Prospective Cohort Study

INTERNATIONAL JOURNAL OF SURGERY

OPEN

Diagnostic value of endoscopic ultrasound in pelvic masses with bowel involvement

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Background: The diagnostic ability of endoscopic ultrasound (EUS) for intestinal infiltration by pelvic masses has aroused considerable interest in many oncological settings. This study aimed to evaluate the effectiveness of EUS in predicting colorectal invasion in patients with pelvic masses and compare its accuracy with that of other imaging methods, namely pelvic MRI and abdominal computed tomography (CT), in predicting intestinal involvement in patients with histologically confirmed colorectal invasion.

Methods: A hundred and eighty-four female patients with histologically confirmed benign or malignant pelvic masses were enrolled in a retrospective-prospective study. All patients underwent EUS, pelvic MRI, and one or more of abdominal CT, transvaginal sonography, and colonoscopy examinations before surgery. The surgical and pathological results were used as the gold standard to evaluate the diagnostic accuracy of EUS for colorectal invasion of pelvic masses.

Results: This study included 184 patients who underwent surgery, with the time between EUS and surgery ranging from 1 to 309 (mean, 13.2) days. The diagnostic sensitivity, specificity, positive predictive value, and negative predictive value of EUS for benign and malignant pelvic masses infiltrating the intestine were 83.3, 97.8, 99.1, and 66.2%, respectively. The overall diagnostic accuracy was 87.0%.

Conclusions: EUS is a simple, noninvasive, reliable, and accurate technique for the preoperative diagnosis of pelvic masses infiltrating the intestine. The authors recommend the use of this technology by gynecologists, as well as its incorporation into the preoperative diagnostic process to determine the most suitable surgical method. This would help in avoiding unexpected situations and unnecessary resource wastage during surgery.

Keywords: benign and malignant pelvic masses, endometriosis, endoscopic ultrasound, magnetic resonance imaging

Introduction

Pelvic masses may occur in benign pelvic diseases, such as endometriosis, as well as in malignant diseases. The intestinal tract is the most common extragenital invasion site for benign pelvic tumors such as endometriosis, affecting 3.8–37% of patients with endometriosis; up to 95% of intestinal endometriosis cases are observed in the rectum and sigmoid colon[1]. In malignant tumors, intestinal infiltration may occur in both the early and late stages of the disease at different infiltration depths. Symptoms of the digestive system related to pelvic masses infiltrating the rectum or sigmoid colon may include diarrhea, constipation, abdominal distention, and periodic rectal bleeding. These symptoms are similar to or overlap with those of irritable bowel syndrome, making the diagnosis of pelvic masses infiltrating the intestine challenging[2]. Pelvic masses with intestinal infiltration are difficult to diagnose in 30–40% of cases, posing challenges in treatment.

HIGHLIGHTS

- The symptoms of intestinal infiltration in pelvic masses are not typical, making preoperative diagnosis difficult.
- Endoscopic ultrasound (EUS) utilizes real-time scanning to obtain the relationship and depth of invasion between diseases and the intestine.
- The diagnostic ability of EUS for intestinal infiltration of benign and malignant pelvic masses is satisfactory.

Traditional imaging methods have poor accuracy in diagnosing pelvic masses with intestinal infiltration, and intestinal involvement is usually detected only before or during surgery, resulting in incomplete treatment. Since the late 1990s, endoscopic ultrasound (EUS) has been used for preoperative evaluation of patients with endometriosis suspected of having rectal or sigmoid colon infiltration[3]. This has increased the potential of preoperative diagnosis of benign and malignant pelvic tumors. EUS has high diagnostic accuracy, and its negative and positive predictive values (PPV) for patients with intestinal infiltrating endometriosis are higher than those of pelvic MRI and other examinations[4–7]. This indicates the reliability of EUS in diagnosing intestinal infiltrating endometriosis. However, there is limited literature regarding the diagnostic ability of EUS for other

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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International Journal of Surgery (2024) 110:2085–2091

Received 27 November 2023; Accepted 9 January 2024

Published online 17 January 2024

http://dx.doi.org/10.1097/JS9.0000000000001124

pelvic masses, particularly malignant pelvic masses, in terms of intestinal infiltration. Therefore, this study aimed to evaluate the effectiveness of EUS in predicting colorectal infiltration in patients with benign and malignant pelvic masses and its diagnostic accuracy compared to other imaging methods.

