Application of Ultrasonography in Sentinel Lymph Node Examination of Breast Cancer

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Abstract: After routine axillary lymph node dissection, it is easy to cause ipsilateral upper limb edema in breast cancer patients, which is difficult to treat and has a greater impact on the quality of life of patients. Sentinel lymph node is a common local metastasis site in patients with breast cancer. To determine whether axillary lymph node metastasis is the key information for formulating individualized treatment. Sentinel lymph node metastasis in breast cancer is a predictor of recurrence rate and overall survival rate of patients, and its status directly determines the scope of surgery and whether radiotherapy is performed after mastectomy. With the development of clinical imaging, contrast-enhanced ultrasound has been widely used in sentinel lymph node examination of breast cancer, which can improve the accuracy of the examination. This article reviews the application of ultrasound in sentinel lymph node examination of breast cancer, hoping to provide reference for clinical related work.

Key words: sentinel lymph nodes of breast cancer; ultrasound examination; breast cancer patients; check accuracy

In recent years, breast cancer has become one of the most common malignant tumors among women in the world, and it is also one of the important reasons for women's death. As a developing country, due to various factors, the incidence rate of breast cancer in China continues to increase, and shows a younger trend. Breast cancer occurs when breast epithelial cells proliferate out of control under the action of a variety of carcinogens. In the early stages of this disease, it usually presents as breast lumps, nipple discharge, and enlarged axillary lymph nodes. However, in the later stages, multiple organ lesions may occur due to distant metastasis of cancer cells, posing a great threat to the patient's life [1-3]. Sentinel lymph nodes are the first stop lymph nodes for primary tumor drainage, and their histological morphology can represent the status of the entire axillary lymph nodes. Sentinel lymph node metastasis in breast cancer is a predictor of recurrence rate and overall survival rate of patients, and its status directly determines the scope of surgery of patients and whether radiotherapy is performed after mastectomy [4]. With the development of clinical imaging, contrast-enhanced ultrasound has been widely used in sentinel lymph node examination of breast cancer, which can improve the accuracy of the examination. This article reviews the application of ultrasound in sentinel lymph node examination of breast cancer.

1 Principles of contrast-enhanced ultrasound

CEUS is used in sentinel lymph node examination of breast cancer. It is mainly through the absorption of the ultrasound contrast agent injected subcutaneously by the true subcutaneous lymphatic vessels around the areola, and then through the lymphatic vessels in the breast to the armpit to reach the sentinel lymph node [5-6]. Studies abroad have confirmed that injecting ultrasound contrast agents around the tumor can identify draining lymphatic vessels and sentinel lymph nodes, and it has been found that injecting 1mL and 2mL of contrast agents does not significantly affect the development of lymphatic vessels and lymph nodes [7]. Subsequently, the Guide for Extrahepatic Application of Contrast Ultrasound of the Federation of Biomedical Ultrasound Societies of Foreign Countries also introduced the application of contrast-enhanced ultrasound in sentinel lymph node examination of breast cancer, and clearly pointed out that ultrasound contrast agents are non-toxic, and their diagnostic efficacy is equivalent to that of radioisotope methods. Ultrasound contrast can guide sentinel lymph node biopsy, ultimately facilitating clinical treatment [8]. Currently, the examination method for sentinel lymph nodes in clinical practice is to scan the breast and armpits under conventional ultrasound, and inject ultrasound contrast agent intradermal or subcutaneous around the areola at 3 o'clock, 6 o'clock, 9 o'clock, and 12 o'clock directions. By tracking and draining lymphatic vessels to the sentinel lymph nodes at the end of the lymphatic vessels, the sentinel lymph nodes

are ultimately located and examined.

2 Application of contrast-enhanced ultrasound in sentinel lymph node examination of breast cancer

2.1 Preoperative positioning

Accurate preoperative location is a prerequisite for detecting sentinel lymph nodes in breast cancer, and also an important basis for surgical clinicians to treat sentinel lymph nodes in breast cancer. At present, conventional ultrasound and contrast-enhanced ultrasound cannot identify sentinel lymph nodes, and therefore cannot perform preoperative localization of sentinel lymph nodes [9]. The sentinel lymph node localization methods guided by contrast-enhanced ultrasound include hook needle localization, intraoperative dye localization, surface localization, and I^{125} particle implantation localization, each of which has its own advantages and disadvantages. Scholars have compared the above positioning methods and found that the accuracy of body surface positioning is as high as 80%. In addition, other scholars compared crochet positioning with intraoperative dye method and found that the number of sentinel lymph nodes displayed by crochet positioning and dye method was 1.78 and 1.88 pieces. Using contrast-enhanced ultrasound to guide the implantation of I^{125} particles into sentinel lymph nodes, the localization accuracy was found to be around 80%. The above studies indicate that ultrasound guided localization of sentinel lymph nodes has the advantages of simple operation and cost-effectiveness, which can provide a reference plan for clinical surgeons to clean axillary lymph nodes. In a study, 45 patients with early invasive breast cancer were selected as subjects, and two methods, namely, percutaneous contrast-enhanced ultrasound and indocyanine green combined with methylene blue, were selected for sentinel lymph node localization. The results showed that the number of sentinel lymph nodes detected in the combined group was better than that in the contrast-enhanced ultrasound group, and the positive predictive value, negative predictive value, and accuracy were 93.3%, 96.4%, 95.3%. Meng Yao et al. [10] explored the application value of contrast-enhanced ultrasound in sentinel lymph node localization of breast cancer, and found that the sensitivity of percutaneous contrast-enhanced ultrasound in detecting sentinel lymph nodes was 100%, and the accuracy was 92.21%.

