Chemical Oral Health care and Aspiration Pneumonia (AP) in Elderly Patients: A Systematic Literature Review

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Abstract

To thoroughly review the literature on chemical oral health care interventions in the elderly without mechanical ventilation and the denouement of AP.

The prevention of AP in the elderly using oral health care seems to play an important role reducing the microorganisms that cause of the lung infection.

The intervention studies in the elderly were searched by Pubmed, Web of Science, Cochrane Library and EMBASE. The method of evaluated processing the quality was independently shown in the journals by two other authors.

The intervention studies were included in six studies. Four studies showed that oral care plus chlorhexidine gluconate (variable in concentration 0.05%, 0.12% and 0.2%) to improve of oral care reducing the risk of AP. Two studies showed that cetylpyridinium chloride, decreased the number of oral anaerobic bacteria that caused a lower respiratory tract infection.

As reported by the results, the current thorough review of the literature, chemical oral health care, consisting of chlorhexidine gluconate, cetylpyridinium chloride, seem to be the best chemical mouthwash agent in reducing the risk of developing AP.

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Introduction

Mortality and morbidity have increased due to AP in the elderly[1]. AP is an inflammation of lung parenchyma, usually originated by the influx of microorganisms which passed the trachea into the lung alveoli[2]. The prevalence of community-acquired pneumonia (CAP) differs per country and increases strongly by age. The rate of new case of people aged ≥75 years are reported 3-5 folds than in the general public[1].

The pathological mechanisms of AP are acquired in hospitals. These occurrences involve the aspiration of oral or respiratory microorganisms both of bacteria and fungi that can be considered virulent. It is related with the lying down position, difficulty in swallowing, changes in their mental health, abnormalities of oesophageal motility disorders, alcohol use disorders, gastric reflux, regurgitation, enteral feeding devices, and establishment of microorganisms at pharynges and bronchi[3]. The mechanical ventilation in patients have been correlated with AP due to deposition of the bacterial colonization of the oropharynx. The insertion of the endotracheal tube acts as an inducer of the oropharyngeal microbes into the lower respiratory tract. These are diagnosed as causes of nosocomial pneumonia (NP) [4]. Moreover, a foreign material in the mouth, including, saliva, biofilm or a mixture of these can also cause the AP[5]. The several guidelines for preventing pneumonia published including the Healthcare Infection Control Practices Advisory Committee and the Centres for Disease Control recommends the development a comprehensive oral hygiene care, without providing any detailed information. It only suggests including the patients in care for acute health conditions should use an oral antiseptic solution[2]. The conclusion of systematic literature review has confirm the instruction to implementing comprehensive oral health care[6].

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As we know from previous reviews of the literature, oral health care seems to play an important role reducing the microorganisms that cause of the AP in the elderly. However, it is not clear what chemical oral health care is the most effective in decreasing risk of developing AP[6]. The aim of this systematic review was to perform clinical trials in the elderly that investigated if chemical oral health care can decrease the risk of AP.

Materials and methods

We completed a comprehensive search in the chemical oral health care literature. The clinical trials in the elderly were searched by an electronic retrieval system and searched databases for relevant studies including Pubmed (Medline), Web of Science, Cochrane Library, EMBASE and CINAHL. The Medical Subject Headings in Medline were isolated or in different combinations using different Boolean operators. The key words were 'aspiration pneumonia' or 'pneumonia', 'oral care', 'chemical mouthwash', 'chemical oral health care', 'prevention', 'intervention' and 'reducing risk'. We used the key words 'aspiration pneumonia' as well as 'pneumonia', because the clinical diagnosis was hardly different between AP and pneumonia. We specifically paid attention to study reference lists, associated studies, and searching for supplementary relevant studies not found in the beginning quest.

The search was limited to clinical studies in human, studies published in English only and studies published in the period of January 2009–January 2019. There were no clinical trials in the elderly to have been published with adequate technical quality investigating the denouement of chemical oral health care on the development of AP in the 10 year before. Titles and abstracts of journals were screened using the research approaches described. Only journals with regard to nursing home or care home, people aged ≥ 60 years who were bedridden or bedbound or independent of mechanical ventilation, were included. Finally, the first and second author read potentially full relevant journals and analysed independently processing the quality of the journals. The technical processing the quality was checked by checklists reported by Straus et al. [7].

Results

The Medical Subject Headings in the search identified 374 potentially appropriate journals. It was found that 51 journals by Pubmed (Medline), 14 by Web of Science, 2 by The Cochrane Library, 46 by EMBASE and 309 by CINAHL. The Duplicated journals were excluded. Titles and abstracts were screened. It showed that 8 journals were relevant for further review. These journals were read in full text and analysed indepently the processed quality by the two authors. Two journals were excluded after processed qualitative analysis due to selection bias and information bias[2, 5]. Table 1 shows the characteristics of the six remaining studies[8-13].