Materials and methods

Research participants and data collection

This single-center retrospective-prospective study was conducted between 17 July 2013 and 17 July 2023. We included 184 consecutive female patients who underwent surgery for benign and malignant pelvic masses. Data were collected prospectively upon commencement of the study, while data on all consecutive cases before commencement were collected retrospectively. All patients with gynecological disease symptoms underwent EUS, pelvic MRI, and one or more of abdominal computed tomography (CT), transvaginal sonography (TVS), and colonoscopy examinations. Surgical records and pathological results were complete, and were regarded as the gold standard for determining the presence of intestinal infiltration of pelvic masses. Only patients who underwent both EUS and pelvic MRI and ultimately underwent surgery were included in the study. Patients with contraindications to EUS, those with poor intestinal preparation, those who did not undergo surgery, or those who had previously undergone colorectal resection were excluded.

The following data were collected from patients included in the study: age; height; weight; clinical symptoms; frequency of pregnancy and childbirth; number of previous gynecological surgeries; EUS, pelvic MRI, and other imaging findings, including the size, location, and infiltration layer of the lesion; type of surgery; surgical records; and pathological type. This study was approved by our Institutional Review Board (2022PS941K) and registered as a clinical trial. All patients were informed that their deidentified data would be collected for research. The study concept and design were investigator-initiated, and no financial support was received. The data was collected in accordance with the provisions of the Declaration of Helsinki. The work has been reported in line with the strengthening the reporting of cohort, cross-sectional and case–control studies in surgery (STROCSS) criteria[8].

Methods

EUS

EUS was performed using a Pentax linear electronic system (Pentax EG38J10UT, EG3870UTK) with adjustable probe frequencies of 5, 7.5, and 10 MHz. All procedures were performed by senior examiners. Prior to the EUS examination, the patients underwent intestinal preparation (oral polyethylene glycol electrolyte powder). The criteria for determining pelvic mass invasion of the intestine with EUS include loss of the five-layer structure of the intestine, thickening of the intestinal wall, and fusion of pelvic lesions with adjacent intestinal walls. The criteria for nonadhesion include the mass being adjacent to the intestinal wall with a clear five-layer structure of the intestine, and no observation of thickening.

MRI

MRI was performed using a Philips 3.0T unit (Ingenia 3.0T CX; Philips HealthTech) in axial T1-weighted, T2-weighted, and fat suppression sequences T2; sagittal T2-weighted and fat suppression sequences T2, coronal T2-weighted. If two radiologists with more than 10 years of experience in imaging diagnosis had different opinions regarding the analysis, a third radiologist (with more than 15 years of work experience) made the judgment.

CT

The CT examination was performed using a Toshiba CT Aquilion/640 and a Philips iCT 256. The scanning parameters were as follows: tube voltage, 120 kV; tube current, 250–490 mA; FieldofView (FOV),500; layer thickness, 3–5 mm; and layer spacing, 3.5 mm. A nonionic iodine contrast agent (350 mgI/ml) was injected through the elbow vein using a high-pressure syringe with a total volume of 90 ml, an injection flow rate of 2.5 ml/s, an arterial phase of 40–45 s, and a delay period of 60–65 s.

TVS

TVS was performed using a Voluson 730 scanner (GE Healthcare, Zipf) with a 5–9 MHz multifrequency transvaginal probe.

