A meta-analysis of the effects of various interventions in preventing endotracheal suction-induced hypoxemia

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CRD summary
This review assesses the effects of interventions applied to prevent endotracheal suction-induced hypoxia. The interventions, regardless of their application times or methods, were reported to significantly reduce suction-induced hypoxia. The conclusions are based on studies that were statistically similar, and do not represent all of the studies selected for inclusion. Therefore, it is possible that the conclusions may not be reliable.

Authors' objectives
To determine the effects of interventions that were applied to prevent endotracheal suction-induced hypoxia (EndoSIH).

Searching
MEDLINE was searched and the bibliographies of past reports were checked for further relevant studies. To be included in the review, studies needed to be published after 1970. The search terms were not reported, and the authors did not state whether any language restrictions were applied.

Study selection

Study designs of evaluations included in the review
The authors did not pre-specify the design of studies to be included in the review.

Specific interventions included in the review
Studies that investigated the effectiveness of at least one intervention used to prevent EndoSIH were eligible for inclusion. The techniques used in the included studies were bagging, changes in ventilation, mechanical sigh, double lumen catheter, sidearm of an endotracheal tube adaptor, bagging with supplemental oxygen, increasing the ventilator oxygen and increasing ventilation.

Participants included in the review
Studies that included patients requiring endotracheal suction were eligible. The participants included in the review had a wide range of clinical diagnoses.

Outcomes assessed in the review
Studies that assessed the prevention of EndoSIH were included in the review. There were no inclusion criteria relating to specific outcome measures.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.

Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction. A number of study characteristics were extracted and tabulated, including the name of the diagnosed disease, method of endotracheal suction and time of hypoxia measurement. When more than one intervention was
investigated in a study, each intervention was dealt with as an independent study. The standardised mean difference was calculated using either P-values or the t-, F- or chi-squared value for each outcome.

Methods of synthesis

How were the studies combined?
Statistically homogeneous studies were combined in meta-analyses (see Other Publications of Related Interest). Separate analyses were performed for the overall effectiveness of the interventions, oxygenation times, and methods of oxygenation. The 95% confidence intervals (CIs) were calculated for the mean effect size (ES). Cohen's criteria were used to assign a magnitude of effect to summary estimates. The studies were also combined narratively, under the three groups above, by stating numbers and percentages of those studies showing a statistically significant result. Patient characteristics, time periods and methods of oxygenation, techniques of applying suction, and indices of hypoxia were discussed and illustrated using descriptive statistics.

How were differences between studies investigated?
Differences between the studies were investigated statistically. The findings were used to determine which studies were included in the meta-analyses. Studies displaying outliers (excessively large or small effect sizes) were excluded until the analysis showed a homogeneous group.

Results of the review
Thirty studies, comprising approximately 633 patients, were included in the review (322 patients were included in the meta analyses).

Sixteen statistically homogeneous study results (out of 30 included studies) found the interventions to be effective at reducing suction-induced hypoxia (ES 0.86, 95% CIs not reported, P=0.0005).

Oxygenation times.

Five statistically homogeneous studies using preoxygenation (out of 12 included studies) were significantly effective at reducing suction-induced hypoxia (ES 0.68, 95% CI: 0.14, 1.21, P=0.01).

Five statistically homogeneous studies using insufflation (out of 13 included studies) were significantly effective (ES -1.59, 95% CI: -2.15, -1.03, P=0.0005), as were 5 statistically homogeneous studies using preoxygenation and postoxygenation (out of 11 included studies) (ES 1.11, 95% CI: 0.75, 1.47, P=0.0005).

There was also one study that used postoxygenation alone, 8 studies that used preoxygenation and insufflation, and 5 studies that used preoxygenation, insufflation and postoxygenation.

Oxygenation methods.

Five statistically homogeneous studies of hyperoxygenation (out of 10 included studies) were significantly effective at reducing suction-induced hypoxia (ES 0.62, 95% CI: 0.23, 1.01, P=0.002).

Seven statistically homogeneous studies using hyperoxygenation in combination with hyperinflation (out of 20 included studies) were significantly effective (ES 1.33, 95% CI: 0.92, 1.73, P=0.0005).

There were also 8 studies that used hyperinflation, and one study that used hyperventilation and hyperinflation.

Authors' conclusions
Interventions used to prevent EndoSIH significantly reduce suction-induced hypoxia, regardless of their application times or methods.

CRD commentary
The review had clear inclusion criteria for the outcome and patient group only. The search was limited to one electronic database and reference lists, and the authors did not specify whether any language restrictions were applied; the potential for language and publication bias cannot, therefore, be ruled out. The methods used to select studies for inclusion and abstract the data from the included studies were not reported, hence the possibility of selection bias and reviewer error cannot be assessed. A formal assessment of study quality was not performed, thus it is not possible to comment on the validity of the included studies and how this might have impacted on the results.

Details on each of the included studies were tabulated. However, no information on study design was given, which makes it difficult to assess whether the decision to statistically pool the studies was appropriate. The authors did not explore possible reasons for heterogeneity found in the studies excluded from the meta-analyses. In addition, they did not address, through adjustment, the fact that results included in the analysis were from the same studies and were therefore likely to be correlated.

The authors based their conclusions on those studies that were statistically homogeneous and included in their meta-analyses. These do not represent all of the studies selected for inclusion. It is therefore possible that the conclusions may not be reliable.

**Implications of the review for practice and research**
The authors did not state any implications for practice or further research.

**Bibliographic details**

**PubMedID**
14632984

**Other publications of related interest**

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Adult; Anoxia /etiology /prevention & control; Humans; Insufflation /methods; Intubation, Intratracheal /adverse effects; Middle Aged; Oxygen /administration & dosage; Suction /adverse effects

**AccessionNumber**
12003004430

**Date bibliographic record published**
31/05/2005

**Date abstract record published**
31/05/2005

**Record Status**
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.