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Original Article

Comparative study of B-ultrasound and CT in preoperative diagnosis of myometrial invasion and lymph node metastasis in endometrial carcinoma

Longjiang Wang[1*], Yanbin Sui[2*], Guowei Zhang[1], Guanghui Zhang[1]

[1]Department of Radiology, Yantaishan Hospital, Yantai, Shandong Province, P. R. China; [2]Department of Radiology, Yantai Yuhuangding Hospital, Yantai, Shandong Province, P. R. China. [*]Equal contributors and co-first authors.

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Abstract: Objective: To examine the diagnostic performance of B-ultrasound and CT in preoperative assessment of endometrial carcinoma. Methods: From January 2015 to December 2017, a retrospective analysis was performed for the clinical data from 100 patients admitted to our hospital who had endometrial carcinoma confirmed by postoperative pathologic examination. All patients received B-ultrasound and CT examination before surgery. Postoperative pathologic findings were taken as the gold standard. The specificity, sensitivity, positive predictive value (PPV), negative predictive value (NPV) and Youden's index of the two imaging techniques were compared in preoperative diagnosis of myometrial invasion and lymph node metastasis. Agreement analysis (kappa test) was used to evaluate the performance of B-ultrasound and CT in preoperative diagnosis of myometrial invasion and lymph node metastasis. Results: In diagnosis of myometrial invasion, the specificity, sensitivity, PPV, NPV and Youden's index of B-ultrasound were 69.6%, 61.0%, 87%, 34.8% and 0.306, respectively, and the corresponding values of CT were 78.3%, 66.2%, 91.1%, 40.9%, and 0.445, respectively. The diagnostic measures of CT were better than those of B-ultrasound, but the difference was statistically insignificant. In diagnosis of lymph node metastasis of endometrial carcinoma, the specificity, sensitivity, PPV, NPV and Youden's index of B-ultrasound were 100%, 25.0%, 100%, 90.7% and 0.250, respectively; the corresponding values of CT were 96.6%, 75.0%, 75.0%, 96.6% and 0.716, respectively. Among them, the value for sensitivity of CT was significantly better than that of B-ultrasound (P=0.041), and the rest diagnostic measures were not significantly different between the two imaging techniques. Agreement analysis (kappa test) showed that there were poor agreements between preoperative B-ultrasound diagnosis of myometrial invasion and lymph node metastasis and the corresponding postoperative pathologic findings. There was also a poor agreement between preoperative CT diagnosis of myometrial invasion and the corresponding postoperative pathologic findings, but there was a good agreement between preoperative CT diagnosis of lymph node metastasis and the corresponding postoperative pathologic findings. Conclusion: CT may have a better performance in preoperative diagnosis of myometrial invasion and lymph node metastasis in patients with endometrial carcinoma than B-ultrasound.

Keywords: Endometrial carcinoma, CT, B-ultrasound, diagnostic performance

Introduction

Endometrial carcinoma is defined as a serial of epithelial malignant tumors of the endometrium, and is one of the most common tumors in gynecological tumors [1]. Endometrial carcinoma is increasingly prevalent, with a trend of patients at younger age [2]. Surgical treatment is the most effective and feasible for endometrial carcinoma [3]. Studies have shown that myometrial invasion of the endometrium and pelvic lymph node metastases are closely associated with prognosis of patients [4]. If myometrial invasion and pelvic lymph node metastasis in endometrial carcinoma patients can be accurately evaluated before surgery, it may contribute to surgical choice and prognosis [5].

B-ultrasound and CT are common imaging techniques used in diagnosing patients with endometrial carcinoma. Imaging examination, a non-invasive test, is of significance for preoperative assessment of endometrial carcinoma [5, 6].

Table 1. Postoperative pathologic characteristics of patients

Characteristic	Case (n)
Menopausal status	
Pre-menopause	30
Post-menopause	70
Comorbid uterine lesions	
Adenomyosis	3
Hysteromyoma	9
Tumor differentiation	
Poorly differentiated	17
Moderately differentiated	29
Well-differentiated	54
Pathologic type	
Endometrioid carcinogenesis	90
Special pathology type	10
Lymph node metastasis	
yes	12
No	88
Myometrial invasion	
No	23
<1/2	50
>1/2	27
Pathologic staging	
I	70
II	15
III	12
IV	3

B-ultrasound has been extensively used for preoperative assessment of endometrial carcinoma owning to its simple operation and low costs. B-ultrasound has shown to accurately evaluate the depth of myometrial invasion, but its specificity and sensitivity are lower [7, 8]. CT examination has a higher resolution and can clearly show the extent of tumor involvement in the body. Studies have shown that CT directly assesses the presence or absence of extrauterine tumor extension [9, 10]. However, to the best of our knowledge, no consensus has been reached that which imaging technique is more effective in preoperative evaluation of endometrial carcinoma in patients [11, 12].