Statistical analysis

All data were analyzed using SPSS 26.0, with surgical and pathological results as the diagnostic gold standards. The sensitivity, specificity, PPV, and negative predictive value (NPV) of EUS, pelvic MRI, abdominal contrast-enhanced CT, TVS, colonoscopy, and other methods for diagnosing colorectal infiltration of pelvic masses were evaluated. A Kappa consistency test was used to compare the different diagnostic methods. For qualitative variables, Fisher's exact test was performed when one or more of the theoretical frequencies was less than five. A χ^2 test was performed when all theoretical frequencies were greater than or equal to five. Student's *t*-tests were performed for quantitative variables. The level of statistical significance was set at $P < 0.05$. A receiver operating characteristic (ROC) curve was used to compare the diagnostic efficiencies between EUS and pelvic MRI.

Results

Population examined

Between July 2013 and July 2023, 230 patients underwent EUS for evaluation of pelvic masses. Of these 230 patients, 45 did not undergo surgery and/or were lost to follow-up, and one was found to have intestinal schwannoma as the primary disease after admission to the hospital due to pelvic masses. Finally, 184 patients who underwent surgery were enrolled (Fig. 1) (mean age, 43.3 years; range, 32–54 years). Among them, 140 patients were pathologically diagnosed with benign disease and 44 with malignant disease. There were 104 patients with intestinal infiltration in the benign group and 33 in the malignant group.

Seventeen patients had not conceived before surgery (14%), 24 had not given birth before surgery (19%), and 96 had not undergone gynecological surgery before this surgery (68%). The most common symptom when seeking medical treatment was dysmenorrhea (22%). Approximately 35% of patients with abdominal pain and bloating, abnormal defecation, and bloody stools were referred for treatment. The difference in gastrointestinal symptoms between patients with and without intestinal infiltration was statistically significant ($P = 0.018$). The preoperative patient characteristics are presented in Table 1.

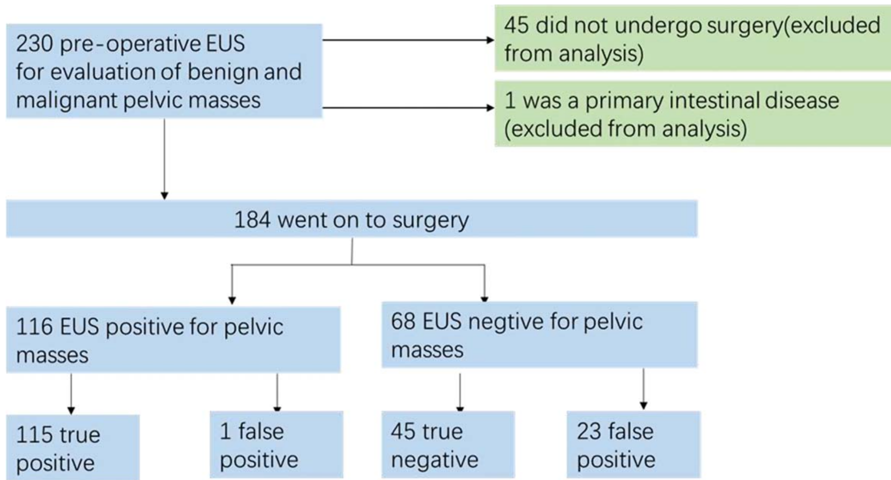

Figure 1. Schema of the analyses and results. EUS, endoscopic ultrasound.

Diagnostic value of TVS

Among the 130 patients who underwent preoperative TVS, only 12 (9%; nine benign and three malignant cases) were diagnosed with pelvic mass adhesion to the intestinal wall in cases with final pathological confirmation of intestinal infiltration with unclear boundaries. One patient was pathologically confirmed to have no intestinal infiltration, while the TVS report showed pelvic masses and intestinal adhesions.

Diagnostic value of CT

A total of 108 patients underwent preoperative abdominal CT, with 50 patients showing intestinal infiltration (31 benign and 19 malignant cases) and 58 without intestinal infiltration (41 benign and 17 malignant cases). Among the benign cases, 26 were false-negative results (pathologically confirmed intestinal infiltration while CT showed no intestinal infiltration), and five were false-positive (intestinal infiltration not pathologically confirmed while CT showed intestinal infiltration). Among the malignant cases, 10 results were false-negative, and three were false-positive.

