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The Changing Landscape of Breast Cancer Treatment

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Rezumat

Transformarea abordării terapeutice în cancerul de sân

Context: Managementul cancerului de sân a cunoscut o evoluție importantă, trecând de la intervenții chirurgicale agresive şi invazive către strategii personalizate, multidisciplinare, ghidate de biologia tumorală şi de rezultate orientate către pacient.
Progrese recente: Studiile clinice randomizate au permis deescaladarea tratamentului chirurgical în anumite cazuri. În paralel, progresele în terapiile sistemice, inclusiv agenți țintiți, conjugați anticorp medicament (ADC), precum trastuzumab emtansină (T-DM1) şi trastuzumab deruxtecan (T-DXd), terapii endocrine şi imunoterapie în contexte selectate, au îmbunătățit semnificativ supraviețuirea şi calitatea vieții. Tehnologii emergente precum degradatorii selectivi orali ai receptorului estrogenic (SERD), antagoniştii covalenți selectivi ai receptorului estrogenic (SERCA), chimerii de tip PROTAC (proteolysis-targeting chimeras) şi antagoniştii compleți ai receptorului estrogenic (CERAN) extind în continuare opțiunile terapeutice.
Concluzii: Managementul modern al cancerului de sân este definit de medicina de precizie, integrarea multidisciplinară şi deescaladarea selectivă a intervențiilor chirurgicale cu indeplinirea criteriilor oncologice. Provocările persistente includ rezistența terapeutică, toxicitatea tratamentelor, costurile şi asigurarea unui acces echitabil la inovație.

Cuvinte cheie: cancer de san, chirurgie oncoplastica, terapie endocrina, chimioterapie

Abstract

Background: Breast cancer management has undergone an important evolution, from aggressive, invasive surgical interventions towards personalized, multidisciplinary strategies guided by tumor biology and patient oriented outcomes.
Recent advances: Randomized trials have enabled the possibility of less invasive

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surgery in some cases, while advances in systemic therapy including targeted agents, antibody drug conjugates (ADCs) such as Trastuzumab emtansine (T-DM1) and Trastuzumab deruxtecan (T-Dxd), endocrine therapy and immunotherapy in selected cases have improved survival and quality of life. Emerging technologies such as oral selective estrogen receptor degraders (SERDs), selective estrogen receptor covalent antagonists (SERCAs), proteolysis targeting chimeric (PROTACs) and complete estrogen receptor antagonists (CERANs) are expanding therapeutic options.
Conclusions: Modern breast cancer management is defined by precision medicine, multidisciplinary integration and less invasive surgical interventions in selected cases. Ongoing challenges include therapeutic resistance, toxicity, cost, and equitable access to innovation.

Keywords: breast cancer, oncoplastic surgery, endocrine therapy, chemotherapy

Introduction

Breast cancer is widely known to be the leading cause of cancer-related deaths in women. Significant research and the study of the various molecular subtypes of breast cancer have greatly improved outcomes while taking into consideration the quality of life of the patient involved. The etiology of breast cancer is composed of an intricate interplay between genetic predisposition, environmental and lifestyle factors and while the incidence of the disease continues to increase in high-income countries, mortality rates in these areas are dropping due to access to early intervention and the possibility to apply rigorous treatment protocols (1). Differences in breast cancer risk are multifactorial and reflect not only hormonal exposure but also breast tissue biology, cumulative lifetime estrogen exposure and genetic susceptibility (2). Moreover, younger age at menarche has been found to be linked to an increased lifetime risk for developing breast cancer, due to a longer exposure to endogenous estrogens. Hormone replacement therapies in postmenopausal women who underwent more than 4 years of combined estrogen-progestin replacement therapy, were also found to be a risk factor (3). Genetic predisposition with pathogenic variants in the two breast cancer susceptibility genes (BRCA1 and BRCA2) account not only for the personal increase in breast cancer risk for women who test positive for mutations in one or both of these genes but also for positive family history of breast cancer (4). Levels of physical activity, nutrition, obesity, consumption of alcohol and smoking have also been found to be etiological factors in the development of the disease (5).

