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Original Article

MRI is more valuable than CT in the diagnosis of cervical cancer

Jun Zhang, Xinlin Liu

Department of Radiology, Zhejiang Putuo Hospital, Zhoushan 316100, Zhejiang, PR China

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Abstract: Objective: To analyze the diagnostic values of CT and MRI for cervical cancer. Method: The clinical data of 83 patients with cervical cancer and 16 patients with cervicitis admitted to Zhejiang Putuo Hospital from January 2017 to December 2021 were retrospectively analyzed. Among them, 18 patients receiving CT examination were categorized as the CT group, and the remaining 81 patients with MRI examination were the MRI group. In total, 83 patients were finally diagnosed with cervical cancer through pathologic examination. The diagnostic values of CT and MRI for cervical cancer staging and pathologic features were analyzed. Results: Compared to CT, the sensitivity and accuracy of MRI in diagnosing cervical cancer were higher ($P<0.05$), as was its detection rate in the diagnosis of stage I and II ($P<0.05$), but the difference in the detection rate of stage III was not statistically significant. In addition, among the 83 cases of cervical cancer, it was confirmed by surgical and pathological examination that 41 cases experienced parametrial invasion, 65 had interstitial invasion, and 39 had lymph node metastasis. The detection rate of MRI in the diagnosis of interstitial and parametrial invasion was also markedly higher than that of CT ($P<0.05$), but the difference in the lymph node metastasis detection was not significant. Conclusion: MRI can clearly display the structure of various layers of the cervix and its lesions. It is more accurate in clinical diagnosis, staging, and evaluation of pathologic features of cervical cancer compared to CT, and is available on a more reliable basis for diagnosis and treatment.

Keywords: Cervical cancer, CT, MRI, staging, clinical diagnosis

Introduction

Cervical cancer is a common gynecological malignancy that mostly occurs in young and middle-aged women and seriously affects their health and well-being [1]. Timely detection and early intervention and treatment are key to prognosis improvement inj cervical cancer patients, and the treatment plans for patients with different stages vary in individual cases. Surgery is often used for early-stage cervical cancer, while chemotherapy is mainly for advanced stage patients. Therefore, clear and specific staging of cervical cancer is of great importance for the selection of treatment methods [2, 3]. With the widespread application of cervical cytology screening and the enhancement of residents' health awareness, early detection of cervical cancer and precancerous lesions has become more general, resulting in a significant decrease in the incidence and mortality of cervical cancer [4]. However, cervical cytology screening cannot identify the path and scope of tumor invasion, and is not effective in accurate assessment of cervical cancer [5]. Therefore, we should explore better non-invasive methods for cervical cancer staging, so as to adopt a more appropriate and effective treatment regimen.

Imaging examination is the most common non-invasive examination method. With the continuous development of imaging technology, computerized tomography (CT) and magnetic resonance imaging (MRI) have been widely used in the examination of female malignant tumors due to their advantages of high tissue resolution, multi-sequence and multi-directional imaging [6, 7]. These two inspection methods have their own advantages and disadvantages, as well as different diagnostic value for cervical cancer staging. Specifically, CT is of high spatial resolution that can display tumor volume and degree of invasion from different planes; while

MRI can effectively assess tumor size and adjacent organ involvement with high soft tissue resolution [8, 9].

So far, few studies have comprehensively analyzed the value of MRI and CT in staging diagnosis of cervical cancer. Therefore, this study analyzed and compared the accuracy of CT and MRI in the diagnosis of cervical cancer staging, in order to explore the best diagnostic method and achieve the purpose of guiding clinical treatment.

Materials and methods

Clinical information

The clinical data of 83 patients with cervical cancer and 16 patients with cervicitis (with an average age of (45.67±3.04)) admitted to Zhejiang Putuo hospital from January 2017 to December 2021 were retrospectively analyzed. (N=Z 2× (P× (1-P))/E 2 where Z is the confidence interval, n is the sample size, E is the total error, P is the proportion of the target population to the population, which is generally taken as 0.5, not randomly distributed). Among them, 18 patients undergoing CT examination were collected as the CT group, and 81 patients with MRI examination were the MRI group. This was a retrospective study, and because the analysis used anonymous clinical data approved by the Ethics Committee of Zhejiang Putuo Hospital, subjects or guardians do not need to give informed consent to the study.

