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Research Article

Diagnostic Value Analysis of Dynamic Contrast-enhanced Magnetic Resonance Imaging (DCE-MRI) combined with Diffusion Weighted Imaging (DWI) before Breast Cancer Surgery

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Abstract: Objective: The objective of this study was to investigate the diagnostic efficacy of pre-operative magnetic resonance imaging (MRI)–dynamic contrast imaging (dynamic contrast-enhanced [DCE]-MRI) combined with diffusion-weighted imaging (DWI) in detecting breast cancer. **Research Methodology:** A retrospective study was performed to compare the results of DCE-MRI combined with DWI in 78 patients with breast cancer who were treated in our hospital between January 20 and December 2018. **Results:** After diagnosis, the coincidence rate of diagnosis by DCE-MRI combined with DWI was significantly higher than ultrasound (91.0% vs. 55.1%, respectively, $P<0.05$). Among the two diagnostic methods, DCE-MRI combined with DWI imaging showed more obvious tumor signals, and the difference was statistically significant ($P<0.05$). **Conclusion:** Pre-operative application of DCE-MRI combined with DWI can provide a more accurate and effective reference for surgical planning.

Keywords: *breast cancer; dynamic contrast-enhanced-magnetic resonance imaging; diffusion-weighted imaging; diagnostic value*

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0 Introduction

According to the medical literature available, in China, breast cancer is the second most malignant tumor in women and is now prevalent in younger women[1]. Effective improvement in the disease can be achieved through early diagnosis of breast cancer and providing surgical treatment as early as possible. Ultrasound is the most common method of imaging for breast cancer examination. Dynamic contrast-enhanced (DCE)-magnetic resonance imaging (MRI) combined with diffusion-weighted imaging (DWI) has a high accuracy rate for breast cancer, which provides an effective reference for breast cancer surgery. This article focuses on the diagnostic efficacy of pre-operative DCE-MRI combined with DWI in breast cancer. The detailed report is as follows:

1 Research Methodology

1.1 Study patients

A retrospective study was performed on the preoperative diagnosis of 78 breast cancer patients in our hospital from January 2018 to December 2018. All patients who participated in the study were diagnosed with breast cancer by pathological diagnosis. The age of the patients ranged between 35 and 67 years (average age: 50.91±3.48 years). Eighty-two lesions were detected in these 78 patients.

1.2 Diagnostic methods

Ultrasound examination was performed using Doppler ultrasound diagnostic instrument with a probe frequency range of 3–9 MHz. Patients were examined in the supine position with both hands raised to the top of the head, focusing on the breast area and the bilateral axilla. The location, size, shape, presence or absence of envelope, internal echo, and calcification were examined. Conventional MRI scans were performed using fast spin echo (SE) sequences, T1-weighted imaging scans with a repetition time (TR)/echo time (TE) of 495/10 ms, field of view (FOV) of 340 mm, and scan time of 3 min and 18 s. For T2-weighted imaging scans, the TR/TE is 470/120 ms, the FOV is 340 mm, and the scan time is 3 min and 48 s. Using the T2-pressured sequence, the TR/TE was 4983/60 ms, the FOV was 340 mm, and the scan time was 2 min and 39 s.

The DWI examination was performed using a single secondary SE and planar echo imaging sequence to perform sagittal and axial scanning, respectively. The TR/TE is 5000/155 ms, the visual field FOV value is 340 mm, and the diffusion sensitivity coefficient are 0 s/mm^2, 800 s/mm^2, and 1000 s/mm^2, respectively.

The DCE-MRI examination used a fast small-angle excitation sequence. Patients were administered gadolinium-diethylenetriamine pentaacetic acid 0.0 ml/kg intravenously using a high-pressure syringe to ensure an injection speed of 0.3 ml/s. One phase scan is performed on the patient for contrast injection, and seven phases are scanned after the injection is completed while ensuring TR/TE is 4.4/2.2 ms and the angle of inversion is 120°. After the completion of the scan, at least two experienced radiologists interpreted the scans and their opinions were recorded.

