Treatment of pulmonary disease following cervical spinal cord injury

Authors’ objectives
To assess the evidence on interventions for the prevention and treatment of pulmonary disease following traumatic cervical spinal cord injury (SCI).

Searching
MEDLINE (from 1966 to February 2000), HealthSTAR (from 1975 to February 2000), CINAHL (from 1983 to February 2000), EMBASE (from 1980 to February 2000), and the Cochrane Controlled Trials Register and Cochrane Database of Systematic Reviews were searched for studies published in English; the search terms were reported. In addition, the references of all included studies and review articles were checked and e-mail alerts from newly published journal articles were obtained.

Study selection
Study designs of evaluations included in the review
Controlled trials, prospective trials with a historical control group, prospective or retrospective cohort studies, and case series with 20 or more participants were initially eligible for inclusion. If few studies were identified then case series with more than 10 participants were eligible.

Specific interventions included in the review
Studies that assessed any interventions for ventilator management of pulmonary disease during the acute phase of SCI, or interventions to reduce the risk of pulmonary disease during the chronic phase of SCI, were eligible for inclusion. The review addressed specific questions about the need for mechanical ventilatory assistance, acute phase ventilation management, weaning techniques, chronic ventilation management, nonmechanical ventilation assistance, drug therapies, secretion management and airway management.

Participants included in the review
Studies that assessed adult patients with traumatic cervical SCI with a pulmonary complication were eligible for inclusion. Studies that either assessed a paediatric population or included patients with thromboembolism or pulmonary embolism were excluded.

Outcomes assessed in the review
Studies that assessed any health outcomes, health service utilisation, economic evaluation, or physiological measures related to respiratory status, were eligible for inclusion.

How were decisions on the relevance of primary studies made?
Two reviewers independently assessed studies for inclusion in the review. Any disagreements were resolved though discussion.

Assessment of study quality
The quality of the primary studies was assessed according to an internal validity scale, which focused on study design, and an external validity scale (see Other Publications of Related Interest nos.1-2). The latter assessed whether the criteria for selection of the patients were described; the patients included in the studies were adequately characterised with regard to level and completeness of SCI; the criteria for the outcomes were clearly described; the clinical care of the patients was clearly described; and the results were reported according to the level of cervical SCI. The authors did not state how many reviewers performed the quality assessment, or how any disagreements were resolved.

Data extraction
One reviewer extracted the data, while a second reviewer checked for accuracy. Data were extracted on the results and outcomes as reported in the individual studies. Additional data were extracted on study design and quality, patient population (neurological status, time since injury, level or injury, completeness of injury, pulmonary status), study protocol and interventions, and the results.

**Methods of synthesis**

How were the studies combined?
The studies were grouped according to the type of intervention and combined in a narrative discussion.

How were differences between studies investigated?
The narrative was separated by study, with descriptions of the participants, interventions and outcomes. Differences between the studies were therefore apparent from the text, and could be assessed from the study tables.

**Results of the review**

Seventy-five studies were included in the review: 3 randomised controlled trials (RCTs), 1 non-randomised controlled trial, 10 cohort studies, 3 diagnostic studies, 20 n-of-1 studies, 2 case-control studies, 35 case series studies, and 1 retrospective chart review. The total number of participants included in the review was approximately 3,900; the participants of some studies had been included in more than one comparison.

What follows is a brief summary of the principal findings. Readers who require more detail should consult the relevant sections of interest in the full report.

Participants who had a C4-level SCI had greater weaning success using progressive ventilatory-free breathing than with synchronised intermittent mandatory ventilation techniques. Higher ventilator volume was also associated with less atelectasis and faster weaning.

Aggressive combination respiratory therapy interventions (including frequent turning, suctioning with or without bronchial lavage, chest percussion and assisted cough, inhaled bronchodilator treatments, deep breathing and incentive spirometry) and rotating beds were all associated with lower rates of mortality, atelectasis, need for mechanical ventilation, and tracheostomy. Studies of other secretion clearance modalities (manual cough, assisted cough, mechanical insufflator-exsufflator, glosopharyngeal breathing) provided no data on health outcomes, but showed some evidence of improved cough. There was little evidence on active respiratory muscle training with incentive spirometry, inspiratory resistance training and abdominal weight training.

Electrophrenic respiration, noninvasive positive-pressure ventilation, intermittent positive-pressure breathing, pneumobelt and glosopharyngeal breathing have all been demonstrated as alternatives to tracheostomy positive-pressure ventilation for use in long-term ventilatory support. It was also demonstrated that for patients who need long-term ventilatory support, noninvasive ventilation may reduce the risk of pneumonia compared with tracheostomy positive-pressure ventilation.

**Authors' conclusions**

Treatments aimed at improving ventilation, cough and secretion clearance can reduce atelectasis, pneumonia and the need for mechanical ventilation.

**CRD commentary**

The review question was broad but was reasonably defined in terms of the interventions, participants, outcomes and study designs. Several sources were searched for relevant studies, but no efforts were made to minimise either language or publication bias. This means that studies with positive findings may have been more likely to have been included in the review. Steps were taken to minimise reviewer bias and errors in the study inclusion and data extraction processes. The quality of the included studies was assessed and reported. The use of a narrative summary was appropriate given the differences in the study characteristics. The conclusions appear to be a fair interpretation of the findings, although
Judgement is somewhat limited by the fact that study design was not considered in the synthesis of the included studies.

**Implications of the review for practice and research**

Practice: The authors did not state any implications for practice.

Research: The authors stated that further research needs to be conducted using RCTs or other study designs to reduce bias. In particular, treatments need to be better characterised, appropriate control groups should be used, participant groups need to be better described in terms of important prognostic features, and the methods of clinical care should be adequately reported. In addition, as the majority of the literature focuses upon pulmonary disease in acute SCI, further research that assesses interventions for the prevention and management of pulmonary complications in chronic SCI needs to be undertaken.

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This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.