Suctioning adults with an artificial airway: a systematic review

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Authors' objectives
To present the best available evidence on interventions, which are effective in preventing or reducing the prevalence of complications associated with suctioning, in hospitalised adult patients with an artificial airway who are breathing spontaneously or are artificially ventilated and who require suctioning. The specific questions addressed were as follows.

Which methods of suctioning reduce the prevalence of mucosal trauma or mucosal dysfunction, and promote the removal of respiratory secretions?

Which techniques or methods are effective in reducing the occurrence of suctioning-induced hypoxaemia, during or following the suctioning procedure?

Which techniques or methods are effective in minimising the haemodynamic or pulmonary complications associated with the suctioning procedure?

Searching
MEDLINE (from 1966 to May 1999), CINAHL (from 1982 to March 1999) and EMBASE (from 1980 to March 1999) were searched using the following MeSH terms (MH) and textwords (mp): 'respiration, artificial'(MH), 'ventilation, mechanical' (MH), 'intubation, intratracheal' (MH), 'intubation' (MH), 'intubation' (mp), '(endotracheal or intratracheal)'(mp), '(tracheotomy or tracheotomy)MH, '(tracheostomy or tracheotomy)')(mp), 'artificial airway$' (mp), 'suction' (MH) or 'suction$' (mp).

The other databases searched were: CONZUL Current Contents (all editions) from week 27 1995 to week 18, 1999; ABI/INFORM from 1985 to March 1999; PsycLIT from 1887 to March 1999; HealthSTAR from 1981 to March 1994; Index New Zealand from January 1987 to February 1999); and all thirteen AUSTROM databases to 1999. The searches were conducted using the textwords 'suction$', 'artificial respiration', 'artificial ventilation', 'artificial airway$', '(intratracheal or endotracheal)', '(tracheostomy or tracheotomy)' and 'intubation'. In addition, the Cochrane Library was searched up to Issue 1, 1999.

Studies reported in languages other than English were included. The reference lists in all identified studies and review papers were also examined for further studies. Unpublished studies were identified by searching UMI Digital Library of Dissertations and Theses (from 1861 to 1999), Cambridge Scientific Databases (from 1972 to 1999), Emerald (from 1989 to 1999), and Expanded Academic ASAP (from 1980 to 5 June 1999). Clinical experts and key researchers in the area were also contacted.

Study selection
Study designs of evaluations included in the review
All randomised controlled trials (RCTs) that addressed the issue of suctioning artificial airways were included. The author states that in the absence of RCTs other (unspecified) designs were considered for inclusion.

Specific interventions included in the review
The review included interventions if they were currently employed in the nursing management of patients with an artificial airway. Of specific interest were: methods used for tracheal suctioning; the instillation of saline prior to suctioning; the use of hyperinflation or hyperoxygenation during suctioning; techniques used in minimising trauma to the trachea during suctioning; and techniques used in promoting the prevention of infection.

Participants included in the review
Studies with adult patients (over 15 years old) within the acute care hospital setting, with either an endotracheal tube or a tracheostomy tube in situ, were included. Studies with both spontaneously breathing and/or artificially ventilated
participants were included.

Outcomes assessed in the review
The following outcome measures were included: changes to arterial blood gases, i.e. oxygen pressure (PaO2), carbon dioxide pressure (PaCO2) and saturated oxygen (SaO2) levels; cardiovascular, neurological, haemodynamic or pulmonary changes associated with suctioning; the assessment tools utilised during suctioning; the prevalence of mucosal trauma or mucosal dysfunction; the volume of secretion removal or the frequency of suctioning; the prevalence of atelectasis, tracheitis or pneumonia; and changes in patients’ comfort associated with suctioning.

How were decisions on the relevance of primary studies made?
The abstracts were assessed independently by two reviewers. The reviewers were blinded to the authors and titles of the studies.

Assessment of study quality
Methodological quality was assessed using a checklist based on the work of the Cochrane Collaboration and the NHS Centre for Reviews and Dissemination (see Other Publications of Related Interest nos.1-2). Quality was assessed on criteria such as whether allocation concealment was adequate, whether there was blinding of the interventions and outcomes assessment, and whether intention to treat analysis was used. All studies were categorised according to the strength of evidence using a published scale (see Other Publications of Related Interest no.3). Validity was assessed by ‘several’ reviewers, and any disagreements between the reviewers were resolved by discussion with an independent reviewer.

Data extraction
The data were extracted independently by two reviewers, and any disagreements were dealt with by a third reviewer. The data extraction tool was developed and tested prior to use. The extracted data included: author, source, design, purpose of study, population, interventions, outcomes, results, level of evidence, and comments in relation to methodological issues. The latter related to randomisation, blinding, drop-outs, the number of episodes of treatment, the washout period for crossover studies, and possible confounders.

Methods of synthesis
How were the studies combined?
The findings were described in a narrative summary.

How were differences between studies investigated?
The author grouped the studies based on the subject area. The papers were discussed under the following headings: clinical indicators for suctioning; effects of suctioning; suctioning techniques; oxygenation; and suctioning patients following a cerebral insult.

Results of the review
Ninety-five papers were included. Of these, 11 were RCTs, 29 were crossover studies, 9 were controlled trials, 7 were case studies, 26 were descriptive studies, 11 were literature reviews, 1 was a survey, and 1 was a clinical practice guideline.

Clinical indicators for suctioning.
There was minimal research relating to clinical indicators for suctioning, or focusing on suctioning practices. The included studies were observational with a small number of participants. The author stated that the studies provided a valuable focus on the importance of individualised assessment in the suctioning of patients. The majority of the studies suggested that if the patient is able to cough up the secretions themselves then they should be encouraged to do so.