Ever since its discovery in the ancient times, theories about the origins and best treatment methods for breast cancer have shaped the protocols which we follow today, with proper staging and understanding of the molecular subtype of the tumor being crucial for obtaining the best outcome. The late 19th century marked the beginning of the "Halsted mastectomy" (developed by William Halsted in 1890) and involved radical mastectomy, removal of axillary lymph nodes as well as the pectoralis major and minor muscles. This procedure went on to become the gold standard of treatment for breast cancer for about 80 years. Debilitating and disfiguring, it set up the need for a deeper understanding of the different stages of breast cancer in order to proceed accordingly to treat the disease while maintaining the quality of life (6). Subsequent landmark randomized trials, including NSABP B-04 and B-06, revealed equivalent survival with less extensive surgery, putting the foundation for conservative approaches in breast cancer. These trials marked a change in the management of breast cancer towards patients' quality of life taking into consideration the oncological results (7).

Materials and Methods

This article represents a narrative review of the historical evolution and contemporary multidisciplinary management of breast cancer. A literature search was carried out using PubMed/MEDLINE and important oncology society resources. The primary objective was to synthesize clinically relevant evidence regarding modern treatment strategies, including less aggressive surgical interventions, when possible, targeted therapies, antibody drug conjugates, endocrine new treatments and immunotherapy. Priority was given to articles from January 2022 to September 2025 in order to capture the most recent developments in breast cancer management, including newly published phase III trials, emerging therapeutic classes and updated clinical guidelines that reflect current standards of care. Earlier landmark studies were selectively included to provide historical context and illustrate major paradigm shifts in treatment evolution. Search terms included

"breast cancer treatment updates," "immunotherapy in breast cancer", "targeted therapy," "endocrine therapy", "oncoplastic surgery" and "breast cancer surgery evolution."

Regarding inclusion criteria of the publications, studies were considered eligible if they met one or more of the following criteria: randomized controlled trials or phase II/III clinical trials, meta-analyses or systematic reviews, major international clinical guidelines, high quality observational studies with significant clinical relevance and historical trials influencing current treatment methods.

Exclusion criteria included: case reports and small case series with limited external validity, publications without peer review, studies not available in English and articles lacking clear methodological description or clinical applicability.

Study selection was guided by clinical relevance, methodological rigor and contribution to understanding multidisciplinary breast cancer management. Evidence was synthesized narratively rather than quantitatively due to heterogeneity in study designs, therapeutic modalities and outcomes.

Priority was given to: large randomized trials and guideline studies, recent publications introducing novel therapeutic approaches, evidence demonstrating changes in clinical practice or treatment paradigms.

The study was organized thematically according to biological subtypes of breast cancer and major treatment modalities (surgery, radiotherapy, systemic therapy) allowing integration of historical evolution with contemporary clinical practice.

Results

Modern breast cancer treatment is fundamentally guided by molecular subtype, stage, and patient related parameters. Therapeutic strategies are therefore discussed according to the main biological subtypes:

Hormon Receptor (HR) Positive / HER2 Negative Breast Cancer

Endocrine therapy remains the main treatment in these cases. Aromatase inhibitors are effective only in postmenopausal women or in premenopausal women receiving concomitant ovarian suppression. CDK4/6 inhibitors (palbociclib, ribociclib, abemaciclib) combined with endocrine therapy represent standard of care in advanced disease. Alpelisib, a PI3K inhibitor, is used in selected patients with PIK3CA mutations. The phase III EMBER-3 trial analyzed the oral selective estrogen receptor degraders (SERD) imlunestrant in combination with abemaciclib, showing better results compared with endocrine therapy alone in estrogen positive advanced disease (8).

VERITAC-2 studied vepdegestrant, a new generation oral SERD, demonstrating clinically meaningful activity in ESR1-mutant cancers after prior endocrine resistance. These studies support continued refinement of endocrine sequencing strategies in HR-positive disease (9).

HER2 Positive Breast Cancer

Targeted therapy represents the most important treatment option in HER2 positive breast tumors. Dual HER2 blockade combined with chemotherapy is the standard treatment in early and advanced settings. Antibody drug conjugates (ADC), including trastuzumab emtansine (T-DM1) and trastuzumab deruxtecan (T-DXd), represent an important advance by delivering cytotoxic agents directly to HER2-expressing cells, improving efficacy while limiting systemic toxicity (10).

Triple Negative Breast Cancer (TNBC)

TNBC is characterized by aggressive behavior and limited therapeutic options. Chemotherapy remains a central component of treatment. Immune inhibitors, especially pembrolizumab, are used in PD-L1–positive TNBC in both early and metastatic stages (11).

The role of immunotherapy in HER2 positive breast cancer remains investigational. Recent trial studies such as ASCENT-04/KEYNOTE-D19 have expanded understanding of ADC and immuno-therapy combinations in TNBC (12).

