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Microbial Flora of Oral cavity

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Abstract

The oral cavity being the collection of variety of microbes, promotes the growth of microbial organisms, such as on the mucosa and teeth. These organisms are beneficial when present in right numbers. A delicate balance is maintained in the microbial ecosystem, with these organisms contributing to normal development and defenses. However, any change or disruption in the microbial profile due to any factors can result in an unfavorable shift toward pathogenic organisms triggering various diseases. The objective of the article is to benefit the student population as the concept of oral microbial flora has been put forward in a simplified format.

Keywords: Microbial flora, oral cavity, oral disease.

Microbial ecosystem in oral cavity

The mouth is a place of a huge, diverse microorganisms. More than 750 types of bacteria or phylotypes, of which

50% are not yet cultivated, are detected in the oral cavity. They developed mechanisms of host adaptation. But the human immune system constantly monitors their growth and reproduction, preventing their invasion of the surrounding tissue and the development of disease. In fact, there is a dynamic equilibrium between the bacterial community and the human immune system The oral cavity of the new-born is devoid of bacteria but is rapidly colonized with Streptococcus Salivarius. With the onset of the first teeth, Streptococcus mutans and Streptococcus Saguinis appear. Various anaerobes predominantly inhabit gingival sulcus, while Bacteroides and spirochaetes appear in the mouth during puberty. The dental plaque is a dense, non-mineralized, complex mass of bacterial colonies that live in a gel-intermixing matrix and adheres to the tooth. Contains bacterial cells, salivary polymers, and bacterial extracellular products.

Types of oral flora

Indigenous flora

It refers to the organisms' present > 1% of total viable count. They are in a compatible relationship with the host and do not compromise the survival of the host. E.g., streptococcus, Actinomyces &Neisseria

Supplemental flora

It refers to the organisms identified in a significant amount (< 1%) in certain individuals. Egg lactobacillus

Transient flora

This flora comprises of organisms that may be present in the oral cavity for very short periods (hours to days) of time.

Factors contributing to normal microbial growth

Anatomical

Shape, topography and malalignment of teeth, Poor quality of restoration, non - keratinized sulcular epithelium

Saliva

Adsorption of salivary glycoprotein results in formation of salivary pellicle which in turn facilitates bacterial adhesion, Acidic saliva promotes growth of cariogenic bacteria.\, It is a rich source of food

Gingival crevicular fluid(gcf)

GCF flushes microbes out of crevice, It also acts as a primary source of nutrients to the crevicular bacteria, Maintain pH of gingival crevice, It has specific and non-specific defense factors like IgG, Neutrophils involved in GCF are involved in phagocytosis

Microbial factors

There is competition for receptors among different microbes resulting in prevention of attachment by 'late comers', Production of metabolic end products by certain bacteria lower the pH, some bacteria use the metabolic end products of other bacteria for nutritional purposes, Coaggregation of same or different species e.g., bacteria-corn-hub formation[2]

Miscellaneous factors

Local Environment Ph, Oxidation-reduction potential, antimicrobial therapy, Diet, Iatrogenic factors, Diurnal variations, Drugs, Extraction of teeth, Intraoral appliance[2]

Role of dental plague

The oral cavity houses various habitats for microorganisms like, the mucosal surfaces (such as the lips, cheek, palate and tongue) and teeth which support the growth of microbial communities.6 Dental plaque is the community of microorganisms found on a tooth surface as a biofilm. Plaque formation is a normal phenomenon which contributes to the host's normal development and defenses. Problems arise as a result of disruption in the homeostasis existing between microbial communities in the plaque. Two common examples

explaining this imbalance are dental caries and periodontal disease. In the former a change in the nutrient status like excess carbohydrates (increased supragingival plaque) results in the balance tilting toward more aciduric and acidogenic bacteria (e.g., Streptococcus mutans) to thrive, resulting in the disease. In the latter, accumulation of plaque, due to poor oral hygiene can result in deepening of pockets, creating anaerobic environments, thus favoring the proliferation of pathogenic bacteria (anaerobic species like Fusobacterium, Prevotella) leading to periodontal disease. Thus, any change in the dynamics within this ecosystem can alter the flora, increase its potential pathogenicity, and subsequently initiate and promote oral diseases.[1]

Plague related disease- 'periodontitis and periimplantitis '

Periodontitis

Periodontal disease affects the great majority of the adult population an. Teeth are the ideal substrate for plaque formation because of their non-exfoliating surfaces. Chronic Periodontitis is defined as an infectious pathology leading to slow or moderately slow, progressive loss of attachment and bone. It occurs mainly in adult patients in either a localized or generalized form but can nonetheless affect children and adolescents. Predisposing factors such as cigarette smoke, stress and local (e.g., tooth-related, or iatrogenic) or systemic (e.g., diabetes mellitus or HIV infection) conditions can enhance the destructive effects of the microbiota. Aggressive Periodontitis, on the other hand, is characterized by rapid loss of attachment and bone destruction in otherwise clinically healthy patients and presents familial aggregation.

