Int J Clin Exp Med 2020;13(6):4324-4330
www.ijcem.com /ISSN:1940-5901/IJCEM0108650

Original Article

Comparative analysis on MRI manifestations and pathology of ovarian cystic teratoma and its clinical application value

Jing Han

Department of Medical Imaging, Hangzhou Meizhao Comprehensive Outpatient Department Co., Ltd., Hangzhou, Zhejiang Province, China

Received February 3, 2020; Accepted March 3, 2020; Epub June 15, 2020; Published June 30, 2020

Abstract: Objective: To explore the contrast between magnetic resonance imaging (MRI) manifestation and pathology of ovarian cystic teratoma and its clinical application value. Methods: A total of 104 patients with ovarian cystic teratoma admitted to our hospital were enrolled and analyzed retrospectively. All the enrolled patients were confirmed as having ovarian cystic teratoma by surgery-based tissue examination, and they were all examined through MRI before operation. In addition, the MRI examination results were compared with pathological results after surgery. Results: The 104 patients were confirmed with cystic teratoma by pathological examination, including 86 patients with unilateral cystic teratoma and 18 patients with bilateral cystic teratoma, and there were 122 tumors in total among the patients, with the largest diameter of 12.59 cm and the smallest diameter of 2.89 cm. The MRI diagnosis results of the patients before operation were basically consistent with their pathological results after operation. The specificity, sensitivity, and accuracy of MRI in diagnosis were 100.00%, 97.67%, and 98.08%, respectively, and the results of the MRI diagnosis were mainly as follows: Cystic teratoma, relatively low signal intensity on T1-weighted imaging (T1WI), relatively high signal intensity on T2-weighted imaging (T2WI), smooth cyst wall, relatively high signal intensity on the area with T1WI and T2WI, and relatively low signal intensity, cystoid signal or solid mixed signals on fat-suppressed sequences. Conclusion: MRI can provide a high diagnostic accuracy in examining ovarian cystic teratoma patients, and has a high diagnostic coincidence with pathological results after operation, so it can provide a good imaging basis for clinical diagnosis and treatment of ovarian cystic teratoma and can be widely applied.

Keywords: Ovarian teratoma, ovarian cystic teratoma, pathological manifestations, MRI manifestation, clinical application

Introduction

Ovarian teratoma is a common ovarian germ cell tumor, which is not a tumor due to pregnancy, but a tumor due to abnormal proliferation and aggregation of germ cells in ovarian tissues [1]. Germinal layer, ectoderm, and mesoderm are three crucial constituent structures in germ cells of the human body, so many ectodermal tissues such as tissues of sclerite, sebum, hair, teeth, and skin and germinal layer tissues such as gastrointestinal tissues and muscular tissues will be involved in tumors [2]. Ovarian teratoma can be classified into malignant tumors and benign tumors, of which mature teratomas are benign, while immature teratomas are malignant. The latter involves some cystic lesions and eventually brings about ovarian cystic teratoma [3]. Patients with ovarian cystic teratoma suffer from abdominal masses of different sizes, tenderness, irregular menstruation, lower abdomen bulge, malaise, and fever, and even suffer from peritoneal irritation signs and ascites under severe situations. If the patients are not treated in a timely manner, they are likely to have canceration or may suffer from acute abdominal pain, peritoneal irritation signs, and massive hemorrhaging due to tumor dehiscence; which will compromise their life quality, and pose a huge threat to their health [4]. The etiology of ovarian teratoma is still under investigation at present,

which may be related to the living habits, genetic elements, and endocrine elements, or may be linked to the parthenogenesis caused by atypical division due to the stimulation of initial germ cells and abnormal tissue development in the early stages of pregnancy [5]. Therefore, middle-aged and elderly women should harbor stronger preventative awareness and participate in regular physical examination to receive early diagnosis and early treatment, so as to effectively improve the diagnosis and treatment effects.

Colour Doppler ultrasonography has advantages of being a simple operation, low cost, and ability of finding intra-abdominal masses, but its scanning imaging quality is not as high as that of magnetic resonance imaging (MRI), which is not conducive to diagnosis. MRI is the main clinical examination method for ovarian cystic teratoma, which has the advantages of low radiation, high repeatability and high accuracy, so it is widely applied. Pathological examination is the basis of diagnosis, and MRI and pathological examination can both provide significant basis for later treatment. One study by Li Yuming has also revealed that MRI can provide sufficient basis for clinical treatment, with more clear morphology and signal characteristics of ovarian cystadenoma [6]. Therefore, this study carried out a comparative analysis on MRI manifestations and pathology of ovarian cystic teratoma and explored its clinical application value.

