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Microbiology of Periodontal Diseases

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Abstract

The term periodontal disease refers to gingivitis and periodontitis as well. Gingivitis is a reversible dental plaque induced. Periodontal diseases are destructive and inflammatory diseases of the dentogingival associated with periodontal pathogens of some specific Gram-negative microorganisms in the sub-gingival biofilm. Other microorganisms have been implicated as predominant species as Aggregatibacter, actinomycetemcomitans, Fusobacterium, nucleatum, Campylobacter rectus, Peptostreptococcus migros, Eikenella corrodens. In periodontitis, colonization of pathogen occur in the tissues then invasion of pathogenic products into the periodontal tissues then interactions of bacterial substances with host cells causing degradation and tissue destruction of the periodontium. Besides pathogenic microorganisms, genetic and environmental factors contribute to the development of this disease. The objective is to provide an overview of periodontal disease, as well as the microbiology aspects of this worldwide prevalent oral infection.

Keywords: Microbiology, Periodontal, Diseases

Introduction:

Periodontal diseases are chronic infectious disorders caused primarily by bacteria, (Albandar,2002) includes any inherited or acquired disorders of the tissues that are investing and supporting the teeth; gingiva, cementum, and alveolar bone, (Pihlstrom et al.,2005). Nowadays ubiquitous among children, adolescents, and adults, (adolescent,,2005). Periodontitis by bacterial infections can be defined as a chronic inflammatory disease initiated by dental plaque biofilm and perpetuated by a deregulated immune response (Suvan et al., 2011), it usually accompanied by gingivitis resulting in irreversible destruction of the supporting tissues surrounding the Periodontitis caused by both pathogenic microflora and abnormality in host defense mechanisms. The microbiological picture of gingivitis in children and adolescents has not been completely characterized, Aggregatibacter sp., Leptotrichia sp,

Actinobacillus, Capnocytophaga sp., have been found in experimental studies (Clerehugh et al., 1997; *forsythensis*,2004; Pinkham et al., 2005).

Periodontitis generally is defined as a condition where the supporting tissue of the teeth is destroyed (Reeves et al., 2006) and which leads to gingival recession (Saini et al., 2010), gingivitis (Lopez et al., 2005), loss of alveolar bone or teeth at the last stage of periodontal disease (Nesbitt et al., 2010), besides the loss of gingival collagen (LeRoy et al., 2010) and degradation of the periodontal ligament (Bonifait and Grenier, 2010). The hard and soft tissues of the oral cavity are colonized by bacterial biofilms composed by proteins epithelial cells, food residues, enzymes, plus different species of bacteria responsible for causing dental caries and periodontal disease (Bonifait and Grenier 2010). The gingiva, periodontium, alveolar bone and cement are structures that provide support to the tooth. Any pathological process affecting periodontum is defined as periodontitis. For a long time, it was thought that gingivitis and periodontal disease appeared as a result of aging of the periodontal tissues that gave rise to inflammation and recession of the gingival tissues bone and finally tooth loss. However, several studies have indicated that this is not just an adult disease, but also appears frequently in children (Escudero et al., 2008). Many studies illustrate the unique infectious nature of chronic periodontitis and aggressive periodontal diseases**,** periodontal diseases initiated by a limited number of periodontal pathogens in the complex dental biofilm, Most of the periodontal pathogens are anaerobes equal proportions of Gram- positive (56 %) and Gram-negative (44 %)

species; 59 % are facultative anaerobes and 41 % obligate ones. Biofilm can harbour facultative aerobes, capnophiles and microaerophiles whose number depends on the environment in the developed biofilm and periodontal pocket. Most periodontal pathogens represent the true periodontal infection. Some bacterial species in the periodontal environment that are part of the commensal flora; Actinomyces, certain Streptococcus and Staphylococcus spp., certain enterobacteria, viruses and Saccharomyces spp. Bacterial species should be able to colonize the subgingival area, to produce virulence factors directly Includes enzymes and toxins or indirectly which are antigens and activators lead to initiation of a destructive inflammatory reaction in of the periodontal tissues , (Pihlstrom et al., 2005). Although results relate to the presence of certain periodontopathogens with fixed periodontal status, there is still no convincing evidence for the specificity of bacterial species in different periodontal diseases.

