

Diagnostic Accuracy of Transvaginal Ultrasonography for Diagnosis of Ovarian Endometriosis Taking Laparoscopy as Gold Standard

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Abstract

Objective: The goal of this study was to assess the diagnostic accuracy of TVS in the diagnosis of ovarian endometriosis by taking laparoscopic findings as the gold standard.

Methodology: It was a cross sectional study conducted in Radiology Department of Sir Ganga Ram Hospital, Lahore from June 2017 to December 2018. One hundred and twenty five females fulfilling inclusion criteria were referred to Radiology Department from Gynaecology OPD and were enrolled in the study after taking informed consent. Demographic data and the duration of symptoms were recorded and the patients were undergone TVS scan using endovaginal probe having frequency 6 MHz by the researcher. Patients were labeled as positive or negative as per their findings. Then patients underwent laparoscopy by a single senior gynecologist. Reports were assessed and patients were confirmed as positive or negative for ovarian endometriosis. Data was analyzed by SPSS 20. A 2x2 contingency table was generated to calculate sensitivity, specificity, PPV, NPV and accuracy.

Results: The mean age of the patients was illustrated to be 37.4 ± 2.67 years of which the minimum age was 25 years and maximum of 37 years. Out of 125 women who underwent preoperative TVS the diagnosis of ovarian endometriosis was positive in 99 (79.2%) and observed negative in 26 (20.8%) on TVS. However; at laparoscopy 106 (84.8%) women had evidence of ovarian endometriosis and 19 (15.2%) were detected negative. The accuracy, sensitivity, specificity, positive predictive value and negative predictive value TVS was established to be 91.2%, 91.5%, 89.5%, 98%, and 65.4%, respectively by taking laparoscopy as gold standard among patients presenting with the symptoms of pain, secondary dysmenorrhea or infertility

Conclusion: Our study results has shown that the TVS had better sensitivity and specificity in the diagnosis of endometriosis which is a cheap and accessible diagnostic tool and can be recommended in daily clinical practice

Keywords: Transvaginal Ultrasonography (TVS), Laparoscopy, Ovarian Endometriosis, diagnostic accuracy

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Introduction

The presence of normal endometrial tissue outside the endometrial cavity defines endometriosis. This ectopic endometrial tissue remains functional and responds to normal cyclic hormones, resulting in bleeding, inflammation and subsequent adhesion formation in its locality.¹ Only a handful of studies have assessed the ability of ultrasound examination to detect the presence of pelvic adhesions in women with pelvic endometriosis and their severity.² Ovarian cysts were labelled as endometriomas if they appeared as well circumscribed thick walled cysts containing homogenous low level

internal echoes ("ground glass").³One study reported the frequency of ovarian endometriosis was 58.5% females.⁴

Trans-vaginal ultrasound (TVS) is an accurate non-invasive test for presurgical detection of deep infiltrating endometriosis.⁵ One study has reported that the sensitivity, specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV) and diagnostic accuracy of TVS in diagnosing endometriosis were 85.3%, 80.7%, 84.1%, 82.1% and 83.2%, respectively.⁶ One more study showed that the sensitivity, specificity,

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NPV and PPV of TVS in diagnosing endometriosis were 84%, 95.6%, 81.8% and 96.2%, respectively.⁷ But one study showed that TVS had sensitivity, specificity, and accuracy of 98%, 100%, and 99%, respectively.¹

However still, surgery, either open or laparoscopic, is the gold standard for ovarian endometriosis.⁸ Rationale of our study was to determine the diagnostic accuracy of TVS for diagnosis of ovarian endometriosis taking laparoscopy as gold standard in females. Laparoscopy is an expensive procedure and is not readily available in all set-ups and because of this, the burden of patients on radiologists as well as on hospital for laparoscopy is high. Instead of that, TVS is a cheap and easily accessible diagnostic tool for prediction of endometriosis. Through literature, it has been noticed that TVS is a useful diagnostic tool and can replace laparoscopy for diagnosis of endometriosis. But the previous studies contained controversies regarding its accuracy. Moreover, there is hardly any local evidence available in this regard. Conducting this study in a local setting would greatly improve our local guidelines and practice to implement the use of TVS scan as an initial imaging modality to detect endometriosis.

