Oral Health Care and Aspiration Pneumonia

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ABSTRACT

Background: *Oral health care is important to prevent aspiration pneumonia. Poor oral hygiene in elderly patients heightens the risk of aspiration pneumonia due to the growth of potential periodontopathogen bacteria. This literature review aims to describe the effect of oral health care on the incidence of pneumonia and/or the number of oral bacteria.*
Method: *The literature search was conducted based on the PRISMA guideline with the PICO framework by utilizing electronic search engines in databases: PubMed, Cochrane's Library, and Google Scholar from March through May 2024. All articles to be reviewed were ''full text" published from 2014 to 2024. An eligibility assessment was conducted based on inclusion and exclusion criteria; thus, seven articles were selected.*
Result: *Mechanical tooth and mouth cleaning, in addition to using mouthwash and moisturizing agents, effectively reduces the risk of aspiration pneumonia in the elderly.*
Conclusion: *Oral health care with mechanical and pharmacological interventions are deemed appropriate to be given to elderly individuals to prevent aspiration pneumonia.*

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INTRODUCTION

Dental plaque biofilm is the primary etiological agent of dental and oral diseases. It is estimated that every 1 mm^3 of dental biofilm contains 100 million bacteria. Oral bacteria involved in periodontal disease are known to have a vital role in causing a variety of systemic diseases, including those affecting the respiratory tract. The increasing number over time, as well as the presence of periodontopathogens in dental plaque biofilms, are considered a reservoir of microorganisms associated with pneumonia.(1) Periodontopathogens may promote pneumococcal adhesion to human alveolar epithelial via induction of pneumococcal receptors.(2)

The incidence of pneumonia is relatively high in elderly individuals. It is reported that 75% of pneumonia patients are over 70 years old.(3) Pneumonia is one of the common causes of death in individuals aged 65 years and over.(4) 86,7% of pneumonia cases in elderly individuals are aspiration pneumonia.(5) Aspiration pneumonia is a condition characterized by lung inflammation due to inhaling bacteria-rich oropharyngeal or gastrointestinal secretions into the lungs, leading to alveolar and systemic inflammation.(6)

Aspiration is known to be the primary cause of aspiration pneumonia. However, not all instances result in pneumonia. The development of aspiration pneumonia depends on the balance of factors affecting host resistance, including respiratory and immune function, and factors contributing to invasion, such as the volume of aspirates and bacteria presence.(5) Several conditions are associated with microaspiration and the development of pneumonia, such as dysphagia-associated swallowing disorders, chronic obstructive pulmonary disease, stroke, dementia, and mechanical ventilation. Impaired consciousness due to acute stroke, head injury, brain lesions, seizures, or sedation, as well as conditions that increase gastric content reaching the lung (e.g., reflux and tube feeding); and disorders affecting the cough reflex, also play a significant role.(7)

Oral health care is important to prevent aspiration pneumonia. In elderly patients, inadequate oral hygiene increases the risk of aspiration pneumonia due to the growth of potentially pathogenic anaerobic bacteria such as periodontopathogen.(7) There are two methods to eliminate dental plaque biofilm and the associated microorganisms, such as mechanical intervention and/or pharmacological intervention.(8)

RESEARCH METHOD

Literature search

The literature search was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The review was prepared using the PICO framework, namely 1) Population: elderly patients ($\geq$ 65 years old), 2) Intervention: providing oral health care with mechanical and/or pharmacological interventions, 3) Comparison: positive or negative control group, 4) Outcomes: the effect of oral health care on the incidence of pneumonia and/or the number of oral bacteria. Article search was conducted by utilizing electronic search engines in databases: PubMed, Cochrane's Library, and Google Scholar. The search strategies in electronic databases applied keywords and Boolean operators (AND, AND NOT, OR, OR NOT) to expand topics and/or make searches more specific. The search strategy employed the **Text Word** method: "((((Aspiration pneumonia[Text Word]) OR (pneumonia[Text Word])) AND (oral care[Text Word])) OR (oral hygiene[Text Word])) AND (elderly[Text Word])". All articles to be reviewed were ''full text" published from 2014 to 2024. The search was conducted by the author from March through May 2024.

