Role of Saliva in Dental Practice – A Review

Bhumika Badiyani¹, Amit Kumar², Viral Pravin Maru³*

¹Community and Preventive Dentistry, School of Dental Sciences, Karda 415539, India.
²Community and Preventive Dentistry, Sarjug Dental College and Hospital, Bihar, India
³Consulting Pedodontist, Maharashtra, Mumbai, India.

Review Article

Received: 25/09/2012
Revised: 17/01/2013
Accepted: 19/01/2013

*For Correspondence:
Consulting Pedodontist, Maharashtra, Mumbai, India.
Email: viralmaru@yahoo.co.in

Keywords: saliva, diagnosis, dental practice.

ABSTRACT

As a diagnostic fluid, saliva offers distinctive advantages over serum because it can be collected non-invasively by individuals with modest training. Furthermore, saliva may provide a cost-effective approach for the screening of large populations. Gland-specific saliva can be used for diagnosis of pathology specific to one of the major salivary glands. Whole saliva, however, is most frequently used for diagnosis of systemic diseases, since it is readily collected and contains serum constituents. Analysis of saliva may be useful for the diagnosis of hereditary disorders, autoimmune diseases, malignant and infectious diseases, and endocrine disorders, as well as in the assessment of therapeutic levels of drugs and the monitoring of illicit drug use.

INTRODUCTION

Human saliva plays an important role in the health of the oral cavity and of the body as a whole. It is a complex fluid that is actively secreted by the major and minor salivary glands. It provides a window to the physiological and pathological state of the body as a whole. Salivary diagnostics is an emerging field that has tremendous potential in clinical applications because its collection is non-invasive and contains a wide spectrum of analytes, which can serve as biomarkers for assessment of oral and systemic health. This review intends to give an overview of this exciting area of salivary research.

Saliva as Diagnostic Fluid

Salivary diagnosis is an increasingly important field in dentistry, physiology, internal medicine, endocrinology, pediatrics, immunology, clinical pathology, forensic medicine, psychology and sports medicine. A growing number of drugs, hormones and antibodies can be reliably monitored in saliva, which is an easily obtainable, non-invasive diagnostic medium. Thus, salivary diagnosis is anticipated to be particularly useful in cases where repeated samples of body fluid are needed but where drawing blood is impractical, unethical, or both. Salivary concentrations of drugs and hormones also represent the free fractions of serum in many instances, with good correlations with the respective total concentrations in serum. Multiple specimens of saliva for steroid hormone analysis can be easily collected by the patient, at home, to monitor fertility cycles, menopausal fluctuations, stress and other diurnal variations.

Salivary antibody levels can be determined to screen for infectious diseases. Anti-HIV antibody immunocapture assays have also been developed and tested for saliva, which could be useful in high-risk groups under field conditions in developing countries. Salivary assays have been used for monitoring of hepatitis A, B and C, measles, Epstein–Barr virus, rubella, parvovirus B 19, human herpesvirus 6, Helicobacter pylori and rotavirus infection. In addition to measuring antibody, it is possible to identify a number of viral antigens in saliva, for example mumps and cytomegalovirus. Saliva has also proven to be a convenient source of host and microbial DNAs.

There has been growing interest in the use of saliva in pharmacokinetic studies of drugs and in therapeutic drug monitoring in a variety of clinical situations. It has been suggested that drug levels in saliva reflect the free, non-protein-bound portion in plasma and
It has recently been shown that low secretion rate of saliva and the high scores of lactobacilli and *Streptococcus mutans* have a significant influence on complications of fixed metal ceramic bridge prostheses and this should be taken into consideration in choosing patients for prosthetic treatment with fixed prosthodontics [23]. Since salivary flow and its composition is essential in the protection and lubrication of oral mucosal tissues, salivary tests have also significant predictive value in prosthodontic treatment planning. Successful
management of complete and removable partial dentures is complicated by a reduction in salivary flow \cite{26}. It has been suggested that salivary tests should be performed and analyzed before planning an extensive and expensive restorative therapy or orthodontic treatment and on a routine basis with geriatric patients.

