R E V I E W P A P E R

A Review of the Common Mouthwashes for Oral Care Utilised by Nurses in the Critical Intubated Patients: A Literature Review of Clinical Effectiveness

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Abstract

Pneumonia is the most frequent infection occurring in mechanically ventilated patients in the intensive care unit (ICU). Antibacterial mouthwashes are utilized in many clinical conditions for prophylactic and therapeutic purposes. The mouthwashes most commonly conveyed in the literature, including hydrogen peroxide, sodium bicarbonate, sodium chloride 0.9 %, water, povidone-iodine, and chlorhexidine (CHX). The aim of this review article is to evaluate articles to conclude the best existing evidence for providing oral hygiene to ICU patients receiving MV (mechanical ventilation), discuss considering practical oral washes, and to document a research to improve care interventions used for oral care and critical patients' outcomes.

Key-words: Ventilator-associated pneumonia, Critical care, Oral care, Mechanical ventilation, ICU

Introduction

Ventilator-associated pneumonia (VAP) happens in patients receiving MV for longer than 48 hours. VAP is the most common hospital-acquired infection among patients receiving MV in the intensive care unit (ICU) (Fathy et al., 2013, Tablan et al., 2004). It is a major cause of morbidity and mortality in ICU. Mortality rates for VAP between 15% to 50% have been stated (Taraghi et al., 2011). VAP occurs in 9% to 28% of patients with MV. Also, It is associated with prolonged ICU and hospital stay, increased costs and late extubation (Taraghi et al., 2011, Rello et al., 2002). The normal oral flora be changed with pathogenic organisms (gram negative and positive bacteria) after 48 houre in the intubated patients (Table 1) (Augustyn, 2007, Park, 2005, Golia et al., 2013). Subsequently, microaspiration of oropharyngeal secretions is a main risk factor for the development of VAP (Khezri et al., 2014, Baradari et al., 2012, Safdar et al., 2005). Moreover, dental plaques are another source for microorganisms causing VAP: therefore; oral hygiene one of the key strategy in reducing the pathological oral colonization and occurrence of VAP (Khezri et al., 2014).

Objectives

The aim of this review article is to appraise peer reviewed publications to conclude the best existing evidence for providing oral hygiene to ICU

patients receiving MV, discuss considering practical oral washes, and to document a research to improve care interventions used for oral care and critical patients' outcomes.

Table1. Pathogens causing ventilator-associated pneumonia

Early onset VAP	Late onset VAP
48 to 96 hours after intubation	96 hours after intubation
Staphylococcus aureus	*Pseudomonas aeruginosa*
Streptococcus pneumoniae	*Methicillin-resistant staphylococcus aureus*
Hemophilus influenzae	*Acinetobacter calcoaceticus and baumannii*
Proteus species	*Enterobacter species*
Serratia marcescens	
Klebsiella pneumoniae	
Escherichia coli	

Oral Care

A major origin of contamination of oral secretions is due to colonization of dental plaque and oropharynx with respiratory pathogens (Khezri et al., 2014). Usage of remarkable antiseptic mouthwashes directed against gram negative and positive microorganisms can decrease the rate of VAP (Pugin et al., 1991, DeRiso et al., 1996). Antibacterial mouthwashes are utilized in many clinical conditions for prophylactic and therapeutic purposes. The mouthwashes most commonly conveyed in the literature, including hydrogen peroxide, sodium bicarbonate, sodium chloride 0.9 %, water, povidone-iodine, and chlorhexidine (CHX). A review of the common oral rinses in the critical intubated patients is provided as follows:

Hydrogen Proxide

Hydrogen peroxide is a reactive oxygen species (ROS), clear, colourless and odour-free solution. It is completely soluble in water and gives an aciditic solution (Berry and Davidson, 2006). Fischman SL et al., showed that hydrogen peroxide has antimicrobial effects with slight or no adverse effects. The concentration of hydrogen peroxide debated was 1.5% and 3%, and suggested that it often be used in combination with other substances (Marshall et al., 1995). In the study, thirty-five normal subjects were randomly assigned to wash with hydrogen peroxide oral rinse, then significant mucosal abnormalities were detected. The results of this study showed that there were numerous subjective complaints of discomfort in the hydrogen peroxide groups, although this study was not unbiased (Berry and Davidson, 2006). Moreover, Holberton et al stated that some ICU patients found hydrogen peroxide mouthwashe refused to use it (Holberton et al., 1996).

