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Oral Micro Flora and Streptococcus Mutans- Culture, Pathogenicity and Virulence

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Abstract: Oral microrganisms such as bacteria, fungi, virus and protozoa are associated with various oral diseases.When the bacterial molecules adsorb onto the tooth surface a so-called acquired film is formed called biofilm.From the nidus bacteria and bacterial products are propogated to distant parts to cause disease in these organ systems. Streptococcus mutans is a gram positive facultative anaerobic bacterium belonging to a group of mutans streptococci which consists of S.sobrinus and several other species.S. mutans species members also have adhesins on their surface that help mediate binding to salivary glycoproteins and bacteria derived salivary components. S mutans is actively associated with dental caries.
Search Strategy: Medline, Pubmed, Ebsco, Google Scholar were searched using the following terms in different combinations. Oral microflora, S.mutans, .microbiome, virulence, adhesins, pathogenicity

Keywords: Oral microflora, S.mutans, .microbiome, virulence, adhesins, pathogenicity

Introduction:

Oral cavity serves as a home to several million bacteria. Oral microrganisms such as bacteria, fungi, virus and protozoa are associated with various oral diseases. Bidirectional communications and regulatory mechanisms during a person's life maintains a homeostatic balance in the oral cavity. But the dysbiosis of oral microbiota can cause oral infectious diseases such as caries, periodontal disease and oral candidiasis.[1]

What is Biofilm?

There are several stages in the formation of Biofilm. In the beginning when the host and bacterial molecules adsorb onto the tooth surface a so-called acquired film is formed. This film allows the microorganisms which have been passively transported there to interact with it by means of forces of attraction of Van der Waals and electrostatic forces of repulsion thus creating a weak bond. This bond is lateron reinforced by the appearance of strong interaactions mediated by specific

molecules on the surface of the bacteria (adhesins) with complementary receptors of the dental films. Specifically the early early colonizers are saccharolytic aerobes and facultative anaerobes which depend on their survival on glycoproteins and salivary mucins. The 80% of early colonizers are streptococcus species. New colonizers co-aggregate over time and multiply which enables the bacteria to adhere firmly to dental surfaces. When the process of initial colonization takes place the surface attached bacteria change their metabolic and gene expression profiles to produce and search EPMs which for oral biofilms is made up of polysaccharides , proteins, lipids and extracellular DNA(e DNA). Thus , the clinical expression of the different periodontitis syndromes will depend on the interaction between host related factors, the environmental factors and microbiological agents.[2,3]

What is Microbiome?

The microbial resident community in our body is called the Microbiome. Joshua Ledereberg a nobel prize winner coined the term ‘‘Microbiome’’ to describe the ecological community of symbiotic, commensal and pathogenic microorgaanisms.
Antony Van Leeuwenhoek who first identified microbiomes was called father of microbiology and a pioneer who discovered both protists and bacteria. In 1974, he observed his dental plaque and reported them as living animalcules prettily moving.[4]

Oral Microflora in Health

Types of Oral Flora-

Indigenous Flora- This type of flora is in a compatible and symbiotic relationship with the Host. It does’nt allow the pathogenic bacteria to grow. In general, these microorganisms are present in greater than 1% of the total viable count. They are present on the surface of tongue or supragingival plaque.

Supplimental Flora- They are present in a significant amount but less than 1%. Microorganism such as Lactobacillus is present in low level in plaque 0.00001 to 0.001% of the viable flora. In a carious lesion when pH is acidic ,Lactobacillus being acid tolerant multiplies and becomes the dominant microorganisms.

Transient Flora- Such kind of bacteria are usually present in immune compromised patients, as the immunity lowers they become opportunistic and multiply, although they may be present in the oral cavity for a short period.[5]

The principal bacterial genera found in the healthy oral cavity are as follows-

I.**Gram positive**

1. COCCI: Abiotrophia Peptostreptococcus, Streptococcus, Stomatococcus
2. RODS: Actinomyces , Bifidobacterium, Corynebacterium, Eubacterium Corynebacterium, Eubacterium, Lactobacillus, Propionibacterium, Pseudoramibacter, Rothia.

