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RESEARCH ARTICLE

Cancer diagnosis by Light Induced Fluorescence Spectroscopy

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ABSTRACT

We collect the samples from 25 patients suffering from the cancer of different organs. The samples were taken from affected portion and the adjoining normal portion of the human body. The 17 samples are from breast cancer. 02 each from tongue and oesaphagous and one each from penis, uterus, kidney and stomach. The collected samples are from the patients of different ages. The cancerous samples were pathologically confirmed by the conventional method.

We record the Light Induced Fluorescence (LIF) spectra emitted from the normal and cancerous tissues and compare with each other. In LIF technique, excitation wavelength is kept constant and emission wavelength is scanned to get the emission spectrum.

In present study, the excitation wavelength was kept constant at 280 nm and emission spectrum was obtained by scanning the emission wavelength from 300-500 nm. The LIF spectra show the distinct features and have got high potential to be utilized as diagnostic tool. In all the LIF spectra, intensity emitted from cancerous tissues is more than that from normal tissues and peaks are observed between 328 nm to 338 nm for different samples. We also calculate the intensity ratio of the cancerous to normal tissues at all wavelengths and plot the intensity ratio against wavelength. The intensity ratio ranges from 1 to 200. By using the intensity ratio of cancerous to normal tissues, we can find the degree of malignancy and discriminate the tissue types. In the present study, we conclude that suitable source wavelength can be used for the mapping of the affected portion and cancer can be diagnosed in an earlier stage.

Key words: - Light Induced Fluorescence (LIF), Cancer.

INTRODUCTION

Cancer in various forms accounts for more than 6.4 million deaths each year all over the world. Survival rates for many cancers are shown to depend heavily on the stage of detection. Early detection is one of the most important factors for all successful therapy of the cancer [1].

Cancer is a leading cause of death in the western world, United States and a number of European countries. Cancer is second leading killer after cardiovascular disease in the European countries. Cancer is second leading killer after cardiovascular disease in the European countries. People of all ages get cancer but nearly all types are more common in middle aged and elder people than in young people.

Malignancies of breast are one of the leading cancers in the world and second among Indian woman. Widely used screening methods, mammography has several disadvantages which include incapability of discriminating malignant condition (high rate of false positives results) and risk of repeated exposure to harmful ionizing radiation [2].

The fluorescence spectrum contains broad peaks and it may give sufficient amount of information to identify the cancer. In many cases the LIF may help in confirming the cancer. More understanding about the fluorescence emission mechanism and use of polarized radiation to excite the cancerous and normal tissues can help in diagnosing the disease in an earlier stage.

In present study, we have recorded the fluorescence spectra of 25 samples out of which 17 samples are from breast, 02 each from tongue and oesaphagous and one each from penis, uterus, kidney and stomach and explored the possibility of the diagnosis of the disease using LIF technique. By using the intensity ratio of cancerous to normal tissues, it is easy to discriminate between the tissue types.

METHODOLOGY

We collect the samples from the affected portion and the adjacent normal portion of different organs from the 25 patients suffering from the cancer. The samples were procured from the RST Cancer Hospital, Nagpur and Dhoot Hospital, Aurangabad.

A commercial spectrofluorometer (SPEX, USA, Fluoromax-II) was used to record the LIF spectra. A xenon lamp of 450 W is used as the excitation source. The light from xenon lamp was incident perpendicular to the sample surface. The size of the sample is approximately of 2 mm X 4 mm. The emitted light was collected at approximately 20^{0} angle with respect to the direction of excitation light.

The grating monochromator is utilized as a spectrum analyzer. The photomultiplier tube is employed as a detector and PC as the event controller, Synchroniser and data analyzer.

The general-purpose spectroflourometer has Xenon lamp as a source of exciting light. Such a lamps are generally useful because of their high intensity at all wavelengths, ranging upward from 250-1000 nm. The instrument shown is equipped with monochromator contains two gratings, which increases the purity of the exciting wavelength. In addition, these monochromators use concave grating, which further decreases stray light. Both monochromators are motorized to allow automatic scanning of wavelength. The fluorescence is detected with photomultiplier tube.

RESULTS AND DISCUSSION

The laser induced fluorescence spectra emitted by the samples and intensity ratio C/N have been displayed in figure 1 and 2. The figures 1 (a,b,c and d) shows the LIF spectra emitted by the samples from breast, penis, uterus and oesaphagous respectively. The figures 2 (a,b,c and d) shows the intensity ratio C/N of the samples from breast, penis, uterus and oesaphagous respectively

In breast tissue spectra, the peak appears at 334 nm and further peaks are observed at 450,466,482 and 492 nm. The difference in intensities between cancerous and normal tissues is more at 334 nm than at other peaks. The maximum intensity ratio of cancerous to normal tissues is 4.5 and corresponding ratio at pulsed nitrogen wavelength (337.1 nm) is 4.4.

