ADHA/Sigma Phi Alpha Journalism Award: Baccalaureate

Oral Health and Hospital-Acquired Pneumonia in Elderly Patients: A Review of the Literature

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Abstract

Purpose: The U.S. spends an average of $6.5 billion each year to treat patients who suffer from pneumonia. Pneumonia currently has the highest morbidity and mortality rates of all nosocomial infections, is hypothesized to account for 15% of all hospital-acquired illnesses and is responsible for 13 to 48% of all nursing home-associated illnesses. For years, researchers have tried to develop methods to prevent pneumonia because of its detrimental effects on the body, but only in the last decade have they been able to uncover possible methods to do so. Inadequate oral hygiene care is one of the ways that elderly patients contract hospital-acquired pneumonia (HAP). Proper oral disease prevention could possibly be considered the standard of care in long-term stay facilities to reduce and prevent elderly patients from contracting HAP. The purpose of this literature review is to explore the relationship between oral health care practices and HAP.

Keywords: periodontal disease, pneumonia, elderly patients, dental hygiene educators

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Introduction

Periodontal disease is an inflammatory response to a continual source of bacteria that if left untreated can cause severe destruction to the oral tissues and surrounding structures.[1] It is a commonly found infection in elderly patients that can disturb the host's immune system and potentially impact systemic illnesses.[2] The prevalence of American adults who suffer from periodontal disease has been linked to an increase in age, with 47% occurring in younger adults and 70% occurring in elderly adults.[3] Within the past decade, there have been several research studies suggesting periodontal disease to be a major risk factor for hospital-acquired pneumonia (HAP).[2,4-11] Oral bacteria can be easily aspirated into the respiratory tract and can encourage the development of future systemic diseases, like HAP.[2,4-6]

HAP is a contracted lung infection that produces a positive respiratory culture after 48 hours of being in the primary care of a hospital facility.[6-7,12] It is an inflammatory condition of the lungs that is influenced by infectious agents that are not present at the time of hospital admittance.[13] Current research suggests that HAP occurs in 5 to 10 patients out of 1,000 admitted hospital patients.[14-16] The incidence of HAP cases increases as much as 6 to 20 fold in patients with mechanical ventilation.[14-16] Although the mortality rate of patients with HAP may be as prevalent as 70%,[17,18] approximately 30 to 50% can be attributed to infection. It has been found that the mortality rate could possibly increase even further from bacterial pathogens being present.[19,20]

Bacterial pneumonia, which is a form of HAP, is usually caused by resistant periodontal pathogens, such as Staphylococcus aureus, Klebsiella pneumoniae, Psuedomonas aeruginosa and Escherichia coli.[4,5,12,21] These particular strains of resistant periodontal pathogens in conjunction with risk factors such as smoking, aging and heightened stress levels can increase the risk of contracting HAP in an elderly

patient.[4-6,12] Resistant pathogenic bacteria that forms in response to periodontal disease supplies the respiratory tissues with all of the armamentarium it needs to develop HAP.[4-6]

Periodontal Disease

Periodontitis is a chronic infectious inflammatory disease that negatively impacts the periodontium and destroys the remaining tooth-supporting structures.[1] Periodontitis is also a bacterially-induced disease that occurs in the oral cavity.[1] Periodontal-diseased pathogenic bacteria have the ability to gain entry into a patient's lungs by specific pathways, with the most common way via aspiration of the oropharyngeal secretions by way of endotracheal intubation or mechanical ventilation.[7,22-23] Of the periodontal bacteria commonly found in the oral cavity and respiratory tracts, K. pneumoniae is the most common pathogen to cause HAP and ventilator-associated pneumonia (VAP), followed by Streptococcus pyogenes, Staphylococcus aureus, Peptostreptococcoi species, Actinomyces species, K. pneumoniae, and Prevotella aeruginosa.[5,8,12,24] According to the CDC, approximately 63% of all patients admitted to the Intensive Care Unit (ICU) in 2009 had colonization of a periodontal pathogen in their pulmonary tract and 76% of all patients that required ventilator-breathing assistance had the same bacterial colonization present in both their mouth and lungs.[25]

