

Exploration of the Treatment of Granulomatous Mastitis with Microwave Ablation

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How to cite: Hai-Tao P, Su-Yan G, Ping-Ping Z, Zhuo-Hua L. Exploration of the treatment of granulomatous mastitis with microwave ablation[J]. *Trends in Oncology*, 2023; vol. 5(iss. 1): No.1. DOI: [10.37155/2717-5278-0501-1](https://doi.org/10.37155/2717-5278-0501-1)

Abstract: Granulomatous mastitis is an inflammatory breast disease characterized primarily by granuloma formation, with traditional treatment methods exhibiting certain limitations. This article begins with the pathophysiology of granulomatous mastitis, analyzes the fundamental knowledge of microwave ablation technology, and discusses the effectiveness and influencing factors of microwave ablation treatment for granulomatous mastitis. The aim is to provide a reference for clinical treatment.

Keywords: Microwave ablation treatment; Granulomatous mastitis; Exploration

Introduction

The traditional treatment of granulomatous mastitis includes antibiotic therapy, hormone therapy, surgical treatment, etc., but the efficacy is not ideal, and there are problems such as side effects and recurrence. Microwave ablation technology is a new type of minimally invasive treatment technology, which has the advantages of high efficiency, safety and precision, and is widely used in the treatment of tumors, benign diseases and non-vascular lesions. In recent years, microwave ablation technology has been gradually applied to the treatment of granulomatous mastitis and has achieved good results.

1. Pathophysiology of Granulomatous Mastitis

1.1 Pathophysiological Process

The cause of granulomatous mastitis is not fully understood, but studies have found that it may be related to a variety of factors, such as autoimmune diseases, infections, trauma, and chemical irritation. Among them, autoimmune diseases are one of the most important causes, and the patient's own immune system overreacts to breast tissue, resulting in granuloma formation and inflammation. The pathophysiological process of granulomatous mastitis is complex, mainly including the following aspects:

(1) Autoimmune diseases are one of the most important causes. In these cases, the immune system



mistakenly attacks and destroys its own breast tissue. This self-attack leads to the formation of granulomas and the occurrence of inflammation.

(2) Macrophages play a key role in the immune response. Macrophages are a large type of white blood cell with strong phagocytic capacity. In granulomatous mastitis, macrophages engulf fat and epithelial cells in the breast tissue, forming granulomas. Granulomas are specialized aggregations of cells that are made up of macrophages, epithelial cells, and fat cells. These cells interact in granulomas to form a complex microenvironment in which macrophages secrete various growth factors and inflammatory mediators that further promote granuloma formation and the persistence of inflammation.

(3) Granulomatous mastitis is accompanied by a strong inflammatory response. Inflammation is the body's defensive response to external stimuli and usually manifests as symptoms such as redness, warmth, pain, and swelling. In granulomatous mastitis, inflammatory cells infiltrate into the breast tissue, further aggravating the destruction of the breast tissue. These inflammatory cells, including leukocytes, macrophages, and lymphocytes, among others, amplify and prolong the inflammatory response by releasing various inflammatory mediators and cytokines ^[1].

(4) Granuloma formation and inflammatory response have caused serious damage to breast tissue. As inflammation continues and granulomas form, the structure and function of breast tissue are disrupted, leading to symptoms such as breast pain and swelling. This tissue damage can lead to consequences such as breast deformation, tissue defects, and scarring. For lactating women, this damage may further affect milk production and lactation function.

1.2 Impact on Breast Tissue

Granulomatous mastitis is a relatively rare inflammatory disease of the breast characterized by granulomatous inflammation of the breast tissue, often accompanied by an immune response. The disease is clinically rare, so research and understanding of it is relatively limited. However, the impact of granulomatous mastitis on breast tissue is significant, it not only destroys breast tissue, but also may affect milk production, which has a certain impact on women's physical and mental health. First, granulomatous mastitis causes the destruction of breast tissue. This inflammatory response leads