Current Treatment Modalities of Breast Cancer

There are many factors that contribute to the treatment plan that the breast cancer patient will follow. Tumor staging, grading, the presence or absence of certain biomarkers within the tumor tissue as well as the preferences and expectations of the patient are all taken into consideration when selecting the treatment protocol (13).

Surgery

Sentinel lymph node biopsy has largely replaced routine axillary dissection in clinically node-negative patients, further contributing to de-escalation.

Surgery is a common treatment method among breast cancer patients with various stages of the disease. A lumpectomy, typically reserved for cases of localized early-stage tumors, is a breast-conserving surgical procedure which aims to remove only the affected portion of breast tissue and in some cases

part of the lining of the chest wall when the tumor is in proximity to it. It typically has better cosmetic outcomes and shorter recovery time, but is usually followed by radiation therapy with the scope of removing any malignant cells which may remain post-surgery. The mastectomy is a procedure in which the entire affected breast is removed. Radical (Halsted) mastectomy is now considered obsolete. Contemporary surgical options include: total (simple) mastectomy, modified radical mastectomy, skin and nipple sparing mastectomy. These approaches, particularly when combined with oncoplastic techniques, allow for oncologic safety while optimizing aesthetic results and improving the quality of life.

The sentinel lymph node biopsy, which includes the first anatomic lymph node station where the cancer cells could disseminate to, is usually performed to determine if further removal of lymph nodes is necessary. The mastectomy can be subdivided into a modified radical mastectomy, in which the entire breast tissue, including the areola and the nipple are removed along with some axillary lymph nodes and a radical mastectomy in which the entire breast tissue, the axillary lymph nodes and the chest muscles are removed together. The latter is performed rarely nowadays and only in specific cases where such extensive removal is warranted (13).

Radiation therapy

Radiotherapy plays a role across disease stages, reducing local recurrence and providing palliation in metastatic settings. Neoadjuvant radiotherapy is under investigation in selected patients and may facilitate immediate reconstruction without compromising oncologic outcomes.

Radiation therapy is performed with the scope of decreasing recurrence of the disease, targeting malignant cells in cases of metastasis to other parts of the body and to eliminate possible remaining cancer cells post-surgery. Cancer cells are particularly sensitive to the effects of radiation in comparison to normal cells and radiotherapy uses matter in the various forms such as photons, protons, neutrons and electrons to target these groups of cells. Whether it's used to relieve symptoms in metastatic breast cancer or to decrease the chances of recurrence in early-stage breast cancer, radiation therapy can be a part of the treatment protocol in any stage of breast cancer, depending on the particularities of each case (14). While radiation therapy is typically started when the surgical incision is fully healed, the order in which treatment is administered has been closely studied recently, with neoadjuvant radiation therapy before the surgical procedure showing promising results and less delay between initial surgery and reconstruction in patients who are eligible. Besides the evident impact on the quality of life of the patient and the psychological benefits in not delaying the reconstructive procedure, it was found that these patients did not have a higher recurrence of disease than those who underwent surgery before radiation therapy (15).

Chemotherapy

While chemotherapy is used widely used in breast cancer, its usage and regimen depend heavily on the subtype of cancer present and on the presence or absence of various immunohistochemical markers which are continuously studied. The combination of these markers, along with the marker percentages expressed in the tumor tissue dictate the systemic treatment that the patient will receive. Chemotherapy can be used as neoadjuvant or adjuvant therapy to surgery to enhance results and reduce recurrence (13). Generally, the effects of chemotherapy are amplified and more efficient when used in combination with other drugs, either hormone therapy, targeted therapy, immuno-therapy or in combination with other types of chemotherapy drugs. Several chemotherapy drugs have been approved and are used in treatment regimens for breast cancer. Some of these include taxanes (paclitaxel and docetaxel), anthracyclines (doxorubicin, epirubicin), 5-fluorouracil, carboplatin (paraplatin), cyclophosphamide. Chemotherapy is usually given in treatment cycles, with typical durations between 2-3 weeks per cycle followed by a period of no treatment (rest cycles) to recover from the side effects of the medication and prepare for a new cycle. As previously mentioned, immunohistochemical markers are essential in deciding which type of systemic therapy and in what combination is used for each patient. For examples, in cases of luminal A breast cancer (ER+/PR+/HER2- with low Ki-67 expression) which is indolent and less aggressive compared to other subtypes, chemotherapy may be omitted entirely in favor of other treatment methods such as hormone therapy (endocrine therapy), with excellent prognosis and less side effects from classic chemo-therapy regimens which are usually used in luminal B, HER2+ and triple negative breast cancer. Chemotherapy drugs are typically administered into a vein, sometimes with the use of a central venous catheter (CVC) which can be a more efficient way to administer drugs repeatedly over many cycles, while also having the option to draw blood for testing via the same catheter (16).

