ABSTRACT

Cancer is the uncontrolled growth of abnormal cells. If not detected and treated at the early stage cancer would become fatal. Breast cancer remains the second leading cause of cancer induced deaths, despite the advances taken place in treatment methods. The incidence of breast cancer in India is on the rise that one in 22 women in India is likely to suffer from breast cancer during their lifetime. One in eight women is affected by this dangerous disease in America.

According to a new report released by the Australian Institute of Health and Welfare (AIHW) and the National Breast Cancer Centre (NBCC), survival from breast cancer is very high in women whose cancer has been diagnosed at an early stage. The Australian Institute of Health and Welfare, 2011 studies report that as India becomes westernized, the incidence rate for breast cancer increases. A 2005 study conducted by the International Association of Cancer Research, based in Lyon, France, projected that there would be 250 000 cases of breast cancer in India by 2015, a 3% increase per year and currently, India reports roughly 100 000 new cases annually. Breast cancer accounts for 17.2% of all cancer deaths and 22.2% of all new cancer diagnosed among women in India and breast cancer in urban areas of India is three times higher than in rural parts of the country.

According to Indian Council of Medical Research, the number of breast cancer cases in India would rise to 106,124 in 2015 and to 123,634 in 2020. Early detection of the disease increases the percentage of survival, avoids breast removal and saves the normal life style of the patients. Though there are several diagnostic methods, each method is having its own merits and
demerits. Presently clinical examination and X-ray mammography are used for
detecting breast cancer. Clinical examination suffers a sensitivity of 65%.
Survival for cancers detected by CBE are somewhat less (59% to 84% at 10
years) compared to those detected by mammography alone (77% to 93%).
Only by using better techniques and taking a longer time to do the
examination, the accuracy of CBE is increased. X-ray mammography is
inexpensive and reliable but the patient is exposed to ionizing radiation and
the test is uncomfortable to the patient for the breast is compressed. For soft
tissues like human breast, X-ray cannot image the breast anomalies at an early
stage, since there is no significant variation in density between normal and
malignant breast tissues.

Breast density leads to false-negative findings in mammography. In
addition, mammographically dense breast tissue has been identified as an
independent marker strongly associated with breast cancer risk and in
particular with higher risk of interval cancer, i.e. cancer detected between
screening tests. As the young women have dense breast generally,
mammography is not effective. But it is very much important that young
women need to be screened for early breast cancer since dense breast is an
independent biomarker for breast cancer and breast cancer becomes fatal if it
affects them. The 5 year survival is 87% and the 10 year survival is 81% for
women in 50-64 age group where as the 5 year survival is 72% and the 10
year survival is 63% for women in 34 and under age group.

A woman whose breast cancer is detected before it has spread beyond
its original location has more chances of survival than a woman whose cancer
is detected at a later stage. The only solution to this problem is to screen the
women for breast cancer. Despite the fact that the mammograms require very
small doses of radiation, repeated X-rays have the potential to cause cancer. Hence there is a need for a non invasive, safe and comfortable method to detect early breast cancer. If the breasts are dense or with implants, it is very difficult to obtain adequate images by mammogram. Hence thermogram can be used as a tool for breast cancer detection. Using thermogram is a simple, safe and comfortable method for breast cancer detection. Since breast is not compressed in this, it can be used conveniently for young women or whom mammography is not very effective. Thermographic imaging of breast is a non contact, non invasive technique and can be easily used outside hospitals. But conventional thermographic detection method suffers from false positives in findings.

Despite the fact that thermal asymmetry between contra-lateral regions of the breasts with temperature differentials of more than 1° c is taken as a sign of cancerous growth in conventional thermographic detection method, a temperature difference of 2° c between breasts is common among women and occasionally a temperature difference of up to 3.5 °c is also found. This leads to false positives in findings. Though thermographic method for breast cancer detection seems to be superior to other techniques in many respects, the passive thermographic method suffers from the problem of false positives, due to which the effectiveness of early detection suffers.

The overall objective of this research work is to propose a non invasive technique to obtain an active thermogram to diagnose breast cancer at early stage that would reduce the false positives. This leads to the objective of producing active thermograms of phantom models using experimental values obtained from various irradiation techniques and to prove the validity of the proposed method to find out the impact of the various irradiation
techniques. Far Infra-red irradiation technique, Microwave single irradiation technique, Hybrid irradiation technique, Microwave double and multiple irradiation techniques, Hybrid multiple irradiation technique were the irradiation techniques tested in this research work. The results obtained from the various irradiation techniques were compared to suggest the suitable irradiation technique for obtaining the active thermogram.

An active thermogram is obtained by irradiating the patient’s breasts using an external source and allowing the breasts to cool naturally before taking the thermogram. The conductive heating and FIR heating techniques increased the temperature difference between the normal and cancerous breast phantoms to 2°C for a temperature difference of 1 °c between them before irradiation. Microwave single irradiation technique produced 4°C temperature difference between the normal breast phantom and the cancerous breast phantom for a temperature difference of 1 °c between them before irradiation. Hence FIR, Microwave single irradiation techniques may lead to early diagnosis of breast cancer. Since the proposed Hybrid irradiation, Microwave Double irradiation methods increased the temperature difference between the normal and cancerous breasts tissue phantoms to about 5.75 °c, 6.75°C for a temperature difference of 1 °c between them before irradiation, these methods would reduce the false positives in addition to early detection of the disease. Since the third irradiation itself was found to be not superior to double irradiation technique, Microwave multiple irradiation and Hybrid multiple irradiation techniques may not produce significant increase in the temperature difference between the normal and the cancerous breast tissues.