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Salivaomics: Future in Early Diagnosis of Dental Disease

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Abstract

Saliva plays an important role in health of the oral cavity and of the body as a whole. Salivary diagnostic is a dynamic and emerging field in the diagnosis of oral and systemic diseases. Saliva fulfills the various requirements necessary for a body fluid to be used for a diagnostic purpose.

The term “salivaomics” was coined to reflect the rapid development of knowledge about the various “omics” constituents of saliva Salivaomics includes the five diagnostic alphabets Proteins, mRNA, miRNA, metabolic compounds and microbes offering a substantial advantage. Salivaomics the saliva based diagnostic technique is promising offer a alternative for clinician to use in near future.

Keyword: Saliva, Proteins, mRNA, metabolic compounds.

Introduction

Periodontal diseases are affecting the majority of the world population with varying degrees. Periodontal diseases include a group of chronic inflammatory diseases that affect the periodontal supporting tissues of teeth. The various samples used for diagnosis of periodontal diseases are gingival crevicular fluid, saliva, plasma, biopsies peripheral blood cells. [1]

Currently, diagnosis of periodontal disease relies primarily on clinical and radiographic parameters. These measures are useful in detecting evidence of past disease or verifying periodontal health, but provide only limited information about patients and sites at risk for future periodontal breakdown. [2]

Ideally, diagnostic tests should demonstrate high specificity and sensitivity. Numerous markers in saliva have been proposed and used as diagnostic tests for periodontal disease. [2] Given the complex nature of periodontal disease, it is unlikely that a single marker will prove to be both sensitive and specific. A combination of two or more markers may provide a more accurate assessment of the periodontal patient. [3]

Early detection of disease or risk of disease should be the main aim of a diagnostic test, allowing to minimize the dynamics of progression of disease or to prevent the disease.

Traditional clinical criteria are insufficient for determining sites of active disease, for monitoring the response to therapy, or for measuring the degree of susceptibility to future disease progression. Limitations in recognizing the full potential of disease detection are lack of an easy and inexpensive sampling method with minimal discomfort,

and lack of an accurate, easy-to-use, and portable platform to facilitate early disease detection. [5,6]

The term “salivaomics” was coined in 2008 to reflect the rapid development of knowledge about the various “omics” constituents of saliva[1] (that is, the study of related sets of biological molecules). In just few years, the terms “salivary proteome,” “transcriptome,” “microRNA” (miRNA), “metabolome” and “microbiome” have entered the scientific lexicon. The metabolome is the complete set of small molecular metabolites found within a biological sample (including metabolic intermediates in carbohydrate, lipid, amino acid, nucleic acid and other biochemical pathways, along with hormones and other signaling molecules). These are the diagnostic alphabets of saliva, and their discovery has positioned saliva for translational and clinical applications, including personalized medicine and dentistry. Though saliva has enormous elements with diagnostic potential, omic technology made it possible to achieve the best of the saliva's diagnostic potential into the clinical practice.

Aim

The aim of the present review is to update information on the use of salivaomic technology for early diagnosis of dental diseases.

Inclusion criteria

Articles currently available on salivaomic technologies with regard to dental research were taken into consideration.

Exclusion criteria

Studies on omic technologies with gingival crevicular fluid, plaque, biopsies, peripheral blood cells, and plasma samples were not considered in this review.

Saliva

Saliva has a complex secretion of salivary glands which constantly bathes the teeth and oral mucosa. Saliva performs several key functions, including protection of the oral cavity from infections such as caries and promotes swallowing and degradation of ingested food. Saliva also affects taste sensation.[7]

In general, antibacterial, antifungal, and antiviral activities are associated with the mucins, lactoferrin, lactoperoxidase, histatins, cystatins, and immunoglobulins found in saliva.[8] Diagnosis of active phase of periodontal disease and the identification of the patients at risk for active disease represents a challenge for both clinicians and clinical investigators. Saliva is a fluid that can be easily collected and contains locally derived and systemically derived markers of oral disease. [9]

Many clinically important molecules can be detected through salivary testing, including salivary constituents that have been studied as potential diagnostic biomarkers for periodontal disease mainly include locally produced proteins of host and bacterial origin (enzymes, immune-globulins, and cytokines), genetic⁄genomic biomarkers such as DNA and mRNA of host origin, bacteria and bacterial products, ions, steroid hormones, and volatile compounds.[10]

Salivary markers of periodontal diseases

A biomarker should aid in early detection of disease, prognosis of disease outcome and possible patient stratification allowing personalized medical interventions, prediction of treatment outcome, identification of patients who will respond well to a particular treatment, and surrogate end-point. [11,12]