Hormone therapy

The importance of immunohistochemical markers is

once again made evident through the use of endocrine therapy in breast cancer. The presence of estrogen (ER+) and progesterone (PR+) receptors in the tumor tissue opens up the possibility of targeting these hormones and their effects on tumor tissue in scope of decreasing the chances of disease recurrence. This is due to the fact that ER+/PR+ breast cancer growth is fueled by these circulating hormones. Likewise, the absence of these receptors signals the fact that hormone therapy would not be an efficient therapeutical choice and warrants other drug combinations on a case-by-case basis. The mechanisms involved in hormone therapy can refer either to decreasing the circulating hormones which can bind to the tumor receptors or blocking the interaction between the hormone and the receptor (13). Selective estrogen receptor modulators (SERMS) deliver an anti-estrogen effect on the tumor tissue by blocking estrogen-receptor coupling. Tamoxifen is a well-known, widely used SERM that can be integrated as an adjuvant or neoadjuvant treatment in patients who can undergo surgical intervention, and as a part of the treatment regimen in hormone-positive breast cancer in cases with metastasis to minimize the growth and further spread of the cancer. When used as adjuvant therapy, it is typically administered for 5-10 years and is usually a drug of choice in women who have not yet gone through menopause. When used in cases such as hormone positive ductal carcinoma in situ for 5 years after breast-conserving surgery, its use can be linked to a reduced recurrence of the disease in the same breast or the appearance of the same type of cancer in the opposite breast at a distance of time. Other SERMS include Toremifene, used and approved only in cases of metastatic breast cancer in women who have undergone menopause at the time of diagnosis. These hormone therapies, although useful and efficient in cases of hormone receptor positive breast cancer, have common side effects such as interference with the normal menstrual cycle in pre-menopausal women, hot flashes and night sweats, nausea, tiredness and weakness, skin rashes, pruritus and depression. Deep vein thrombosis, pulmonary embolism, loss of bone density and increased incidence of cataracts represent the more serious and dangerous side effects which can occur in patients undergoing treatment with these commonly used medications. Other hormone drug therapy classes include selective estrogen receptor degraders (SERDs) such as Fulvestrant, used in the treatment of advanced breast cancer which has not been treated with other hormone therapies or when other therapies such as Tamoxifen no longer have effects. Elacestrant and Imlunestrant are two other types of SERDs approved in the treatment of ER+ HER2- , ESR1 mutation positive breast cancer where other hormone therapies are no longer able to suppress the growth of the tumor. An important aspect that is taken into consideration when this class of drug is used in pre-menopausal women is the need for ovarian suppression, usually achieved by combining the treatment with a luteinizing-hormone releasing hormone to regulate the positive feedback of hormone production in the ovaries. Aromatase inhibitors (Letrozole, Exemestane and Anastrozole) represent another class of hormone therapy drugs, which inhibit the production of the hormone estrogen in menopausal women and also in premenopausal women if combined with ovarian suppression. With similar side effects including hot flashes, bone pain and vaginal dryness they are less likely to cause blood clots (when compared to Tamoxifen) and may rather have more negative effects on bone and joints. Physiologically, bone density decreases after menopause as estrogen has a protective effect on bone thickness and health in pre-menopausal women. It is no surprise that the use of aromatase inhibitors can cause bone thinning in women who have them as part of their treatment regimen, predisposing them to bone fractures and osteoporosis (17).

Targeted therapy

Targeted therapies have greatly improved the prognosis of many subtypes of breast cancer. These therapies include the use of monoclonal antibodies (pertuzumab, trastuzumab, margetuximab) which can be used in combination with chemotherapy as part of adjuvant therapy. Tyrosine kinase inhibitors (lapatinib, tucatinib, neratinib) are used in the treatment of HER2+ breast cancer and are being investigated in clinical trials for their possible use in triple negative breast cancer (18). Cyclin-dependent kinase inhibitors (abemaciclib, palbociclib) can be combined with hormone therapy in the treatment regimen of hormone positive, HER2- breast cancer. Other classes such as mammalian target of rapamycin (mTOR) inhibitors slow growth and angiogenesis within the tumor and the drug everolimus has been used in the treatment of hormone positive, HER2- breast cancer, with studies showing that it may potentiate the effects of hormone therapies in these cases. Olaparib and talazoparib, medications belonging to a drug class called PARP inhibitors are used in HER2-, BRCA1 and BRCA2 mutation positive patients (19).