to changes in the structure and function of breast tissue. In the early stages of the disease, patients may experience symptoms such as breast pain, swelling, etc., which may affect the patient's daily life and work. As the disease progresses, the degree of destruction of breast tissue gradually increases, leading to breast deformation and tissue loss. This will not only affect the patient's physical appearance, but may also cause certain stress and distress to the patient's psychology. Second, granulomatous mastitis may affect milk production. For lactating women, milk production is an important source of growth and development for their babies. However, granulomatous mastitis can cause blockage of the ducts in the milk, affecting the secretion and discharge of milk. This can lead to difficulty or inability to breastfeed, which can affect the baby's growth and development. In addition, due to the impaired milk production, patients may need to breastfeed frequently or use a breast pump to maintain the baby's dietary needs, which can place additional burden and stress on the patient. Finally, granulomatous mastitis can lead to impaired breast function. In addition to destroying breast tissue and affecting milk production, granulomatous mastitis may also affect other functions of the breast, such as lactation, sexual function, etc. This can have a negative impact on the patient's fertility and sex life. For young women, impaired breast function can take a toll on their self-confidence, affecting their social and mental health.

2. Basic Knowledge of Microwave Ablation Technology

Microwave ablation technology uses microwave energy to convert electromagnetic energy into heat energy, which ablates or solidifies the tissue by creating high temperatures at the target tissue site. The principle of microwave ablation is based on the characteristics of microwave radiation, which can penetrate the dielectric material of biological tissue at a certain depth, and cause violent friction and collision of water molecules under the action of alternating electric field, resulting in an increase in the temperature inside the tissue. When the temperature rises to a certain level, the target tissue is denatured, coagulated, or abled. Microwave ablation technology is widely used in the medical field, and it is not only used to treat various types of tumors, but also for the treatment of benign tumors and non-vascular

lesions.

Firstly, microwave ablation technology can be used to treat various types of tumors, including lung cancer, liver cancer, breast cancer, etc. These tumors often grow and spread in the body, threatening the patient's life. Microwave ablation technology controls the growth and spread of tumors by creating high temperatures at the tumor site to ablate or coagulate tumor tissue. For example, in the treatment of lung cancer, microwave ablation technology can be used to treat early-stage non-small cell lung cancer [2]. This technique can heat the tumour tissue to a high temperature with microwave energy, allowing it to die and be absorbed by the body. Microwave ablation techniques have a faster recovery time and less trauma than traditional surgery.

Secondly, for benign tumors, microwave ablation technology also has good efficacy. For example, in the treatment of thyroid nodules, microwave ablation techniques can coagulate the nodule tissue by creating high temperatures and promote its gradual absorption by the body. This approach not only eliminates the nodule itself, but also reduces the likelihood of recurrence after surgery. In the treatment of uterine fibroids, microwave ablation technology also has good efficacy. Uterine fibroids are a common benign tumor that often causes symptoms such as irregular menstruation and dysmenorrhea. The high temperature generated by microwave ablation technology can coagulate fibroid tissue, reduce the volume of fibroids, relieve symptoms, and preserve the physiological function of the uterus.

Thirdly, microwave ablation technology can also be used to treat non-vascular lesions, such as cysts, abscesses, etc. These lesions are usually caused by inflammation, infection, or other factors, and by creating high temperatures at the lesion site, it can promote the resolution of inflammation and the repair of tissues. For example, in the treatment of ovarian cysts, microwave ablation techniques can destroy the cyst wall by creating high temperatures and promote its gradual absorption by the body. This method not only eliminates the cyst itself, but also reduces the likelihood of recurrence after surgery. In addition, for some deep abscesses, such as liver abscesses, microwave ablation techniques can also promote the resolution of abscesses and tissue repair by creating high temperatures. This

approach not only eliminates the abscess itself, but also reduces the patient's systemic symptoms and improves the patient's quality of life.

3. Effectiveness and Influencing Factors of Microwave Ablation Treatment for Granulomatous Mastitis

3.1 Short-term and Long-term Effectiveness

The short- and long-term efficacy of microwave ablation in the treatment of granulomatous mastitis is significant. In terms of short-term efficacy, microwave ablation can quickly relieve patients' symptoms, such as pain, swelling, etc., and improve patients' quality of life. At the same time, microwave ablation technology can effectively reduce the volume of the mass and reduce the pain of patients. In terms of long-term efficacy, microwave ablation technology has also shown good results. Studies have shown that microwave ablation technology can effectively control the recurrence of granulomatous mastitis and improve the quality of life of patients. Granulomatous mastitis is a disease that tends to recur, and microwave ablation technology can reduce the likelihood of recurrence by precisely ablating diseased tissue. In addition, microwave ablation technology can also avoid scarring and damage caused by traditional surgery, maintaining the aesthetics and integrity of the breast.

