

General Notions about Breast Cancer

Noções Gerais sobre o Câncer de Mama

Nociones Generales sobre el Cáncer de Mama

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ABSTRACT

Breast cancer is a multifactorial, non-communicable disease with high global prevalence, responsible for approximately 2.3 million new cases and over 666,000 deaths worldwide in a single year. It is the most commonly diagnosed cancer in women and the second most frequent overall in Brazil, representing over 10% of all diagnoses. Anatomically, the female breast contains 15 to 20 glandular lobes responsible for milk production, lactiferous ducts converging at the nipple, and a surrounding matrix of connective and adipose tissue, typically located between the second and seventh ribs, over the pectoralis major and serratus anterior muscles. This structure varies across individuals, influencing both breast density, which complicates imaging diagnostics in younger women, and the patterns of tumor dissemination. The disease arises from genetic alterations that lead to deregulated cell growth and failure of apoptosis, with a subset of cases linked to inherited mutations in genes such as BRCA1, BRCA2, PALB2, and TP53. Risk factors include hormonal influences like early menarche and late menopause, behavioral aspects such as alcohol consumption, obesity, and sedentary lifestyle, and environmental exposure to ionizing radiation. Women have a breast cancer risk approximately 100 times higher than men, and this risk increases significantly with age, reaching a lifetime probability of about 1 in 8. Clinically, breast cancer usually presents as a painless, immobile lump, often accompanied by changes in skin texture, nipple inversion or discharge, and axillary lymph node enlargement, although most breast lumps—around 90%—are benign. While predominantly a female disease, it also affects men in rare cases. Early detection through screening mammography, especially between the ages of 50 and 69, can increase cure rates up to 95% for tumors smaller than one centimeter. Treatment is based on staging: early stages are managed with conservative surgery and radiotherapy; intermediate stages often require neoadjuvant chemotherapy followed by surgical and local measures; and advanced or metastatic stages demand systemic therapies including chemotherapy, hormone therapy, and molecularly targeted agents like monoclonal antibodies, tailored to tumor biology and receptor status.

Keywords: Breast cancer; Epidemiology; Risk factors; Early diagnosis; treatment.

RESUMO

O câncer de mama é uma doença multifatorial e não transmissível, com elevada prevalência global, sendo responsável por aproximadamente 2,3 milhões de novos casos e mais de 666 mil mortes em apenas um ano. Trata-se do tipo de câncer mais frequentemente diagnosticado em mulheres e o segundo mais incidente no Brasil, representando mais de 10% de todos os diagnósticos. Anatomicamente, a mama feminina é composta por 15 a 20 lóbulos glandulares responsáveis pela produção de leite, ductos lactíferos que convergem no mamilo, e uma matriz de tecido conjuntivo e adiposo que a envolve, situando-se entre a segunda e a sétima costela, sobre os músculos peitoral maior e serrátil anterior. Essa estrutura apresenta variações entre indivíduos, o que influencia tanto a densidade mamária — dificultando a detecção por imagem em mulheres jovens — quanto os padrões de disseminação tumoral. A doença tem origem em alterações genéticas que resultam na desregulação do crescimento celular e falhas no processo de apoptose, com uma parcela dos casos associada a mutações hereditárias em genes como BRCA1, BRCA2, PALB2 e TP53. Os fatores de risco incluem influências hormonais, como menarca precoce e menopausa tardia, hábitos comportamentais como consumo de álcool, obesidade e sedentarismo, além da exposição ambiental à radiação ionizante. Mulheres apresentam risco aproximadamente 100 vezes maior do que os homens, e esse risco aumenta significativamente com a idade, atingindo uma probabilidade ao longo da vida de cerca de 1 em cada 8 mulheres. Clinicamente, o câncer de mama manifesta-se geralmente como um nódulo indolor e fixo, frequentemente acompanhado por alterações na textura da pele, inversão ou secreção do mamilo e aumento de linfonodos axilares, embora cerca de 90% dos nódulos mamários sejam benignos. Apesar de ser predominantemente feminino, o câncer de mama também pode afetar homens, embora raramente. A detecção precoce por mamografia, especialmente entre 50 e 69 anos, pode elevar as taxas de cura para até 95% em tumores com menos de um centímetro. O tratamento é definido de acordo com o estadiamento: nos estágios iniciais, utiliza-se cirurgia conservadora e radioterapia; nos intermediários, recorre-se à quimioterapia neoadjuvante seguida de intervenções locais; e nos estágios avançados ou metastáticos, empregam-se terapias sistêmicas, como quimioterapia, hormonioterapia e agentes moleculares específicos como anticorpos monoclonais, conforme a biologia tumoral e o perfil de receptores da neoplasia.

