

Recent approach in the diagnosis in oral medicine.

Nithya VR*

Department of Oral Medicine, Jawaharlal Nehru University, Delhi, India

Abstract

In recent years, the diagnostic process of oral medicine has seen significant progress and results. Combining altogether the technical foremost from histopathology, biochemistry, immunology, molecular biology and optical physics have radically changed the process of diagnosis from laboratories to dental clinics. This study aims at approaching the recent advances in the methods of diagnosis in the field of oral medicine allowing better prognosis, management and impact in the practice of dental clinic.

Keywords: Oral medicine, Oral diagnosis, Recent advances, Dental caries, Periodontal diseases, Oral cancer.

Introduction

The fundamental aim of diagnostic approach in oral medicine is to decrease the mortality and morbidity of oral diseases by following early diagnosis protocols as it provides conservative and therapeutic approach favoring a better prognosis and fleeting recovery of patients [1]. With an increase in the rate of occurrence of head and neck cancer and the obstacles associated with late diagnosis it seems judicious to validate advanced measures of diagnosis also in order to decrease the chances of occurrence of public health complications associated with continuous exposure to radiation. The ability to accurately detect dental caries with the aids of early diagnosis provides effectiveness to the dental practitioner and ensures delivery of preventive treatment to patients in need thus intensify dental health and merits priority consideration. Regarding the periodontal health status, an urgent need to educate the public regarding periodontal diseases and its complication is required. Therefore, an approach towards prevention and early diagnosis of periodontal diseases must be taken into consideration [2].

As advancement in the application of recent technical developments in the area of diagnosis, it has paved its way to investigation of numerous questions which could not be answered in the previous years of diagnosis. Currently modern diagnostic trends approaches at focusing in areas of molecular biology and various methods to transform the traditional methods in relation to oral and dental diseases for better management [3].

Literature Review

Advances in diagnosis of oral cancer

Neoplastic encloses all the malignancies involving in the oral tissues and is ranked 6th overall worldwide in common cancer sites for its incidence rate. Moreover, the survival rate of patient has not seen significant improvement for the past 20 years with only 45%-50% in the 5-year survival rate. In order

to reduce the risk and occurrence rate of cancer, early diagnosis approach is taken into consideration providing therapeutic and conservative approach proving to be a better prognosis with better progression in recovery. Early diagnosis approach includes application of specific diagnostic tools and screening scheme to spot the asymptomatic victims with suspicious lesions are listed below in consideration [4].

Brush biopsy

A technique introduced in the 1980's for cervical smears in gynaecological lesion and later subjected for its use in oral smears. Also known as CDx brush test system, the method comprises of collection of trans-epithelial cells sample from the mucosal lesion representing the superficial, intermediate and parabasal/basal layers of the epithelium. The diagnostic brush is a non-lacerational device designed to investigate mucosal abnormalities that would otherwise not be subjected to biopsy because of low-risk clinical features. Samples are collected from full thickness of epithelial cells, fixed onto the glass slide, stained with a modified papanicolaou test and analysed microscopically *via* a computer-based imaging system. It is a chair-side, painless, easy to perform test that is used to evaluate any suspicious lesion which includes small white and red oral lesions to rule out dysplasia.

According to various studies, an oral lesion was tested simultaneously with both brush and scalpel biopsy, where 90% of brush biopsy test indicated high sensitivity and specificity in ruling out the presence of dysplasia and making it a practical norm in evaluation of lesions without a specific etiologic factor. However, several literatures have noted discrepancies of scalpel and brush biopsy labelling them as "false negatives" despite not having any validity at all [5]. Current data shows that oralCDx's cytologic test when used in low risk population with benign-appearing oral epithelial lesions have resulted in reduced and increase rate of false-positive findings whereas in high-risk mucosal lesions it was reported as highly specific and sensitive.

*Correspondence to: Nithya VR, Department of Oral Medicine, Jawaharlal Nehru University, Delhi, India, E-mail: vrnithya@rediffmail.com

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Therefore, further studies are required to investigate the specificity and sensitivity of brush biopsy technique in detection of clinically innocuous lesions.

Bio nano-chip

Lab-on-a-chip or neoplastic biomarkers is regarded as a fast oral-cytology test that amalgamates the power of cytological morphometric examination for detection of dysplasia or cancer. It is an adaptation, miniaturization and automation of analytical laboratory procedures into a single device or “chip” also known as microfluidics technology or micro-Total-Analysis (TAS). Often applied as a diagnostic aid in the detection of oral dysplastic and cancer cells, it utilizes the membrane associated cell protein which are singularly expressed on the cell membrane of dysplastic and cancer cells and their distinct gene transcription profiles [6].