Therefore, in this study, a retrospective analysis was made regarding 100 patients with surgically and pathologically confirmed endometrial carcinoma to explore the performance of B-ultrasound and CT in preoperative diagnosis of myometrial invasion and lymph node metastasis in patients with endometrial carcinoma, providing evidence for clinical assessment and prognostic analysis.

Materials and methods

General data of patients

Between January 2015 and December 2017, clinical data were retrospectively analyzed from 100 patients with endometrial carcinoma confirmed by postoperative pathologic examination. All enrolled patients underwent vaginal B-ultrasound and CT examination within 1 week before surgery. Inclusion criteria were an age of older than 18 years; no chemotherapy or radiotherapy before surgery; the presence of pathologically-confirmed endometrial carcinoma; assessed the depth of myometrial invasion and metastases of lymph nodes in the pelvis or adjacent to the abdominal aorta. Exclusion criteria included the presence of metastatic tumors; other comorbid malignant tumors; contraindications to CT and B-ultrasound examination; reluctance to cooperate actively. This study was reviewed and approved by the hospital ethics committee.

Methods

Transvaginal ultrasound examination: Before transvaginal ultrasound examination, patients were asked to drink sufficient water. When the patients felt that the bladder was filled with water, a B-ultrasound examination was performed with a Philips Hnl 5000 color ultrasound system. A 5.5 MHz transvaginal probe was employed to screen the associated signs (the uterus size, endometrial thickness and lymph nodes) at a scanning angle of 150 degrees and a depth of 8 cm, to observe the myometrium and lymph nodes.

Contrast-enhanced CT

Before contrast-enhanced CT, patients were asked to take 2% meglumine diatrizoate. When the bladder and small intestine were full, a Philips 64-row spiral CT scanner was used for CT examination. Scanning was set within the range from the diaphragm to the bottom of the pelvis cavity, and was performed in a continuous volume mode with a matrix of 512*512

Table 2. Assessment of myometrial invasion in endometrial carcinoma patients by B-ultrasound and CT

Chi-square test for three-way contingency tables		+ (True positive)					
		B-ultrasound					
		+ (Positive)	- (Negative)	Total	+ (Positive)	- (Negative)	Total
CT	+ (Positive)	47	4	51	5	0	5
	- (Negative)	0	26	26	2	16	18
	Total	47	30	77	7	16	23

Table 3. Comparison of assessment of myometrial invasion in endometrial carcinoma patients by B-ultrasound and CT

Imaging technique	Specificity (%)	Sensitivity (%)	PPV (%)	NPV (%)	Youden's index
B-ultrasound	69.6	61.0	87.0	34.8	0.306
CT	78.3	66.2	91.1	40.9	0.445
P value	0.502	0.513	0.497	0.549	0.418

Note: PPV denotes positive predictive value; NPV, negative predictive value.

and a slice thickness of 10 mm. Iopamidol-370 (150 mL in total), a contrast agent, was injected intravenously at a rate of 2.5 mL/s. Patients were observed for their preoperative invasion and lymph node metastasis.

Assessments

The diagnosis-related indicators of B-ultrasound and CT examination, including the specificity, sensitivity, negative predictive value (NPV), positive predictive value (PPV) and Youden's index were compared. The data were calculated by the chi-square test for three-way contingency tables. In patients with endometrial carcinoma, Kappa tests were used to assess the agreement between the preoperative diagnostic results of myometrial invasion and lymph node metastasis by B-ultrasound and CT and postoperative pathologic findings.

Statistical analysis

Statistical analyses were performed on all experimental data with the use of SPSS, version 21.0. Count data was represented as percentages, and between-group comparisons were made by the chi-square tests. The postoperative pathologic findings were taken as a gold standard. The agreement of the preoperative diagnosis of B-ultrasound and CT and relevant postoperative pathologic findings was analyzed by Kappa tests. The criteria for diagnostic assessment were as follows: κ value >0.75 indicated an excellent diagnostic agreement; κ value between 0.75 and 0.4 indicated a fair agreement; κ value <0.4 indicated a poor agreement. P<0.05 was deemed to be statistically significant.