Palavras-chave: Câncer de mama; Epidemiologia; Fatores de risco; Diagnóstico precoce; Tratamento.

RESUMEN

El cáncer de mama es una enfermedad multifactorial y no transmisble con alta prevalencia global, responsable de aproximadamente 2,3 millones de nuevos casos y más de 666 mil muertes en un solo año. Es el tipo de cáncer más comúnmente diagnosticado en mujeres y el segundo más incidente en Brasil, representando más del 10% de todos los diagnósticos. Anatómicamente, la mama femenina está compuesta por 15 a 20 lóbulos glandulares responsables de la producción de leche, conductos galactóforos que convergen en el pezón, y una matriz de tejido conectivo y adiposo que la rodea, situada entre la segunda y la séptima costilla, sobre los músculos pectoral mayor y serrato anterior. Esta estructura varía entre individuos, lo que influye tanto en la densidad mamaria —que dificulta la detección por imagen en mujeres jóvenes— como en los patrones de diseminación tumoral. La enfermedad se origina en alteraciones genéticas que provocan desregulación del crecimiento celular y fallas en la apoptosis, con una proporción de casos asociada a mutaciones hereditarias en genes como BRCA1, BRCA2, PALB2 y TP53. Los factores de riesgo incluyen influencias hormonales como menarquia precoz y menopausia tardía, hábitos conductuales como consumo de alcohol, obesidad e inactividad física, además de la exposición ambiental a radiación ionizante. Las mujeres tienen un riesgo aproximadamente 100 veces mayor que los hombres, y este riesgo aumenta considerablemente con la edad, alcanzando una probabilidad acumulada de aproximadamente 1 de cada 8 mujeres a lo largo de la vida. Clínicamente, el cáncer de mama suele presentarse como un nódulo indoloro y fijo, a menudo acompañado de cambios en la textura de la piel, inversión o secreción del pezón y aumento de ganglios linfáticos axilares, aunque cerca del 90% de los nódulos mamarios son benignos. Aunque es predominantemente femenino, el cáncer de mama también puede afectar a los hombres, aunque en casos poco frecuentes. La detección precoz mediante mamografía, especialmente entre los 50 y 69 años, puede aumentar las tasas de curación hasta en un 95% para tumores menores de un centímetro. El tratamiento se determina según el estadio: en las etapas iniciales se utiliza cirugía conservadora y radioterapia; en las intermedias, quimioterapia neoadjuvante seguida de intervenciones locales; y en las etapas avanzadas o metastásicas, se aplican terapias sistémicas como quimioterapia, hormonoterapia y agentes moleculares dirigidos como anticuerpos monoclonales, de acuerdo con la biología del tumor y el perfil de receptores de la neoplasia.

Palabras clave: Cáncer de mama; Epidemiología; Factores de riesgo; Diagnóstico precoz; Tratamiento.

1. INTRODUCTION

Breast cancer accounts for approximately 30% of all cancer cases diagnosed in women worldwide, with a mortality rate proportional to the estimated incidence at 15% (Siegel; Miller; Jemal, 2020). The distribution of the disease is heterogeneous, with the lowest incidence rates observed in regions such as East Asia and Africa (27 cases per 100,000 women) and the highest in North America (97 cases per 100,000 women) (Loibl *et al.*, 2021). This disparity may be associated with factors related to economic development, lifestyle habits, and social conditions.

In 2018, approximately 18.1 million new cancer cases were recorded worldwide, resulting in about 9.6 million deaths (Bray *et al.*, 2018). In Brazil, breast cancer is the second most common type of cancer, accounting for 10.5% of all diagnosed cases, second only to non-melanoma skin cancer, which represents 31.3% and has one of the highest female mortality rates due to neoplasia (INCA, 2022). In recent decades, advances in therapies, greater access to treatment, and early detection efforts have contributed to improving patient survival, making it a disease with a good prognosis when treated early (Silva and Riul, 2012).

Breast cancer causes various physical, emotional, and social consequences, to a greater or lesser extent, but which undoubtedly lead to some degree of impairment in the quality of life of affected women. Among the most common physical complications are chronic pain, lymphedema, sensory changes due to nerve damage, loss of shoulder range of motion, and muscle weakness, often resulting from surgical treatments such as partial or total mastectomy (Lufiego *et al.*, 2019). Furthermore, the diagnosis and treatment of breast cancer are associated with feelings of fear, dissatisfaction with self-image, depressive symptoms, and anxiety, which are triggered or worsened by changes in the body and the perception of the severity of the disease (Dias *et al.*, 2022). The need to take leave from work and other responsibilities to prioritize treatment is also cited as a factor that further aggravates the situation of these patients (Silva *et al.*, 2020).