Methodology

It was a cross sectional study, conducted in Department of Radiology, Sir Ganga Ram Hospital, Lahore from June 2017 to December 2018. One hundred and twenty five females of age 20-45 years, presenting with pain in the lower abdomen or pelvis, secondary dysmenorrhea or infertility for at least 6-months duration (whether primary or secondary infertility) were enrolled after taking informed consent. Dysmenorrhea was defined as the pain caused by disorder in woman's reproductive organs such as endometriosis, pain begins earlier in the menstrual cycle and lasts longer than common menstrual cramps and is not accompanied by nausea and vomiting. Females with diagnosis of malignancy or ovarian tumor (on medical record), active bleeding (on history) or with medical record of hysterectomy were excluded. Demographic data (including name, age, parity, duration of symptoms) was also be recorded. Then patients had undergone TVS scan by using TOSHIBA Aplio 50 with endovaginal probe having frequency 6 MHz. Patients were labeled as positive or negative (as per operational definition). All TVS scans had done by researcher herself. Then patients had undergone laparoscopy by a single senior gynecologist having at least 4 year's residency experience. Reports were assessed and patients were confirmed as positive

or negative (as per operational definition). A specially designed proforma was used for collecting all the information.

The collected data was entered and analyzed through SPSS version 20. Quantitative data like age and duration of symptoms were presented in the form of mean and Standard Deviation (SD). Qualitative data like parity and endometriosis (on TVS and laparoscopy) was presented as a function of frequency and percentage. 2x2 table was generated to calculate sensitivity, specificity, PPV, NPV and diagnostic accuracy of TVS taking laparoscopy as gold standard. Data was stratified for age, parity (secondary infertility) and duration of symptoms. Post-stratification, 2x2 tables was generated to calculate sensitivity, specificity, PPV, NPV and diagnostic accuracy of TVS taking laparoscopy as gold standard for each stratum.

Results

There were total 125 patients who underwent transvaginal scan for various symptoms and were enrolled in this study after taking an informed consent. The mean age of these patients was (31.47 ± 2.67) years of which the minimum age was 25 year and maximum of 37 years. Female patients who presented with the symptoms of pain in lower abdomen, secondary amenorrhea or infertility (either primary or secondary), the mean duration of symptoms among these females was calculated to be (17.72 ± 9.95) months with minimum of 0 month and maximum of 36 months duration. A total of 90 females (72%) were found in primary infertility group whereas in the secondary infertility maximum had parity 1 i.e. 27 (21.6%) followed by parity 2 (4.0%) and 3 women were conceived in their history but had 0 parity shared (2.4%) burden of the total percentage. The minimum parity was noted as 0 and the maximum was 2. All the patients undergone transvaginal ultrasonography for the diagnosis of ovarian endometriosis and revealed positive by TVS in 99 (79.2%) patients and it was diagnosed negative in 26 (20.8%) patients. Correspondingly, taking Laparoscopy results as the gold standard the positive cases demonstrated with ovarian endometriosis were 106 (84.8%) and negative diagnosis was perceived in 19 (15.2%) females. (Table I)

The true positive cases were verified 97 and the true negative cases were confirmed 17 on both diagnostic modalities, whereas 2 false positive cases on TVS were professed and 9 cases were declared false negative. A contingency table was generated to calculate the

sensitivity of transvaginal ultrasound and reported to be 91.5% sensitivity, followed by specificity 89.5%, Positive predictive value (PPV) 98.0%, Negative predictive value 65.4% and accuracy 91.2% in the diagnosis of ovarian endometriosis. (Table II)