There are 4 publications that show that oral care plus CHX may be effective in reducing the risk of AP. The publication of Hollarr *et al.*[8] showed that a cluster - randomized controlled clinical trial, multicenter of 500 care home residents who are physically disabled and had difficulty in swallowing were allocated to either the intervention or the control group. The intervention group received oral care plus 0.05% CHX twice a day rapidly after their typical oral care regimen. The control group received the typical oral care without CHX. The results of this study showed that older people who had impaired function had a reduced risk of AP by using this intervention.

The publication of Juthani-Mehta *et al.*[9] reported that 834 residents (36 nursing homes) who were older than 65 years with at least 1 or 2 risk factors of AP (ie, defective oral health care, difficulty in swallowing) were randomized to multicomponent intervention groups or control groups. The 434 residents of the intervention group, received brushing teeth/gum plus 0.12% CHX twice a day and also employed upright-positioning during feeding. The 400 residents of the control group received their typical oral care. The residents were followed up with the incidence of radiographically documented AP, AP without radiographic documentation for 2.5 years.

The results of this study showed that the residents with first pneumonia without radiographic documentation in the intervention group was 125 (28.8%) and the control group was 100 (25.0%). In a multivariable Cox regression model, the hazard ratio between the intervention group was 1.12 (95% confidence interval [CI], 84– 1.50; P = .44) for first

pneumonia and the control group was 1.07 (95% CI, .79–1.46, P = .65) for pneumonia. The multicomponent intervention group did not significantly reduce the development of the first radiographically confirmed pneumonia compared with the control group. Nevertheless, the oral care plus 0.12% CHX and upright position during feeding seem to be important protocols for keeping oral hygiene among in the elderly.

The study of Maeda and Akagi[10] was a retrospective interventional study. The aim was to evaluate the effect of oral care for total dependence elderly with NG tube for an increased risk of AP. It was carried out in 63 residents from July 2011 to June 2013. The intervention group had 31 residents who received the oral care in July 2012 to June 2013. The control group had 32 residents who did not receive the oral care from July 2011 to June 2012. The result showed the incidence of pneumonia, the numbers of days with a recorded fever, antibiotics application, blood tests and radiological tests had decreased in the intervention group compared with control group from 1.20 to 0.45, 24.57 to 17.48, 25.52 to 10.12, 10.91 to 6.54, 6.33 to 3.09 %, respectively.

The study of Sharif-Ab-dullah *et al.*[11] was a double-blind, randomized controlled clinical trial. The aim of the study was to investigate the effect of CHX compared to the typical oral care in edentate elderly residents. Ninety residents were allocated randomly to the intervention group or the control group. The intervention group received oral care plus 0.2% CHX 20 mL for 7 days. The control group received typical oral care plus thymol. The result of this study showed the effect of CHX decreased oral microorganisms compared to typical oral care ($p < 0.001$).

There are 2 publications that showed that effectiveness of oral care plus CPC and the risk for AP. The first publication of Tajima et *al.*[12]. They studied the 12 NG tube elderly residents in the nursing home. It was a crossover design. This aim of the study was to investigate the time-dependent change a number of microorganisms on the dorsal of tongue for each tongue cleaning group. The elderly received tongue cleaning in 4 groups: group 1, used CPC; group 2, used MMA; group 3, used water; and group 4, Non- cleaning. The total number of microorganism were measured on the dorsal of tongue at started, rapidly after cleaning, at 1, 3 and 5 hours. The result of the study showed that tongue cleaning with CPC decreased oral microorganisms for 5 hours after tongue cleaning. The tongue cleaning plus MMA also decreases oral microorganisms[12].

The second publication of Kobayashi *et al.*[13] investigated the outcome of cleaning teeth/tongue which used CPC and MMA on a number of oral microorganisms, and coated the tongue scores in addition to moisture levels of the dorsal of tongue. This journal showed that 60 older people who needed care in nursing homes were allocated into randomly divided into 4 oral cleaning groups; group 1, used CPC and MMA; group 2, used CPC; group 3, used water and MMA; and group 4, used water. The measurement of oral microorganisms, coated tongue scores and moisture level was at started, at 1 and 2 weeks after oral cleaning. Among the groups was compared to the outcome of oral cleaning. The results of this journal showed that among the groups there was no significant difference in baseline measurement. The number of oral microorganism reduced for all 4 groups. After oral cleaning for 2 weeks, there were significant differences in the rates of reduction between group 1 and group 3, group 1 and group 4, and group 2 and group 4. The coated tongue score reduced for 4 groups. After 1 week, among the groups there was no significant difference in the rate of reduction of the coated tongue score. After 2 weeks, group 1 and group 4 showed a significant difference in scores. All 4 groups showed an increase in moisture. After 2 weeks, there were significant differences between group 1 and 2, group 1 and 4, and group 3 and 4. The conclusions of the six studies are summarized in Table 2 and 3.

