

Frontiers in Multidisciplinary Research and Studies

journal homepage: <https://openj.edwiserinternational.com/index.php/fmrs>

Review Article

A Review on Breast Cancer Treatment & their Management

Ravikant Thakur¹, Shantanu Ranjan^{1*}, Manish Kumar², Pankaj Kumar³, Basit Fazal²

¹Department of Pharmaceutics, Nibha Institute of Pharmaceutical Sciences, Rajgir, Nalanda, India

²Department of Pharmacology, Nibha Institute of Pharmaceutical Sciences, Rajgir, Nalanda, India

³Department of Pharmaceutical Chemistry, Nibha Institute of Pharmaceutical Sciences, Rajgir, India

ARTICLE INFO

Received: 17 September 2026

Revised: 20 October 2026

Available Online: 24 October 2026

*Corresponding author:

Shantanu Ranjan, Department of
Pharmaceutics, Nibha Institute of
Pharmaceutical Sciences, Rajgir, India.

ABSTRACT

Cancer remains one of the most complex and devastating diseases, characterized by uncontrolled cell growth and the ability to invade and metastasize. Over the past two decades, significant progress has been made in understanding cancer at the molecular level, particularly the roles of proto-oncogenes and tumor suppressor genes in regulating cell proliferation. Mutations in these genes disrupt normal cellular mechanisms, leading to malignant transformation. Breast cancer, the most prevalent cancer among women worldwide, exemplifies the interplay of genetic, hormonal, and environmental factors in disease development. Familial clustering and mutations in BRCA1 and BRCA2 genes highlight the genetic predisposition, while lifestyle and environmental influences serve as modifiable risk factors. Breast cancer manifests in diverse forms, ranging from non-invasive ductal carcinoma in situ (DCIS) to invasive ductal carcinoma (IDC), which accounts for the majority of cases. Less common types, such as medullary, mucinous, and inflammatory breast cancers, present unique clinical challenges. Early detection through screening and awareness of symptoms—such as lumps, nipple discharge, and skin changes—remains critical for improving survival outcomes. Advances in systemic therapies, including hormone-targeted treatments, have contributed to declining mortality rates in developed nations. However, disparities in awareness, access to healthcare, and treatment outcomes persist globally. This chapter emphasizes the importance of integrating molecular insights, genetic risk assessment, and public health strategies to reduce the burden of breast cancer and improve patient quality of life.

Keywords: Cancer; Breast Cancer; Proto-oncogenes; Tumor Suppressor Genes; BRCA1/BRCA2.

Introduction

Breast cancer continues to be the most prevalent cancer in women globally and the primary cause of cancer-related death. Over 1.2 million cases are diagnosed annually, affecting 10–12% of women and causing 500,000 deaths globally. Even though breast cancer is more common in industrialized nations than in non-industrialized ones, incidence rates are continuously rising in less affluent cultures. Over 75% of breast cancer tumors are hormone sensitive, and the

disease is primarily postmenopausal. The occurrence and course of the illness are determined by the interaction of this hormone dependence with hereditary and environmental variables. Environmental and lifestyle factors are modifiable risk factors that offer the possibility of actions that could eventually lessen the disease's worldwide burden. The effect of risk modification is demonstrated by the observed decline in breast cancer rates in the USA in 2003, following a steady increase over the previous 30 years. This

decline has been associated with a decrease in the usage of exogenous hormones following negative reports of an association with an elevated risk of breast cancer⁴, as well as a potential decline in the use of screening mammography due to its questionable limited benefit. After being constant or rising for several decades in a row, breast cancer mortality rates

have decreased in several developed countries since about 1990. The development of mammography screening programs and the widespread use of adjuvant systemic therapy with tamoxifen have been identified as the primary causes of these death declines.

