

Application of ultrasound and magnetic resonance imaging in diagnosis of extra-abdominal desmoid-type fibromatosis

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Research

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Abstract

Objective : To investigate the imaging characteristics of ultrasound and magnetic resonance imaging in extra-abdominal desmoid-type fibromatosis.

Methods : Ultrasonic images of 58 patients with extra-abdominal desmoid-type fibromatosis and MRI images of 59 patients with extra-abdominal desmoid-type fibromatosis were analyzed retrospectively. The imaging characteristics of the two methods in the diagnosis of extra-abdominal desmoid-type fibromatosis were analyzed.

Results : Among the 58 patients detected by ultrasound, obvious strong cord-like, columnar, and flocculent echoes were seen in 50 patients; blood flow signal was abundant in 37 patients. Among the 59 patients detected by MRI, fat-suppressed sequence scanning mainly presented high signal intensities. Spot-like and cordlike low signal intensities could be seen in lesions. Enhancement was obvious in 59 patients. In 58 patients detected by ultrasound, preoperative tumor diameter (4.46 ± 1.95) cm was shorter than the postoperative pathological result (6.33 ± 1.32) cm ($P < 0.05$). In 59 patients detected by MRI, no significant difference in tumor diameter was detectable between preoperative (6.17 ± 0.98) cm and postoperative (6.32 ± 0.77) cm results ($P > 0.05$).

Conclusion : Ultrasound can reveal the fiber composition of desmoid-type fibromatosis well. MRI has certain advantages in diagnosing the true size and invasion range of desmoid-type fibromatosis, and can provide imaging reference for preoperative and postoperative evaluation.

Introduction

With the development of health service in China, the detection rate and treatment level of tumors have been significantly improved. Soft tissue tumors of musculoskeletal system have always been the difficulty and hot spot of imaging diagnosticians. Desmoid-type fibromatosis is a borderline tumor with local invasion but rarely distant metastasis, and extra-abdominal desmoid-type fibromatosis is a relatively common type of desmoid-type fibromatosis^[1]. This study retrospectively analyzed the ultrasound images of 58 patients with extra-abdominal desmoid-type fibromatosis and the MRI images of 59 patients with extra-abdominal desmoid-type fibromatosis, and discussed the imaging features of the two methods in the diagnosis of extra-abdominal desmoid-type fibromatosis.

Data And Methods

General data

Totally 117 patients with extra-abdominal desmoid-type fibromatosis confirmed by surgical pathology (117 lesions, 58 patients detected by ultrasound and 59 patients detected by MRI) were recruited from The Second Affiliated Hospital of Inner Mongolia Medical University and Affiliated Hospital of Inner Mongolia Medical University, China from March 2003 to September 2019. All patients underwent routine

and enhanced scans of ultrasound or MRI before surgery. The 117 patients were aged from 4 to 69 (mean 33.2 ± 3.9) and contained 64 males and 53 females. All patients experienced the first onset, and recurrent cases were excluded. Among them, 34 cases had a history of trauma, 27 cases had a history of surgery, and no one had a family history.

Instruments And Ultrasound

In the ultrasound group, all patients were treated with ultrasound instrument (Siemens, Germany and GE, USA) with linear array probe and convex array probe at the frequency of 3–15 MHz. Two-dimensional gray scale: The lesion size was measured in multiple sections. Whether the lesion shape was regular, whether the lesion boundary was clear, and the uniformity of the internal echo were observed. The relationship between the lesion and the surrounding tissue was judged. Color Doppler was utilized to observe the intensity of blood flow signals in and around the lesion.

MRI

All patients in the MRI group received the Siemens 3.0T and GE 1.5T MRI scanner (plain and enhanced) with abdominal coils. The scanning scheme is as follows: slice thickness = 3 mm, interval = 1 mm; the field of view was to be determined according to the lesion size. Scanning sequences are as follows: (1) Coronal fat-suppressed (Cor-STIR) sequence: TR 3950 ms (upper limbs), TR 4300 ms (lower limbs), and TE 42 ms. To enhance the signal-to-noise ratio, the number of excitation could be increased appropriately at an acceptable scanning time. (2) Coronal T1-weighted fast spin echo (Cor-T1-FSE) sequence: TR 580 ms, TE Min Full; (3) axial T1-weighted fast spin echo (AX-T1-FSE) sequence: TR 620 ms, TE 5 ms; (4) axial diffusion-weighted imaging (AX-DWI) sequence: TR-5000 ms, TE 85 ms; the number of stimuli was properly increased within the acceptable range of the total scan time. (5) Sagittal fat-suppressed T2 (Sag-fs-T2-FSE) sequence: TR 3050 ms, TE 70 ms; Gd-DTPA-enhanced MRI via cubital vein injection, 0.1 mmol/kg, at 3 mL/s; coronal, axial and sagittal images were captured by enhanced scanning.