Inclusion criteria: patients diagnosed with cervical cancer by pathologic diagnosis with experience of preoperative CT or MRI imaging examinations; aged 24-81 years; able to undergo surgery; with complete clinical data.

Exclusion criteria: with severe organ dysfunction; with serious medical and surgical underlying diseases; with inflammation and infection; a history of multiple abdominal operations; with contraindications to surgery; with suspected multiple tumor metastasis; refusal of surgical treatment.

Inspection method

CT: the patient was instructed to fill the bladder and scanned with a Philips 64-row spiral CT machine (Produced by Philips, the Netherlands), with the scanning site from the lower border of the pubic symphysis to the iliac spine. Scanning slice thickness was set to 7-8 mm, the pitch 1-1.2 mm, and the slice interval 0.8-1.5 mm, matrix 256×256. Ioversol (National Medicine Zhunzi H20000494, produced by Bayer Pharmaceuticals) was used as an enhanced contrast agent, and 80-100 ml (rate 3-4 ml/s) was injected through the cubital vein. When the CT value of abdominal aorta reached 170-180 HU, arterial phase scan was performed and completed after a delay of 65 s to ensure the maximum enhancement of the uterine body and cervix, and the bladder and ureter were imaged after a delay of 3-4 minutes.

MRI: the GE Signa HD twinspeed 1.5T superconducting MRI scanner (GE Company, USA) was used, with 8-channel body phased array coil scanning. The slice thickness was set to 5~7 mm, slice interval 0.5~1.0 mm, the matrix 512×256, and the field of view 280~400 mm. SE sequence and spoiled gradient echo (SPGR) sequence were used in axial plain T1-weighted image (T1WI). Fast cyclotron (PSE) sequence was used in T2-weighted image (T2WI). After the T2WI sagittal and coronal scans were completed, 0.01 mmol/kg of contrast agent (meglumine zapentinate) was administered intravenously, and then T1WI fat suppression sequence axial, coronal, and sagittal scans were performed. A typical case image is shown in **Figure 1**.

CT and MRI images were observed by two senior physicians, including the size and shape of the lesions, imaging features, the extent of infiltration, and the relationship with surrounding organs and tissues.

Image analysis

CT: stage Ia: no obvious change; stage Ib: isodensity or low density in the cervix; stage IIa: enlarged cervix, clear parametrium, and no invasion of other surrounding tissues and organs; stage IIb: varying degrees of blurred shadows; stage IIIa: the tumor invades the lower third of the vagina, but does not invade the pelvis; stage IIIb: the tumor invades the pelvis, and the inhomogeneous mass spreads to the obturator internus muscle or piriformis muscle; stage IVa: the cervical mass invades the rectum, showing the destruction and disappearance of the adjacent fat interface, and the bladder or rectum opposes the nodule; stage IVb: the cervical mass invades the rectum and