The diagnostic accuracy, sensitivity, specificity, PPV, NPV, positive likelihood ratio, and negative likelihood ratio of CT in detecting the intestinal infiltration of benign and malignant pelvic masses were 59.3, 53.8, 73.3, 84.0, 37.9, 2.01, and 0.63%, respectively. The accuracy, sensitivity, specificity, PPV, NPV, positive likelihood ratio, and negative likelihood ratio for the intestinal infiltration of benign masses were 56.9, 50.0, 75.0, 83.9, 36.6, 2.00, and 0.67%, respectively. The accuracy, sensitivity, specificity, PPV, NPV, positive likelihood ratio, and negative likelihood ratio for the intestinal infiltration of malignant masses were 63.9, 61.5, 70.0, 84.2, 41.2,2.05 and 0.55%, respectively (Table 2).

Diagnostic value of MRI

Among the 184 patients, MRI confirmed 72 with intestinal infiltration (56 benign and 16 malignant cases) and 112 without intestinal infiltration (84 benign and 28 malignant cases). Among benign cases, 56 were false negatives, and seven were false positives. Among malignant cases, 20 were false negatives, and three were false positives.

The accuracy, sensitivity, specificity, PPV, NPV, positive likelihood ratio, and negative likelihood ratio of MRI in detecting the intestinal infiltration of benign and malignant pelvic masses were 53.3, 44.9, 78.3, 86.1, 32.1, 2.03, and 0.70%, respectively. The accuracy, sensitivity, specificity, PPV, NPV, positive likelihood ratio, and negative likelihood ratio for the intestinal infiltration of benign masses were 55.0, 46.7, 80.0, 87.5, 33.3, 2.34, and 0.67%, respectively. The accuracy, sensitivity, specificity, PPV, NPV, positive likelihood ratio, and negative likelihood ratio for the intestinal infiltration of malignant masses were 47.7, 39.4, 72.7, 81.3, 28.6, 1.44, and 0.83%, respectively (Table 2).

Diagnostic value of EUS

Among the 184 patients, EUS confirmed 116 with intestinal infiltration (84 benign and 32 malignant cases) and 68 without intestinal infiltration (56 benign and 12 malignant cases). Among the benign cases, 22 were false negatives, and one was a false-positive. Among the malignant cases, one was a false-negative result, and none was false-positive.

The accuracy, sensitivity, specificity, PPV, NPV, positive likelihood ratio, and negative likelihood ratio of EUS in detecting the intestinal infiltration of benign and malignant pelvic tumors were 87.0, 83.3, 97.8, 99.1, 66.2, 37.86, and 0.17%, respectively. The accuracy, sensitivity, specificity, PPV, NPV, positive likelihood ratio, and negative likelihood ratio for the intestinal infiltration of benign tumors were 83.6, 79.0, 97.1, 98.8, 60.7, 27.24, and 0.22%, respectively. The accuracy, sensitivity, specificity, PPV, NPV, and negative likelihood ratio for the intestinal infiltration of malignant tumors were 97.7, 97.0, 100.0, 100.0, 91.7, and 0.03%, respectively (Table 2).

In the univariate analysis of EUS diagnostic accuracy in this study, there were significant differences in the pathological type ($P=0.015$) and number of lesions ($P=0.011$). However, differences pertaining to the diameter of lesions ($P=0.445$), infiltration level of lesions ($P=0.32$), and lesion location ($P=0.493$) were not statistically significant (Table 3).

Table 1

Patient characteristics.

