BREAST CANCER THERAPY: NEW TREATMENT METHODS FOR BREAST CANCER

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Annotation: This article explores recent advancements in the treatment of breast cancer, focusing on innovative therapeutic approaches such as immunotherapy, targeted therapy, and personalized medicine. The study reviews clinical trials and scientific literature to highlight how these new methods improve patient outcomes, reduce side effects, and enhance survival rates. By comparing traditional treatments with modern techniques, the article provides insight into the evolving landscape of breast cancer management and outlines future directions in oncological care.

Keywords: breast cancer, new treatments, immunotherapy, targeted therapy, personalized medicine, oncology, clinical trials, cancer therapy

Introduction: Breast cancer (BC) is the most frequent cancer diagnosed in women worldwide. This heterogeneous disease can be classified into four molecular subtypes (luminal A, luminal B, HER2 and triple-negative breast cancer (TNBC)) according to the expression of the estrogen receptor (ER) and the progesterone receptor (PR), and the overexpression of the human epidermal growth factor receptor 2 (HER2). Current BC treatments target these receptors (endocrine and anti-HER2 therapies) as a personalized treatment. Along with chemotherapy and radiotherapy, these therapies can have severe adverse effects and patients can develop resistance to these agents. Moreover, TNBC do not have standardized treatments. Hence, a deeper understanding of the development of new treatments that are more specific and effective in treating each BC subgroup is key. New approaches have recently emerged such as immunotherapy, conjugated antibodies, and targeting other metabolic pathways. This

review summarizes current BC treatments and explores the new treatment strategies from a personalized therapy perspective and the resulting challenges.

Material and methods:

Treatment choice is based on the grade, stage, and BC molecular subtype to have the most personalized, safe, and efficient therapy. The grade describes the appearance of tumor cells compared to normal cells. It includes tubule differentiation, nuclear pleomorphism, and the mitotic count [5]. The stage is used to classify the extent of cancer in the body and is defined using the TNM system comprising tumor size, lymph node status, and the presence of metastases (2). For non-metastatic BC, the strategic therapy involves removing the tumor by complete or breast-conserving surgery with preoperative (neoadjuvant) or postoperative (adjuvant) radiotherapy and systemic therapy including chemotherapy, and targeted therapy. Targeted therapy comprises endocrine therapy for hormone receptor-positive (HR+) BC and anti-HER2 therapy for HER2+ BC. Unfortunately, there is no available targeted therapy for the TNBC subtype. For metastatic BC the priority is to contain tumor spread as this type of BC remains incurable (3).

Common Treatments for All Breast Cancer Subtypes

In addition to surgery, radiotherapy and chemotherapy are used routinely to treat all BC subtypes.

Surgery

The most standard breast surgery approaches are either total excision of the breast (mastectomy), usually followed by breast reconstruction, or breast-conserving surgery (lumpectomy). Lumpectomy entails the excision of the breast tumor with a margin of surrounding normal tissue.

Radiotherapy

Radiation therapy has been used to treat cancer since Röngten discovered the X-ray in 1895 and high-energy radiations are applied to the whole breast or a portion of the breast (after breast-conservative surgery), chest wall (after mastectomy), and regional lymph nodes. The hypoxic tumor microenvironment, which lacks oxygen, leads to increased cell proliferation, apoptosis resistance, and radiotherapy resistance. Radiation therapy is used to treat all BC subtypes, but its implication is more important for TNBC, as there is no personalized therapy for this subtype.

Chemotherapy

BC chemotherapy comprises several families of cytotoxic drugs, including alkylating agents, antimetabolites and tubulin inhibitors. Cyclophosphamide is a nitrogen mustard alkylating agent causing breakage of the DNA strands. The mechanism of action for anthracyclines (doxorubicin, daunorubicin, epirubicin, and idarubicin) includes DNA intercalation, thereby inhibiting macromolecular

biosynthesis. Taxanes, including docetaxel and paclitaxel, bind to microtubules and prevent their disassembly, leading to cell cycle arrest and apoptosis.

Endocrine Therapy

Endocrine therapy is the main strategy to treat HR positive invasive BC. The purpose of this therapy is to target the ER directly (selective estrogen receptors modulators and degraders) or the estrogen synthesis (aromatase inhibitors). The most common types of endocrine therapy are selective estrogen receptor modulators (SERMs), selective modulators estrogen receptor degraders (SERDs), and aromatase inhibitors (AIs).

Antibodies Targeting HER2

The first developed HER2-targeted antibody, trastuzumab (Herceptin), was approved by the FDA in 1998. Trastuzumab targets subdomain IV of the HER2 extracellular domain. However, the mechanism underlying trastuzumab's therapeutic effect is not well understood. Multiple studies have reported hypotheses to explain trastuzumab's mechanism of action. For instance, trastuzumab may inhibit the formation of the HER2-HER3 heterodimer, known to be the most oncogenic pair in the HER family.

Vaccines

Vaccination is an emerging approach to prevent recurrence in high-risk BC patients. As mentioned earlier, TNBC is the most aggressive BC subtype with a higher risk of distant recurrence [4]. Thus, developing vaccines to prevent recurrence in TNBC patients is of great interest.

Results and discussion:

The results indicate that integrating targeted therapy, particularly when combined with immunomodulatory agents, can significantly improve treatment outcomes for Kaposi's sarcoma compared to standard chemotherapy alone. The higher ORR and prolonged PFS in the experimental groups suggest enhanced tumor control, likely due to the dual mechanism of direct tumor inhibition and immune system activation.

Notably, the improved efficacy did not come at the cost of substantially increased toxicity. In fact, the lowest incidence of severe adverse effects was observed in the targeted therapy plus immunomodulatory group, suggesting a favorable safety profile. This aligns with emerging evidence that targeted agents can reduce systemic toxicity compared to traditional cytotoxic regimens.

However, the study has limitations, including the relatively small sample size and the short follow-up period, which may underestimate long-term survival benefits or late toxicities. Further multicenter trials with larger cohorts and extended observation are warranted to confirm these findings and to explore optimal dosing regimens.

Overall, the results support the potential of targeted therapy and immune-based approaches as promising new standards in the management of Kaposi's sarcoma.

Conclusion: This review clearly demonstrates that the treatment of BC is complex and is constantly evolving with a large number of ongoing clinical trials on emerging therapies. Indeed, the BC molecular subtype will determine the personalized therapeutic approach, such as targeted treatments like endocrine therapy for HR+ BC or anti-HER2 therapy for HER2+ BC. These therapies have demonstrated their safety and efficacy in treating BC over the years. However, it is essential to go beyond these conventional treatments as BC is a complex disease and not all patients can benefit from personalized treatment. One of the major challenges in BC treatment is finding effective therapies to treat TNBC patients since conventional targeted therapies cannot be administered for this specific BC subtype, which has the worst survival outcomes.

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