Eligibility criteria

The included articles have met the inclusion criteria, such as original articles, randomized controlled trials, and clinical trials with research subjects aged ≥ 65 years. The selected articles have titles and abstracts that match this article's research objectives and report oral health care in elderly patients regarding the incidence of aspiration pneumonia. Excluded articles were review ones and/or non-human studies. The literature search strategy in the database is shown in Table 1.

Table 1. Search strategies in electronic databases

Search strategy	**Specification**
Date of search	March-May 2024
Databases	PubMed, Cochrane's Library, Google Scholar.
Keyword and Boolean operator	**Text Word:** "((((Aspiration pneumonia[Text Word]) OR (pneumonia[Text Word])) AND (oral care[Text Word])) OR (oral hygiene[Text Word])) AND (elderly[Text Word])".
Timeframe	2014-2024
Inclusion and exclusion criteria	Inclusion: 1) original article, 2) randomized controlled trial, 3) clinical trial, 4) research subject ≥ 65 years old Exclusion: 1) article review, 2) non-human study.

RESULTS

The literature search was conducted based on PRISMA guidance with the PICO framework and filtering was performed, thus, the selected literature met the inclusion criteria. The method of determining inclusion articles is illustrated in Figure 1. A total of 5270 articles were successfully identified in searches conducted on PubMed, Cochrane Library, and Google Scholar databases. There were 886 articles published in less than 10 years, in English, available in "full text", and without duplication. An eligibility assessment was conducted based on inclusion and exclusion criteria and thus, seven articles were selected, from which data would be extracted and analyzed. Table 2 shows the characteristics of the seven included articles. Studies conducted by Maeda, *et al.,* Higashiguchi, *et al.,* Juthani-Mehta, *et al.,* and Hollaar, *et al*., reported the incidence of pneumonia as an outcome variable. Meanwhile, three other studies reported the number of oral microbes as an outcome variable. Studies show that mechanical tooth and mouth cleaning, in addition to the use of mouthwash and moisturizing agents, is effective in reducing the risk of aspiration pneumonia in the elderly.