	Bowel involvement	Without bowel involvement	*P*
Age [years, Mean (SD)]			
Overall	43 (11)	44 (12)	0.423[a]
Benign	39.7 (8.9)	40.5 (8.8)	0.667[a]
Malignant	53 (10)	57 (11)	0.231[a]
Weight			
Overall	60.5 (9.5)	61.2 (9.2)	0.702[a]
Benign	60.8 (10.3)	62.8 (9.2)	0.342[a]
Malignant	59.8 (7.1)	56.2 (7.5)	0.178[a]
Symptoms (n): Overall; Benign; Malignant			
Dysmenorrhea	34; 33; 1	7; 7; 0	0.018[bd]; 0.097[c]; 0.289[c]
None	23; 13; 10	14; 12; 2	
Irregular vaginal bleeding	9; 4; 5	7; 3; 4	
Abdominal pain/ distention[d]	30; 19; 11	7; 5; 2	
Abnormal defecation[d]	23; 17; 6	2; 2; 0	
Melena/bloody stool[d]	4; 3; 1	0; 0; 0	
Other	20; 17; 3	7; 6; 1	
Pregnancy (*n*)			
0	14	3	0.592[c]
1–3	62	25	
4–6	13	6	
Parity (*n*)			
0	19	5	0.392[c]
1	56	21	
2	15	7	
> 2	0	1	
History of gynecological surgery (*n*)			0.295[c]
0	66	30	
1	28	8	
2	9	1	
Colonoscopic manifestation			0.116[c]
None	12	5	
Protuberant lesion	49	6	

[a]Student *t*-test.
[b]$\chi2$ test.
[c]Fisher exact test.
[d]Gastrointestinal symptoms.

Comparison of EUS and MRI diagnosis of intestinal infiltration by pelvic masses

Exactly 104 cases (57 benign and 47 malignant) with consistent results were observed using EUS and MRI. The pathological examination revealed an infiltrative relationship between the pelvic mass and intestine in only one benign case. Both EUS and MRI revealed that the intestine was not infiltrated, while the conclusions of the other cases were consistent with the final pathological results.

MRI indicated that the intestines of 59 patients were not infiltrated; however, EUS suggested infiltration (40 benign and 19 malignant cases). The pathological examination ultimately confirmed that all 59 patients in fact, had intestinal infiltration.

EUS indicated no intestinal infiltration in 21 patients; however, MRI suggested infiltration (12 benign and nine malignant cases). In the benign cases, the final pathological examination revealed that six patients had intestinal infiltration, while the other six had pelvic masses with no intestinal infiltration. In the malignant cases, the final pathological examination showed that eight patients had pelvic masses without intestinal infiltration, while one had intestinal infiltration.

According to the ROC curve analysis, the area under the curve (AUC) of EUS was greater than that of MRI. The AUC difference between the two diagnostic methods was 0.29 (95% CI: 0.215–0.365, $P<0.001$), indicating that the AUC difference between the two diagnostic methods was statistically significant; that is, the accuracy difference between the two diagnostic methods was statistically significant (Fig. 2).

There was a difference in the diagnostic ability of EUS and MRI for intestinal infiltration by pelvic masses ($P<0.05$), with a kappa of 0.164. For benign and malignant masses, there was a difference in the diagnostic ability between EUS and MRI ($P_{\text{benign}}<0.05$; $P_{\text{malignant}}=0.042$), with kappa values of 0.286 and −0.273, respectively.

For the determination of the extent of intestinal infiltration, EUS accurately determined whether it was benign or malignant. MRI had an accuracy of 40% (4/10), 48.9% (22/45), 20% (1/5), and 62.5% (10/16) for the serosa, muscularis propria, submucosa-muscularis mucosa, and full-layer infiltration, respectively. Although EUS had a higher diagnostic accuracy than MRI, there was no statistically significant difference in the diagnostic abilities of both with regard to different levels of intestinal infiltration in benign or malignant cases ($P_{\text{total}}=0.829$, $P_{\text{benign}}=0.507$, and $P_{\text{malignant}}=1$).

For lesions with a diameter ≤2 cm, the diagnostic accuracy of EUS and MRI were 100% and 72.7% (32/44), respectively. When the diameter of the lesion was >2 cm but ≤5 cm, the diagnostic accuracy of EUS and MRI were 100 and 78.4% (29/37), respectively. When the diameter of the lesion was >5 cm, the diagnostic accuracy of EUS and MRI were 90% (9/10) and 80% (8/10), respectively. However, there was no significant difference in the diagnostic accuracies of EUS and MRI for benign and malignant lesions of different diameters ($P_{\text{total}}=0.927$, $P_{\text{benign}}=0.825$, and $P_{\text{malignant}}=0.868$).