Discussion

The risk factor of AP are involved with oral microorganisms, this question arises, if the risk of dental biofilm is decreased by oral hygiene care measurement. Whereas the incidence of pneumonia decreased using mechanical oral care, the incidence of AP showed little development using the chemical mouthwash agent alone[13]. They suggest that the incidence of AP reduces using mechanical oral care including cleaning teeth after every meal, cleaning removable artificial teeth once per day and professional oral care once per week[8]. The reviewed journals[15-18] showed oral colonization decreased through oral care with chemical

mouthwash agents and mechanical oral care.

The more intensive oral care prevention program may be the best guide to resolve the content individualized access based on the risk assessment of AP. In the previous published systematic literature review found the two or more risk factors of AP in the elderly such as difficulty in swallowing, respiratory disorders, and diabetes mellitus, advanced dementia, poor nutrition, Parkinson's disease, and patients who used neuroleptic medications and proton pump inhibitors. Those cases could be received specific oral care[6]. An adequate oral care might be a mix method of mechanical intervention and chemical intervention.

The effectiveness of oral care plus CHX for the prevention of NP and ventilator-associated pneumonia (VAP) for sufferers in an intensive care units (ICU) offer conflicting results in previously randomized medical studies, systematic reviews and meta-analyses[19-22]. The other relevant factor that hampers the comparison of researches to show the effectiveness of CHX is variable in the posology in oral care protocols. The minimal and reversible side effects of CHX in the previous review is irritation of the oral mucosa, the dental stains or taste disorder[21, 23-24]. Although it is at higher concentrations, it has low toxicity of CHX, so the benefits dominate the risks[22]. The Centre for Disease Control in USA recommend applied 0.12% CHX as oral care protocols for prevention of AP in the peri-operative period of adult patients admitted to heart surgery [25]. This recommendation in oral care has been used for ICU patients around the world[26]. The evidence presented in the reviews included in this overview, the use of CHX in adult ICU patients comprises a therapeutic alternative. They may acquire extra benefit of 0.12% CHX applied twice a day for AP and VAP prevention. Over the different CHX concentrations (2%, 0.12%, 0.05%) is difficult to compare the publications because of the variety of interventions and results for each experiment.

The patients in care for acute health conditions who are at high risk for health-care associated pneumonia may be development a comprehensive oral care protocols including the use of CPC[25]. The aid in reduction the risk of VAP may apply to an antiseptic mouthwash, such as CHX and CPC, combined with brushing. The effectiveness of CPC has been shown to be effective for the removal of dental plaque[27,28] and the prevention of gingivitis[29]. The key prevention protocols are recommend by Association for Professionals in Infection Control and Epidemiology 2009 including the application of the typical antiseptic mouthwash[30]. The outcome of reducing VAP through advanced oral-dental care: a 48-month study is 33% reduction in VAP, less time on the ventilator, and less time in an ICU [31].

Pneumonia impacts both the patient's health, worsening their status and may lead to death. The oral problems is presented in many patients who are admitted to hospital due to oral care inadequacy. For example, tooth decay, gum disease, which become the cause of systemic infection[32]. Dentistry has a changing history of curative treatments only for preventative care to prevent odontogenic infection to systemic infections. We are looking at the patient as holistic health and seeking the best quality of service, not only in hospital, but extending to community[32].

An important finding of this review showed that proper oral hygiene care reduced the number of oropharyngeal potential respiratory pathogen, and recommended a reduction in the risk of developing AP. However, it still remains the question in the elderly what is the best oral hygiene protocol that effect of reducing the development of AP. The more intensive oral care prevention protocol may be the best guide to resolve the content individualized access based on risk assessment of AP[8]. CHX twice per day may prevent the development of AP in physically disabled and older people with difficulty swallowing. It can reduce oral microorganisms when compared to typical oral care. The tongue cleaning plus CPC reduces oral microbes for 5 hours. The oral care plus CPC and MMA are shown to be the most effective method in decreasing oral microorganisms and increasing moisture levels[8, 11-13].

