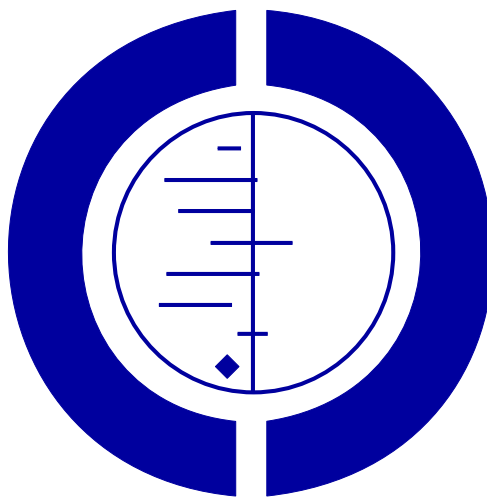


Chest physiotherapy compared to no chest physiotherapy for cystic fibrosis (Review)

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ABSTRACT

Background

Chest physiotherapy is widely used in people with cystic fibrosis in order to clear mucus from the airways.

Objectives

To determine the effectiveness and acceptability of chest physiotherapy compared to no treatment or spontaneous cough alone to improve mucus clearance in cystic fibrosis.

Search strategy

We searched the Cochrane Cystic Fibrosis and Genetic Disorders Group Trials Register which comprises references identified from comprehensive electronic database searches and handsearches of relevant journals and abstract books of conference proceedings.

Date of the most recent search of the Group's Cystic Fibrosis Trials Register: September 2006.

Selection criteria

Randomised or quasi-randomised clinical trials in which a form of chest physiotherapy (airway clearance technique) were taken for consideration in people with cystic fibrosis compared with either no physiotherapy treatment or spontaneous cough alone.

Data collection and analysis

Both authors independently assessed trial eligibility, extracted data and assessed trial quality.

Main results

One hundred and twenty-six trials were identified by the search, of which six cross-over trials with 66 participants were found eligible for inclusion in the review. Five studies were single treatment studies; in one study each treatment regimen was used twice daily for two consecutive days. Three studies, involving 36 participants, found a higher amount of expectorated secretions during chest physiotherapy as compared to a control period. Two studies, involving 24 participants found no significant effect on pulmonary function variables following intervention. In four studies radioactive tracer clearance was used as an outcome variable. In three of these, involving 28 participants, it was found that chest physiotherapy, including coughing, increased radioactive tracer clearance as compared to the control period. One study of eight participants, reported no significant difference between chest physiotherapy, without coughing, compared to the control period.

Authors' conclusions

The results of this review show that airway clearance techniques have short-term effects in the terms of increasing mucus transport. No evidence was found on which to draw conclusions concerning the long-term effects.

PLAIN LANGUAGE SUMMARY

There is some evidence to support short-term but not long-term beneficial effects of chest physiotherapy in people with cystic fibrosis

Excess production of mucus leads to recurrent infection and tissue damage in lungs of people with cystic fibrosis. It is important to clear secretions using medications and chest physiotherapy (CPT). Physiotherapy clears secretions by various drainage and breathing techniques or mechanical devices or both. Daily physiotherapy is time-consuming and burdensome. Airway clearance techniques have short-term beneficial effects on mucus transport. Four studies measuring radioactive tracer clearance, found increased clearance with CPT; three studies measuring expectorated sputum, found a higher amount with CPT. There is currently no clear evidence of long-term effects in chest clearance, quality of life or survival.

BACKGROUND

Cystic fibrosis (CF) is a common inherited life-limiting disorder. Persistent infection and inflammation within the lungs are the major contributory factors to severe airway damage and loss of respiratory function over the years (Cantin 1995; Konstan 1997). Excessive production of thick mucus may overwhelm the normal mucus transport mechanisms and thereby lead to airway obstruction and mucus plugging (Zach 1990). Removal of airway secretions is therefore an integral part of the management of CF. A variety of methods are used to help remove secretions from the lungs, some physical, i.e. chest physiotherapy, and some chemical, i.e. medications and inhalation therapies. Treatment methods which improve mucus clearance are considered essential in optimising respiratory status and reducing the progression of lung disease.