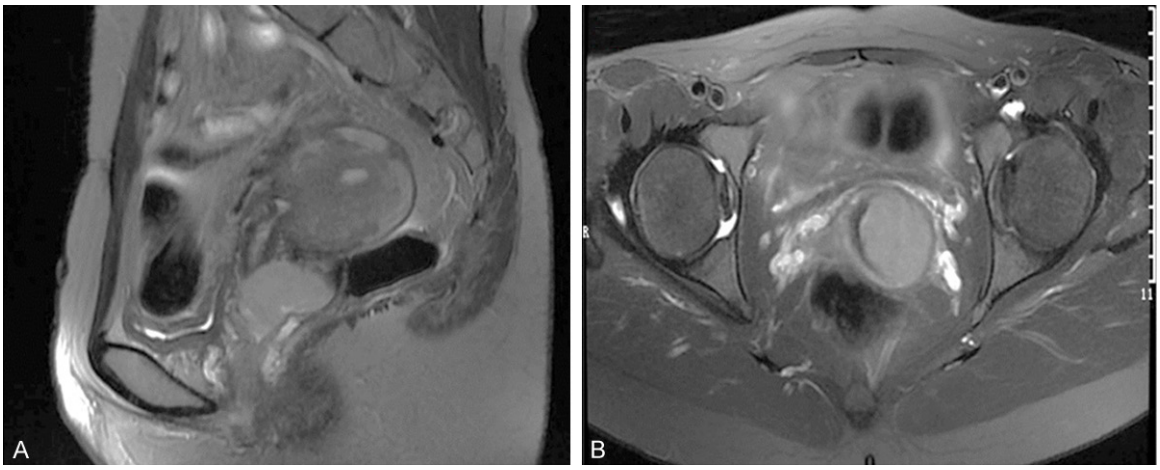

Figure 1. MRI images of a 40-year-old female. There was lymphovascular infiltration and deep interstitial infiltration. A. Lateral view; B. Anteroposterior view.

involves the uterine body, and the nodule shadow of the uterine body can be seen.

MRI: stage Ia: negative; stage Ib: medium-signal tumor foci in the axial cervical region; stage IIa: moderate signal in the cervix in the sagittal view, and the tumor invades the upper 2/3 of the lower vagina with low signal; stage IIb: axial view shows enlarged and asymmetric cervix, protruding axial hyperintensity parametrial tissue; stage IIIa: moderate signal in the cervix in sagittal view, tumor infiltrating the lower third of vagina with low signal; stage IIIb: cervical protruding axial high signal parametrium and reaching the attachment of the main ligament; stage IVa: bladder and rectal wall thickening, with unclear demarcation of cervical tumor signal; stage IVb: tumor involving the uterus and distant organs.

Statistical methods

SPSS 19.0 was used for statistical analysis of the data. t-test was applied for measured data ($\bar{x} \pm S$), and chi-square test was for counted data (%). The sensitivity and specificity of CT and MRI in the diagnosis of cervical cancer were analyzed using the calculation formula. P<0.05 indicated a significant difference.

Results

General information

Subjects were comparable due to insignificant differences observed regarding gender, age, BMI, etc. between the two groups (all P>0.05, **Table 1**).

Comparison of CT and MRI in clinical diagnosis of cervical cancer

The sensitivity and accuracy of MRI in diagnosing cervical cancer were 95.65% and 92.59%, which were both significantly higher than those of CT (P<0.05). There was no statistical difference in specificity between the two inspection methods (P>0.05, **Tables 2** and **3**).

Comparison of clinical staging diagnosis of cervical cancer by MRI and CT

The detection rates of MRI for stage I and II were 95% and 95.655, respectively, which were both evidently higher than those of CT diagnosis (P<0.05), while no difference was observed regarding the detection rate of stage III (P>0.05, **Table 4**).

Diagnostic results of MRI and CT on pathological features of cervical cancer

Surgical and pathological examinations confirmed that 41 of the 83 cervical cancer patients had parametrial invasion (35 in MRI group and 6 in CT group), 65 had interstitial invasion (61 in MRI group, 4 in CT group), and 39 had lymph nodes metastasis (35 cases in MRI group and 4 cases in CT group). The detection rate of MRI in the diagnosis of interstitial invasion and parametrial invasion was higher than that of CT (P<0.05), and no significant dif-

Table 1. General information of the two groups of patients [n (%)]

