 2009). Two trials were unpublished at the time of this update and so we contacted the researchers for further clarification and data gathering (Aviram 1992; Lopez Galbany 2004). In addition, we identified an ongoing trial (Dantas 2009) but the results are not yet available.

In the first published version of this review (Perrotta 2005) we identified six studies that evaluated chest physiotherapy for acute bronchiolitis. We included three of them (Bohe 2004; Nicholas 1999; Webb 1985) and excluded three as they were not RCTs (Belcastro 1984; Bernard-Narbone 2003; Quitell 1988). In the 2007 update (Perrotta 2007) we only identified one excluded study (Postiaux 2004).

Included studies

See Characteristics of included studies.

We have included nine studies in this review (Aviram 1992; Bohe 2004; De Córdoba 2008; Gajdos 2010; Lopez Galbany 2004; Nicholas 1999; Postiaux 2011; Rochat 2010; Webb 1985), totaling 891 participants. Two of the trials are unpublished (Aviram 1992; Lopez Galbany 2004). Five trials assessed percussion and vibration techniques in 246 participants (Aviram 1992; Bohe 2004; De Córdoba 2008; Nicholas 1999; Webb 1985) while four trials assessed different passive expiratory techniques in 645 participants (Gajdos 2010; Lopez Galbany 2004; Postiaux 2011; Rochat 2010). The passive expiratory techniques explored were the increased exhalation technique (IET), a high flow technique based on passive forced expiration, and the prolonged slow expiration technique (PSE), a low flow technique based on progressive expiration that avoids occlusion of the airway. All nine trials evaluated the efficacy of chest physiotherapy in hospitalised infants with a clinical diagnosis of acute bronchiolitis. Gajdos 2010 included infants with severe bronchiolitis and Nicholas 1999 included infants who required nasogastric feeding or intravenous fluid. Two studies were carried out in the UK (Nicholas 1999; Webb 1985), two in France (Postiaux 2011; Gajdos 2010) and one in Israel (Aviram 1992), Spain (Lopez Galbany 2004), Argentina (Bohe 2004), Switzerland (Rochat 2010) and Brazil (De Córdoba 2008).

Published trials

The most recent trial was conducted in Belgium (Postiaux 2011) and recruited 20 infants with acute RSV bronchiolitis, with a mean age of 4.19 months. Infants were randomised to inhalation of a 3% hypertonic saline solution and salbutamol (n = eight) or to a physiotherapy protocol combining prolonged slow expiration technique and coughing provoked after the same inhalation of saline solution and salbutamol (n = 12). The two groups were similar with regards to age, sex and Wang clinical severity score (Wang 1992) on admission. The trial main outcome is Wang's clinical score, which assigns a value between zero and three to each of the four variables: respiratory rate, wheezing, retractions and general condition. The maximum Wang score is 12 and a higher Wang score indicates worse condition. Secondary outcomes were SpO_2 and heart rate (HR). All outcomes were assessed before the session, at the end of the session and two hours afterwards. Both of the paediatrician evaluators were blinded to the applied treatment and goals. Physiotherapists in charge of administering the treatments were instructed to ignore the results of each evaluation until the end of the study. The participants' parents were unaware of the group in which their child was included. In both groups the periods of time spent in the room were identical, so outside observers were blinded to the applied treatment.

The largest trial was also conducted in France (Gajdos 2010), randomising 496 hospitalised infants with a first acute bronchiolitis episode between the ages of 15 days and 24 months (mean age two months, range 1.3 to 3.9 months). Infants had to present at least one of the following on admission: toxic aspect; history of apnoea or cyanosis; respiratory rate > 60/min, pulse oxymetry < 95%, alimentary intake < 2/3 of needs. The control group presented a higher proportion of RSV-positive patients than the intervention group (76.4% versus 73.3%), as well as the proportion of cases of lung atelectasia diagnosis on X-ray (12.9% versus 7.6%). Patients were allocated to receive either the passive increased exhalation technique with assisted cough (n = 246) or nasal suction (n = 250). All interventions were administered three times a day, with the physiotherapist staying alone with the infant in a room with a covered window pane. The primary outcome was time to recovery, defined as eight hours without oxygen supplementation associated with minimal or no chest recession and ingesting more than two-thirds of daily food requirements. Survival analyses of time to recovery were adjusted for prognostic baseline covariates (personal eczema or history of atopy, age in months, hypoxaemia at randomisation, need for intravenous (IV) fluids at randomisation, atelectasia at randomisation, duration of symptoms, use of mucolytic before randomisation or RSV infection). The therapists were not involved in the evaluation of time to recovery. Secondary outcomes were intensive care unit admissions, artificial ventilation, antibiotic treatment, description of side effects during procedures and parental perception of comfort.

Rochat 2010 analyzed 99 infants admitted to a Swiss hospital with bronchiolitis during two consecutive respiratory syncytial virus (RSV) seasons (2005 to 2006 and 2006 to 2007). Participants had a mean age of 3.9 months. All infants received standard care including oxygen therapy and rhinopharyngeal suctioning. Infants were either randomised to additionally receive physiotherapy protocol combining prolonged slow expiratory technique, slow accelerated expiratory technique and coughing provoked (n = 51), or randomised to no physiotherapy (n = 53). The two groups were similar with regard to age, sex, clinical and respiratory severity score on admission, proportion who were RSV ELISA positive (overall proportion 75%) and history of eczema (overall proportion 7%). The trial assessed time to clinical stability, clinical and respiratory scores, respiratory rate, pulse oximetry oxygen saturation (SpO_2) and complications such as transfer to the intensive care unit.

De Córdoba 2008 randomised 24 hospitalised infants below two years of age, in Brazil. Nineteen of those infants were analyzed, of whom five were allocated to vibration and postural drainage, eight to percussion and postural drainage and six to

the control group (bronchial aspiration). Infants had to present clinical and laboratory signs of acute viral bronchiolitis and bronchial hypersecretion (pulmonary auscultation). There was no information on percentage of RSV patients or patients with collapse/consolidation at baseline or during the trial. The three groups were similar with regard to age, sex, oxygen saturation and cardiac and respiratory frequency on admission. Mean age was 93 days, 131 days and 125 days in each intervention group. The main outcomes were: saturation of oxygen pulse, cardiac frequency, respiratory frequency, Silverman-Anderson Score of respiratory discomfort and amount of inhaled secretions. Outcomes were assessed immediately after treatment and 15 minutes later. Results were expressed as means and standard deviations (SDs).

In the Bohe 2004 study conducted in Argentina, 16 infants were randomly allocated to the physiotherapy group and 16 to the control group. Patients were included if they had a clinical diagnosis of acute bronchiolitis defined by an acute upper respiratory infection plus fever, tachypnoea or increase of respiratory effort. The mean age of the participants was 2.8 months and 78.1% of participants were positive for RSV. There was no information on percentage of patients with atelectasis/consolidation at baseline or during the trial. The intervention was percussion, postural drainage, vibration and nasopharyngeal aspiration twice a day. The control group received only nasopharyngeal aspiration. The end points were length of hospital stay and a severity score constructed out of five clinical variables: respiratory rate, heart rate, lung auscultation and accessory muscle use.

A trial conducted in the UK (Nicholas 1999) randomly allocated 50 infants to control (n = 24) or treatment (n = 26) groups; their mean age was 2.8 months (range 0.4 to 7.6 months). Infants had to present clinical diagnoses of acute bronchiolitis and severe respiratory distress requiring nasogastric tube feeding or intravenous fluids. The intervention and control groups presented similar proportions of RSV-positive patients (79% versus 85%). There was no information on the atelectasis/consolidation at study entry or afterwards. The physiotherapy protocol established manual techniques of percussion and vibrations performed in postural drainage positions with possible modifications as required in relation to infant tolerance. The main outcomes were clinical status and length of hospital stay. Secondary end points were oxygen requirements and change in oxygen saturation levels after physiotherapy; these outcomes were measured only in the intervention arm. Results were expressed using means but SDs were not reported. The study author could not provide clarification as she was no longer in possession of the complete database.