Chest physiotherapy has, for a long time, played an important role in assisting the clearance of airway secretions and is usually commenced as soon as the diagnosis of CF is made. However, the performance of chest physiotherapy may be unpleasant, uncomfortable, and time-consuming. Early chest physiotherapy relied on techniques for which the assistance of another person, such as a physiotherapist or relative, was needed and which included postural drainage, percussion, vibration, and shaking performed by an assistant and huffing or coughing. More recently, several self-administered alternatives to these conventional techniques have been developed. These include the active cycle of breathing techniques (ACBT), forced expiration technique (FET), autogenic drainage (AD), positive expiratory pressure (PEP), flutter, high frequency chest compression (HFCC) and exercise. We have defined all of these methods under the interventions below. These methods of treatment help to give the individual with CF more independence in their management. Despite the expansion of treatment modalities, there remains little evidence supporting their efficacy (Prasad 1998; van der Schans 1996). A previous meta-analysis (Thomas 1995a) concluded that standard chest physiotherapy resulted in more mucus (phlegm or sputum) expectoration than no treatment in people with CF, however a recent Cochrane review reported that there is not enough evidence to support or refute mucus clearance techniques for people with COPD or bronchiectasis (Jones 1998). This review compares the efficacy of any of these interventions as compared to no treatment or spontaneous coughing alone. Subsequent reviews will aim to determine whether a specific type of treatment offers any advantage over others.

OBJECTIVES

To determine the effectiveness of chest physiotherapy (airway clearance) compared to no treatment or cough alone in people with CF. This review does not address all possible comparisons between the multiple treatment techniques available for people with CF. This review is the first in a series of reviews which will compare the efficacy of different treatment modalities.

The following hypotheses will be tested: chest physiotherapy, whatever the type of intervention, is more:

- (1) effective than no chest physiotherapy;
- (2) effective than spontaneous coughing alone;
- (3) acceptable than no chest physiotherapy;
- (4) acceptable than spontaneous coughing alone.

CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

Types of studies

Randomised or quasi-randomised clinical trials.

Short-term studies (less than seven days duration, including single treatment studies) will be analysed separately from studies of longer duration.

Types of participants

People with CF, of any age, diagnosed on the basis of clinical criteria and sweat testing or genotype analysis.

Types of intervention

Chest physiotherapy of any type (see below) compared to no chest physiotherapy or spontaneous coughing alone.

In existing literature and in practical terms, variation occurs in the application of specific techniques. For the purposes of this series of reviews, it is necessary to group these variations under their broader headings. Separate analysis of each variation would render the reviews unmanageable. The following interventions aim to improve mucus transport or facilitate expectoration:

Conventional chest physiotherapy

This will include any combination of the following: postural drainage; percussion; chest shaking; huffing; and directed cough-

ing. It should not include the use of exercise, PEP or other mechanical devices.

Positive expiratory pressure (PEP) mask therapy

As described by the authors to be the primary intervention, with or without additional techniques. PEP is defined as breathing with a positive expiratory pressure of 10 to 25 cmH₂O.

High pressure PEP (hPEP) mask therapy

As described by the authors to be the primary intervention, with or without additional techniques. It is a modification of the above PEP technique but includes a full forced expiration against a fixed mechanical resistance.

Active cycle of breathing techniques (ACBT)

This includes relaxation or breathing control, forced expiration technique (FET), thoracic expansion exercises and may include postural drainage or chest clapping.

Autogenic Drainage (AD)

As described originally by Chevalier or modified versions thereof. The authors should have identified AD to be the primary intervention, with or without additional techniques.

Exercise

With the sole purpose of improving mucus clearance as the primary intervention, with or without additional techniques.

Oscillating devices

Oscillating devices including flutter or cornet, thoracic oscillation, and oral oscillation. Flutter or cornet as described by the authors to be the primary intervention, with or without additional techniques. These devices produce an oscillatory PEP effect. Thoracic oscillation as defined by the authors to be the primary intervention, with or without additional techniques, to provide oscillation to the chest wall. Oral oscillation as defined by the authors to be the primary intervention, with or without additional techniques, to provide oscillation to the airways via the mouth.

Two authors independently categorised the physiotherapeutic interventions.

Types of outcome measures

(1) Expectorated secretions (mucus, sputum, phlegm), dry or wet weight, or volume

An increase in the amount of expectorated secretions as a short-term effect of the intervention is considered as beneficial.