Table 2

Performances of CT, MRI, and EUS in the diagnosis of pelvic masses with or without bowel involvement.

	Overall					Benign					Malignant				
	Accuracy	Sensitivity	Specificity	PPV	NPV	Accuracy	Sensitivity	Specificity	PPV	NPV	Accuracy	Sensitivity	Specificity	PPV	NPV
EUS	87.0%	83.3%	97.8%	99.1%	66.2%	83.6%	79.0%	97.1%	98.8%	60.7%	97.7%	97.0%	100.0%	100.0%	91.7%
MRI	53.3%	44.9%	78.3%	86.1%	32.1%	55.0%	46.7%	80.0%	87.5%	33.3%	47.7%	39.4%	72.7%	81.3%	28.6%
CT	59.3%	53.8%	73.3%	84%	37.9%	56.9%	50.0%	75.0%	83.9%	36.6%	63.9%	61.5%	70.0%	84.2%	41.2%

CT, computed tomography; EUS, endoscopic ultrasound; NPV, negative predictive value; PPV, positive predictive value.

Table 3

Univariate analysis regarding the diagnostic performance of EUS.

	EUS is consistent with pathological diagnosis	EUS is inconsistent with pathological diagnosis	*P*
Pathology			0.015[a]
Benign	117	23	
Malignant	43	1	
Lesion diameter (cm)			0.445[b]
$>0, \le 2$	27	2	
$>2, \le 5$	47	7	
>5	14	3	
Infiltration layer			0.32[b]
Surface layer (serosa layer + intrinsic muscle layer)	55	5	
Deep layer (mucosal layer + submucosal layer + full layer)	21	0	
Location			0.493[b]
Rectum	97	20	
Sigmoid colon	23	3	
Upper colon	9	0	
Number of lesions			0.011[a]
1	82	11	
>1	28	12	

[a] $\chi 2$ test.
[b] Fisher exact test.
EUS, endoscopic ultrasound.

Factors affecting the selection of surgical methods

For pelvic masses with clear intestinal infiltration, surgical options include lesion removal or intestinal resection. In our univariate analysis, there was a statistically significant difference in the pathological style (benign and malignant) between the lesion removal group and the intestinal resection group ($P<0.05$). The difference in lesion diameter between the two groups was also statistically significant ($P=0.005$). Furthermore, the difference in tumor infiltration levels (the surface layer - serosa + muscularis propria layer and the deep layer - submucosa + muscularis mucosa + full layer) between the two groups was statistically significant ($P=0.041$). No significant difference was noted between the two groups with regard to the location of the lesion in the rectum, sigmoid colon, or upper colon ($P=0.274$). Difference with regard to single or multiple lesions was also not statistically significant ($P=0.415$) (Table 4).

In the multivariate analysis of the surgical methods, pathological type, lesion length, and lesion infiltration level were included. Logistic regression indicated significant differences only between pathological benign and malignant types, with an odds ratio (OR) of 9.61 (95% CI: 1.27–72.70, $P=0.028$). However, there was a significant trend in the infiltration depth. Compared to the lesion removal group, the depth of lesion infiltration was increased in the intestinal resection group (OR = 7.16, 95% CI: 0.77–66.23, $P=0.083$) (Table 5).

