Keywords: Ventilator-associated pneumonia/Silver-coated endotracheal tubes/Mechanical ventilation/Intubation

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A review of the literature determined whether silver-coated endotracheal tubes were effective in preventing ventilator-associated pneumonia

Silver tube coatings in pneumonia prevention

In this article...

- The efficacy of silver-coated endotracheal tubes in preventing ventilator-associated pneumonia
- Strategies to help staff deliver best practice in preventing VAP

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Background Ventilator-associated pneumonia (VAP) is a common hospital-acquired infection that is associated with higher mortality rates, increased healthcare costs and longer hospitalisations. One intervention that has recently been used to reduce the prevalence of VAP is a new type of endotracheal tube impregnated with silver sulfadiazine.

Aim To investigate whether the use of silver-coated endotracheal tubes reduces VAP in adult intubated patients.

Method A thorough evidence-based literature review was conducted to investigate whether the use of silver-coated endotracheal tubes reduces VAP in intubated patients.

Results The use of silver-coated endotracheal tubes reduces the prevalence of VAP in intubated patients but should not be used as an isolated intervention.

Conclusion More research is needed to assess whether the benefits of silver-coated endotracheal tubes, coupled with additional VAP prevention strategies, outweigh the costs incurred.

Ventilator-associated pneumonia (VAP) is the leading cause of hospital-acquired infections in intensive care unit settings (Chastre, 2008; Chastre and Fagon, 2002). Around one third of hospital-acquired pneumonia occurs in intensive care units with more than 85% of these cases occurring in patients on mechanical ventilation (Rotstein et al, 2008).

The prevention of VAP continues to be a priority as it is associated with longer hospital stays, mortality, morbidity and increased healthcare costs (Chastre, 2008; Kollef et al, 2008; American Thoracic Society and Infectious Diseases Society of America, 2005; Chastre and Fagon, 2002; Rello et al, 2002). The length of time spent in hospital for patients with VAP is estimated to increase by 5-7 days in ICU, with an additional stay of 10-12 days in hospital overall (Shorr et al, 2009). Furthermore, the additional hospital costs associated with the management of VAP range from approximately £6,500 to £16,000 (Shorr et al, 2009).

There is evidence that using an endotracheal tube (ETT) for mechanical ventilation increases the occurrence of VAP (Chastre, 2008). The infection can occur as a result of aspiration of contaminated secretions from the colonisation of pathogens in the oropharyngeal mucosa (Chastre, 2008; Kollef et al, 2008; American Thoracic Society and Infectious Diseases Society of America, 2005). In addition, biofilms of colonised bacteria that form on both the inner and outer lumens of the ETT can be dislodged during suctioning and can migrate to the lungs (Chastre, 2008).

There is a variety of techniques that can help reduce the occurrence of VAP in adult patients who are receiving mechanical ventilation.
A relatively new VAP prevention technique is the use of an ETT coated with silver sulfadiazine on the inner and outer lumens of the tube (Kollef et al., 2008).

Silver sulfadiazine is non-toxic and effective in preventing infection in wounds and burns (Kollef et al., 2008; Landsdown, 2006; Rello et al., 2006). It has also been shown to be effective in reducing urinary tract infections when used in indwelling catheters (Rello et al., 2006; Karchmer et al., 2000). Kollef et al. (2008) speculated that when silver sulfadiazine is used as a coating in ETTs, it prevents the colonisation of bacteria and the formation of biofilms within the ETT components, thereby reducing the likelihood of VAP development.

In the US, nursing efforts are concentrated on exploring interventions that contribute to managing VAP, as well as reducing its incidence. In 2004, the American Nurses Association’s (ANA) National Center for Nursing Quality (NCNQ) designated VAP as a priority nursing-specific indicator (Montalvo, 2007). This distinction by the ANA requires nurses to become more accountable for tracking VAP-related patient outcomes, costs and prevention protocols.

In the UK, the Department of Health has established a high-impact intervention policy for use in the prevention of VAP (Department of Health, 2011). Compliance with high-interaction interventions is mandated by law for registered health professionals and those who use them must complete staff-compliance audits with these clinical protocols (DH, 2010).

### Searching the literature

A thorough literature review was conducted using the dates 2000-2010 and the following databases: CINAHL; Medline; Health Source: Nursing and Academic edition; ProQuest Nursing and Allied Health; Cochrane Database of Systematic Reviews; TRIP Database; and the National Guideline Clearinghouse. Search terms included: VAP; ventilator-associated pneumonia; silver-coated endotracheal tubes; VAP bundle; infection control; mechanical ventilation; intubation; prevention; reduction; and cost-effectiveness.

Thirty-two references were obtained. Exclusions were employed including in-vitro, animal and paediatric studies, and studies with unsubstantial experimental evidence. A total of 22 references remained for review. Five primary studies were appraised for the evidence-based review; these are summarised in Table 1.

