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Compare the Treatment Effects of Various Therapies for Breast Cancer Based on Data Analysis

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Abstract. Breast cancer is one of the life-threatening tumors around the world. While some researchers have discovered a strong correlation between human health issues in contemporary society and the medication of breast cancer, a comparison of the impacts of different breast cancer treatments is still lacking in the literature. Thus, for the purpose of compare the therapeutic outcomes of targeted medication therapy, immunotherapy, and surgical treatment, this research gathers clinical treatment data and does SPSS data analysis. Research has demonstrated the efficacy of surgical intervention, immunotherapy, and targeted medication therapy in the managing the remedy of breast cancer. The specific targets of each therapeutic modality vary. Individuals diagnosed with advanced breast cancer may select several treatment options based on their unique circumstances.

Keywords: Breast cancer; modified radical resection; Immunotherapy; Targeted drug therapy.

1. Introduction

Breast cancer, the most widespread form of cancer, accounts for thereabouts 30% of newly diagnosed cases among female patients globally, which is the primary occasion of cancer-related deaths between women [1]. According to the statistician of GLOBOCAN in 2020, it shows that in terms of mortality, breast cancer is currently the most common type of cancer, second only to lung cancer. It is approximated that the number of breast cancer-related deaths worldwide will reach 760,000 by 2025, indicating a significant upward trend [2]. To prepare for the rapid increase of breast cancer in advance, The Global Breast Cancer Initiative was launched by the World Health Organization in 2021. [3]. The initiative's three main pillars—health improvement, prompt in treatment and diagnosis, comprehensive therapy and supporting care—are intended to improve the survival rates of patients around the world [3]. Nowadays, surgical intervention, immunotherapy, gene therapy, medication therapy, and other approaches have been employed in the therapy of breast cancer broadly. Clinical research on targeted axillary lymph node dissection and the creation of a predictive model BRCA-C risk for contralateral breast cancer risk provide more evidence for the de-escalation of surgical treatment [4]. Pyrotinib has demonstrated notable success in the treatment of advanced HER2-positive breast cancer [4]. For invalids with triple-negative breast cancer, the use of specific subtypes of treatment and immunotherapy persist in enhancing survival rates [4]. In relation to hormone receptor-positive breast cancer, notable researches have been conducted to exclude patients at low risk from chemotherapy and to investigate different treatments following their resistance to endocrine therapy [4]. Regarding BRCA mutations caused breast cancer, the combined application of BGB-290-201 reinforced the effectiveness and safety of poly (ADP-ribose) polymerase (PARP)inhibitors within Chinese demographic [4]. Pamiparib emerges as a prime medicament option for invalids with advanced HER2-negative status and germline BRCA (gBRCA)1/2 mutations [4]. At present, China has a large number of breast cancer sufferers, with high morbidity and mortality, and unique characteristics. The main objectives of treating breast cancer now focus on enhancing its cure rate, minimizing recurrence risks, and extending patient lifespans. In light of the preceding points, enhancing the standard of clinical therapy is crucial, and investigating the healing impact of different breast cancer treatment plans holds immense importance. This research will choose three surgical, immunotherapeutic and Targeted drugs treatments from the current standard breast cancer therapies in clinical settings, examining and contrasting the pros and cons of each. By comparing the cure

effectiveness, side effects rate and recurrence rates of these treatments in different breast cancer types, the pros and cons of these treatments could be outlined.

2. Breast cancer pathogenesis and prognostic features

Breast cancer has heterogeneity in terms of tumor form, molecular features, and clinical outcome [1].There are racial disparities in the incidence and death rate of breast cancer, and it is becoming more and more obvious that these variations are caused by variations in the distribution of individual risk factors, socioeconomic and contextual variables, tumor biology, and other factors [1].In China, the prevalence of breast cancer is rising annually, particularly in the economically developed large cities and coastal regions near the east. When considering the age at which a person develops the disease, the prevalence of breast cancer in China has been steadily uprising since the age of 20, peaking at 45 to 50 years old. Although both the incidence and categories of breast cancer keep increasing, the global mortality of it is gradually declining as novel treatment approaches become more widely used.