2.2 Preoperative diagnosis

At present, there are three types of enhancement modes for contrast-enhanced ultrasound, namely no enhancement, uneven enhancement, and uniform enhancement. Through research, it has been found that contrast-enhanced ultrasound has high specificity, sensitivity, positive predictive value, and negative predictive value in diagnosing sentinel lymph nodes. Scholars [11] have found that if classified according to the enhancement pattern, type I represents negative lymph nodes, and types II and III both represent malignant lymph nodes, the sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of contrast-enhanced ultrasound in diagnosing metastatic sentinel lymph nodes are 81.8%, 86.2%, 84.7%, 75.0%, 90.3%. Another scholar [12] performed contrast-enhanced ultrasonography in 126 patients with breast cancer. 146 sentinel lymph nodes were detected by contrast-enhanced ultrasonography, with an accuracy rate of 95. 24% (based on fine needle aspiration cytological examination as the gold standard), with a false positive rate of 0. The combination of contrast-enhanced ultrasound and fine needle aspiration for cellular pathology examination is a minimally invasive method that has high accuracy and sensitivity in preoperative evaluation of axillary lymph node status, and is highly consistent with sentinel lymph node biopsy. It may serve as a new alternative to sentinel lymph node biopsy. Some scholars also used contrast-enhanced ultrasound in sentinel lymph node examination of breast cancer, and found that contrast-enhanced ultrasound can display sentinel lymph nodes in real-time and three-dimensional. Wu Jungang et al. [13] gave routine ultrasound and percutaneous contrast-enhanced ultrasound examination to 70 patients with breast cancer, and found that the accuracy rate of percutaneous contrast-enhanced ultrasound diagnosis was as high as 96.67%, significantly higher than 77.78%. And the specificity of percutaneous contrast-enhanced ultrasound diagnosis is 96.25%, sensitivity of 97.30%, with a positive predictive value of 94.74%, with a negative predictive value of 98.08%. The study fully confirmed that contrast-enhanced ultrasound

can clearly show the status of sentinel lymph nodes in breast cancer, the size and location of breast cancer lesions, etc. Qin Wen et al. [14] performed percutaneous contrast-enhanced ultrasound sentinel lymph node localization and ultrasound-guided fine needle aspiration in 95 patients with breast cancer, and performed methylene blue sentinel lymph node localization during surgery and resection for pathological examination. The results showed that the detection rate of sentinel lymph nodes by percutaneous contrast-enhanced ultrasound was 90.00%. Compared with the pathological results of surgical lymph node resection, the specificity of contrast-enhanced ultrasound examination reached 98.3%, with a positive predictive value of 94.7%, with a negative predictive value of 94.7%, with a diagnostic accuracy of 91.80%. Dong Jiandang et al. [5] explored the application value of contrast-enhanced ultrasound in the diagnosis of breast cancer metastatic sentinel lymph nodes, and found that the consistency of contrast-enhanced ultrasound and pathological diagnosis results Kappa value was as high as 0.829, significantly higher than conventional ultrasound (Kappa=0.549), and the area under the curve (AUC) of contrast-enhanced ultrasound in the diagnosis of breast cancer sentinel lymph node metastasis was 0.913, significantly higher than conventional ultrasound (AUC=0.744). The above studies fully demonstrate the high accuracy of contrast-enhanced ultrasound tracking technology, which can effectively evaluate the status of axillary lymph nodes and provide reference for clinical treatment [15-16].

3 Conclusion

To sum up, CEUS is simple and repeatable, and has high value in the location monitoring and qualitative evaluation of sentinel lymph nodes in breast cancer. Contrast enhanced ultrasound can track sentinel lymph nodes in real-time, guiding clinical treatment, which can to some extent reduce the number of biopsies and improve the quality of life of patients. However, there are also some challenges, such as the relatively low specificity of sentinel lymph node metastasis diagnosis, and there are false negatives. For example, some scholars [22] have compared and analyzed the feasibility of enhanced ultrasound in detecting sentinel lymph nodes in breast cancer patients before surgery, and the diagnostic value of enhancement methods for lymph node metastasis and axillary lymph node load, The results showed that the sensitivity of predicting sentinel lymph node metastasis through contrast-enhanced ultrasound mode was 100%, but the specificity was only 52.0%. Wang Ying et al. [23] also achieved similar results in their research. It can be seen that in later research, deeper and broader research should be conducted to ultimately improve the clinical treatment effectiveness of patients.

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