While localized periodontitis is strongly associated with the presence of Actinobacillus (Haemophilus) actinomycetemcomitans and Capnocytophaga and Eikenella corrodens, for the major part of periodontal diseases there is no correlation with a definite composition of the bacterial flora. Interbacterial relationships have been observed in mature biofilms. Three types of positive relationships are known (symbiosis): mutualism, synergism, and commensalism. Mutualism is a symbiosis in which the bacterial species have equal benefit from their coexistence Porphyromonas gingivalis,Treponema. Synergism as in Porphyromonas gingivalis. commensalism is a bacterial interaction that favors one of the two species Porphyromonas gingivalis and Campylobacter rectus.Negative interactions between bacterial species exist in the form of antagonism (Streptococcus mutans and Aggregatibacter, Streptococcus sanguis and competitive relations ; Gram- positive Actinomyces, Streptococcus mutans, Streptococcus mitis, Corynebacterium sp. According to haffajee and Socransky classification of the pathogenic bacteria according to the strength of their relationship to periodontal disease. Many different bacterial species live in the healthy gingival sulcus and are present in different periodontal diseases. the bacterial flora associated with healthy periodontal tissue contains mainly Gram-positive microorganisms with a dominance of Actinomyces and Streptococcus spp. There is a balance between “beneficial” and “pathogenic” in the subgingival flora species in inactive sites. Some of the studies, using different microbiological techniques to determine the effect of different periodontal therapies on the sub gingival micro biota, are described, (Teles et al., 2006).

Bacterial species	Complex
Actinomyces Veillonella	Purple
Streptococcus: gordonii, intermedius, mitis,	Yellow
Capnocytophaga	Green
Campilobacter rectus	orange
T. denticola	Red

The importance of all identified periodontal bacteria in different periodontal diseases is not well understood, but these bacteria can act in different ways: by passively occupying the niches; by limiting the ability of a periodontal pathogen to adhere to appropriate tissue surfaces; by enhancing the vitality and growth of a pathogen; by enhancing the ability of a pathogen to produce virulence factors; some of the beneficial microorganisms can produce anti-periodontal pathogen factors (Streptococcus sanguis produces hydrogen peroxide H_2O_2, which either directly or by host-enzyme amplification can kill Actinomycetemcomitans), (Albandar,2002).

There is evidence that gingivitis-associated microflora: Periodontal diseases are most commonly caused by pathogenic microorganism specially Gram-negative bacteria and anaerobes in subgingival plaque, (Ximénez-Fyvie et al.,2000;Teles et al., 2000), in the oral biofilm or dental plaque and these pathogenic microorganism accumulated around the teeth due to poor oral hygiene, (adolescent,2002); Pinkham et al.,2005) Actinobacillus, Porphyromonas gingivalis, Tannerella forsythensis, and spirochaete Treponema denticola are the most periodontal gingivitis microflora, (forsythensis,2004)]. Recently, Candida albicans, and Herpes viruses (Robinson,2002) beside genetic, developmental, traumatic, neoplastic, and metabolic factors, (Clerehugh and Tugnait,2001). Furthermore, some systemic diseases and medications also have periodontal manifestations, (Pinkham, 2005 & Pihlstrom, 2005).

Effect of periodontal treatment on the subgingival microbiota. The long-term objective of the work described in this issue of Periodontology 2000 is to improve the diagnosis, treatment and prevention of periodontal infections. This will not be an easy process. Earlier papers in this issue of Periodontology 2000 describe the complexity of subgingival biofilms, their plasticity, in terms of changing in response to their environment, and the probability that the clinician will have to control multiple species in biofilms of different individuals or even in the same individual.

Main methods for microbiological diagnosis as shown in table:

Method	Description
Bacterial Culture	Currently the gold standard.
Immunological diagnostic methods	Immunofluorescence (Direct&Indirect). Flow cytometry Latex agglutination Enzyme-linked immunoabsorbent assay (ELISA)
Enzymatic detection methods	Bacterias don't detect directly, can detect by enzymes that bacterias produce.
Molecular biology techniques PCR	Polymerase chain reaction (PCR): amplifies DNA strands.

