Evidence-based nursing strategies to prevent ventilator-acquired pneumonia

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Abstract
Mechanically ventilated patients are at risk of developing ventilator-acquired pneumonia (VAP). Critical care nurses working with intubated patients need to adopt strategies to prevent VAP within their clinical practice. VAP results from microaspiration of colonized secretions (the colonization of the aerodigestive tract by gram-negative bacteria found in the nares, oropharynx, sinus cavities, and the bacteria on dental plaque). This article is an overview of the risk factors, pathophysiology, and current strategies needed to prevent the occurrence of VAP, with focus specifically on the importance of oral health and oral care. Critical care nurses should promote the development and implementation of evidence-based oral care protocols and treatment regimens into their clinical areas to reduce the incidence and prevalence of VAP.

Critical care nurses must be cognizant of evidence-based nursing strategies to prevent ventilator-acquired pneumonia (VAP) among intubated, mechanically ventilated patients.

VAP is responsible for 90% of nosocomial infections (NI) in the mechanically ventilated population (Grap, Munro, Elswick, Sessler, & Ward, 2004) and occurs within 48 hours of intubation (Kollef, 2004). This population has six to 21 times increased risk of developing NI. This risk increases by 1% for each ventilator day incurred (Grap & Munro, 1997). The incidence of VAP among intubated adults ranges from 10% to 25% (Hixson, Sole, & King, 1998), with the prevalence ranging from 10% to 65% (Ibrahim, Tracy, Hill, Fraser, & Kollef, 2001).

This article contains an overview of the risk factors and pathogenesis of VAP, and current nursing strategies aimed at preventing VAP with specific focus on the importance of oral health and oral care of the intubated patient.

Risk factors
The risk factors associated with VAP include colonization of the oropharynx, migration of oral secretions to the subglottic area, length of mechanical intubation, patient demographics and co-morbidities, patient oral health, compromised patient oral immunity, hospital environment and equipment, invasive procedures, treatment regimens, and contact with other patients and hospital staff (Fitch, Munro, Glass, and Pellegrini, 1999; Hixson et al., 1998; Schleder, Stott, & Lloyd, 2002).

Pathogenesis
The very nature of intubation bypasses the body’s natural defence against respiratory infection. The placement of an endotracheal tube (ETT) negates the effective cough reflex to protect the airway from invasive pathogens, impedes the mucociliary clearance of secretions, and depresses the epiglottic reflexes. Thus, the entry of virulent bacteria pools and leaks around the ETT cuff (Vincent, 2004) infiltrating the lungs causing pneumonia.

Understanding the pathogenesis of this nosocomial infection is central to the development of targeted strategies intended to prevent the occurrence of VAP. VAP results from the colonization of the aerodigestive tract by gram-negative bacteria found in the nares, oropharynx, sinus cavities, and the bacteria found on dental plaque (Kunis & Puntillo, 2003). VAP is caused by direct microaspiration of colonized secretions from the upper respiratory tract into the patient’s lungs (Kunis & Puntillo, 2003). Being exposed to the risk factors without preventive interventions renders patients vulnerable to active colonization of the aerodigestive tract, thereby predisposing patients to VAP. In addition, the composition of the oropharyngeal flora changes within 48 hours of hospital admission from gram-positive streptococci to a gram-negative flora, which potentiates the development of virulent organisms in the oral cavity (Fitch et al., 1999).

Poor oral hygiene has been found to contribute to the colonization of oral flora that precedes pulmonary colonization that leads to gram-negative NIs (Fitch et al., 1999).

Oral airways, ETTs, bite blocks, and feeding tubes serve to keep the patient’s mouth continually open, a condition that contributes to xerostomia. Xerostomia (a dry oral mucosa) is enhanced by the stress response that accompanies critical illness (Al-Hashimi, 1994). Patients who are intubated cannot counteract xerostomia because their natural oral immunity (i.e., the saliva’s ability to remove dental plaque and microorganisms from the oral cavity) is impeded (Fitch et al., 1999).
Preventive strategies

Researchers recommend several strategies to prevent VAP. Strategies to prevent bacterial colonization of the oropharynx, stomach, and sinuses include appropriate hand disinfection, oral versus nasal intubation, avoiding unnecessary antibiotic administration, avoiding unnecessary stress ulcer prophylaxis, selective digestive decontamination, short course antibiotics, nasal, oral and subglottal suctioning, and the use of Chlorhexidine oral rinse (Kollef, 2004).

