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Diagnostic Accuracy of the Kissing Ovaries Sign on Transvaginal Ultrasound for Prediction of Bowel Endometriosis in Women with Surgically Confirmed Endometriosis

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Abstract

Background: Endometriosis is a common gynecological disorder. Non-invasive imaging markers that predict disease severity and bowel involvement are clinically valuable. The purpose of the current study was to evaluate the diagnostic performance of the kissing ovaries (KO) sign on transvaginal ultrasound for predicting bowel endometriosis and advanced disease.

Methods: This retrospective diagnostic accuracy study included 252 women with surgically and histopathologically confirmed endometriosis who underwent laparoscopic surgery at Avicenna Fertility Center between 2019 and 2021. Preoperative transvaginal ultrasound findings were reviewed, and the presence of the KO sign was assessed. Associations with bowel endometriosis and disease severity were analyzed. Diagnostic performance metrics, chi-square and independent t-tests, ORs with 95% CIs, and multivariable logistic regression were used to evaluate predictors of bowel endometriosis. The $p<0.05$ was considered statistically significant.

Results: The KO sign was significantly associated with advanced-stage disease (stage IV: 88.1% *vs*. 22.2%) and bowel involvement (61.1% *vs*. 12.7%; OR=10.3, 95%CI: 5.47–19.4). It also showed significant associations with pouch of Douglas obliteration, uterosacral ligament involvement, and fallopian tube involvement. No significant association was observed for bladder or appendiceal involvement. The KO sign demonstrated a sensitivity of 82.8%, specificity of 69.2%, and accuracy of 74.2% for predicting bowel endometriosis. In multivariable analysis, it remained an independent predictor of bowel involvement (adjusted OR=8.45, 95%CI: 4.62–15.48). The area under the ROC curve was 0.76.

Conclusion: The KO sign on transvaginal ultrasound is a useful non-invasive imaging marker for predicting bowel endometriosis and advanced-stage disease, with good diagnostic performance and potential value in preoperative surgical planning.

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Introduction

Endometriosis is a chronic benign inflammatory disease in women, defined by the presence of endometrial-like tissue outside the uterine cavity (1). Its prevalence among women of reproductive age is estimated to be 6–10%, and it is considered one of the most common causes of

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chronic pelvic pain, dyspareunia, and infertility (1). Endometriotic lesions vary widely in severity and anatomical distribution and may present as small peritoneal implants, large ovarian cysts (endometriomas), or extensive adhesions involving pelvic organs such as the bowel, bladder, and uterus (1). This heterogeneity in clinical and anatomical presentation makes the diagnosis and management of endometriosis particularly challenging.

Laparoscopy is considered the gold standard for definitive diagnosis and staging of disease severity (2). However, the lack of noninvasive tools capable of accurately predicting the extent, severity, and location of lesions, particularly in the absence of obvious endometriomas, significantly limits preoperative assessment (3).

One of the key imaging findings in endometriosis is the kissing ovaries (KO) sign, in which the ovaries are pulled toward the midline due to pelvic adhesions and come into close contact or adhere to each other in the pouch of Douglas (4, 5). This sign can be detected on transvaginal ultrasound, magnetic resonance imaging (MRI), and computed tomography (CT) scan and is most commonly observed in severe pelvic endometriosis and deep infiltrating endometriosis (DIE) (3). The presence of this sign is often associated with more extensive pelvic disease, including involvement of the bowel, fallopian tubes, uterosacral ligaments, and obliteration of the pouch of Douglas (3). However, its ability to accurately predict bowel involvement and disease severity has not been fully established.

Bowel endometriosis, as a severe form of DIE, can lead to significant complications such as rectal pain, painful defecation, and intestinal obstruction (6). Early detection of bowel involvement is crucial for optimal surgical planning and for reducing complications related to inadequate treatment (7). Previous studies have shown that transvaginal ultrasound is a useful first-line imaging modality with high accuracy for detecting endometriomas and some pelvic lesions (8). However, its diagnostic performance for bowel and other deep lesions depends on factors such as operator experience and equipment quality (3). In this context, the KO sign may represent a valuable noninvasive marker for predicting bowel involvement and disease severity.

