Open Access Journal

Indian Journal of Medical Research and Pharmaceutical Sciences

July 2014; 1(2) ISSN: 2349 – 5340

IDENTIFICATION OF PATHOGENIC RESPIRATORY BACTERIA IN DENTAL PLAQUE, PHARYNX, AND NASOPHARYNX IN CLINICALLY HEALTHY POPULATION AND HOSPITALIZED PATIENTS

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Keywords:
dental plaque, pharynx, nasopharynx, pathogenic bacterium.

Abstract

Background: The oral cavity is a moist environment which promotes the development of bacteria accumulation called dental plaque. When oral pH is altered there is a change in salivary secretion, which favors the colonization of microorganisms. **Methods:** 50 individuals were included, divided into two groups I: patients with more than 48 hours of hospitalization and II: clinically healthy non-hospitalized individuals. Demographic information was collected from each individual and an odontological assessment was performed. Bacterial cultures of dental plaque, pharynx, nasopharynx were made and saliva pH was measured. **Results:** The oral health status of all individuals was determined by a specialist. In group I: it was found that the risk of periodontal disease was 5.5 higher, halitosis, change in color of the mucosa, and saliva pH was 2.2, 5 and 3.9 higher than group II. 150 bacterial cultures were processed, bacteria such as: *K. pneumoniae, S. aureus, S. pneumoniae, S. pyogenes* among others were isolated in both groups. The possibility of a pathogen in dental plaque was 11 times higher in group I. **Conclusions:** We observed that when oral mucosa is altered, some microorganisms take advantage of this imbalance to adhere to the mucosa, as a first step in colonization and infection.

Introduction

Transient normal microbial flora corresponds to non-pathogenic or potentially pathogenic microorganisms hosted on skin and mucosa for hours or days.

The oral cavity has a moist environment, with a relatively constant temperature (34-36°C), with a pH of 7, in most surfaces[1], leading to a bacterial or biofilm accumulation which may be located on tooth surfaces, sulci and cavities of the occlusal face and gingival sulcus, called dental plaque.[2] One of the conditions for oral pH to be altered is probably the change in salivary secretion, which influences the immunity thus favoring the colonization of microorganisms processes, maintaining a balance between the presence of those considered normal or pathogenic,[3] until due to adverse conditions such as stress it is broken, affecting the secretion of the oral mucosa and favoring the implantation of some pathogenic microorganisms, leaving open the possibility of entry of infectious diseases. [4-6]

Dental plaque may be composed of up to 30 different bacterial genres and its products.[5] Recent studies based on the ribosomal RNA analysis reveal the diversity of bacterial populations within these dental biofilms, and have highlighted its significant contribution to oral health and disease, these dental biofilms are extremely complex and the ecosystems of multiple species, where oral bacteria interact cooperatively or competitively.[7]

Studies of bacterial cultures have shown that dental plaque is a reservoir for respiratory microorganisms, particularly in hospitalized or nursing home patients who are debilitated, and who are at risk of acquiring bacterial pneumonia as demonstrated by Didilescu et al.[5], as well as El-Solh Ali et al.[6], who has linked the colonization of respiratory pathogens in dental plaque with respiratory infections in residents of extended care facilities such as nursing homes.

There is evidence that cleaning or oral interventions with chlorhexidine solution[8], gel with chlorhexidine[9] and topical antibiotics[10] in hospitalized patients, contribute to the control and reduction of dental plaque reducing the risk of contracting pneumonia, among other respiratory infections[11], due to aspiration of oral secretions with pathogenic microorganisms.

Multiple factors that cause nosocomial pneumonia have been associated which contribute to increase the bacterial colonization of the oral cavity or facilitating the entry of pathogenic bacteria to the lower respiratory tract.[12]

Some of these factors are the use of nasogastric tubes (catheters), supine position, manipulation of air through ventilation circuit, subglottic secretions, transfusions, oral pH altering agents and colonization of dental plaque.

The purpose of this study was to identify the presence of respiratory pathogenic bacteria in dental plaque, pharynx and nasopharynx of healthy population and hospitalized patients[12].

Material and methods

A cross-sectional study was conducted during the period of June to October 2008 at a 2nd level hospital in Mexico City, a total of 50 individuals were included, of which 25 individuals were patients with more than 48 hours of hospitalization (group I) and 25 clinically classified as healthy, non-hospitalized (group II), both groups excluded: edentulous individuals, minors, pregnant women, in group II those with a diagnosis of respiratory infection and a history of antibiotics in the previous two months. The study was submitted and accepted by the ethics and research committees and all participants signed an informed consent letter. Demographic information was collected from each individual and an odontological assessment was performed to determine periodontal disease, exposed cavities, tartar, abscesses, halitosis and change of color in the mucosa. The oral health status of all individuals was determined by a dentist who performed a clinical examination of the entire mouth, which included inspection of the teeth, oral mucosa and periodontal tissues. All participants had normal oral mucosa and were free of unrestored cavity lesions. In most sites, the periodontal tissues showed no clinical signs of inflammation, such as redness, swelling or bleeding on catheterization and were considered free of gingivitis or periodontitis