Reducing bacterial colonization is essential in the prevention of VAP. Attention to meticulous handwashing should be stressed along with the adherence to universal precautions by wearing sterile gloves with open suctioning, and clean gloves with a closed suction system. Unfortunately, researchers have demonstrated poor compliance with handwashing protocols in the ICU and indicate that a mere 22% of critical care nurses adequately performed handwashing. In addition, only 28% of physicians in an ICU washed their hands after each patient contact (Grap & Munro, 1997).

Nasal hygiene is needed and often neglected within a busy high-tech environment and not seen as a priority within the critically ill adult population (Hixson et al., 1998). Placement of nasal feeding tubes or nasotracheal tubes predispose the patient to sinus infections if routine cleansing of the nose and suctioning are not performed.

Supine positioning in the first 24 hours of mechanical ventilation, as compared to elevation of the head of the bed (HOB) to 30 to 45 degrees (a semi-recumbent position) has been shown to increase the incidence of VAP (Grap & Munro, 1997). The semi-recumbent position is preferred because of the reduced risk of gastric aspiration (Vincent, 2004). The implementation of concurrent treatment regimens such as nasal enteral feeds with high gastric residuals increasing incidence of aspiration, provide more evidence supporting elevation of the HOB in the semi-recumbent position. Even though a semi-recumbent position would appear inexpensive, easy, and unproblematic to maintain in the clinical area, evidence suggests that compliance is poor (Collard, Saint, & Matthay, 2003).

Researchers have verified that gastric colonization increases with decreasing gastric acidity and that VAP was increased when antacid preparations were used (Vincent, 2004). Use of broad-spectrum antibiotics to clear the stomach and oropharynx of potentially pathogenic organisms is argued to decrease the incidence of VAP. However, such use could increase the development of anti-microbial resistance (Vincent, 2004) and, therefore, is not recommended as a preventive strategy.

Use of chemical sedation for extended periods of time or prolonged use of neuromuscular blockers while patients are ventilated may contribute to VAP (Kunis & Puntillo, 2003). Sedation and neuromuscular blockers impede the patient’s ability to swallow effectively, which prevents clearance of saliva from the oral cavity. Hence, oral secretions that contain gram-negative bacteria pool around the inflated ETT cuff and are subsequently aspirated into the patient’s lungs. Researchers have found that continuous aspiration of subglottic secretions facilitated by the Hi-Lo Evac ETT decreases VAP rates by 52% (Valles et al., 1995). Diligent oral, ETT, and subglottic suctioning on a routine basis has been shown to be a proactive preventive measure in decreasing the incidence of VAP (Kollef, 2004).

Oral decontamination

Oral colonization has been studied widely and is associated with the occurrence of VAP. Delivery of effective oral care has the potential to positively affect the course of a patient’s ICU stay. Oral health is defined to include the degree of dental plaque evident, the evidence of oral flora that contain virulent microorganisms that cause VAP, and the patient’s natural oral immunity (the immune components in the saliva). Any disturbance in oral health can contribute to the development of VAP (Grap et al., 2004).

Oral care in the form of oral decontamination, either by mechanical methods of tooth brushing and/or rinsing the oral cavity and oral-subglottic suctioning, and direct pharmacological intervention with the application of an anti-microbial agent have been researched with increased interest as effective strategies to decrease the incidence of VAP. DeRiso and colleagues, in a randomized, placebo-controlled clinical trial, evaluated 353 cardiac surgery patients with twice-daily oral rinses of Chlorhexidine Gluconate compared to placebo liquid solutions (comparable in colour, taste, labelling, and smell), and found that patients treated with the Chlorhexidine rinses had 69% fewer respiratory infections than those in the control group (DeRiso, Ladowski, Dillon, Justice, & Peterson, 1996). Similarly, Houston, Houghland, Anderson, LaRocco, Kennedy, and Gentry (2002) reported 58% fewer cases of pneumonia in cardiac patients who were intubated more than 24 hours and had received Chlorhexidine rinses than those in the control group. This could indicate that preventive oral regimens instituted within our ICUs with Chlorhexidine rinses among intubated patients would be an effective strategy to decrease the incidence of VAP.

Grap and colleagues, in a pilot study of 34 intubated patients, gave a single application of Chlorhexidine (swab or spray) post-intubation. Results indicated that there were reductions in positive cultures in the treatment groups. This trend could suggest that early use of Chlorhexidine could reduce or delay the development of VAP (Grap et al., 2004).