3. Existing clinical breast cancer treatment options

3.1. Surgical treatment - modified radical resection

Surgical treatment is one out of the multitude common remedy for breast cancer sufferers; nevertheless, this course of action is not recommended for those with severe illnesses affecting key organs, poor general health, or intolerance for advanced age. A thorough evaluation of the patient's physical state and the breast cancer's stage should inform the surgical method selection. While operation, the entire breast as well as every lymph node in the armpit are removed by modified radical resection, which is a frequently utilized surgical technique as it preserves the pectoral muscle and has a better postoperative appearance than other excisional operations [5].

3.2. Immunotherapy

The primary goal of immunotherapy, a novel approach to treating tumors that differs greatly from earlier cancer treatments, is to alter the tumor microenvironment in order to restore the human body's natural immune system's capacity to eradicate cancer cells [6]. PD-1 inhibitors bind to PD-1 on the surface of T cells in the tumor microenvironment, and PD-L1 inhibitors specifically bind to PD-L1 expressed by tumor cells, disrupting the PD-1/PD-L1 pathway and restoring the immune effect of T cells [7]. Tumor cells also activate the negative feedback regulatory signal way downstream of PD-1, inducing the weakening and apoptosis of cytotoxic T cells, inhibiting the proliferation and activation of working cells, reducing the production of cytokines, and impeding the antigen presentation process to elude the body's anti-tumor immune response [7] (Fig 1). Immunotherapy presents a fresh promise for the medical treatment of breast cancers, which has made great progress as a current hub for breast cancer research and treatment. Numerous clinical trials combining different immunotherapy modalities with chemotherapy and other treatment modalities have been conducted [6].

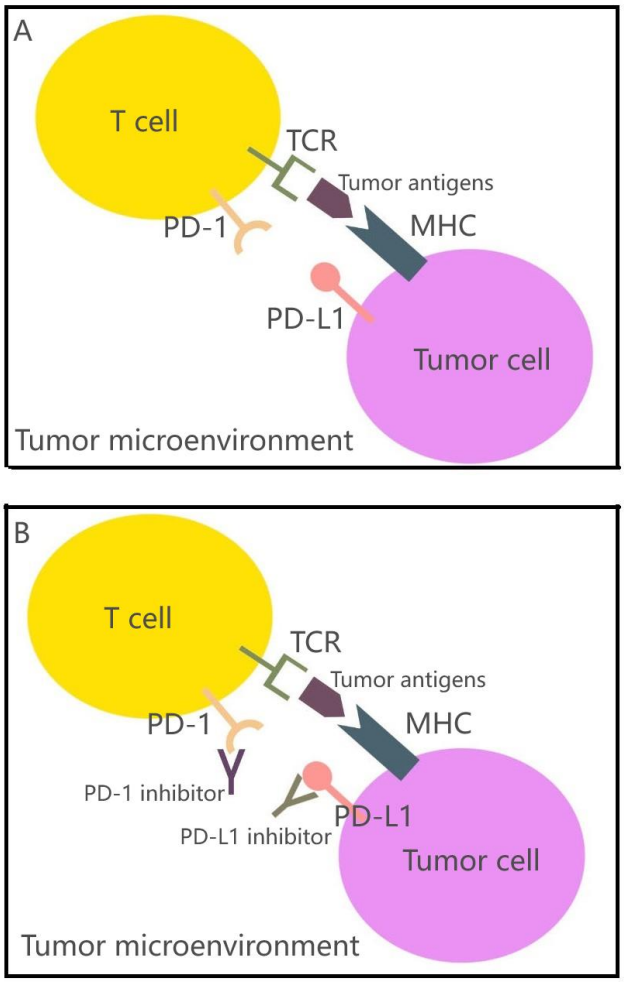

Fig. 1 A schematic representation showing how PD-1/PD-L1 inhibitors work [7]. (A) TCR signaling and T cell activation are blocked by the binding of PD-1 and PD-L1, which is given expression to the cell envelope of tumor cells; (B) TCR signaling and T cell activation are reactivated by PD-1/PD-L1 inhibitors, which bind exclusively to PD-1/PD-L1.