Pneumonia Epidemiology

In 2004, the American Thoracic Society (ATS) and the Infectious Disease Society of America (IDSA) published a document explaining the new evidence-based guidelines and management of HAP, VAP and health care-associated pneumonia (HCAP).[23] HAP was described as a type of pneumonia that occurs in patients at least 48 hours after hospital initiation that was not present prior to admittance; VAP was referred to as a type of pneumonia that occurs at least 48 hours after endotracheal intubation has occurred; and HCAP includes patients that live in nursing homes, long-term care facilities, receiving parenteral antimicrobial therapy, chemotherapy, and wound care within 30 days after the patient has been successfully treated for pneumonia for 90 days.[23] Endotracheal intubation and mechanical ventilation are the most common risk factors to developing HAP and VAP conditions.[23]

Endotracheal intubation is a procedure performed by means of a tube being inserted through the oral cavity to the trachea.[9] If the tube is inadvertently placed into the esophagus and stomach, aspiration of the stomach contents can result in HAP.[9] Mechanical ventilation is attributed to the ventilating machine that circulates oxygen for the patient to breathe.[9] According to the ATS and IDSA, 90% of mechanically ventilated patients in the ICU were diagnosed with VAP.[23] A study at the University of North Carolina reported on a hospital-wide surveillance of nosocomial infections that examined the pathogens causing VAP and nosocomial pneumonia in non-intubated patients over the course of 3 years.[23] In the study, investigators isolated 92% of pathogens from mechanical ventilation and 77% of pathogens from non-ventilated patients with pneumonia infections.[23] The study also found that some bacterial organisms, such as Medicine-Resistant Systemic Antibiotics (MRSA) and K. pneumoniae, were found more commonly in non-ventilated patients, whereas certain resistant gram-negative bacilli were more common in patients with VAP.[23] Other common risk factors seen in patients with HAP and VAP are non-modifiable and modifiable risk factors.[23]

Non-Modifiable Risk Factors

The non-modifiable risk factors are those that are not easily modified or changed by the patient. These non-modifiable risk factors include: a patient's gender, age, history of Chronic Obstructive Pulmonary Disease (COPD), presence of a tracheotomy or cranial trauma, recent neurologic surgery, acute respiratory distress, multiple organ system failure, cerebral palsy, weakened immune system, and impaired consciousness.[8,26-28] Although these risk factors cannot be modified by the patient, periodontal disease can be modified and prevented with adequate oral hygiene care. Scannapieco et al found that elderly patients frequently experience health consequences from poor oral health and will therefore be at a higher risk for developing localized infection, endocarditis and HAP.[10]

Medical risk factors seen commonly in elderly patients are those with a somewhat diminished salivary flow, depressed cough reflex, dysphagia and have the inability to perform acceptable oral hygiene.[4,28] Terpenning et al found a positive correlation between 8 medical factors and their incidental risk of causing HAP in elderly

patients.[28] Of the 8 medical risk factors discovered in the study, dysphagia, was considered to have the strongest association to HAP.[2]

Dental risk factors that are frequently seen in elderly patients directly coincide with the number of decayed teeth, active periodontal disease, appearance of resistant periodontal disease pathogens and the need for feeding tube assistance for sufficient nutritional requirements.[4] Scannapieco et al reported there to be insufficient oral hygiene protocols in both hospitals and long-term care facilities.[21] Furthermore, not having an oral hygiene protocol for an elderly patient that has active periodontal disease could support the progression of the induction to oropharyngeal bacterial colonization by potential periodontal pathogens.[21] Investigators have found that having a higher dental plaque count can further increase the risk of HAP in an elderly patient.[4-6,21-22,28-30]

Sjogren et al found that utilizing preventive methods is a successful way to decrease respiratory infections in elderly patients.[31] They also found there to be benefits of proper oral hygiene in pneumonia and respiratory infections in HAP patients.[31] The study's results showed that the absolute risk of respiratory illness was reduced to 6.6 to 11.7% of all HAP patients when proper oral hygiene was used.[31] From this study, it was also concluded that 1 out of every 10 pneumonia-related nursing home deaths could have possibly been prevented by the patient's oral health status.[31]