Materials and methods

Clinical data

A total of 104 patients diagnosed with ovarian cystic teratoma according to MRI and pathology from May 2017 to December 2018 in Hangzhou Meizhao Comprehensive Outpatient Department Co., Ltd. were retrospectively analyzed. The enrolled patients were all between 18 and 70 years old, with an average age of (38.3±5.5) years, including 74 patients with clear symptoms (36 patients with abdominal masses, 24 with abdomen bulge and 14 with irregular menstruation) and 30 patients without clinical symptoms. The study was carried out under the approval of the Ethics Committee of Hangzhou Meizhao Comprehensive Outpatient Department Co., Ltd. after all patients and their families signed informed consent forms.

Inclusion and exclusion criteria

The inclusion criteria of the patients were as follows: Patients meeting the clinical diagnosis criteria of ovarian cystic teratoma [5], patients confirmed with ovarian cystic teratoma according to pathological examination, patients with cystic space-occupying masses in the pelvic cavity, and with lipid tissues or hair and skeletal tissues according to MRI and ultrasound examination, patients in a stable condition and without other comorbid cardiovascular diseases, and patients tolerant to surgical treatment.

The exclusion criteria were as follows: Patients with other comorbid immune diseases or without detailed medical records, patients who had received other treatments or others affecting the results of this study within one month, and those comorbid with coagulant function abnormalities, coma, multiple organ injury, or mental disorders.

Methods

MRI examination was carried out on all patients with a Siemens 1.5T superconducting magnetic resonance imaging system as follows: Before examination, each patient was required to fast for 6 hours and prohibited from taking any drugs, and all jewelry and metal articles were removed. Then the patient was instructed to keep a supine position, and given routine scanning and enhanced scanning under a scanning area from her umbilical site to her pelvic bone. During scanning, the oblique sagittal plane was set at T1-weighted imaging (T1WI) and T2-weighted imaging (T2WI), the conventional coronal plane at T2WI and gradient recalled echo (GRE), and the axial plane at fluid attenuated inversion recovery (FLAIR) T2WI sequence. During enhanced scanning, the axial plane was set at T1WI and fat suppression (FS), the sagittal plane at fat-suppressed T1WI and FS, and the coronal plane at T1WI. The examination run for 40 minutes with 40.5 ms of repetition time (TR), 26.0 ms of echo time (TE), 22 cm × 22 cm of field of view (FOV), and 448 × 384 of matrix. The samples were taken for pathological examination. The index parameters were set as follows: TR=160 ms and TE=10 ms. For T2-weighted fat-suppression in fast relaxation fast spin echo (FRFSE) sequence, TR was set as 5000 ms and TE was set as 120 ms; for T2-weighted fat suppression in the sagittal plane

Table 1. Results of pathological examination

Inspection method	Pathological examination
Number of cases	104
Number of confirmed pathological cases	104
Unilateral cystic teratoma (case)	86
Bilateral cystic teratoma (case)	18
Tumors (case)	122
Tumor largest diameter (cm)	12.59
Tumor smallest diameter (cm)	2.89

Table 2. Specific comparison of MRI diagnosis and postoperative pathological results (n, %)

MRI diagnosis	Pathological results		Total
	Positive	Negative	
Positive	84	0	84
Negative	2	18	20
Total	86	18	104

Note: MRI: magnetic resonance imaging.

with FRFSE sequence, TR was set as 6000 ms and TE was set as 85 ms; for FSPGRT1 weighting in the coronal plane, TR was set as 105 ms and TE was set as 4.2 ms. In addition, the scan slice thickness was set as 4.0 mm, the interslice spacing as 0.8 mm, the field of view as 32.0 cm, and the array as 320*224. Under the above settings, the images were sampled three times, and patients were injected intravenously with 0.1 mmoL/Kg Gd-DTPA contrast agent. Patients were all treated through surgery after being diagnosed with ovarian cystic teratoma, and their samples were sent for pathological diagnosis.

Outcome measures

(1) Coincidence between MRI diagnosis before operation and pathological results after operation. (2) Sequence characteristics of ovarian cystic teratoma in MRI examination. (3) MRI scanning manifestation and pathological results. (4) Findings from pathological examination results. (5) Comparison of specificity between MRI diagnosis and pathological results after operation: Sensitivity % = the number of patients with true positivity/(the number of patients with true positivity + the number of patients with false negativity) × 100; Specificity % = the number of patients with true negativity/(the number of patients with false positivity + the number of patients with true negativity) × 100; and accuracy % = (the number of patients with true positivity + the number of patients with true negativity)/the total number of patients) × 100.