The oldest trial was conducted in the UK (Webb 1985) and analyzed 90 infants with a mean age of 4.6 months (range 0 to 15 months) presenting a clinical diagnosis of acute viral bronchiolitis. Forty-four infants were allocated to physiotherapy and 46 infants to the control group. The two groups were similar with regard to age, sex, severity score on admission, proportion who were RSV-positive (overall proportion 69%), proportion with a first-degree family history of atopy (overall proportion 36%), those participants with smokers in their household (overall proportion 66%) and participants with some degree of atelectasis/consolidation on chest radiographs (overall proportion 24.5%). The intervention tested consisted of "chest percussion with a cupped hand for three minutes in each of five postural drainage positions followed by assisted coughing" or "gentle oropharyngeal suction performed twice each day while in the hospital". Three medical doctors made clinical assessments of the severity of the illness at a fixed time every day. A score of zero to three was allocated for each of 10 clinical signs: heart rate, respiratory rate, hyperinflation, use of accessory muscles, recession, rhinitis, wheeze, cough, crepitations and rhonchi, to give a total severity clinical score of a maximum of 30 points. At hospital discharge, parents were asked to maintain a symptom record diary and children were reviewed in outpatient clinics after two weeks. The main outcomes were: clinical score on admission, every day and after five days, length of hospital stay and total length of illness. Results were expressed as median and range. The study author was unable to provide the mean and standard deviation of each parameter because the raw data were no longer available.

Unpublished trials

In the Lopez Galbany 2004 pilot study conducted in Spain, 30 infants with RSV-positive bronchiolitis were randomly allocated to receive physiotherapy with forced expiratory technique (n = 15) or no intervention (n = 15). Outcomes assessed were the Bierman Pierson modified severity clinical score and hospital length of stay.

The Aviram 1992 study was a randomised controlled intervention study conducted in Israel which included 50 infants aged one to five months, paired by age and clinical severity score. Participants were allocated to receive chest physiotherapy or not, in addition to salbutamol inhalations every six hours. Although there is no information on the physiotherapy technique applied, it is assumed to be based on vibration and percussion. Outcomes assessed were length of stay in hospital, improvement in clinical score and changes in SaO_2. Clinical scoring was performed in a blinded manner.

Excluded studies

See Characteristics of excluded studies and Characteristics of ongoing studies tables.

We excluded five studies: three of them were uncontrolled intervention studies (Bernard-Narbone 2003; Postiaux 2004; Quitell 1988) and two were non-randomised comparative trials (Belcastro 1984; Pupin 2009). Also, we identified an ongoing trial (Dantas 2009) but the trialists could not be contacted to obtain detailed information about the trial.

The two comparative trials' details are as follows:

Belcastro 1984 was a pilot study with 12 patients that compared:

1. osteopathic manipulative treatment to postural drainage (PD) in a non-randomised fashion (first three patients received osteopathy and the rest PD); and
2. bronchodilators to placebo in a randomised, double-blind fashion.

The end points were number of hospital days and mean daily respiratory rates.

Pupin 2009 was a comparative controlled intervention study which included 81 infants with clinically and radiologically diagnosed acute viral bronchiolitis. Participants were non-randomly allocated to receive expiratory flow increase technique (EFIT), vibration plus

postural drainage or a control procedure (no respiratory therapy, only manual contact of the physical therapist on the thorax). Each procedure consisted of a single therapeutic session performed in the morning for 10 minutes. Heart rate, respiratory rate and SpO_2 were assessed before the procedure and at 10, 30 and 60 minutes after it. The authors conclude that "In terms of overall improvement of cardiorespiratory parameters, neither the EFIT nor vibration/PD provided any benefit to infants with acute viral bronchiolitis. However, over time, respiratory physical therapy seems to contribute to decreasing the respiratory rate in these patients".

Risk of bias in included studies

Overall, the risk of bias of result for the comparison of passive expiratory techniques is low due to a single trial of low risk of bias in all domains (Gajdos 2010). On the other hand, the overall risk of bias for the comparison of vibration and percussion techniques is moderate to high, because of the uncertainties and limitations associated with the assessment of risk of bias in the four trials in this comparison (Figure 1; Figure 2).

Figure 1. 'Risk of bias' graph: review authors' judgements about each methodological quality item presented as percentages across all included studies.

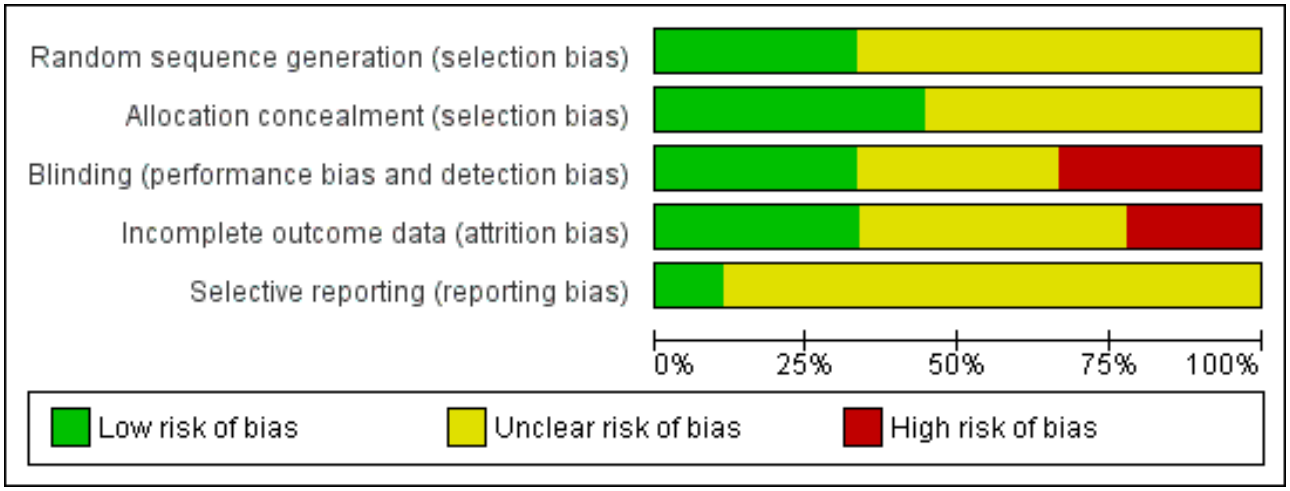
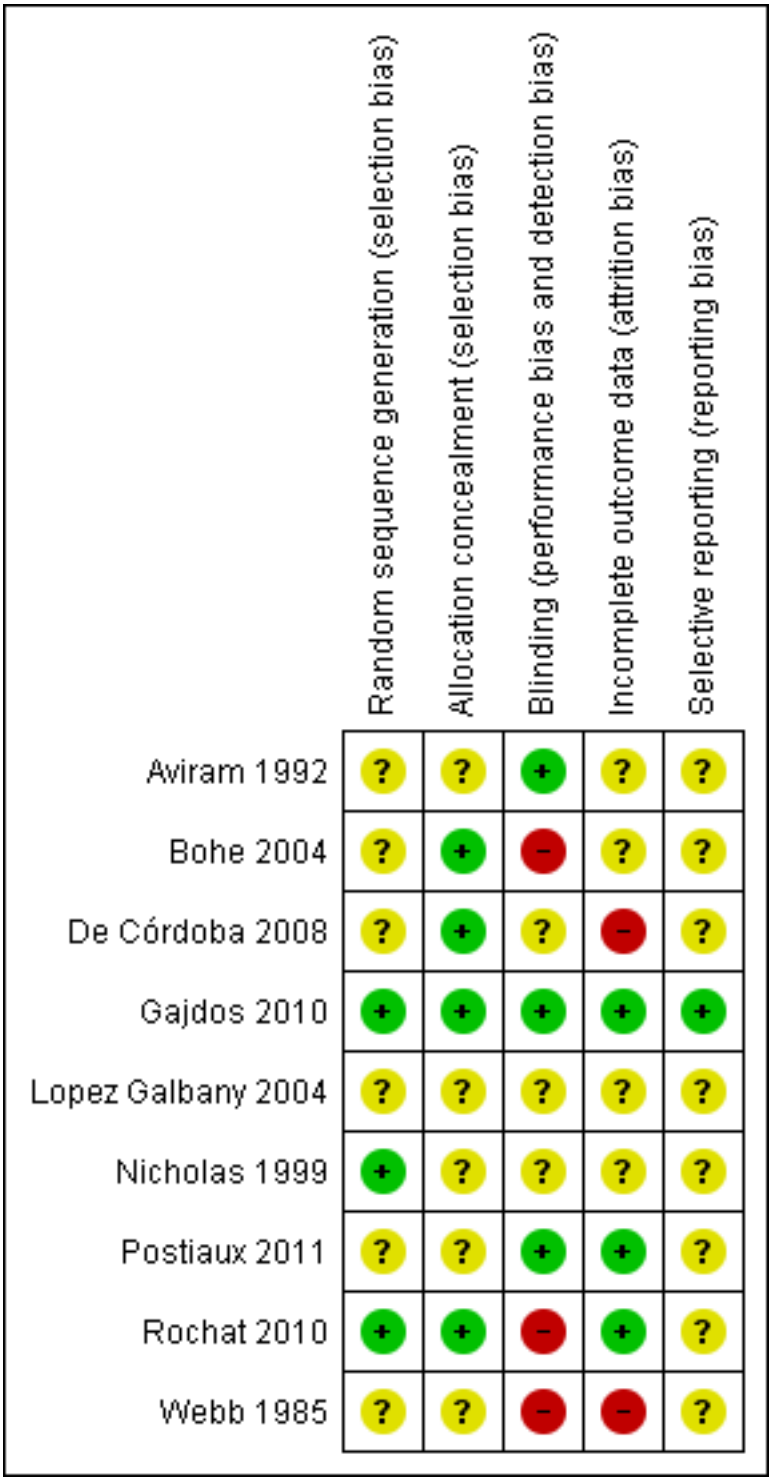