3.3. Targeted drug therapy

A treatment called targeted medication therapy uses particular interference to stop the growth of tumors. Its superiority includes higher specificity and broader tolerance, which avoids the damage to normal cells. By now, Trastuzumab, pertuzumab, T-DM1, lapatinib, pyrotinib, etc. have been approved to be effectual in the healing of breast cancer. All of them can be administered sequentially or in conjunction with chemotherapy, depending on the situation, to treat neoadjuvant, adjuvant, and advanced breast cancer. It occasionally works well when combined with endocrine medications.

4. Comparison of treatment regimens

4.1. Surgical treatment - modified radical resection

Clinical data on breast cancer patients from 2011 to 2021 were analyzed in the SEER database, with a random sample of 294 breast cancer patients. On the strength of the convey of progesterone receptor (PR), estrogen receptor (ER), and human epidermal growth factor receptor 2 (HER2), four molecular subgroups were identified among patients with breast cancer namely Luminal A, Luminal B, HER2-positive, and triple-negative. Among the 294 patients, 112 of them belong to Luminal A, 108 to Luminal B, 46 to HER2 46 positive and 28 to triple-negative. The relationship between clinicopathological factors and molecular typing was analyzed to compare local recurrence and distant metastasis in breast cancer patients with different molecular typing.

Data was analyzed using SPSS 27.0 statistical software, intergroup comparisons were performed using independent sample t-assays, counting data was uttered at a rate, and X^2 test were used for data comparison, with statistically significant differences of $P<0.05$.

For these four types of patients, they are similar in age, pathologic type, tumor size, lymph node metastasis, Cancer (AJCC) stage, vascular cancer thrombus, resection margins, chemotherapy cycles and endocrine therapy, etc. as the P value is larger than 0.05. Besides, as shown in table 1, we also calculated the local recurrence and distant metastasis rates for each group, which also shows no significant difference between them.

Table 1. Therapeutic effect of modified radical resection in four molecular subtypes of breast cancer

molecular subtypes	Local recurrence rate (%)	Distant metastasis rate (%)
Luminal A	14.3(16/112)	24.1(27/112)
Luminal B	14.9(16/108)	22.2(24/108)
HER2-positive	10.9(5/46)	34.8(16/46)
triple-negative	10.7(3/28)	39.3(11/28)
P	>0.05	>0.05

There was no momentous dissimilarity in the local recurrence rate and distant metastasis between patients with different subtypes of breast cancer (Table 1).

4.2. Immunotherapy

An immunological checkpoint called PD-1 is crucial for immune system regulation [6]. Studies have transpired that activation of the PD-1/PD-L1 pathway leads to cytotoxic T cell incapacitation, depletion, apoptosis, and reduction of cytokine production, thereby inhibiting antitumor response [6]. Keynote-012 showed 18.5% objective response rate (ORR) PD-1 antibodies in triple-negative breast cancer (TNBC). In the PD-L1 antibody and PD-1 antibody groups, the ORR was significantly higher in sufferers receiving first-line medical treatment than in those acquiring second-line or higher treatment (Table 2). In the PD-L1 antibody group, the median overall survival time was 19.2 months, while in the other group, it was 9.3 months [8,9]. Immunocheckpoint inhibitor monotherapy in hormone-receptor positive breast showed unsatisfactory results, with 12 percent ORR for PD-1 antibodies and 2.8 percent for PD-L1 antibodies [10,11]. PD-1 and PD-L1 are also currently used as prognostic and prognostic molecules in a number of clinical studies.

