



Review Article

VALIDATION OF SCREENING MODEL OF BREAST CANCER: A REVIEW

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ABSTRACT

Globally, Breast Cancer is mostly detecting in women's due to family history, obesity, irregular menstruation, intake of alcohol/tobacco, etc. When uncontrollable grow of cells in breast which turns into cancer, occur at lobules or duct of breast. Various indications are seen like – appearance of lumps, swelling, size & color of breast is change, unusual discharge, etc. Breast cancer can be diagnosis by oneself by doing some physical activity and by advance modern technology can help to detect the cancerous cells. Mammography and Sonography is the initial diagnosing method to detect the cancer cells without any incision or inserting tools into the breast. Doctors or trained healthcare observe the tumor i.e. it's benign or malignant after that screening model is use to confirmation of the tumor.

Key words: Breast Cancer, Screening Model, Tumor

INTRODUCTION

Breast cancer is the second most cause of death (2.09 million) worldwide after lung cancer¹. Breast cancer is spread rapidly and most common cancer in women worldwide and cause major death cases from this cancer among women² but men can get breast cancer too. India is a culturally rich and diverse country with a current population of 1.33 billion. Although relating to about community health non-communicable diseases are assuming significant in developing countries, where at present cancer is leading cause of death. Recently rise in incidences of risk factors of breast cancers due to urbanization, life expectancy, lifestyles and interaction pattern of people with environment and chemical causes leading to the onset of these non-communicable diseases.

Breast cancer refers to cancer that originates from breast tissue, most frequently from the inner lining of milk ducts or the lobules that supply the ducts with milk³.



Fig 1: Breast Cancer Cell⁴

Usually, breast cancer either starting from cells of the lobules, which are the milk-producing glands, or the ducts, the passages that drain milk from the lobules to the nipple, but breast cancer rarely start from stromal tissues, which include the fatty and fibrous connective tissues of the breast.

SYMPTOMS OF BREAST CANCER

- Lump in breast or underarm
- Dimpled or depressed skin
- Swelling in your armpit or near your collarbone
- Nipple inversion
- Pain and tenderness in breast
- Change in breast color
- Pitting of the breast skin
- Changes in your nipple
- Unusual nipple discharge (Bloody discharge)
- Skin irritation or textural change
- A marble-like area under your skin

Breast lump - Breast lump is the most common sign and reported in about four-fifths of all women (83%)⁵. Uncontrolled growth of tissues in breast which form hard stone like structure called lumps.

The next most reported presenting symptoms were nipple abnormalities (7%), breast pain (6%), and breast skin abnormalities (2%)⁵.

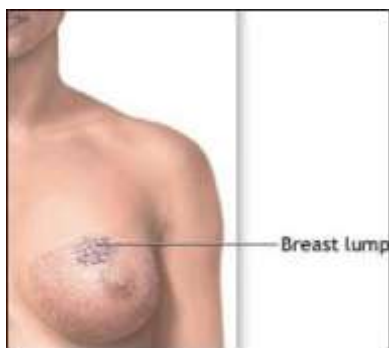


Fig 2: Breast Lump⁶

Nipple retraction - Nipple retraction, which can also be called nipple inversion, invaginated nipple, or inverted nipple, i.e, when the point of the breast to be turned inside or become inverted. When the tumor attacks the duct behind the nipple, it leads to nipple retraction⁵.

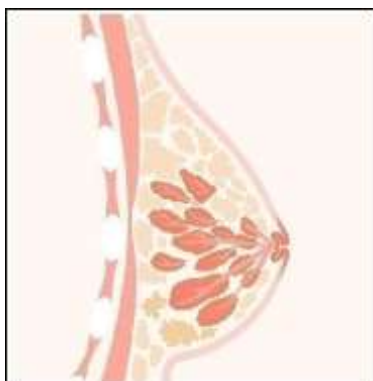


Fig 3: Nipple Retraction⁷

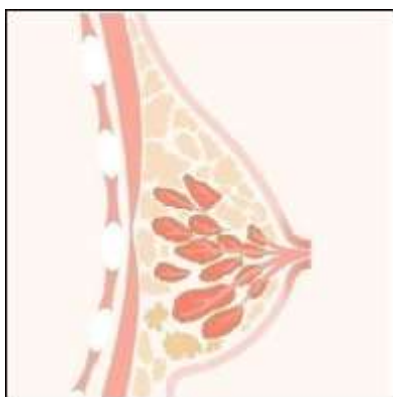


Fig 4: Nipple Unretraction⁷ (normal)

Change in breast shape and size - The size or shape of the nipple might be affected by natural changes or any changes in the body weight⁸. Changes in the breast size and shape after puberty may be a symptom of the swelling of the milk ducts or lobes deep within the breast and can be due to regular monthly hormonal cycles, fibrocystic breast cancer or a warning sign of a more serious disease^{9,10}.



