Best evidence topic – Cardiac general
Continuous subglottic suction is effective for prevention of ventilator associated pneumonia

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Received 5 October 2004; accepted 21 December 2004

Summary

A best evidence topic in cardiac surgery was written according to a structured protocol. The question addressed was whether subglottic suction is an effective preventative measure for ventilator associated pneumonia (VAP) after cardiac surgery. Altogether 457 papers were found using the reported search, of which 13 presented the best evidence to answer the clinical question. The author, journal, date and country of publication, patient group studied, study type, relevant outcomes, results, and study weaknesses of these papers are tabulated.

We conclude Subglottic suction significantly reduces the incidence of VAP in high risk patients (NNT of 8 if ventilated over 3 days), although the benefit is lower in elective cardiac patients. Subglottic suction is currently not commonly used, but even with marginal benefits, its use is likely to be highly cost effective.

Keywords: Evidence-based medicine; Subglottic suction; Ventilator-associated pneumonia; Review

1. Introduction

A best evidence topic was constructed according to a structured protocol. This protocol is fully described in the ICVTS [1].

1.1. Clinical scenario

You performed a difficult Aortic Valve replacement and triple-coronary arterial-bypass-graft on a 77-year-old man, with a 30-year history of smoking. The operation proceeded uneventfully, but in the Intensive care it was not possible to extubate him on the first night due to basal collapse, and over the next few days he develops a ventilator-associated-pneumonia (VAP).

You search the internet for manoeuvres that may avoid this frustrating complication and find that continuous subglottic suction would avoid pooling of secretions around the endotracheal tube and thus perhaps reduce VAP. Thus you resolve to search for evidence for this simple intervention.

1.2. Three-part question

In patients undergoing [mechanical ventilation] does [subglottic suction] reduce the incidence of [Ventilator associated pneumonia]?

1.3. Search strategy

[glottic.mp OR subglottic.mp OR sub-glottic.mp ]AND [ exp pneumonia/OR pneumonia.mp OR secreti$.mp OR ventilat$.mp OR aspirat$.mp] Limit to human studies.

1.4. Search outcome

Four hundred and fifty seven papers were found from the reported search and cross-checking reference lists, of which 13 were deemed to be relevant. This included 7 RCTs, one cohort study and several reviews, from which 3 were selected [2–14]. The papers are presented in Table 1.

2. Results

Valles et al. in 1995 [2] performed a large randomized study in 190 patients who were likely to be ventilated for more than 3 days. They found a relative reduction of 43% in ventilator-associated-pneumonia (VAP) and continuous suction delayed the time to the onset of VAP from a mean of 5 days to 12 days (NNT of 5). The same authors [3] then performed a cohort study in 83 patients intubated in their general ICU or emergency department, where all patients received continuous subglottic suction. They found that 43% of patients who developed pneumonia suffered failure of the suction compared to 30% of those who did not. In addition low cuff pressure was also significantly associated with pneumonia.
<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Study type (level of evidence)</th>
<th>Outcomes</th>
<th>Key results</th>
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<tr>
<td>Girou et al. (2004), Intensive Care Med, France [4]</td>
<td>18 critically ill patients requiring mechanical ventilation for &gt;5 days Randomised to continuous subglottic suction and semi-recumbent body position (N=8) or to receive standard care in supine position, (N=10)</td>
<td>PRCT (level 2b)</td>
<td>Daily sampling and culturing of oropharyngeal and tracheal secretions</td>
<td>Median bacterial count in trachea were 6.6 ±10 CFU/ml (interquartile range, IQR, 4.4–8.3) in patients who received continuous suction and 5.1 ±10 CFU/ml (IQR 3.6–5.5) in control patients</td>
<td>Study period was only ten days from start of mechanical ventilation</td>
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<td>Valles et al. (1995), Spain, Ann Intern Med [2]</td>
<td>190 critically ill general patients requiring mechanical ventilation for &gt;3 days. Randomised to receive continuous aspiration of subglottic secretions (CASS) (n=76) or to receive usual care (N=77).</td>
<td>PRCT (level 1b)</td>
<td>Duration of ventilation Subglottic suction (CASS) 13 ± 1 day</td>
<td>Incidence of VAP Subglottic suction (CASS) 14/76 (18.4%) and 19.9 episodes/1000 ventilator days in the patients Control patients 39/77 (32.5%) and 39.6 episodes/1000 ventilator days (RR=1.98; CI 95%; 1.03 to 3.82)</td>
<td>Of 190 patients entered into the study, 15 were extubated and 16 died before the end of the study.</td>
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<td>Smulders et al. (2002), Netherlands, Chest [5]</td>
<td>150 Patients admitted to a general ICU, expected to receive ventilation &gt;72 h Intermittent suction ET tube with intermittent secretion drainage every 20 s, for 8 s (N=75) Control group Standard ET tube (N=75)</td>
<td>PRCT (level 1b)</td>
<td>Incidence of ventilator associated pneumonia Intermittent suction 3/75 (4%) Control patients 12/75 (16%)</td>
<td>Incidence of VAP Time to VAP Episodes of VAP occurred later in patients receiving CASS (12.0 ± 7.1 days) than in control patients (5.9 ± 2.1 days) (P = 0.003) Clinical diagnosis of VAP without quantitative cultures of LRTI Chest Radiograph interpreted by one radiologist only Possibility of bias cannot be excluded</td>
<td>Intermittent suction 5.8 ± 4.4 days Control patients 7.1 ± 5.4 days P=NS</td>
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Table 1 (Continued)