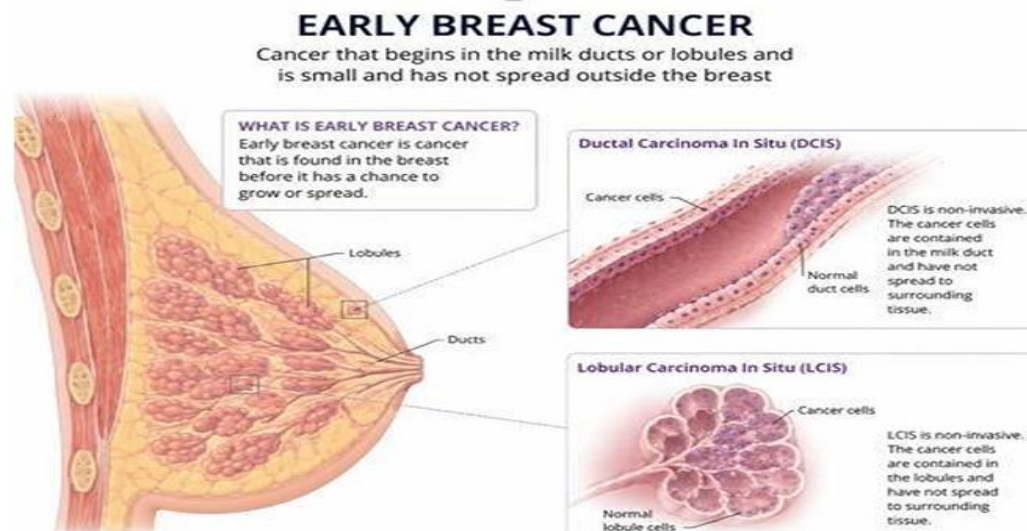


Figure 1: Early Breast Cancer – Ductal Carcinoma in situ (DCIS) and Lobular Carcinoma in situ

These mortality increases are more pronounced in women with estrogen-receptor-positive tumors than in those with hormone-insensitive illness, according to a US population-based study. Furthermore, women under the age of 70 accounted for nearly all of this decline in mortality. The epidemiology, diagnosis, and treatment of early-stage breast cancer—when there is no obvious evidence of distant metastases and the goal of treatment is curative—will be the main topics of this seminar. While many patients may have undetected micro metastatic illness and need adjuvant systemic therapy, other people can be cured with locoregional therapy alone.^[6]

Genetics of Breast Cancer

Breast cancer familial clusters have existed since at least AD 100. In 1866, French surgeon Paul Broca reported that ten out of twenty-four women from five generations in his wife's family had perished from breast cancer. Mothers and sisters of patients with breast cancer have a two- to three-fold increased chance of developing breast cancer, according to modern analytical epidemiologic literature. The degree of this risk varies according to laterality, intimacy of relationship, and age of breast cancer diagnosis. The disease appeared to be "familial" in 23% of the 328 consecutive women with breast cancer, according to an investigation; 9% of all pedigrees showed a pattern consistent with a hereditary problem.

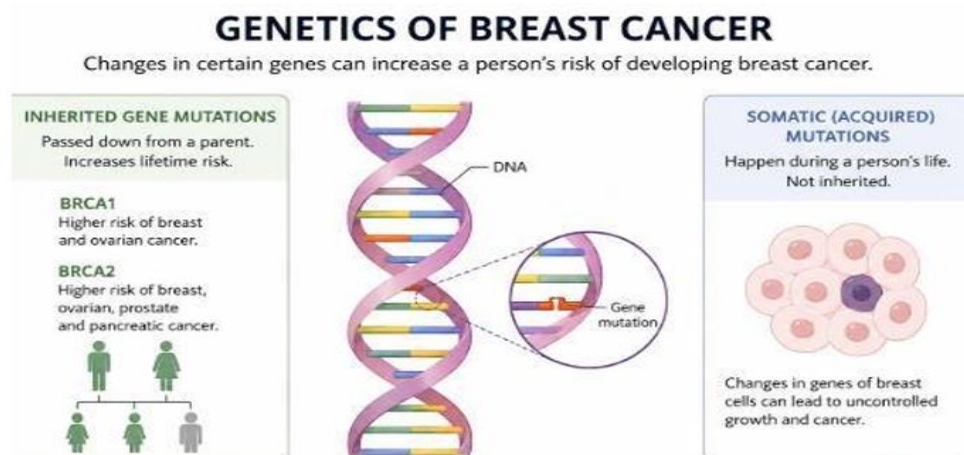


Figure 2: Genetics of Breast Cancer – Inherited and Somatic Gene Mutations.