Fig 5: Change in Breast Shape and Size¹¹

Breast Pain - If you are having breast pain, note whether it is changing with your monthly period, and if it is present in one or the two breasts. Even though it feels normal, it can be uncomfortable, and it might not be worrisome⁸.



Fig 6: Breast Pain¹²

Changes in Breast Color - Discoloration of Breast is an earlier sign of Breast Cancer. Color of Breast become red, pink or purple at some small section. In some cases, discoloration can look like a bruise, so you might shrug it off as nothing serious. But redness in breast is a symptom of Inflammatory Breast Cancer¹³.

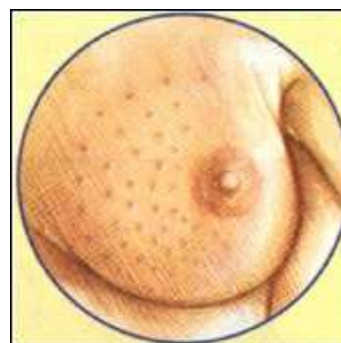


Fig 7: Change in Skin Color or Texture

ETIOLOGY OF BREAST CANCER

- Age
- Marital status and parity
- Menarche and menopause
- Weight and height
- Diet
- Endocrine factors¹⁸
- Physical activity
- Alcohol consumption and tobacco smoking

- Breastfeeding¹⁹
- Genetic
- Family history
- Environmental Factor

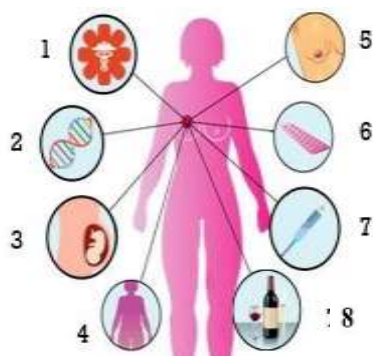


Fig 8: Causes of Breast Cancer²⁰

1. Family History
2. Gene Mutation
3. Late Childbearing

4. Early Menstruation & Late Menopause /obesity
5. Increased Breast Density
6. Prolonged use of oral contraceptives
7. Hormone replacement therapy after Menopause
8. Alcohol Intake/Tobacco

RISK FACTOR FOR BREAST CANCER

Risk Factors You Can't Change

- **Being a woman** – Women has a more chances for the breast cancer as compare to Men.
- **History of breast cancer** – if the women already suffering from Breast Cancer in one breast (Ductal Carcinoma In Situ (DCIS) or Invasive Breast Cancer) so, there are more chances to develop a new breast cancer which different from the previous (at other breast or another part of the same breast¹⁵).
- **Age** – Increasing age in women may risk of Breast Cancer¹⁶. 77% of women detect Breast Cancer at 50 and 40% cases at 65 and older age¹⁵.
- **Direct family history** – If women have a Blood relative with this Cancer have a higher risk for Breast cancer¹⁶. But in male have a close blood relative with these diseases will also have a high risk to affect¹⁵.

