A brief research progress of breast cancer

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Abstract. Breast cancer is distributed worldwide, and its number accounts for 23% of all cancer patients. This article will first start with the background of breast cancer, including its types and population. Then there are the pathogenic factors, signals, pathology, and cancer stages of the disease itself. Finally, the most important treatment in this article. With the rapid development of the modern medical system, the treatment options that people can choose have increased a lot, and the safety and success rate of surgery have also increased. There are even non-invasive cancer drug treatments. However, whether it is surgery or drug treatment, both have their advantages and disadvantages. Later in the article, these will be introduced to enable readers to understand various methods and make the best choice. The purpose of this article is also to review the current technology of breast cancer people so that they can have a better idea of the future development direction.

1 Introduction

Breast cancer, as a relatively common disease, accounts for 25% of female cancer patients. There are nearly 2 million cases and 500,000 deaths worldwide each year. Nevertheless, the survival rate of breast cancer patients in developed countries is as high as 80%. So, this article will introduce the types and differences of breast cancer and then focus on its causes and specific pathogenic mechanisms and the changes in the patient's body at different stages of the disease. At the end, the article will slightly mention five treatments for breast cancer and follow-up work.

2 Overview of the Breast Cancer

2.1. Different types of breast cancer

Histological classification is a common classification method in diseases, especially cancer. It is a classification based on its structure, function, and location. There are at least ten subspecies of breast cancer under histological classification. The most common types of breast cancer are invasive ductal carcinoma and invasive lobular carcinoma, which account for more than 50% of the total cases [1]. And the following text will mainly focus on these two types. The classification of these two types of breast cancer is also as the name suggests. The location of the former is on the inner wall of the breast milk duct—the breast duct. The latter appears on the lobules that produce milk in the breast. At the same time, there is another classification method: in clinical manifestations and treatment, people divide breast cancer into cavity A, cavity B, basal-like, triple-negative, and HER2 subtypes, and they have very different treatments and responses [2].

2.2 Population distribution

Apart from the worldwide distribution of breast cancer cases mentioned in the introduction, people from different regions and races have very different chances of developing different types of breast cancer due to genetic differences. For example, triple-negative breast cancer has the highest incidence among women of African descent, followed by women of European descent [3]. In Asia, China, or Japan (Human epidermal growth factor receptor 2), HER2 breast cancer has a dominant position. Among them, triple-negative cancers mostly occur in the elderly, while HER2 is biased towards younger women and is more susceptible to genetic factors [3]. If to rank the incidence of these four breast cancer subtypes in the population from high to low, the most common is cavity A, which occurs more than 40%, followed by cavity B. With HER2 type, the ratio of the total number of breast cancer patients is about 20%, and the rarest one is triple-negative [3].

2.3 Sign and discovery

Like a cancer, the risk of breast cancer is no lower than any other disease. One of the terrifying reasons for breast cancer is that it appears in the human body silently without any obvious signs. Therefore, understanding the possible signs before the onset of breast cancer and active self-examination is especially important for special populations—with family history, old age, or obesity. X-rays can easily determine whether a person has breast cancer. Generally, breast cancer will produce lumps in the breast and changes that affect the size of the breast. Then there is local skin swelling, rashes, and even ulcers. The
area varies according to the severity of cancer [4]. Most people will treat this signal as skin disease and other diseases and miss the best time to treat breast cancer. Another typical symptom is pain [5], which is not limited to the chest and breasts but can even spread to the forearms and armpits.

2.4 Pathology and structure

First, most cancers appear because of signal imbalance in cells or genetic mutations that lead to unlimited self-replication and division. Most breast cancers are caused by cancerous changes in the epidermal cells on the breast ducts or lobules. [6] In the early stage of cancellation, when the cancer cells have not grown on a large scale and the location is only on the breast ducts or lobules, this type of breast cancer is also called carcinoma in situ [6]. As shown in Fig.1. But a major feature of cancer cells is that they will continue to break through and spread to the surrounding body tissues: the most common is through the lymphatic system [7] and blood flow throughout the body. This is why lung cancer, lymphoma, and bone cancer follow breast cancer. The reason for the high probability of proliferation. In situ breast cancer that has spread to surrounding tissues is called invasive breast cancer.