1.3 DCE-MRI curve type

The main types of DCE-MRI curves include the following:

a. Type I-Indicates continuous enhancement.
b. Type II-Indicates enhanced tumor signal, maintaining the same level in the middle and late stages.
c. Type III-Indicates that after early enhancement, the trend of signal enhancement decreases in the middle and late stages. Uneven enhancement and centripetal enhancement are presented as malignant tumors[2].

1.4 Statistical methods

The SPSS 20.0 statistical software was used to process the data of this study. ($\bar{x} \pm s$) is the measurement data, t is the test method; % is the count data, X^2 is the test method, and $P<0.05$ indicates that the difference is statistically significant.

2 Results

In the pre-operative examination of breast cancer patients, ultrasound examination was performed in 43 cases with surgical pathological diagnosis, and the coincidence rate was 55.1%. In comparison, DCE-MRI combined with DWI examination was consistent with surgical pathological diagnosis of 71 cases, and the coincidence rate was significantly higher (91.0%, $P<0.05$).

The ultrasonography findings showed no encapsulation reality, the tumor boundary was not clear, and it was burr-like and visible malignant halo sign. Moreover, the internal echo of the ultrasound examination lacked uniformity, especially weakened posterior echo, and showed microcalcifications on the lesions.

Using DCE-MRI examination, 60 lesions were diagnosed in 60 cases. The diameter of the tumor examined ranged between 0.8 and 0.9 cm, which was linear or dendritic, and a small part was round or similar to the circular. There were 38 lumps with blurred imaging edges, 21 burr-like, and 6 rims. The curve types are 1 Type I, 17 Type II, and 47 Type III.

Using DWI examination, 65 lesions were diagnosed in 65 cases, the signal performance was obvious, and the apparent diffusion coefficient (ADC) imaging signal was low. When the diffusion sensitivity coefficient was 0, the ADC imaging signal was high; when the diffusion sensitivity coefficient was 800 s/mm^2, the ADC imaging signal was low.

3 Discussion

Breast cancer, one of the most common malignant tumors, has an increasing incidence rate and has a detrimental effect on the life and mental health of female patients. Surgical treatment is an important method to treat early breast cancer and greatly improve the long-term quality of life of patients[3]. Therefore, breast cancer must be diagnosed and treated as soon as possible to significantly prolong the life of the patients. Ultrasound diagnosis is the most commonly used method for diagnosing breast cancer. It has a relatively simple operation process and is also economical. However, ultrasonography cannot accurately scan the tiny lesions and the glands around the lesion[4]. With the development and advancement of imaging, DCE-MRI combined with DWI technology has applied to the pre-operative examination of breast cancer to detect the size and internal structure of the tumor. DCE can show the extent of tumor lesions, etc., can provide a reliable reference for the surgical plan.

At the same time, the use of DWI technology can detect the microscopic motion of water molecules in living tissues and has a very high application value in distinguishing the benign and malignant breast lesions[5]. DWI technology is currently the only method that can non-invasively detect the diffusion of water molecules in living tissue. The signal intensity in living tissue on DWI is mainly affected by the diffusion-sensitive gradient field, which is proportional to the trend. The longer the duration of the diffusion-sensitive gradient, the more obvious the attenuation of the tissue signal. The current DWI technology is widely used in clinical applications and can be applied to the detection of cytotoxic edema caused by acute cerebral ischemia and hypoxia, and the signal abnormality in the infarct area can be accurately and timely detected. In addition, DWI technology can provide reliable information for the impact of tumors on peripheral white matter in brain science research and can prevent damage to important white matter fibers during surgery.