In the end, formal segregation analysis showed that a small proportion of breast cancer cases had an autosomal dominant pattern of inheritance. According to the results, breast cancer may have been caused by one or more uncommon but highly penetrant genes. The first chapter in the molecular genetics of breast cancer began with the recent cloning of the genes BRCA14 and BRCA2 5,6. The motivation to compile the state of current knowledge in this quickly developing topic came from the associated influx of new information.[7]

Types of Breast Cancer

Non-Invasive Breast Cancer

Cells that stay inside the ducts and do not spread to the breast's surrounding connective and fatty tissues. Ninety percent of non-invasive breast cancer cases are ductal carcinoma in situ (DCIS). Although less prevalent, lobular carcinoma in situ (LCIS) is thought to be a sign of a higher risk of breast cancer.[8]

Invasive Breast Cancer

cells that infiltrate the breast's surrounding fatty and connective tissues after breaching the duct and lobular wall. It is possible for cancer to be invasive without spreading to other organs or lymph nodes.

Frequently occurring Breast cancer

Lobular carcinoma in situ, also known as lobular neoplasia, is a type of cancer that has not progressed beyond its original site. LCIS is a dramatic rise in the number of cells in the breast's lobules, or milk glands.

DCIS, or ductal carcinoma in situ

The most prevalent kind of non-invasive breast cancer, DCIS, is limited to the breast's ducts. Ductal comedocarcinoma, for instance.

Infiltrating lobular carcinoma (ILC)

Another name for ILC is invasive lobular carcinoma. ILC starts in the breast's milk glands, or lobules, but it frequently metastasizes to other parts of the body. 10% to 15% of breast cancers are caused by ILC.

Infiltrating ductal carcinoma (IDC)

Another name for IDC is invasive ductal carcinoma. IDC starts in the breast's milk ducts, breaks through the duct wall, and invades the breast's fatty tissue as well as possibly other parts of the body. Eighty percent of cases of breast cancer are IDC, making it the most prevalent kind of the disease.[9]

Less commonly occurring Breast cancer

Medullary carcinoma

An invasive breast cancer that clearly distinguishes between tumor and normal tissue is called medullary carcinoma. Medullary carcinoma accounts for just 5% of breast cancer cases.

Mucinous carcinoma

Mucinous carcinoma, also known as colloid carcinoma, is an uncommon kind of breast cancer caused by cancer cells that produce mucus. Compared to women with more prevalent forms of invasive carcinoma, women with mucinous carcinoma typically have a better prognosis.

Tubular carcinoma

One particular kind of infiltrating (invasive) breast cancer is tubular carcinoma. Compared to women with more prevalent forms of invasive carcinoma, women with tubular carcinoma typically have a better prognosis. About 2% of cases of breast cancer are tubular carcinomas.

Inflammatory breast cancer

When cancer cells obstruct lymph veins or channels in the skin over the breast, the result is inflammatory breast cancer, which manifests as red, heated, inflamed breasts with dimples and/or thick ridges. Despite being uncommon (making up only 1% of all breast cancer cases), inflammatory breast cancer grows incredibly quickly.[10]

Paget's disease of the nipple

Paget's disease of the nipple, a rare type of breast cancer that starts in the milk ducts and spreads to the skin of the nipple and areola, only makes up 1% of all breast cancer cases.

Phyllodes tumor

Both benign (non-cancerous) and malignant (cancerous) phyllodes tumors (also spelled "phyllodes") are possible. Phyllodes tumors can be surgically removed after developing in the breast's connective tissues. Phyllodes tumors are extremely uncommon; in the US, less than ten women pass away from this kind of breast cancer annually.

Secondary Sexual Characteristics

Secondary sexual characteristics are the physical features that develop during puberty under the influence of sex hormones. These characteristics distinguish males and females but are not directly involved in reproduction. They appear during adolescence and help in the development of adult body appearance [11]

Secondary sexual characteristics are traits that develop at puberty due to hormonal changes and differentiate males from females without being part of the reproduce. The physical, physiological, and behavioral traits that emerge throughout puberty as a result of sex hormones are known as secondary sexual characteristics. Although they are not directly related to reproduction, these traits set males and females apart from one another. Secondary sexual traits emerge during adolescence as a result of increased hormone secretion, such as testosterone in males and estrogen and progesterone in females, in contrast to primary sexual traits, which include the reproductive organs present from birth. The endocrine system regulates the emergence of secondary sexual traits. The hypothalamus causes the pituitary gland to release hormones throughout puberty, which activate the gonads female ovaries and male testes Breast development, hip enlargement, pubic and axillary hair growth, increased hip and thigh fat deposition, and the start of menstruation are examples of secondary sexual traits in females. These alterations get the body ready for adulthood and possible motherhood.