Statistical analysis

Data were analyzed using Graphpad Prism 8.0.2 software. Independent sample t test (with homogeneous variance) was used in preoperative tumor diameter, which was measured by ultrasound, MRI and postoperative pathology result. The difference between ultrasound and MRI was analyzed using paired comparison and χ^2 test.

Results

Location and size of lesions

All 117 lesions of 117 patients were solitary. The location of the lesions contained neck in 6 cases, shoulder and back in 11 cases, upper limbs in 21 cases, buttocks in 23 cases, thighs in 32 cases and

lower legs in 24 cases. The mean tumor diameter measured by pathology was compared with that measured by preoperative imaging: In 58 patients of the ultrasound group, preoperative mean tumor diameter (4.46 ± 1.95) cm was shorter than postoperative pathological result (6.33 ± 1.32) cm. Significant difference was found between preoperative mean tumor diameter of ultrasound and postoperative pathological result ($P < 0.05$). In 59 patients of the MRI group, no significant difference was found of the mean tumor diameter between preoperative (6.17 ± 0.98) cm and postoperative (6.32 ± 0.77) cm results ($P > 0.05$).

Ultrasonic Manifestations

Among the 58 patients of the ultrasound group, some masses were irregular or locally lobulated (67.2%, 39/58). The shape of other masses was regular and mainly fusiform. The boundary between focus and surrounding tissue was not clear in 44 cases. Uneven strong cord-like, columnar, and flocculent echoes were seen in 50 patients (Fig. 1–2). Even echoes were found in 8 cases. Liquid anechoic area was not visible in all cases. Blood flow signal was abundant in 37 patients. Signs of adjacent bone invasion were obvious in 42 cases. Complete hyperechoic capsules were found in 3 cases.

MRI Signs

A total of 59 lesions were detected by MRI in 59 patients, and all of them were solitary. The masses were irregular in 52 cases. Plain T1WI scanning: The lesions of 46 cases presented isointensity (compared with muscle). The 13 lesions showed slightly varied signal intensity, mainly isointensity. Plain T2WI scanning: The lesions of 55 cases mainly presented high signal intensity; signal intensity was slightly varied; Spot-like and cordlike low-signal intensity was scattered in the mass. The varied signal intensity was obvious in 4 cases. STIR sequence scanning: all 59 lesions presented high signal intensities. Spot-like and cordlike low signal intensity was seen in lesions. MRI enhancement: All 59 cases showed moderate or above enhancement, and 25 of them showed obvious enhancement (Fig. 3–6).

Comparison Of Diagnostic Sensitivity Of Ultrasound And MRI(data1)

The diagnostic sensitivities of B-mode ultrasound and MRI were 62.07% (58/36) and 83.05% (59/49), respectively before surgery. The diagnostic sensitivity of MRI was compared with that of high-frequency ultrasound ($\chi^2 = 6.48$). Significant difference was found between MRI and B-mode ultrasound ($P < 0.05$).

Discussion

Survey of desmoid-type fibromatosis

Desmoid-type fibromatosis is a rare fibrous tissue tumor. At the beginning of this century, the World Health Organization classified it as myofibroblastic tumor. Extra-abdominal desmoid-type fibromatosis commonly occurs in the musculoskeletal system. Although the disease has no tendency of distant metastasis, it has the characteristics of local recurrence, and its biological behavior is between benign and malignant. In this study, among 117 patients, 61 patients were followed up, and recurrence was found in 33 patients with a recurrence rate of 54.1%, which was consistent with previous studies. Many scholars believed that the occurrence of extra-abdominal desmoid-type fibromatosis is associated with genetic factors, history of trauma and history of surgery. In the ultrasound group and MRI group, among the 117 cases of extra-abdominal desmoid-type fibromatosis, 34 had a history of trauma, 27 had a history of surgery, and no one had a family history.