DWI is called magnetic resonance DWI, a non-invasive method for quantitative analysis of the dispersion of water molecules inside the body. Dispersion refers to the irregular, random, and colliding motion process excited by molecular thermal energy, which is also commonly known as Brownian motion or molecular thermal motion. Because the movement of water molecules in the human body is in a state of thermal motion, this movement of water molecules is an important basis for ensuring DWI techniques. In the DWI technique, the diffusion of each MRI sequence is performed by applying a diffusion-sensitive gradient field. This method can clearly show the diffusion of water molecules in the living organism and thus can accurately reflect the body tissue. Changes in microstructure ensure the accuracy of diagnosis of certain diseases. In the DWI technique, the b-value is mainly used to indicate the parameters of the applied gradient field, which is an important indicator for detecting the ability of water molecules to spread in the body. The main meaning of the diffusion coefficient is the diffusion rate of water molecules in the body, which mainly indicates the range of random diffusion of water molecules in the body within a certain period of time. The imaging basis of DWI techniques is based on the nature of a DWI pulse sequence that is a single-shot SE-Echo-planar imaging (EPI) sequence. On this basis, adding a pair of diffusion gradients can obtain a clear contrast image of free water molecules in the body and then measure the dispersion of free water molecules in the body and finally obtain a DWI image. Common DWI scan sequences include free echo-DWI (SE-DWI), excitation echo-DWI (stimulated echo-DWI), planar echo-DWI (EPI-DWI), background suppression, systemic DWI, and steady-state free-running DWI (steady-state evoked potential-DWI) are the five most commonly used, and plane echo DWI (EPI-DWI) is most commonly used.

After decades of development, current DWI technology can be applied to the examination of the whole-body organs, especially in the central system, which cannot be achieved by ultrasound technology. For example, DWI in the examination of cerebral infarction patients showed that patients with hyperacute period had high signal on DWI, whereas ADC value showed a downward trend; in the acute phase, high signal was on DWI, and ADC value was correspondingly low signal; in the acute phase, the DWI signal showed a downward trend, the ADC value gradually increased and gradually reached the normal value, and pseudonormalization occurred. In the chronic phase, the DWI is low and the ADC value is close to the cerebrospinal fluid signal, presenting a high signal similar to the cerebrospinal fluid signal. In addition, DWI techniques can clearly show the extent of lesions in cystic lesions. The application in the detection of brain abscess and demyelinating lesions can provide doctors with accurate and reliable lesions and has important reference value for determining the pre-treatment options of patients. The imaging effect of ultrasound examination is obviously weaker than the DWI. The tumor compliance rate is relatively low, and the detection signal of the patient’s lesion range is not obvious enough. Therefore, DWI technology will certainly be more widely used in clinical medical testing.

The primary objective of this study was to investigate the diagnostic efficacy of pre-operative MRI dynamic contrast imaging combined with DWI in breast cancer. The retrospective study method was used to compare the results of DCE-MRI combined with DWI in 78 patients with breast cancer in our hospital from January 2018 to December 2018. After comparative analysis, the coincidence rate of ultrasound diagnosis was 55.1%, and the coincidence rate of DCE-MRI combined with DWI was 91.0% (P<0.05). Among the imaging findings of the two diagnostic methods, DCE-MRI imaging combined with DWI showed more obvious tumor signals, and the difference was statistically significant (P<0.05).

In summary, pre-operative application of DCE-MRI combined with DWI can provide a more accurate and effective reference for surgical planning.

References

[1] Yuanbin H. Application of MRI Dynamic Enhanced Imaging Combined with Diffusion-weighted Imaging in Preoperative Diagnosis of Breast Cancer. J Henan Univ Med Sci 2016;29:134-7.

[2] Wen Z, Wenbin H, Zhubi C. The Value of MRI Dynamic Contrast Imaging Combined with Diffusion-weighted Imaging in Preoperative Diagnosis of Breast Cancer. Chin J CT MRI 2018;16.
[3] Hailong W. 3.0T-MRI Dynamic Contrast-enhanced Fischer Score Combined with Diffusion-weighted Imaging for the Diagnosis of Breast Cancer; 2015.
[4] Dongliang W. The Value of Dynamic Contrast-enhanced Magnetic Resonance Imaging Combined with Magnetic Resonance Diffusion-weighted Imaging in the Diagnosis of Breast Cancer Patients. J Pract Med Imaging 2018;19:45-7.
[5] Jun Y, Ke S, Xin Z. Diagnostic and Application Value of Dynamic Contrast-enhanced Magnetic Resonance and Diffusion-weighted Imaging in the Diagnosis of Ring-shaped Lesions of the Breast. J Clin Radiol 2016;35:1490-4.