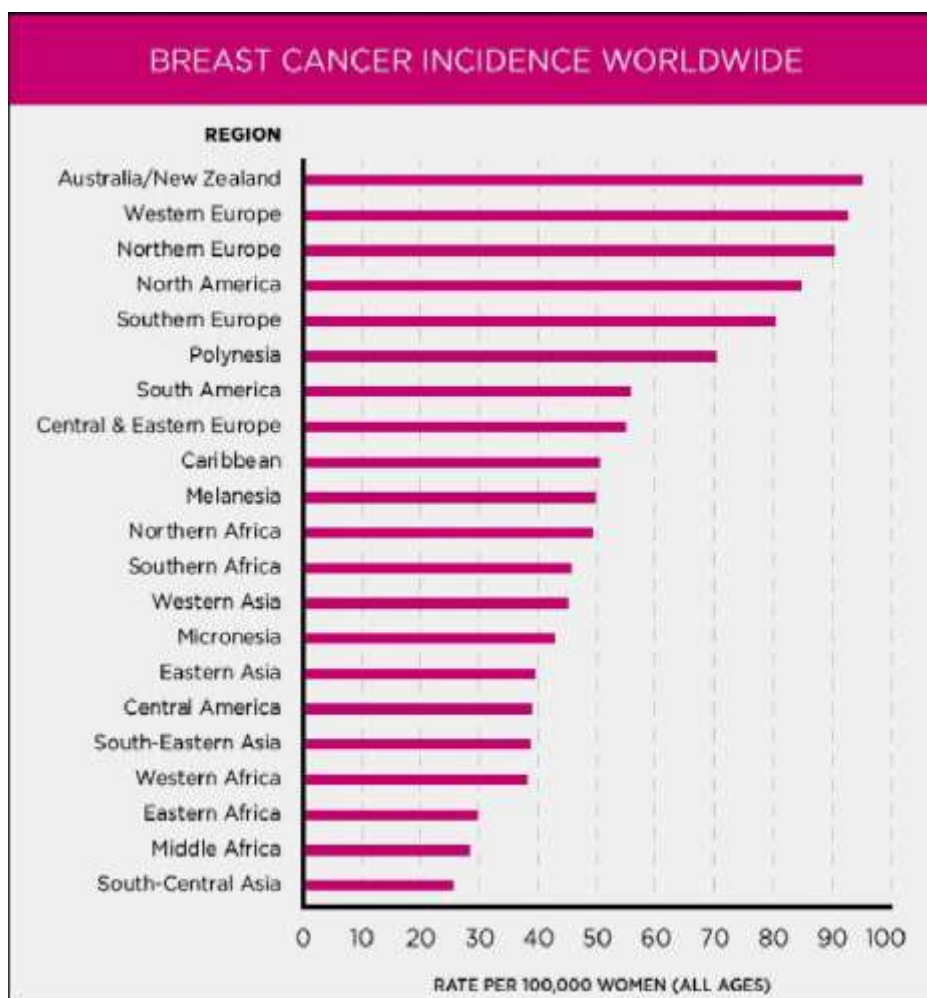


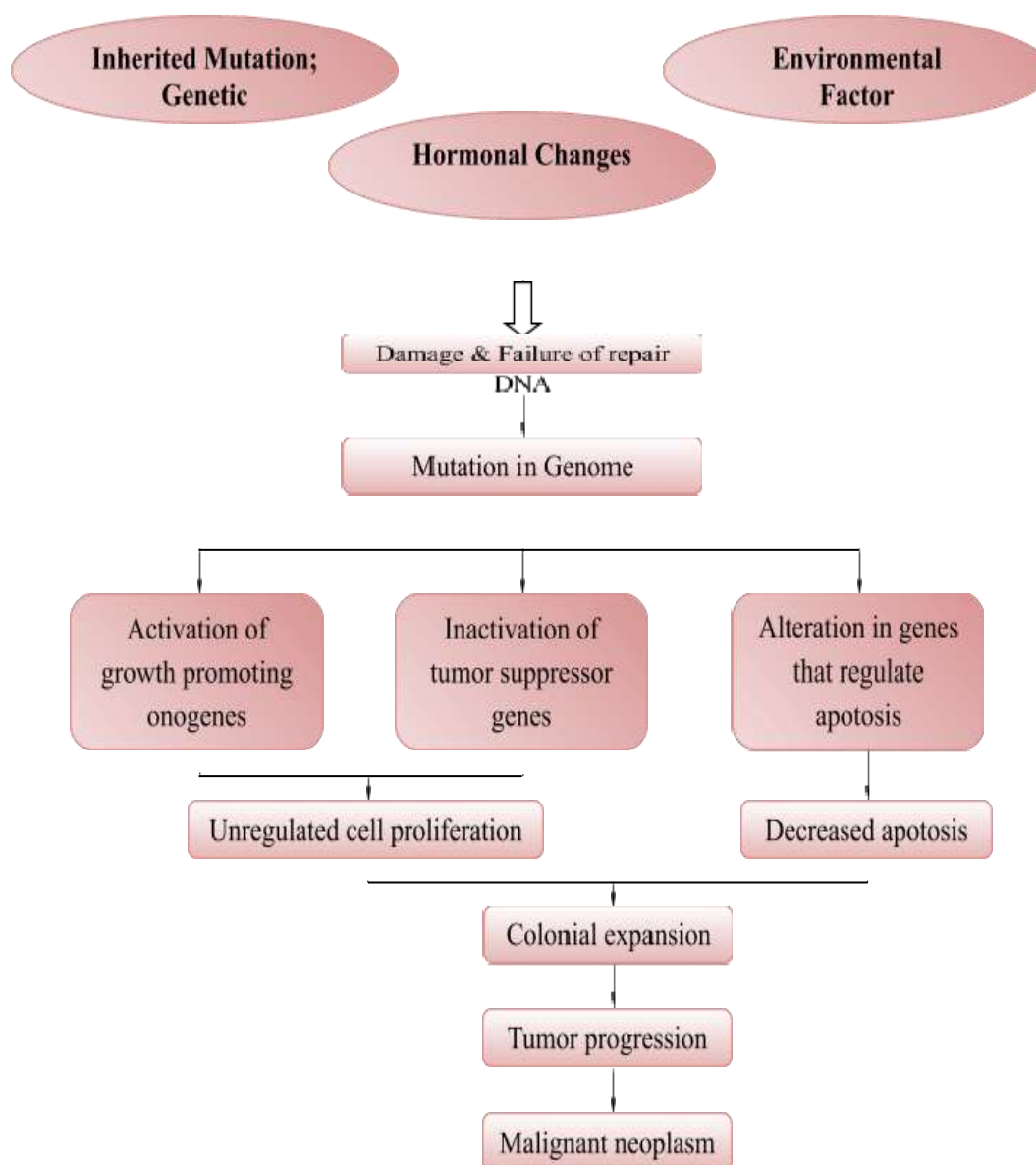
Fig 9: Breast Cancer Statistics²¹ (of all Ages)