Improve the diagnosis, treatment and prevention of periodontal infections need long-term work, and not be an easy process. Earlier papers in this issue of Periodontology 2000 describe the complexity of subgingival biofilms, their plasticity, in terms of changing in response to their environment, and the probability that the clinician will have to control multiple species in biofilms of different individuals. The overwhelming majority of patients with chronic periodontitis, despite their diverse oral microbiological profiles, respond remarkably well to traditional mechanical methods of periodontal treatment. For these patients, a sustainable reduction in the total level of periodontopathogenic bacteria in their pockets, through professional and personal plaque control, is usually adequate to stop the progression of the disease. However, there are some patients who do not respond well to traditional periodontal therapy. These patients are sometimes referred to as refractory to treatment. They continue to lose clinical attachment despite having received periodontal therapy that succeeds in most patients. Conceptually, patients with chronic refractory periodontitis have a persistent infection that will most likely require diagnostic and treatment approaches beyond those that have already been tried.

One of these approaches follows a medical model where microbiological testing is performed on a clinical sample, putative pathogens are identified, and an appropriate antibiotic is administered. These tests provide information that can help guide the clinician in determining whether or not an antimicrobial agent, and which particular one, may provide an additional therapeutic benefit for the patient. The utility of these tests for patients who have not responded to conventional therapy.

Discussion:

Periodontal pathogen is one of the etiological agents of periodontal diseases,

Onset of disease will occur when all minimal conditions of the sufficient cause have taken place. These concepts agree with our understanding of periodontal diseases as multifactorial as the virulent periodontal pathogen, local environment, host susceptibility, host resistance. The concept of multiple causes is clearly not unique to periodontal diseases. The model described above for sufficient causes for periodontal tissue destruction. Periodontal diseases are specific bacterial infections several researchers had a different interpretation of the apparent lack of correlation between the amount of plaque accumulation and periodontal tissue destruction. Most dentists have seen patients with dirty mouths with periodontal disturbances. In addition, cases of acute necrotizing ulcerative gingivitis and localized juvenile periodontitis where associated with distinctly different sub gingival micro biotas, aggressive periodontitis, gingival inflammation. Microorganisms responsible for destructive periodontal diseases was interrupted in the field of periodontal microbiology. By research in periodontal microbiology that focused on understanding the role of the many species that colonized the subgingival environment in health and disease. Several periodontal pathogens were identified, with the designation of Actinobacillus actinomycetemcomitans (currently Aggregatibacter actinomycetemcomitans), Porphyromonas gingivalis and Tannerella forsythia as periodontal pathogens Difficulties in determining the role of specific components in the subgingival microbiota include: diversity of microbial taxa that found in subgingival environment,difficulties in obtaining a representative sample, identification of active sites that are undergoing tissue destruction and understanding that periodontal diseases are mixed infections with pathogens, (Haffajee & Socransky, 1994. Set of criteria helped to define subgingival bacterial species as periodontal pathogens, as association; elimination; host response; virulence factors.

Recently, some studies showed certain families of virus and periodontal disease, (Contreras et al. 2000) like Epstein-Barr type 1, cytomegalovirus and human herpes Nigerian children with necrotizing ulcerative gingivitis.

This pathogenicity is attributed to the degradation of the host defense mechanisms due to viral infection of the gingiva, (Ling et al., 2004). Only about 50 species are strongly related to periodontal disease (Colombo et al., 2009) but their virulence and immunobiology are still unknown. Bacteria are responsible for stimulating the host response, which define tissue changes causing periodontal lesions (Ling et al., 2004). Such bacteria are in communities within a glycocalyx forming a biofilm, which allows microorganisms to join and multiply on different surfaces (Lamont et al., 2013). The biofilm protects the microorganisms from toxic substances in the environment; it also facilitates the uptake of nutrients, the development of an appropriate environment with suitable physicochemical condition for their growth (Socransky and Haffajee, 2002).