Given the high incidence of breast cancer, this study aims to systematize information related to the anatomopathology, etiology, epidemiology, clinical manifestations, diagnostic aspects, and therapeutic approaches of the disease.

2. METHODOLOGY

This is a narrative literature review, for which a search for articles was conducted in the following databases: Latin American and Caribbean Health Sciences Literature (LILACS), Scientific Electronic

Library Online (SciELO), Medical Literature Analysis and Retrieval System Online (MEDLINE/PubMed), and Google Scholar. The Health Sciences Descriptors (DeCS) and the Medical Subject Headings (MeSH) used were: “Breast Cancer”, “Epidemiology”, “Risk Factors”, “Diagnosis”, and “Treatment”, combined using the Boolean operators AND and OR.

Complete, open-access studies available in Portuguese, English, or Spanish, with no time frame restriction, and addressing breast cancer from anatomical, clinical, diagnostic, and therapeutic perspectives were included. Exclusion criteria comprised duplicate articles and publications not relevant to the proposed topic.

3. RESULTS AND DISCUSSIONS

3.1 Anatomical Concepts

The female breast is an exocrine gland located on the anterior chest wall, typically extending from the second to the seventh rib, positioned over the pectoralis major and serratus anterior muscles. Its shape may be conical or hemispherical, and its size can vary depending on factors such as age, body weight, and individual anatomical characteristics. The breast is composed of 15 to 20 glandular lobes responsible for milk production, and lactiferous ducts that converge toward the nipple. Additionally, the gland is surrounded by adipose tissue, which not only gives volume to the breast but also plays a role in mechanical and thermal protection (Hinkle; Cheever, 2017).

3.2 Breast Cancer

3.2.1 Etiology and Histopathological Classifications

Breast cancer is a chronic non-communicable disease (NCD) resulting from changes in the genetic material of breast cells, which cause deregulation of the cell cycle and suppression of apoptosis, the natural process responsible for programmed cell death (Cruz *et al.*, 2023). Breast cancer does not have a single defined cause and is influenced by genetic, hormonal, behavioral, and environmental factors (Adami; Hunter; Trichopoulos *et al.*, 2008).

Women have a risk of developing breast cancer that is 100 times higher than that of men. Furthermore, this risk increases progressively with age, being one of the main associated factors. An American epidemiological study showed that the risk of breast cancer increases with age: 1 in every 53 women under the age of 50, 1 in 44 between 50 and 69 years, 1 in 29 between 60 and 69 years, and reaching a peak of 1 in every 15 women after the age of 70. Considering the entire lifespan, the cumulative probability of a woman developing the disease is approximately 12.4%, or 1 in every 8 women (Chlebowski *et al.*, 2005).

It is estimated that 5–10% of breast cancer cases are related to hereditary forms (Sartori and Basso, 2019). The main genes involved in the disease's pathogenesis include BRCA1 and BRCA2, as well as others that are less common, such as: PALB2, CHEK2, BARD1, ATM, RAD51C, RAD51D, and TP53 (INCA, 2022). These genes are involved in DNA damage repair, maintaining cellular integrity, and regulating cell growth. When these mechanisms fail, cells begin to multiply in a disordered manner, resulting in the development of mammary carcinoma, which can invade adjacent tissues and spread to other regions of the body (Cruz *et al.*, 2023).

Endocrine conditions related to ovarian function—such as early menarche, late menopause, and pregnancy at an older age—as well as the use of exogenous estrogens (e.g., long-term oral contraceptives, hormone replacement therapy for more than five years), are considered significant elements in increasing breast cancer risk (INCA, 2023; Sartori and Basso, 2019). On the other hand, unhealthy lifestyle habits such as physical inactivity, obesity, and excessive alcohol consumption are also associated with the disease's development (Sartori and Basso, 2019). Additionally, environmental factors such as frequent exposure to ionizing radiation (X-rays, mammography, and computed tomography) are also related to the genesis of the disease (INCA, 2023).

Although popularly known as a single disease, breast cancer actually represents a diverse group of lesions that differ in microscopic appearance, clinical manifestations, genetic signatures, and therapeutic responses (Cruz *et al.*, 2023; Li; Uribe; Daling, 2005). According to Femama (2019), breast cancer can be classified based on its origin, location, and hormone dependence. The most prevalent subtypes include: invasive ductal carcinoma (76%), invasive lobular carcinoma (8%), and ductal/lobular carcinoma (7%). Less common subtypes include mucinous or colloid carcinoma (2.4%), tubular (1.5%), medullary (1.2%), and papillary carcinoma (1%). Metaplastic breast carcinoma and invasive micropapillary carcinoma are also recognized as rare presentations, together accounting for less than 5% of cases (Li; Uribe; Daling, 2005).