Puberty begins when hormones released by the brain stimulate the gonads (testes in males and ovaries in females) to produce sex hormones. These hormones cause various physical and physiological changes.[12]

Secondary sexual characteristics in males include:

- Growth of facial hair (beard and moustache).
- Growth of hair on the chest, armpits, and pubic region.
- Deepening of the voice due to enlargement of the larynx (Adam's apple).
- Broadening of shoulders and chest.
- Increase in muscle mass and strength.
- Rapid increase in height and body weight.
- Increased activity of sweat and sebaceous glands, causing body odor and acne.
- Male pattern distribution of body fat.

Secondary sexual characteristics in females include:

- Development and enlargement of breasts.
- Growth of hair in the pubic and axillary (armpit) regions.
- Widening of hips and pelvis.
- Increased deposition of fat on hips, thighs, and buttocks.
- Growth spurt during puberty.
- Softening and smoothening of the skin.
- Increased activity of sweat and sebaceous glands.
- Onset of menstruation and maturation of the reproductive system.

Importance of Secondary Sexual Characteristics

- Indicate sexual maturity.
- Help differentiate males and females physically.
- Prepare the body for adult life.
- Contribute to psychological and social development.
- Play a role in attraction and reproductive behavior

Hormonal Regulation

The development of secondary sexual characteristics is controlled by the endocrine system:[13]

- The hypothalamus releases Gonadotropin-Releasing Hormone (GnRH).
- The pituitary gland secretes Follicle-Stimulating Hormone (FSH) and Luteinizing Hormone (LH).
- These hormones stimulate the testes and ovaries to produce sex hormones.
- Testosterone, estrogen, and progesterone then promote the development of secondary sexual characteristics.

Importance of Hormonal Regulation

- Initiates puberty.
- Controls growth and development.
- Produces secondary sexual characteristics.
- Maintains reproductive health.
- Regulates menstrual and reproductive cycles.
- Supports normal sexual maturation.
- Maintains hormonal balance through feedback mechanisms.

Table 1: Secondary sexual characteristics of male and female.

Feature	Male Secondary Sexual Characteristics	Female Secondary Sexual Characteristics
Body Hair	Growth of beard, mustache, chest, and body hair	Growth of pubic and axillary (underarm) hair
Voice	Voice deepens due to enlargement of larynx (Adam's apple)	Slight change in voice; remains relatively high-pitched
Body builds	Broad shoulders and increased muscle mass Wider hips and increased fat deposition around hips and thighs	Wider hips and increased fat deposition around hips and thighs
Breasts	No significant breast development	Enlargement and development of breasts
Skin	Increased oil production; acne may occur	Softer skin with increased subcutaneous fat

Sign and Symptoms

Cancer is a disease that occurs when abnormal cells divide out of control and destroy tissue. This continuous cell division results in a malignant tumor.

When malignant cells develop in the tissues of the breast, it is breast cancer. These cancerous cells can spread to the lymph nodes, and possibly to other organs of the body. Anyone with breast tissue can develop breast cancer, which affects primarily women. A woman's chance of being diagnosed is one out of eight (1 of 8) by the time she is 80 years old. Men can also develop breast cancer, which are about one out of 125 men.[29]

Symptoms of breast cancer vary from person to person. Some common warning

Signs and symptoms include:

- A breast lump or hard thickening on or inside of the breast
- Skin changes, such as swelling, redness, scaling or other visible
- Change in the shape and/or size of one or both breasts
- Changes in the appearance of one or both nipples, bulges or sinks inward
- Nipple discharge that is bloody, clear, greenish, pus, other than breast milk
- General pain in any part of the breast, chest, nipple, or underarms
- Itchy or sore breasts

Diagnosis and Treatment

Diagnosis

Mammography is a low-dose X-ray used to detect breast cancer. If an abnormality that could be cancerous is detected, a biopsy is performed. A mammogram can detect many but not all cases of breast cancer. Other types of breast imaging methods may be needed. During a biopsy, the physician may remove some cells from the lump through various methods:

- Fine-needle aspiration biopsy: This is the simplest type of breast biopsy and may be used to evaluate a lump that can be felt during a clinical breast exam.[31]
- Core needle biopsy

- Stereotactic biopsy
- Ultrasound-guided core needle biopsy.
- MRI-guided core needle biopsy.

Breast Cancer Detection Tests, Tools and Technologies

Various tests are utilized to diagnose breast cancer and other breast conditions.

Screening tools and tests can be in the form of biopsy, blood, genetics or images of the tumor.

The type of diagnostic test used is determined by the specific needs of each patient.