The emission bands at 290 nm, 340 nm, and 440 nm can be attributed to the increased concentration of amino

acids, tryptophan and NADH in cancerous tissues respectively.

Earlier studies on autofluorescence from human breast tissue revealed that the relative concentration of some fluorophores particularly NADH was higher in malignant breast tissue compared to normal breast tissue. Cancerous cells have more concentration of NADH. The results of the ezcitation/emission spectroscopic studies on human cancerous and normal breast cells suggest higher concentration of tryptophan and NADH in cancerous cells compared to normal cells [3].

In penis tissue, the peak appears at 338 nm and further peaks are observed at 450,465,482 and 492 nm. The difference in intensities between cancerous and normal tissues is more at 338 nm than at other peaks. The maximum intensity ratio of cancerous to normal tissues is 3.6 and the corresponding ratio at pulsed nitrogen wavelength is 2.1.

In uterus tissue spectra, the peak appears at 338 nm and additional peaks are at 436,452,466,480 and 488 nm. The difference in intensities between cancerous and normal tissues is more at 338 nm than at other peaks. The maximum intensity ratio of cancerous to normal tissue is 4.0 and corresponding ratio at pulsed nitrogen wavelength is 3.8.

In oesapharagous tissue spectra, the peak appears at 328 nm and next peaks are observed at 442,454,468,475,482,492 and 496 nm. The difference in intensities between cancerous and normal tissues is more at 328 nm than at other peaks. The maximum intensity ratio of cancerous to normal tissues is 1.5 and corresponding ratio at pulsed nitrogen laser wavelength is 1.34 [4, 5].

