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The Oral Care Imperative

The Link Between Oral Hygiene and Aspiration Pneumonia

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Oral health has increasingly become a priority issue for healthcare agencies in North America and worldwide. This review article attempts to (1) inform various healthcare providers of the risk factors that can arise from poor oral hygiene, specifically aspiration pneumonia; (2) report the mechanisms of bacterial colonization that are responsible for the development of aspiration pneumonia and the factors that can influence these mechanisms; and (3) propose an interdisciplinary approach to enhance oral care delivery that is imperative to limiting the risks of developing systemic diseases such as aspiration pneumonia. **Key words:** *aged*, *aspiration*, *dysphagia*, *health promotion*, *long-term care*, *oral hygiene*, *pneumonia*, *risk factors*

THE links between oral health, general health, and systemic disease in institutionalized elderly populations have been established in the literature.[1,2] As a result, major health organizations, both within North America and worldwide, have increasingly mandated oral health as a priority.[3–5] As a result of dramatic improvements in general dental health in the western world during the latter half of the 20th century, people are increasingly reaching old age with intact dentition.[6] Although this trend indicates improvements in the delivery of dental services, it brings with it an imperative to promote proper oral care delivery to seniors and persons with disability to limit the oral-health–related risk of systemic diseases such as pneumonia.

Pneumonia is the leading cause of acute care hospitalization and the primary cause of death in many diseases found among long-term care (LTC) residents.[7] The reported incidence of pneumonia in LTC ranges from 0.1 to 2.4 per 1000 patient days.[8] Bacterial pneumonia (as opposed to viral pneumonia) is directly precipitated by aspiration (defined as the inhalation of oropharyngeal secretions into the larynx and down to the lower respiratory tract[9]). Aspiration is a common feature of dysphagia (swallowing difficulty), particularly in the elderly population.[10–12] Poor oral hygiene has been linked with the elevated presence of respiratory pathogen (RP) in oropharyngeal secretions.[13,14] When RPs are aspirated, they can overburden host defense mechanisms and lead to infection.[9] For this reason, the promotion of high-quality oral care should be a priority strategy for limiting the occurrence of bacterial pneumonia, particularly in individuals with an increased risk of aspiration secondary to dysphagia.

SIGNS, SYMPTOMS, AND DIAGNOSIS OF PNEUMONIA

The typical signs and symptoms of bacterial pneumonia are cough, fever, tachypnea, chills, and pleuritic chest pain.[15,16] A differential diagnosis of aspiration pneumonia is made if predisposing risk factors coexist with typical signs and symptoms of bacterial pneumonia[17]; these predisposing risk factors include a history of aspiration

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(such as in the case of dysphagia), decreased level of consciousness, or a primary diagnosis of neurologic disease. The diagnosis of aspiration pneumonia can be further inferred from characteristic chest radiographic abnormalities involving infiltrates in the superior segment of the lower lobes and the posterior segment of the upper lobes.[9,18]

The differential diagnosis of aspiration pneumonia in the elderly can be challenging. These patients may present with fewer and more subtle signs and symptoms, which frequently take the form of nonspecific deteriorations in general health.[19] Comorbidities such as congestive heart failure and chronic obstructive pulmonary disease may further confound the diagnosis by mimicking the classic symptoms of pneumonia.[20] Furthermore, aspiration pneumonitis (defined as an acute lung injury characterized by acute inflammation of lung airways and parenchyma after the inhalation of regurgitated gastric contents[9,17]) presents similar radiographic findings to those observed in aspiration pneumonia. As a result, the diagnostic label of aspiration pneumonia is likely to be overapplied, and estimates of the prevalence of aspiration pneumonia are unlikely to be accurately reflected in the literature.

BACTERIOLOGY

Bacteria are most commonly classified according to observable microscopic and physiologic characteristics. Gram-stain reaction (positive or negative) and dependency on oxygen for growth (aerobic vs anaerobic) are the 2 primary characteristics used to describe bacteria. The structure of the cell wall, determined from the Gram-stain reaction, plays a key role in the resistance of bacteria to various substances. Gram-negative bacteria have cells walls that are more resistant to antibiotics, enzymes, and detergents, and are therefore more likely to be pathogenic.[21]

BACTERIAL PNEUMONIA

Bacterial pneumonia is traditionally divided into 2 etiologically distinct classifications: *community-acquired pneumonia* (CAP) and *hospital-acquired pneumonia* (HAP), otherwise known as *nosocomial pneumonia*. These 2 varieties of bacterial pneumonia can be differentiated on the basis of the usual location or timeline of their development, their bacteriology, and characteristics of the patient populations in which they most frequently occur (Table 1). CAP is the diagnostic label applied to pneumonia that develops outside the institutional setting or in patients who have been hospitalized for fewer than 3 days.[18] The incidence of CAP is reported to be highest in patients with histories of smoking, alcoholism, chronic pulmonary disease, and/or prior viral infections.[18] The main causative organisms of CAP are *Streptococcus pneumoniae* (an aerobic gram-positive bacterium, or AGPB) and *Haemophilus influenzae* (an aerobic gram-negative bacterium, or AGNB).[2,9,18,19,22]

