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Advancements in Oral Cancer Diagnosis: A Narrative Review

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ABSTRACT: One of the leading cause of deaths is cancer amongst them, oral cancer has a shorter survival rate. Visual oral examination remains the first line of treatment in detection of oral cancers but still, it has certain drawbacks. Even timely reported questionable lesion may not get diagnosed early. Either cancer reaches a severe stage or misdiagnosed and left untreated. Thus the aim of the present study is to review the advances in diagnostic modalities of oral cancer. This is the need of hour to get the lesions diagnosed not just at earliest but also with higher rates of positive results.

KEYWORDS: Oral cancer, Vizilite, Biomarker, Microarrays, Biopsy.

I. INTRODUCTION

Treatment of cancer is race against time! Following functional deficit, cosmetic normalcy is also hampered in Head and neck cancers. One of the most common amongst them is Oral Cancer. It nearly constitutes about 12% of all malignancies in the world with significant mortality and morbidity rate. Unlike other cancers, it could be detected early because of its occurrence as a precursor lesion. In recent years, it has increased incidence and prevalence and has become the sixth most common cancer worldwide and third most common in South Central Asia[8]. An early and better detection of these cancers helps in improving the prognosis to some extent[6]. It will not just improve the prognosis by treating the same at an early stage, but also reduce the complexity and complications of treatment and the monitory burden on patient. The survival rate can exceed if it is diagnosed and treated at the earliest. Recent studies show that, the latest techniques are mostly non-invasive and are capable of diagnosing oral cancers at an earlier stage[1].So with the phenomenal developments in the field of science and technology, diagnostic modalities of oral cancer have seen marked advancements.

With this context, the present paper provides a brief insight into the advancements in diagnostic modalities of oral cancer and Future technologies that remain in the development stage[8].

II. LIGHT BASED DETECTION SYSTEM – VIZILITE

Light-based detection system is based on reflective properties of tissues that have cellular alterations such as higher nuclear/cytoplasmic ratio. One such recently developed system is ViziLite that encompasses 1% acetic acid solution, a capsule, a retractor and the manufacturer's guidelines. The foremost step in this system is acetic acid pre-rinse which removes the debris and glycoprotein layer to enhance the penetration and reflection of light besides causes cellular dehydration and protein coagulation which reduce the epithelial transparency[5,9].ViziLite capsule has an outer plastic layer (flexible) and an inner (fragile) glass ampule. The capsule can be bent to break the inner ampule to mix the contents. It produces a bluish-white light with a wavelength ranging from 430nm to 580nm. Sensitivity and Specificity of Vizilite are 77.3% and 27.8% respectively[11]. A numerous study have shown varying results with the ViziLite®. This device detects lesions that have not been identified by standard visual oral examination (VOE). A positive ViziLite® appearance does not discriminate between lesions, also proved to be ineffective in detecting dysplasia or cancer[7].

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III. SALIVARY BIOMARKERS

Saliva, as a non-invasive alternative to serum testing, can be a powerful modality for determining diagnosis and prognosis of oral cancers. Saliva, as a diagnostic device, has many advantages over serum, apart from the capability of being collected non-invasively. Additionally, it may offer a powerful and realistic approach for the screening of large populations. It is able to be used with unique salivary macromolecules as well as examining proteomics or genomic targets along with enzymes, cytokines, boom factors, metalloproteinases, endothelin, telomerase, cytokeratins, mRNAs and DNA transcripts. The six most studied epithelial serum circulatory tumor markers in the saliva of carcinoma patients are Cyfra 21-1, TPS, carcinoembryonic antigen (CEA), SCC, CA125, and CA19-nine. Tremendous increase (of four hundred%) in salivary concentrations of Cyfra 21-1, TPS and CA125 have been shown with sensitivity, specificity, and negative and positive predictive values of seventy-one%, 75%, 71%, and 75%, respectively. However CEA, SCC and CA19-9, did not reach statistical importance. CD44, a multi-structural and multifunctional cellular floor transmembrane glycoprotein molecule has additionally been detected in saliva[10].