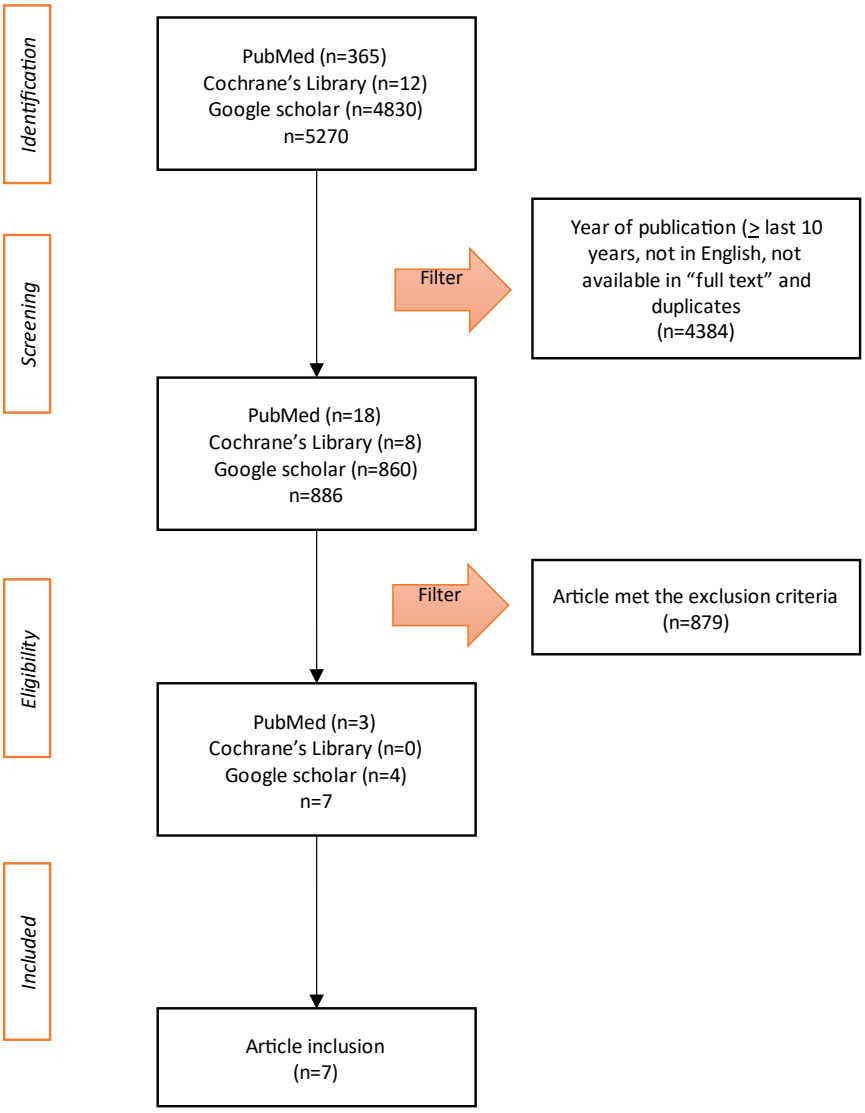

Figure 1. Literature searching and screening process.

This literature review explains oral health care measures related to the incidence of aspiration pneumonia for elderly patients. A variety of oral care interventions in elderly individuals and the results related to oral bacterial colonization, as well as the incidence of aspiration pneumonia is shown in Table 3.

Table 2. Characteristics of the seven included articles

No	Authors	Year	Country	Study design
1	Maeda, *et al.*[9]	2014	Japan	A Retrospective intervention study
2	Kobayashi K, *et al*.[10]	2015	Japan	The randomized controlled clinical trial
3	Juthani-Mehta M, *et al.*[11]	2015	US	A cluster-randomized controlled clinical trial
4	Sharif-Abdullah, *et al*.[12]	2016	Singapore	Double blind, randomized controlled clinical trial
5	Higashiguchi T, *et al*.[13]	2017	Japan	A Multicenter, Randomized, Comparative Trial
6	Tajima S, *et al*.[14]	2017	Japan	Prospective crossover study

7	Hollaar V, *et al*.[15]	2017	Netherlands	Multicenter cluster randomized controlled clinical trial

Maeda, *et al.,* conducted a study to assess the impact of oral hygiene practices on the risk of pneumonia in bedridden and tube-fed patients. A total of 31 elderly patients in the intervention group were given daily oral care protocol, such as: (1) brushing teeth and tongue with a toothbrush and cleaning the oral mucosa with a sponge brush and 0.2% chlorhexidine (CHX) solution, (2) administering glyceryl polymethacrylate gel to moisturized oral cavity, and (3) massaging salivary gland. In contrast, the control group, consisting of 32 elderly patients, received irregular or infrequent oral care, typically once daily or less. The study found a significantly lower incidence of aspiration pneumonia in the intervention group compared to the control group (p=0.006). Oral care protocol with the administration of 0.2% chlorhexidine (CHX) and moisturizing agent in patients with NGT/PEGT has been proven effective in lowering the incidence of pneumonia.[9] Higashiguchi, *et al.*, conducted a study on 252 elderly individuals to see the efficacy of using wet tissue in cleaning oral cavities, along with the administration of oral nutritional supplements (ONS) to prevent aspiration pneumonia. The study results indicated a lower cumulative incidence of pneumonia at 8 months in the intervention group compared to the control group, who received conventional oral care (COC) (p=0.056).[13]

Juthani-Mehta, *et al.*, compared conventional oral care with a variety of multicomponent intervention protocols, including manual tooth/gum brushing supplemented by the administration of 0.12% chlorhexidine twice a day in lowering the incidence of radiographically documented pneumonia in 834 participants at 36 nursing homes. Pneumonia is assessed by considering (1) appropriated infiltrates visible on chest radiography (CXR), where any prior CXR should show new or worsening infiltrates, and (2) at least 2 of the following clinical symptoms within 72 hours of the CXR-identified infiltrate: fever, pleuritic chest pain, respiratory rate >25 breaths per minute, worsening cough, sputum production, asphyxiation, or findings from an upper-body examination. The results suggested that no significant differences were shown between the intervention group and the control group (p=0.44). It was recorded that 119 patients (27,4%) in the intervention group and 94 patients (23,5%) in the control group suffered from pneumonia.[11] A similar study was conducted by Hollaar, *et al*., on 103 elderly individuals with physical disabilities, residing in long-term care units and diagnosed with dysphagia to evaluate the incidence of aspiration pneumonia. The intervention group received oral health care including administering 0.05% CHX twice daily, while the control group received conventional oral hygiene without using mouthwash. The results showed that the incidence of pneumonia in the intervention group was proven lower compared to that in the control group despite not showing a statistically significant difference (p=0.571). The significant effect of administering 0.05% CHX could not be described properly due to the researcher's limitations in meeting the number of participants who were willing to take part in the research.[15]