Bacterial cultures were performed in the dental plaque and pharynx with sterile cotton swabs and nasopharyngeal culture with flexible calcium alginate swab (Calgiswab[MR]). All samples were included in Stuart transport medium and sent immediately to the laboratory, to be cultured and identify any bacterial development, according to the colonial morphology, microscopic and biochemical characteristics. [13-18]

Saliva pH was measured by indicator strips (Universalindikator MERCK[MR]), placing these between the anterior dorsum of the tongue for a few seconds, the result was interpreted as normal (pH 7) or altered (pH other than 7)

The results are expressed with simple frequencies and proportions. To compare the prevalence of colonization for respiratory pathogens, odontological abnormalities and the saliva pH of both groups, the Chi-squared test was used to calculate the odds ratios and confidence intervals, it was considered statistically significant if p was <0.5

Results

Two groups of 25 people were included in the study, according to the inclusion criteria forming a group of Hospitalized patients (Group I) and Non-hospitalized population (Group II). Table 1 shows the demographic characteristics of the study population.

In the oral examination, it was observed that the presence of exposed cavities, tartar and abscess was equally present in both groups (table 2).

The risk of periodontal disease was 5.5 times higher among hospitalized patients, the risk of halitosis was 2.2 times higher and the change in color of the mucosa was 5 times more in hospitalized individuals. The possibility of altered salivary pH was 3.9 more among hospitalized individuals.

A total of 150 bacteriological cultures were processed, the results of the study population are summarized in table 3. Bacterium identified and considered as pathogens were: *Escherichia coli, Klebsiella pneumoniae, Moraxella catarrhalis, Staphylococcus aureus,* Estafilococo coagulasa negativa, *Streptococcus pneumoniae y Streptococcus pyogenes,* they were isolated in both groups, but the possibility of having a pathogen in the dental plaque was 11 times higher in hospitalized individuals, there were no significant differences in the frequency of colonization for respiratory pathogens detected by nasopharyngeal and pharyngeal cultures.

Discussion

The composition of microbial communities in the human body varies among individuals. The knowledge about the different individual interrelations in the microbial flora of the human mouth and the uniqueness thereof compared to other microbial communities in our body is still quite scarce. The presence of potential pathogens[19] may be present in small amounts in dental plaque and yet this situation may be compatible with health.

A significant ecological pressure will be necessary for such pathogens and other members of the resident microbial flora to reach the levels necessary for the disease to be produced.

Other groups have reported the presence of respiratory pathogens from one or two sites within the mouth.[20]

In our country there are no published studies on the prevalence of respiratory pathogens in the mouth. It is however recognized that the pathologies most frequently associated with periodontal disease are: bacterial pneumonia, bronchitis, chronic obstructive pulmonary disease (COPD) and lung abscesses[21]. Based on studies reported in literature it appears that oral colonization of respiratory pathogens which are associated with nosocomial pneumonia and contribute to lung infections.

Our data suggests that the frequency of tartar and abscesses occur almost twice as frequently in group I, but nevertheless there are no statistically significant differences probably due to the sample size.

Disease periodontal, halitosis and the change in color of the mucosa were more frequent and statistically significant in hospitalized individuals probably due to poor hygiene during hospitalization.

As for the results of the pharynx and nasopharyngeal cultures of hospitalized patients it was observed that the difference in both groups was not statistically significant, as for the pharynx culture apparently there was the presence of pathogen agents in greater proportion in group II, but this difference was not statistically significant.

It is worth mentioning that the results of dental plaque were 11.2 times greater risk in hospitalized patients than in non-hospitalized (table 3); furthermore this difference in the risk of finding a pathogen agent in dental plaque of hospitalized patients makes them highly susceptible to autoinfections, source of transmission and generally represent a risk for nosocomial infections. A limitation of our analysis is that we did not carry out an adjustment of the colonization of dental plaque due to confounding factors, such as the pH of saliva and oral alterations, so therefore we may not discern if something as easy as dental hygiene in hospitals may prevent nosocomial infections or if these infections are prompted by additional factors.

There is good evidence of the relationship between stress and susceptibility to infectious diseases. The most common route of acquisition of infectious agents is through the adhesion and subsequent colonization of the mucous.[22]

Mucous secretory proteins, such as saliva, play a key role in the acquisition and regulation of oral microbial flora, in which among other factors, pH has an influence.[23,24]

We consider that in hospitalized patients (group I) most likely the mucosa is altered based on the measurement of pH and alteration of the bacterial flora. Thus, some microorganisms take advantage of this imbalance to adhere to the mucosa, as a first step in colonization and infection.

Based on the pH measurement, we consider that hospitalized patients have an altered oral mucosa, which makes the entrance of pathogenic bacteria that can cause nosocomial pneumonia easier.