The purpose of the current study was to evaluate the association between the KO sign on preoperative ultrasound and the presence of bowel endometriosis at laparoscopy. In addition, the sensitivity and specificity of this sign for predicting bowel involvement and the anatomical distribution of lesions in affected patients were assessed. The findings of this study may contribute to improved surgical planning, appropriate treatment selection, and reduction of healthcare costs and complications related to inadequate management. Considering the recurrent nature of endometriosis and the high cost of treatment in specialized centers (9), identifying accurate noninvasive predictive markers of disease severity represents an important step toward improving clinical management.

Methods

This retrospective diagnostic accuracy study was conducted at Pelvic Pain, Endometriosis, and Advanced Laparoscopy Clinic of Avicenna Fertility Center affiliated to Avicenna Research Institute (ARI), Tehran, Iran, between 2019 and 2021. The study population included women aged 18–45 years with surgically and histopathologically confirmed endometriosis who underwent laparoscopic surgery during the study period. Patients were categorized based on the presence or absence of the KO sign on preoperative transvaginal ultrasound (126 patients with the KO sign and 126 without).

Eligible patients were identified through medical record review. Inclusion criteria were age 18–45 years, laparoscopic and histopathological confirmation of endometriosis, and availability of preoperative transvaginal ultrasound data. Exclusion criteria included menopause, prior uterine or ovarian surgery, gynecologic, gastrointestinal, or genitourinary malignancy, and incomplete records.

The sample size was calculated based on the findings reported by Ghezzi et al. (3), assuming a significance level of $\alpha=0.05$ and a statistical power of 80%, resulting in a minimum required sample of 252 participants. All eligible participants were included, resulting in a final sample of 252 individuals.

All patients underwent standardized preoperative transvaginal ultrasonography performed by experienced radiologists according to institutional protocols. The KO sign was defined as the presence of bilateral ovaries adherent in the pouch of Douglas, posterior to the uterus, and non-separable by probe manipulation. Ultrasonographic variables included adenomyosis, endometriomas, bowel endometriotic nodules, and KO sign.

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All laparoscopic procedures were performed according to institutional and international guidelines. Intraoperative findings, including lesion location and extent, were recorded. Disease severity was classified using the revised American Society for Reproductive Medicine (rASRM) staging system. Bowel endometriosis was defined as superficial or deep infiltrating endometriosis lesions involving the bowel wall, confirmed intraoperatively and/or histopathologically. Additional pelvic involvement, including bladder, ureters, fallopian tubes, uterosacral ligaments, appendix, and pouch of Douglas, was documented and confirmed by pathology. Data were collected using a standardized checklist covering demographic, imaging, operative, and pathological variables. The primary objective was to evaluate the diagnostic performance of the KO sign for bowel endometriosis. Secondary objectives included assessment of disease severity and pelvic disease distribution.

Statistical analysis: Statistical analyses were performed using SPSS version 21 (IBM Corp., USA). Continuous variables were expressed as mean±standard deviation (SD) and compared using the independent-samples t-test. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test or Fisher's exact test.

Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to assess the association between the KO sign and bowel endometriosis, as well as other indicators of severe disease. Multivariable logistic regression analysis was performed to determine whether the KO sign was independently associated with bowel endometriosis after adjustment for potential confounders, including age, body mass index (BMI), adenomyosis, and bilateral endometrioma. Diagnostic performance measures, including sensitivity, specificity, positive predictive value, negative predictive value, likelihood ratios, and accuracy, were also calculated. A two-sided $p<0.05$ was considered statistically significant.

The study protocol was approved by the Ethics Committee of Avicenna Research Institute (IR.ACECR.AVICENNA.REC.1400.007). All participants provided informed consent for the use of their medical records for research purposes. Patient confidentiality and data anonymity were maintained throughout the study.