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<td>Rello, Valles et al. (1996), Am J Resp Critical Care Med, Spain [3]</td>
<td>All patients intubated in the ICU or the emergency department (N=83)</td>
<td>Cohort study (level 2b)</td>
<td>Incidence of Ventilator associated pneumonia</td>
<td>Pneumonia occurred in 12/83 patients</td>
<td>Single centre study - Possibility of institutional bias in patient selection or institutional practices</td>
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<tr>
<td>Kollef et al. (1999), NEJM [10]</td>
<td>Systematic review of a wide range of non-pharmacological and pharmacological preventative strategies against VAP</td>
<td>Systematic review (level 1a)</td>
<td>Guide for the development of a programme to prevent VAP</td>
<td>Continuous subglottic suction recommended for clinical use as non-pharmacological measure to prevent VAP (grade A recommendation)</td>
<td>Health status of patients in each study reviewed was not taken into consideration</td>
</tr>
<tr>
<td>Kollef et al. (1999), Chest, USA [9]</td>
<td>343 patients undergoing cardiac surgery and requiring mechanical ventilation in the cardiothoracic ITU (CTICU).</td>
<td>PRCT (level 2b)</td>
<td>Incidence of VAP</td>
<td>CASS Patients 8/160 (5.0%) Routine care patients 15/183 (8.2%) RR = 0.61%; (CI 95% 0.27 to 1.40) P = 0.238</td>
<td>Diagnosis of VAP was made clinically and not confirmed by examination of bronchoscopically obtained specimens.</td>
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<tr>
<td>Pneumatikos et al. (2002), Inten Care Med [6]</td>
<td>61 Patients admitted to the ICU who were predicted to need ventilation for &gt; 5 days.</td>
<td>PRCT (level 1b)</td>
<td>Incidence of VAP</td>
<td>SDSA Patients 5/30 (16%)</td>
<td>Confounding factor - Infused cuff not completely sealed i.e. leakage of antibiotics possibly resulting decreased tracheal colonisation.</td>
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<td>Mahul et al. (1992), Inten Care Med, USA [7]</td>
<td>145 patients with probable intubation for more than 3 days admitted to a general ICU (46% Medical, 54% surgical)</td>
<td>Single blind PRCT (Level 1b)</td>
<td>Incidence of nosocomial pneumonia</td>
<td>Subglottic suction groups 9/70 (13%) Standard Intubation groups 21/75 (29%)</td>
<td>Infiltrates on CXR after day 2 and positive Bronchoalveolar Lavage was considered positive for Nosocomial pneumonia.</td>
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<td>Hourly suction groups Hourly suction and Evac ET tube versus standard ET tube Stress ulcer prophylaxis Either Aluminium hydroxide (20 ml/6 h) or Sucralfate 1 g/6 h given</td>
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<td>Patients randomized to one of 4 groups in combinations of above protocols</td>
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<td>Dodek et al. (2004), Ann Int Med, Canada [14]</td>
<td>Systematic Review of RCTs that presented evidence on prevention of ventilator associated pneumonia. Searched Medline, Embase, and Cochrane Databases up to April 2003.</td>
<td>Systematic Review (level 1a)</td>
<td>Drainage of Subglottic secretions</td>
<td>5 studies (labelled as level 2 trials) found that shows that subglottic suction decreases VAP Recommend that clinicians consider the use of subglottic suction secretion drainage.</td>
<td>Missed the study by Girou et al. [2] and Pneumatikos et al. [6]</td>
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From Literature review incidence of VAP was estimated as 25%, and the benefit of subglottic suction was estimated as a 30% relative risk reduction.