Table 1. Differentiating characteristics of bacterial pneumonia

	Community-acquired pneumonia	Hospital-acquired pneumonia
Timeline	Outside hospital or after <3 days of hospitalization	After 3 or more days of hospitalization
Causative agents	*Streptococcus pnenumoniae* *Haemophilus influenzae*	*Staphylococcus aureus* aerobic gram-negative bacterium
At-risk population	History of smoking, alcoholism, chronic pulmonary disease	Slightly older population with terminal disease; weak, frail; Immunocompromised or depressed mental status

HAP contrasts with CAP in its timeline of occurrence, developing typically after stays of 3 days or longer in a medical facility.[18] The organisms that are most frequently implicated in HAP are *Staphylococcus aureus* (an AGPB) and AGNB including *Pseudomonas aeruginosa*.[18,19,22,23] HAP is reported to occur preferentially in a slightly older population with terminal disease,[19] and in patients who are weak and frail, have compromised immunity, or have depressed mental status that increases their propensity to aspirate.[18]

RISK FACTORS FOR DEVELOPING PNEUMONIA

Functional dependency either for feeding or for oral care has been reported to be highly correlated with risk for developing pneumonia.[7,24–26] Patients who require feeding have reduced control over the manner in which food or liquid is administered; this is associated with an increased risk of aspiration, particularly in individuals with dysphagia.[2,25,27] Individuals who are dependent for feeding are also likely to be unable to independently perform routine oral care.[25,27] Numerous articles speak to the inadequacies of oral care provided in nursing facilities,[28–33] and these inadequacies are presumed to contribute to observed differences in oral health between institutionalized and community-dwelling seniors. Research has documented elevated levels of both anaerobic and aerobic bacteria in the dental plaque and oral secretions of institutionalized seniors, in comparison with community-dwelling individuals who are more likely to be independent for oral hygiene.[34] Similarly, populations known to have a high incidence of aspiration pneumonia (such as stroke patients) have been shown to have abnormally high levels of oral colonization with AGNB.[23]

ASPIRATION AND PNEUMONIA

Aspiration may occur during the swallowing of food and liquid (prandial) or with secretions at other times not associated with oral intake (nonprandial). The occult aspiration of microscopic volumes of saliva and oropharyngeal secretions during sleep is a common occurrence in approximately half of the healthy population.[35] When aspiration occurs, the risk of ensuing infection depends on (1) the type, volume, and bacterial load of the aspirated material, and (2) the host's response to the aspirated material via defense mechanisms such as the cough reflex, mucociliary action of the respiratory epithelium, and cellular immune responses.[9] Given these risks, strategies to limit the development of aspiration pneumonia should aim to (*a*) reduce the occurrence of aspiration events, (*b*) reduce the bacterial load and pathogenicity of oropharyngeal secretions that may be aspirated, and (*c*) medically support and enhance host defenses in immunocompromised patients. The delivery of quality oral care services addresses the second of these mandates.

DENTAL PLAQUE AND MECHANISMS OF RESPIRATORY PATHOGEN COLONIZATION

Figure 1 illustrates 2 mechanisms by which poor oral hygiene is reported to lead to the colonization of oropharyngeal secretions by RPs.[14,36] In mechanism 1, the precipitating factor is a proliferation of dental plaque, a thick biofilm that plays host to many microorganisms implicated in periodontal disease.[2,36,37] Poor oral hygiene facilitates the buildup of plaque, which grows more complex as it matures.[14,36,38] This facilitates the growth of periodontal pathogens such as *Porphyromonas gingivalis*, a gram-negative anaerobic bacterium commonly found in diseased periodontal pockets and in the saliva of older patients with periodontal disease.[39] In healthy subjects, fibronectin (a fibrous glycoprotein) provides a protective coating that prevents the adherence of AGNB to oral epithelial cell surfaces.[2,40] *P gingivalis* produces and releases hydrolyzing enzymes into the saliva, leading to the degradation of fibronectin and other extracellular matrix