Results

Postoperative pathologic characteristics of patients

In the current study, we enrolled 100 patients with endometrial carcinoma who had a mean age of 57.2±4.6 years. All patients underwent routine surgical treatment. Postoperative pathologic findings proved that 77 patients had myometrial invasion and 12 had lymph node metastasis. Patients with endometrial carcinoma were staged according to the surgical-pathologic staging criteria published by the International Federation of Gynecology and Obstetrics (FIGO) in 2009 [13]. Basic data regarding menopausal status, comorbid uterine lesions, tumor differentiation, pathologic types, lymph node metastasis, myometrial invasion and pathologic staging pooled from the patients were listed in **Table 1**.

Assessment of myometrial invasion

Among the 100 patients with endometrial carcinoma, postoperative pathologic examination showed 77 cases of myometrial invasion. Preoperative B-ultrasound and CT detected 54 cases and 56 cases of myometrial invasion, respectively. Seven cases were misdiagnosed as myometrial invasion by B-ultrasound, and 5 patients by CT as compared with postoperative pathologic findings. For preoperative diagnosis of myometrial invasion, no significant differenc-

Table 4. Assessment of lymph node metastasis in endometrial carcinoma patients by B-ultrasound and CT

Chi-square test for three-way contingency tables		+ (True positive)					
		B-ultrasound					
		+ (Positive)	- (Negative)	Total	+ (Positive)	- (Negative)	Total
CT	+ (Positive)	3	6	9	0	3	3
	- (Negative)	0	3	3	0	85	85
	Total	3	9	12	0	88	88

Table 5. Comparison of assessment of lymph node metastasis in endometrial carcinoma patients by B-ultrasound and CT

Imaging technique	Specificity (%)	Sensitivity (%)	PPV (%)	NPV (%)	Youden's index
B-ultrasound	100.0	25.0	100.0%	90.7	0.250
CT	96.6	75.0*	75.0	96.6	0.716
P value	0.244	0.041	0.218	0.187	0.035

Note: Chi-square test for three-way contingency tables. Compared with B-ultrasound, *χ^2=4.167, P=0.041.

Table 6. Agreement of performance of B-ultrasound or CT for diagnosing myometrial invasion

Imaging technique	Kappa index		
	κ value	Z value	*P* value
B-ultrasound	0.239	2.825	0.004
CT	0.328	3.046	0.002

Table 7. Agreement of performance of B-ultrasound or CT for diagnosing lymph node metastasis of endometrial carcinoma

Examination tool	Kappa index		
	κ value	Z value	*P* value
B-ultrasound	0.341	5.021	<0.001
CT	0.715	6.277	<0.001

es were observed between B-ultrasound and CT regarding the values of sensitivity, specificity, PPV and NPV (all P>0.05; **Tables 2**, **3**).

Assessment of lymphatic metastasis in patients with endometrial carcinoma

Preoperatively, B-ultrasound detected 3 patients had lymph node metastasis, and postoperative pathologic examination revealed the presence of lymph node metastasis. Preoperatively CT found 12 patients had lymph node metastasis, and postoperative pathologic findings confirmed 9 of them had lymph node metastasis. For preoperative assessment of lymph node metastasis, CT had a significantly higher sensitivity than B-ultrasound (P=0.041; **Tables 4**, **5**).

Agreement of performance of B-ultrasound and CT for diagnosing myometrial invasion

Taken the postoperative pathologic findings as the gold standard, the Kappa test showed that the κ values of B-ultrasound and CT were 0.239 and 0.328, respectively, indicating that there was a poor agreement for B-ultrasound and CT in preoperative diagnosis of myometrial invasion (**Table 6**).

Agreement of performance of B-ultrasound and CT for diagnosing lymph node metastasis in patients with endometrial carcinoma

Taken the postoperative pathologic findings as the gold standard, the Kappa test indicated that the κ values of B-ultrasound and CT were 0.341 and 0.715, respectively, suggesting that there was a poor agreement for B-ultrasound in preoperative diagnosis of lymph node metastasis in endometrial carcinoma, but a better agreement for CT (**Table 7**).