Previously stress was considered as a cause of specific changes in the composition of the saliva[25], so far little is known about how, or even if, stress affects the processes involved in colonization as a first step in the infection.

However it is well known that the salivary secretion of these proteins is under strong autonomic control[26] and the composition of saliva is modulated by psychosocial stress, such as inpatient stay or the presence of any disease or condition, [22,27,28] thus providing a potential link between susceptibility to infectious diseases, through saliva pH, then the change in oral microbial flora and the absence of oral hygiene as happens in the hospitalized population.

Dental plaque is a typical example of biofilm, involved in the etiology of periodontal disease and cariogenesis associated with chronic inflammation, and local production of cytokines. The genetic and phenotypic versatility of biofilm cells represent a challenge for the discovery of new methods of treatment and prevention of biofilm associated infections.[29]

Daily oral hygiene is a part of the care of all hospitalized patients; doing so in a consistent manner in hospitals may actually decrease the risk of colonization by respiratory pathogens and of acquiring nosocomial pneumonia. Thus, future studies are needed to define whether daily oral hygiene in hospitalized patients would reduce the risk of nosocomial pneumonia.

The role of the odontology professional is to monitor patients and offer them the best recommendations for preserving oral health throughout their lives. With this in mind, chemical control should be indicated as part of daily oral hygiene, along with mechanical procedures for all individuals with supragingival and/or subgingival biofilm, taking into consideration their age, physical and/or psychological limitations, allergies, and other factors.

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Table 1.- Demographic characteristics of the population included in the study, from clinical healthy population and hospitalized patients in a Hospital of Mexico City.

Demographics		**Hospitalized GROUP I N=25 Percentage**	**Non-Hospitalized GROUP II N=25 Percentage**
Genre	Female	44	52
	Male	56	48
Occupation	Health employee	0	88
	General employee	28	4
	Housewife	36	4
	Laborer	16	0
	Unemployed	12	4
	No data	8	0
Education Level	Elementary School	12	4
	Middle School	40	24
	Technical School	8	28
	High School	12	4
	Bachelor's degree	12	36
	Postgraduate	0	4
	Other	0	0
	No data	16	0

Table 2.- Data obtained from the odontological examination performed to both study groups, as well as the statistical analysis of the related variables. From clinical healthy population and hospitalized patients in a Hospital of Mexico City.

		Hospitalized Group I N=25 Percentage	**Non-Hospitalized Group II N=25 Percentage**	**Risk**	**IC 95%**		**Chi-Square**	***p<0.05***
Periodontal disease	Present	68	28	5.4640	1.6270	18.3570	8.0128	0.0046
	Absent	32	72					
Exposed cavity	With cavity	40	40	1.0000	0.3225	3.1006	0.0000	1.0000
	Without cavity	60	60					
Tartar	With tartar	28	16	2.0417	0.5134	8.1186	1.0490	0.3057
	Without tartar	72	84					
Abscess	With abscesses	8	4	2.0870	0.1769	24.6149	0.3546	0.5515
	Without abscesses	92	96					
Halitosis	With halitosis	16	0	2.1905	1.5981	3.0024	4.3478	0.0371
	Without halitosis	84	100					
Change in color of the mucosa	With Changes	68	28	5.4643	1.6266	18.3565	8.0128	0.0046
	Without Changes	32	72					

Table 3.- Results of bacteriological culture of dental plaque, pharynx and nasopharynx performed on clinical healthy population and hospitalized patients in a Hospital of Mexico City.

Bacterial isolation	Hospitalized Group I				Non-hospitalized Group II			
	Dental plaque culture	Pharhyngeal culture	Nasopharyngeal cultures	Total	Dental plaque culture	Pharhyngeal culture	Nasopharyngeal cultures	Total
Normal microbial flora	8	8	6	22	21	6	5	32
Escherichia coli	1	0	0	1	0	0	0	0
Klebsiella pneumonia	0	0	2	2	0	0	1	1
Moraxella catahrralis	5	6	1	12	2	7	0	9
Staohylococcus aureus	3	4	3	10	1	4	8	13
Streptococcus pneumoniae	0	0	0	0	0	2	1	3
Staphylococcus negative coagulase	3	3	13	19	1	6	8	15
Escherichia coli + Staphylococcus aureus	1	0	0	1	0	0	0	0
Haemophilus influenzae + Klebsiella pneumoniae	1	0	0	1	0	0	0	0
Klebsiella pneumoniae +Escherichia coli	0	1	0	1	0	0	0	0
Moraxella catahrralis + Escherichia coli	0	1	0	1	0	0	0	0
Moraxella catahrralis + Staphylococcus aureus	1	1	0	2	0	0	0	0
Moraxella catahrralis + Staphylococcus negative coagulase	2	1	0	3	0	0	0	0
Streptococcus pyogenes + Staphylococcus negative coagulase	0	0	0	0	0	0	2	2