Application of Fluorescence spectroscopy in the field of cancer treatment

Saswata Saha[1] and Kakoli Dutta[2]

[1,2]Institute of Engineering & Management Saltlake, D1 Sector V, Kolkata:- 70091

Email: [1]saswatasaha20@gmail.com,[2]kakoli.dutta@iemcal.com

Abstract

In the present work we have investigated the use of fluroscence spectroscopy in the field of cancer treatment. The disease cancer is a curse to our human world . In most of the cases , the disease is diagonised at the last stage where it is almost impossible to cure the patient .And sometimes the technique of chaemotherapy and radiation does not suits down the patient. The technique of fluroscence spectroscopy has been applied for the diagnosis of multisysterm cancer and it minimizes the need for repetitive biopsy. There are various techniques, in the field of fluroscence spectroscopy but here the process of optical imaging will be discussed.Optical imaging is a technology that measures light produced by biological or chemical moieties.This technique has been applied over animals in research and laboratories. The technique of optical imaging is safe as it is nonradiating and cheap . Our research would mainly focus on the techniques and fluroscent probes.

Keywords: F*luroscence, cancer, moieties, optical imaging*

1. Introduction

The process of optical imaging and spectroscopy is a highly diverse and active field in the field of radiation research. Here we are going to provide an overview of few basic principles and the techniques used in the field of radiation research. There are several potential applications of optical imaging and fluroscent spectroscopy to radiation therapy. Advantages of optical methods include their high specificity and sensitivity, with a wide range of functional endpoints possible.The process is also safe coz it utilizes nonionizing radiation as it provides a relatively safe imaging modality. Although there are some limitations in its applicability of optical method which includes the relatively high scattering in tissue at optical and near infrared wavelengths. Moreover the negative side effects of normal tissue radiation can be potentially monitored by optical methods.

2. Principles of Optical Imaging

The information is obtained by measuring photons originating form a certain target in the process of optical imaging. Photons emit as a result of product of biochemical reaction or as an excitation of fluroscent molecules. The propagation of photons through tissue is determined by several optical parameters including absorption and scattering.

Absorption mainly takes place through biological tissue which absorbs photons collectively known as endogenous tissue chromophore. Haemoglobin, melanins are examples of such chromophore.

The process where photon is absorbed and reemitted at the same wavelength following interaction with different cellular structuires like cell membranes, nuclei or mitochondria is known as elastic scattering.

3. Fluorescence imaging

When an external light source of certain wavelength is used to excite a target fluroscent molecule, the fluroscent molecule during its excitation emits a photon of lower energy at higher wavelength . This phenomenan is called fl;uroscence imaging.

4. Auto fluorescence imaging

The intrinsic fluorescence of endogenous flurophores in cells and tissues which is activated by excitation of light of appropriate fluorescence is known as autofluorescence imaging . It originates from amino acids structural proteins and fluorescent pigments.
This technique can be applied in imaging of cancer tissues. As malignant transformation leads to morphologic and biochemical alternation of the tissue,autofluorescence imaging highlights in optical properties through a shift in intrinsic fluorescence.

5. Active fluorescent probes

This probes mainly consists of large tumour targeted molecules. According to various studies, the feasibility of the fluorescent probes to specifically target tumour lesions with signal to noise ratios.

Fluorescent labelling dyes and kits which are commercially available for labelling and antibodies and small peptides. Fluorescent dyes can be conjugated to nonpeptide molecules. This probe consists of a fluorescent dye conjugated to a glucose molecule.

6. Activable fluorescent probes

Actually these probes do not show any fluroscence activity in their native state . Their composition is mainly of covalently linked pair of flurophores with similar optical characterstics in cell. Transmission of the excitation energy from 1st to 2nd flurophore quenches the fluroscent signals by minimizing background signals.

A series of active fluroscent probes has been developed that are activated by .eproteolytic enzymes

Example :-cathepsins and matrix metalloproteinasaes play a major role in carcinogenis and spreading of tumor

7. Optical Imaging techniques: Planar fluroscence imaging

This technique can be applied in epi - illumination or trans illumination mode. In this method after getting the image, the recorded intensity of the photon emitted is converted into a 2d image.

In epi illumination mode photon originating from a source are captured from an entire animal by applying photographic techniques.

In trans illumination, mode the excitation light source is poisoned on the opposite side of the detector as it results in the excitation and emission light passed through the entire animal. Each measurement represents an average of the tissue volume through which light is passed. This mode contains more information and they are deeply associated with flurophores.

8. Fluroscence molecular tomography

The greek word "tomein" means dissection or cut and "graphein" means write which results in making a meaning of display plane series of steric object.The principle of operation mainly resembles that X-ray of computed tomography, in that tissue is illuminated at different points or projections and the collected light is used in combination with a mathematical formulation that describes propagation tissues.

9. Discussions

The process of optical imaging and spectroscopy is a diverse field in the wide array of technologies and applications. The main advantage of these techniques is that it is able to elucidate the spatiotemporal dynamics of the therapeutic response.As technology develops we can expect that sensitivity , resolution and molecular specificity will continue to improve.

REFERENCES

[1] Haisch C Optical tomography (2012) Annnu Rev Anal Chem, 5 57-77

[2] Ishiwaza T , Fukushima n, Shilabhra (2009) Real time identification of liver cancers by using indocyanine green fl;uroscentimaging,Cancer 115, 2491-2504

[3] Kaizel, EL SNOEKS , (2009) Multimodal imaging and treatment metasis, ClinExpMetastis 26(4) , 371-379