Hydrogen peroxide oral wash has been used for many years in ICU patients. Although, their effectiveness has not been thoroughly evaluated for the provision of oral care in critically ill patients. Hydrogen peroxide has antimicrobial properties and mechanical cleaning of debris, but current evidence suggests it harms the oral mucosa and provokes many negative reactions (such as oral mucositis), so it is not recommended (Coleman, 2002).

Sodium Bicarbonate

Sodium bicarbonate mouthwash is a cleaning agent which has the ability to remove oral debris by reduce the viscosity of oral mucous but can cause oral mucosal burns if not diluted correctly. Moreover, altering the pH may disturb the normal oral flora. (Coleman, 2002, Carl et al., 1999, Dodd et al., 2000). In a study noted that there is the possibility of electrolyte changes in the

critical patients with use of the sodium bicarbonate (Jones, 1998).

Subsequent studies by Fourrier et al., sodium bicarbonate was used as a control substance compared to 0.2% CHX gel. Although the amount of colonization of plaque was higher in the sodium bicarbonate group after five days, but no significant difference detected between groups (Fourrier et al., 2000).

As a result, sodium bicarbonate must be ensure correct dilution when preparing the solution for use as a mouthwash. This is important because if the recommended concentration is not adhered to, the possibility of oral mucosa irritation may result (Berry and Davidson, 2006). However, to date, there are little randomised controlled trials that support the practice of sodium bicarbonate over any other oral rinse in critically ill patients. More investigation needs to be carried out before sodium bicarbonate can be recommended for routine oral care of the ICU patients.

Normal Saline

There is some evidence that the use of physiological salt solution can promote healing of oral mucosal lesions (Berry and Davidson, 2006). In a small study (47 patients), the subjects did not accept the use of normal saline as a routine oral rinse (Holberton et al., 1996). In the study by Seguin P et al., compared a saline rinse with usual care (no wash) and found a decrease in VAP, although there was no evidence of a difference in either duration of MV or duration of ICU stay (Seguin P et al., 2006). Similarly, a number of studies compared povidone iodine rinse with a saline rinse and revealed evidence of a reduction in VAP (Feng S et al., 2012, Seguin P et al., 2006). Also, Choi SH et al, determinated that normal saline is more effective than the tantum solution for the oral care of the patients in ICU (Choi and Kim, 2004). However, two studies (totally: 83 subjects) which compared a saline rinse with a saline soaked swab found no difference in incidence of VAP (Xu et al., 2007, Xu HL, 2008).

Although, there was not enough research information available to provide evidence of the effects of mouth care rinses normal saline, but because of its tendency to cause drying, its routine use as a mouthwash is limited in the critical care setting (Berry and Davidson, 2006).

Water

Water, a safe, ubiquitous solution can be used in combination with toothbrush to clean the teeth and gums to rinse and remoisten the oral cavity to minimize xerostomia. Saliva is 99.5% water and 0.5% solutes (Tortora and Derrickson, 2008). For these reason, several authors (Roberts, 2000, Buglass, 1995, Davies, 1997) declare that water is the ideal mucosal moistening agent, low-cost, and it is associated with few side effects. Also, was noted that oral rinse with water helps to alleviate thirst and a dry mouth. Jones CV, also suggests that to remove crusting in the oral cavity, washing with warm water may be useful (Jones, 1998).

Although, there is not sufficient investigation data available to provide evidence of the effects of sterile water as oral washe, but it seem that the use of sterile water a safe and cost effective means of providing humidity to the oral cavity. Given the general absence of side effects, easy access and economical profits of sterile water, it use is recommended in the routine oral care of the ICU patient. It should be noted that tap water, although readily available and free, can be a source of hospital infections, notably those attributed to *Pseudomonas aeruginosa* (Anaissie et al., 2002, Trautmann et al., 2001). We recommend that should not be used hospital tap water for oral care in critically ill patients.

Povidone-iodine

This solution has been used for many years in general wound care including wounds of the oral cavity (Chandu et al., 2002). Garrouste-Orgeas et al., reported that microbes related to VAP, were more marked in the oropharyngeal secretion than the gastric samples (Garrouste-Orgeas et al., 1997).