Ultrasound Imaging Performance

Ultrasound has a strong ability to display fibrous tissue. With the performance of ultrasound instrument greatly enhanced, the accuracy of color Doppler ultrasound alone in the diagnosis of soft tissue tumors has been significantly improved^[3, 4]. The results from this study demonstrated that the preoperative diagnostic sensitivity of B-mode ultrasound was 62.07%. Ultrasound can significantly improve the identification of extra-abdominal desmoid-type fibromatosis by judging the blood flow signals and distribution in and around the tumor. In the present study, among 58 patients detected by ultrasound, the blood supply in 37 tumors was relatively abundant, and all experienced the first onset, which was not consistent with previous studies^[2, 4]. The difference may be associated with our selection of extra-abdominal cases. In all ultrasound-detected cases, no obvious liquid anechoic area was detected. Fibrous echo could be obvious in 53 cases. These could be used as a diagnostic basis to distinguish other soft tissue tumors of musculoskeletal system. The disadvantages of ultrasonic diagnosis of desmoid-type fibromatosis are the subjective factors of diagnostic physicians and the limited ability of ultrasound itself to show the extent of invasion of surrounding tissues. In all 58 cases of ultrasound group, the tumor size was less than the pathological results in 30 cases(Data2). Because of its well-known advantages, ultrasound is still the first choice for patients with extra-abdominal desmoid-type fibromatosis.

MRI imaging performance

Since the advent of MRI, its superior soft tissue resolution has made it one of the indispensable inspection methods for imaging soft tissue lesions, especially soft tissue tumors. MRI diagnosis of extra-abdominal desmoid-type fibromatosis has certain advantages in all imaging examinations. In this study, the sensitivity of MRI reached 83.05%. On the MRI images of a typical extra-abdominal desmoid-type fibromatosis, T1WI showed equal or slightly lower signal intensity, and T2WI and STIR showed high signal intensity. Spot-like and cordlike low-signal fiber components could be seen in high signals. Most of the lesions showed more than medium homogeneous enhancement^[5, 6, 7, 8]. In this study, 25 lesions showed obvious enhancement, accounting for 42.37%, which indicated that the blood supply of the

tumor itself was relatively rich. The morphology of extra-abdominal desmoid-type fibromatosis is generally large, but there are few signs of liquefaction or necrosis in the lesions, which is one of the key points to distinguish it from other soft tissue tumors. MRI could perfectly reveal the invasion of the peritumoral tissue. Because of the high recurrence rate of extra-abdominal desmoid-type fibromatosis^[9], the actual boundary of extra-abdominal desmoid-type fibromatosis has always been the focus of clinicians' attention(Data3). The determination of the resection range is the key factor to determine whether the tumor will recur after resection. MRI has become an important method for the diagnosis of extra-abdominal desmoid-type fibromatosis, the guidance of clinical tumor staging, the selection of surgical methods and the scope of resection.

Differential Diagnosis Of Extra-abdominal Desmoid-type Fibromatosis

The typical extra-abdominal desmoid-type fibromatosis has obvious imaging features on ultrasound and MRI, but it is difficult to distinguish it from some fibrous tumors, especially with some atypical fibrous tumors.

Fibroproliferative fibroma

The disease occurs frequently in the mandible, mainly at the age of 10–30 years old. The onset age coincides with that of desmoid-type fibromatosis. Fibroproliferative fibroma has the same characteristics as extra-abdominal desmoid-type fibromatosis tissues. It is extremely difficult to distinguish with imaging methods such as ultrasound and MRI. The final diagnosis relies on pathological results.

Fibrosarcoma

Fibrosarcoma is more common in the middle-aged and the elderly and the lesions grow faster. The center of the lesion easily suffers from necrosis and bleeding. The degree of enhancement is more obvious than that of desmoid-type fibromatosis. Different from desmoid-type fibromatosis's compression of the surrounding bone, fibrosarcoma can invade the surrounding bone, which can cause many kinds of map-like, insect-like bone destruction. According to the general conditions such as medical history, it is not difficult to make the corresponding diagnosis by ultrasound and MRI, but attention should be paid to the identification of fibrosarcoma without early signs of liquefaction or necrosis.

Benign fibrous histiocytoma

The disease commonly occurs at the age of 20–60 years old in the pelvis and femur. The appearance of fat in the center of the lesion can be used as a characteristic diagnosis.

Malignant fibrous histiocytoma

A typical malignant fibrous histiocytoma has a large tumor mass; liquefaction and necrosis easily appear in the lesion. The boundary between the lesion and surrounding tissues is unclear. The onset age shows a bimodal distribution (20–40 years old and 60–80 years old). Ultrasound and MRI can make a correct diagnosis based on the above conditions.