(2) Pulmonary function tests

Forced expiratory volume in one second (FEV₁), forced vital capacity (FVC), forced expiratory flow between 25% and 75% expired FVC (FEF₂₅₋₇₅) post-intervention objective change from baseline compared to control

(3) Oxygen saturation measured by pulse or transcutaneous oximetry

(4) Total lung capacity (TLC) and functional residual capacity (FRC)

Objective change from baseline compared to control

(5) Mucus transport rate

Assessed by radioactive tracer clearance

(6) Radiological ventilation scanning

(7) Subjective perception of well-being, ability to participate in activities of daily living

(8) Therapy compliance

(9) Objective change in exercise tolerance;

(10) Nutritional status

Assessed by growth, weight, body composition

(11) Number of respiratory exacerbations per year

(12) Number of days in hospital per year

(13) Number of days of intravenous antibiotics per year

(14) Cost of intervention

Equipment and duration

(15) Deaths

Outcome data from longer-term studies (more than seven days) will be grouped into those measured at one, three, six, twelve months and annually thereafter. If outcome data is recorded at other time periods, then consideration will be given to examining these as well. Short-term studies are defined as studies with a duration less than seven days.

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

See: Cochrane Cystic Fibrosis and Genetic Disorders Group methods used in reviews.

Relevant studies were identified from the Group's Cystic Fibrosis Trials Register using the terms: physiotherapy AND conventional.

The Cystic Fibrosis Trials Register is compiled from electronic searches of the Cochrane Central Register of Controlled Trials (CENTRAL) (updated each new issue of *The Cochrane Library*), quarterly searches of MEDLINE, a search of EMBASE to 1995 and the prospective handsearching of two journals - *Pediatric Pulmonology* and the *Journal of Cystic Fibrosis*. Unpublished work is identified by searching the abstract books of three major cystic fibrosis conferences: the International Cystic Fibrosis Conference; the European Cystic Fibrosis Conference and the North American Cystic Fibrosis Conference. For full details of all searching activities for the register, please see the relevant sections of the Cystic Fibrosis and Genetic Disorders Group Module.

Date of the most recent search of the Group's Trials Register: September 2006.

METHODS OF THE REVIEW

We reviewed the studies according to the protocol outlined below.

- (1) Two authors from different centres independently assessed which trials should be included.
- (2) Two authors independently assessed the quality of the included studies using a system as described by Jadad (Jadad 1996). In the event of disagreement about inclusion of a trial, or the quality score, we asked an independent author from a third centre to review the paper(s) in question.
- (3) Each author independently extracted data on the outcome measures listed above.
- (4) Reviewers used the Cochrane Review Manager software to compile and analyse the data (Review Manager 2004).

For continuous outcomes, we recorded either the mean change from baseline for each group or mean post-treatment or intervention values and the standard deviation or standard error for each group. In the case of binary outcomes, in order to allow an intention-to-treat analysis, we collected data on the number of participants with each outcome event by allocated treated group irrespective of compliance and whether or not the participant was later thought to be ineligible or otherwise excluded for treatment or follow up.

If trials had a cross-over design, the analysis that we planned to carry out is one recommended by Elbourne, however this was not possible with the data currently available (Elbourne 2002).

DESCRIPTION OF STUDIES

Summary details are given in the 'Characteristics of included studies' section.

Of the 126 studies of airway clearance techniques identified by the literature search, 106 were excluded as they lacked a 'no treatment' or 'spontaneous coughing' control group. Of the 20 remaining studies, two were not clinical trials; four included diagnoses other than cystic fibrosis; five did not evaluate chest physiotherapy; one because none of the outcome measures which we had defined for this review were used; one because the intervention was not thought to improve mucus clearance; and one was in participants during an intra-operative period under anaesthesia. The remaining six studies were included. These were cross-over in design and included a control period.

Mortensen compared two treatments, postural drainage combined with the FET; and PEP breathing combined with the FET with a control period (spontaneous coughing) in a three-day cross-over trial. This was described in one abstract as having 10 participants and in another abstract as having 11 participants (Mortensen 1991). In this short-term study each treatment was given only once on one of three separate days. Falk compared the same treatments and the same study design in 12 people with CF (Falk 1993).

Pfleger compared four forms of chest physiotherapy (PEP breathing, AD, PEP breathing followed by AD or AD followed by PEP breathing) with a control period (including some directed coughing) in 14 people with CF (Pfleger 1992). In this short-term study each treatment was undertaken once on separate days.