Discussion

Endometrial carcinoma, a common malignant tumor in the female reproductive system, is mainly characterized by irregular vaginal bleeding after menopause, and the number of deaths from the disease is rising [14]. The pathogenesis of endometrial carcinoma is still unclear, and surgical treatment is the preferred treatment for patients with endometrial carcinoma as surgery can remove the lesions and provide diagnostic evidence for alternative therapy and prognosis assessment [15, 16]. Preoperative

assessment of the extent of endometrial carcinoma is important for guidance of preoperative clinical staging, choice of surgical protocols and assessment of patient prognosis. Clinically, the markers for endometrial carcinoma are primarily assessed by the imaging tools such as B-ultrasound and CT [17].

A study reported a poor performance of B-ultrasound in preoperative assessment of the depth of myometrial invasion in patients with endometrial carcinoma [18]. The results of our current study showed that for preoperative evaluation of myometrial invasion, the specificity, sensitivity, PPV, NPV and Youden's index of B-ultrasound imaging were 69.6%, 61.0%, 87%, 34.8% and 0.306, respectively. Notably, the values for markers diagnosizing B-ultrasound were all low. Agreement analysis (Kappa test) indicated the κ value for B-ultrasound was 0.239, suggesting that B-ultrasound had poor diagnostic accuracy in preoperative assessment of myometrial invasion when compared with the gold standard, the postoperative pathologic findings, which is similar to that reported in previous studies [19, 20]. For lymph node metastasis, we found the sensitivity of B-ultrasound was 25%, which was significantly lower than that of CT. Agreement analysis (Kappa test) showed PPV, NPV and Youden's index of B-ultrasound were 87%, 34.8% and 0.306, respectively. Notably, B-ultrasound had low diagnostic indicators. Agreement analysis (Kappa test) revealed that the κ value of B-ultrasound was 0.341, indicating poor accuracy of B-ultrasound diagnosis of lymph node metastasis in endometrial carcinoma. This might be due to the limited resolution of B-ultrasound, and B-ultrasound has a low sensitivity in diagnosing micro-metastases of lymph nodes as it can only detect large metastatic lesions [21].

We also found that the diagnostic indicators of CT were better than the corresponding indicators of B-ultrasound in preoperative evaluation of myometrial invasion, but there was no significant difference. This might be attributed to the small sample size in our current study. Although plain and contrast-enhanced CT examinations have relatively higher resolution, they only play limited roles in preoperative diagnosis of myometrial invasion [22]. Agreement analysis (kappa test) in our current study showed that the κ value for CT was 0.328 in preoperative diagnosis of myometrial invasion, and the diagnostic agreement was poor. This might be due to the fact that CT could not differentiate the superficial myometrial invasion of patients with early endometrial carcinoma. This is consistent with the results reported by Lund et al. [23]. For lymph node metastasis of endometrial carcinoma, CT had a good diagnostic performance, with a κ value of 0.715, which is in line with the postoperative pathologic findings. This may be explained that the lymph nodes adjacent to the arteriovenous fistula were easily visualized due to significant enhancement in the blood vessels during the contrast-enhanced scanning. This suggests that CT has a better diagnostic performance for preoperative evaluation of lymph node metastasis of endometrial carcinoma. This is similar to the findings reported by Cokmert et al. [24].

In conclusion, B-ultrasound is widely applied in management of patients with endometrial carcinoma due to its convenient operation and low cost, but it has a poor performance in preoperative diagnosis of endometrial carcinoma. CT has a poor performance in preoperative diagnosis of myometrial invasion, especially of lesions involved in the superficial myometrium, but it has a good performance in preoperative diagnosis of lymph node metastasis, and better than B-ultrasound. Therefore, CT as an imaging tool for preoperative evaluation of endometrial carcinoma is worthy of extensively clinical use. However, our current study is not free from limitations, such as a small sample size and a retrospective trial in nature. In the future research, additional studies with larger sample size and more included diagnosis-related markers are required for further confirm that CT has a better diagnostic performance in preoperative assessment of endometrial carcinoma than B-ultrasound.

Disclosure of conflict of interest

None.

Address correspondence to: Guanghui Zhang, Department of Radiology, Yantaishan Hospital, No.91, Jiefang Road, Yantai 264000, Shandong Province, P. R. China. Tel: +86-0535-6602001; Fax: +86-0535-6602001; E-mail: guanghuizhang6@163.com

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