

Effect of Oral Care Solutions in Reducing Ventilator-Associated Pneumonia: Review of Current Evidence

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Ventilator-associated pneumonia (VAP) is an important nosocomial infection worldwide, which leads to increases in length of hospital stay, healthcare costs and mortality (Vincent et al, 1995). Many hypotheses proposed about the development of VAP, but recently oral hygiene is gaining much interest, due to reduction noticed in incidence of VAP in ICU patients. Although oral hygiene is not a sole intervention used in prevention of VAP, still it is one of the very vital procedure included in many VAP prevention bundles (Sufdar et al, 2005). The normal flora of the oral cavity may include up to 350 different bacterial species, with tendencies for groups of bacteria to colonise different surfaces in the mouth. Normal oral flora becomes pathogenic within 48 hours of intubation in critically ill patients. Because of a number of processes, critically ill patients lose a protective substance called fibronectin from the tooth surface. Loss of fibronectin reduces the host defence mechanism mediated by reticulo-endothelial cells. This reduction in turn results in attachment of bacteria to the tooth surface gradually that coalesce to produce a biofilm, and after further development lead to the formation of dental plaque, which is occupied by a diverse micro organisms (Gibbons, 1989).

Method

Nurses worldwide for a long period have been practising oral care for critically ill patients. There has been wide discrepancies existing in oral care practice among nurses in terms of forms of oral care agents, frequency of oral care, use of adjuvant oral care products and specificity of population where oral care is provided. The purpose of this review is to systematically evaluate the best agents for oral hygiene based on the current evidence. An extensive search was carried thorough online data base in Pubmed, Pubmed central, Medline, Sciverse, Embase, Neuorscience citation index, and Cochrane library using the key words like oral hygiene oral care, oral decontamination agents, VAP etc. to find out full length articles on different oral care agents in prevention of VAP. Studies were initially graded as per Harbour and Miller classifica-

tion, thereafter it was excluded from the review if they had an insufficient data and a significant bias which could affect in drawing a reliable conclusion. Finally the conclusion was made as per the popular recommendation classification system as follows; effective, possibly effective, not effective, and possibly harmful.

Results

This review helped to locate a variety of oral care agents which were used across the world. The list of oral care agents has been summarised in Table 1. Each oral care agent listed had its pros and cons. Brief description of each agent are as follows.

Chlorhexidine: Chlorhexidine is a positively charged molecule which binds to the negatively charged tooth enamel and buccal surface, thereby it prevents adherence of bacterial colonisation; moreover it alters the bacterial cell wall structure causing disruption in potassium and phosphorus and bacterial cell death. It has been well proved effective agent in many ICU patients' especially cardiothoracic ICU patients. Hence this agent is recommended as possibly effective in reducing VAP (Pineda et al, 2006). Both mouth spray and mouth rinse seemed to be effective. But further studies are required to know the frequency of chlorhexidine in ICU patients.

Providone-iodine: This agent has been used for many years in healing post-operative oral wounds, beneficial effect of providone iodine is limited because of lack of studies, but it has shown a significant reduction of VAP in severe head injury patients.

Table 1: Oral care agents used in different settings

	Oral care agents	Concentration
1	Chlorhexidine	0.1-0.2%
2	Providone iodine	0.1%
3	Hydrogen peroxide	1%
4	Sodium bicarbonate	NA
5	Lemon and glycerin	NA
6	Glycothymol	0.1-1%
7	Normal saline	0.9%
8	Water	NA
9	Listerine	Mixed chemicals
10	Toothpaste- Non foaming	NA

NA - Data not available

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Some disadvantage of using this agents is, it has no anti-plaque effect and a risk of systemic absorption exists in long term use, so recommendations cannot be made until further studies are available (Muscedere et al, 2008).

Hydrogen peroxide : It has been used untested for long years in ICU, however, studies involving this agent in patients have been very limited. Moreover published studies have shown its adverse effect in using this agents, like mucosal abnormality and distasteful experience by patients. This has no effect in preventing plaque and colonisation except removing of debris in mouth, hence it is no longer recommended in clinical use keeping in mind its potential adverse effects (Tombes & Gallucci, 1993).

Sodium bicarbonate: Oral hygiene using sodium bicarbonate has shown benefit in reducing viscosity of oral mucosa, but no effect in reduction of VAP. Moreover, incorrectly diluted solution can result in burns and alteration of normal pH which may contribute in colonisation of microorganism. Hence this agents is also no longer to be used in clinical setting (Fourrier et al, 2000).

Lemon and glycerine: This agent was traditionally used as a stimulating agent during oral care. Initially it stimulates salivary flow but later it may exhaust the mechanism and cause Xerostomia, which may result in proliferation of bacterial colony. Lemon also reduces oral pH to 2-4 (normal 6-7), reduces salivary amylase and finally the acidic condition will decalcify the tooth enamel; hence this agent should not be used in oral hygiene practice (Buglass, 1995).

Listerine: Only one published study reported the effect of Listerine oil in reducing VAP. In that study Listerine didn't show any significant reduction of VAP incidence, hence recommendation cannot be made until further studies are available (Houston et al, 2002).