Secondary features are represented by: High levels of A. actin omycetemcomitans and, in some subjects, P. gingival is in the associated plaque, Discrepancies between plaque deposits and severity of attachment and bone loss, Abnormalities in the host response, such as decreased PMN chemotaxis due to lower levels

Periimplantitis

Peri-implantitis can be considered the "twin-sister" of periodontitis, even though some important differences between natural teeth and dental implants must clearly be borne in mind, the most important being that implants are not surrounded by periodontal ligament and therefore present different biomechanics and defensive cell recruitment.

Biofilm

Bacteria colonize the oral cavity soon after birth and form organized, co-operating communities called biofilms within specific ecological niches, for example, the tongue, tooth, subgingival sulcus, tonsil and buccal mucosa. These biofilms allow the bacteria to live in a nutrient-rich environment that is protected from environmental insults, antimicrobial agents and frictional forces. These biofilms perform two important functions e (i) they prevent pathogenic colonization and (ii) they educate the immune system to recognize 'friend and foe'. In a state of health, equilibrium exists between biofilm antigens and toxins and the host immune response.[4] Inclusion in a biofilm brings about profound changes in microorganisms, which may therefore exhibit important differences from their planktonic counterparts, including physiological properties, susceptibility to antimicrobial agents, interaction with host tissues and immunological response. Initially, the aspecific plaque theory dominated, but later it became evident that every biofilm differs from others, and that only the selection of

some specific species can lead, under certain circumstances, to disease.

Clinical gingivitis is associated with the development of a more organized dental plaque. The species involved vary depending on local environmental characteristics, but the colonization pattern is always the same. The shift from gingivitis to periodontitis does not come about automatically, either in every patient or every site, but depends on three main factors: host susceptibility, pathogenic bacteria and "protective bacteria".

Dental caries

Dental caries is a chronic disease that progresses slowly in most individuals and is characterized by localized destruction of the tooth following long contact/ interaction with acidic products that result from the bacterial fermentation of dietary carbohydrates.[1] The most common chronic infectious disease, bacteria as main pathogen. It can lead to chronic and progressive destruction of dental hard tissue under many factors. Have a wide range and high incidence. Occur at any age. And the early childhood caries is the most harmful and has become a prevalent public health problem among preschool children globally, which it has many factors influence the incidence of, including oral microbiome[3].

Microflora alteration can cause a disease. The normal microflora usually consists of non-mutans streptococci like the salivarius group (e.g., Streptococcus salivarius) on the root surface, mitis group (e.g., S. sanguis) in the pit and fissures and also a small number of microbes of the mutans group (not enough to induce caries). .[3] As the supragingival plaque accumulates or if there is an increased supply of carbohydrates, an acidic and anaerobic environment is created. The normal flora adapts to this change in the environment and can become aciduric. These conditions now become more favorable for aciduric organisms like mutans streptococci thus demineralizing the tooth surface. [1]

Periodontal diseases

The subgingival crevice is flooded with gingival crevicular fluid (GCF) which creates a neutral/alkaline environment due to the presence of nitrogenous compounds, such as amino acids, peptides and proteins.[1] Periodontal diseases frequently occur in human mouth, and can be divided into two categories, gingival diseases and periodontitis. It cause destruction of periodontium (tooth-supporting tissues such as gingiva and alveolar bone) and constitute a potential risk factor for certain systemic diseases.[3] As the gingival sulcus deepens, this environment is established and under these conditions, a saccharolytic and anaerobic and/or proteolytic bacteria, such as Fusobacterium, Eubacterium, Campylobacter, Prevotella and Porphyromonas are found. Proteolytic bacteria can degrade nitrogenous compounds into small peptides and amino acids by cell membrane-bound and/ or extracellularly secreted proteases, for subsequent use as metabolic substrates. These enzymes secreted by the micro-organisms for degrading the nitrogenous compounds, induce inflammation and immunoreactions [1]. The red complex bacteria, Fusobacterium nucleatum (F. nucleatum) were the most prevalent with very high levels in all groups.