Figure 2. 'Risk of bias' summary: review authors' judgements about each methodological quality item for each included study.



Allocation

Scant information was provided regarding randomisation methods and allocation concealment. Three trials described adequate sequence generation procedures (Gajdos 2010; Nicholas 1999; Rochat 2010). Four trials either described procedures to conceal allocation (De Córdoba 2008; Gajdos 2010; Rochat 2010) or claimed to have concealed allocation (Bohe 2004).

Blinding

Masking of outcome assessment was most likely absent in all but two of the included trials. Two trials implemented rigorous

procedures to mask outcome assessments (Gajdos 2010; Postiaux 2011) but the other trials were admittedly open (Bohe 2004; Rochat 2010; Webb 1985) or most likely so (Aviram 1992; De Córdoba 2008; Lopez Galbany 2004; Nicholas 1999). Even though some outcomes were objective and not subject to bias (oxygen saturation, heart rate), other outcomes depended on observation and could be more vulnerable (clinical scores and respiratory discomfort questionnaire).

Incomplete outcome data

A single trial (Gajdos 2010) had a large sample size and had an adequate description of attrition of participants, as well as a description of how they were handled (ITT analysis). Another trial had a large sample and an adequate description of attrition of participants (Rochat 2010). The rest of the included trials were small and the attrition of participants was either null (Postiaux 2011) or low and unclearly dealt with (Bohe 2004; De Córdoba 2008; Nicholas 1999; Webb 1985).

Selective reporting

A single trial (Gajdos 2010) had a low risk of selective reporting bias, as shown by comparing the trial protocol with the published paper. Assessment of selective reporting bias is not possible for the rest of the trials due to the scarcity of available data.

Effects of interventions

Although the included trials provided some data on clinical scores and length of stay, no pooling of these data was performed for clinical and statistical considerations. First of all, the clinical scores assessed in the included trials were heterogeneous:

1. the studies used different scores, although admittedly based on similar recordings;
2. the timing of the assessments was quite variable (15 minutes after the intervention (De Córdoba 2008), two hours after the intervention (Postiaux 2011), at hospital discharge (Bohe 2004), on the 5th day (Lopez Galbany 2004);
3. not all trials provided data for this outcome, in particular the largest, most valid trial (Gajdos 2010).

It seems unreliable to present a statistical analysis which only partially incorporates the available evidence, lacking the most influential trial with a sample size that doubles that of the rest of the trials. Finally, length of hospital stay is a quite asymmetric variable presented often as medians and the usual meta-analysis methods, based on symmetry, are not the right tools to analyze it.

Primary outcomes

Change in status of severity of bronchiolitis

Vibration and percussion techniques

Four trials (222 participants) in this comparison (Aviram 1992; Bohe 2004; Nicholas 1999; Webb 1985) assessed severity of bronchiolitis by means of clinical scores and none of them showed statistical differences between groups at day five.

Nicholas 1999 and Webb 1985 assessed this outcome using a common clinical score. In the Webb 1985 study there were no statistically significant differences between groups in relation to the clinical score or to the proportion who remained in hospital at day five. The clinical score was similar in both groups at baseline and on each of the first five days of assessment at the hospital. In the control group the median score on admission was 12 (range 4 to 24) in 46 patients and in the physiotherapy group the median score was 10 (range 4 to 22) in 44 patients. On the fifth day, 18 patients who remained in hospital had a median score of five (range 1 to 11) in the control group; 11 patients in the physiotherapy group had a median score of six (range not presented in the original article). The study also assessed the length of illness, which was not significantly different between the groups (Mann-Whitney test). In the control group the median length of illness was 14 (range 4 to 27) and in the physiotherapy group the median was 13 (range 7 to 26). Nicholas 1999 expressed clinical scores using means but did not report standard deviations (SDs). There were no differences in the admission mean clinical scores (intervention group 9.1 versus control group 10.9) between groups. The authors reported that clinical scores did not show any statistically significant differences between groups during the five-day trial. Data were provided on a graph but could not be extracted. Bohe 2004 used a different severity clinical score to the one used in the other two trials. The score at day five or the day of discharge was 3.25 (SD 1.27) in the physiotherapy group and 3.12 (SD 1.15) in the control group (mean difference (MD) 0.13, 95% confidence interval CI -0.71 to 0.97). The unpublished trial (Aviram 1992) did not describe the clinical score used but it also failed to show differences between treatment groups.

Passive expiratory techniques

Four trials (645 participants) in this comparison assessed severity of bronchiolitis in terms of time to recovery (Gajdos 2010), time to clinical stability (Rochat 2010) or severity of clinical scores (Lopez Galbany 2004; Postiaux 2011; Rochat 2010). Overall, there were no significant differences between groups in any of these trials.

In Gajdos 2010, the physiotherapy intervention (increased exhalation technique with assisted cough) had no significant effect on time to recovery as assessed by the logrank test and a Cox regression. The median time to recovery was 2.31 days (95% CI 1.97 to 2.73) for the control group and 2.02 days (95% CI 1.96 to 2.34) for the physiotherapy group (heart rate (HR) 1.09, 95% CI 0.91 to 1.31, P = 0.33). In Rochat 2010, time to clinical stability, assessed as primary outcome, was similar for IET and placebo (2.9 ± 2.1 versus 3.2 ± 2.8 days, logrank test P = 0.45). No differences were observed in changes in the clinical score assessing feeding, vomiting and sleep (mixed linear models P = 0.37).

In Postiaux 2011, a significant small improvement in Wang clinical score was observed immediately after the intervention in the group receiving PSE physiotherapy and salbutamol (3.6 versus 5.1, ANOVA P = 0.02), which disappeared two hours later (4.6 versus 3.7, ANOVA P = 0.21). The authors report a "day-to-day baseline improvement in Wang score significantly better [in the CPT group] than that in the control group" but this conclusion is based on within group tests on a diminishing sample due to discharge of patients ("After 5 days, 6 of the 8 control group patients had been discharged, whereas all 12 of the new-method-CPT group had been discharged").

Finally, in Lopez Galbany 2004 no significant differences were observed between groups in change from baseline values (P = 0.175). Mean values for the Bierman Pierson modified score (Bierman 1974; Tal 1983) at five days were 2.46 for the physiotherapy group and 2.79 for the control group.