Statistical analyses

Data in this study were analyzed statistically using SPSS18.0. Enumeration data were analyzed using the χ^2 test and expressed as n (%), while measurement data were analyzed using the t test and expressed as ($\bar{x}$ ± sd). Receiver operating characteristic (ROC) curves were drawn to analyze the sensitivity and specificity of MRI in diagnosing ovarian cystic teratoma.

Results

Analysis on the pathological results of ovarian cystic teratoma patients

The 104 patients were confirmed as having cystic teratoma by pathological examination, including 86 patients with unilateral cystic teratoma and 18 patients with bilateral cystic teratoma, and there were 122 tumors in total among the patients, with the largest diameter of 12.59 cm and the smallest diameter of 2.89 cm (**Table 1**).

Comparison of diagnostic accuracy and specificity between MRI diagnosis before operation and pathological results after operation

The MRI diagnosis before operation was basically consistent with pathological results after operation. The specificity, sensitivity, and accuracy of MRI in diagnosis were 100.00%, 97.67%, and 98.08%, respectively, and the area-under-the-curve of it was 0.846 (**Table 2** and **Figure 1**).

Sequence characteristics of ovarian cystic teratoma in MRI examination

The results of the MRI diagnosis were mainly as follows: Cystic teratoma, relatively low signal intensity on T1WI, relatively high signal intensity on T2WI, smooth cyst wall, relatively high signal intensity on the area with T1WI and T2WI, and relatively low signal intensity, cystoid signal or solid mixed signals on fat-suppressed sequences (**Table 3**).

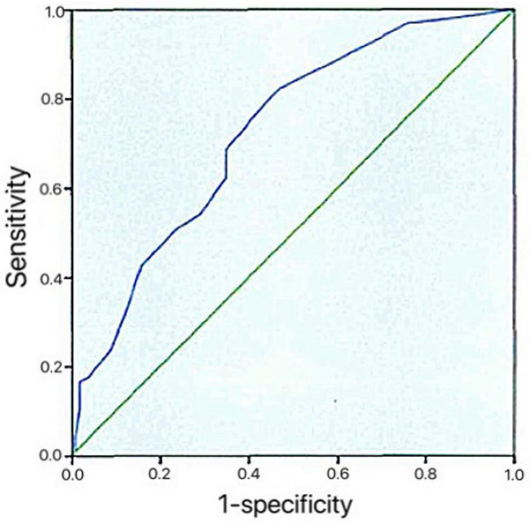

Figure 1. Receiver operating characteristic curve of MRI in ovarian cystadenomas (area-under-the-curve: 0.846). MRI: magnetic resonance imaging.

Typical cases

A 70-year-old woman was a typical case. Her MRI results were as follows: Solid cystic space-occupying mass in the right pelvic cavity with a size of 7.6 cm*8.6 cm*9.2 cm, multilocular, separated, mixed high and low signal intensities on T1WI and T2WI. In contrast, her pathological results were as follows: A mature cystic teratoma in the right ovary and adhesions of tubal umbrella tissues (**Figure 2**).

Discussion

The clinical symptoms of ovarian cystic teratoma are not obvious; so many patients have no clinical symptoms after suffering from it, which increases the difficulty of clinical diagnosis [7-9]. Ovarian cystic teratoma is commonly diagnosed through imaging examination and pathological examination according to the patients' clinical manifestations. Generally, at least 2-3 kinds of tissue components can be found during pathological examination. The proportion of tissue components in tumors is different, and the adipose tissue rate in mature teratomas is as high as 95% [9, 10].

MRI is an imaging examination technology with high soft tissue discrimination ability. Its main advantage is that it can reflect the specific location, shape, size and surrounding conditions of the lesion, which promotes the application value of this technology in the diagnosis of ovarian cystic teratoma [11, 12]. In this study, 84 patients were diagnosed with ovarian cystic teratoma according to MRI based on the pathological results as gold criteria, and the diagnostic accuracy of it is as high as 98.08%; which was in line with the MRI diagnostic coincidence rate (91.42%) in a study by Xu Xiaoliang. This indicates that MRI can clearly reflect the morphology and surrounding tissues of tumors, providing a key diagnostic basis for clinicians, thus assisting doctors to accurately locate cystic lesions and providing targeted guidance for surgical treatment [13, 14].