Effects of suctioning.
Patient experiences: although most of the studies were observational with a small number of participants, the author stated that they highlighted the importance of ongoing assessment in the suctioning of patients. The need for skill and
gentleness when administering care was highlighted.

Cardiac arrhythmias: the majority of the studies were case reports. There were contradictory reports about whether suctioning could trigger cardiac arrhythmias. However, the author stated that the importance of individual assessment and nursing judgment cannot be overstressed.

Suctioning techniques.

Suctioning trauma: the majority of the studies had very small samples and were conducted on animals or lung simulation models. The research also varied in relation to the suction pressures used (50 to 380 mmHg), the duration and frequency of suctioning, and the type of equipment used. No recent studies that focused on the effectiveness of suctioning techniques were identified.

Asepsis/prevention of infection: there were very few studies. The author stated that the findings should be interpreted with caution, as the majority of the studies had small numbers and some had uncontrolled confounding variables. The potential for selection bias and reactive bias existed in the majority of the studies. The aseptic technique continues to be recommended.

Saline instillation: there was contradictory evidence regarding any benefits of the instillation of saline prior to suctioning. A Cochrane review in this area indicated that there was no conclusive evidence to suggest that instilling saline prior to suctioning adults with an artificial airway increases the removal of respiratory secretions.

Oxygenation.

Insufflation catheters: several studies identified insufflation catheters as a useful method in minimising hypoxaemia associated with suctioning. However, the studies were inconsistent in their recommendations on whether insufflation catheters should be used alone, or to augment other methods of preoxygenation during suctioning protocols. The quality of the studies varied considerably and there was heterogeneity in the populations and catheters used.

Open and closed suction systems: several studies reported no significant differences in the occurrence of nosocomial pneumonia between the two methods of suctioning. Research using the outcome incidence of colonisation showed contradictory results. Only one study using the removal of secretions as an outcome variable was identified, and no differences were found between the two suctioning systems. There are potential risks of using closed systems with certain modes of ventilation. However, research in this area is minimal.

Methods of hyperoxygenation/hyperinflation: the studies were heterogeneous in a number of ways, including the populations and interventions used; therefore, it was difficult to make comparisons. It is unclear what the optimum level of oxygenation for hyperinflation should be. Research has consistently shown that patients who receive no preoxygenation prior to suctioning show a significant decline in PaO2 and SaO2 with suctioning.

Suctioning patients following a cerebral insult.

These studies tended to have small sample sizes, were heterogeneous in terms of the study design and patient characteristics, and were susceptible to a number of confounding variables. In the studies reviewed, patients with severe head injury who had tracheal suctioning experienced negative effects on intracranial pressure, which increased with additional suctioning sequences.

Cost information
There was minimal cost information on comparisons of open and closed suction systems. The in-line suctioning system has generally been reported as being more expensive than the open system. However, not all of the costs of the open system may have been considered.

Authors' conclusions
This review identified a variety of adverse effects associated with the suctioning procedure. The potential complications and adverse effects of this procedure require that it be undertaken with caution, and only once clinical assessment has identified its necessity. The need for close observation of patients, throughout and following the procedure, cannot be
overstressed since the adverse effects of suctioning frequently manifest themselves throughout and beyond completion
of the procedure.

**CRD commentary**

This was a reasonably well-conducted systematic review. The literature search was comprehensive, non-English
language papers were included, and efforts were made to identify unpublished research. Decisions on the relevance and
quality of the studies were made independently by at least two reviewers, and there were procedures in place to deal
with any disagreements. Similar procedures were used for the data extraction. The research question was stated clearly
although the inclusion criteria were very wide, resulting in the inclusion of very heterogeneous studies. The inclusion
criteria relating to the participants specified patients over 15 years of age, but in vitro and animal studies were included
in the review. The author does not state why this inclusion criteria was changed. The validity assessment only seems to
have been appropriate for experimental studies. While all the studies were graded into levels of evidence based on their
study design, a validity assessment of non-experimental papers such as literature reviews does not appear to have been
carried out. Therefore, it is not possible to distinguish between poor and good quality literature reviews.

The narrative synthesis was appropriate given the heterogeneity of the studies. The studies for each of the four subject
areas were discussed separately, but quite diverse studies were discussed together within these. For example, animal and
human studies were discussed together, as were RCTs and non-systematic literature reviews. Detailed information on
each of the studies (information seems to be missing on one of the studies) was tabulated. However, it would have been
helpful if the studies had been grouped according to the four subject headings and quality.

When identifying the practice implications, the author highlights clearly the level of evidence on which they were
based.

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

Practice: The author states that practitioners should consider that adverse effects may occur in some patients when
using hyperinflation, and combine this with thorough individual patient assessment when planning suctioning
interventions. Hyperinflation may have clinical implications for patients who have raised intracranial pressure, are
postoperative following vascular or cardiac surgery, or who are haemodynamically unstable.

Repeated hyperinflation and hyperoxygenation suction sequences can have adverse haemodynamic effects and,
therefore, should be limited to those patients in which it is necessary to maintain airway patency. Some researchers
recommend that hyperinflation-suction episodes be limited to two per session.

The above implications for practice are based on grade B evidence. The paper contains further recommendations based
on lower grade evidence.

Research: The author states that there is a need for quality research on all aspects of suctioning adult patients with an
artificial airway. More research is also required on patients who are not ventilated but who have an artificial airway.

**Bibliographic details**

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Briggs Institute for Evidence Based Nursing and Midwifery. Systematic Review; 9. 2000

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10677679

**Other publications of related interest**


2. NHS Centre for Reviews and Dissemination. Undertaking systematic reviews of research on effectiveness. CRD's
   guidance for those carrying out or commissioning reviews. York: University of York, NHS Centre for Reviews and
   Dissemination; 1996.


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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.