Results

A total of 252 women with surgically confirmed endometriosis were included in the study. The participants were categorized into KO-positive (n=126) and KO-negative (n=126) groups. The mean age was comparable between the groups (36.51±6.60 years versus 36.59±5.91 years; p= 0.920). However, the mean BMI was significantly lower in the KO-positive group (23.11± 3.15 versus 24.04±3.27; p=0.022) (Table 1).

Ultrasonographic findings are summarized in table 2. Adenomyosis was more frequent in the KO-positive group (84.1% versus 71.4%; p=0.032). Endometriomas were significantly more prevalent in both ovaries among KO-positive patients (right ovary: 65.1% versus 30.1%; left ovary: 66.7% versus 36.5%; both p<0.001). Bowel endometriotic nodules were detected more frequently on ultrasound in the KO-positive group (46.0% versus 27.0%; p=0.002) (Table 2).

Intraoperative findings are presented in table 3. Stage IV endometriosis was more prevalent in the KO-positive group (88.1% versus 22.2%; p< 0.001). Bowel involvement demonstrated the strongest association with the KO sign (61.1% *vs.* 12.7%; OR=10.3; p<0.001). KO-positive patients also exhibited significantly higher rates of pelvic involvement, including obliteration of the pouch of Douglas (63.5% *vs.* 31.7%; OR=3.73; p< 0.001), uterosacral ligament nodules (65.9% *vs.* 24.6%; OR=5.65; p<0.001), fallopian tube involvement (90.2% *vs.* 64.9%; OR=5.21; p<0.001), and bilateral endometriomas (43.6% *vs.* 22.4%; OR=2.73; p<0.001). No significant differences were observed for bladder involvement (4.8% *vs.* 4.0%; p=0.415) or appendiceal involvement (28.6% *vs.* 25.4%; p= 0.747) (Table 3).

The diagnostic performance of the KO sign for predicting bowel endometriosis is shown in table 4. The KO sign demonstrated a sensitivity of 82.8% (95%CI: 73.6–89.8), specificity of 69.2%

Table 1. Comparison of age and BMI between KO-positive and KO-negative groups

Variables	Group	Mean ± SD	p-value
Age			
	Case	36.51±6.60	0.920
	Control	36.59±5.91	
BMI			
	Case	23.11±3.15	0.022
	Control	24.04±3.27	

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Table 2. Ultrasonographic findings between KO-positive and KO-negative groups

Variables	Case	Control	p-value
Uterus (TVS)			
Adenomyosis	106 (84.1)	90 (71.4)	
Myoma	7 (5.6)	8 (6.3)	0.032
Normal	13 (10.3)	28 (22.2)	
Right ovary (TVS)			
Absent	0	2 (1.6)	
Endometrioma + adherent	80 (63.5)	26 (20.6)	
Endometrioma, free	2 (1.6)	12 (9.5)	0.001
No endometrioma, adherent	38 (30.2)	10 (7.9)	
Normal	6 (4.8)	72 (57.1)	
PCOS	0	4 (3.2)	
Left ovary (TVS)			
Absent	0	2 (1.6)	
Endometrioma + adherent	82 (65.1)	38 (30.2)	
Endometrioma, free	2 (1.6)	8 (6.3)	0.001
No endometrioma, adherent	38 (30.2)	8 (6.3)	
Normal	4 (3.2)	66 (52.4)	
PCOS	0	4 (3.2)	
Bowel endometriotic nodule (TVS)			
No	68 (54.0)	92 (73.0)	0.002
Yes	58 (46.0)	34 (27.0)	