Sharif, *et al*., compared the effect of administering chlorhexidine with routine oral care in geriatric edentulous inpatients. A total of 78 elderly patients agreed to participate in the study. Oral care was given, supplemented with the administration of 0.2% chlorhexidine (20 ml/day) in the intervention group and thymol gargle in the control group. The results suggested that a significant difference in oral bacterial colonization is shown between the intervention group and the control group (p<0.001). The administration of 0.2% CHX was proven effective in reducing microbial colonization when compared with the use of thymol gargle. In addition to CHX, the use of cetylpiridinium chloride (CPC) as mouthwash has also been proven effective in lowering the number of oral bacteria.[12] Kobayashi K, *et al*., evaluated the effect of oral cleaning with mouthwash and mouth

moisturizing gel on the number of bacteria and tongue surface moisture levels of elderly patients. Each participant was given a different intervention, such as: (1) cleaning teeth for 3 minutes using a toothbrush soaked in mouthwash containing CPC (M) or tap water (W); (2) cleaning tongue with a tongue brush soaked in mouthwash (M) or tap water (W); and (3) applying moisturizing gel (m) containing lactoferrin, glycerin and whey protein on the tongue dorsum. The results showed that all groups had an average reduction in the number of anaerobic bacteria on the tongue surface. There was a significant difference between the mouthwash (M)+moisturizing gel (m) and tap water (W)+moisturizing gel (m) groups (p=0.050), and the mouthwash (M)+moisturizing gel (m) and tap water (W) groups (p=0.050) in the first week. In the second week, a significant decrease was visible between the mouthwash (M)+moisturizing gel (m) and tap water (W)+moisturizing gel (m) groups (p=0.003), the mouthwash (M)+moisturizing gel (m) and tap water (W) groups (p=0.000), as well as the mouthwash (M) and tap water (W) groups (p=0.001).[10]

Table 3. Oral care intervention and the result

Authors	Age group	Population (n)	Intervention	Results
Maeda, *et al.*[9]	Mean age 81.7±2.5 years	63 patients (25 men and 38 woman); hospitalized on the long-term care ward, recieved extended medical care, given EN (NGT/PEGT), loss of swallowing function. I(n)=31, K(n)=32	Intervention OCP was performed everday, include: (1) Cleaning tooth and tongue with a toothbrush, and using a sponge brush with a 0.2 % CHX solution to clean the oral mucosa; (2) glyceryl polymethacrylate gel was applied to moisten the inner mouth; (3) performing a salivary gland massage after OCP	The incidence of pneumonia was significantly less in the intervention group. I: 0.45 ± 0.23 % K: 1.20 ± 0.28 % p=0.006
Kobayashi K, *et al.*[10]	Mean age 83±5 years	60 patients (29 men and 31 woman; patients who had recieve treatment for cerebral stroke and required daily nursing care and given tube feeding	(1) Brushing teeth for 3 minutes with a toothbrush was saoked in mouthwash containing CPC (M) or tap water (W); (2) Tongue cleaning with a tongue brush was soaked in mouthwash (M) or water (W); (3) Application of moisturizing gel (M) on the dorsum of the tongue using an elastomeric tongue scraper	There was a significant decrease in the mean number of anaerobic bacteria on the patient's tongue after 1 week. M+m and W+m (p=0.050), M+m and W (p=0.050)
Juthani-Mehta M, *et al.*[11]	Mean age 86.3±8.1 years	834 participants; lived in a nursing home for at least 1 month, had 1 of 2 modifiable risk factors for pneumonia such as swallowing difficulty and impaired oral hygiene. I(n)=434, K(n)=400	Oral care administered twice a day: (1) Manual tooth/gum brushing; (2) 0.12% CHX oral rinse	There was no significant difference in outcomes between the intervention group and the control group. I: 119 (27.4%) RR(95% CI)=0.28(0.22-0.37) K: 94 (23.5%)