The green and blue complex bacteria were less prevalent compared with red and orange complex, except Aggregatibacter actino my cetemcomitas was detected in all localized aggressive periodontitis groups.[3] P. intermedia and F. nucleatum are capable of growth at acidic and neutral pH, and are frequently found in supragingival plaque. In addition, P. intermedia and F. nucleatum are capable of neutralizing the acidic environmental pH by changing the acid-base balance

through amino acid metabolism. F. nucleatum and P. Intermedia colonize a shallow gingival pocket (where the pH is variable and sometimes becomes acidic) and then promote the establishment of a neutral pH environment. This induces inflammation and an increase in GCF, inducing and promoting the growth of more proteolytic bacteria like P. gingival is, and enhance the pathogenicity of P. intermedia through the increase in proteolytic activity and cytotoxic end products.[1]

Cross-sectional studies have demonstrated that dentate patients, those with poor oral hygiene, and those who do not regularly visit their dentist are more likely to develop pneumonia, suggesting a potential link between poor oral health and lung disease Dental plaque of hospitalized subjects with pneumonia has been shown to be a reservoir for P. aeruginosa . Thus, there appears to an association between periodontal pathogens and the incidence of cardiovascular disease.[3]

Lactobacillus

Absent from oral cavity of new born appear during first year of life. Their presence of depends of numerous factors such as presence of ecological niches e.g., natural anfractuosities of the teeth,42.3% came from tongue 11.8% from gums and species L. fermentum and L. plantarum are predominant on tongue; L. rhamnosus is predominant on gum.[2] A correlation also exists between Lactobacillus rates in dental plaque and in saliva. One factor that could influence the rate of salivary lactobacilli during childhood is the carbohydrate intake. Higher counts have been found in subjects harbouring removable prostheses and in subjects consuming a lot of medicine. On the other hand, a low level of Lactobacillus count seems to indicate, with a good probability, a low carious activity. The clinical significance of the Lactobacillus count is also more reliable when applied to huge samples than to one person. Actinomyces species promoted growth of key Lactobacillus species in a biofilm, as did S. mutans to a lesser extent, and that the ability of individual bacteria to form mono-culture biofilms is not necessarily an indicator of their survival and pathogenic potential in a complex multispecies biofilm community.[9]

Endodontic infections

The microbial flora of root canals has been studied extensively over the years, by using different sampling techniques and identification method [1.] Infected root canals are colonized by a consortium of bacterial species. Certain Streptococcus spp. persists in treated root canals. Diversity of bacterial species across geographical locations has confirmed that there are shared, location specific and exclusive bacterial species.[5.]

Candidiasis

Candidiasis or oral candidosis is one of the most common human opportunistic fungal infections of the oral cavity[13.]Candidiasis is caused by a yeast like fungus, Candida albicans. Other species like C. tropicalis, C. Para psilosis, C. stellatoidea and C. krusei may also be involved (Table 5). Candida is a component of the normal oral microflora, with 30 to 50% of people carrying it in their oral cavity and is kept under control by means of specific and nonspecific defense mechanisms and also by the competition of the microbes in the normal flora. Colonization in the newborn occurs from the mother's vaginal flora or other exogenous sources. Most people usually carry a distinct strain of Candida and the colonizer is usually the culprit (infecting strain) if at all infection occurs[1.]

Conclusion

Oral microbial flora, beyond doubt, have a very important role to play in maintenance of homeostasis of the ecosystem in the oral cavity. It is crucial for clinicians to be aware of this fact and they should focus their treatment toward control of this flora rather than eliminating it. A thorough knowledge of the normal and altered flora and the mechanics behind how the change can happen and what it might lead to would give us a fair idea of how various oral diseases could be controlled and preventive strategies be developed.[1]

Despite the large bacterial flora that inhabits the oral cavity, microbiological diagnosis of oral disorders remains largely confined to research laboratories. However, advances in technology indicate that some of the traditional as well as novel techniques could readily be employed to aid clinicians at point of care. Comprehensive and miniaturized kit-based methods of traditional microbiological testing methods, could help identify pathogen(s) even by novices with a basic knowledge in microbiology.[5]

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