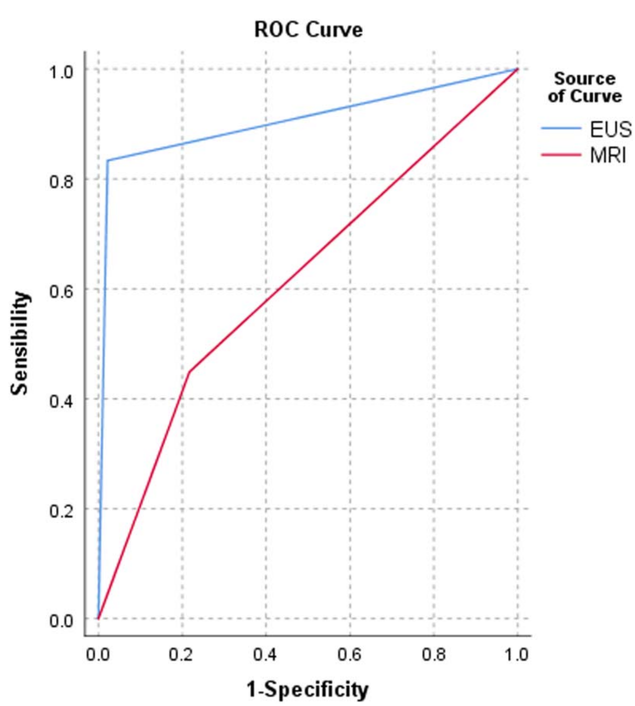

Figure 2. Receiver operating characteristic curve regarding the diagnostic performances of EUS and MRI. EUS, endoscopic ultrasound.

Discussion

This study confirmed the significant role of EUS in predicting intestinal infiltration by benign and malignant pelvic masses before surgery, and compared its diagnostic ability with that of other imaging methods. We found that the sensitivity and specificity of EUS for detecting intestinal infiltration were 83.3 and 97.8%, respectively, consistent with the results of previous studies[9–12]. We believe our results were satisfactory because intestinal infiltration by pelvic masses is usually difficult to accurately determine before surgery using common imaging methods, even MRI, which has recently been widely used as a

Table 4

Univariate analysis regarding the surgical methods.

	Lesion removal	Intestinal resection	*P*
Pathology			<0.05[a]
Benign	53	18	
Malignant	5	19	
Lesion length			
$>0, \le 2$	30	5	0.005[a]
$>2, \le 5$	28	24	
>5	10	9	
Infiltration layer			0.041[a]
Surface layer (serosa layer + intrinsic muscle layer)	32	16	
Deep layer (mucosal layer + submucosal layer + full layer)	7	11	
Location			0.274[b]
Rectum	77	40	
Sigmoid colon	10	9	
Upper colon	4	5	
Number of lesions			0.415[b]
1	58	28	
>1	24	16	

[a] $\chi 2$ test.
[b] Fisher exact test.

Table 5

Logistic regression regarding the significant variables after multiple imputations for missing data.

	OR (95% CI)	*P*
Pathology	9.606 (1.27–72.71)	0.028
Lesion length	7.160 (0.77–66.23)	0.083
Infiltration layer	4.532 (0.67–30.82)	0.122

All other data generated and analyzed during the current study are available from the corresponding authors on reasonable request.
OR, odds ratio.

first-line diagnostic tool[13–15]. In this study, the sensitivity and specificity of MRI diagnosis were lower than those reported in previous studies, possibly because previously, intestinal infiltration was defined as the infiltration of pelvic masses into the muscular layer and below. This study confirmed intestinal infiltration if adhesion was observed between the lesion and intestine[16,17]. The PPV of EUS for the intestinal infiltration of pelvic tumors was 99.1%, and that for the intestinal infiltration of malignant tumors was as high as 100%. This indicates that EUS prediction of the presence of intestinal infiltration before surgery is highly accurate, and surgeons can make better decisions based on this.

In this study, the diagnostic ability of EUS for benign and malignant pelvic masses was stronger than that of MRI. For all pelvic masses in this study, the Kappa value was 0.164, indicating poor consistency between EUS and MRI with regard to their diagnostic abilities. For benign lesions, the kappa value was 0.286, indicating a significant difference in the diagnostic abilities. For malignant lesions, although there was a difference in the diagnostic ability between EUS and MRI ($P = 0.042$), the kappa value was –0.273, indicating a weak inconsistency between the two, which may be related to the relatively small number of malignant cases. Future research should further validate this conclusion by including more patients with malignant pelvic masses.

The factors that affect the accuracy of EUS diagnosis include pathological type and number of lesions ($P = 0.015$, $P = 0.011$); however, we could not conduct a multivariate analysis of the factors that affect the accuracy of EUS diagnosis, as there were no cases in which EUS was inconsistent with pathological examinations.