With advantages of universal application, mature technology, reduction of motion artifacts, multiplanar imaging, and clear imaging pictures, MRI has certain sequence features in the diagnosis of ovarian cystic teratoma. When abnormal cystic-solid signals are seen in the pelvic cavity during MRI examination, T1WI generally shows relatively low signal intensity and T2WI shows relatively high signal intensity [6, 15]. The nature and pathological components of ovarian cystic teratoma and the relationship with surrounding tissues are judged according to the signal characteristics of patients on T1WI and T2WI, signal characteristics in enhanced scanning and fat-suppressed scanning characteristics of the diseased area displayed in the scanning process, and then the location and shape of the lesion are determined, thus providing effective basis for clinical identification and necessary reference for surgical diagnosis and treatment [16, 17]. In this study, the MRI results mainly indicted cystic features, relatively low signal intensity on T1WI and relatively high signal intensity on T2WI in cystic region, smooth and flat cyst wall, relatively high signal intensity on some blocks including T1WI and T2WI, and ultra-low fat signal intensity in fat-suppressed sequences showing cystic or solid mixed signals, which was consistent with the results in a study by Zhang Jing and Zhu Shulong: Relatively low signal intensity on T1WI and relatively high signal intensity on T2WI in cystic region, relatively low signal intensity on fat-suppressed MRI and high signal intensity on chemical shift imaging in the same phase. According to the above research, it can be concluded that for ovarian cystic teratoma, MRI examination is more comprehensive and can provide high image quality.

Table 3. Sequence characteristics of ovarian cystic teratoma in MRI examination

Inspection method	MRI
Lesion shape	Smooth cyst wall
Sac area	
T1WI	Showing low signal
T2WI	Showing high signal
Partial area	
T1WI	Showing high signal
T2WI	Showing high signal
Fat inhibitory sequence	Low signal or cystoidsignalor solid mixed signal
Enhanced scan	Capsule wall can be enhanced

Note: MRI: magnetic resonance imaging; T1WI: T1-weighted imaging; T2WI: T2-weighted imaging.

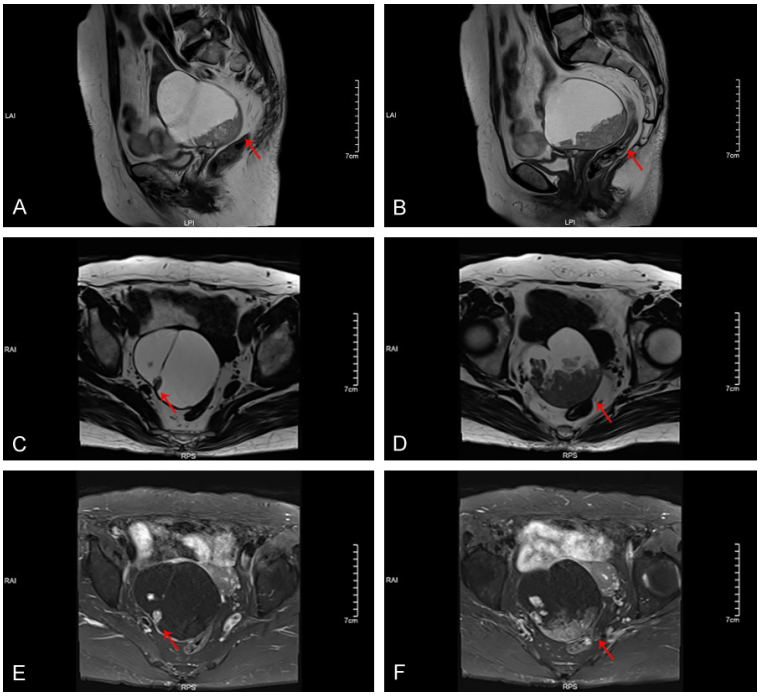

Figure 2. Typical mature cystic teratoma case. A, B. T1WI sagittal; C, D. T1WI axial; E, F. T2WI; T1WI: T1-weighted imaging; T2WI: T2-weighted imaging.