The information of microbiological analysis from a periodontally diseased site is dependent on the sampling technique. There are two primary methods that can be collected for subsequent analysis: removal using curets or adsorption onto endodontic paper points. Both require careful removal of supragingival plaque at the site prior to sampling in order not to contaminate or dilute the subgingival sample. Culture methods are considered the gold standard method for microbiological identifIcation. Despite our inability to grow all microorganisms, the technique is available for the positive identifIcation of many putative periodonto-pathogenic microorganisms through the use of selective and non-selective mediaand other biochemical criteria, (Tempro,1988). Culturing has one unique advantage over the other microbiological identifIcation methods, it permits the assessment of antibiotic sensitivity. However, it also has some signifIcant limitations, including its inability to detect low levels of microorganisms, high cost, labor intensiveness, prolonged period of time before results can be obtained and inability or difflculty in growing several bacterial species, (Chan et al.,1993). Numerous clinical studies have utilized microbiolo- gical diagnostic testing as part of their experimental protocols. For the most part, the studies have con- sisted of non-controlled case reports or case series. In these studies, microbiological testing was per- formed for several reasons including as an aid in treatment planning and as an outcome variable when monitoring patient response to therapy.

There have not yet been any controlled clinical trials exam- ining the utility of microbiological diagnostic tests in the treatment or monitoring of periodontally diseased subjects.

The studies that have been carried out thus far have examined subjects with most types of periodontal diseases, including chronic per- iodontitis, (Haffajee et al.1995.) aggressive periodontitis, refractory chronic periodontitis, (Fine,1994),and systemic disease associated periodontitis. Microbiological diagnostic tests have also been made use of in clinical studies evaluating peri-implant infections, (Rosenberg and Torosian,1991).

Conclusion

It is important to perform both qualitative and quantitative determination of well-known periodontopathogens in the periodontal pockets and prediction of the disease progression would allow targeted preventive therapy. The term periodontal disease refers to gingivitis and periodontitis as well. The gingiva, periodontium, are structures that provide support to the tooth. Any pathological process affecting periodontum is defined as periodontitis. For a long time, it was thought that gingivitis and periodontal disease appeared as a result of aging of the periodontal tissues that gave rise to inflammation and recession of the gingival tissues bone and finally tooth loss. However, several studies have indicated that this is not just an adult disease, but also appears frequently in children (Escudero et al., 2008). Infectious diseases have in common, the fact that they are necessarily associated with the presence of bacteria that colonize the sub gingival niche (Escribano et al., 2005). The mouth facilitates the growth of a characteristic resident microbiota. The composition of the oral microbiota is influenced by temperature, pH and atmosphere, as well as by the host defences and host genetics (Marsh and Devine, 2011). The subgingival microbiota involved in periodontal disease has been a mayor research topic for more than 40 years (Contreras et al., 2000). Gingivitis is a reversible dental plaque induced inflammation of the gingiva, is a common occurrence in children as young as 5 years old. Periodontitis, which is bacterially induced, can be defined as a chronic inflammatory disease initiated by dental plaque biofilm and perpetuated by a deregulated immune response (Suvan et al., 2011) usually accompanied by gingivitis resulting in irreversible destruction of the supporting tissues surrounding the tooth, including the alveolar bone (Yamamoto et al., 2011).

Periodontitis generally is defined as a condition where the supporting tissue of the teeth is destroyed (Reeves et al., 2006) and which leads to gingival recession (Saini et al., 2010), gingivitis (Lopez et al., 2005),

Loss of alveolar bone or teeth at the last stage of periodontal disease (Nesbitt et al., 2010), besides the loss of gingival collagen (LeRoy et al., 2010) and degradation of the periodontal ligament (Bonifait and Grenier, 2010). The hard and soft tissues of the oral cavity are colonized by bacterial biofilmscomposed by proteins epithelial cells, food residues, enzymes, plus different species of bacteria responsible for causing dental caries and periodontal disease the identification of subgingival pathogenic strains in gingivitis and periodontitis could aid in the better differentiation of the different periodontal diseases, (Bonifait and Grenier 2010). Varies microbiological diagnostic tests are able for clinicians to use for evaluation of patients with periodontal disease. Each one has its own unique set of advantages and disadvantages, and probably the most useful information for the clini-cian can be obtained using a combination of the various analytic methods. The major limitation of all microbiological tests is that the information obtained is relevant to the site sampled, and may not be representative of the microflora of the entire dentition. However, since it is often only specific sites that do not respond to initial therapy, knowing the constituents of the microflora that populate these sites is clinically relevant.

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