Modifiable Risk Factors

Modifiable risk factors for HAP and VAP patients is a targeted area of concern that can be improved through increased education and interdisciplinary collaboration. As stated in the ATS and IDSA document, there are several areas that can be improved to prevent modifiable risk factors from occurring.[23] Using a non-invasive positive-pressure ventilation face mask can be a good alternative for patients with acute symptoms of COPD, hypoxic respiratory failure and immunocompromised hospital patients.[23] Improving sedation methods and utilizing protocols to quicken the ventilation weaning process have been proven successful in the reduction of VAP incidences for mechanical ventilation patients.[23] Similarly for endotracheal intubation patients, re-intubation has not been recommended, as it also increases the risk of VAP.[23] Regular aspirations of subglottic fluids, through a purposefully designed endotracheal tube, have been shown to significantly decrease the risk of early onset VAP.[23]

Oral Hygiene Guidelines

A protocol established by the CDC could be implemented in long-term care facilities, and includes the following procedures:[25]

1. Brush teeth every 12 hours with a sodium bicarbonate impregnated suction toothbrush
2. Clean the mouth every 4 hours with a foam suction swab and the prepackaged cleanser (cetylpyridinium chloride 0.05%)
3. To use a moisturizer for the lips and mouth every 2 to 4 hours

Several studies have utilized these or similar guidelines to determine if an oral hygiene protocol was necessary to reduce the prevalence of HAP and VAP.[2,12,22-23,28,32-37] To analyze the incidence of pneumonia as well as patient compliance, Bouadma et al added 6 strategies to his study in conjunction with the CDC's guidelines.[32] The strategies were: back rest elevation, tracheal cuff pressure maintenance, orogastric tube use, avoidance of gastric over-distention and proper oral hygiene.[32] They found that utilizing this form of provincial treatment almost doubled the success rate in patient compliance (90%).[32] They were also able to reduce the need of patients requiring assistance for the treatment of ventilator-associated diseases by 51% after the oral hygiene protocol was implemented.[32] Zurmehly et al had an even greater reduction of HAP cases in his study (62.5%) after the establishment of an oral hygiene program.[33] The participants in the Hutchins et al study utilized similar CDC prevention guidelines, but were instead instructed to brush their teeth with cetylpyridium chloride (which was later changed to 0.012% chlorhexidine solution), use suction swabs that were treated with hydrogen peroxide to disinfect the remaining surfaces of the oral cavity, mouth moisturizer and deep suctioning of the oropharyngeal tubules. With the oral care protocol provided, they saw an 89.7% decrease in the number of patients that contracted HAP.[2]

Additional prevention strategies in collaboration with the CDC's guidelines were implemented in a cohort's study, which included raising the bed 30 to 40 degrees (or as much as the patient could tolerate), executing incentive spi-

rometry testing in patients that have signs of coughing and deep breathing, and encouraging patients to become mobile as soon as possible.[6] Orr et al found a 45% reduction in HAP and concluded that implementing an oral hygiene protocol in long-term care facilities could save the patients up to $65,000 in additional hospital fees.[6]

Chlorhexidine is a common antimicrobial used to prevent biofilm accumulation. Pajus et al estimated future research will find chlorhexidine beneficial in the reduction of bacterial colonization in patients requiring respiratory ventilation and may even decrease the need of antibiotics or shorten the patient's hospital visit.[4] Shi et al compared 4 different types of oral care prevention strategies which included chlorhexidine vs. placebo, tooth brushing vs. no tooth brushing, powered vs. manual tooth brushing, and other chemicals vs. placebo.[34] The results of this study found chlorhexidine mouth rinse to be associated with a 40% reduction of admitted pneumonia cases.[34] In performing a literature search of 17 studies, Roberts et al concluded that combining chlorhexidine with colistin, which is another type of antibiotic that specifically targets gram-negative bacteria,[11] can result in fewer pathogenic bacterial colonies developing in the patient's oropharyngeal tube and can delay the occurrence of HAP.[35] Pobo et al found that adding tooth-brushing to an already-existing chlorhexidine oral care protocol does not further eliminate any risk of contracting HAP when compared to using a chlorhexidine oral care protocol by itself.[36] Paju et al found chlorhexidine to be a useful antimicrobial for HAP oral care protocols.[4,11,34-36]