Respiratory parameters

Vibration and percussion techniques

Data for respiratory parameters are available in only one of the included trials (De Córdoba 2008), assessed immediately after treatment and at 15 minutes. No significant differences were observed in oxygen saturation levels nor in respiratory frequency between the treatment groups in their 15-minute results (Kruskal Wallis test). The amount of aspired secretions was significantly smaller in the control group than in the intervention groups (P = 0.02, Kruskal Wallis test). Respiratory discomfort was assessed by means of the Silverman-Andersen Questionnaire, which significantly improved (P < 0.05, Friedman analysis of variance) post 15 minutes with respect to baseline in the two treatment groups but not in the control group. It is not clear from the paper whether differences across the groups were tested but it can be assumed that the lack of data means that there were not significant differences across the groups.

Passive expiratory techniques

In Rochat 2010, the rate of improvement of a respiratory score, defined as secondary outcome, only showed a slightly faster improvement of the respiratory score in the PSE group when including stethacoustic properties (mixed linear model P = 0.044). No differences were observed in oxygen saturation (SpO_2) (mixed linear models P = 0.85) or respiratory rates (mixed linear models P = 0.24) .

Secondary outcomes

Duration of oxygen supplementation

Vibration and percussion techniques

Nicholas (Nicholas 1999) found that the mean number of hours with supplemental oxygen in the control group was 63 (range 2.3 hours to 128 hours) compared with 86 (range 36 hours to 148 hours) in the physiotherapy group. Differences were reported as not significant using a non-parametric test.

Length of hospital stay

No statistical differences were observed in any trial in length of stay between physiotherapy and control groups, which showed almost identical values.

Vibration and percussion techniques

In Bohe (Bohe 2004), mean length of hospital stay was four days (SD 2) in the treatment group and 3.9 days (SD 1.3) in the control arm. There were no statistically significant differences between them (MD 0.13, 95% CI -1 to 1.26). In the Nicholas study (Nicholas 1999), mean length of hospital stay was 6.6 days (range 2.3 days to 11.5 days) in the control group and 6.7 days (range 3 days to 9.5 days) in the physiotherapy arm. Webb (Webb 1985) showed a median length of hospital stay of four days (range one day to 15 days) in the control group and a median of four days (range 2 days to 11 days) in the physiotherapy group.

Passive expiratory techniques

Mean length of stay in Lopez Galbany 2004 was 6.18 days in the IET physiotherapy group and 5.88 in the control group. Average hospital stay in Postiaux 2011 was 5.3 ± 1.8 days in the PSE physiotherapy group and 6.3 ± 2 days in the control group (Mann-Whitney U test P = 0.25).

Use of bronchodilators and steroids

This outcome was not reported in the included trials.

Adverse events

Vibration and percussion techniques

In Bohe's study (Bohe 2004) one case of atelectasia was reported in the control arm. The patient was withdrawn from the trial and assigned to receive chest physiotherapy.

Passive expiratory techniques

In the only trial that specifically monitored adverse events (Gajdos 2010), there were no significant differences between groups in the proportion of children who experienced one episode of bradycardia with desaturation (risk ratio (RR) 1.0, 95% CI 0.2 to 5.0, P = 1.00) or without desaturation (RR 3.6, 95% CI 0.7 to 16.9, P = 0.10). Conversely, in the IET physiotherapy group there was a higher proportion of children who had transient respiratory destabilisation (RR 10.2, 95% CI 1.3 to 78.8, P = 0.005) or vomited during the procedure (RR 5.4, 95% CI 1.6 to 18.4, P = 0.002).

Regarding the PSE technique, in Rochat's study (Rochat 2010), complications were defined as concomitant bacterial infection or transfer to the intensive care unit due to respiratory fatigue. The trial authors state that complications related to bronchiolitis severity were rare and occurred more frequently in the control group (n = 19, 12 control group, seven intervention group), albeit not significantly (P = 0.21). Also, they state that no direct complications of physiotherapy, such as respiratory deterioration, occurred. Finally, in Postiaux's study (Postiaux 2011) there is an explicit mention that no adverse events were observed but there is no definition on the events considered.

Subgroup analysis of the included trials

Gadjos (Gajdos 2010) performed subgroup analyses by personal eczema or history of atopy; respiratory syncytial virus (RSV) infection and hypoxaemia at randomisation. There was no statistically significant quantitative interaction on time to recovery between any of these subgroups.

Nicholas (Nicholas 1999) performed a subgroup analysis between patients who had more than 10 points on the baseline clinical score and those with a baseline clinical score below 9.5. There were no differences between the physiotherapy and control groups in this subgroup analysis.

Webb (Webb 1985) reports that there were no differences between treatments in daily scores or length of illness in the subset of participants with some degree of collapse/consolidation on chest radiographs.

DISCUSSION

Summary of main results

This review included nine trials and 891 participants exploring the efficacy of two physiotherapy modalities, vibration and percussion and passive expiratory techniques, compared to no intervention in hospitalised infants with acute bronchiolitis not on mechanical

ventilation. None of the included trials showed a significant benefit of either chest physiotherapy modalities in change of disease severity, respiratory parameters, length of stay or oxygen requirements in this population. A transient effect was shown with prolonged slow expiration techniques combined with salbutamol in children with moderate bronchiolitis. The included trials did not report severe adverse events. In Gajdos 2010 a significant risk of vomiting (risk ratio (RR) > 5) and respiratory instability (RR > 10) was reported in children receiving physiotherapy with passive increased exhalation technique and assisted cough, while no complications related to physiotherapy and few complications related to bronchiolitis severity were observed in trials applying prolonged slow expiration techniques (Postiaux 2011; Rochat 2010).

Quality of the evidence

The quality of the evidence in this review is moderate, stemming from a small number of trials with moderate risk of bias but consistent across trials and consistent with a large trial of low risk of bias. This allows us to draw robust conclusions.

All but two of the trials had small to moderate sample sizes. The risk of bias in those trials was moderate to high due to the limitations in methodological design (selection bias) of the trials as well as in their conduct (performance and attrition bias). Nevertheless, this review update has included the most recent trial on this topic, with a large sample size and a low risk of bias related to its excellent design and conduct. This trial results are negative, consistent with the other included trials' results.

The included trials used different measures of clinical severity and some of them presented incomplete data, precluding a meta-analysis. Nevertheless, all the included trials were consistent in the non-significance of results. Lack of power was an issue raised in the first version of this review as most authors did not specify the expected differences for the interventions.

Gajdos 2010 designed the study to detect a 20% decrease in time to recovery, assessed eight-hourly. Since this adequately powered trial was negative, it is reasonable to think that the results in other trials assessing a related outcome (clinical severity score) were truly negative and not an artefact of lack of power. Also, the negative results are consistent in all the assessed outcomes, including respiratory parameters, which are more sensible to the treatment and nevertheless do not show a statistical benefit. There are also negative results in length of hospital stay, a less relevant outcome since it is a crude measure of length of illness and it is sensible to unrelated factors (i.e. hospital discharge practices, day of the week, parental wishes, etc). In summary, we do not think a meta-analysis would have shown otherwise significant results, even with a reduced probability of a type II error.

Another methodological issue in the trials was the lack of a valid placebo. Since the trials had a non-intervention group, the researchers would have been expected to establish an outcome assessment procedure that prevented bias. Again, this was effectively and imaginatively established in the Gajdos 2010 and Postiaux 2011 trials. However, it has not shown to have an impact on the overall trial results as this lack of placebo alternative will usually over estimate the results, favouring the intervention.

An important issue in any intervention assessment is safety. Only two of the trials included in this review did an explicit assessment of adverse events. Participants in the Rochat 2010 trial testing prolonged slow expiration physiotherapy did not present direct complications of physiotherapy such as respiratory deterioration, and the complications related to bronchiolitis severity were similar in both groups of participants. Participants in the Gajdos trial (Gajdos 2010) testing increased exhalation physiotherapy did not present serious adverse effects but there were significant differences in incidence of vomiting and respiratory instability. Even though these adverse events were transient, they become relevant when the intervention is not showing any effect on the outcome of the infants. Other adverse events reported in the literature, such as brain lesion (encephaloclastic porencephaly (ECPE)) in extremely pre-term infants and rib fractures, were not observed. Brain lesion was suggested in a retrospective case-control study by Harding (Harding 1998) but no cases were observed in later larger studies (Beeby 1998; Knight 2001), so it may be unlikely to happen in older babies and softer manoeuvres. A retrospective observational study in the literature suggests an association between rib fractures and chest physiotherapy (Chalumeau 2002) but this adverse effect was not observed in any of the nine clinical trials included in this review.