Mature teratomas of the ovary are a common ovarian tumor, which is characterized by yellow and thick liquid fat with hair inside [18]. Tumors confirmed by MRI are usually cystic, but a few are cystic solid, so the subcutaneous fat signals are consistent with scanned fat signals, both with relatively high signal intensify on T1WI and T2WI, relatively low signal intensify in fat-suppressed sequences, and limiting effect on high signals. In the meantime, it can be observed that there is a close relationship between adipose tissues contained in cystic solid tumors and sebum in cysts, so this conclusion can be used as an important basis for clinical diagnosis of ovarian cystic teratoma [19, 20].

With many different characteristics and shapes, ovarian tumors can be classified into a malignant or benignant tumor, a mixed or single tumor, a bilateral or unilateral tumor, a cystic or solid tumor, of which cystic tumor is the most common, with a high lesion malignancy. MRI scanning can reflect cystic lesions of different sizes in the diagnosis of ovarian cystic teratoma, with thin and smooth cyst wall and clear boundaries. Ovarian cystic teratomas are mostly unilateral and rarely bilateral. In the diagnosis, the tumor body diameter was found to be 2.7-12.8 cm, and most ovarian cystic teratomas would show thin effusion [21]. In this study, 104 patients were all confirmed with cystic teratoma by pathological examination, including 86 patients with unilateral cystic teratoma and 18 patients with bilateral cystic teratoma, and there were 122 tumors in total among the patients, with the largest diameter of 12.59 cm and the smallest diameter of 2.89 cm. Thus, multilocular tumors are the most common ovarian cystic teratoma, which has a relatively long diameter, and clear boundary, so they are easy to diagnose. MRI can be used as a reliable examination method for ovarian cystic teratomas. MRI scanning involving oblique sagittal plane, conventional coronal plane and transverse axis plane, enhanced scanning and lipid-compression scanning of multi-directional imaging can clearly reflect the detailed conditions of ovarian cystic teratoma. In this study, MRI diagnosis before operation was basically consistent with pathological results after operation, and the specificity and sensitivity of MRI for diagnosis of ovarian cystic teratoma were

100.00% and 97.67%, respectively, implying relatively high accuracy and sensitivity of MRI for diagnosis of ovarian cystic teratoma. However, MRI diagnosis results of ovarian cystic teratoma are similar to those of lipid-containing cystic mass, which is prone to cause confusion, so attention should be paid to it in clinical diagnosis. MRI can be used with other diagnostic methods to improve the accuracy of diagnosis. However, the number of cases included in this study is small, so further verification with a large sample size is needed. Furthermore, there are some human errors in data statistics, which need further exploration.

To sum up, the ovary is sensitive to radiation and its imaging has little radiation to human body, so imaging examination in the ovary is a reliable method for examination of women in their reproductive period. MRI can provide multi-directional imaging with high resolution, and can clearly reflect pathological changes without bladder filling. Therefore, MRI has an extremely high diagnostic accuracy for patients with ovarian cystic teratoma, and has a very high diagnostic coincidence with pathological findings after operation, so it can provide imaging basis for clinical diagnosis and treatment, and enjoys a great promotion value.

Disclosure of conflict of interest

None.

Address correspondence to: Jing Han, Department of Medical Imaging, Hangzhou Meizhao Comprehensive Outpatient Department Co., Ltd., No. 1 Baifu Road, Shangcheng District, Hangzhou 310002, Zhejiang Province, China. Tel: +86-15968131547; E-mail: hanjingmz1h@163.com

References

[1] Wang JT, Peng JF, Xia XW, Hong Y, Yan ZW, Yuan Q, Wu ZC and Xu WB. MRI diagnostic value of ovarian cystic lesions. J Med Imaging 2016; 26: 1719-1722.

[2] Tian L, Cui CY, Lu SY, Cai PQ, Xi SY and Fan W. Clinical presentation and CT/MRI findings of alveolar soft part sarcoma: a retrospective single-center analysis of 14 cases. Acta Radiol 2016; 57: 475-480.

[3] Perani D, Cerami C, Caminiti SP, Santangelo R, Coppi E, Ferrari L, Pinto P, Passerini G, Falini A, Iannaccone S, Cappa SF, Comi G, Gianolli L and Magnani G. Erratum to: cross-validation of biomarkers for the early differential diagnosis and prognosis of dementia in a clinical setting. Eur J Nucl Med Mol Imaging 2016; 43: 202-203.

[4] Braman NM, Etesami M, Prasanna P, Dubchuk C, Gilmore H, Tiwari P, Plecha D and Madabhushi A. Erratum to: intratumoral and peritumoral radiomics for the pretreatment prediction of pathological complete response to neoadjuvant chemotherapy based on breast DCE-MRI. Breast Cancer Res 2017; 19: 80.