Factor	CT Group n=18	MRI Group n=81	χ^2	P
Age			0.173	0.677
≤45	6 (33.33)	23 (28.40)		
>45	12 (66.67)	58 (71.60)		
BMI (kg/m^2)			0.083	0.773
≤22	8 (44.44)	33 (40.74)		
>22	10 (55.56)	48 (59.26)		
Marital status			0.001	0.999
Married	16 (88.89)	72 (88.89)		
Unmarried	2 (11.11)	9 (11.11)		
Disease Type			0.947	0.814
Squamous Cell Carcinoma	6 (33.33)	30 (37.04)		
Adenocarcinoma	4 (22.22)	24 (29.63)		
Adenosquamous Carcinoma	4 (22.22)	15 (18.52)		
Cervicitis	4 (22.22)	12 (14.81)		
Staging			0.991	0.609
Phase I to II	10 (55.56)	43 (53.09)		
Phase III	4 (22.22)	26 (32.10)		
Non-Cervical Cancer	4 (22.22)	12 (14.81)		
Reproductive History			0.004	0.950
Have Given Birth	15 (83.33)	67 (82.72)		
Nulliparous	3 (16.67)	14 (17.28)		

Table 2. Clinical diagnosis results of CT and MRI for cervical cancer

Method	Pathologic Diagnosis		
	Cervical Cancer	Non-Cervical Cancer	Total
MRI:			
Cervical Cancer	66	3	69
Non-Cervical Cancer	3	9	12
Total	69	12	81
CT:			
Cervical Cancer	10	2	12
Non-Cervical Cancer	3	3	6
Total	13	5	18

Table 3. Comparison of the diagnostic values of CT and MRI for cervical cancer

Diagnosis	MRI Group n=81	CT Group n=18	χ^2	P
Sensitivity	66/69 (95.65)	10/13 (76.92)	5.658	0.017
Specificity	9/12 (75.00)	3/5 (60.00)	0.038	0.536
Accuracy	75/81 (92.59)	13/18 (72.22)	6.188	0.013

ference was identified in the detection rate of lymph node metastasis (P>0.05, **Table 5**).

Discussion

Cervical cancer in China has a high incidence, with a serious negative impact on the well-being of women diagnosed. The pathogenesis of the disease is complex, and with the changes of living habits and dietary structure in recent years, the incidence of cervical cancer has shown an upward trend towards younger age that should be paid attention to [10]. Early diagnosis and treatment are the keys to improv-

Table 4. Results of clinical staging of cervical cancer by MRI and CT

Detection Rate	MRI Group n=69	CT Group n=14	χ^2	P
Stage I	19/20 (95.00)	2/4 (50.00)	2.484	0.013
Stage II	22/23 (95.65)	4/6 (66.67)	4.311	0.038
Stage III	26/26 (100.00)	4/4 (100.00)	0.001	0.999

Table 5. Diagnostic results of MRI and CT on pathologic features of cervical cancer

Symptom	MRI Group n=69		CT Group n=14		χ^2	P
	Number of detections/cases	Detection rate (%)	Number of detections/cases	Detection rate (%)		
Para Palace Violation	34/35	97.14	4/6	66.67	7.015	0.008
Interstitial Infiltration	58/61	95.08	2/4	50.00	10.74	0.001
Lymph Node Metastasis	35/35	100.00	4/4	100.00	0.001	0.999

ing survival rate of patient. However, clinical studies have shown that early stage of cervical cancer often present without obvious symptoms, such as irregular vaginal bleeding, contact bleeding, etc., making it difficult for its early diagnosis [11]. Cervical liquid-based cytology and colposcopy are considered conducive to an early diagnosis of cervical cancer to certain extent. Unfortunately, specific data such as lesion range and blood flow information are not yet provided, nor an effective reference for early treatment of cervical cancer [12].

Use of CT or MRI as the imaging method for the pelvis and abdominal cavity is generally believed effective in the initial diagnosis for tumor staging [13]. In our study, we analyzed the value of CT and MRI in the diagnosis of cervical cancer and found that the sensitivity and accuracy of MRI were higher than that of CT, as well as the detection rate of stage I and stage II cervical cancer. This suggested that the accuracy of MRI is better for the staging diagnosis of cervical cancer. In short, MRI had more clinical application value than CT for confirming the staging of cervical cancer, and could improve the diagnostic effectiveness.