Immunotherapy

Immune checkpoint inhibitors such as Pembrolizumab target PD-1, a protein found on the T cells of the

immune system which prevents them from directing an attack on other cells of the body. Blocking these proteins greatly increases the immune systems response against the malignant cells and is a treatment method used in PD-L1 positive triple negative breast cancer (an aggressive type of breast cancer with otherwise limited treatment modalities due to the lack of hormone receptors). Because Pembrolizumab is an immune checkpoint inhibitor, its use may increase the risk of autoimmunity which can have serious effects on the kidneys, lungs, glands and other organs against which the immune system may act when subjected to these treatments. Therefore, close monitoring of the patient is imperative when using this drug class (20).

Updates in the Treatment of Breast Cancer

The evolution of breast cancer treatment has primarily focused on improvement of the quality of life while maintaining the best therapeutic outcome possible. Whereas historically the overall quality of life was not as heavily taken into consideration when choosing the treatment for breast cancer patients. presently there are many trials and studies in progress which are aiming to provide the best outcomes without the cost of the quality of life (21).

One of the treatment modalities which has the greatest impact on quality of life, in any malignant disease, is chemotherapy. One of the biggest challenges that comes with the use of chemotherapy drugs is the generalized toxicity, not only towards the tumor tissue, but also towards healthy cells in the body. Antibody drug conjugates (ADCs) have gained recent interest and have bridged the gap between targeted therapies and chemotherapy in breast cancer. ADCs are able to deliver cytotoxic drugs directly to the tumor through a monoclonal antibody that is able to bind and offload the therapeutic agents via a specific protein on the malignant cell surface which causes endocytosis of the drug conjugate. Lysosomal degradation then allows the drugs to be expelled into the cytoplasm of the targeted cancer cell, thereby focusing the cytotoxic effects and sparing the rest of the healthy cells of the effects. A good example of a breast cancer subtype where such a mechanism can be used is HER2 positive breast cancer. Two examples of ADCs which have been approved by the FDA for use in HER2 positive breast cancer are Trastuzumab emtansine (T-DM1) and Trastuzumab deruxtecan (T-Dxd). Both exhibit two mechanisms which make them efficient in the treatment of HER2+ breast cancer; trastuzumab anti-tumor effect mediated by the Fab segment which can block the extra-cellular domain of the HER2 on the surface of the malignant cell, thereby blocking further cell proliferation through inhibition of the P13K/AKT pathway, and the offloading of the "payload", which are mostly limited to tubulin inhibitors, drugs which damage cellular DNA and even immuno-modulators (22). T-Dxd has also been found to have effects on low HER2 breast cancer and many other ADCs are under trial for treatment of this subtype (23). Clinical trials are well underway for the combination of ADCs with multiple medication regimens, as drug resistance due to use of a single regimen is a continuous challenge. The balance between efficacy and toxicity has to be taken into account when working with such combinations, as significantly increased toxicity can occur (24). An example of this is the combination of gemcitabine with T-DM1. Gemcitabine can up-regulate the expression of HER2 on the surface of the cell, the target of trastuzumab, increasing efficacy of the ADC in this manner (25). Combinations of T-DM1 and paclitaxel are still being evaluated and studied (26).

Combination of ADCs with targeted therapies is also a topic of interest as integration between ADCs and targeted therapies such as CDK4/6i, PARP inhibitors and P13K inhibitors could potentiate the effects of the ADC and decrease the possibility of drug resistance (27). Such studies are also underway for the combination of ADCs with immunotherapy, as T-DM1 has been found to increase tumor-specific immunity through an increased amount of stromal tumor-infiltrating lymphocytes (28).

Research and advancements are also being made in endocrine therapy for breast cancer. New drug classes such as selective estrogen receptor covalent antagonists (SERCAs), complete estrogen receptor antagonists (CERANs), proteolysis-targeting chimerics (PROTACs) as well as oral selective estrogen receptor degraders (SERDs) are being intensely studied for their effect on the estrogen receptor and for their possible use in hormone positive breast cancer (30). Up until 2023, Fulvestrant was the only approved SERD used in ER+ breast cancer, because of its higher efficacy in treating ESR1 mutations when compared to aromatase inhibitors (31). However, because it is administered only through injection, limitations for patients who have a difficult time with injectable medications or those who prefer oral medication was evident (32). Elacestrant was the first oral SERD which gained approval for treatment of ER+, HER2 negative metastatic breast cancer in January of 2023, redefining the way SERDs could be administered and opening the horizons for other such drugs to be developed and approved in the future. Oral administration overpassed some of the major limitations of fulvestrant which included the need for intramuscular injections with a large volume and decreased bioavailability (33).