The diagnostic ability of EUS for pelvic masses infiltrating different intestinal levels was higher than that of MRI; however, there was no statistical difference between the two. MRI was more accurate in diagnosing lesions with larger diameters. With EUS, the diagnostic accuracy for lesions with diameters greater than 5 cm decreases, possibly owing to the inability of EUS probes to access a complete range and hierarchy of lesions during exploration or due to the location of lesions being too far from the probe.

Other EUS-related technologies, such as EUS-elastography (EUS-E) and fine-needle aspiration/biopsy (EUS-FNA/B), are also used to diagnose intestinal infiltration of pelvic masses[18–21]. EUS-FNA is often used to evaluate lesions that cannot be detected using other imaging techniques and has achieved good results. Similarly, EUS-E can distinguish fibrous tissues from benign and malignant lesions based on changes in tissue hardness caused by certain diseases, such as cancer. However, these techniques are mostly reported in case reports, are only applied in limited diagnostic and treatment centers, and are not routinely used for preoperative examinations. In contrast, EUS is a common and easy examination method. In previous studies on the diagnosis of deep invasive endometriosis, EUS showed better sensitivity and NPV than MRI. This suggests that MRI cannot detect certain EUS-detectable nodules[22,23]. This is consistent with our results. Therefore, EUS is more valuable for the preoperative evaluation of the intestinal infiltration of pelvic masses. However, EUS remains a third-line method of examination in most diagnostic and treatment centers, and its priority needs to be reassessed.

The main factors affecting the decision on surgical methods used in this study were the benign and malignant pathologies. Although the results were not statistically significant, the infiltration depth tended to predict a preference for intestinal resection. Further investigation in more patients should be conducted to confirm these findings. The depth of infiltration may be another independent predictor of intestinal resection.

The strengths of our study are, first, this is the first study to evaluate the accuracy of EUS in detecting the intestinal infiltration of benign and malignant pelvic tumors. Previous studies mostly focused on benign diseases, such as endometriosis, while this study has expanded the scope to include malignant diseases. Second, this was a retrospective-prospective study with a relatively large sample size, which reduced some bias compared to previous retrospective studies with small sample sizes. However, this study also has certain limitations. For some patients with possible changes in the size of pelvic masses, the time between EUS and surgery ranged from 1 to 309 days (mean, 13.2 days), which was relatively long. Moreover, this study comprised relatively few malignant cases; future multicenter studies should be conducted to validate our results.

Conclusion

This study confirmed that EUS is a reliable and noninvasive technique for diagnosing intestinal infiltration in benign and malignant pelvic diseases. Despite the limitations of our study, we believe EUS should be widely used in the preparation process for gynecological surgery. This technique helps gynecologists formulate preoperative surgical plans; in addition, it helps patients gain an informed understanding of different treatment methods and reduces the incidence of intraoperative emergencies. Given the excellent diagnostic value of EUS, it should be widely used in large diagnostic and treatment centers in conjunction with other imaging examinations as a first-line method of examination, for the preoperative assessment of intestinal infiltration of pelvic masses.

Ethical approval

Ethical approval for this study (2022PS941K) was provided by the Ethical Committee of Shengjing Hospital of China Medical University, Shenyang, China on 5 September 2022.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Sources of funding

This work was supported by the National Natural Science Foundation of China (Grant No. 82070683).

Author contribution

Y.S.: data curation, formal analysis, investigation, methodology, and writing – original draft; S.S.: investigation and methodology; N.G.: data curation, formal analysis, investigation, methodology, and writing – review and editing.

Conflicts of interest disclosure

Nan Ge ,Yumo She, and Siyu Sun have no conflicts of interest to disclose.

Research registration unique identifying number (UIN)

Chinese Clinical Trial Registry chictr.org.cn ChiCTR2200066579.

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Data availability statement

Data sharing is not applicable to this article.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Acknowledgements

The authors thank all the participants in this study. The authors are also grateful to the hospital staff who provided perspective and advice during the preparation of this manuscript.

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