![Ductal carcinoma in situ (stage-0) of the breast](https://doi.org/10.1051/e3sconf/202130802022)

**Figure.1** Ductal carcinoma in situ (stage-0) of the breast [6].

2.5 Risk factors for breast cancer

The genes that can cause or increase the incidence of breast cancer after mutation are mainly BRCA1 and BRCA2[8-10], and these two genes are very easy to be inherited, which is why the risk of hereditary breast cancer is higher. Even in some patients with ovarian cancer, endometrial cancer, and prostate cancer, (Breast Cancer 1) BRCA1 and (Breast Cancer 2) BRCA2 gene mutations can be detected [11]. However, it is worth noting that the BRCA gene itself does not induce breast cancer. On the contrary, it plays a huge role in cancer suppression, repair of DNA and cell checkpoints, and cell cycle regulation in the human body. Although the detailed mechanism of how BRCA mutation induces cancer has not been discovered, its excessive effect or mutation is harmful to the human body [11].

Because some breast cancer cells use estrogen as receptors and the female thymus is generally more developed than males, gender is the main factor in the incidence of breast cancer [12]. Because of this, women with a family history are less likely to get the disease after ovariectomy. Of course, in addition to the natural estrogen in the human body, external hormonal stimulation can also increase the risk of breast cancer, such as taking birth control pills or hormonal drugs for a long time. Also, bad lifestyle habits such as excessive drinking, smoking, and excessive fat intake in the diet can increase the risk of breast cancer because alcohol will increase the level of estrogen-related hormones in the blood and trigger receptor channels [12]. Because the basic cause of breast cancer is mutations in genes and DA, any environment that can cause such factors will increase the risk of disease: radiation, excessive sun, high temperature, long-term pressure, etc.

2.6 Different stages of cancer

The subject of this article is the different treatments for breast cancer. But before explaining the treatment methods, it is necessary to introduce the different stages of breast cancer. There are five stages from zero to four, and the severity ranges from shallow to deep [13]. The general determination of the stage of breast cancer depends on the size and scope of cancer and the degree of penetration in the breast tissue [14].

In the beginning, just like figure 1 shows, breast cancer at stage 0 is cancer in situ mentioned in the previous paragraph, and cancer at this time is also called the non-invasive stage. Stage 0 breast cancer stays where they mutate or start to grow, partly on the epidermal cells of the ducts and lobules, and there is no trace of invasion of surrounding tissues [14]. From stage 1, the subsequent stages of breast cancer are called invasive breast cancer. Stage 1 cancer begins to expand to surrounding tissues based on carcinoma in situ. It is clinically divided into two types: A and B. Stage 1A type breast cancer tumors are no more than 2 cm in size, and there is no sign of invasion of lymph in the chest; while stage 1B type of lymph has signs of invasion, but the size will not exceed 2 mm. So far, breast cancer is still in its early stages. Similarly, stage 2 also has two types, A and B. At this time, breast cancer tumors can be found in the armpits or sentinel lymph nodes, and the overall tumor size is more than two centimeters. Stage 2A tumors are found in the lymph nodes in both of the above two places, and the size is between two centimeters and five centimeters. Stage 2B tumors do not spread to the lymph nodes in the axilla but maybe more than five centimeters in size. By breast cancer stage 3, cancer has officially entered the middle and late stages. At this time, the tumor has spread to four to ten or more lymph nodes, which can be located in the armpit, before the sentinel, and around the collarbone. At the same time, the skin of the breast may have started to become red, swollen, or even ulcerated. Finally, in the advanced stage of breast cancer, stage 4, cancer has reached the metastatic stage. Cancer will spread to other organs of the body with lymph and blood, including bones, lungs, and brains [14]. As shown in the table.1.
that the detection method of Nuclear Medicine introduces radioactive rays into the human body [17]. Although breast cancer can be detected, radioactive substances are originally a factor in causing cancer. The best medical diagnosis of breast cancer is a breast biopsy technique, or surgical biopsy, which is usually performed in conjunction with X-rays. Basically, the patient undergoing this test will have a doctor use different methods to extract a cell sample from the chest: it may be a needle to extract a sample from the inside of the tumor, or a manual sample of the cell is extracted for testing after local anesthesia [18].