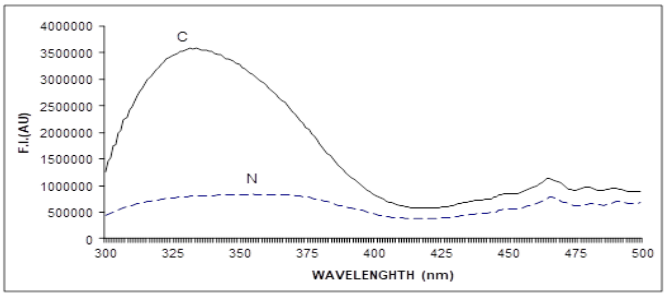

Figure 1 (a): LIF spectra of cancer and normal tissues of Breast cancer

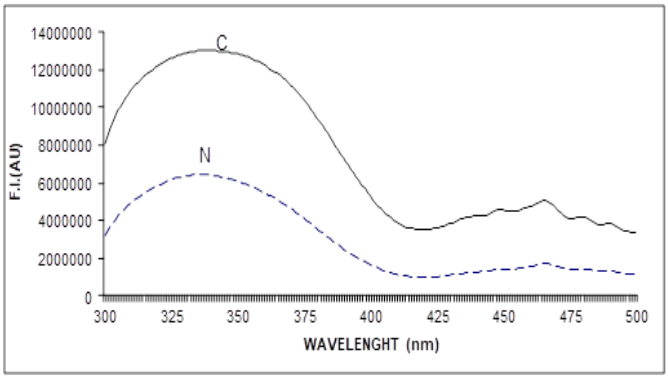

Figure 1 (b): LIF spectra of cancer and normal tissues of Penis cancer

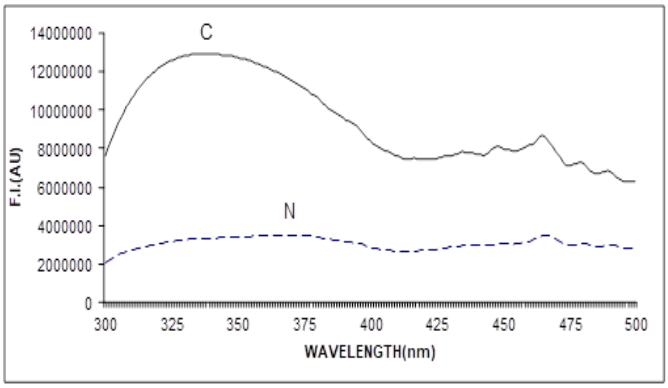

Figure 1 (c): LIF spectra of cancer and normal tissues of Uterus cancer

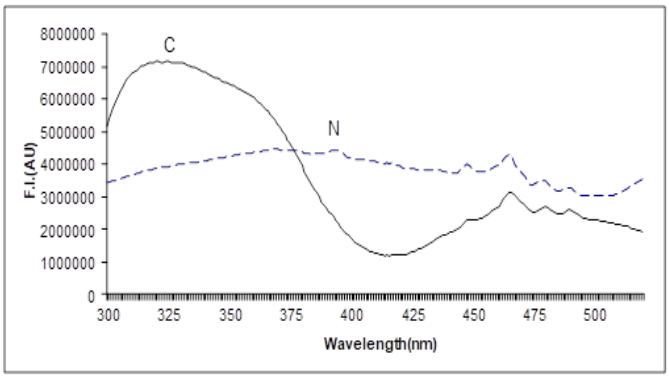

Figure 1 (d): LIF spectra of cancer and normal tissues of Oesaphagas cancer

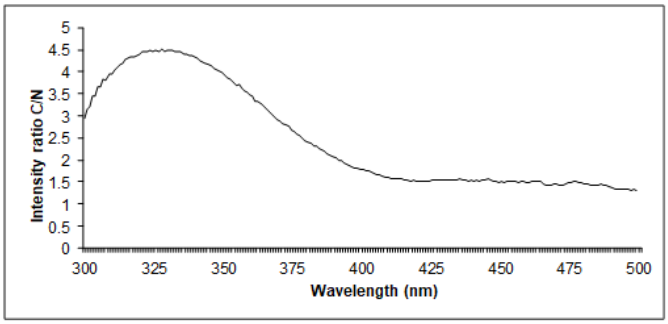

Figure 2 (a): Intensity ratio C/N of Breast cancer of LIF spectra

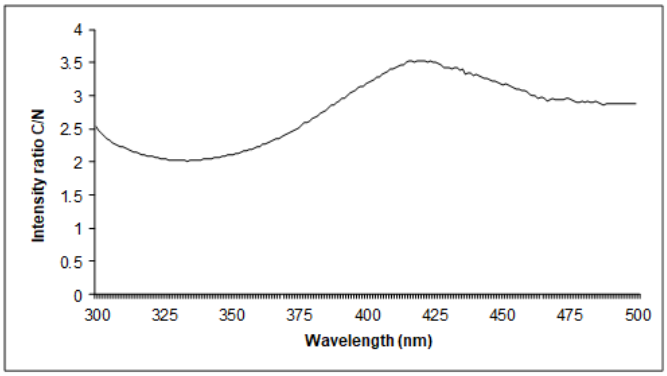

Figure 2 (b): Intensity ratio C/N of Penis cancer in LIF spectra

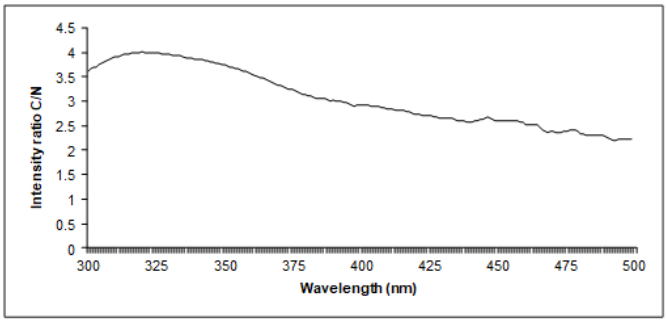

Figure 2 (c): Intensity ratio C/N of Uterus cancer in LIF spectra

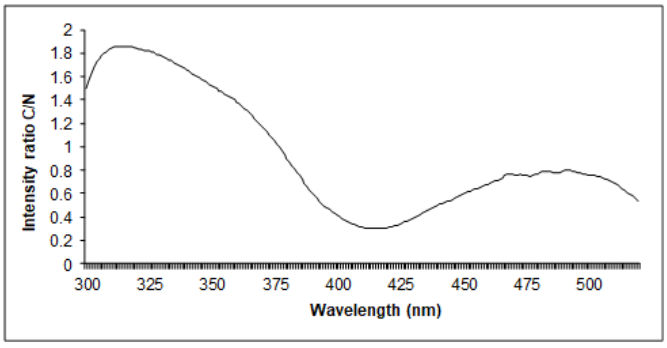

Figure 2 (d): Intensity ratio C/N of Oesaphagous cancer in LIF spectra

In most of the cases, the fluorescence intensities of cancerous tissues were always observed to be much higher than the normal tissues.

CONCLUSION

The most of the groups of workers have studied the LIF spectra of breast cancer and oral cancer and analysed them. But we have recorded the LIF spectra of different organs such as breast, penis, uterus and osephagous and compared them. By the comparison of these spectra, we observe that the fluorescence intensity emitted from cancerous tissues is more in the wavelength range 328-338 nm than the other wavelength range and therefore, the pulsed nitrogen laser wavelength is suitable for the mapping of the affected portion. Thus nitrogen laser has got the potential of non-invasive diagnostic tool for the detection of cancer.

The most important feature of the LIF is that, the technique is non-invasive and in vivo recording of the spectra may be obtained. The technique may be employed to record the LIF spectra from the interior part of the body without removing it from the body. The degree of malignancy and stage of the cancer can be studied by using this technique.

Conflicts of interest: The authors stated that no conflicts of interest.

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