3.2.2 Epidemiology

Breast cancer is the most common type of cancer among women worldwide and represents one of the leading causes of female cancer-related mortality (Cruz *et al.*, 2023; Li; Uribe; Daling, 2005). In 2020, the disease was responsible for approximately 685,000 deaths globally, and this number reached an estimated 666,103 deaths in 2022, with 2.3 million new cases diagnosed in the same year (IARC, 2024). In Brazil, breast cancer also holds a prominent position, being the most incident type of cancer among women in all regions, second only to non-melanoma skin cancer. The highest incidence rates are recorded in the South and Southeast regions, while the lowest are concentrated in the North and Northeast (INCA, 2022).

Although breast cancer primarily affects females, it can also occur in males (Cruz *et al.*, 2023). Between 2001 and 2010, Brazil's Mortality Information System, from the Ministry of Health, identified that 0.97% of the 106,425 breast cancer-related deaths occurred in men, highlighting the low but existent occurrence of the disease in this group (Silva, 2024).

3.2.3 Clinical Presentation

In terms of clinical presentation, breast cancer commonly manifests as a lump in the breast, usually painless. However, the majority of breast masses—about 90%—are benign, including fibroadenomas, cysts, and fibrocystic changes (WHO, 2021). Signs of breast cancer may include: hardened, immobile, or irregular lumps in the breast or axilla; changes in breast size and shape; skin alterations such as erythema, dimpling, ulceration, or a “peau d’orange” appearance; and nipple changes, including inversion, discharge, or skin changes.

3.2.4 Diagnosis and Treatment

Screening and early diagnosis of breast cancer increase the chances of cure and reduce the mortality associated with the disease. Treatment success rates can reach up to 95% when the tumor is identified at an early stage, with dimensions smaller than 1 centimeter (VENCE ONCO, 2022). In this regard, Brazil's Ministry of Health, in partnership with INCA, recommends clinical breast examinations (CBE) along with imaging tests such as mammography. It is recommended that women aged 50 to 69 undergo mammography every two years (Rocha *et al.*, 2020). However, in cases where the patient presents risk factors or suspicious

findings during the CBE, earlier initiation of mammography and medical follow-up is advised, starting from the age of 35 (Abrahão, 2022; Gobbi, 2012; Meneses *et al.*, 2022).

Therapeutic options for breast cancer are divided into two main groups: local and systemic treatment. The definition of a treatment plan depends on the disease staging, which ranges from Stage I to Stage IV. In early stages (I and II), treatment is predominantly local, including conservative surgery or mastectomy and, in many cases, adjuvant radiotherapy. In Stage III, due to greater loco-regional involvement, treatment generally begins with neoadjuvant chemotherapy, followed by radiotherapy and/or surgery, with the goal of tumor reduction before more invasive local interventions (Jomar *et al.*, 2023; Gonçalves *et al.*, 2023). In Stage IV, characterized by the presence of distant metastases, the therapeutic focus is on systemic treatment, which includes chemotherapy, hormone therapy, and targeted therapies, depending on the tumor's molecular profile and the patient's clinical presentation.

4. CONCLUSION

Breast cancer is a multifactorial neoplasm with a high global incidence, with 2.3 million new cases and 666,103 deaths recorded in 2022 alone. It is the most common type of cancer among women and the second most incident in Brazil, accounting for 10.5% of cancer diagnoses (INCA, 2022; IARC, 2024). From an anatomical perspective, the female breast is composed of 15 to 20 glandular lobes, lactiferous ducts, connective and adipose tissue, and is located between the second and seventh ribs, over the pectoralis major and serratus anterior muscles. Anatomical variation of the breast influences both breast density—which hinders mammographic diagnosis in younger women—and the pattern of tumor spread. Mutations in the BRCA1, BRCA2, PALB2, and TP53 genes are associated with hereditary forms of breast cancer, which represent 5% to 10% of cases. In addition, notable risk factors include hormonal (early menarche, late menopause), behavioral (obesity, physical inactivity, alcohol consumption), and environmental factors (exposure to ionizing radiation).

The disease primarily presents as a painless, fixed lump, although skin, nipple, and lymph node changes are also present in a large number of cases. Early diagnosis through mammography, especially between the ages of 50 and 69, can increase cure rates to up to 95% for tumors smaller than 1 cm. Treatment varies according to disease staging, ranging from conservative surgery and radiotherapy (Stages I and II) to neoadjuvant chemotherapy and systemic therapies such as hormone therapy and monoclonal antibodies in advanced or metastatic cases (Stages III and IV).

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