Potential biases in the review process

To avoid biases in the review process, we have applied robust methods for searching, study selection, data collection and risk of bias assessment. To guarantee the comprehensiveness of the search, we have sought both published and unpublished trials and have contacted authors when possible to gather additional information about unpublished trials. Although pooling of data has not been possible, we have considered its potential impact and performed a careful assessment of individual trials. In addition, we have performed a rigorous risk of bias assessment for the included trials.

Agreements and disagreements with other studies or reviews

The first publication of this review in 2005 (Perrotta 2005) prompted the recommendation that chest physiotherapy based on vibration and percussion not be applied routinely in hospital settings (AAP 2006; BGT 2005; SIGN 2006). During recent years, few systematic reviews have been published in this topic (González 2010b; Schechter 2007; Wainwright 2010) based on the same evidence and reaching similar conclusions to us. In consequence, this updated review including the most recent randomised controlled trials remains the main source of evidence on chest physiotherapy for acute bronchiolitis.

AUTHORS' CONCLUSIONS

Implications for practice

Based on nine trials, chest physiotherapy either using percussion and vibration techniques or passive expiratory techniques has not shown to improve the course of the illness in hospitalised infants with acute bronchiolitis, and it does not reduce time until recovery or length of stay. Therefore, it should not be recommended standard practice. Clinicians should take into account the lack of evidence supporting any clinical benefit of chest physiotherapy, as well as its possible adverse effects (both mild frequent effects like

vomiting and respiratory imbalance and other severe rare effects) and its costs.

Even though chest physiotherapy is unlikely to change the course of the disease, in one trial slow expiration technique physiotherapy combined with salbutamol has provided transient relief in children with moderate bronchiolitis. Given that no adverse effects have been reported with this technique, clinicians could consider its use in specific clinical circumstances during the illness to aid with clearing of secretions.

Implications for research

It seems clearer now that chest physiotherapy will not change the course of the disease. So the question remains as to whether there is a role for chest physiotherapy during a bronchiolitis episode. The clinical relevance of transient short-term relief should be discussed and studied.

Other aspects to be further researched are the effect of low flow physiotherapy techniques combined or not with salbutamol, as well as the effect of chest physiotherapy in moderate bronchiolitis. A specific assessment of adverse effects would be needed.

ACKNOWLEDGEMENTS

Dr Gadjós, Dr Asher Tal, Ms Núria Lopez and Dr Postiaux for their help in providing information regarding their studies.

Dr Vilaró (Blanquerna University School of Nursing, Physiotherapy and Nutrition, Universitat Ramon Llull, Barcelona) for helping answer the feedback to the review.

Zulma Ortiz, co-author of the first version of this review. The first version of the review was developed with the help of: Iberoamerican Cochrane Center, "Centro de Investigaciones Epidemiológicas", Academia Nacional de Medicina de Buenos Aires and with partial funding by the Child Health Field, The Cochrane Collaboration. The authors wish to thank the following people for commenting on versions of the review: Mariano Gallo, Durhane Wong-Rieger, Georges De Bilderling, Sree Nair, Abigail Fraser, Cindy Cai, Martin Chalumeau, Max Bulsara and Hans van der Wouden.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Aviram 1992

Methods	Randomised, single-blinded controlled trial
Participants	50 young infants with acute bronchiolitis, paired by age and severity of disease
Interventions	Group 1: chest physiotherapy Group 2: no intervention All participants were treated with fluids, oxygen (when SaO_2 in room < 92%) and received inhaled salbutamol every 6 hours
Outcomes	- Length of stay in hospital - Improvement in clinical score (12 hours) (Tal 1983) - Changes in SaO_2
Notes	Authors confirmed trial unpublished (July 2010) and provided additional information Personal communication: the decision to discharge was based on improvement of the infant to a score of < 5 and no need for oxygen. There was no difference whatsoever between the 2 groups

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information available
Allocation concealment (selection bias)	Unclear risk	No information available
Blinding (performance bias and detection bias) All outcomes	Low risk	"Clinical scoring was done by a physician who was blinded to the [chest physiotherapy] therapy" Personal communication: "Patient's condition was monitored using our clinical score by one of two physicians, twice a day, blinded to the yes or no chest physiotherapy done by a third person, who was blinded to the scores."
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	50 infants were randomised and analyzed
Selective reporting (reporting bias)	Unclear risk	No information available

Bohe 2004

Methods	Patients were randomly allocated to control and intervention Children were assessed every evening

Bohe 2004 *(Continued)*

Participants	Infants admitted to the hospital with a clinical diagnosis of acute bronchiolitis. 16 were allocated to the control group and 16 to the intervention arm
Interventions	Group 1: vibration and postural drainage techniques twice a day Group 2: no intervention
Outcomes	- Length of stay (days): 4 +/- 2 (intervention) 3.87 +/- 1.3 (control) - Clinical score
Notes	1 patient in the intervention group was withdrawn after developing atelectasia

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Patient allocation was random, by means of concealed allocation according to admission number, independently assigned by the hospital admission centre
Allocation concealment (selection bias)	Low risk	Allocation was described as concealed
Blinding (performance bias and detection bias) All outcomes	High risk	Study described as open
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	32 patients were randomised and analyzed. A child included in Group 2 presented right basal atelectasis by 4th day of hospitalisation, he received respiratory physiotherapy and was excluded from the trial. It is not clear how the data were treated
Selective reporting (reporting bias)	Unclear risk	Not described

De Córdoba 2008

Methods	Participants were allocated by opaque sealed envelopes
Participants	Children below 2 years admitted to the hospital and emergency department, with clinical and radiological diagnosis of acute viral bronchiolitis, with bronchial hypersecretion (pulmonary auscultation) N = 24 patients randomised, 19 patients analyzed: 5 in Group 1, 8 in Group 2 and 6 in Group 3. Exclusions due to haemodynamic instability (2), heart disease (1), non-invasive mechanical ventilation (1), prematurity (1) Mean age: 93 days in Group 1, 131.1 days in Group 2, 125.0 days in Group 3 12 M/7 F
Interventions	Group 1: vibration + postural drainage Group 2: percussion + postural drainage Group 3: tracheal aspiration. Bronchial aspiration in dorsal decubitus Postural drainage for 5 min in each decubitus (right and left lateral randomly chosen) + bronchial aspiration in dorsal decubitus

De Córdoba 2008 *(Continued)*

Outcomes	- Saturation of oxygen pulse - Cardiac frequency - Respiratory frequency - Silverman-Anderson score of respiratory discomfort - Amount of inhaled secretion
Notes	Treatment was delivered once. Outcomes were assessed immediately after treatment and after 15 minutes

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described
Allocation concealment (selection bias)	Low risk	Patients were randomised by means of opaque sealed envelopes
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	High risk	24 randomised patients and 5 exclusions described with reasons but not the group they belonged to. Two due to haemodynamic instability, 1 by heart disease, 1 in non-invasive mechanical ventilation and 1 preterm baby. Results are presented for 19 patients
Selective reporting (reporting bias)	Unclear risk	Not described

Gajdos 2010

Methods	Allocation: randomised Control: active control Endpoint classification: safety/efficacy study Intervention model: parallel assignment Masking: double-blind (caregiver, investigator) Primary purpose: treatment
Participants	496 participants Inclusion criteria: • Child aged 15 days to 24 months • First acute bronchiolitis • Indication of hospitalisation • One or more of these criteria: toxic aspect; apnoea or cyanosis; respiratory rate > 60/min; pulse oxymetry < 95%; alimentary intake < 2/3 of the needs
Interventions	Group 1: chest physiotherapy with forced expiratory technique Group 2: nasopharyngeal aspiration