### Results

Of the five studies appraised, two of the three randomised control trials found a

### Table 1. Studies included in the review

<table>
<thead>
<tr>
<th>Author</th>
<th>Study design</th>
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<th>Results/key findings</th>
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<tr>
<td>Berra et al (2008)</td>
<td>Randomised control trial</td>
<td>Assess efficacy of silver-coated endotracheal tubes (ETTs) in preventing bacterial colonisation</td>
<td>Absence of bacterial colonisation in silver-coated ETT lumens (n=23, p&lt;0.01) Presence of bacterial colonisation in 35% of non-coated ETTs (n=23, p&lt;0.01)</td>
<td>Study was limited to a 24-hour period Additional VAP preventive measures not used</td>
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<tr>
<td>Coffin et al (2008)</td>
<td>Systematic review</td>
<td>Identify recommendations to implement evidence-based VAP prevention efforts</td>
<td>Unsubstantial evidence for recommendation</td>
<td>Authors’ conclusion not to recommend silver-coated ETTs was based on two studies conducted in 2004; later studies not considered</td>
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<tr>
<td>Kollef et al (2008)</td>
<td>Randomised control trial</td>
<td>Determine whether silver-coated ETTs reduce incidence of VAP in patients intubated &gt;24 hours</td>
<td>Use of silver-coated ETTs=2.7% reduction and 35.9% reduced risk of VAP &gt;24 hours (n=1,509, p=0.03). Use of silver-coated ETTs=3.2% reduction and 48% reduced risk of VAP development within 10 days of intubation (n=1,509, p=0.006)</td>
<td>VAP prevention measures not standardised among participating centres (54 in US)</td>
</tr>
<tr>
<td>Rello et al (2006)</td>
<td>Randomised control trial</td>
<td>Assess the effects of silver-coated ETTs on bacterial colonisation in patients intubated ≥24 hours</td>
<td>Delayed development and reduced bacterial colonisation in silver-coated ETT lumens (n=121, p=0.02) and in tracheal aspirates (n=67, p=0.04)</td>
<td>Infection control measures not standardised among participating centres (one in US and three in Spain)</td>
</tr>
<tr>
<td>Shorr et al (2009)</td>
<td>Retrospective decision model cohort</td>
<td>Analyse costs of silver-coated ETTs in the reduction of VAP</td>
<td>Silver-coated ETTs associated with significant hospital cost savings (n=1,000)</td>
<td>Study lacked rigour in methodology – hypothetical patient cohort employed. Input figures for VAP incidence and hospital costs were estimated. Input estimates for relative risk reduction were derived from a previous study</td>
</tr>
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</table>
significant reduction in bacterial colonisation in the silver-coated ETTs. Specifically, there was reduced colonisation in patients’ trachea and bronchial aspirates, as determined by microscopic assessment (Berra et al. 2008). In addition, for patients intubated for longer than 24 hours, bacterial colonisation was delayed and reduced in the silver-coated ETT lumens and in tracheal aspirates (Rello et al. 2006). Kollef et al.’s (2008) investigation found a reduction in actual VAP incidence when silver-coated ETTs were used with patients intubated for longer than 24 hours. Although the systematic review completed by Coffin et al (2008) did not support changing practice change because the evidence was insubstantial, the authors noted additional VAP prevention measures for best practice. These included:

- Continued surveillance and data collection;
- Staff education on VAP epidemiology, risk factors and patient outcomes;
- Direct observation of staff compliance with VAP prevention measures.

The study conducted by Shorr et al (2009) indicated cost savings associated with the use of silver-coated ETTs.

Discussion and recommendations

Continued active surveillance and data collection of VAP is considered best practice for VAP prevention (Coffin et al, 2008). One example of a programme that allows for compliance with this recommendation is the ANA’s NCNQ. The NCNQ has included VAP as a priority nursing-specific indicator and tracks institution-specific data related to VAP, paying particular attention to patient care and outcomes (ANA, 2012).

Even with current or future scientific research into the effectiveness of silver-coated ETTs, staff-education and compliance issues need to be addressed. Additional best practices for VAP prevention include staff education on epidemiology, risk factors and patient outcomes as well as direct observation of staff compliance with VAP prevention measures (Coffin et al, 2008). Research has demonstrated that the use of multimodule interventions involving staff-education workshops and subsequent staff surveillance may lead to significant increases in staff compliance with VAP prevention bundles as well as a reduction in VAP (Hawe et al, 2009).

Another novel strategy to increase staff knowledge and strengthen compliance with VAP bundle protocols is the use of morbidity and mortality peer-review conferences (MMPRCs) (Nolan et al, 2010). These are composed of peer-discussion sessions that include active clinical thinking and reasoning among the group members about the care of specific patients in relation to VAP prevention. A study conducted by Nolan et al (2010) demonstrated that the use of MMPRCs increased nurses’ accountability and compliance when using VAP prevention bundles.

Conclusion

Based on the review of the literature, the use of silver-coated ETTs is effective at reducing VAP in intubated patients receiving mechanical ventilation. However, further research is needed before changes to practice can be recommended. Additional randomised controlled studies using patients with diverse diagnoses should be carried out to demonstrate the reduction of VAP with the use of silver-coated ETTs in combination with evidence-based VAP bundles.

In addition, future research efforts need to prioritise and package the various individual strategies that have demonstrated best practice to date in VAP prevention. There is also a paucity of evidence that addresses fiscal feasibility and resources as they relate to methods used in VAP prevention.

As frontline, bedside clinicians, nurses are ethically responsible for improving patient safety, promoting optimal patient outcomes and reducing long-term hospital costs and complications. Increasing nurses’ knowledge of VAP and their accountability with the implementation of VAP prevention measures is imperative. Of equal importance is the need for the nursing profession to participate in further VAP research to advance knowledge of the benefits and cost-effectiveness of the use of silver-coated ETTs within bundled care that is aimed at preventing VAP.

References


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