Risk Factors You Can Change

- **Weight** – If women gain weight or being overweight after menopause has a high risk of Breast Cancer¹⁵.
- **Drinking alcohol** – Habitually drinking of alcohol having more risk for Breast Cancer¹⁷.

- **Hormone replacement therapy (HRT)** – HRT use for menopause, this therapy having high risk for Breast Cancer and may be detected at more advanced stage¹⁷.
- **Reproductive History** – Women having her first child after 30 age or never get pregnant (full-term pregnancy) get more risk for Breast Cancer¹⁵.

PATHOPHYSIOLOGY OF BREAST CANCER



Pathology pathway for Breast Cancer²²

SCREENING MODELS FOR BREAST CANCER

Various screening model are developed. This model helps to ascertaining Breast Cancer at early stage. Following models are using for the detection of Breast Cancer:

- Breast self-examination
- Breast exam by a health care provider
- Mammography
- Ultrasound
- Magnetic resonance imaging (MRI)
- Positron emission mammography (PEM)

- BREAST-SPECIFIC GAMMA IMAGING (BSGI)
- THERMOGRAPHY
- BIOPSY

BREAST SELF-EXAMINATION – This technique involves the woman herself looks & feeling of each breast for possible lumps,

distortions or swelling²³. Doctors recommend to each Woman for performing monthly Breast Self-Examination. This assist, to know the existence of cancerous lumps and get diagnosed by specialists and get better treatment for breast cancer at early stage²⁴. Breast Self-Examination has been universally promoting but analyzer have been unable to determine the confirmation of reducing the rate of Breast Cancer²⁵.

Steps for Breast Self-Examination:

By Looking

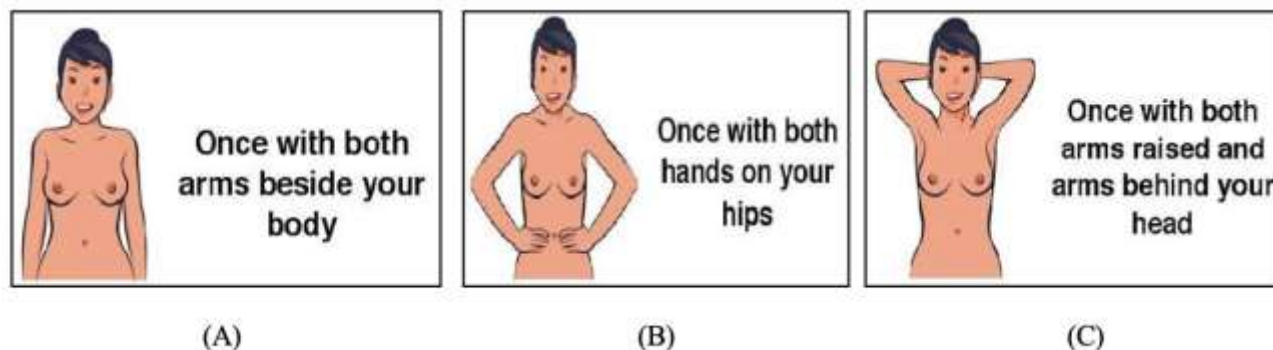


Fig 10: Stand before a mirror and look at both breasts and nipples²⁶.