Gajdos 2010 *(Continued)*

Outcomes	- Time to recovery defined in the study protocol as verifying, for at least 8 hours in a row, the following requirements: pulse oxymetry >= 95% AND normal feeding AND specific respiratory distress score lower than one as described in the protocol AND normal respiratory rate - Safety of the forced expiratory technique - Comparison of pulse oxymetry before/after chest physiotherapy - Quality of life scale
Notes	ClinicalTrials.gov identifier: NCT00125450

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"random allocation computer generated with SAS software packages in advance by the biostatistician", "permutation blocks with a block size of four"
Allocation concealment (selection bias)	Low risk	"physiotherapist opening a sealed sequentially numbered envelope" "block size of four that was not mentioned to the physicians involved in the patient recruitment"
Blinding (performance bias and detection bias) All outcomes	Low risk	"all paediatric department staff, parents and guardians were blind to treatment assignment." "Those involved in the evaluation of primary outcome or in the decision of the co interventions were blinded to group assignment." "The treatment was performed by the physiotherapist staying alone with the infant, in a room with a covered window pane"
Incomplete outcome data (attrition bias) All outcomes	Low risk	"Analysis was performed on an intent-to-treat basis and all patients included in the study were analyzed, including the two lost to follow-up (one in each group)"
Selective reporting (reporting bias)	Low risk	Protocol available and consistent with report

Lopez Galbany 2004

Methods	Allocation: randomised Control: inactive control End point classification: efficacy study Intervention model: parallel assignment Masking: single-blind (outcome assessment) Primary purpose: treatment
Participants	Pilot study enrolled 30 participants 1. Hospitalised patients 2. Less than 1 year old 3. Respiratory syncytial virus-positive
Interventions	Group 1: forced expiratory technique for 10 minutes, single daily session during the first 5 days of hospitalisation Group 2: no intervention
Outcomes	- Severity clinical score (Bierman Pierson modified score) (Bierman 1974; Tal 1983)

Lopez Galbany 2004 *(Continued)*

	- Length of stay
Notes	Authors confirmed trial unpublished (July 2010)

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information
Allocation concealment (selection bias)	Unclear risk	No information
Blinding (performance bias and detection bias) All outcomes	Unclear risk	No information
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No information
Selective reporting (reporting bias)	Unclear risk	No information

Nicholas 1999

Methods	Participants were randomly allocated to control and treatment groups using a random sequence number
Participants	Infants admitted to the hospital with a clinical diagnosis of acute bronchiolitis and with respiratory distress severe enough that required nasogastric tube feeding or intravenous fluids. 24 were allocated to control group and 26 to treatment. Mean age of control group: 3.2 (range 0.4 to 8.3); intervention group 2.4 (range 0.4 to 6.9). RSV positive: control 79%, intervention 85%
Interventions	Group 1: vibration and postural drainage techniques twice a day Group 2: no intervention In the physiotherapy arm, the participant was treated on the physiotherapist´s knee, percussion and vibration lying on right side, lying on left side and sitting; suction performed after on each side, if necessary, until clear; no oxygen required during treatment. Modifications were allowed if participant did not tolerate the procedure. Oxygen was allowed depending on infant tolerability
Outcomes	- Clinical score: data not reported - Length of stay (days): mean 6.6 in control (2.3 to 11.5) and 6.7 (3 to 9.5) in intervention groups - Nasogastric feeds: mean in control 92 hours (range 8 to 225) and in intervention group 86 (range 36 to 148)
Notes	The study ended at 5 days Authors did not report the standard deviation

Risk of bias

Bias	Authors' judgement	Support for judgement

Nicholas 1999 *(Continued)*

Random sequence generation (selection bias)	Low risk	“random sequence number generated by the Medical Statistics Unit of the University of Edinburgh”
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding (performance bias and detection bias) All outcomes	Unclear risk	Not described
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	50 patients were randomised and assessed, although 1 child was excluded from the trial after being admitted to the intensive care unit. It is not clear how data were treated. Saturation of oxygen pulse assessments comprised those of 2 excluded children which were not assessed for clinical outcomes
Selective reporting (reporting bias)	Unclear risk	Not described

Postiaux 2011

Methods	Randomised clinical trial
Participants	Hospitalised infants less than 1 year of age presenting with acute RSV bronchiolitis and a clinical Wang score >= 3 20 infants (mean age: 4, 19 months)
Interventions	Group 1: 3% hypertonic saline solution and salbutamol (HS therapy) (n = 8 totaling 27 sessions) Group 2: HS therapy followed by one session of 10 to 15 minutes of prolonged slow expiration technique and coughing provoked (n = 12, totaling 31 sessions) Sessions lasted 30 minutes
Outcomes	- Wang's clinical score (respiratory rate, wheezing, retraction, general appearance) - SpO_2 - Heart rate Outcomes were evaluated at t0, t30 and t150
Notes	

Risk of bias

Bias	**Authors' judgement**	**Support for judgement**
Random sequence generation (selection bias)	Unclear risk	Not described
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding (performance bias and detection bias) All outcomes	Low risk	"Both of our pediatrician evaluators were blinded to the applied treatment and goals" "Physiotherapists in charge of administering the treatments were instructed to ignore the results of each evaluation until the end of the study. The patient' parents were unaware of the group in which their child was in-

Postiaux 2011 *(Continued)*

		cluded. In both groups the periods of time spent in the room were identical, so outside observers were blinded to the applied treatment."
Incomplete outcome data (attrition bias) All outcomes	Low risk	20 patients were randomised and assessed
Selective reporting (reporting bias)	Unclear risk	No information available

Rochat 2010

Methods	Randomised clinical trial
Participants	Infants < 1 year with bronchiolitis admitted in a hospital during 2 consecutive RSV seasons 103 children where randomised (51 to physiotherapy and 53 to control). Mean age was 3, 9 months. RSV ELISA positive: 74% intervention, 75.5 control
Interventions	Group 1: physiotherapy group (n = 50) received 2 daily physiotherapy sessions (prolonged slow expiratory technique, slow accelerated expiratory technique and coughing provoked) plus standard care Group 2: control group (n = 49) received standard care (minimal handling, oxygen therapy for SpO_2 >= 92%, fractionated meals and rhino pharyngeal suctioning)
Outcomes	Primary outcome: time to clinical stability. Secondary outcomes: change in clinical state measured by a general score, change in respiratory state measured by a respiratory score, complications
Notes	Outcomes assessed daily at a fixed time point, prior physiotherapy sessions

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	"Randomisation list in blocks of random length (8, 10 or 12) by the study epidemiologist, not involved in the clinical phase of the study."
Allocation concealment (selection bias)	Low risk	"Randomisation was done by the attribution of a number contained in a sealed opaque envelope opened following the inclusion consent"
Blinding (performance bias and detection bias) All outcomes	High risk	Open trial. Nevertheless, "All children underwent daily clinical evaluations /.../ performed by a study physiotherapist who was different from the physiotherapist administering the treatment"
Incomplete outcome data (attrition bias) All outcomes	Low risk	103 randomised infants, 4 of whom were later excluded (1 in physiotherapy, 3 in control) for the following reasons: parental withdrawal of content, erroneous initial diagnosis and direct admission to intensive care, or age > 12 months. Results presented for the 99 remaining eligible infants
Selective reporting (reporting bias)	Unclear risk	An abstract presented to a scientific meeting in 2010 focuses its conclusions on the daily improvement of a severity score, while the published paper states that the primary outcome is the time to clinical stability. Nevertheless, we believe this change does not introduce bias into the results since both outcomes are related and non-significant

Webb 1985

Methods	Children with clinical diagnosis of acute bronchiolitis were randomly allocated to chest physiotherapy or control During 5 days they were assessed using a severity clinical score. There was a follow-up after 2 weeks at the outpatient clinic
Participants	90 infants admitted with a clinical diagnosis of acute bronchiolitis. Mean age 46 months (range 0.5 to 15) 69% had respiratory syncytial virus 36% had a first-degree family history of atopy 66% had smokers in the household
Interventions	Group 1: chest physiotherapy comprising standard techniques applied by a trained paediatric physiotherapist Group 2: no intervention They performed chest percussion with a cupped hand for 3 minutes in each of 5 postural drainage positions followed by assisted coughing or gentle oropharyngeal suction twice a day
Outcomes	- Length of stay (days): control group 4 (range 1 to 15) and intervention 4 (range 2 to 11) - Clinical score at day 5: control group 5 (range 1 to 11) and intervention 6 (range 3 to 10) - Clinical score at day 1: control group 10 (range 2 to 27) and intervention 7 (range 2 to 24)
Notes	Authors did not report mean and standard deviation of the mean. Results were expressed as median values and range