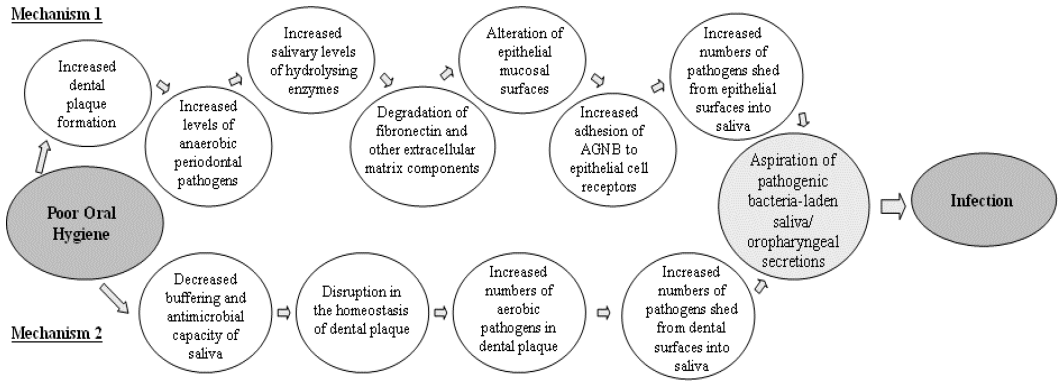

Figure 1. Mechanisms of dental plaque colonization by respiratory pathogen leading to infection.

components.[40] This process alters the surfaces of the oral mucosa, enabling the adherence of AGNB such as *Pseudomonas aeruginosa*, which, in turn, are shed into the saliva and aspirated to instigate infection.[14,25,40,41] In the second mechanism, poor oral hygiene disrupts the usual buffering and antimicrobial properties of saliva. This upsets the homeostasis of dental plaque, leading to conditions that favor the proliferation of aerobic bacteria,[37] which are then shed into the saliva. This situation has been observed in dental plaque samples taken from ICU patients[42]; colonization is reported to increase with the passage of time spent in the ICU and is highly predictive of HAP.[42]

INFLUENCE OF SALIVARY FLOW

Saliva provides a natural mechanism for ridding the body of pathogenic bacteria from the oral cavity. However, many elderly persons experience reduced salivary flow secondary to the use of common medications that have a side effect of xerostomia (dry-mouth). Xerostomia is reported to deepen the fissures of the tongue and contribute to the accumulation of bacteria in the oral cavity.[38] As the volume of saliva decreases, its washing, antimicrobial, and buffering capacity diminishes, the oral pH decreases,[43,44] and the bacterial[2] and fungal[45] load increases. This raises the likelihood of infection following aspiration.[2,27,34]

INFLUENCE OF ANTIBIOTIC USAGE

Another factor that contributes to the overgrowth of nonresident microorganisms in the oropharynx is the long-term use of broad-spectrum antibiotics.[37] Specifically, these medications are reported to lower the colonization resistance of dental plaque, facilitating the emergence of AGNB in the oropharyngeal secretions.[2,46] Yeasts such as *Candida albicans* can become opportunistic and cause disease in the presence of repeated and prolonged antibiotic treatments and other predisposing factors such as poor oral hygiene, low salivary flow, and ill-fitting dentures.[44,45]

INFLUENCE OF NATURAL VERSUS PROSTHETIC DENTITION

An apparent paradox inherent to the strategy of promoting oral care as a means to limit the risk of pneumonia is the fact that the presence of teeth actually increases the risk of oral colonization by pathogenic bacteria.[14] Thus, while public health initiatives aimed at improving general dental health have succeeded in increasing the number of seniors who retain their natural teeth, this success brings with it an increased risk for pneumonia in these individuals. RPs have been shown to be more likely to colonize the oral cavities of patients with natural teeth or dentures than those of patients who have neither

natural teeth nor dentures.[14,41] In elderly people who retain their natural teeth, periodontal disease may directly contribute to greater shedding of anaerobic bacteria into the saliva,[2] thereby contributing to the risk of aspiration pneumonia as described in mechanism 1 of Figure 1.

Plaque can, however, also accumulate on dentures and promote oropharyngeal colonization by RPs.[47] Poor denture care is considered to be one of the mitigating factors for denture stomatitis (irritation of the oral mucosal surfaces that come into contact with the dentures), a condition that affects approximately two thirds of denture wearers.[45,48,49] Denture stomatitis is reported to be a precipitating factor for the development of oral yeast infections (*Candida*).[50] Individuals with full dentures have been found to have significantly higher yeast counts than those with natural dentition[51]; this is thought to be due to the fact that full upper dentures act as a barrier to the natural surface-washing activity of saliva.[45]

Proper denture care entails regular removal of the dentures, brushing the dentures to remove plaque buildup, especially on the tissue fitting surfaces, and the cleaning of the oral cavity.[48] However, these steps are often neglected and individuals have the predilection to simply remove and soak dentures without mechanical removal of plaque or cleaning of the oral cavity.[52]

