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REVIEW ARTICLE **OPEN ACCESS**

Dental Caries Markers-A Review

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ABSTRACT
Dental caries is a multifactorial infectious disease that affects a large proportion of the world's population. Cariogenic microorganisms in the biofilm ferment dietary carbohydrates to produce acid, resulting in mineral loss from tooth hardness as a result, destruction of the tooth structures. The interaction of microorganisms, diet, and host susceptibility determines whether the presence of Caries in the teeth or not. Because teeth are constantly bathed in saliva, the constituents and properties of this oral fluid play an important role in the maintenance of teeth. Dental caries occurrence and progression one of the most important host factors is saliva, which is thought to be one of the most important host factors.as well as an important mediator in controlling the speed and the cariogenic pathway's direction.
KEY WORDS: Dental caries, Biofilm, Caries markers, Oral fluid, Multifactorial disease

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INTRODUCTION

Dental caries is one of the most common chronic infectious diseases in preschool-aged children, characterized by the destruction of tooth tissues as a result of synergistic complex effects between acids produced by bacteria during the fermentation of dietary carbohydrates and susceptible host factors such as teeth and saliva. Because teeth are constantly bathed in saliva, the constituents and properties of this oral fluid are crucial in the development and progression of dental caries. Saliva is thought to be one of the most important host factors, as well as an important mediator in controlling the speed and direction of the cariogenic pathway [1]. Saliva may protect teeth through a variety of mechanisms, including the removal of food debris and sugar, the aggregation and elimination of microorganisms, buffering actions to neutralize acid, the maintenance of supersaturation with respect to tooth mineral, participation in acquired enamel pellicle formation which slows demineralization during acid attack, and antimicrobial defence[2,3]. Many measurable salivary characteristics are potential biomarkers for dental caries. These salivary biomarkers is being used to predict, diagnose, prognosis, and manage dental caries, as well as to assess the efficacy of therapeutic regimens. The purpose of this narrative review is to provide an overview of current knowledge about salivary biomarkers for dental caries.

MICROORGANISMS IN SALIVA AS BIOMARKERS OF CARIES

Because caries is an infectious disease, the colonisation, proliferation, and metabolism of cariogenic (aciduric and acidogenic) bacteria have been widely used to identify caries-prone individuals.Whilethe'specific plaque hypothesis' blames caries on a few specific species of bacteria, the 'ecological plaque hypothesis' blames caries on the overall activity of heterogeneous mixture of microorganisms and a cariogenic shift of the plaque microbiomes [5].

Mutans streptococci have a well-established role in the initiation of caries [4] *Streptococcus mutans, Streptococcus sobrinus, Streptococcus cricetus, Streptococcus rattus, Streptococcus ferus, Streptococcus macacae,* and *Streptococcus downei* are bacteria of seven species [5]. *S. mutans* has been identified as a strong pathogen for caries among these species; however, other species, such as *S. sobrinus*, may also play a role [5] *S. mutans* will ferment and infect the hard tissues of the teeth, resulting in acid products. (6) S. mutans has characteristics such as the ability to attach to the enamel surface, produce metabolicity, and

form biofilms that produce extracellular polysaccharides substance (EPS), all of which contribute to the occurrence of dental caries. [7].

Periodontal tissue infections are caused by *Aggregatibacter actinomycetemcomitans* bacteria which produces some products that can harm the periodontal ligaments and alveolar bone, as well as cause pockets and gingival recession (Periodontal disease). A. *actinomycetemcomitans* rare bacteria that are commonly found in aggressive periodontitis (around 90% of the time) and chronic periodontitis with a frequency of 20 %.[8]. Some nonmutans streptococci, such as Streptococcus sanguinis and Streptococcus salivarius (9, 10, 11), and Actinomyces spp., are also potentially involved in caries; the latter contributes to the onset of root surface caries [12]. The interaction of S. sanguinis and S. mutans has been proposed as a significant factor associated with caries [13].Lactobacilli have also been implicated as important contributory species in dental caries. As a late colonizer, lactobacilli may not be a requisite for caries initiation. However, they may potently contribute to caries progression once lesions are established (5, 14)

Candida albicans contributes significantly to caries pathogenesis, particularly in children, adolescents, and young adults [15, 16, 17, 18]. This was due to its acidogenicity, ability to form hyphae, and secretion of dentine-degrading enzymes [19, 20]. Other oral microbial species associated with ECC, in addition to oral streptococci and Candida spp., include Biofidobacteria spp., Actinomyces spp., Veillonella spp., and Prevotella spp [21, 22].