IV. DNA PLOIDY

DNA ploidy is the measurement of nuclear DNA content material that provides a dimension of gross genetic damage. If the chromosomes are not uniformly distributed to the daughter cells throughout mitosis or if some parts of chromosomes become detached, the chromosomal segregation will become unbalanced and aneuploidy is seen which is normally observed in lots of cancers. Pre-malignant lesions consisting of oral leukoplakias, the nuclear DNA distribution styles can be analyzed by a way of waft-cytometry, showing extraordinary rates of dysplasia, however the quantity of specimens ought to be greater for the examination. Even cytology with DNA-cytometry has emerged as a rather sensitive and non-invasive technique for the early prognosis of oral epithelial neoplasm[6].

V. DNA MICROARRAYS

DNA microarrays involve a single assay that can evaluate the expression of hundreds of genes simultaneously and provide thousands of genetic details in a shorter period of time than traditional PCR techniques[7]. In this technique, thousands of oligonucleotides / DNA fragments are attached in the known sequence of rows and columns in 2D or 3D configuration onto a chip (solid surface) through covalent bonding. The sample RNA would be hybridized and then reverse-transcribed, labelled thus enabling the detection and quantification of specific transcripts. Microarray technique involves cutting the unknown DNA fragments by restriction endonucleases; Fluorescent markers are allowed to react with probes of the DNA chip. The target DNA fragments bind to the probes and are identified by fluorescence emission[8]. The applications of microarrays include: gene expression analysis, transcription factor binding analysis and genotyping. In OSCC, microarray helps in identification of single-nucleotide polymorphisms (SNPs), gene mutations, identification of cancer biomarkers, and genes for chemo resistance and drug discovery. Some of the limitations of microarrays are they provide indirect measure of relative concentration, the signal is linear only over limited range of concentration in the given solution and genes that are not yet annotated on the genome will not be represented on the array. Though gene identification is done in a single step, it requires extensive and long term labor and also preservation of DNA[7].

VI. LAB ON A CHIP

Lab-on-a-chip (LOC) is a completely unique microelectromechanical system that can be used to identify protein and ribonucleic acid (RNA) biomarkers. Microfluidic technology also called lab-on-a-chip or micro-total-analysis system (TAS) is the adaptation, miniaturization, integration, and automation of analytical laboratory procedures into a single device or “chip”. Microfluidics is often considered as the chemistry or biotechnology equivalent of the silicon integrated circuit chip that has revolutionized electronics, computers, and communications. The detection of dysplastic cells in the chip utilizes membrane-associated cell proteins which might be singularly expressed on the cell membranes in addition to their unique gene transcription profiles[3]. An extensive range of molecular diagnostics, biochemical methods, and immunoassays have been implemented using LOC platforms, such as nucleic acid assays, protein assays, cell sorting, etc., [4]

VII. ARTIFICIAL INTELLIGENCE

In recent years, Artificial intelligence (AI) technology has marked growth and been used in medical diagnoses. AI is a simulation of human intelligence and behavior, consisting of two important divisions, such as machine learning (ML) and deep learning (DL). A clinical study was

conducted, where very low-cost DL–supported smartphone-based oral cancer probe was developed for high-risk populations in rural areas with poor infrastructure. Combined with risk factors, this system provides triage guidance and classified the intraoral-lesion images and paired them into 'suspicious' and 'not suspicious' with sensitivity and specificity between 81% and 95%. This study showcased the potential screening effectiveness of an AI-based technology for healthcare providers such as general practitioners, dentists, and community workers in rural areas. Still, this technology is in its infancy and needed in-depth development for diagnosis and for the prediction of an oral cancer risk[4].

VIII. BIOPSY

Scalpel or punch biopsy and histopathology stay the gold standard analysis of probably malignant issues. The diagnosis of mild and slight dysplasias and backbone of early-degree invasion of carcinoma in situ (CIS) or squamous cell carcinomas (SCC) is dependent upon the variations among the pathologist's findings. Good enough sampling of oral lesions is an essential issue for the histopathological diagnosis of oral SCC. Histopathological modifications can be seen even when visible examination fails to detect an oral lesion clinically[2].

IX. CONCLUSION

In the field of oncology and technology, a lot is happening, and a lot is yet to happen. By now, the diagnostic modalities discussed in this article are mostly in clinical use or commercially available and are showing great promising outcomes in clinical application. Globally, the utilization of these advanced techniques will promote early detection and enhance the patient's survival rate by leading to early intervention[1].

Each diagnostic modality mentioned above discloses its uniqueness of technology and implementation of these will be a breakthrough in the efficacy of oral cancer diagnosis. Accelerating new trends can play a major role in early intervention with less impairment and a better chance of therapy[4].

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