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not described
Allocation concealment (selection bias)	Unclear risk	Not described
Blinding (performance bias and detection bias) All outcomes	High risk	”Strictly speaking, [assessments] could not be ‘blind’ with respect to treatment status though in practice that status was not obvious at each assessment”
Incomplete outcome data (attrition bias) All outcomes	High risk	90 analyzed patients but it is not clear how many were randomised and if there was any attrition of patients
Selective reporting (reporting bias)	Unclear risk	Not described

ELISA: enzyme-linked immunosorbent assay
RSV: respiratory syncytial virus
SaO_2: oxygen saturation
t: time point

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Belcastro 1984	Controlled clinical trial

Study	Reason for exclusion
Bernard-Narbone 2003	Uncontrolled intervention study
Postiaux 2004	Uncontrolled intervention study
Pupin 2009	Controlled clinical trial
Quitell 1988	Uncontrolled intervention study

Characteristics of ongoing studies *[ordered by study ID]*

Dantas 2009

Trial name or title	Effectiveness of chest physiotherapy: actual versus conventional techniques in infants with acute viral bronchiolitis. Random clinical trial
Methods	Allocation: randomised Control: uncontrolled End point classification: efficacy study Intervention model: parallel assignment Masking: single-blind (investigator) Primary purpose: treatment
Participants	33 participants Inclusion criteria: • Child aged up to 24 months • Clinical diagnosis of acute viral bronchiolitis • RSV positive
Interventions	- Conventional chest physiotherapy: percussion postural drainage and thorax compression - Actual techniques chest physiotherapy: slow prolonged expiration and clearance rhino pharynx retrograde - 3-airway suction
Outcomes	- Respiratory distress evaluated with Wang's score for infants with bronchiolitis
Starting date	Enrolment April 2009 to April 2010
Contact information	Dr Evelim Dantas, Hospital Sirio Libanes, Sao Paulo. Brazil
Notes	ClinicalTrials.gov identifier: NCT00884429 Unsuccessfully contacted via post mail (July 2010)

RSV: respiratory syncytial virus

APPENDICES

Appendix 1. Details of previous searches

In the first version of this review we searched the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2004, Issue 2) which contains the Cochrane Acute Respiratory Infections Group's Specialised Register; MEDLINE (January 1966 to June 2004); EMBASE (1990 to June 2004); PASCAL, SCISEARCH, LILACS and Cumulative Index to the Nursing & Allied Health Literature (CINAHL) (1982 to May 2004).

In June 2006 we updated the searches of CENTRAL (*The Cochrane Library* 2006, Issue 2); MEDLINE (2004 to May Week 4 2006); EMBASE (July 2004 to December 2005) and CINAHL (1982 to May Week 4 2006).

We used the following search strategy to search MEDLINE and CENTRAL in June 2006. The highly sensitive search strategy filter (Dickersin 1994) was combined with the search strategy and run over MEDLINE. The MEDLINE search was modified slightly to search CINAHL. No language restrictions were applied.

MEDLINE (OVID)
1 exp BRONCHIOLITIS
2 exp Bronchiolitis, Viral/
3 bronchiolitis.mp.
4 exp Respiratory Syncytial Viruses/
5 exp Respiratory Syncytial Virus Infections/
6 respiratory syncytial virus$.mp.
7 exp Physical Therapy Techniques/
8 chest physiotherapy.mp.
9 exp Drainage, Postural/
10 postural drainage.mp.
11 chest percussion.mp.
12 exp VIBRATION/
13 vibration.mp.
14 chest shaking.mp.
15 directed coughing.mp.
16 forced exhalation.mp.
17 exp Breathing Exercises/
18 breathing exercise$.mp.
19 or/1-6
20 or/7-18
21 19 and 20

EMBASE (WebSpirs)
#1 explode 'bronchiolitis-' / all subheadings in DEM,DER,DRM,DRR
#2 (bronchiolitis in ti) or (bronchiolitis in ab)
#3 explode 'Respiratory-syncytial-pneumovirus' / all subheadings in DEM,DER,DRM,DRR
#4 (respiratory syncytial virus* or RSV) in ti
#5 #1 or #2 or #3 or #4
#6 explode 'physiotherapy-' / all subheadings in DEM,DER,DRM,DRR
#7 (physiotherapy in ti) or (physiotherapy in ab)
#8 explode 'postural-drainage' / all subheadings in DEM,DER,DRM,DRR
#9 (postural drainage in ti) or (postural drainage in ab)
#10 (chest percussion in ti) or (chest percussion in ab)
#11 explode 'vibration-' / all subheadings in DEM,DER,DRM,DRR
#12 (vibration in ti) or (vibration in ab)
#13 (chest shaking in ti) or (chest shaking in ab)
#14 (directed coughing in ti) or (directed coughing in ab)
#15 (forced exhalation in ti) or (forced exhalation in ab)
#16 explode 'breathing-exercise' / all subheadings in DEM,DER,DRM,DRR
#17 (breathing exercise* in ti) or (breathing exercise* in ab)
#18 #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17
#19 #5 and #18

Appendix 2. MEDLINE in-process and other non-indexed citations

1 bronchiolit*.tw.
2 (repiratory syncytial virus* or rsv).tw.

3 (chest adj2 (physiotherap* or physical therap*)).tw.
4 (postural adj2 drainage*).tw.
5 (chest* adj3 percuss*).tw.
6 vibrat*.tw.
7 (chest* adj3 shak*).tw.
8 directed cough*.tw.
9 forced exhalation.tw.
10 forced expiration.tw.
11 breathing exercise*.tw.
12 (physiotherap* or physical therap*).tw.
13 1 or 2
14 or/3-12
15 13 and 14

Appendix 3. Embase.com search strategy

21. #6 AND #20
20. #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19
19. (breathing NEAR/2 exercise*):ab,ti
18. 'breathing exercise'/de
17. 'forced exhalation':ab,ti OR 'forced expiration':ab,ti
16. 'directed coughing':ab,ti
15. (chest* NEAR/3 shak*):ab,ti
14. vibrat*:ab,ti
13. 'vibration'/de
12. (chest* NEAR/3 percuss*):ab,ti
11. 'percussion'/de
10. 'postural drainage':ab,ti
9. 'postural drainage'/de
8. (physiotherapy NEAR/4 chest):ab,ti
7. 'physiotherapy'/exp
6. #1 OR #2 OR #3 OR #4 OR #5
5. 'respiratory syncytial virus':ab,ti OR 'respiratory syncytial viruses':ab,ti OR rsv:ab,ti
4. 'respiratory syncytial virus infection'/de
3. 'respiratory syncytial pneumovirus'/de
2. bronchiolit*:ab,ti
1. 'bronchiolitis'/exp

Appendix 4. CINAHL search strategy

S24 S6 and S23
S23 S21 or S22
S22 S7 or S8 or S9 or S10 or S11 or S12 or S13
S21 S14 or S15 or S16 or S17 or S18 or S19 or S20
S20 TI breathing exercise* or AB breathing exercise*
S19 (MH "Breathing Exercises+")
S18 TI ("forced exhalation" or "forced expiration") or AB ("forced exhalation" or "forced expiration")
S17 TI directed N3 cough* or AB directed N3 cough*
S16 TI chest N3 shak* or AB chest N3 shak*
S15 TI vibrat* or AB vibrat*
S14 (MH "Vibration")
S13 TI chest N3 percuss* or AB chest N3 percuss*
S12 (MH "Percussion")
S11 TI "postural drainage" or AB "postural drainage"
S10 TI chest N3 "physical therapy" or AB chest N3 "physical therapy"
S9 TI chest N3 physiotherap* or AB chest N3 physiotherap*
S8 (MH "Chest Physical Therapy+")
S7 (MH "Physical Therapy")
S6 S1 or S2 or S3 or S4 or S5
S5 TI (respiratory syncytial virus* or rsv) or AB (respiratory syncytial virus* or rsv)
S4 (MH "Respiratory Syncytial Virus Infections")
S3 (MH "Respiratory Syncytial Viruses")
S2 TI bronchiolit* or AB bronchiolit*