Cook et al. [12] Survey of 84 French and 32 Canadian university affiliated ICUs into the use of ventilator circuit and secretion management strategies

Metz C et al. (1998), Clinical Inten Care, Germany [8] 39 critically ill patients with an expected ventilation time of more than 3 days. Randomised to 3 groups. All patients received the Hi-lo Evac II ET tube

Smulders et al. in 2002 [5] performed a large PRCT in 150 general ICU patients with predicted ventilation of over 3 days. They used subglottic suction, but in order to avoid possible tracheal wall damage they instituted intermittent suction with 8 seconds of suction every 20 seconds. They found a significantly reduced incidence of pneumonia in the suction group, reducing the incidence of VAP from 16% to 4%. This is a number needed to treat of 8.

Pneumatikos et al. [6] performed a slightly different study where they randomised 61 patients to use of the Hi-Low Evac subglottic suction tubing or controls. However, instead of simple suction they used a continuous infusion of antibiotics down the tube with intermittent suction. They found a marked reduction of VAP from 53% down to 16%.

Mahul [7] performed a randomized trial in 145 patients with a predicted intubation time of over 3 days. A significant reduction in nosocomial pneumonia was found with hourly subglottic suction. 29% of controls suffered pneumonia compared to only 13% in the suction group.

Kollef et al. [9] performed the only study in patients post cardiac surgery. They randomized 343 patients using their birth years to either continuous subglottic suction or normal ET-tube. They found a non-significant reduction of VAP from 8.2% in controls to 5% in the subglottic suction group, \( P = 0.238 \). They did, however, find a significant delay in the onset of VAP, with a mean time of 2.9 days in the control group compared to 5.6 days in the subglottic suction group (\( P = 0.006 \)). They concluded that 1006 patients would have been required to achieve significance for the difference that they found, but that if their findings were significant, the number needed to treat to prevent one pneumonia in all cardiac surgical patients would be 32.

Marin Kollef [10] also performed a systematic review for the New England Journal of Medicine in the same year and concluded that
there was grade A evidence to support the use of continuous subglottic suction routinely.

Among the many reviews in the literature Collard [11] performed one of the most recent and well performed. They stated that the evidence was in fact quite mixed, grading it at IIa and stated that continuous suction has not convincingly been shown to reduce VAP in all patients but should perhaps be considered in all patients who may require more than 3 days of ventilation. In addition a recent systematic review performed by Dodek et al. in 2004 [14] for the Canadian Critical Care trials Group recommended that clinicians consider the use of subglottic secretion drainage in all their patients.

A survey of practise was performed in 2002 in France and Canada [12] into protocols used to reduce VAP in university affiliated ICUs. They found that less than 5% of units used subglottic suction. The primary reason cited was lack of evidence for benefit, with cost and lack of availability also cited.

In contrast an interesting cost analysis was performed in 2003 [13]. The cost of subglottic suction is $15 per tube compared to $1 per conventional ET tube, and the cost of one episode of VAP was estimated to be $5,365. With a 30% reduction assumed for the suction strategy they estimated the cost benefit to be $4,992 per case of VAP saved. They also reported that the cost of VAP would have to be as low as $330 for the strategy to be non-cost effective.

Thus, in summary, clinical benefits have been shown for subglottic suction in the highest-risk patients. Only 8 patients being ventilated for more than 3–5 days need to be treated to prevent one episode of pneumonia. The benefits markedly reduce when you consider lower risk patients such as patients post cardiac surgery where 32-patients must be treated to prevent one pneumonia. Subglottic suction has also been shown to delay the onset of VAP but no benefits in terms of ventilation time, hospital stay or mortality benefit have ever been shown. However, it has been shown that even if the benefits of subglottic suction are marginal, the cost benefit of this cheap intervention is likely to be substantial.

2.1. Clinical bottom line

Subglottic suction significantly reduces the incidence of VAP in high-risk patients (NNT of 8 if ventilated over 3 days), although the benefit is lower in elective cardiac patients. Subglottic suction is currently not commonly used, but even with marginal benefits, its use is likely to be highly cost effective.

References