Mammogram: Is a compression x-ray of the breasts.

- MRI: Magnets and radio waves produce a 3-D image of the breast. A contrast dye may be injected into a vein to increase the visibility of cancerous tissues.
- Ultrasound: Sound waves are used to create an internal image of breast glands and underlying
- Breast Specific Gamma Imaging: This is a non-compression type mammogram used to detect blood flow to cancer cells. [32]
- Tomosynthesis: A form of digital mammography that takes multiple x-rays creating a 3-D picture of the breast allowing a visual between layers of breast tissue.
- PEM: Position Emission Mammography uses a small amount of radioactive tracer dye injected during the PEM to scan an image the breast.
- Chest X-Ray: An imaging test to check the inside of your chest to see if the breast cancer has spread to your lungs or ribs.
- Bone Scan: an imaging test used to help diagnose if cancer has metastasized; spread to your bones.
- Computed Tomography (CT/CAT) Scan: An X-ray that gives a more detailed picture that can detect extremely small tumors and if the cancer has spread to the lymph nodes, liver, brain, lungs, or bones.
- Imaging techniques are not intended to replace mammograms but are additional diagnostic tools for women with increased risk for breast cancer. In some instances, these imaging diagnostic tools may help some women avoid unnecessary biopsies.

- There are alternative screening techniques to detect breast cancer in women with dense or large breasts and women with health conditions that prohibit the use of a mammography. Breast cancer detected in the early stages increase the chance of early treatment and better outcomes. [33]

Be aware that diagnostic errors can occur. A misdiagnosis, delayed diagnosis or failed diagnosis can make a difference in delays and options of treatment, outcomes, survival or lead to death.

Treatment

Cancer that develops when cells in the breast grow uncontrollably and form a tumor. It is one of the most common cancers affecting women worldwide, although it can also occur in men. Early detection and advances in treatment have significantly improved survival rates and quality of life for patients with breast cancer. The treatment of breast cancer depends on several factors, including and stage of cancer, tumor size, hormone receptor status, genetic factors, and the patient's overall health. The main goals of treatment are to remove or destroy cancer cells, prevent the spread of cancer, reduce the risk of recurrence, and improve the patient's quality of life. Breast cancer treatment often involves a combination of therapies. Local treatments, such as surgery and radiation therapy, target the tumor within the breast and nearby tissues. Systemic treatments, including chemotherapy, hormone therapy, targeted therapy, and immunotherapy, travel throughout the body to destroy cancer cells that may have spread beyond the breast. Recent advances in medical research have led to more personalized treatment approaches, allowing healthcare providers to select therapies based on the specific characteristics of each patient's cancer. This has resulted in better treatment outcomes and reduced side effects. A multidisciplinary team consisting of surgeons, oncologists, radiologists, pathologists, nurses, and other healthcare professionals works together to develop an individualized treatment plan for each patient. With continued progress in diagnosis and treatment, many patients with breast cancer can achieve long-term survival and maintain a good quality of life.[34]

Breast Cancer Staging and Classification

Breast cancer staging is determined by tumor size, nodal involvement, the presence of metastases, and specific biomarkers such as estrogen receptors, progesterone receptors, and the ERBB2 receptor (formerly HER2) After a histologic diagnosis of breast cancer, all pathology samples should be tested for estrogen receptors, progesterone receptors, and ERBB2 status. Breast cancers that express none of

these markers are referred to as triple-negative. Stage 0 noninvasive breast cancer is known as ductal carcinoma in situ (DCIS). Stages I, IIa, and IIb are classified as early invasive cancer, while stages IIIa, IIIb, and IIIc are classified as local progressed. These breast cancer stages are all nonmetastatic.

DCIS, Noninvasive Breast Cancer

The most common way to detect DCIS, a type of pure, noninvasive cancer, is through mammography that reveals microcalcifications limited to the breast ducts.[26] Up to 40% of DCIS instances will develop into invasive breast cancer if treatment is not received.[27] Treatment options for DCIS include mastectomy, radiotherapy, and lumpectomy (with a target of 2-mm surgical margins).[28] To identify the (unlikely) chance of lymph node involvement, a sentinel lymph node (SLN) biopsy is performed at the time of mastectomy. An SLN biopsy might not be technically feasible following a mastectomy. Patients undergoing lumpectomy are offered radiation therapy; the combination of radiation with lumpectomy is seen as a breast-conserving treatment. Patients with small, low-grade lesions deemed to have a low risk of recurrence may be exempt from radiation therapy. Patients receiving mastectomy treatment should not be exposed to radiation. Endocrine therapy should be administered for five years to patients with remaining breast tissue and estrogen receptor-positive DCIS. If the patient is premenopausal, this treatment consists of tamoxifen; if the patient is postmenopausal, it consists of either tamoxifen or an aromatase inhibitor. In the past, lobular carcinoma in situ was regarded as a cancer. Despite its name, it is a proliferative condition that raises the risk of developing breast cancer in the future rather than carcinoma. The staging standards for breast cancer no longer mention it.