S1 (MH "Bronchiolitis+")

Appendix 5. LILACS search strategy

Database:	**LILACS**
Search on:	Mh bronchiolitis or Tw bronchiolit$ or Tw Bronquiolitis or Tw Bronquiolite or Mh Respiratory syncytial viruses or Tw respiratory syncytial virus$ or Tw Virus Sincitiales Respiratorios or Tw Vírus Sinciciais Respiratórios or Mh Respiratory syncytial virus infections or Tw Infecciones por Virus Sincitial Respiratorio or Tw Infecções por Vírus Respiratório Sincicial [Words] and Mh physical therapy modalities or Tw physical therap$ or Tw Modalidades de Terapia Física or Tw Modalidades de Fisioterapia or Tw physiotherap$ or Tw Física$ or Tw Fisioterap$ or Mh Drainage, Postural or Tw postural drainage$ or Tw Drenaje Postural or Tw Drenagem Postural or Mh Percussion or Tw Percusión or Tw Percussão or Mh vibration or Tw vibrat$ or Tw Vibración or Tw shaking or Tw directed cough $ or Tw forced exhalation or Tw forced expiration or Tw Espiración or Tw Expiração or Mh Breathing exercises or Tw breathing exercise$ or Tw Ejercicios Respiratorios or Tw Exercícios Respiratórios [Words]

Appendix 6. Web of Science search strategy

Topic=(bronchiolit* or rsv or respiratory syncytial virus*) AND Topic=(chest physical therap* or chest physiotherap* or postural drainage or chest percussion or chest vibration or chest shaking or directed coughing or forced exhalation or breathing exercises) Timespan=2006-2009. Databases=SCI-EXPANDED, CPCI-S.

F E E D B A C K

Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old, 5 March 2012

Summary

We have read with much interest the last Cochrane review devoted to Chest Physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months. (1) M. Roqué and her co-authors have reported the most recent publications in this field.

We would like to present some remarks:

1. The study of Postiaux et al. has been performed in Belgium, and not in France as mentioned in the Cochrane publication. (2) Even if this aspect is not scientifically relevant, it implies different methodological PT approaches.

2. M. Roqué et al. have merged two different PT approaches in a same appellation “forced expiration techniques”, adding to the confusion concerning the PT techniques. Indeed, their different functional features are essential. The first one is the Increased Exhalation Technique - IET (augmentation/accélération du flux expiratoire) mainly used in France (see the Gajdos and Sanchez studies (3, 4)), which is a passive forced (i.e. rapid, robust) expiration technique - FET, and the second one is the Prolonged Slow (i.e. progressive) Expiration technique – PSE proposed by our group in 1992 to avoid the mechanical drawbacks of the IET such as the tracheal collapse. (5) PSE is more attuned to the infant’s specific ventilatory mechanics. (6) 3. It is important to stress that the therapeutic regimens are different. In the Postiaux’ study, PT is preceded by a hypertonic saline solution nebulization NaCL3% – HS3%, while it is not in the other studies. HS3% dilutes the bronchial secretions and helps the mucociliary transport. (7) Both, HS3% and PSE act in synergy.

4. The Cochrane Review states that in the Postiaux’ study, the effect of the treatment “disappeared two hours later”. However the study has shown that the effect of the treatment lasted at least two hours and that a significant day-to-day cumulative effect had been observed. These results envision a long term effect of such a treatment.

5. Explaining the apparent controversial results are also the different levels of severity of the patients samples. The Gajdos’, Sanchez’ and Rochat’ (8) studies were dealing with severe bronchiolitides while the Postiaux’ study dealt with moderate bronchiolitis. Severe bronchiolitides are known to be poorly tolerating any handling procedure, probably explaining the lack ok positive outcome of IET in this group.

We think that those elements are likely to clarify the PT methods and better define the indications/contraindications of PT in RSVB.

1. Roqué I Figuls M, Giné-garriga M, Granados Rugeles C, Perrotta C. Chest physiotherapy for acute bronchiolitis in paediatric patients between 0 and 24 months old. Cochrane database of Systematic Review 2012 Issue 2.Art No.:CD004873, DOI:10.1002/14651858.CD004873.pub4.
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3. Gajdos V, Katsahian S, Beydon N, et al. Effectiveness of Chest Physiotherapy in Infants Hospitalized with Acute Bronchiolitis : A Multicenter, randomized, Controlled Trial. PLoS Med 2010 ;7(9) : e1000345.doi :10.1371/journal.pmed.1000345.
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Submitter agrees with default conflict of interest statement: I certify that I have no affiliations with or involvement in any organization or entity with a financial interest in the subject matter of my feedback.

Reply

Dear Dr Postiaux, thank you for your comments that allow us to improve our work. In response to your feedback, we would like to formulate the following remarks:

1. We apologise for the confusion regarding countries, and we have amended the review accordingly.

2. Througout the text we have tried to clarify the differences between these techniques, grouped now as passive expiratory techniques instead of forced expiratory techniques. Efficacy and safety results for both techniques have been clearly labelled in the results and discussion sections.

3. We have clarified this point in the discussion and conclusions sections.

4. We have added a quote in the results section mentioning the day-to-day cumulative effect. Nevertheless, we've considered that this result is inconclusive and doesn't change the overall results and conclusions of the review. The reasons are that this apparent cumulative effect is based on 1) within group comparisons and not between group comparisons, and 2) assessment of a reduced number of patients due to discharges during follow up.

5. We have added specific mentions to the severity of patients.

After careful consideration of this feedback we have introduced several changes in the review with the aim to clarify the differences between the diverse passive expiratory techniques, and to highlight their respective efficacy and safety results. This greater detail has lead to amend the implications for research section, given that the prolonged slow expiration technique appears to be safe and that it may be related to (at least) a transient effect. Nevertheless, the overall conclusion of the review and its implications for practice have not changed.

Contributors

Guy Postiaux. Occupation: An author cited in the Review
Jacques Louis.

WHAT'S NEW

Date	Event	Description
9 November 2012	Feedback has been incorporated	Reply to feedback comment added to the review

HISTORY

Protocol first published: Issue 3, 2004
Review first published: Issue 2, 2005

Date	Event	Description
3 July 2012	Feedback has been incorporated	Feedback comment added to the review

Date	Event	Description
13 December 2011	New search has been performed	Searches conducted. Six new trials were included in this update (Aviram 1992; De Córdoba 2008; Gajdos 2010; Lopez Galbany 2004; Postiaux 2011; Rochat 2010) and one trial was excluded (Pupin 2009).
13 December 2011	New citation required and conclusions have changed	New evidence shows no benefit of forced expiratory techniques. A new review author joined the original author team to update this review.
14 May 2008	Amended	Converted to new review format.
19 July 2006	New search has been performed	Updated review Issue 1, 2007.
9 June 2004	New search has been performed	First published Issue 2, 2005.

CONTRIBUTIONS OF AUTHORS

Marta Roqué was responsible for reference screening, risk of bias assessment, data extraction and updating the review.
Maria Giné was responsible for reference screening, risk of bias assessment, data extraction and commented on the review.
Claudia Granados was responsible for reference screening and commented on the review.
Carla Perrota commented on the review.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- Iberoamerican Cochrane Center, Barcelona, Spain.
- UCD School of Public Health and Population Sciences, Ireland.

External sources

- Instituto de Salud Carlos III Subdireccion General de Investigacion Sanitaria (01/A060), Spain.

INDEX TERMS

Medical Subject Headings (MeSH)

Acute Disease; Albuterol [therapeutic use]; Bronchiolitis [*therapy]; Bronchodilator Agents [therapeutic use]; Drainage, Postural; Oxygen Inhalation Therapy [methods]; Percussion [methods]; Randomized Controlled Trials as Topic; Respiratory Therapy [*methods]; Sodium Chloride [therapeutic use]; Vibration [therapeutic use]

MeSH check words

Humans; Infant; Infant, Newborn