In summary, ultrasound and MRI can make a qualitative diagnosis of extra-abdominal desmoid-type fibromatosis based on its inherent superiority and its good ability to display the composition of extra-abdominal desmoid-type fibromatosis fibers. The ability of MRI to show the true boundary of tumor mass and the extent of invasion to the surrounding area can provide clinical help as much as possible. However, it is still difficult for the imaging physicians to make a differential diagnosis between extra-abdominal desmoid-type fibromatosis and some atypical soft tissue tumors using ultrasound and MRI.

Declarations

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Availability of data and material

Not applicable.

Authors' contributions

Wei Li, Bing-Hui Fan and Yan-Bo Jia planned and wrote the manuscript. Zhi-Ying Guo and Zong-Bo Wang contributed to the planning and reviewing of the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The trial was approved by the Ethics Committee of the Second Affiliated Hospital of Inner Mongolia Medical University, and informed consent was obtained from all enrolled patients.

Consent for publication

All authors read the final manuscript and approved for publication..

Competing interests

The authors declare that they have no competing interests.

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Data 1-3

Due to technical limitations, Data images 1-3 are only available as a download in the supplemental files section.

Figures



Figure 2

Female, 37 years old, with a tumor on the lateral side of the left forearm. Fusiform and heterogeneous echo tumor with clear boundary and strong cord-like echo were showed in Ultrasonic two-dimensional image.

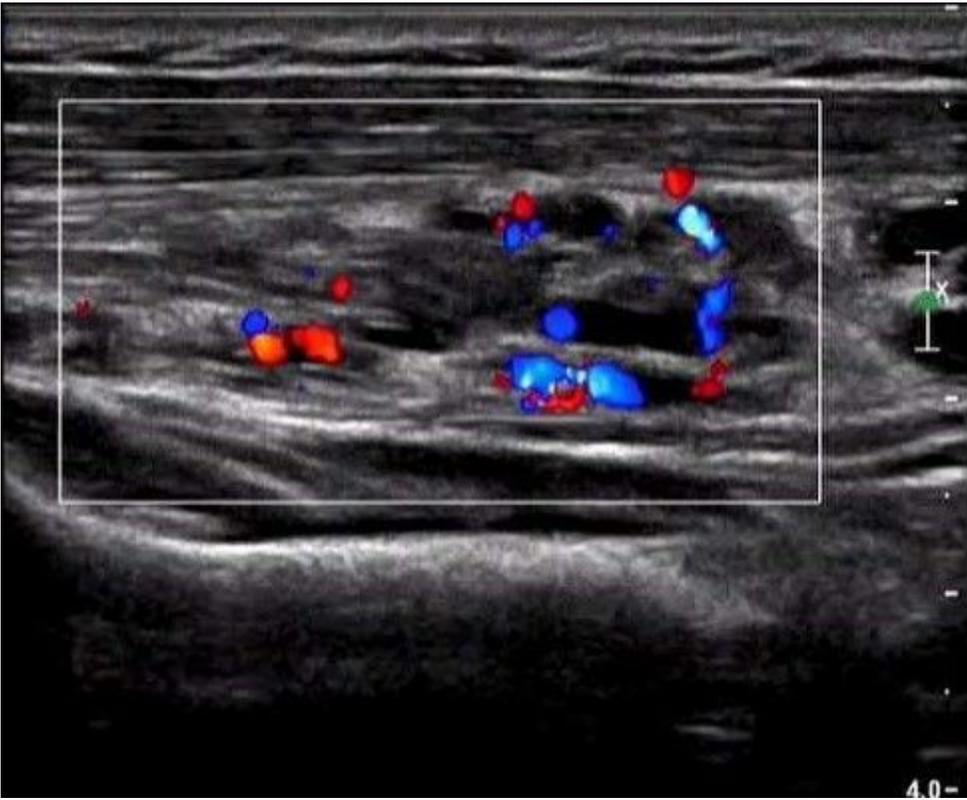


Figure 4

Female, 37 years old, with a tumor on the lateral side of the left forearm. CDFI: short rod-like and spot-like blood flow signals were showed in the tumor.



Figure 6

T1WI showed irregular T1 isointensity.tumor with linear hyposignal in the left gluteus maximus.



Figure 8

STIR image showed obvious high signal with multiple strips low signal



Figure 10

TIWI enhanced image showed obvious enhancement in the tumor, with no significant enhancement was observed in the internal strip-like low signal of the enhanced tumor.



Figure 12

TIWI enhanced image showed obvious enhancement in the tumor, with no significant enhancement was observed in the internal strip-like low signal of the enhanced tumor.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Data1.PNG](#)
- [Data2.PNG](#)
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