[5] Yang L, Ling X, Zhang GR, Guo WH, Liang FL, Yang J, Zhang P, Sun YX and Zhang M. Analysis of MRI features of cystic meningiomas (17 cases). J Mod Oncol 2017; 25: 2654-2657.

[6] Li YM, Tang WW, Cheng H, Wang LL, Chen H and Gu HL. MRI diagnosis and pathological analysis of ovarian cystadenomas. Chin J CT MRI 2018; 16: 106-109.

[7] Wang SY, Yin L, Guan XM, Xiao BB, Zhang Y and Delgado A. Single port transumbilical laparoscopic surgery versus conventional laparoscopic surgery for benign adnexal masses: a retrospective study of feasibility and safety. Chin Med J (Engl) 2016; 129: 1305-1310.

[8] Wu GL, Wang SP, Fu GY, Han DL, Li H and Yang YL. Analysis of CT and MRI diagnostic value and imaging characteristics of ovarian cystadenomas. Chin J Woman Child Health Res 2017; 28: 893-896.

[9] Charidimou A, Martinez-Ramirez S, Reijmer YD, Oliveira-Filho J, Lauer A, Roongpiboonsopit D, Frosch M, Vashkevich A, Ayres A, Rosand J, Gurol ME, Greenberg SM and Viswanathan A. Total magnetic resonance imaging burden of small vessel disease in cerebral amyloid angiopathy: an imaging-pathologic study of concept validation. JAMA Neurol 2016; 73: 994-1001.

[10] Flynn C, Gullo G, Walshe J, O'doherty A, Fennelly D, Mcdermott E and Crown J. Use of contrast-enhanced Magnetic Resonance Imaging (MRI) to predict pathological response after trastuzumab (T) - based neoadjuvant chemotherapy (NAC) for HER2-positive breast cancer (HER2BrCa). Eur J Cancer 2018; 92: S83.

[11] Zhao WL, Wang JK, Guo HY and Sun XY. Correlation between the pathologic manifestitions and MRI features of ovarian benign tumor. Shiyong Fangshexue Zazhi 2016; 32: 1250-1253.

[12] Wu J, Gong G, Cui Y and Li R. TU-D-207B-05: Intra-tumor partitioning and texture analysis of DCE-MRI identifies relevant tumor subregions to predict early pathological response of breast cancer to neoadjuvant chemotherapy. Med Phys 2016; 43: 3751-3751.

[13] Sharma N, Dave R, Millicanslater R, Dodwell D and Horgan K. Abstract P4-02-09: can MRI be used to determine pathological complete re-

sponse following neo-adjuvant chemotherapy for breast cancer? Cancer Res 2016; 76: P4-02-09-P04-02-09.
[14] Inglese M and Petracca M. MRI in multiple sclerosis: clinical and research update. Curr Opin Neurol 2018; 31: 249-255.
[15] Barbaro B, Leccisotti L, Vecchio FM, Di Matteo M, Serra T, Salsano M, Poscia A, Coco C, Persiani R, Alfieri S, Gambacorta MA, Valentini V, Giordano A and Bonomo L. The potential predictive value of MRI and PET-CT in mucinous and nonmucinous rectal cancer to identify patients at high risk of metastatic disease. Br J Radiol 2017; 90: 20150836.
[16] Pan L and Niu ZX. MRI diagnosis and pathological analysis of borderline ovarian mucinous cystadenocarcinoma. Chin J CT MRI 2017; 15: 117-119.
[17] Zhang HL, Xu L, Xu JM, Li XB, Zhang JB and Shen JK. MRI and clinicopathological analysis of ovarian immature teratoma. J Chin Clin Med Imag 2016; 27: 275-277.
[18] Cao XF and Yang QY. MRI features and differential diagnosis of ovarian tumors. Xiandai Yiqi Yu Yiliao 2018; 24: 19-20,38.
[19] Duan XL, Chen ZQ, Zhong Q, Liu L, Lin TY and He CY. MRI findings of ovarian follicular cell tumor. Chin J CT 2017; 15: 83-85.
[20] Zhang N, Nan N, Zhang Z, Yang F, Li D and Yu TL. Characteristic imaging features of mature cystic teratoma in the chest. Int J Med Radiol 2017; 40: 705-709.
[21] Yuan YF, Zeng L and Zhu X. Clinical value of high field strength MRI in the diagnosis of ovarian tumors. Chin J Clin Res 2017; 30: 1408-1411.