Prendergast et al found long-term care facility nurses to be hesitant in performing tooth brushing treatment care for endotracheal intubated patients because of its risk of increased cranial pressure diagnosis.[37] According to the nurses that participated in the study, the tongue scraper, power toothbrush, non-foaming tooth paste and oral moisturizers were the most effective products to use for oral hygiene on intubated patients.[37] Among the participants in the study that received comprehensive oral care, a decrease in bacterial conversion to oral nosocomial colonization was seen.[37] Subsequently, some hospitals have now hired an in-clinic registered dental hygienist.[37]

Oral hygiene methods for intubated patients may be compromised by the oral endotracheal tubes, oral gastric tubes, bite blocks or the adhesive tape keeping the tubes in place.[37] ATS recommends the performance of effective infection control methods as well as continuous surveillance of ICU infections during prophylaxis appointments.[23] ATS also recommends for patients to be positioned in a semi-recumbent position rather than a supine position to prevent possible aspiration and enteral nutrition is recommended over parenteral nutrition for endotracheal intubation patients.[23]

Discussion

While dental hygienists cannot diagnose HAP nor VAP, they can play a pivotal role in the detection, education and implementation of prevention methodology for patients at risk in hospitals and long-term care facilities. For years, studies have affirmed that periodontal disease increases an elderly patient's risk for developing pneumonia that could potentially become fatal if not prevented and treated properly.[22] Research also suggests that inadequate oral hygiene is a preeminent risk factor of HAP for patients in long-term care facilities.[3-6,12,28,32,34,35] Pneumonia is a convoluted disease that still requires additional research, especially for elderly patients and their care providers in long-term care facilities.[28,33]

The link connecting inadequate oral hygiene to HAP at a microscopic level originates from periodontal pathogens colonizing in the oral cavity and living in the respiratory tract flora.[5] Resistant pathogenic bacteria that forms in response to periodontal disease supplies the respiratory tissues with everything it needs in order to develop HAP.[4-6] Most of the research available today concludes that S. pneumoniae is the most common bacterial source of pneumonia, followed by S. aureus.[5,8,10,12] Being able to identify potential periodontal pathogens can help prevent an at-risk elderly patient of acquiring HAP, VAP and HCAP.[25]

A common limitation identified in this literature review includes the lack of applied knowledge by the medical personnel and compliance by the elderly patient. For example, all medical personnel in the Bouadma et al study were provided a 3-hour continuing education course that covered extensive information about the epidemiology, morbidity, mortality, risk factors, pathophysiology and pneumonia preventative measures.[32] This study relied heavily on the medical personnel's ability to educate and persuade the patient to use the oral health

preventive methods properly.[32] The study also ultimately depended on the compliance of the patient to follow the recommended hygiene protocol.[32] Fortunately for Bouadma et al, the results of the study concluded that this prevention program for VAP can in fact increase the level of patient compliance.[32]

There are several procedures dental hygiene educators and medical providers can utilize in the prevention of HAP. Both periodontal risk assessments and oral hygiene protocols have shown success in preventing future incidences of HAP, VAP and HCAP in hospitals and long-term care facilities.[5-6,22] Although more research is needed to determine the causal relationship between poor oral health and HAP, pneumonia screenings and oral hygiene protocols have already been shown to be a successful treatment method in patients with diagnosed periodontal disease.[4,22]

In the future, collaboration of medical and dental personnel is imperative in providing paramount standards of care for elderly patients in hospitals and long-term care facilities. Establishing an oral health care protocol in long-term care facilities contributes to a multifaceted approach to prevent the risk of HAP. With education in disease prevention being a main professional goal, dental hygienists are a pivotal resource for hospitals and long-term care facilities in providing education, prevention protocols and care to elderly patients. It is suggested for hospitals and long-term care facilities to execute an oral hygiene protocol to prevent and reduce the patient's risk of contracting HAP, VAP and HCAP.[5]

Conclusion

Current research suggests that poor oral health in hospitals and long-term care facilities is linked to HAP. As dental care providers, we should explore the possibility of at the very least providing "in-service" training to elderly patients in hospitals and long-term care facilities. In the future, a more comprehensive approach would be for dental hygienists to actively work in hospitals and long-term care facilities to provide specialized education on oral hygiene preventative procedures. Dental hygienists are a crucial asset for hospitals and long-term care facilities in being able to contribute exemplary education for both elderly patients and their caregivers on the link between oral and systemic health.