By Touching

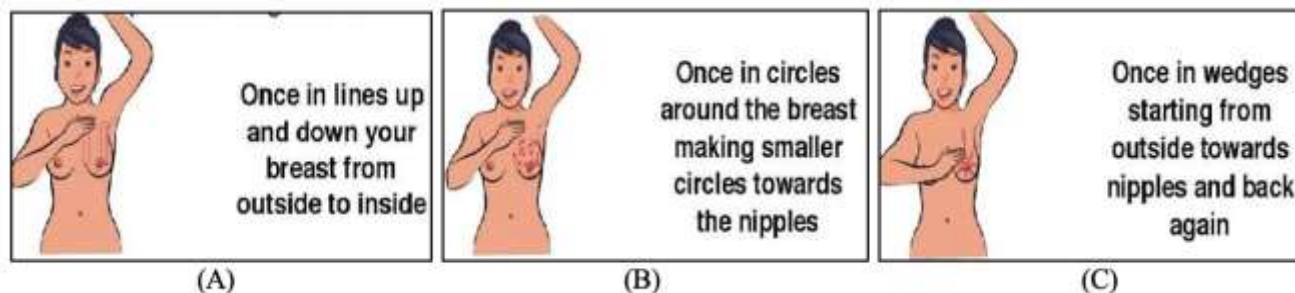


Fig 11: Raise your left arm. Use the pads of your 3 or 4 fingers at the right hand to examine your left breast. Repeat on the right side²⁶.

While Lying Down



Fig 12: Lie on your back, left arm over your head and pillow under your left shoulder. Examine your left breast with your right hand as described before. Repeat for the right side. This position flattens the breast and makes it is easier to examine²⁶.

BREAST EXAM BY A HEALTH CARE PROVIDER – A Clinical breast examination (CBE) is a physical examination of the breasts and under the arm by the well professional healthcare trainer^{24,27}. During routine checkup. The National Comprehensive Cancer Network (NCCN) instruct the healthcare trainer to examine carefully, feel the patients' breasts, underarm and the area just

below your clavicle (breastbone) for any changes or abnormalities (such as a lump)²⁸. Clinical breast examination doesn't reduce the Breast Cancer Dead Rate. If a lump is observed in the breast or underarm, instantly contact to the specialist for the diagnostic testing²⁴.



Fig 13: Doctors examine patient ²⁸



Fig 14: Clinical breast examination³⁰

MAMMOGRAPHY – Mammography is done by using low-energy X-rays (around 30 kVp) to analyze the human breast for diagnosis and screening. The main goal of Mammography is to investigate Lumps in Breast/Breast Cancer at early stage^{24,30}. But mammography is not a successful technique to investigate breast cancer in younger & pre-menopausal women. A breast tissue tends to be denser than post-menopausal women, and it's hard to read mammography results by the specialists. Also, breast cancers seem white in a mammogram because young breast tissue is also white, but as the breast ages and become fatty, it shows up dark on breast imaging, so, that breast cancer easily recognize²⁴.

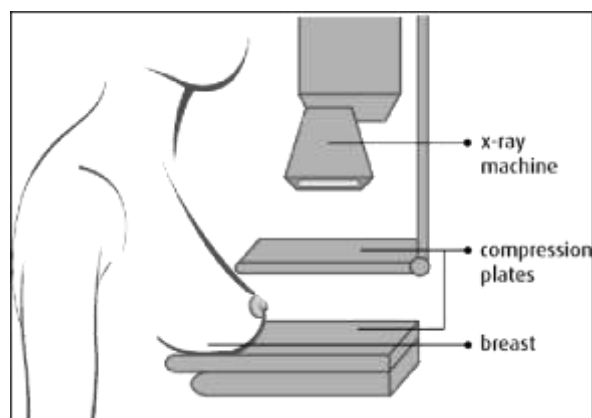


Fig 15: Mammogram³²



Fig 16: Physician examine Patient through Mammogram³³

PROCEDURE FOR MAMMOGRAPHY^{34,35}

- This procedure taking about 30 minutes.
- Breast is compressed between the 2 parallel plates of Mammogram machine. Decreases the thickness of breast tissue to increase the image quality of tissue that X-rays must be

penetrate, reduce the amount of scattered radiation, lower the requirement of radiation dose and grasp the breast.