PET-Positron Emission Tomography

Positron Emission Tomography (PET) is a nuclear medicine imaging system which makes a three-dimensional image of the practical action in the body. The methods work by detecting a pair of gamma rays emitted indirectly by a positron-emitting radionuclide (tracer which is additionally introduced into the body on a biologically active molecule and is regenerate within the body by computer analysis. It is a functional image modality that indicates the metabolic activity and perfusion of the glucose analogue fludeoxyglucose F 18 (18FDG) of different tissues of the body. The mechanism of PET works when the FDG enters the cells and is phosphorylated to FDG-6-phosphate and becomes trapped within the malignant tumour cells producing a “hotspot” on the PET image with high glucose metabolism distinguished from surrounding normal tissue. It visualizes the metabolic processes in vivo and detects relatively tumours as small as 3 mm before structural changes occur and as long as they are metabolically active.

According to many studies, it has also shown effectiveness in the detection of unknown primary tumours better than other methods. It is regarded as one of the most reliable procedure for detecting recurrent carcinoma. Utility of PET is also seen in the detection of unknown primary head and neck cancers or tumours. Recent research show that PET/CT have 90% higher rate for locating the tumours when compared to other methods [7].

Microarray

Microarray is a powerful tool that allows both qualitative and quantitative screening variations in the genomic DNA of cancer cells. They are required to classify tumour subtypes, extract molecular information and find common patterns within a group of samples. It is an advanced method which has increased the potential of standard methods among various genome wide biology studies. It can also be combined with other diagnostic methods to gain more information about the tumour by analysing thousand other genes concurrently. It is a sequence based analysis which aids comparative hybridization

to gather information from genotype polymorphism to detection of mutation.

Microarray is also considered as an appropriate tool to acknowledge the impact of the sequence of polymorphism on the biologic functions and its association with heritable phenotypes [8].

Laser Capture Microdissection (LCM)

It is one of the modern technology diagnostic method which aids in defining the molecular basis of malignancy. This method involves the extraction of cells from specimens in which the exact morphology of both surrounding tissue and the captured cells is preserved. Immuno-histochemical staining is combined with LCM to obtain accurate micro-dissection of the cellular subsets.

LCM has greatly boosted in defining the molecular basis of malignancy and made the study of cancer biology more accurate. It is also being used for early detection of Squamous Cell Carcinoma (SCC) by establishing protein finger print models and also to detect biomarkers.

Recent methods for diagnosis of dental caries

The requirement for the spotting and clinical staging of the presence, activity and severity of cavity is of paramount importance within the deployment of treatment strategies that employ increasingly important nonsurgical modalities like fluorides, antimicrobials, sealants and no treatment.

Illumination methods

Fiber-optic transillumination: Fiber-Optic Trans Illumination (FOTI) as a caries detection technique is predicated on the very fact that carious enamel characteristics a lower index of light transmission than sound enamel. The light can be engaged as the demineralization process disrupts the crystalline structure of the enamel and dentin. Basically, this gives the region a more darkened appearance.

Digital imaging fiber-optic transillumination: This is often a digitized and computed version of the FOTI. While FOTI was designed for identification of proximal and occlusal caries, digital imaging fiber-optic transillumination DIFOTI is employed for detection of both incipient and frank caries altogether. DIFOTI also can be wont to detect fractures, cracks and secondary caries around restorations.

Wavelength dependent FOTI: In incipient white-spot lesions, mineral loss is amid a rise in light scattering. In older, discolored lesions, light absorption is additionally enhanced. The induced effect at the occlusal surface is caused by a mixture of material properties and therefore the distance light propagates through tooth material from the light source to the detector. this mix is going to be called “effective decadic optical thickness” and depends on the light wavelength [9].

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Endoscopy

Endoscopically viewed filtered fluorescence: This technique employs the fluorescence of enamel that occurs when it's illuminated with blue light in wavelength range 499 nm-500 nm. When the tooth is viewed from a selected gelatine green filter number 58, combined to the eyepiece, white spot lesion looks darker than sound enamel.

White light fluorescence: A white light is connected to the endoscope by a fibre-optic cable and teeth are viewed without a filter. Certain limitations like the weight of fibre-optic cable tends to destabilize the machine and therefore the enlarged distance between eyepiece and lightweight source decreases illumination.

Videoscope: The mixing of the camera and endoscope is named a videoscope are often designed in such a way that the image of the surface of enamel can be viewed directly over a television screen.

Intra Oral Television Camera (IOTV)

Intraoral cameras are supported by an equivalent idea as endoscopes, employing a small visualization device to supply a far better view of the mouth. The intraoral wand camera projects magnified digital images from a patient's mouth.

Quantitative Light-induced Fluorescence (QLF)

QLF uses the natural fluorescence of the teeth, which is decided by the light absorption and scattering properties of the teeth, to discriminate between caries and surrounding sound enamel. Caries lesions appear dark when viewed with QLF and this is often supported the principle that a demineralized tissue limits the penetration of light due to excessive scattering of photons entering the lesion with consequent limitation to the prospect of a photon being absorbed and fluorescence remitted [10].