SALIVARY PROTEINS AND PEPTIDES AS BIOMARKERS OF CARIES

Immunoglobulins

The IgA subclass (>85%) and, to a lesser extent, the IgG and IgM subclasses, are the most common immunoglobulins found in saliva [23. Immunoglobulins make up about 5–15% of total salivary proteins. Interfering with microbial flora adhesion to tooth surfaces, inhibiting bacterial metabolism, neutralizing bacterial toxins and enzymes, and agglutinating bacteria are all ways they act as antibacterial agents [24, 23].

INNATE HOST DEFENSE PROTEINS AND PEPTIDES

Acidic proline-rich proteins

role in dental pellicle formation, and influence initial microbial colonisation on tooth surfaces [7, 59]. A lack of acidic proline-rich proteins has been linked to a high caries rate in several studies [25-27].

Mucous glycoproteins

Mucins may interact with dental hard tissues and influence the adhesion of specific bacteria to them as major components of the acquired pellicle Microbial growth is influenced by the surface of the tooth [28].

Agglutinins

Salivary agglutinin is a mucin-like glycoprotein that has been shown to mediate oral bacteria aggregation in vitro. Agglutinins interact with unattached bacteria, causing them to clump together into large aggregates that are easier to swallow or flush away [29, 30].

Amylase

Alpha-amylase is the most abundant salivary enzyme, accounting for 40–50% of total protein produced by the salivary gland. It has several distinct biological functions that may allow or prevent the development of dental caries [31].

Lactoferrin

Lactoferrin is antibacterial, antifungicidal, antiviral, and anti-inflammatory, whereas lysozyme can activate bacterial autolysins and break down cell walls. On the other hand, their effects on dental caries are ambiguous, with studies reporting contradictory results [32].

Cystatins:

Cystatins are a heterogeneous family of proteins that all have a conserved consensus sequence in their active site. Cystatins are antimicrobial and immunomodulatory cysteine proteinase inhibitors found in all mucosal secretions. Cystatins have been found to bind to HAP, suggesting that they may play a role in the formation of acquired dental pellicle as well as the remineralization of enamel.

Histatins

Because it has the ability to incorporate into the acquired pellicle and block the binding site of bacteria on tooth surfaces, histatins, particularly histatin 1, may play a role in reducing bacteria colonisation on tooth surfaces. [8]

Antimicrobial peptides

Innate immunity relies heavily on antimicrobial peptides. They take part in first-line defence reactions and may help to prevent caries. Salivary a-defensins (HNP1, 2, 3) were found to be higher in caries-free children than in caries-affected children [33].

Proteins and peptides with effects on calcium phosphate chemistry

Several proteins and peptides, such as statherin and proline-rich proteins, may play multiple roles in caries risk regulation (34). They can also inhibit the spontaneous precipitation of calcium phosphate salts and maintain a stable supersaturated state of saliva with respect to hydroxyapatite, in addition to their antimicrobial effect [34].

Salivary electrolytes as biomarkers of caries

Fluoride, calcium, phosphate, and bicarbonate are considered to be particularly important salivary electrolytes for protecting teeth from caries. Saliva contains bicarbonate, which acts as an acid buffer. Saliva is kept supersaturated in terms of hydroxyapatite by fluoride, calcium, and phosphate ions, which provide a reparative and protective environment for dental tissues [35].

Total protein level

In caries-affected subjects, both a decreased and increased level of total protein has been reported, whereas mean total protein concentrations appeared to be similar in children with and without early childhood caries [36].

FUNCTIONAL PROPERTIES OF SALIVA AS BIOMARKERS OF CARIES

Salivary flow rate

Because the cariostatic activity or efficacy of practically all other salivary functions, such as buffering and clearance, are dependent on the salivary flow rate, it may be considered one of the most important single parameters [37].

Saliva pH and buffering capacity

Another factor that protects against caries is saliva buffering capacity, which works by counteracting the drop in pH [38]. Bicarbonate, in conjunction with the phosphate and protein buffer systems, is the main component responsible for saliva's buffering capacity [37].

Salivary sugar clearance rate

Several studies that looked at the relationship between caries and salivary sugar clearance rates found no evidence of a link [38]. Despite the fact that salivary sugar clearance is linked to salivary flow rate, Alstad et al. found that salivary sugar clearance was associated with the prevalence of dental caries in the elderly on its own [13].

CONCLUSION

In the diagnosis and treatment of dental caries, saliva biomarkers could play a vital of roles. Salivary flow rate, buffering capacity, and bacterial tests (for *S. mutans* and lactobacilli) have all entered dental clinical practice and can be used to aid in the assessment of patients' caries risk.

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