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References

1. Di Benedetto A, Gigante I, Colucci S, Grano M. Periodontal disease: linking the primary inflammation to bone loss. *Clinical and Developmental Immunology*. 2013;2013:1-7.

2. Hutchins K, Karras G, Erwin J, Sullivan KL. Ventilator-associated pneumonia and oral care: a successful quality improvement project. *Am J Infect Con*. 2009;37(7):590-597.

3. Eke PI, Dye BA, Thornton-Evans GO, Wei L, Genco RJ. Prevalence of periodontitis in adults in the united states: 2009-2010. *J Dent Res*. 2012;91(10):914-920.

4. Paju S, Scannapieco FA. Oral biofilms, periodontitis, and pulmonary infections. *Oral Dis*. 2007;13(6):508-512.

5. Attar MM, Zaghloul MZ, Menoufy HS. Role of periodontitis in hospital-acquired pneumonia. *E Med Heal J*. 2010;16(5):563-569.

6. Orr CJ, Mitchell M. Prevention of hospital-associated pneumonia using a comprehensive oral hygiene protocol. Sage [Internet]. 2008 [cited 2008 June]. Available from: http://sageproducts.com/wp-content/uploads/2015/08/21105_Prevention_of_Hospital_Associated_Pneumonia_Using_a_Comprehensive_Oral_Hygiene_Protocol_handout.pdf

7. Scannapieco FA. Oral inflammation and respiratory diseases. Colegate [Internet]. 2001 [cited 2005]. Available from: http://www.colegateprofessional.com/leadershipUS/professionalEducation/WhitePapers/Resources/pdf/profed_WP_oral-inflam-and-resp.pdf

8. Bansal M, Khatri M, Taneja V. Potential role of periodontal infection in respiratory diseases- a review. *J Med Life*. 2013;6(6):244-248.

9. Reardon RF, McGill JW, Clinton JE. Tracheal Intubation. Clinical procedures in emergency medicine. 6th Ed. Philadelphia, PA: Elsevier Saunders; 2013.

10. Scannapieco FA. Role of oral bacteria in respiratory infection. *J Periodontol*. 1999;70(7):793-802.

11. Lim LM, Ly N, Anderson D, et al. Resurgence of colistin: a review of resistance, toxicity, pharmacodynamics, and dosing. *Pharmacotherapy*. 2010;30(12):1279-1291.

12. American Thoracic Society. Hospital-acquired pneumonia in adults: diagnosis, assessment of severity, initial antimicrobial therapy, and preventive strategies. *Am J Respir Crit Care Med*. 1995;153:1711-1725.

13. Rotstein C, Evans G, Born A, et al. Clinical practice guidelines for hospital-acquired pneumonia and ventilator-associated pneumonia in adults. *Can J Dis Med Microbiol*. 2008;19(1):19-53.

14. Craven DE, Driks MR. Pneumonia in the intubated patient. *Semin Respr Infect*. 1987;2(1):20-33.

15. Celis R, Torres A, Gatell JM, Amela M, Rodriguez-Roisin R, Agusti-Vidol A. Nosocomial pneumonia: a multivariate analysis of risk and prognosis. *Crest*. 1988;93(2):318-324.

16. Torris A, Aznar R, Gatell JM, et al. Incidence, risk, and prognosis factors of nosocomial pneumonia in mechanically ventilated patients. *Am Rev Respir Dis*. 1989;142(3):523-528.

17. Fagon JY, Chastre Y, Domart JL, et al. Nosocomial pneumonia in patients receiving continuous mechanical ventilation. *Am Rev Respir Dis*. 1989;139(4):877-884.