To date, there is no single biomarker that is specific for periodontal disease. Therefore, there is strong potential for the use of microbial and host-response biomarkers in combination to enhance identification of the disease process, given the multifactorial nature of periodontal diseases. [13]

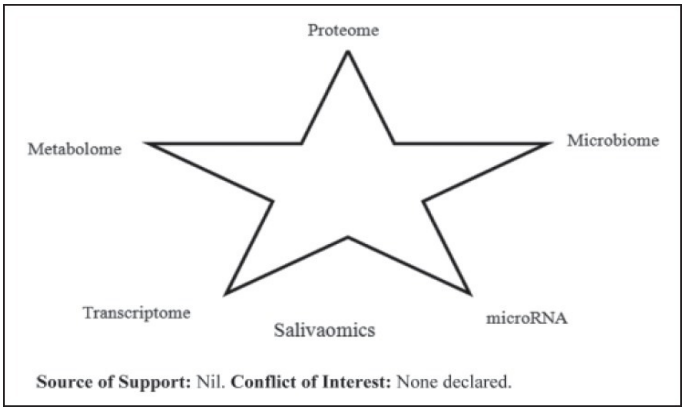
OMIC Technology

Omic technologies include genomics, transcriptomics, proteomics, and metabolomics. The achievements of high-through put approaches such as proteomics including free-flow electrophoresis coupled with linear ion-trap tandem mass spectrometry, multidimensional separation platform based on nano-reversed phase liquid chromatography, and capillary isoelectric focusing, two dimensional gel electrophoresis coupled with matrix-assisted laser desorption/ionization time of flight mass spectrometry or liquid chromatography-mass spectrometry, Isobaric tag for relative and absolute quantitation and label-free quantitation, microarray and microfluidics afforded by modern diagnostic techniques allow for disease-specific salivary biomarker discovery and establishment of multiplex, rapid, and miniaturized analytical salivary assays.[15,16,17,18,19,20]

Salivaomics

The term “salivaomics” was coined in 2008 to reflect the rapid development of knowledge about the various “omics” constituents of saliva.

Salivaomics [Figure 1] includes five diagnostic alphabets proteins, mRNAs, miRNAs, metabolic compounds, and microbes offers substantial advantages because disease states may be accompanied by detectable changes in one, but not in all dimensions. [21]



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Genomics is the study of whole genomes, that is, all the DNA of a single organism.

Most relevant to periodontal diseases are the emerging toolboxes of the salivary proteome and the salivary transcriptome for early detection, disease progression, and therapeutic monitoring.

Salivary proteomics

Proteomics is the study of all the proteins in a given sample.[21]

By using two-dimensional gel electrophoresis⁄ mass spectrometry and shotgun proteomics approaches, it has been identified 309 distinct proteins in human whole saliva. A total of 1,166 salivary proteins have been identified-914 from the parotid fluid and 917 from the combined submandibular and sublingual fluids. [23]

Salivary metabolomics

Metabolomics is the global assessment and validation of endogenous small-molecule metabolites within a biologic system that has gained increasing popularity and significance in life sciences. [26]

Salivary transcriptome

High-density oligonucleotide microarrays were used to profile salivary mRNA and revealed that there are 3,000 human mRNAs in the cell-free saliva supernatant of healthy subjects

The salivary microbiome is a promising clinical diagnostic indicator of oral cancer, periodontitis, and possibly other diseases. [28]

Discussion

Saliva offers an alternative to serum as a biologic fluid that can be analyzed for diagnostic purposes. Saliva meets the demands for an inexpensive, noninvasive, and easy-to-use diagnostic platform. The advantages of easy collection, storage, shipping, and voluminous sampling make saliva a better diagnostic biofluid than serum or urine. It is also easier to handle saliva during diagnostic

procedures than blood, because it does not clot and this reduces the number of manipulations required. Early detection, diagnosis, and assessment of prognosis of systemic diseases could be possible by monitoring the composition of saliva. Recently, due to the combination of emerging biotechnologies and salivary diagnostics, a large number of medically valuable analytes in saliva are gradually unveiled and some of them represent biomarkers for different diseases including cancer, autoimmune diseases, viral diseases, bacterial diseases, cardiovascular diseases, and HIV.

Genomic testing could allow risk-based long-term planning for more effective dental disease prevention, reduce the uncertainty of diagnosis and prognosis.

Conclusion

Saliva is sound for detection of oral diseases like periodontal disease, caries, oral cancer, salivary gland disorders, and nonoral distal diseases. Salivaomics, the future of saliva-based techniques for early diagnosis of dental diseases, is promising. However, as with any new technology, process issues need to be addressed before they are used widely in clinical settings.