This thoroughly review the literature has many limitations, such as the limitation of ethical behaviour to the volunteers, the respect to volunteers right and the protection of the health and oral health of volunteers in the human clinical studies, especially, in the elderly which are considered to be vulnerable group. They need special health and oral health care and it is important to have interdisciplinary collaboration among doctor, dentists or dental hygienist,

nurses and other health staffs to clarify the Volunteers health status, which could lead to acute care hospital, post-acute care facilities and community to control/prevent infection and also decrease the number of death of patients by secondary infections in the elderly.

Conclusions

As reported by the results of the current review of the literature, chemical oral care, consisting of CHX, CPC seem to be the best chemical mouthwash agent to decrease the incidence of AP.

Declaration of Interest

The authors report that there is no conflict of interest.

Study	Design	Objective	Population	Procedure	Results
Hollaar *et al.*[8]	A cluster - randomized controlled clinical trial, Multicenter	Evaluate incidence of AP with typical OHC plus CHX	500 residents who are ≥ 65 years with disabled and DSP	OHC plus 0.05% CHX	OHC plus 0.05% CHX reduce risk of promoting AP
Juthani-Mehta *et al.*[9]	A cluster - randomized controlled clinical trial	Effect of OHC and upright position decrease risk of AP	834 residents who are ≥ 65 years with POH and DSP	POH patients obtained OHC plus 0.12% CHX. DSP were upright position	OHC plus 0.12% CHX and upright position does not decrease risk of AP
Maeda and Akagi[10]	A retrospective intervention study	Effect of OHC in total dependence in the elderly with NG tube	63 residents who are ≥ 65 years with NG tube	OHC plus 0.2% CHX, applied MMA and massage of salivary gland	OHC plus 0.2% CHX, decreasing risk of promoting AP
Sharif-Ab-dullah *et al.*[11]	Double-blind, randomized controlled clinical trial	Compared the efficacy between OHC plus 0.2% CHX and thymol	90 edentulous residents who are ≥ 65 years with impaired function.	The intervention group obtained 0.2% CHX. The control group obtained thymol	OHC plus 0.2% CHX decrease oral microbes
Tajima *et al.*[12]	The cross over study	Evaluate the time-dependent to a number of microbes	12 NG tube elderly residents	Cleaning tongue divided into 4 groups; 1. CPC 2. MMA 3. Water 4. NC	Cleaning tongue plus CPC decrease oral microbes for 5 hours
Koba-yashi *et al.*[13]	The randomized controlled clinical trial	Investigate the outcome of OHC on a number of microbes	60 elderly people who needed care in nursing homes	OHC divided into 4 groups; 1.CPC plus MMA 2.CPC 3.MMA 4.Water	Mouthwash and MMA significantly decrease oral microbes

Table 1. Characteristics of the sixth remaining studies
Abbreviations : Chlorhexidine gluconate (CHX), Oral health care (OHC), Aspiration pneumonia (AP), Difficult swallowing patients (DSP), Poor oral hygiene (POH), Cetylpyridinium chloride (CPC), Mouth moisturizing agent (MMA), Nasogastric tube (NG tube), Non-cleaning (NC).

Author / Year	Conclusion
Hollaar *et al*.[8]	Improving oral care by using 0.05% CHX may prevent AP in the elderly who are physically disabled and have difficulty in swallowing.
Juthani-Mehta *et al*.[9]	The oral care consisting of brushing teeth plus 0.12% CHX and upright positioning during feeding maintains appropriate oral hygiene status among the elderly in nursing homes.
Maeda and Akagi[10]	Cleaning consists of brushing teeth/gum, oral mucosa plus 0.2% CHX, applied MMA and massaging of the salivary gland in the total dependence elderly with NG tube. This can decrease the risk of developing AP.
Sharif-Abdullah *et al*.[11]	The oral care plus 0.2% CHX can decrease oral microorganisms when compared to the typical oral care. The research showed that this method improved the oral hygiene and decreased the risk of AP in the elderly.

Table 2. Conclusions of the oral care plus chlorhexidine gluconate studies

Author / Year	
Tajima et al.[12]	The tongue cleaning plus CPC decreases oral microbes for 5 hours. The tongue cleaning plus MMA also decreases oral microorganism. This tongue cleaning procedure may help to decrease the risk of developing AP in NG tube elderly residents.
Kobayashi et al.[13]	The oral care including CPC and MMA was shown to be the most effective method in decreasing oral microorganisms and increasing the moisture level in elderly people who needed care in nursing homes.

Table 3. Conclusions of the oral care plus cetylpyridinium chloride studies

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