Early Invasive and Locally Advanced, Nonmetastatic Breast Cancer

Chemotherapy, endocrine therapies, immunotherapy using monoclonal antibodies targeted at tumor receptors, surgery, and radiation are among the preoperative and postoperative systemic therapies used to treat nonmetastatic breast cancer. Molecular testing aids in determining if chemotherapy should be included in a treatment plan. A 21-gene expression test called Oncotype DX is the recommended test for patients with hormone receptor-positive, node-negative breast cancer, including men, in order to predict the course of the disease and make judgments regarding the addition of chemotherapy. Chemotherapy always comes first when endocrine therapy and chemotherapy are given after surgery.[36]

Preoperative Systemic Therapy

Preoperative systemic therapy aims to make unresectable tumors operable, reduce the size of resectable breast tumors (improving cosmetic and treatment outcomes), and enable SLN biopsy in place of axillary lymph node dissection (ALND) if axillary nodes are no longer detectable. For early invasive breast cancers (I, IIa, and IIb), preoperative treatment is generally not advised because the tumors are frequently small enough to be removed with a lumpectomy. Patients who want breast-conserving surgery yet have significant original tumors relative to breast size are given preoperative chemotherapy. Additionally, it is applied to individuals who have incur illness. For patients with triple-negative breast cancer, chemotherapeutic medications are the only available systemic treatment. When the malignancy is ERBB2 positive, preoperative therapy with trastuzumab (Herceptin) and/or epratuzumab (Perjeta), which are monoclonal antibodies directed against ERBB2, is utilized in addition to chemotherapy.

Surgical Interventions

If satisfactory cosmesis can be attained with negative margins, lumpectomy with radiation should be considered. Endocrine therapy should be administered for five years to patients with estrogen receptor-positive DCIS and remaining breast tissue. If the patient is premenopausal, this treatment consists of tamoxifen; if the patient is postmenopausal, it consists of either tamoxifen or an aromatase inhibitor. In the past, lobular carcinoma in situ was regarded as a cancer. Despite its name, it is a proliferative condition that raises the risk of developing breast cancer in the future rather than carcinoma. The staging standards for breast cancer no longer mention it.

Postoperative Therapy Radiation

After breast cancer is surgically removed, radiation therapy is utilized to eradicate any residual subclinical illness. Patients with high-risk, node-positive diseases who have undergone mastectomy treatment are typically advised to have a lumpectomy. Radiation reduces the 20-year ipsilateral breast cancer recurrence rate for people who get a lumpectomy. By treating only, the lumpectomy site and surrounding tissue, partial breast irradiation reduces immediate skin toxicity without raising the risk of local recurrence and necessitates fewer radiation treatments.^{33, 34} There is proof that radiation therapy for the whole breast may outcomes compared to partial radiotherapy to the breast. Tumor response to preoperative systemic treatments, nodal involvement, and patient life expectancy should all be taken into account when making shared clinical decisions on radiation.^[37]

Possible Side Effects

- Fatigue
- Hair loss (with some chemotherapy regimens)
- Nausea and vomiting
- Lymphedema (arm swelling after lymph node treatment)
- Menopausal symptoms
- Skin changes from radiation

Conclusion

Breast cancer is one of the most common diseases that affects women around the world. It is still a big issue for public health. It comes from a mix of things like genes and hormones along with environmental and behavioral factors that cause cells in the breast tissue to grow out of control.

Current research has helped a lot with understanding the molecular side of it. Things like oncogenes and tumor suppressor genes plus mutations such as BRCA1 and BRCA2 are mentioned a lot now. There are non-invasive and invasive types too. Each one acts different and needs its own approach. Early detection through screening and knowing the signs seems really important for better results. Treatments like surgery or radiation and chemo have improved things for patients quite a bit. Genetic counseling might matter as well. Some people see the genetic part as the main key while others focus more on access to care. Our knowledge has grown but not everything lines up perfectly yet. Uncontrolled cell growth is the main feature though sometimes it stays in one spot and other times it moves. That part gets a bit messy when trying to connect it all.