				RR(95% CI)=0.26(0.19-0.36) p=0.44
Sharif-Abdullah, *et al.*[12]	Mean age 81.2 ± 9.1 years and 79.9 ± 6.6 years	78 participants; had been admitted to the geriatric unit, edentulous with or without dentures, and had functional impairment, I(n)=43, K(n)=35	Oral care for 7 days (20 ml/day) I: CHX 0.2% mouthwash K: thymol gargle	There was a significant difference in oral microbial colonization between the two groups. I: 11.6% K: 54.3 % p<0.001
Higashiguchi T, *et al.*[13]	Mean age 88.0±6.5 years	252 participants (54 men and 198 woman); high risk aspiration pneumonia patients and (1) ≥75 years; (2) BMI <18.5 kg/m^2 ; (3) serum albumin level <3.5 g/dL ; (4) dysphagia; (5) consented themselves or provided by family or legal representative. I(n)=109, K(n)=143	(1) wiping (2) received ONS in addition to their regular oral care and diet	The incidence of pneumonia was higher in the control group than in the intervention group. There was no significant difference in the cumulative incidence of pneumonia at 8 months. I: 7,8 % K: 17,7% p = 0,056
Tajima S, *et al.*[14]	Mean age 80.1±8.3 years	12 elders (7 men and 5 woman); had a long-term care in the hospital, using NGT; being treated for cerebrovascular disease or dementia.	Different interventions are given to each group: 1. MW 2. MG 3. W 4. NC	There was a significant decrease of oral bacteria on the tongue after mouth cleaning compared to before mouth cleaning. MW and MG (p=.000)
Hollaar V, *et al.*[15]	Mean age 80.5 ± 9.0 years	103 participants; physically disabled, resident in a long-term care unit, and previously diagnosed with dysphagia, I(n):52, K(n):51	Treatment is given twice a day: (1) oral hygiene care (2) applying a 0.05% CHX-containing oral rinse solution	There was no significant difference in the incidence of pneumonia between the two groups. (Cox regression, HR=0.800; 95% CI (0.368–1.737), p=0.572

I: intervention group; K: control group; EN: enteral nutrition; NGT: nasogastric tube; PEGT: percutaneous endoscopic gastrostomy; OCP: oral care protocol, ONS: oral nutritional supplements; CPC: cetylpyridinium chloride; CHX: chlorhexidine gluconate; MW: mouthwash; MG: moisturizing gel; W: water; NC: no tongue cleaning.

Similar results were reported by Tajima, *et al.*, the study was conducted to compare the number of oral bacteria before and after cleaning the tongue using CPC mouthwash and mouth moisturizing gel in elderly individuals who received long-term treatment in hospitals due to cerebrovascular disease or dementia and

utilized NGT. Oral cleaning and tongue cleaning were given once a day. Tongue cleaning starts from the anterior part of the terminal sulcus to the tip of the tongue and is performed five times on each side for 1 minute. Different interventions were given in each group, such as (1) administering CPC (MW); (2) tongue cleaning with applying mouth moisturizing agent (MG); (3) tongue cleaning with water (W); and (4) no tongue cleaning (NC). Significant decreases were observed at 0 hours (p=.000), 1 hour (p=.000), 3 hours (p=.000), and 5 hours (p=.019) after oral cleaning. The results suggested that a significant reduction in the number of oral bacteria was shown after the oral cleaning procedure when compared to before such a procedure in the MW and MG (p=0.000).[14]

The effects of mouth moisturizing agent (MMA) administration have also been described in several studies. The moisturizing effect produced by the application of MMA acts as an antibacterial agent. The MMA application in a few studies has shown satisfactory results in suppressing the number of oral microbiomes in elderly individuals.[9,10,14] The conclusions of intervention studies from the seven included articles are shown in Table 4.