Salivary Flow

Diminished salivary output can have deleterious effects on oral and systemic health \cite{27}. Unstimulated whole saliva is the mixture of secretions which enter the mouth in the absence of exogenous stimuli such as tastants or chewing. Several studies of unstimulated saliva flow rates in healthy individuals have found the average value for whole saliva to be about 0.3 ml/min. Values below 0.1 ml/min are considered as hyposalivation, and values between 0.1–0.25 ml/min low \cite{16}. The normal range is very large and includes individuals with very low flow rates who do not complain of a dry mouth \cite{28}. There is significant difference between genders in unstimulated flow rate. Xerostomia (dry mouth) is the subjective feeling of oral dryness. It is generally accompanied by salivary gland hypofunction and a severe reduction in the secretion of unstimulated whole saliva, but xerostomia is not necessarily reflected in the actually measured flow rates \cite{29}.

Unstimulated saliva is usually collected with the patient sitting quietly, with the head bent down and mouth open to allow the saliva to drip from the lower lip into a sampling tube (the so-called draining method). The other most commonly used techniques for measuring unstimulated saliva are the spitting method, suction method and swab method \cite{17}. The factors affecting unstimulated saliva flow rate are degree of hydration, body position, exposure to light, previous stimulation, circadian rhythms, circannual rhythms, and drugs. Less important factors are age, body weight, psychic effects, and functional stimulation \cite{30}.

Stimulated saliva is secreted in response to either masticatory or gustatory stimulation, or to other less common stimuli such as activation of the vomiting centre. A wide variation among individuals has been found. Men have higher flow rates than women. The factors affecting the flow of stimulated saliva are nature of stimulus, vomiting, smoking, gland size, gag reflex, olfaction, unilateral stimulation, and food intake \cite{11}. Reduced salivary flow may cause a variety of mostly unspecific symptoms to the patient, so the establishment of salivary flow rates is of primary importance in oral medicine and dentistry. Saliva influences caries attacks mainly by its rate of flow and its fluoride content. The salivary flow rate influences to a high degree the rate of oral and salivary clearance of bacterial substrates \cite{31}.

Buffering Capacity of Saliva

Salivary buffering capacity is important in maintaining a pH level in saliva and plaque. The buffer capacity of unstimulated and stimulated whole saliva involves three major buffer systems. The most important buffering system in saliva is the carbonic acid / bicarbonate system. The dynamics of this system is complicated by the fact that it involves the gas carbon dioxide dissolved in the saliva. The complete simplified equilibrium is as follows:

\[
\text{CO}_2 + \text{H}_2 \text{O} \leftrightarrow \text{H}_2 \text{CO}_3 \quad \text{HCO}_3^- + \text{H}^+
\]

The increased carbonic acid concentration will cause more carbon dioxide to escape from the saliva. The saliva bicarbonate increases the pH and buffer capacity of saliva, especially during stimulation \cite{32}.

The second buffering system is the phosphate system, which contributes to some extent to the buffer capacity at low flow rate. The mechanism for the buffering action of inorganic phosphate is due to the ability of the secondary phosphate ion, HPO\text{4}^{2-}, to bind a hydrogen ion and form an H\text{2}PO\text{4}^--ion. The third buffering system is the protein system. In the low range of pH the buffering capacity of saliva is due to the macromolecules (proteins) containing H-binding sites.

The bicarbonate concentration is strongly dependent on secretion rate. Since bicarbonate is the chief determinant of the buffer capacity, there is an interrelationship between pH, secretion rate and salivary buffering capacity \cite{33}.