Acknowledgement

The author would like to thank Nibha Institute of Pharmaceutical Sciences, Rajgir for providing necessary facility to carry out the project.

Funding

No financial assistance was provided for this project.

Conflict of Interest

None declared.

References

1. Paget S. The distribution of secondary growths in cancer of the breast. 1889. *Cancer Metastasis Rev* 1989;8:98–101.
2. American Association for Cancer Research. What is cancer? Available from: <https://www.aacr.org/patients-caregivers/about-cancer/what-iscancer/>.
3. Vogelstein B, Papadopoulos N, Velculescu VE, Zhou S, Diaz LA Jr, Kinzler KW. Cancer genome landscapes. *Science* 2013;339:1546–58.
4. Hortobagyi GN, de la Garza Salazar J, Pritchard K, et al. The global breast cancer burden: variations in epidemiology and survival. *Clin Breast Cancer* 2005; 6: 391–401.
5. Wooster R, Bignell G, Lancaster J, Swift S, Seal S, Mangion J, et al. Identification of the breast cancer susceptibility gene BRCA2. *Nature* 1995; 378:789–792
6. Breastcancer.merck2008.<http://www.merck.com/mhhe/sec22/ch251/ch251f.html>(18 Mar.2010).
7. Dave R, Bromley H, Taxiarchi V, et al. No association between breast pain and breast cancer. A prospective cohort study of 10,830 symptomatic women presenting to a breast cancer diagnostic clinic. *Br J Gen Pract*. 2022;72(717):e234–e243. doi: 10.3399/BJGP.2021.0475
8. Smith R, Pruthi S, Fitzpatrick L. Evaluation and management of breast pain. *Mayo Clin Proc*. 2004;79(3):353–372. doi: 10.4065/79.3.353
9. Ban KA, Godellas CV. Epidemiology of breast cancer. *Surg Oncol Clin N Am* 2014; 23: 409–422
10. Gnerlich JL, Deshpande AD, Jeffe DB, et al. Poorer survival outcomes female breast cancer compared with male breast cancer may be attributable to in-stage migration. *Ann Surg Oncol* 2011; 18: 1837–1844.
11. Sadler TW: Langman's Medical Embryology, (ed 11) Baltimore, MD:Lippincott Williams & Wilkins, 2009Osborne MC, Boolbal SK: Breast anatomy and development. in Harris
12. JR, Lippman ME, Osborne CK, Morrow M (eds.), Diseases of the Breast, (ed 4Philadelphia, PA: Lippincott Williams & Wilkins, 1-11,2009
13. Hall JE. Guyton and Hall Textbook of Medical Physiology. 14th ed. Philadelphia: Elsevier; 2021
14. Sembulingam K, Sembulingam P. Essentials of Medical Physiology. 8th ed. New Delhi: Jaypee Brothers Medical Publishers; 2020
15. World Health Organization. Breast Cancer Fact Sheet. Available from: WHO Official Website
16. Breast Cancer Research Foundation. Breast Cancer Research and Awareness. Available from: Breast Cancer
17. Pagani O, Senkus E, Wood W, Colleoni M, Cufer T, Kyriakides S, Costa A, Winer EP, Cardoso F. International guidelines for management of metastatic breast cancer: can metastatic breast cancer be cured?. *Journal of the National Cancer Institute*. 2010 Jan 1;102(7):456–63
18. Sharma GN, Dave R, Sanadya J, Sharma P, Sharma K. Various types and management of breast cancer: an overview. *Journal of advanced pharmaceutical technology & research*. 2010 Apr 1;1(2):109–26.
19. Sharma, G.N., Dave, R., Sanadya, J., Sharma, P. and Sharma, K., 2010. Various types and management of breast cancer: an overview. *Journal of advanced pharmaceutical technology & research*, 1(2), pp.109–126
20. Dontu G, Al-Hajj M, Abdallah WM, Clarke MF, Wicha MS. Stem cells in normal breast development and breast cancer. *Cell proliferation*. 2003 Oct;36:59–72.
21. Momenimovahed Z, Salehiniya H. Epidemiological characteristics of and risk factors for breast cancer in the world. *Breast cancer: targets and therapy*. 2019 Apr 10:151–64.
22. Stephens PJ, Tarpey PS, Davies H, Van Loo P, Greenman C, Wedge DC, Nik-Zainal S, Martin S, Varela I, Bignell GR, Yates LR. The landscape of cancer genes and mutational processes in breast cancer. *Nature*. 2012 Jun 21;486(7403):400–4.
23. Irvin Jr WJ, Carey LA. What is triple-negative breast cancer?. *European journal of cancer*. 2008 Dec 1;44(18):2799–805.
24. Stephens PJ, Tarpey PS, Davies H, Van Loo P, Greenman C, Wedge DC, Nik-Zainal S, Martin S, Varela I, Bignell GR, Yates LR. The landscape of cancer genes and mutational processes in breast cancer. *Nature*. 2012 Jun 21;486(7403):400–4.
25. Daemen A, Griffith OL, Heiser LM, Wang NJ, Enache OM, Sanborn Z, Pepin F, Durinck S, Korkola JE, Griffith M, Hur JS. Modeling precision treatment of breast cancer. *Genome biology*. 2013 Oct;14(10):R110.
26. Masuda H, Zhang D, Bartholomeusz C, Doihara H, Hortobagyi GN, Ueno NT. Role of epidermal growth factor receptor in breast cancer. *Breast cancer research and treatment*. 2012 Nov;136(2):331–45.
27. Hortobagyi GN, Connolly JL, D'Orsi CJ, et al. Breast. In: Amin MB, Edge SB, Greene FL, et al., eds. *AJCC Cancer Staging Manual*. 8th ed. Springer; 2018: 589–636.
28. NCCN Clinical Practice Guidelines in Oncology, Breast Cancer, Version 1.2021. National Comprehensive Cancer Network. 2021; 2021(January): 15.
29. Allison KH, Hammond MEH, Dowsett M, et al. Estrogen and progesterone receptor testing in