Table 2. ORR and median overall survival time for PD-1 antibody and PD-L1 antibody

	ORR for first-line treatment (%)	ORR for second-line or higher treatment (%)	median overall survival time(months)
PD-1 antibody	23.0	4.7	19.2
PD-L1 antibody	26.0	6.8	9.3

4.3. Targeted drug therapy

Clinical data from 100 trastuzumab treated breast cancer patients from 2011 to 2021 were analyzed in an observational group (n = 100), while 100 breast cancer patients receiving conventional chemotherapy were randomly selected from a SEER database (n = 100). Based on the therapeutic prognosis, the effective rate, the occurrence rate and the incidence of complications were contrasted.

Compared to the control group, the observation group's overall efficacy was higher, with mathematically substantial differences (Table 3).

Table 3. Response rate between two groups

group	Complete response	Partial response	Stable	Progression	Total response rate(%)
control group	42	21	19	18	63
observation group	64	20	14	2	84
P			<0.05		

Complete response (tumor tissue shrinkage >90%); Partial response (tumor tissue shrinkage of 50%~90%); Stable (tumor tissue shrinkage 25%~50%); Progression (enlargement of tumor tissue); Total response rate (complete response + partial response).

From the perspective of side effects, the adverse reactions (nausea, vomiting, fever, rash, etc.) occurred both in the control group and the observation group, and there was no noteworthy discrepancy between the two groups (Table 4).

Table 4. Adverse reactions between two groups

group	nausea and vomiting	fever	rash
control group	40	10	4
observation group	42	10	2
P	>0.05		

For chemotherapy and targeted drug therapy, similar complications are observed, mainly composed of myeloid suppression and anemia. However, the incidence of them was different, the level in the observation group was lower than in the control group, with mathematically substantial differences (Table 5).

Table 5. Complications between two groups

group	myelosuppression	anemia	total incidence (%)
control group	32	24	56
observation group	20	16	36
P		<0.05	

5. Future outlook

For different types of breast cancer, they show diverse overall survival (OS), for example, the triple-negative breast cancer with the lowest OS, so, A thorough investigation on the molecular types may be used to guide the choice of treatment and prognosis for breast cancer.

Immunotherapy, as a research hotspot in recent years, has also made great progress in the vigorous remedy of breast cancer, and clinical trials of multiple immunotherapies in combination with chemotherapy and other therapies have been widely used, which is a new hope for breast tumors treatment [6]. However, combination therapy may also have some problems: tumor antigen expression, neoantigen production, changes in the tumor's local immune microenvironment, and discrepancies in the immunological characteristics of primary and metastatic tumors after different treatments may affect the outcome of the final treatment [6].

The results show that trastuzumab is resultful in the cure of breast cancer invalids, which can decrease the overall incidence of complications, improve the therapeutic effect and reduce the occurrence of ADR. Wang Chunhua et al. [12] demonstrated that overall efficacy was greater in patients treated with trastuzumab than with conventional chemotherapy, and no adverse events higher than Grade III. Trastuzumab targeted treatment has a high safety profile and should be promoted and used.

6. Conclusion

Through investigation, this study discovered that all three of the breast cancer treatments were successful in treating the disease; among these, modified radical resection was most successful in lowering the rates of distant metastasis and local recurrence. However, the treatment effects for the different types of breast cancer were not significantly different from one another. Trastuzumab decreased the frequency of side effects and concomitant symptoms of different breast malignancies, whereas PD-1/PD-L1 immunotherapy enhanced the comprehensive survival of sufferers with breast cancer and had a good effect on the first-line therapy of triple-negative breast cancer. As a result, it is advised that invalids with breast cancer select a course of treatment that is better suited for their particular form of cancer. Patients may also decide to combine several medicines to increase treatment effectiveness and prognosis. This article's primary contribution is a comparison of the therapeutic effects of different breast cancer treatments, which helps clinical breast cancer patients choose the best treatment plans or medications. Lastly, the timeliness of trial data was somewhat limited, and the effectiveness of various treatments for the same type of breast cancer was not sufficiently compared in this paper. The experimental data collection and analysis procedures can be improved in the future, allowing for a more thorough examination of this subject.

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