Table 3. Intraoperative surgical findings in KO-positive and KO-negative groups

Variables		Case group (n=126)	Control group (n=126)	p-value	OR (95% CI)
Pouch of Douglas obliterated	Yes	80 (63.5%)	40 (31.7%)	<0.001	3.73 (2.24–6.21)
	No	46 (36.5%)	86 (68.3%)	-	Reference
Fallopian tube involvement	Yes	110 (90.2%)	74 (64.9%)	<0.001	5.21 (2.79–9.74)
	No	12 (9.8%)	40 (35.1%)	-	Reference
Uterosacral ligament nodule	Yes	83 (65.9%)	31 (24.6%)	<0.001	5.65 (3.19–10.02)
	No	43 (34.1%)	95 (75.4%)	-	Reference
Bowel involvement	Yes	77 (61.1%)	16 (12.7%)	<0.001	10.3 (5.47–19.4)
	No	49 (38.9%)	110 (87.3%)	-	Reference
Endometrioma	Bilateral	55 (43.6%)	28 (22.4%)	<0.001	2.73 (1.56–4.78)
	Unilateral	46 (36.5%)	49 (38.8%)	NS	Reference
	None	25 (19.8%)	49 (38.9%)	NS	Reference
Stage of disease (ASRM)	Stage III	15 (11.9%)	47 (37.3%)	<0.001	Reference
	Stage IV	111 (88.1%)	28 (22.2%)	-	20.2 (10.7–38.1)
Ureteral involvement†	Yes	9/42 (21.4%)	1/24 (4.2%)	0.058	6.29 (0.74–53.3)
	No	33/42 (78.6%)	23/24 (95.8%)	-	Reference
Bladder involvement	Yes	6 (4.8%)	5 (4.0%)	0.415	1.20 (0.35–4.12)
	No	120 (95.2%)	121 (96.0%)	-	Reference
Appendiceal involvement†	Yes	36 (28.6%)	32 (25.4%)	0.747	1.18 (0.70–1.99)
	No	90 (71.4%)	94 (74.6%)	-	Reference

(95%CI: 61.4–76.3), positive predictive value of 36.9% (95%CI: 30.9–43.2), negative predictive value of 87.3% (95%CI: 81.3–91.6), and overall accuracy of 74.2% (95%CI: 68.3–79.5) (Table 4).

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Table 4. Diagnostic performance of the KO sign for predicting bowel involvement

Metrics	Value (%)	95% confidence interval
Sensitivity	82.8	73.6–89.8
Specificity	69.2	61.4–76.3
Positive predictive value (PPV)	36.9	30.9–43.2
Negative predictive value (NPV)	87.3	81.3–91.6
Positive likelihood ratio	2.69	2.09–3.45
Negative likelihood ratio	0.25	0.16–0.39
Accuracy	74.2	68.3–79.5

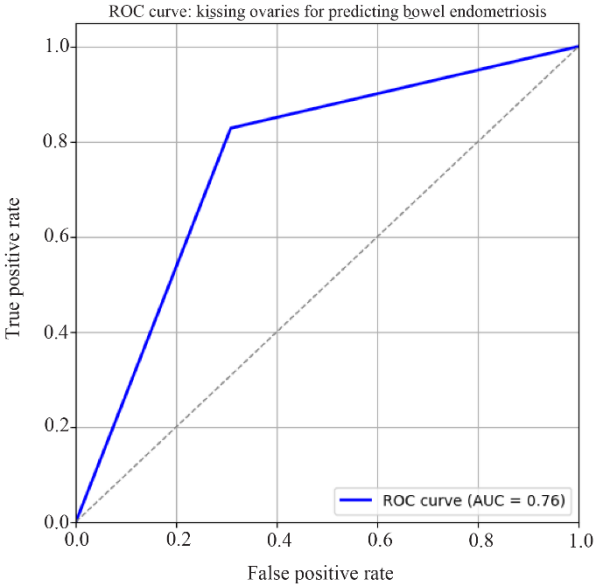

Figure 1. ROC curve demonstrating the diagnostic performance of the KO sign in detecting bowel endometriosis

The discriminatory ability of the KO sign was evaluated using a ROC curve. The area under the curve (AUC) was 0.76, indicating good differentiation between patients with and without bowel involvement. At the optimal cutoff, sensitivity was 82.8% and specificity was 69.2% (Figure 1).