THE STATE OF ORAL CARE IN LONG-TERM CARE

During the routine delivery of healthcare, a variety of different healthcare providers have abundant opportunities to visually inspect the oral cavities of the older patients in their care.[53–57] Those who are well-informed regarding the risks, signs, and symptoms of poor oral hygiene are well positioned to monitor oral health, and to notice, interpret, and report oral health problems. Nursing staff monitor and care for patients on a daily basis; they frequently provide assistance with activities of daily living, including oral care, which they consider to be part of their routine responsibilities. Speech-language pathologists regularly inspect the motor and sensory function of the mouths of adult patients during their evaluations of speech and swallowing.[58,59] Other rehabilitation allied healthcare professionals, physiotherapists and occupational therapists, may also aid in a patient's oral hygiene by enabling individuals to functionally perform their own oral care. Although speech-language pathologists, physiotherapists, and occupational therapists may not directly provide oral care interventions, they may recognize oral health conditions that can be brought to the attention of a nurse or attending physician. In Canada, dental hygienists are the primary dental service providers in rehabilitation and LTC facilities (dentists are seen on a referral basis only for conditions that require their attention). According to an e-mail conversation with M. Casper, MA, CCC-SLP, BRS-S (February 2006), dental services in the United States are more commonly provided by referral to dentists who hold external contracts for LTC facilities. Therefore, differing professions are well suited to collaborate on interprofessional teams to promote the oral hygiene of older adults in institutional facilities.

Nurses are reported to consider oral care important, but further investigation reveals that their concern is primarily for their patients' self-esteem and social acceptability, and does not stem from an appreciation of the relationship between oral care and general health.[29,54] Although nurses may perceive oral care to be routine and common sense, this task is not always carried out or performed effectively.[54,60] Many studies have attributed the poor level of dental and oral care knowledge among nursing staff to misinformation and a lack of education and training.[28,60–62] In addition, it has been noted that the primary responsibility for frontline oral care services is frequently delegated to untrained staff who are overwhelmed with other routine

tasks; this often leads to the neglect of oral care.

Poor oral health knowledge in caregivers also raises the risk that signs of serious oral diseases (such as oral malignancies) will go unrecognized.[63,64] In a study that investigated the abilities of physicians to diagnose oral diseases such as oral cancer, physicians were found to be seriously deficient in diagnostic awareness. The authors suggested that training to familiarize physicians with the clinical features of a healthy mouth and with the more common and important oral diseases could improve their diagnostic abilities.[64] This concept can also be applied to all the different healthcare providers who have the opportunity to participate in the delivery of oral care services.

FUTURE DIRECTIONS

Many interventions for dysphagia are designed to limit the occurrence of aspiration during swallowing.[65] However, literature suggests that common strategies such as texture modification (to remove textures that are aspirated more easily such as thin liquids) may not be effective in preventing aspiration-related respiratory compromise.[66] These findings implicate aspiration at times other than meals (nonprandial) as a primary contributing factor to the development of pneumonia. Consequently, efforts to limit the load of pathogenic bacteria in the oropharyngeal secretions are logically supported as a key strategy in limiting the incidence of aspiration pneumonia. We propose that the improvement of oral health among seniors, both in the community and especially in residential healthcare facilities, needs to become a public health priority. Interdisciplinary collaboration appears to be critical to the design and delivery of initiatives targeting improved oral health among seniors. If eyes are the window to the soul, then the mouth is a portal to the rest of the body, and we must all address the oral care imperative.

CLINICAL TIPS

1. Ensure that the patient has had a dental assessment.
2. Assess patients' level of dependence for oral care. If patients are able to perform their own care,
   - ask for occupational therapists' recommendations to facilitate independent self oral care and
   - observe patients performing their own oral care to ensure that they are cleaning all areas (eg, patients with right hemisphere stroke may neglect one side of the oral cavity and may need reminding to clean the neglected side).
3. Ensure that adequate and proper oral care materials and products are available for use.
   - A soft toothbrush is the best tool.
     - Dentures should also be brushed accompanied with the cleansing of the oral cavity and tongue.
     - Suction toothbrushes may be used with patients with dysphagia, including those on enteral feeding.
   - Foam swabs or sponges are ineffective and should not be used.
   - Mouthwashes containing alcohol are drying.
     - Mouthwashes should contain fluoride for dentate patients.
     - Chlorhexidine (Peridex) use should be monitored by a dental professional as there may be side effects to long-term usage.[67,68]
   - Do not use a petroleum product (ie, Vaseline) or lemon glycerin as moisturizing agents.

Although there is no specific guideline for oral care provision in the literature, an excellent resource caregivers may want to review is a publication entitled *Oral Hygiene Care for Functionally Dependent and Cognitively Impaired Older Adults*.[69]

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