- breast cancer: ASCO/CAP guideline update. *J Clin Oncol*. 2020; 38(12): 1346-1366.
30. Gluz O, Liedtke C, Gottschalk N, Pusztai L, Nitz U, Harbeck N. Triple-negative breast cancer--current status and future directions. *Ann Oncol* 2009;20:1913-1927
 31. Rastogi P, Anderson SJ, Bear HD, Geyer CE, Kahlenberg MS, Robidoux A, et al. Preoperative chemotherapy: updates of National Surgical Adjuvant Breast and Bowel Project Protocols B-18.
 32. Cancer-Its various types along with causes, symptoms, treatments and stages, in: cancer info guide, 2009. <http://www.cancer-info-guide.com/>(15 Mar. 2010)
 33. Mieszkowski, M. R., Cancer – Abiophysicist's point of view. In:Digital Recordings. 04 Sept. 2006.<http://www.digital-recordings.com/publ/cancer.html>(15 Mar 2010).
 34. Breast cancer process India, Breast cancer cost India, Breast cancer, Delhi India. Breast cancer information and resources. 13 April2010.
 35. Breast cancer. merck. 2008.<http://www.merck.com/mmhe/sec>
 36. Ershler W.B. The Influence of Advanced Age on Cancer Occurrence and Growth. In:Balducci L., Extermann M,editors. *Biological Basis of Geriatric Oncology*. Springer US; 2005; 124:75-87
 37. Age Concern (1996) Not at my age: Why the present breast screening system is failing women aged 65 and over. London: Age Concern
 38. Bellet M, Alsonso C, Ojeda B (1995) Breast cancer in the elderly. *Postgrad Med J* 71: 658 – 664
 39. King M-C, Levy-Lahad E, Lahad A. Population-based screening for BRCA1and BRCA2: 2014 Lasker Award. *JAMA*
 40. Hu C, Hart SN, Polley EC, et al. Association between inherited germline mutations in cancer predisposition genes and risk of pancreatic cancer. *JAMA*
 41. Hyman DM, Tran B, Paz-Ares L, Machiels JP, Schellens JH, Bedard PL, et al. Combined PIK3CA and FGFR inhibition with alpelisib and in figratinib in patients with PIK3CA-mutant solid tumors, with or without FGFR alterations. *JCO Precis Oncol*. (2019) 3:1–13. doi: 10.1200/PO.19.00221

Copyright: ©2026 Thakur R, et al. This article is distributed under the terms of the Creative Commons Attribution 4.0 International License [<http://creativecommons.org/licenses/by/4.0/>], which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author[s] and the source, provide a link to the Creative Commons license, and indicate if changes were made.