3 Treatments

When it comes to cancer and tumors, people may first think of surgery to remove them. However, surgery is indeed one of the most direct methods of tumor treatment. However, the surgical treatment of breast cancer is divided into several types according to the different parts of the removal. The simplest is lump removal surgery [19], also called breast-conserving surgery. As the name implies, only malignant cancers and tumors, also a small part of healthy tissue and lymph around it, are removed, while the patient’s chest and thymus can remain relatively intact. But this kind of surgery is only suitable for tumors that have spread or have a small spread. This kind of resection is more common in patients with early breast cancer, and the cost and harm are less. But at the same time, there is a possibility of recurrence. Then there is mastectomy. Compared with the previous operation, this one involves removing the patient’s breasts and all tissues. It is suitable for patients around the middle stage of breast cancer, and the chance of recurrence is much smaller than that of lumpectomy, but it is not zero [20]. Therefore, some patients will undergo ovariectomy to reduce the secretion of estrogen in the body to aid in the treatment of breast cancer.

In addition to surgery, hormone therapy is also a more effective way to treat breast cancer [21]. As we all know, the occurrence of breast cancer is affected by estrogen and its receptors, so hormone therapy is basically to allow patients to use anti-estrogen drugs, such as tamoxifen, raloxifene toremifene. When these drugs enter the cancerous area, they can inhibit the development of breast cancer cells. The advantages of this treatment are obvious. It is much simpler than surgery or chemotherapy, but there are also many disadvantages: the first is the radical cure for cancer. Hormone therapy focuses on suppressing and controlling breast cancer, so it is difficult to cure cancer. Secondly, taking hormone drugs for a long time can easily cause problems such as endocrine disorders in the body, and the drugs themselves are also toxic. They can even cause the patient’s liver, uterus, osteoporosis, and even eye diseases [22]. However, with the development of the times and scientists’ research, the side effects of these drugs have been decreasing year by year.

The next type of treatment is radiation therapy. As mentioned earlier, radioactive substances may increase the probability of cell mutation to cause different types of cancer. Still, as long as the method is used properly, the radiated rays can cause damage to the mutated cells [17].

### Table 1. Breast Cancer Stages Chart [14].

<table>
<thead>
<tr>
<th>Stages</th>
<th>Size &amp; symptom</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage-0</td>
<td>Some mutated ordinary cells have not formed tumors, so they cannot be measured.</td>
<td>Carcinoma in situ, located on the epidermal cells of ducts or lobules.</td>
</tr>
<tr>
<td>Stage-1</td>
<td>1A: ≤ 2cm 1B: ≤ 2mm</td>
<td>Start to spread 1A: No infiltration 1B: There is infiltration of the chest lymph glands</td>
</tr>
<tr>
<td>Stage-2</td>
<td>2A: tumor with a wider range of invasion, 2–5 cm. 2B: tumor with a slightly smaller infiltration area, ≥ 5cm</td>
<td>2A: Spread to sentinel lymph nodes and axilla 2B: Only present in the sentinel lymph node but larger in size</td>
</tr>
<tr>
<td>Stage-3</td>
<td>Breast cancer has entered the middle and advanced stages, and multiple tumors have appeared. The skin on the breasts began to become red, swollen, and even ulcerated.</td>
<td>Spread to four to ten lymph nodes, including the armpits, before the sentinel and around the collarbone.</td>
</tr>
<tr>
<td>Stage-4</td>
<td>It can be transferred everywhere in the body and cannot be measured. The skin around the chest is ulcerated, and the cancer is in its advanced stage</td>
<td>The cancer spreads through lymph and blood to various body organs: bones, lungs, brain, etc.</td>
</tr>
</tbody>
</table>