Glycothymol: This familiar pink solution has proven to have no beneficial effect in reducing VAP, the only property established for this agent is its short living refreshing effect on oral cavity; it has no proven anti microbial effect, hence this is not recommended for use (Grap et al, 2003).

Normal saline: This agent was also widely used in critical care setting, although it has proven efficacy in healing oral mucosal lesion. Recently studies found the drying effect of saline solution to be a predisposing factor for oral colonisation, therefore this solution is also no longer recommended for clinical use (Bowsher et al, 1999).

Tooth paste: Use of a toothbrush and toothpaste

has been recommended by several studies. Further, a toothbrush with toothpaste is more effective than foam swabs for the removal of plaque. Moreover a soft-bristled toothbrush can reach the most posterior aspects of the mouth which cannot be achieved through routine applicators. Although bacteremia after tooth brushing in healthy persons is rare, care is advised when this procedure is used in immunocompromised critically ill patients. Also, because toothbrushes must be treated as potential sources of contamination, thorough cleaning and protected storage of the brushes after each use should be mandatory. The tooth paste used should be of non-foaming type e.g. Elmex, Colgate gel and other gel toothpastes. This agent along with tooth brush is possibly effective in reducing VAP (Franklin et al, 2000).

Water : Efficacy of sterile water is underestimated in comparison to other traditional agents and no studies are available in evaluating the effect of sterile water. If proven this could be cost effective agent in oral care, although there is no compelling evidence in use of this agent.

Discussion

The best evidence documented in this review can guide nurses in clinical setting to promote good outcome in their patients. Although this review could identify the best practice, this should be looked after critically in clinical utility because of lack of well conducted prospective randomised controlled trial. Of the many studies reviewed only two were conducted with a minimum of bias, others possess a significant bias in methodology as well as reporting, hence no studies could recommend a high efficacy of any of the above mentioned agents. These results clearly suggest the need for further randomised controlled trail in these area; nurses in ICU can take up initiates in conducting these types of studies to generate and contribute evidence to nursing body of knowledge.

Conclusion

This review of oral care practice reveals a strong association between oral hygiene and reduction in VAP. Among the oral care agents chlorhexidine and use of tooth brush have been proven to reduce VAP significantly compared to other agents. Hence these can be used in practicing oral hygiene in critical care patients for promoting good outcome in patients. Till the further studies are available chlorhexidine along with tooth brushing may be considered effective oral care agent in reduction of VAP.

References

1. Vincent JL, Bihari DJ, Suter PM. The prevalence of nosocomial infection in intensive care units in Europe: Results of the European Prevalence of Infection in Intensive Care (EPIC) Study. EPIC International Advisory Committee. *JAMA* 1995; 274: 639-44
2. Safdar N, Dezfulian C, Collard HR, Saint S. 'Clinical and economic consequences of ventilator-associated pneumonia: a systematic review'. *Crit Care Med* 2005; 33: 2184-93
3. Gibbons RJ. Bacterial adhesion to oral tissues: a model for infectious diseases. *J Dent Res* 1989; 68(5): 750-60
4. Harbour R, Miller J. A new system for grading recommendations in evidence based guidelines. *BMJ* 2001; 323(7308): 334-36
5. Pineda LA, Saliba RG, El Solh AA. Effect of oral decontamination with chlorhexidine on the incidence of nosocomial pneumonia: A meta-analysis. *Crit Care* 2006; 10: R35
6. Muscedere J, Dodek P, Keenan S, et al. Comprehensive evidence-based clinical practice guidelines for ventilator-associated pneumonia: prevention. *Journal of Critical Care* 2008; 23: 126-37
7. Tombes MB, Gallucci B. The effects of hydrogen peroxide rinses on the normal oral mucosa. *Nurs Res* 1993; 42(6): 332-37
8. Fourrier F, Cau-Pottier E, Boutigny H, Roussel-Delvallez M, Jourdain M, Chopin C. Effects of dental plaque antiseptic decontamination on bacterial colonization and nosocomial infections in critically ill patients'. *Intensive Care Med* 2000; 26(9): 1239-47
9. Buglass E. Oral hygiene. *Br J Nurs* 1995; 4(9): 516-19
10. Houston S, Hougland P, Anderson JJ, LaRocco M, Kennedy V, Gentry LO. Effectiveness of 0.12% chlorhexidine gluconate oral rinse in reducing prevalence of nosocomial pneumonia in patients undergoing heart surgery. *Am J Crit Care* 2002; 11(6): 567-70
11. Grap MJ, Munro C, Ashtiani B, Bryant S. Oral care interventions in critical care: Requery and documentation'. *Am J Crit Care* 2003; 12(3): 113-18
12. Bowsher J, Boyle S, Griffiths J. A clinical effectiveness systematic review of oral care. *Nurs Stand* 1999; 13(37): 31
13. Franklin D, Senior N, James I, Roberts G. Oral health status of children in a pediatric intensive care unit. *Intensive Care Med* 2000; 26(3): 319-24

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