In a single-blind, randomized-control trial, Fourrier and colleagues evaluated the effect of an application of the oral dental plaque antiseptic (2% Chlorhexidine gel) on the development of plaque colonization and the occurrence of VAP. The treatment group received three applications a day during the ICU stay. The main results indicated that the VAP rate and dental plaque index reported in the treatment group were significantly lower. The results again were consistent with the preventive effect of the antiseptic decontamination (Odds Ratio: 0.27; 95% CI: 0.09; 0.80) (Fourrier, Cau-Pottier, Boutigny, Roussel-Delvallez, Jourdain, & Chopin, 2000).
Interestingly, previous studies looking at various compromised patient populations (e.g., nursing home patients or the homeless population) revealed that the patients with poor oral hygiene carry respiratory pathogens on dental plaque and on the buccal mucosa that have caused VAP. Proximal colonization of the oropharynx occurs first with secondary aspiration of these pathogens into the distal airway resulting in pneumonia (Pesola, 2004).

Reducing the amount of dental plaque, the microbes contained in the oral flora, and maintaining optimal patient oral immunity by innovative oral care protocols would appear prudent and cost-effective and could prevent the incidence of VAP. To date, however, little is available in the research on the effects of oral routines among intubated patients. Recent scientific studies conducted specific to ICU ventilated patients regarding evidence-based oral care are as yet unpublished (Grap et al., 2004). It is well-documented, however, that oral care is not perceived as an urgent priority in the critical care setting (Grap et al., 2004) and adherence to oral protocols are not consistent, and not based on evidence (Grap et al., 2004).

Implications for practice and research

There is evidence to support instituting standardized oral care protocols for our ventilated patients. It is our professional responsibility as critical care nurses to be aware of patient outcomes resulting from omitting oral health, delivering timely oral care, and promoting healthy oral immunity to our ventilated patients. These strategies can act as innovative and proactive methods in fighting VAP in the ICU. Decreasing VAP will shorten the length of hospital stay, decrease mortality associated with VAP, and reduce health care costs.

Research is needed to examine the effects of standardized oral care regimens with Chlorhexidine among intubated patients. Grap and colleagues have just completed research on “a peri-intubation intervention to reduce oral flora and VAP” (M.J. Grap, personal communication, November, 16, 2004). See the abstract at: http://www.usuhs.mil/tsnrp/funded/fy2003/grap.html. A second study by Grap et al. is underway examining “oral care intervention in mechanically ventilated adults” scheduled for completion in early 2007 (M.J. Grap, personal communication, November 16, 2004).

Chlorhexidine was shown to be effective in decreasing respiratory infection and acts as an effective anti-microbial agent in procuring oral and tooth decontamination (DeRiso et al., 1996; Fourrier et al., 2000; Grap et al., 2004; Houstan et al., 2002). It would appear prudent to develop oral care interventions at the pre-, intra-, and post-intubation intervals to reduce the pathogens contained in oral flora, maintain and promote oral health, and stabilize our patient’s oral immunity. Further research is needed to examine the best interventions both mechanically and pharmacologically to prevent the occurrence of VAP. To date, there have been no randomized controlled clinical trials to evaluate the effectiveness of combined interventions preventing VAP (Collard et al., 2003). Future studies are warranted to determine the appropriate interval, procedures, materials, and education needed to build evidence-based rationale to develop oral care protocols specific to our ventilated patients at risk of incurring VAP.

Conclusion

There is overwhelming evidence to suggest that certain strategies can be used by critical care nurses to prevent the development of VAP among intubated patients. Prevention of primary colonization of the oropharynx can occur by effective mechanical and pharmacological oral care and the prevention of aerodigestive colonization by avoiding unnecessary antibiotic treatment and stress ulcer prophylaxis or over-sedation while patients are ventilated. Moreover, use of Chlorhexidine oral rinses, the prevention of aspiration of contaminated secretions by nasal/oral and subglottic suctioning, ensuring the HOB is elevated, using oral ETTs rather than nasal intubation, and minimizing gastric distention all are proactive strategies to deter the onset of VAP. Understanding the pathogenesis and risk factors associated with VAP and using universal precautions with diligence in handwashing all assist to delay or prevent the occurrence of VAP within the ICU. Critical care nurses should promote the development of oral care protocols and treatment regimens, including implementation of evidence-based strategies into their clinical areas, to reduce the incidence and prevalence of VAP. 
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References