II. **Gram negative:**

1. COCCI: Moraxella, Neisseria, Veillonella
2. RODS: Campylobacter, Capnocytophaga, Desulfobacter, Desulfovibrio, Eikenella, Fusobacterium, Hemophilus, Leptotrichia, Prevotella, Selemonas, Semonsiella, Treponema, Wolinella.[6]

Focus of Infection:

Nidus or a localized lesion which is clinically asymptomatic and contains pathogenic bacteria. From this focus bacteria and bacterial products are propogated to distant parts to cause disease in these organ systems. [7]

Streptococcus Mutans

In 1924, J. Clarke isolated an organism from carious lesion and called it Streptococcus mutans. The oval shaped cells observed were mutant form of streptococci. In 1950, S.mutans gained widespread attention in scientific community. Lateron in mid 1960, various clinical and animal studies were carried out which confirmed S.mutans as an important etiologic agent in dental caries. The S.mutans usually occur in dental plaque, a multispecies biofilm formed on hard surfaces of the tooth.[8]

Microbiology:

Streptococcus mutans is a gram positive facultative anaerobic bacterium belonging to a group of mutans streptococci which consists of S.sobrinus and several other species. Morphologically the colonies of S.mutans are rough when grown on plates with MitisSalivaraious agar, a selective medium for mutans streptococci. Streptococcus mutans is classified into serotypes c,e,f,and k with serotype c being the most common type in the oral cavity. [9]

Arrangement- usually occurs in pairs or as short to medium length chains. In rod-shaped bacteria this type of arrangement is because of presence of successive division planes that are parallel to one another.

The Streptococcus mutans cell wall consists of the murein which is a peptidoglycan and gives shape to cell wall. An interwoven complex is formed by various carbohydrate structures such as Teichoic acids and number of proteins. The primary carbohydrate of the cell wall is Rhamnose and Glycine is the major amino

acid. Cell membrane consists of typical lipid protein bilayer, composed of mainly phospholipids and proteins. S. mutans species members also have adhesins on their surface that help mediate binding to salivary glycoproteins and bacteria derived salivary components.[8]

These adhesins help recognize extracellular matrices and serum components, particularly fibronectin and plasminogen as well as host and other microbial cells.

Temperature: These organisms grow at average body temperature of the host but it is known to survive in a temperature range of 18 – 40 degree centigrade.

CULTURAL CHARACTERISTIC OF STREPTOCOCCUS MUTANS

On ordinary nutrient media its growth is low, but grows profusely on media enriched with blood, serum or fermentable carbohydrates. Selective Streptococcus agar is best.

1. Nutrient Agar- colonies occur in white to grey colour. Size 1mm in diameter. Usually poor growth.
2. SUCROSE AGAR: Growth on sucrose agar produces rough, heaped colonies about 1mm in diameter.
3. BLOOD AGAR: After incubation anaerobically for 2 days on blood agar growth of colonies is white or grey , circular or irregular in 0.5- 1.0 mm in diameter.[9]

Virulence Factors of Streptococcus Mutans:

1. Biofilms- The process of biofilm formation in S.mutans occurs by one of two mechanisms

   Sucrose Dependent: In sucrose dependent mechanism the glucosyltransferase produced plays an important role.

   Sucrose Independent: in this mechanism bacterial adhesion occurs as a result of an interaction between the adhesive proteins and S.mutans and the agglutinins present in the saliva.
2. **Acid Tolerance**- S. mutans produce large quantities of glucans as well as acids which aids in the virulence factor of the organism. In S.mmutans the ability to tolerate acids is due to the F1FO-ATPase proton pump. The synthesis of water insoluble glucan and formation of biofilms aids in acid tolerance.
3. **Carbohydrate Metabolism**: The sucrose, glucans and other carbohydrates that are considered potential virulence factors , proteins such as fructosyl transferase(Ftf), a fructanase (FruA) an extracellular dextranase (DexA) and other proteins responsible for intracellular polysaccharide accumulation.[10,11]

Conclusion:

Streptococcus mutans is a very selective microorganisms. It is at times difficult to culture this mictoorganism in laboratories due to its specifications. Streptococcus is associated with dental caries and lactobacillus is associated with dentinal caries. Hence it is very essential to understand the behavior, culture characteristics, pathogenicity and virulence of S.mutans.

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