Rossmann compared the immediate effect of four forms of chest physiotherapy (directed vigorous cough, postural drainage, postural drainage with mechanical percussion and conventional physiotherapy) with a control (including some requested cough periods) in six people with CF in a cross-over design (Rossmann 1982). In this short-term study each treatment was given only once on separate days.

Van der Schans compared the immediate effect of two forms of chest physiotherapy (positive expiratory pressure breathing with 5 cm water pressure followed by directed vigorous coughing or PEP breathing with 15 cm water pressure followed by directed vigorous coughing) with a control period in eight CF participants in a cross-over design (van der Schans 1991). In this short-term study each treatment was given only once on separate days.

Braggion compared the immediate effect of three forms of chest physiotherapy (HFCC combined with FET and coughing, PEP combined with FET and coughing or postural drainage combined with vibrations, deep breathing, percussion or FET and coughing) with a control (spontaneous coughing) (Braggion 1995). Each regimen was used twice a day for two consecutive days.

METHODOLOGICAL QUALITY

The methodological quality scored using the Jadad score is as follows: Mortensen: 1 (Mortensen 1991); Falk: 1 (Falk 1993); Pfleger: 2 (Pfleger 1992); Rossmann: 1 (Rossmann 1982); van der Schans: 1 (van der Schans 1991); Braggion: 2 (Braggion 1995). The maximal score according to Jadad is five, however, two items are related to blinding of the investigator. Since blinding of the investigator is impossible in case of chest physiotherapy the maximal possible score for these studies is only three.

RESULTS

Six trials were included. All are cross-over trials and no meta-analysis was possible. All were short-term studies (less than seven days). Five studies were single treatment studies (Falk 1993; Mortensen 1991; Pfleger 1992; Rossmann 1982; van der Schans 1991) and in one study each physiotherapy treatment was given four times (Braggion 1995).

(1) Expecterated secretions

Three studies, involving 36 participants, found a higher amount of expecterated secretions during chest physiotherapy compared to the control period (Braggion 1995; Pfleger 1992; Rossmann 1982).

In the study by Pflieger, the mean weight of expectorated mucus during spontaneous coughing was approximately 17 g and during the three forms of chest physiotherapy between 34 to 45 g (Pflieger 1992). Braggion found a mean wet weight of expectorated secretions during the control day of 6 g and during the chest physiotherapy sessions 23 to 30 g (Braggion 1995). Rossman found a statistically significant higher volume of expectorated secretions during the different forms of chest physiotherapy compared to the control session (Rossman 1982).

(2) Pulmonary function tests

No data were available in any of the studies regarding this outcome.

(3) Oxygen saturation measured by pulse or transcutaneous oximetry

No data were available in any of the studies regarding this outcome.

(4) Total lung capacity (TLC) and functional residual capacity (FRC)

Two studies, involving 24 participants, measured TLC and FRC after chest physiotherapy and found no significant effect on pulmonary function variables following intervention (Braggion 1995; van der Schans 1991).

(5) Mucus transport rate as assessed by radioactive tracer clearance

In four studies radioactive tracer clearance was used as an outcome variable (Falk 1993; Mortensen 1991; Rossman 1982; van der Schans 1991). In three of these, involving 28 participants, it was found that chest physiotherapy, including coughing, increased radioactive tracer clearance as compared to the control period (Falk 1993; Mortensen 1991; Rossman 1982). In the study by Mortensen, median clearance after 30 minutes during control was 7% and during two different chest physiotherapy sessions was 33% and 34% (Mortensen 1991). Falk found approximately 6% clearance during the control measurement and 9% during chest physiotherapy (Falk 1993). Rossman found 32% radioactive tracer clearance during the control measurement and 40 to 46% during the different forms of chest physiotherapy (Rossman 1982). One study, of eight participants, reported no significant difference between two different chest physiotherapy sessions of PEP-breathing (clearance 10% and 6%), without coughing, compared to a control period (clearance 8%) (van der Schans 1991). Different outcomes between the study by van der Schans and the other studies can be explained by the fact that in the van der Schans study participants were requested not to cough, but coughing was encouraged in the other studies as a part of the treatment (van der Schans 1991).

(6) Radiological ventilation scanning

No data were available in any of the studies regarding this outcome.

(7) Subjective perception of well-being, ability to participate in activities of daily living

No data were available in any of the studies regarding this outcome.

(8) Therapy compliance

No data were available in any of the studies regarding this outcome.

(9) Objective change in exercise tolerance

No data were available in any of the studies regarding this outcome.