Cariescan

This device is predicated on the proven technology of AC impedance spectroscopy and involves the passing of an insensitive level of electrical current through the tooth to spot the presence and site of the decay. It cannot be used to assess secondary caries, the integrity of a restoration, dental root caries and the depth of an excavation within a cavity preparation.

Diagnodent laser system

Diagnodent is a laser fluorescence system that detects changes in tooth structure due to demineralization. This with a laser diode generates a pulsed 655 nm laser beam through a central fibre is carried to the tip of the device and into the tooth. Then this incident fluorescent light interacts with the tooth surface and then it stimulates fluorescent light of longer wavelengths. The intensity of fluorescence is a function of degree of demineralization or bacterial concentration in the explored region.

Discussion

Advances in diagnosis of periodontal diseases

The understanding of periodontal diseases has fundamentally changed and has created new, exciting perspectives for both non-surgical and surgical periodontal disease therapy. Over the years, numerous prototypes of periodontal probes, such as the florida probe system, have been built to overcome traditional probe limitations. The most recent of them is the florida pasha probe. Recently, in identifying periodontal disease activity, radionuclides such as technetium 99 m-tindiphosphonate have been evaluated as an indicator for the diagnose of active alveolar bone loss. The development of the probing method, various radiographic technologies have been implemented to provide a three-dimensional view of the defect present in periodontal disease, to helps in better treatment planning and thereby, in the treatment of the disease. The various advances made in the diagnosis and treatments of periodontal diseases are listed [11].

Sialoendoscopy

Sialoendoscopy is a promising new method for the diagnosis, treatment and postoperative management of obstructive salivary gland diseases. It is an outpatient process that requires local anaesthetics and has no significant complications.

Ozone therapy

Oxygen/ozone therapy has a history of human study and clinical practice. The first medical application dates back to 1870, when Dr. C. Lender purified blood in the test tubes. By 1929, more than 114 diseases were reported to be treated with oxygen/ozone therapy.

Ozone is an effective oxidizing agent. It effectively destroys bacteria, fungi, viruses, and parasites at a significantly lower concentration than chlorine, with no toxic side effects. One ozone molecule is equal to between 3,000 and 10,000 chlorine molecules and kills pathogenic organisms 3,500 times faster. Three basic route of administration to oral tissues are gaseous ozone, ozonated water, ozonized oil. However, it is considered safe and effective with no toxic effects or side effects.

Oral fluid testing

Saliva, our bodies most usable and non-invasive bio fluid, provides a wide variety of biomarkers for clinical diagnostics. The molecular composition of saliva represents the amounts of tissue fluid in medicinal, hormonal, immunological or toxicological molecules. Although proteomic constituents were a rational first option as salivary diagnostic analyses, genomic targets were described as highly descriptive and selective.

Microsurgery

In 1980, Serafin defined microsurgery as a technique for modification and the development of current surgical procedures using magnification to enhance visualization,

which had consequences and applications for all fields of study. Use of magnification in the field of periodontology was established in the year 1992. Nowadays, the numerous advances made technology have made it possible to imagine the operating area on the monitor in three dimensions, thereby excluding the need to actually look at the microscope. The main purpose of microsurgery is minimizing pain and morbidity in patient and extreme and accurate closure of the wound.

Tissue engineering

Tissue engineering is a contemporary field of science focused on cell biology, developmental biology and biomaterial science concepts to establish new methods and biomaterials to replace missing or damaged tissues. Cells collected from pulp, periodontal ligament, gingival connective tissue, etc. Are used in various *in vitro* studies in order to determine their ability to distinguish between different periodontium progenitor cells. Tissue engineering is a very new technique and several reforms are required in the future to make this technique workable. Gene therapy is currently being used in antimicrobial therapy to monitor disease progression. Gene or nucleic acid medicines are classified as gene inhibitors, gene vaccines and gene replacements on the basis of their therapeutic use.

Nanotechnology

Nanotechnology has been used in the field of dentistry since the early 1970s, the era of microfills. Since then, numerous nanomaterials have been introduced in the field of dentistry, including periodontology for proper oral health. Nanodiagnosics promise improved sensitivity, multiplexing capacities and reduced costs for many diagnostic applications. New nanodiagnostic methods include quantum dots, gold nanoparticles, and cantilevers. Potential diagnostic uses of QDs are various, with the most promising applications in the areas of tumor detection, tissue imaging, intracellular imaging, infectious agent detection and multiplex diagnostics [12].

Nanomaterials such as bioactive glass, carbon nanomaterials, titanium nanotubes coated dental implants, nanoceramics for bone regeneration; nanobiomaterials used for the preparation of periodontium regeneration scaffolds; metallic nanoparticles in the form of toothpaste and mouth rinses for the regulation of oral biofilm and nanoparticles for local drug delivery; nanorobots for oral analgesia.

Conclusion

Clinicians must aim to progress and improve their diagnostic skills and understand the factors that influence diagnosis and prognosis to create a detailed treatment plan and provide adequate treatment and therefore evaluate the outcome and determine when dental care is required.

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