To name a few, camizestrant, giredestrant, amcenestrant and borestrant are only a few other SERDs which are undergoing clinical studies to be approved in the treatment of breast cancer (34). PROTACs are being studied for their ability to bind to estrogen receptor alpha, responsible for the progression and development of breast cancer, and their ability through several mechanisms to arrest the cell in the G1 phase (35). CERANs are studied for their ability to completely block the estrogen receptor's ability to send signals, achieved via inactivation of the AF1 and AF2 activation functions which ultimately yields more effective results on tumor shrinkage and a good alternative for endocrine resistance. Palazestrant, an oral CERAN, is under study for treatment of ER+/HER2- breast cancer (36). A SERCA which is being studied is H3B-6545 which functions by selectively targeting and inhibiting ERa (wild-type and mutant). It has shown promising results in the treatment of hormone positive metastatic breast cancer (37).

In terms of surgery, new surgical modalities and integration of AI and technology are being tested and slowly introduced into common practice. One such advancement is the integration of technology such as 3D printing with the scope of reproducing anatomical structures and better localization of breast cancer tumors. When such technology is used, it allows the surgeon to better visualize the exact location of the tissue which needs to be excised, minimizing in some cases the amount of tissue which is excised. This technique is achieved with the use of magnetic resonance imaging and the generation of a form which matches the surface of the patient's breast when the patient is laying in a supine position. This 3D tracking allows for better visualization of tumor volumes and accurate position. Evidently, the more accurately the tumor can be represented pre-operatively, the better the outcomes for the patient and the better the pre-operative planning for the surgical team (38). Artificial intelligence applications in breast cancer surgery also include image segmentation, predictive modeling, and surgical planning support. These technologies are distinct from advanced imaging and 3D printing and remain under clinical validation rather than routine practice. In terms of surgical techniques, oncoplastic surgery is another major advancement which has been gaining popularity and recognition in recent years. The ability to perform both the mastectomy and the esthetic reconstruction of the breast in the same surgery is perhaps one of the most important advancements in the maintenance of the quality of life of the patients undergoing treatment for breast cancer. Moreover, meta-analyses as well as prospective cohort studies have shown that the disease-free survival outcomes and local-recurrence in cases where oncoplastic surgery is performed are comparable to those which occur after standard mastectomy. Implementation of this technique has yet to become more widespread worldwide, as a close collaboration between the oncologist, breast surgeon and plastic surgeon is crucial to obtain the best outcomes (39).

Conclusions

It is evident that the treatment of breast cancer has come a long way throughout history. From the Halsted mastectomy to the possibility of oncoplastic surgery and targeted systemic treatment, current treatment protocols aim to preserve the quality of life of the patient while she is undergoing them regardless of the stage of the cancer. Because there is no "one size fits all" when selecting a treatment protocol, the use of histological and immunohistochemistry testing is imperative in tailoring each protocol to the specificity of the tumor such as in hormone receptor positive cancers, for example. The more data about the makeup of the tumor, the better the chances are to find a targeted treatment which can act more selectively, decreasing overall toxicity and side effects. Overall, it is important that any new treatment which is tested yields similar or better results when compared to approved protocols, because the goal is to maintain a balance between results and quality of life. Both are equally important and modern medicine continues to evolve and treat the patient as a whole entity, with both physical and psychological needs. Breast cancer management has evolved toward precision medicine, multidisciplinary integration and less aggressive surgical interventions respecting also oncological principles. Advances in molecular profiling, targeted therapy, and surgical techniques have improved outcomes while prioritizing quality of life. Persistent challenges include treatment resistance, long-term toxicity, financial burden, and easier access to medical treatment. Future directions involve biomarker refinement, real world validation of AI tools and rational combination strategies to sustain progress.

The historical evolution of breast cancer treatment reflects a shift from radical intervention toward personalized, evidence-based care. Continued integration of emerging therapies and technologies holds promise for further improving patient outcomes while minimizing treatment burden.

Conflicts of Interest

The authors declared no conflicts of interest.

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