Table 4. Conclusions of Oral Care Intervention

Authors	Conclusion
Maeda, *et al.*[9]	Daily oral care for bedridden and tube-fed patients reduces the incidence of pneumonia.
Kobayashi K, *et al.*[10]	The use of mouthwash and moisturizing gel effectively reduce the number of anaerobic bacteria on the surface of the tongue.
Juthani-Mehta M, *et al.*[11]	The intervention did not significantly reduce the incidence of pneumonia confirmed by radiographically or LRTI compared to usual care in nursing homes.
Sharif-Abdullah, *et al.*[12]	Chlorhexidine 0.2% has been shown to significantly reduce oral colonization and is recommended as an easier and cost-effective alternative treatment for oral hygiene.
Higashiguchi T, *et al.*[13]	A new intervention method "Wiping plus Oral Nutritional Supplements" can prevent aspiration pneumonia, thereby reducing the risk of death.
Tajima S, *et al.*[14]	Tongue cleaning using mouthwash was proven to reduce the number of oral bacteria for 5 hours. Tongue cleaning using oral moisturizing gel reduces the number of bacteria on the surface of the tongue.
Hollaar V, *et al.*[15]	The use of 0.05% chlorhexidine mouthwash as an additional intervention in daily oral health care did not significantly reduce the incidence of aspiration pneumonia.

DISCUSSION

The condition of the oral cavity is closely related to the development of aspiration pneumonia.[5] Yoon, *et al.,* reported that 40% of elderly patients receiving long-term care have dry mouth.[16] Significant increases in the number of fungi and oral bacteria have been reported in patients with severe dry mouth.[10] Dry mouth is known to contribute to dysphagia.[17] Studies report that individuals with dysphagia have poor oral cavity conditions, including abnormalities in salivary function, oral hygiene, and tongue health, that lead to the prevalence of opportunistic bacteria.[18]

Aspiration pneumonia and dysphagia are interrelated conditions in the elderly population.[17] The risk of aspiration increases in the elderly population due to neurological diseases, such as stroke or dementia, decreased swallowing function, such as dysphagia, and the use of mechanical ventilation.[5,7] Aspiration pneumonia is primarily caused by the inhalation of oropharyngeal bacteria into the lower respiratory tract. In elderly individuals, silent aspiration of these bacteria is a more common cause of pneumonia than infections from other types of pathogens.[19]

Elderly individuals in long-term care facilities are particularly vulnerable to poor oral health conditions due to inadequate oral hygiene and untreated periodontal and/or dental disease.[20] Oral bacteria have been proven involved in the incidence of pneumonia.[20] In elderly individuals, as well as patients in nursing homes, hospitals, or those with nasogastric tubes, Gram-negative bacteria-which are not typically present in healthy individuals can become prevalent.[21] Poor oral health can lead to the aspiration of oropharyngeal secretions, contributing to the development of pneumonia.[19] Studies have shown that microorganisms in the oropharyngeal secretions of individuals with oral disease can be harmful if aspirated into the lungs, especially in medically compromised individuals.[20] Research has documented that the oral cavity serves as a reservoir for respiratory pathogens responsible for the development of aspiration pneumonia in high-risk patients. Additional evidence from studies on transtracheal aspiration of infected lungs supports the involvement of periodontal organisms in aspiration pneumonia.[22]

In broad outline, there are four possibilities explaining the connection between the condition of the oral cavity and the respiratory tract, namely: 1) aspiration of oral pathogens whether periodontopathogens, respiratory diseases, or both; 2) modification of respiratory tract mucosa, thereby promoting adhesion and colonization of respiratory pathogens; 3) destruction of the salivary pellicle by hydrolytic enzymes produced by pathogens, thereby diminishing non-specific host defense mechanisms; and 4) the cytokine release by periodontal tissue, resulting in changes in the respiratory epithelium due to increased levels of periodontopathogens bacteria and their specific enzymes, such as mannosidase, fucosidase, hexosaminidase, that advocates the colonization of respiratory pathogens.[1,22] Periodontopathogens are known to alter the barrier function of the bronchial and alveolar epithelium. They increase the expression of matrix metalloproteinase (MMP)-12, which contributes to the disintegration of the alveolar wall, and decrease the gene expression of claudin 1 and junctional adhesion molecule A (JAM-A), both essential for epithelial integrity. In addition, aspirated oral pathogens also promote mucin production in the respiratory lumen, which later causes respiratory function disorder. Overall, such changes will lead to higher susceptibility to respiratory infections.[23] If periodontal diseases are left untreated, various cytokines and other biologically active molecules continue to be released from the periodontal tissue and peripheral mononuclear cells. In the saliva of patients at high risk of aspiration, these cytokines may regulate the expression of adhesion receptors on the mucosal surface, facilitating the colonization of respiratory pathogens.[22]