References

1. Mandel ID. The diagnostic uses of saliva. J Oral Pathol Med. 1990;19:119–25.

2. Chapple IL. Periodontal disease diagnosis: Current status and future developments. J Dent. 1997;25:3–15.

3. Lee Y, Wong DT. Saliva: An emerging biofluid for early detection of disease. Am J Dent. 2009;22:241–8.

4. Kaufman E, Lamster IB. The diagnostic applications of saliva-A review. Crit Rev Oral Biol Med. 2002;13:197–212

5. Giannobile WV. Salivary diagnostics for periodontal diseases. J Am Dent Assoc. 2012;143(10 suppl):6–11S.

6. Kaufman I, Lamster IB. Analysis of saliva for periodontal diagnosis: A review. J Clin Periodontol. 2000;27:453–65.

7. Giannobile WV, Beikler T, Kinney JS, Ramseier CA, Morelli T, Wong DT. Saliva as a diagnostic tool for periodontal disease: Current state and future directions. Periodontol 2000. 2009;50:52–64.

8. Miller CS, King CP., Jr Salivary biomarkers of existing periodontal disease-A cross-sectional study. J Am Dent Assoc. 2006; 137:322–9.

9. Marcotte H, Lavoie MC. Oral microbial ecology and the role of salivary immunoglobulin A. Microbiol Mol Biol Rev. 1998;62:71–109.

10. Delacroix DL, Dive C, Rambaud JC, Vaerman JP. IgA subclasses in various secretions and in serum. Immunology. 1982;47:383–5.

11. Baum BJ, Yates JR, Srivastava S, Wong DT, Melvin JE. Scientific frontiers: Emerging technologies for salivary diagnostics. Adv Dent Res. 2011;23:360–8.

12. Zhang L, Henson BS, Camargo PM, Wong DT. The clinical value of salivary biomarkers for periodontal disease. Periodontol 2000. 2009;51:25–37.

13. Kinney JS, Ramseier CA, Giannobile WV. Oral fluid-based biomarkers of alveolar bone loss in periodontitis. Ann N Y Acad Sci. 2007;1098:230–51

14. Miller CS, Foley JD, Bailey AL, Campell CL, Humphries RL, Christodoulides N, et al. Current developments in salivary diagnostics. Biomark Med. 2010;4:171–89.

15. Herr AE, Hatch AV, Throckmorton DJ, Tran HM, Brennan JS, Giannobile WV, et al. Microfluidic immunoassays as rapid saliva-based clinical diagnostics. Proc Natl Acad Sci U S A. 2007;104:52 68–73.

16. Nibali L, Donos N, Henderson B. Periodontal infectogenomics. J Med Microbiol. 2009;58:12 69–74.

17. Taba M, Jr, Kinney J, Kim AS, Giannobile WV. Diagnostic biomarkers for oral and periodontal diseases. Dent Clin North Am. 2005;49:551–71.

18. Kojima T, Andersen E, Sanchez JC, Wilkins MR, Hochstrasser DF, Pralong WF, et al. Human gingival crevicular fluid contains MRP8 (S100A8) and MRP14 (S100A9), two calcium-binding proteins of the S100 family. J Dent Res. 2000;79:740–7.

19. Rudney JD, Staikov RK, Johnson JD. Potential biomarkers of human salivary function: A modified proteomic approach. Arch Oral Biol. 2009;54:91–100.

20. Grant MM. What do _omic technologies have to offer periodontal clinical practice in the future? J Periodontal Res. 2012;47:2–14.

21. Wong DT. Salivaomics. J Am Dent Assoc. 2012;143(10 suppl):19–24S.

22. EJ, Oppenheim FG. Saliva: A dynamic proteome. J Dent Res. 2007;86:680–93.

23. Wong D. Salivary diagnostics powered by nanotechnologies, proteomics and genomics. J Am Dent Assoc. 2006;137:284–6.

24. Ngo LH, Veith PD, Chen YY, Chen D, Darby IB, Reynolds EC. Mass spectrometric analyses of peptides and proteins in human gingival crevicular fluid. J Proteome Res. 2010;9:1683–93.

25. Wu Y, Shu R, Luo LJ, Ge LH, Xie YF. Initial comparison of proteomic profiles of whole unstimulated saliva obtained from generalized aggressive periodontitis patients and healthy control subjects. J Periodontal Res. 2009;44:636–44.

26. Taubman MA, Valverde P, Han X, Kawai T. Immune response: The key to bone resorption in periodontal disease. J Periodontol. 2005;76(11 Suppl):2033–41.

27. Tonetti MS, D'Aiuto F, Nibali L, Donald A, Storry C, Parkar M, et al. Treatment of periodontitis and endothelial function. N Engl J Med. 2007;356:911–20.

28. Giannobile WV, Wong DT. Salivary diagnostics: Oral health and beyond! J Dent Res. 2011;90:1153–4.