- There are two types of mammogram studies: Screening Mammograms and Diagnostic Mammograms.

Screening Mammograms – it includes 2 standard X-rays images {both head-to-foot view (craniocaudal, CC) and angled side-view (mediolateral oblique, MLO)}. this process is done for those patients who presents with no symptoms.

Diagnostic Mammograms – it includes 4 standard X-rays images that is (2 views of) screening mammograms views and other views, including geometrically magnified and spot-compressed views of the area of concern.

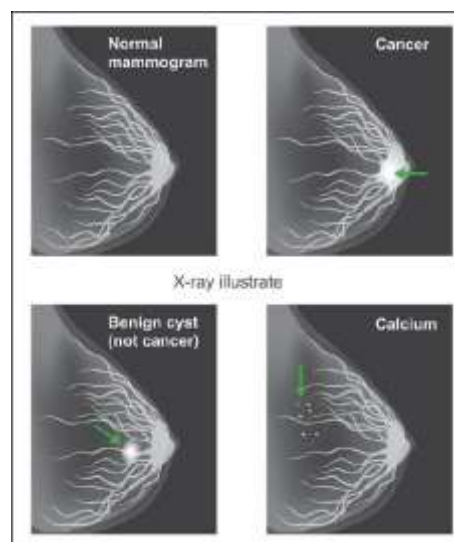


Fig 17: Mammography images³⁶

ULTRASOUND –Ultrasound imaging are also known as Sonography, Breast Ultrasound uses high frequency sound waves to produce a computer image of the internal breast, it clearly shown the breast changes and distinguishing solids from liquids such as solid tumors fluid-filled cysts, that are not detect in mammograms^{24,37}. Ultrasound can also assist for the Biopsy. Ultrasound is also used to diagnosis dense breast tissue, whether it is cancer formation or normal aggregation of cells/tissues³⁸.



Fig 18: Ultrasound³⁹



Fig 19: Ultrasound Image⁴⁰

MAGNETIC RESONANCE IMAGING (MRI) – Generally, MRI used for women who have been diagnosing Breast Cancer, to help measure the size of tumor/lumps for better planning of surgery⁴¹. Breast Magnetic Resonance imaging uses radio waves and strong magnets to construct elaborate images of the internal of the breast⁴² but it doesn't use ionizing radiation (X-rays) but does require an intravenous contrast injection. It's very effective in detecting Invasive Breast Cancer but it also falsely detecting benign lesions as malignant⁴⁴.

How does a breast MRI work?

- Women/Men lies face down, with her/his breast position openly in the table of the MRI machine
- The technician, monitoring the patient through MRI window.
- Generally, it requires an intravenous contrast injection into a vein of arm just before the procedure. This dye helps to create clear images of abnormalities more easily.

MRI report used with mammography and sonography of breast can use as diagnostic tool. Recent research has been found that MRI can locate some small breast lesions which missed by mammography and ultrasound⁴³.



