REVIEW ARTICLE:

POOR ORAL DENTAL HYGIENE AND ASPIRATION PNEUMONIA

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INTRODUCTION:

The oral environment is a very complex ecosystem in which a mix of anaerobic bacteria, facultative aerobes, and spirochetes compete for space and nutrient.[1,2] Bacterial biofilms and a cytokine milieu influenced by constant inflammatory stimulation further complicate the oral microenvironment. Older adults frequently experience major consequences of poor oral health, with high rates of local infection, infectious endocarditis and aspiration pneumonia. The risk of aspiration pneumonia is greatest when periodontal disease, dental caries, and poor oral hygiene are compounded by swallowing disease, feeding problems, and poor functional status. The annual incidence of pneumonia in the community is approximately 12 per 1,000 persons per year, rising to 34 per 1,000 in those 75 years of age and older.[3] Aspiration pneumonia is defined as lower respiratory tract infections mostly in elderly people who have aspirated oropharyngeal or gastric contents.

ORAL FLORA:

The accumulation of dental plaque and colonization of oral surface and dentures with respiratory pathogens serves as a reservoir for recurrent lower respiratory tract infections. Oral environment in dentulous people is quite different from the flora that survives in edentulous person. The dentate mouth contains periodontal pockets with a greater population of spirochetes and anaerobes[4]. Implanted teeth in the older person's mouth may be more easily colonized with Staphylococcus aureus and other aerobic organisms (F. Scannapieco, personal communication). In contrast to the dentate microenvironment, the edentulous mouth contains relatively fewer anaerobes and more yeast and lactobacilli [4, 5].

RISK FACTOR:

Many studies of aspiration pneumonia focused on its probable origin as an anaerobic infection of the lung [6-8]. Aspiration pneumonia is a dynamic disease, and the exact mix of anaerobes and aerobes involved probably changes over time and on the basis of functional status. The medical risk factors includes-

- Swallowing and feeding problems (which have been incompletely quantified) [9]
- Decreased efficacy of lung defence mechanisms, including poor clearance and weak cough [10, 11]
- Diabetes [12]
- Impaired immune status [13]
- Poor Feeding Techniques [14]
- Positioning [15]
- Neurologicissues [10,11, 15]
- Patient's functional status [16,17]

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The dental risk factors includes-

- Dental decay
- Periodontal disease
- High levels of S. aureus in the saliva

- Salivary flow
- Infrequent visits to the dental hygienist
- Poor oral hygiene [16-18].

Aspiration pneumonia in elderly person and oral hygiene:

Probably the most common infectious sequelae of poor oral health in seniors-particularly those who reside in nursing homes-is aspiration pneumonia. Studies from the University of Michigan (Ann Arbor), Yale University (New Haven, CT), and Japan have investigated the oral and dental causes of aspiration pneumonia. These studies have linked the outcome of aspiration pneumonia with dental decay, periodontal disease, poor hygiene, the need for help feeding, and trouble swallowing[16-19]. Number of microorganisms in the oral cavity of the elderly is usually larger than that of young adults because of gradual reduction in production of saliva. A relationship between poor oral health and respiratory disease has been suggested by a number of recent microbiologic and epidemiologic studies, especially in elder subjects; who requiring help with feeding, wearing denture/edentate, with periodontal disease, and so on. In 1994, Kikuchi et al. examined the occurrence of silent aspiration during sleep in elderly patients by using indium-111. Silent aspiration in patients was more frequent than in age-matched control subjects (71% vs 10%)[20]. Therefore, it seems reasonable to conclude that silent aspiration has an important role in pneumonia that occurs in the elderly. Elderly people frequently aspirate during sleep[21,22], and pneumonia develops when the defense mechanism of the healthy lung organization is overwhelmed[23] and/or weaken by aging. Defense of the airway is impaired in the elderly by alteration in respiratory mechanics, decreased mucociliary clearance, immuno-senescence and, in some cases, concomitant illnesses that predispose to aspiration[24,25]. Oropharyngeal deglutition is impaired with aging, because of increased neural processing time and diminished oral control [23]. Evidence linking oral microbes to pneumonia was derived from a prospective study conducted in 2004.[33] Forty-nine institutionalized elderly requiring mechanical ventilation underwent oral examination and dental sampling on admission to the intensive care unit. Thirty-three respiratory pathogens were identified from the dental plaques. Fourteen patients (29%) subsequently developed clinical evidence of pneumonia during hospitalization. Nine respiratory pathogens isolated from the lower respiratory tract matched genetically those recovered from dental plaques. The results of the study convincingly demonstrated that respiratory pathogens from the lung are often genetically indistinguishable from strains isolated from the oral cavity and that dental plaques serve as an important reservoir for respiratory pathogens in these patients.