Various methods have been used to measure the salivary buffer capacity, including titration under oil, titration while open to air and titration with CO\text{2}. Values obtained for buffer capacity in different studies are not comparable. However, final pHs under 3.5 for unstimulated saliva and 4.0 for stimulated saliva are considered low. From a practical point of view, the Dentobuff method has been developed to assess the buffering capacity in dental practice. Based on the color change of the indicator paper, the buffering capacity is assessed in comparison with a color chart. The Dentobuff method to assess the salivary buffering capacities has been shown to be valid \cite{22}.
The lubricating action of saliva is important for oral health. It facilitates the movements of the tongue and the lips during swallowing and eating and is important for clearly articulated speech. The efficacy of saliva as a lubricant depends on its viscosity and how it changes with shear rate. The shear rate can obtain high values, e.g. 160 and 60 l/s during speaking and swallowing, respectively [13].

Tribology is the science and practice of friction, lubrication, and wear applied to surfaces in relative motion [14]. Rheology is the science associated with the deformation of materials subjected to stresses and forces. The rheological aspect includes viscosity and viscoelasticity. Saliva possesses specific rheological properties as a result of its chemical, physical and biological characteristics, these properties being essential for maintaining balanced conditions within the oral cavity [15].

It has been found that salivary viscosity is greatly influenced by pH and calcium [16]. Increased salivary viscosity may also be associated with an increase in dental caries, although it is difficult to examine flow rate and viscosity independently from each other [17]. The apparent viscosity contributes to the rheological properties of saliva, and the elastic properties could be important as well [18]. Salivary viscosity is also suggested to contribute to denture retention. Retention of dentures is a dynamic issue dependent on the control of the flow of the interposed fluid and thus its viscosity and film thickness. In this, the most important concerns are good base adaptation and border seal of the prosthesis, so that full advantage is taken of the saliva flow-related effects. Alterations in salivary composition appear to be reflected in its viscosity and in oral complaints [19].

Salivary Immunoglobulins

Salivary secretory immunoglobulins (sIgA and sIgM) originate from immune cells which home to the salivary glands, and are produced as a host response to an antigenic stimulus [40]. The immunoglobulins may be directed at specific bacterial molecules, including cell surface molecules such as adhesins, or against enzymes. By binding to such molecules, adhesion of specific bacteria to oral surfaces may be blocked, so preventing colonisation by the affected species [41]. Several studies have confirmed that sIgA is mainly dimeric rather than monomeric, and it is associated with an epithelial glycoprotein called SC (secretory component) [42]. At least 95% of the IgA normally appearing in saliva is produced by the local gland-associated immunocytes rather than being derived from the serum.

Salivary Non-Immunoglobulin Proteins

Salivary lysozyme hydrolyses specific bonds in exposed bacterial cell walls, causing cell lysis and death. It is also known that lysozyme contributes to mucosal protection and modulates Candida populations in the oral cavity [43]. Peroxidases, salivary peroxidase and myeloperoxidase, catalyze a reaction involved in the inhibition of bacterial growth and metabolism, and the prevention of hydrogen peroxide accumulation, thus protecting proteins from the action of oxygen and reactive oxygen species [44]. Salivary lactoferrin has antibacterial activity. Lactoferrin binds iron, making it unavailable for microbial use. Lactoferrin, in its unbound state, also has a direct bactericidal effect on some microorganisms including Streptococcus mutans strains [45]. Histatins shows anti fungal activity against Candida Albicans. Histatins have been shown to be tannin-binding proteins in human saliva. Histatins also bind to enamel surfaces and hydroxyapatite in a complex manner [46]. Salivary agglutinins are glycoproteins which have the capacity to interact with unattached bacteria, resulting in clumping of bacteria into large aggregates which are more easily flushed away by saliva and swallowed. Bacterial binding to salivary proteins may in part account for individual differences in the colonization of tooth surfaces. Agglutinins induce the aggregation and clearance of streptococci from the oral cavity and are also important modulators of initial plaque formation [47].

CONCLUSION

The ongoing development of salivary diagnostics and the ease of collection of saliva are resulting in a shifting paradigm in diagnostic and treatment planning approaches in many areas of medicine and dentistry.

REFERENCES