Discussion

The present study demonstrates that the ultrasonographic finding of KO is strongly associated with the presence of endometriosis and, in particular, represents a marker of severe disease. The rate of bowel involvement in patients with KO was significantly higher compared with other women with endometriosis. It is likely that inflammatory processes associated with pelvic inflammation contribute to the development and progression of KO.

Although the exact etiology of endometriosis remains unclear, most researchers agree that the persistence and progression of ectopic endometrial tissue are closely related to a localized inflammatory process within the pelvis (10, 11). It has been shown that women with endometriosis have higher concentrations of pro-inflammatory cytokines in the peritoneal fluid compared with women without the disease (12–14).

Peritoneal fluid accumulates in dependent pelvic areas, particularly the pouch of Douglas (15), and inflammation induced by endometriosis leads to adhesions between adjacent peritoneal surfaces and organs (16), resulting in displacement of the ovaries toward the midline and the cul-de-sac. Previous studies (17–19) evaluating the predictive ability of ultrasound in identifying women with endometriosis have demonstrated optimal concordance between ultrasonographic findings and intraoperative diagnosis mainly in cases of ovarian endometriomas.

Our findings are consistent with those of Exacoustos et al. (20) and Ghezzi et al. (3), who reported a high correlation between ultrasound and surgical findings. In particular, these studies reported an 82% agreement between ultrasound and intraoperative assessment in cases of severe endometriosis.

Our results are also in agreement with Williams et al. (7), who showed that the presence of KO on MRI is independently associated with severe disease, regardless of the presence of endometriomas. Furthermore, our findings are consistent with Guerriero et al. (21), who evaluated the role of soft markers on ultrasound (such as the sliding sign and KO) in predicting rectosigmoid involvement and reported a sensitivity of 75% and a specificity of 82% for rectosigmoid endometriosis in patients with KO.

Based on our findings, when KO is identified on ultrasound, surgeons should anticipate distorted pelvic anatomy and obliterated tissue planes. This observation has important clinical value for preoperative counseling and surgical planning, as it may reduce the likelihood of unexpected intraoperative findings and insufficient primary surgery for moderate or severe endometriosis. Redwine and Wright (22) reported that in cases of complete obliteration of the cul-de-sac, extensive laparoscopic surgery, including bowel resection, is often required. Therefore, informing patients preoperatively about the possible need for bowel

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surgery to achieve complete excision of endometriosis is essential.

Another observation of this study is that the preoperative diagnosis of KO may be a marker of poor reproductive prognosis. Although the proportion of patients with tubal involvement and KO was high in our study, caution is warranted due to the limited sample size. Nevertheless, the presence of KO is highly suggestive of severe fallopian tube involvement, characterized by dense adhesions and impaired tubal function. In addition, infertile patients with KO are more likely to have advanced-stage endometriosis, which is itself associated with lower pregnancy rates. Several studies suggest that the peritoneal microenvironment in severe endometriosis may negatively affect ovarian response, fertilization, implantation, and even outcomes of assisted reproductive technologies (23, 24).

This study has several limitations. First, its retrospective design may introduce selection and information bias. Second, the study was conducted in a single tertiary referral center, which may limit the generalizability of the findings to other populations. Third, although the sample size was adequate for primary analysis, subgroup analyses (*e.g.*, ureteral involvement) were limited by relatively small numbers, resulting in wide confidence intervals. Finally, interobserver variability in ultrasonographic assessment of the KO sign was not evaluated, which may affect reproducibility in different clinical settings.

Conclusion

The presence of KO on ultrasonography is a reliable indicator of severe pelvic endometriosis, which can compromise menstrual function, sexual activity, quality of life, and fertility. Preoperative identification of KO should be considered a critical marker for referral to specialized endometriosis centers, facilitating optimal surgical management that balances radical excision, fertility preservation, and recurrence risk.

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Conflict of Interest

The authors declare no competing interests.

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