(10) Nutritional status as assessed by growth, weight, body composition

No data were available in any of the studies regarding this outcome.

(11) Number of respiratory exacerbations per year

No data were available in any of the studies regarding this outcome.

(12) Number of days in hospital per year

No data were available in any of the studies regarding this outcome.

(13) Number of days of intravenous antibiotics per year

No data were available in any of the studies regarding this outcome.

(14) Cost of intervention (equipment and duration)

No data were available in any of the studies regarding this outcome.

(15) Deaths

No data were available in any of the studies regarding this outcome.

DISCUSSION

Chest physiotherapy has been a mainstay of the respiratory management of people with CF for so long that it may now be difficult for these people, their parents, physiotherapists and medical staff to consider a trial design that incorporated a no treatment control group for any length of time. Despite there being a reasonable degree of equipoise with regard to whether physiotherapy is better than no treatment, many would argue that to recruit participants into a no treatment group would be unethical. This explains in part why there are currently no long-term trials which use this design.

Evidence from short-term or single treatment studies, which incorporate a 'no treatment' group, should be interpreted with caution because of the long-term nature of the disease. The clinical consequences of missing one or two treatments is unlikely to be significant. Despite this limitation, the majority of physiotherapy studies involve single treatment or short-term study designs. In addition, the small participant numbers and enormous heterogeneity of treatments and outcome measures reported in the literature make it impossible to pool results from different studies. The short-term studies that were included in this review suggest that chest physiotherapy increases mucus transport in people with CF. This finding supports the conclusion of an earlier review (Thomas 1995a).

Finally a sham or placebo treatment clearly cannot be substituted for a clearly physical intervention such as percussion, PEP or postural drainage. Similarly, participants and therapists cannot be 'blinded' from the treatment being received. This partly explains the low quality scores of the included studies, as the Jadad scoring

system places significant emphasis on blinding. Methodological variations between systematic reviews/meta-analyses may account for the differences in conclusions regarding treatment efficacy. The included cross-over trials may have provided potentially useful information about the efficacy of physiotherapy treatments.

AUTHORS' CONCLUSIONS

Implications for practice

Short-term cross-over trials suggest that airway clearance regimens have beneficial effects in people with CF in regard to improving mucus transport. However, based on this review, we have not been able to find any robust scientific evidence to support the hypothesis that chest physiotherapy for the purpose of clearing airway secretions has a long-term beneficial effect in people with CF, nor to support the claim by some authors that it is harmful.

Implications for research

The gold standard for establishing efficacy of therapy is the randomised controlled trial with a 'no treatment' group. The application of this study design to the question in this review would be very effective. However, several ethical considerations could be raised in the discussion with regard to the withdrawal of an established and trusted treatment like chest physiotherapy in people with CF, even in the absence of firm evidence. On the other hand, it could be argued that in view of scant evidence to support the use of chest physiotherapy for people with CF and the fact that this intervention can be unpleasant, uncomfortable, and time-consuming, we believe that a study with a control group with no treatment in some circumstances is justified. Therefore, we propose that in future research, control groups or control periods should be included with sufficient numbers of included participants. This would be best studied as a parallel study over a time period of months rather than days or weeks.

NOTES

Information on previous updates

Review update: November 2005

The search of the Group's Cystic Fibrosis Trials Register identified four new references. One study identified was not eligible for inclusion in the review and has been added to the 'Excluded studies'

section (Chatham 2004). The remaining three references were to three already excluded studies (Darbee 1990; Marks 1999; McIlwaine 1997).

Review update: May 2004

Additional references (providing no additional information) have been added to the following already 'Included studies': Mortensen 1991; Falk 1993.

Additional references have been added to the following already 'Excluded studies': Button 1997a; Costantini 1998; Orlik 2001.

Three new studies have been added to 'Excluded studies': Hare 2002; Orlik 2000; Tannenbaum 2001.

Review update: August 2002

Six crossover trials, previously cited in "Excluded Studies" have now been moved to the "Included Studies" section (Braggion 1995; Falk 1993; Mortensen 1991; Pflieger 1992; Rossman 1982; van der Schans 1991). Relevant changes to the text of the review have been made.

Four new "Excluded Studies" have been incorporated into the review (Battistini 2001; Keller 2001; Pollard 2000; Orlick 2001).