This result suggests that MRI could clearly reveal the anatomical structure of the cervix through the low-intensity outer layer of the uterus, the obvious low-intensity inner layer of the uterus, and the obvious high-intensity mucosal layer, which is conducive to evaluating the tumor volume and the degree of involvement of adjacent tissues, so as to accurately diagnose cervical cancer staging [13]. However, some patients with a less severe stage may have uneven thickening of the cervical mucosa and are very likely to be assessed with a complete cervical myometrium, which makes the MRI assessment of cervical inflammatory changes problematic and presents a false negative test result [14]. In this regard, for the clinical diagnosis of cervical cancer staging, the low signal integrity of the cervical myometrium and the clarity of the paracervical fat space should be comprehensively evaluated to reduce the occurrence of missed diagnosis and understaging.

Past studies have shown that MRI had considerable diagnostic value in the clinical diagnosis of cervical cancer with many advantages, such as simple operation, relatively high resolution of tumor tissue, multi-directional and multi-parameter images, accurate and detailed display of cervical condition, high sensitivity and specificity, and a high-accuracy judgment for malignant tumor diagnosis [15]. Studies have also reported that its accuracy in the diagnosis of early cervical cancer was more than 85%, and the accuracy in its clinical staging exceeded 80% [16], which is consistent with our conclusion. CT diagnosis, on the other hand, can provide a reliable basis for the staging diagnosis of patients with primary cervical cancer, but there are limitations and relatively low resolution for complete detection of tumors with a diameter of <4~5 mm [16]. However, the results of this study also revealed that CT had better diagnostic accuracy for stage III cervical cancer. This may be due to the large diameter of the tumor in the late stage of cervical cancer and the invasion of the paracervical structures, so that CT can better evaluate the spe-

cific situation of the tumor because of this spatial structure [17].

Finally, we also compared the diagnostic value of MRI and CT and found that the detection rate of MRI for interstitial invasion and parametrial invasion was markedly higher than that of CT diagnosis. However, there was no significant difference in detection of lymph node metastasis between MRI and CT. Analysis of the results showed that MRI could perform a full range of tomographic scans on patients, to display different clinical stages and severity in detail with clear and comprehensive pictures with higher resolution compared to CT. It also has a higher accuracy in diagnosing stromal invasion and parametrial invasion of cervical cancer [18]. Previous studies [19] have analyzed preoperative MRI images as well as postoperative pathologically confirmed parametrial invasion results in patients with cervical cancer stage. Based on the signs of MRI parametrial invasion, it was found that MRI could improve the sensitivity of preoperative assessment of parametrial invasion by 86.7% compared to the signs of parametrial invasion alone. The reason for lack of significant difference in the accuracy of lymph node diagnosis between MRI and CT may be that CT has been used for many years in the diagnosis of lymph node metastasis of various tumors. It can achieve continuous and rapid volume scanning, significantly enhance imaging of diseased tissue, improves the diagnosis of lymph nodes, and also has a good imaging effect for lymph node metastasis. Its principle is insertion and rearrangement based on thin-slice scanning, so that the image can be scanned and reconstructed comprehensively in the sagittal and coronal planes. This achieves a more comprehensive observation and capture of lymph node metastasis of cervical cancer [20, 21]. However, this study also has some shortcomings. The limited number of cases leads to a large gap in the number of patients between the two groups, which may affect our final conclusions. However, we will further carry out a multicenter large-sample study to further demonstrate our conclusions.

Conclusion

MRI can clearly display the structure of each layer of the cervix and lesions. Compared to CT, it is more accurate for clinical diagnosis, staging, and evaluation of pathologic features of cervical cancer, and is available on a more reliable basis for the diagnosis and treatment of cervical cancer.

Disclosure of conflict of interest

None.

Address correspondence to: Xinlin Liu, Department of Radiology, Zhejiang Putuo Hospital, Zhoushan 316100, Zhejiang, PR China. Tel: +86-13772809549; E-mail: Lxl6302608071@163.com

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