Fig 20: Magnetic Resonance Imaging⁴⁴

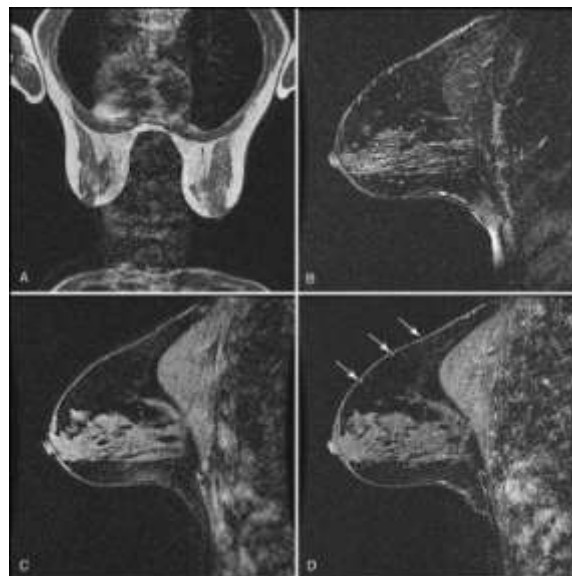


Fig 21: Magnetic Resonance Imaging⁴⁵

POSITRON EMISSION MAMMOGRAPHY (PEM)–PEM is a nuclear medicine imaging modality used to recognizing the characteristics of breast cancer with high resolution image^{46,47}. PEM has been approved by the US Food and Drug Administration and give approval to use as additional diagnostic reference with mammography and ultrasound of breast cancer usually, to identify small invasion cancers and ductal carcinoma insitu (DCIS). In this technique gamma rays are use to detect “hot spots” of rapid growth cancerous cells after injected of fluorine-18 fluorodeoxyglucose (F-FDG) but PEM is not broadly available because research is still going on it and may not be covered by any type of insurance. It may sometimes use for preoperative evaluation in breast cancer patients^{24,47}.



Fig 22: Positron Emission Mammography⁴⁸

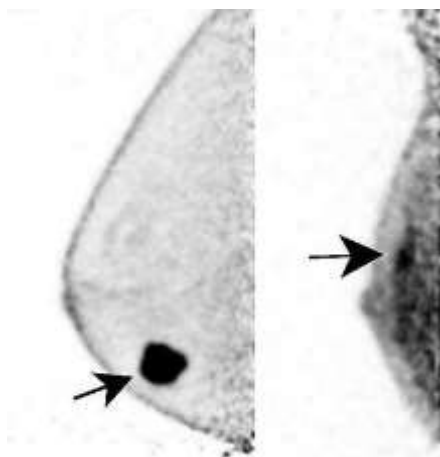


Fig 23: PEM breast cancer image⁴⁹

BREAST-SPECIFIC GAMMA IMAGING (BSGI) – This is Molecular based imaging technique in which radioactive tracer is used to detect cancerous cells^{24,35}. BSGI is used to functional difference between tumor and normal cells because of injected radioactive tracer⁵⁰. BSGI is not broadly available and need more research on the working of it. And it may not be covered by insurance²⁴.

Procedure⁵¹

- Small amount of radioactive substance is injected to women/men.
- Then, gamma camera captures the image of breast.
- But in Breast-Specific Gamma Imaging and Positron Emission Mammography needs very high doses of radiation so it is not good for routine screening of breast cancer. Sometimes it may use for preoperative evaluation in breast cancer patients²⁴.

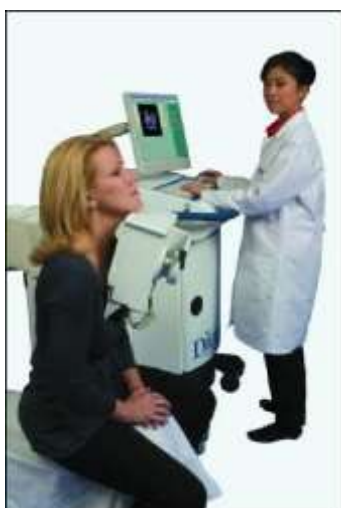


Fig 24: Breast-Specific Gamma Imaging⁵²



Fig 25: Breast image in Breast-Specific Gamma Imaging⁵³

THERMOGRAPHY – Thermography is a technique in which temperature of breast is measured on the surface of breast skin. Thermography has been available for several decades, but there is no proof to said that it is good screening tool to detect breast cancer early (when cancer can be treated)⁵⁴.

Thermography is based on two ideas:^{24,54}

- Breast cancerous cells have high temperature than the normal cells because of fast blood flow and higher metabolic rate.
- Due to higher metabolic rate and blood flow increases the temperature of skin.