Oral health care plays an important role in preventing aspiration pneumonia in the elderly population.[5] Professional oral hygiene has been proven effective in lowering the risk of aspiration pneumonia in elderly individuals living in care facilities.[24] Various literature reviews report that routine oral health care by professionals lessens the development of respiratory diseases and the incidence of aspiration pneumonia by up to 40% in high-risk elderly individuals residing in nursing homes or intensive care units.[22,25,26]

In general, oral dental care for the average healthy individual is to brush teeth twice a day, use dental floss every day, and visit the dentist every six months. Different matters happen to elderly individuals with medical compromise who are being treated in hospitals or those who live in nursing homes. Dental and oral care become much more complex, particularly when patients are incapable of caring for themselves.[20] In individuals with cognitive impairment, medical needs, and oral care, such as basic tooth brushing are often inadequate or even abandoned.[20] This makes additional treatments, such as pharmacological interventions with bactericidal effects advisable.[10] In addition to mechanical toothbrushing and interdental cleaning, the use

of antiseptic products has been suggested as an adjuvant agent. The most effective adjunctive agents for controlling dental plaque biofilm and gingival inflammation according to The European Federation of Periodontology (EFP) guidelines, contain chlorhexidine gluconate and cetylpyridinium chloride.[27]

Chlorhexidine gluconate (CHX) has been approved and introduced for use in periodontal treatment. CHX is a broad-spectrum antiseptic rinse that remains chemically active on tissue for up to 6 hours.[20] As an antiseptic mouthwash, CSX has antimicrobial effects on fungi, bacteria, and viruses that inflict a variety of different oral diseases. In vitro, the antibacterial effect of CHX correlates to changes in cell membrane permeability. At low concentrations (0.02-0.06%) CHX initiates the movement of Ca^{2+}, Mg^{2+}, and the deficiency of K^{+} from the cell wall, resulting in a bacteriostatic effect. Meanwhile, at high concentrations (>0,1%), CHX causes cell leakage, leading to the release of intracellular components out of the cell and creating a bactericidal effect.[27,28]

Cetylpyridinium chloride (CPC) is a safe and effective amphiphilic compound for use in a variety of oral hygiene products. The positive charge on such molecules facilitates attachment of negative charge bacterial surfaces and exerts antimicrobial activity.[29] Clinical studies suggest that short-term exposure to a duration of CPC use for six months may lessen dental plaque and gingivitis.[30] Sreenivasan PK, et al. conducted a study to evaluate the efficacy of the antimicrobial activity of CPC rinse fluid with alcohol (CPC+) and without alcohol (CPC-). The results explained that both CPC rinse fluids (CPC+ dan CPC-) show microbial inhibition at lower concentrations compared to fluoride mouthwash. At a concentration of 0.3–0.7%, both CPC mouthwashes provide a restrain effect on *Campylobacter*, *Actinomyces, Moraxella, Veillonella*, and periodontal bacteria, including *Porphyromonas gingivalis, Prevotella intermedia*, *Prevotella nigrescens,* and *Eikenella corrodens.*[30]

In addition to mouthwash, mouth moisturizing agents play a significant role in manipulating oral bacteria in the elderly population. A study by Suzuki H, *et al*., demonstrated that using of gel-like oral moisturizers in dental and oral care significantly reduces the risk of aspiration.[31] The use of MMA is reported to be effective in decreasing the number of bacteria. MMA is proven effective in increasing oral cavity moisture in elderly individuals with dysphagia.[9,10] Glyceryl polymethacrylate, hyaluronic acid, or lactoferrin in MMA provides a moisturizing effect, thereby restraining pathogen attachment to the oral cavity.[10] In general, not only does MMA improve oral health but also maintains a healthy oral microbiome in the elderly population.

CONCLUSION

Controlling dental plaque biofilm has been proven effective in reducing the incidence of aspiration pneumonia. Routine oral health care protocols using mouthwash and mouth moisturizing agents are effective in reducing oral bacterial colonization compared to conventional oral care. Mechanical and pharmacological interventions are deemed appropriate to be given to elderly individuals to prevent aspiration pneumonia.

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