Additional references to studies already listed in "Excluded Studies" have been incorporated into the review within the following study ID's: Button 1997a; Gondor 1999; Grasso 2000; Marks 1999; Newhouse 1998).

POTENTIAL CONFLICT OF INTEREST

None known.

SOURCES OF SUPPORT

External sources of support

- No sources of support supplied

Internal sources of support

- No sources of support supplied

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Falk 1993 {published data only}

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*Indicates the major publication for the study

TABLES**Characteristics of included studies**

Study	Braggion 1995
Methods	Cross-over trial with random order of the interventions
Participants	Cystic fibrosis n = 16 mean (sd) age 20.3 (4) years
Interventions	- high-frequency chest compression - postural drainage, breathing exercises, vibrations, manual percussion - PEP breathing - control
Outcomes	- wet and dry weight expectorated mucus - FVC, FEV1, FEF25-75% - subjective assessment
Notes	Measurement 30 minutes after intervention
Allocation concealment	A – Adequate
Study	Falk 1993
Methods	Cross-over trial with random order of the interventions
Participants	Cystic fibrosis n = 12
Interventions	- FET, postural drainage - FET, PEP breathing - control
Outcomes	- radioactive tracer clearance
Notes	Measurements 30 minutes, 1 hour, 2 hours and 24 hours after intervention
Allocation concealment	B – Unclear
Study	Mortensen 1991
Methods	Cross-over trial with random order of the interventions
Participants	Cystic fibrosis n = 10 mean (sd) age 20 (3.4) years

Characteristics of included studies (Continued)

Interventions	- postural drainage, FET, thoracic expansion exercises, relaxation - PEP breathing, FET - control, spontaneous coughing
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Outcomes	- radioactive tracer clearance
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Notes	Measurements 30 minutes, 1 hour and 24 hours after intervention
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Allocation concealment	B – Unclear
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Study	Pfleger 1992
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Methods	Cross-over trial with random order of the interventions
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Participants	Cystic fibrosis n = 14 mean (range) age 14 (9.8 - 22.4) years
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Interventions	- PEP breathing - AD - PEP followed by AD - AD followed by PEP - control, spontaneous coughing
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Outcomes	- FVC, FEV1, RV/TLC, Raw - weight expectorated mucus
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Notes	Measurements during an immediately after intervention
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Allocation concealment	B – Unclear
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Study	Rossmann 1982
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Methods	Cross-over trial with random order of the interventions
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Participants	Cystic fibrosis n = 6 mean (sd) age: 22.8 (5.6) years
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Interventions	- postural drainage - postural drainage, mechanical percussion - regimented coughing - chest physiotherapy, breathing exercises, vibrations, manual percussion, postural drainage - control, spontaneous coughing
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Outcomes	- radioactive tracer clearance
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Notes	Measurements during and up to 2 hours after intervention
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Allocation concealment	B – Unclear
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Study	van der Schans 1991
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Methods	Cross-over trial with random order of the interventions
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Participants	Cystic fibrosis n = 8 mean (sd) age: 16 (3) years
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Interventions	- PEP breathing with a resistance of 5 cmH ₂ O followed by 5 minutes of coughing - PEP breathing with a resistance of 15 cmH ₂ O followed by 5 minutes of coughing - control followed by 5 minutes of coughing
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Outcomes	- radioactive tracer clearance - TLC, FRC
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Falk 1984	No control group without chest physiotherapy
Falk 1988	No control group without chest physiotherapy
Fauroux 1999	No chest physiotherapy (airway clearance technique) studied
Gaskin 1998	No control group without chest physiotherapy
Gayer 1988	No chest physiotherapy (airway clearance technique) studied
Giles 1995	No control group without chest physiotherapy
Giles 1996	No control group without chest physiotherapy
Gondor 1999	No control group without chest physiotherapy
Gotz 1995	No control group without chest physiotherapy
Grasso 2000	No control group without chest physiotherapy
Hare 2002	No control group without chest physiotherapy
Hartsell 1978	No control group without chest physiotherapy
Hofmeyr 1986	No control group without chest physiotherapy
Homnick 1995	No control group without chest physiotherapy
Homnick 1998	No control group without chest physiotherapy
Jacobs 1981	No control group without chest physiotherapy
Keller 2001	No control group without chest physiotherapy
Kerrebijn 1982	No control group without chest physiotherapy
Klig 1989	No control group without chest physiotherapy
Kluft 1996	No control group without chest physiotherapy
Kofler 1994	No control group without chest physiotherapy
Kofler 1998	No control group without chest physiotherapy
Konstan 1994	No control group without chest physiotherapy
Kraig 1995	No control group without chest physiotherapy
Lagerkvist 1997	No control group without chest physiotherapy
Langenderfer 1998	Not a clinical trial
Lannefors 1992	No control group without chest physiotherapy
Lindemann 1992	No control group without chest physiotherapy
Lorin 1971	No control group without chest physiotherapy
Lyons 1992	No control group without chest physiotherapy
Majaesic 1996	No control group without chest physiotherapy
Marks 1999	No control group without chest physiotherapy
Maxwell 1979	No control group without chest physiotherapy
McIlwaine 1997	No control group without chest physiotherapy
Miller 1995	No control group without chest physiotherapy
Morris 1982	No control group without chest physiotherapy
Mulholland 1994	No control group without chest physiotherapy
Murphy 1983	No control group without chest physiotherapy
Murphy 1988	No outcome measures that were the primary purpose of this review were used
Natale 1994	No control group without chest physiotherapy