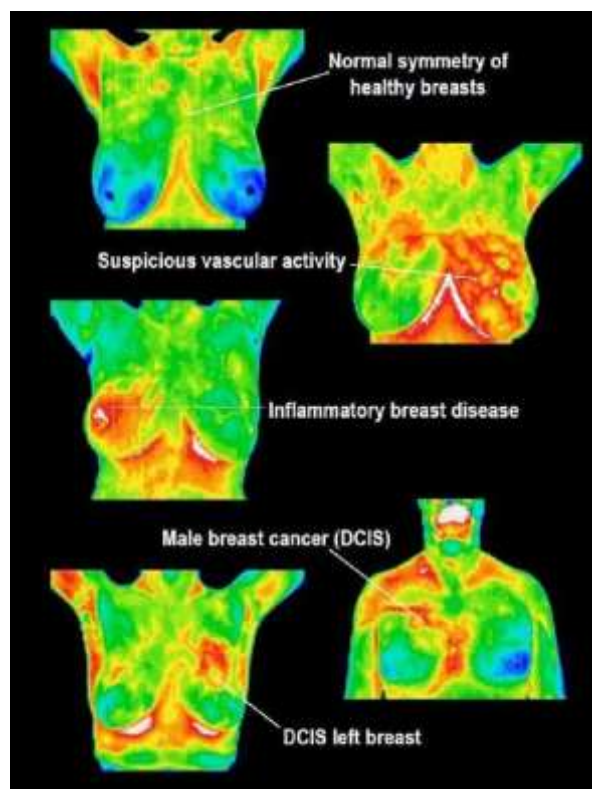


Fig 26: Measuring the temperature of breast by infrared radiation⁵⁵

BIOPSY – Biopsy is a screening test for detecting breast cancer by removing a small living tissue or sometimes fluid from suspicious area with the help of fine-needle (fine needle aspiration cytology {FNAC}). Living cells/tissue analyze under the microscope to check the presence of breast cancer. This technique has a severe risk of seeding tumor cells either into the interstitial tissue fluid

from where it is carried to lymph nodes, or into the veins draining the tissue from where they enter the vasculature and may travel to lodge into any organ or tissue and also the risk of pulling out the cells through needle of surgical incision which increases the chance of spreading cancer^{56,57}.

Types of biopsy [58]-

- Fine needle aspiration (FNA) cytology
- Core needle biopsy (CNB)
- Vacuum assisted breast biopsy (VABB)

Fine needle aspiration (FNA) cytology – This technique is done through skin to diagnosis breast cancer by taking sample of fluid or tissue from the lumps or cyst through fine needle and then examine under the microscope^{58,59}. This is quite easy, safe and cheap first line diagnostic method by all doctors, before incision. Fine needle aspiration (FNA) cytology report helps to give direction in treatment. Benefits of Fine needle aspiration (FNA) cytology⁶⁰:

- Rapid diagnosis
- Comfortable process for the patient
- Allow to detect the begin tumor which don't need incision
- Painless, no local anesthesia is required



Fig 27: Fine Needle⁶⁰

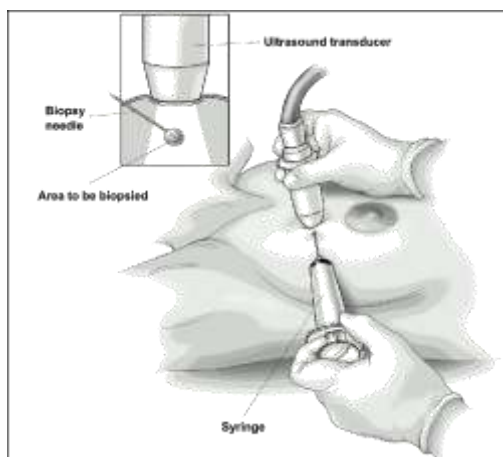


Fig 28: FNAC with Ultrasound⁶¹

Core needle biopsy (CNB) – CNB is another technique done through skin and it is more popular method than FNA because of large tissue sample collecting. This is done with Ultrasound for locating exact position of lumps. Needle fixed with spring-loaded sheath to move the needle in and out of the tissue rapidly and/or tissue attached to aspirator that helps to pull out breast tissue into the needle. Sometimes seems Core Needle Biopsy cause swelling & bleeding due to enlargement of breast lump after this process⁶².

Vacuum assisted breast biopsy (VABB) – It is special type of core needle biopsy in which hollow probe is set at small cut on breast lumps. This technique is more popular then FNAC and CNB because many samples are collected from the same site of cut⁶³.

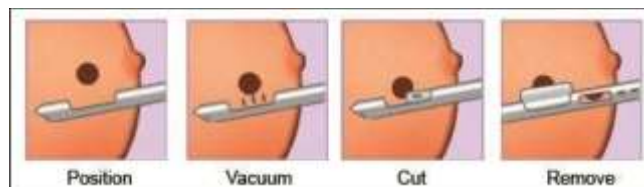


Fig 29: Vacuum assisted breast biopsy⁶³

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