In addition, stated that although povidone-iodine may be valuable in treating mucosal wounds following surgery, it does not have an anti-plaque effect and prolonged use leads to significant amount being absorbed (Chandu et al., 2002). Furthermore, Vokurka et al, confirmed the lower tolerability of the povidone-iodine mouthwash in critical patients (Vokurka et al., 2005).

Beside, author reported that antimicrobial povidone iodine used for oral cavity prophylactic care associated with lower incidence of infections, when compared to normal saline mouthwash (Vokurka et al., 2005). Seguin P et al., also compared povidone iodine rinse with usual care (no rinse) and found a reduction in VAP (Seguin P et al., 2006).

There is some weak evidence that VAP can be reduced by povidone iodine rinse. Its routine use as a mouthwash for ICU patients is of questionable value.

Chlorhexidine

Chlorhexidine gluconate is a broad-spectrum bactericidal against gram-positive, gram-negative agents and yeasts that is effective at low concentrations (Dodd et al., 2000, Jones, 1997, Khezri et al., 2014). It has been used to inhibit plaque progression and treat periodontal disease and other oral infections (Brecx, 1997). Many studies confirmed that oral care with chlorhexidine mouthwash diminish the incidence of VAP (Koeman et al., 2006, Grap et al., 2004, DeRiso et al., 1996, Genuit et al., 2001). In the studies by DeRiso AJ et al., (DeRiso et al., 1996) and Houston S et al., (Houston et al., 2002), patients were randomly assigned to receive CHX or placebo; the rate of VAP was lower in patients who received CHX than placebo group (17 of 180 vs 5 of 173; $P < 0.05$- 4 of 270 vs 9 of 291; $P = 0.21$, respectively). A review by Labeau SO et al., stress that the use of either chlorhexidine or povidone iodine as part of oral care, decrease the incidence of VAP by approximately one third (Labeau et al., 2011). A Cochrane review stated that the CHX mouthwash is associated with a 40% reduction in the odds of developing VAP in the adult critically ill patient. Although, there is a contradictory results; a meta-analysis by Pineda LA et al., founded that the use of CHX for oral cleansing did not decrease the incidence of nosocomial pneumonia (Pineda et al., 2006).Numerous studies evaluated the substantivity (prolonged adherence of the antiseptic to the teeth and mucosas) of CHX in the oral cavity (Moran et al., 1992, Jenkins et al., 1994, Elworthy et al., 1996, Balbuena et al., 1998). Cousido MC et al., determinated that the 0.2% CHX mouthwash had the highest antimicrobial activity on the salivary flora up to 7 hour after its application.

The differences detected with respect to the 0.12% CHX mouthwash demonstrate the influence of the concentration on its immediate antimicrobial activity and substantivity (Cousido et al., 2010). Also, other studies have shown that CHX has a greater in vivo immediate antibacterial effect and a more substantivity than other antiseptics used in the oral cavity (Moran et al., 1992, Jenkins et al., 1994, Elworthy et al., 1996, Balbuena et al., 1998). There is no evidence that use of CHX is associated with a difference in mortality, time of MV and time of ICU stay (Shi Z et al., 2013, Koeman et al., 2006). Although oral care with antimicrobial agents reduces incidences of VAP, but its routine use as a mouthwash for all ICU patients is not recommended; because of development of antibiotic-resistant bacteria.

Probiotics

Probiotics can be defined as living microbes, or as food components having living microbes, that usefully influence the health of the host when used in sufficient numbers (Bowen, 2013). Applications of probiotics have generally been limited to the treatment of gastrointestinal diseases (Reid et al., 2003, Kruis, 2004). However, during the last decade some investigators have also suggested the use of probiotics for oral care. Forestier et al., in a pilot study, oral administration of a probiotic delayed respiratory tract colonization by ***pseudomonas aeruginosa*** (Forestier et al., 2008). Further clinical studies will be necessary to determine which probiotic mouthwash is optimal for oral care in critical care patients. Furthermore, the efficacy and safety of probiotics should be precisely verified.

Conclusion

Many different mouthwashes are available and the choice needs to take into consideration factors such as the patient's oral condition, VAP risk and the efficacy and safety of the mouthwash.

Recommendation Based on Current Evidence

Althouth, CHX is gold standard mouthwash, but antimicrobial resistance has been reported for the

agent used and remains a theoretical risk: therefore; we suggest that, the combination high efficaye herbal mouthwashes (matrica & persica) with CHX could be consider in this important population as well as mechanical interventions. Studies to determine the best practices and frequency of care are also needed.

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