### 2.7 Diagnosis

Diagnosis is also an important part of the treatment of breast cancer. A good diagnostic method can determine whether a patient has breast cancer and detect the type and stage of cancer. The crudest and primary examination for cancer is self-examination and medical history examination. First, the patient sees whether he has a disease similar to breast cancer and then judges whether he wants to go to the hospital for further examinations. Then, because of the genes of breast cancer, it is extremely easy. It is inherited from generation, so if there is a case of breast cancer in the patient's family, you can judge your chances of getting the disease to some extent. But when it comes to the most common examination for breast cancer in the hospital is the X-ray examination. Using X-ray tomography through the human body and then processing the image by a computer, you can see a tumor. However, there is a very versatile detection method that is ultrasound imaging. This method is not only used in hospitals but also used by scientists who study breast cancer. Sonic imaging can bring clearer images when the patient’s fat is thick, and it is difficult for X-rays to penetrate deep tissues. [15] And it doesn’t matter whether the tissue surrounding the tumor is solid or liquid. Nuclear medicine is partly similar to the previous two detection methods [16]. They both introduce some kind of radiation into the body and then use the perceiptron to map an image on the computer. It's just
Therefore, the method of radiotherapy is to irradiate the tumor area with the high-energy rays it produces to achieve the effect of killing cancer cells without affecting normal cells. However, due to problems such as radiation penetration, simple radiotherapy is mostly used to treat early breast cancer. If it is necessary to deal with a more serious situation, the combination of radiotherapy and lumpectomy is often used clinically to replace mastectomy. And according to research, radiation therapy can effectively kill cancer cells that may be missed by surgery and reduce the chance of breast cancer recurrence.

Chemotherapy is a well-known way to treat various cancers and serious diseases. It works simply by injecting drugs into the body to kill or inhibit cancer cells. Chemotherapy drugs mainly include Docetaxel, Paclitaxel, Platinum agents, and so on [23]. But of course, chemotherapy will have various side effects on the human body, such as hair loss, vomiting, weight loss, etc. Chemotherapy is generally the patient's final choice, so breast cancer patients who choose to undergo chemotherapy are generally advanced patients whose cancer has metastasized, or patients with secondary breast cancer, so the treatment process may last for several years.

Finally, there is a relatively new treatment method in recent years: targeted therapy. This method is not only in cancer but also has applications in other fields. Simply put, targeted therapy is the use of drugs at the molecular level to interfere with specific functions of cancerous cells, such as division or spread [15]. In this way, the effect of controlling or curing breast cancer can be achieved. However, there are many difficulties in this type of treatment. The first difficulty lies in finding cancer cells and their genetic targets, and at the same time, finding the best combination of chemical drugs to achieve the best effect and the least side effects. But now, scientists have identified some potential targets for breast cancer cells: for example, targeted drugs for the commonly mutated genes BRCA1 and BRCA2; P53 & CHK1 [24].

4 Conclusion

Through the analysis of the article and the comparison of various treatment methods, it is concluded that although the mortality rate of breast cancer remains high in recent years, modern medical technology is also difficult to cure patients with advanced cancer. Still, as long as you understand the advantages of various treatment methods, the shortcomings can make the best choice for the patient. The conclusion is: the advantage of surgical treatment is that the treatment course is short, the effect is quick, and the least side effects can make the best choice for the patient. Still, as long as you understand the advantages of various treatment methods, it is concluded that although the mortality rate of breast cancer remains high in recent years, modern medical technology is also difficult to cure patients with advanced cancer. Still, as long as you understand the advantages of various treatment methods, the shortcomings can make the best choice for the patient.

References

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