Oral Care:

Several interventional studies have demonstrated a reduction in lower respiratory tract infections following improvement in oral hygiene. The table on overleaf shows effectiveness of oral care in reducing risk of pneumonia in nursing home residents.

Reference	Population	Design	Intervention	Outcomes
Yoneyama et al [34]	417 NH Residents	Randomized control trial over 2 year period	Daily tooth brushing plus scrubbing of pharynx with povidone iodine 1% (including professional care once a week)	RR of developing pneumonia 1.67 in the group on no oral care compared with oral care (p=0.04)

			Vs. routine oral care	
Simons et al [35]	111 dentate elderly	Double blind, randomized control trial over 12 month period	CH /Xylitol gum Vs. Xylitol (X) gum Vs. no gum	Significant reduction in denture debris, stomatitis and chelitis in CHX/X and X groups compared to no gum
Ueda et al [36]	105 long term care residents	Prospective interventional study	Oral care intervention at intervals of 1,2,3,4 and 6 weeks	Oral hygiene condition could be improved by performing oral care at intervals of 1 week for 12 consecutive weeks and maintained at intervals of 1 week thereafter
Abe et al [37]	190 elderly patients	Prospective, randomized for 6 month	Weekly professional oral care Vs. self oral care	RR of developing influenza while underprofessional oral care compared to that in the control group was 0.1 (95% CI 0.01-0.81, p=0.008)
Adachi et al [38]	216 NH Residents	Prospective interventional study for 24 month	Daily routine oral careplus either mechanical cleaning Vs. basic oral hygiene (swabbing and denture cleaning)	Fatal aspiration pneumonia (RR=2.67; p<0.5)higher in those who did not receive professional oral care compared tointerventional group
Ishikawa et al [39]	202 NH Residents	Prospective interventional study over 3 month period	Professional oral care weekly Vs. gargling with 0.35% povidone iodine daily Vs. no professional care	Professional oral care decreased burden of oral pharyngeal bacteria and was more effective than gargling with povidone iodine
Bassim et al [40]	143 NH Residents	Retrospective review upto 79 weeks	Assisted oral hygiene (tooth brushing, antiseptic mouth wash) Vs. no assisted oral care	Odds ratio of dying from pneumonia 3.57 higher in the control group than the oral hygiene group

The content of the above table has to be considered with respect to the pathogenesis as explain below.

PATHOGENESIS:

The pathogenesis of pneumonia begins with the colonization of the oropharyngeal surfaces by potential respiratory pathogens. The adhesion of bacteria to these surfaces is usually mediated by specialized bacterial surface structures, which bind to specific receptors on the host surface. Oral bacteria are potent stimulators of cytokine production from oral epithelial cells[26], and those may also modulate the adhesion of respiratory pathogens to respiratory epithelial cells. Oral bacterial products or cytokines in oral/pharyngeal aspirates have 2 kinds of function; one is stimulating cytokine production from oral/respiratory epithelial cells [26,27], and the other is modulating the adhesion of respiratory epithelial cells [27]. Then, epithelial cells also alter expression of various cell adhesion molecules on their surface in response to cytokine stimulation [28]. Variation in expression of such adhesion molecules may alter the interaction of bacterial pathogens on the mucosal surface [29]. Once aspirated into the lower airway, the bacteria adhere to the bronchial or alveolar epithelium, again via specific adhesion-receptor interactions, which include lectin as well as protein-protein interactions for glycoproteins and glucolipids[27]. Epithelial cell destruction by adhered bacteria may be due to the direct effect of bacterial products on membrane permeability.

Wilson R et al. have demonstrated that bronchial secretions may also contain bacterial toxins, which can cause epithelial necrosis and disrupt ciliary ultrastructure[30]. One of the main functions of the airway epithelium is to inactivate and remove infectious particles from inhaled air and thereby prevent infection of the distal lung.

Necrosis in airway epithelium might decrease removal capacity. Aspiration pneumonia is characterized histopathologically as granulomatous bronchopneumonia with prominent formation of macrophages/ multi-nucleated giant cells. Migration of macrophages is caused by repeatable chronic aspiration of particulate food matter [31] and response of acid-induced lung injury [32].

CONCLUSION:

Pneumonia is the leading cause of death among elderly[41].Moreover, 30% of those who die of pneumonia are diagnosed with aspiration pneumonia. Aspiration pneumonia is a leading cause of illness and health in person who resides in long term care facilities and combined with a lack of proper oral health care and services, the risk of aspiration pneumonia rises. In order to successfully prevent aspiration pneumonia, a patient must- (a) improves his/her ability to ingest food items, and (b) receive sufficient oral care including proper cleaning. Incorporating oral care in daily routine practice helps to reduce systemic diseases and to promote over all quality of life.

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