3.2 Factors Influencing the Effectiveness

Granulomatous mastitis is a type of mastitis characterized by granulomatous formation of breast tissue, and its treatment is varied, including medication, surgery, physical therapy, etc. As a new type of physical therapy, microwave ablation technology has been widely used in the treatment of granulomatous mastitis. However, the factors that affect the efficacy of microwave ablation in the treatment of granulomatous mastitis are multifaceted.

(1) The condition and course of granulomatous mastitis are important factors affecting the efficacy of microwave ablation. Generally speaking, patients with early granulomatous mastitis have milder disease and smaller lesions, and the effect of microwave ablation treatment is better, and even the goal of radical cure can be achieved. However, for patients with a longer course of disease and more severe disease, the difficulty and effect of microwave ablation treatment may be affected to a certain extent, and some patients

may need multiple treatments to achieve better results.

(2) The patient's immune status, nutritional status and other conditions will also affect the efficacy of microwave ablation therapy. Immunocompromised patients have a slower recovery and a relatively poor treatment effect. In addition, malnourished patients may also have poor recovery ability, which may affect the effectiveness of treatment.

(3) The operation method and parameter setting of microwave ablation technology will also affect the efficacy. For example, parameters such as power, time, and frequency of microwave ablation need to be individualized according to the specific situation of the patient to achieve the best treatment effect. If the parameters are not set properly, it may affect the treatment effect and even lead to treatment failure^[3].

(4) After microwave ablation treatment, the postoperative care of patients will also affect the efficacy. Post-operative care includes wound cleaning, anti-infection treatment, regular follow-up, etc. If postoperative care is not appropriate, it may lead to problems such as infection, poor wound healing, etc., which can affect the treatment effect.

(5) Microwave ablation technology requires doctors to have professional skills and experience, so the skills and experience of doctors will also affect the treatment effect. Doctors need to accurately grasp the depth and scope of microwave ablation during the operation to avoid damage to the surrounding normal tissues. At the same time, doctors also need to formulate individualized treatment plans according to the specific conditions of patients to achieve the best treatment results.

3.3 Methods and Indicators for Assessing Effectiveness

The evaluation methods and indicators of the efficacy of microwave ablation in the treatment of granulomatous mastitis are very important, because they can help doctors judge the changes in the patient's condition and the effect of treatment. First, a clinical examination is a method of assessing a patient's condition by looking at their symptoms and signs. After microwave ablation treatment, doctors can tell if the lump has regressed and how the breast has changed by palpating and observing the appearance of the breast. If the patient's symptoms are significantly reduced and the appearance of the breasts returns

to normal, then microwave ablation treatment is effective. Second, ultrasonography is a commonly used method to examine breast diseases, which can observe the structure and blood flow of breast tissue. Ultrasonography can be used to determine features such as the size, shape, and internal echo of the mass, as well as to see changes in surrounding blood flow. If the lump shrinks significantly and blood flow decreases or disappears after treatment, then microwave ablation is effective. Third, MRI is a test that can provide more accurate and comprehensive information about the condition. MRI can be used to see the extent and depth of the diseased tissue, as well as its relationship to the surrounding tissue. Post-treatment MRI can be used to determine whether the diseased tissue has been effectively ablated, thereby evaluating the efficacy of microwave ablation^[4]. Fourth, laboratory indicators are an indirect method of assessing the condition, and commonly used indicators include erythrocyte sedimentation rate, C-reactive protein, etc. These indicators can reflect the patient's inflammatory response and immune status, thus helping doctors judge the patient's condition changes and the effectiveness of treatment. If these markers decrease significantly after treatment, microwave ablation is effective. Fifth, a comprehensive evaluation of the above methods and indicators can lead to a comprehensive efficacy evaluation result. The evaluation indicators mainly include lump size, pain level, quality of life, etc. Through a comprehensive evaluation of these indicators after treatment, a comprehensive understanding of the patient's condition changes and treatment effect can be fully understood. If the lump is significantly smaller, the pain is reduced, and the quality of life is improved, then microwave ablation treatment is effective.

Conclusion

In summary, microwave ablation, as a new minimally invasive treatment technology, has good efficacy and safety in the treatment of granulomatous mastitis. By comprehensively evaluating the patient's condition and treatment effect, a more effective treatment plan can be formulated to improve the quality of life and cure rate of patients. In the future, the efficacy and safety of microwave ablation technology in the treatment of granulomatous mastitis can be improved through further research and improvement.

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