18. Leu HS, Kaiser DL, Mori M, Woolston RF, Wenzel RP. Hospital-acquired pneumonia attributable mortality and morbidity. *Am J Epidemiol*. 1989;129(6):1258-1267.

19. Fagon JY, Chastre J, Hance A, et al. Nosocomial pneumonia in ventilated patients: a co-hort study evaluating attributable mortality and hospital stay. *Am J Med*. 1993;94(3):281-288.

20. Bryan CS, Reynolds KL. Bacteremic nosocomial pneumonia. *Am Rev Respir Dis*. 1984;129(5):668-671.

21. Scannapeico FA, Mylotte JM. Relationships between periodontal disease and bacterial pneumonia. *J Periodontol*. 1996;67(10):1114-1122.

22. Goyal L, Bey A, Gupta ND, Sharma VK. Comparative evaluation of serum c-reactive protein levels in chronic and aggressive periodontitis patients and association with periodontal disease severity. *Contemp Clin Dent*. 2014;5(4):484-488.

23. American Thoracic Society, Infectious Disease Society of America. Guidelines for management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. *Amer J Resp Crit Care Med*. 2005;171(1):388-416.

24. Organisms that cause pneumonia. A.T. Still University [Internet]. 2013 [cited 2013 August 9]. Available from: www.atsu.edu/faculty/chamberlain/website/pnebact.htm

25. Tablan OC, Anderson LJ, Besser R, Bridges C, Hajjeh R. Guidelines for preventing healthcare-associated pneumonia: recommendations of CDC and the healthcare infection control practices advisory committee. Centers for Disease Control and Prevention. 2003.

26. Keyt H, Faverlo P, Restrepo MI. Prevention of ventilator-associated pneumonia in the intensive care unit: a review of the clinically relevant recent advancements. *Indian J Med Res*. 2014;139(6):814-821.

27. Understanding Pneumonia. American Lung Association [internet]. 2003 [cited 2012 March 2]. Available from: http://www.lung.org/lung-disease/pneumonia/understanding-pneumonia.html

28. Terpenning M. Geriatric oral health and pneumonia risk. *Clin Infect Dis*. 2005;40(2):1807-1810.

29. Marrie TJ. Pneumonia in the long-term care facility. *Infect Control Hosp Epidemiol*. 2002;23(3):159-164.

30. Barron J. Gum disease, the forest not the trees. Dent Health News [Internet]. 2009 [cited 2009 June 22]. Available from: Jonbarron.org/article/gum-disease-forest-not-trees#.VNfdRIE8Kru

31. Sjogren P, Nilsson E, Forsell M, Johansson O, Hoogstraate J. A systematic review of the preventive effect of oral hygiene on pneumonia and respiratory tract infection in elderly people in hospitals and nursing homes: effect estimates and methodological quality of randomized control trials. *J Am Geriatr Soc*. 2008;56(11):2124-2130.

32. Bouadma L, Mourvillar B, Deiler V, et al. A multifacited program to prevent ventilator-associated pneumonia: impact on compliance with preventive measures. *Crit Care Med*. 2010;38(3):789-796.

33. Zurmehly J. Oral care education in the prevention of ventilator-associated pneumonia: quality patient outcomes in the intensive care unit. *J Contin Ed Nurs*. 2013;44(2):67-75.

34. Shi Z, Xie H, Wang P, et al. Oral hygiene care for critically ill patients to prevent ventilator-associated pneumonia. *Cochrane Database Syst Rev*. 2013;8:CD008367

35. Roberts N, Moule P. Chlorhexidine and tooth-brushing as prevention strategies in reducing ventilator-associated pneumonia rates. *Nurs Crit Care*. 2011;16(6):295-302.

36. Pobo A, Lisboa T, Rodriguez A, et al. A randomized trial of dental brushing for preventing ventilator-associated pneumonia. *Chest*. 2009;136:433-439.

37. Predergast V, Kleiman C. Interprofessional practice: translating evidence-based oral care to hospital care. *J Dent Hyg*. 2015;89(1):33-36.