Newhouse 1998	No control group without chest physiotherapy
Oberwaldner 1986	No control group without chest physiotherapy
Oberwaldner 1991	No control group without chest physiotherapy
Orlik 2000	No control group without chest physiotherapy
Orlik 2001	No control group without chest physiotherapy
Padman 1999	No control group without chest physiotherapy
Parker 1984	Mixed group of participants: four with cystic fibrosis, five with bronchiectasis, one with asthma
Parsons 1995	No control group without chest physiotherapy
Phillips 1998a	No control group without chest physiotherapy
Phillips 1998b	No control group without chest physiotherapy
Pike 1999	No control group without chest physiotherapy
Pollard 2000	No control group without chest physiotherapy
Pryor 1979a	No control group without chest physiotherapy
Pryor 1979b	No control group without chest physiotherapy
Pryor 1981	No control group without chest physiotherapy
Pryor 1990	No control group without chest physiotherapy
Pryor 1994	No control group without chest physiotherapy
Reisman 1988	No control group without chest physiotherapy
Roos 1987	No control group without chest physiotherapy
Salh 1989	No control group without chest physiotherapy
Samuelson 1994	No control group without chest physiotherapy
Sanchez 1999	No control group without chest physiotherapy
Scherer 1998	No control group without chest physiotherapy
Steen 1991	No control group without chest physiotherapy
Steven 1992	No control group without chest physiotherapy
Stiller 1996	No control group without chest physiotherapy
Stites 2006	Intervention not thought to improve mucus clearance
Sutton 1985	Mixed group of participants: five with bronchiectasis, two with chronic bronchitis and only one with cystic fibrosis
Tannenbaum 2001	Study in participants during intra-operative period under anaesthesia and mechanical ventilation
Tecklin 1976	No control group without chest physiotherapy
Thomas 1995	Not a clinical trial, a review
Tonnesen 1982	No control group without chest physiotherapy
Tugay 2000	No control group without chest physiotherapy
Tyrrell 1985	No control group without chest physiotherapy
Tyrrell 1986	No control group without chest physiotherapy
VanGinderdeuren 2000	No control group without chest physiotherapy
Verboon 1986	No control group without chest physiotherapy
Warwick 1990	No control group without chest physiotherapy
Warwick 1991	No control group without chest physiotherapy
Warwick 2004	No control group without chest physiotherapy

Characteristics of excluded studies (Continued)

Webber 1985	No control group without chest physiotherapy
White 1997	No control group without chest physiotherapy
Wilson 1995	No control group without chest physiotherapy
Wong 1999	No control group without chest physiotherapy
Wordsworth 1996	No chest physiotherapy
Zapletal 1983	No control group without chest physiotherapy
Znotina 2000	No control group without chest physiotherapy
de Boeck 1984	No control group without chest physiotherapy
van Asperen 1987	No control group without chest physiotherapy
van Hengstum 1987	No cystic fibrosis participants
van Hengstum 1988	No control group without chest physiotherapy
van Winden 1998	No control group without chest physiotherapy

GRAPHS AND OTHER TABLES

This review has no analyses.

INDEX TERMS

Medical Subject Headings (MeSH)

Cystic Fibrosis [*therapy]; *Physical Therapy Modalities

MeSH check words

Humans

COVER SHEET

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Date new studies found and included/excluded	06 September 2006
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