Table I: Descriptive Statistics for variables

		Mean+SD
Age (years)		31.47+2.67
Duration of symptoms		17.72+9.95
		N (%)
Parity	Primary	90 (72.0)
	Secondary	3 (2.4)
Infertility	Yes	27 (21.6)
	No	5 (4.0)
TVS	Positive	99 (79.2)
	Negative	26 (20.8)
Laparoscopy findings	Positive	106 (84.8)
	Negative	19 (15.2)

Data was stratified for the age groups it was noticed that

Table II: Contingency table for Transvaginal Sonography with Laparoscopy for detecting Endometriosis diagnosis

Diagnosis of Endometriosis on TVS	Laparoscopic Diagnosis		
	Positive	Negative	Total
Positive	97	2	99
Negative	9	17	26
Total	106	19	125

Sensitivity: 91.5%, Specificity: 89.5%, PPV:98.0%, NPV:65.4%, Diagnostic Accuracy:91.2%

maximum number of patients present with the various symptoms of endometriosis belongs to age group (20-34) years i.e. 106/125 (84.8%), followed by the age group (34-45) years 19 (15.2%). But on comparison it was noticed that TVS was more sensitive for age (35-45) years as compared to (20-34) years i.e. (100.0% vs 90.0%), and more specific in age (20-34) years as compared to (35-45) years (93.8% vs 66.7%), PPV (98.8% vs 94.1%), NPV (62.5% vs 100.0%) respectively. And statistically significant difference was validating between both groups. (Table III)

Similarly stratification with respect to duration of symptoms; most of the patients presented in the hospital with the duration less than 12 months i.e. 71/125 (56.8%) but the sensitivity was higher and specificity of TVS was less in the patients with the duration of more than 12 months i.e. sensitivity (87.0% vs 96.5%), specificity (94.1% vs 50.0%), PPV (97.9% vs 98.0%), NPV (69.6% vs 33.3%) and the accuracy (88.7% vs 94.4%) respectively. The difference among the groups was found to be significant. (Table IV)

Table III: Stratification with respect to Age groups.

Age groups	TVS Diagnosis	Laparoscopy diagnosis		Total	P-value
		Positive	Negative		
(20-34) years	Positive	81	1	82	0.000
	Negative	9	15	24	
	Total	90	16	106	
(35-45) years	Positive	16	1	17	0.000
	Negative	0	2	2	
	Total	16	3	19	

(20-34) years :Sn 90%, Sp 93.8%, PPV 98.8%, NPV 62.5%, DA 90.6%
(35-45) years: Sn 100.0%, Sp 66.7%, PPV 94.1%, NPV 100.0%, DA 94.7%

Table IV: Stratification with respect to Duration of Symptoms groups

Duration of symptoms groups	TVS Diagnosis	Laparoscopy diagnosis		Total	P-value
		Positive	Negative		
< 12 months	Positive	47	1	48	0.000
	Negative	7	16	23	
	Total	54	17	71	
> 12 months	Positive	50	1	51	0.005
	Negative	2	1	3	
	Total	52	2	54	

< 12 months: Sn 87.0%,Sp 94.1%,PPV 97.9%, NPV 69.6%, DA 88.7%
> 12 months: Sn 96.2%,Sp 50.0%, PPV 98.0%, NPV 33.3%, DA 94.4%

Discussion

Endometriosis is a gynecological disorder primarily affecting women during their child-bearing age. Its early diagnosis is a major challenge as it can avoid unnecessary surgeries and improve quality of life with chances of improved fertility.⁸ In our study the cause of dyspareunia, dyschezia and infertility among the patients can be attributed to adhesions between the posterior uterine wall, cervix or vagina and the anterior wall of the recto sigmoid.⁹ Although an association between endometriosis and infertility has been found (prevalence about 30%), a causal relationship between them remains controversial, especially in minimal or mild endometriosis.¹⁰ Hence, the importance of early detection of endometriosis in infertility lies in opting suitable treatment modalities. Adequate assessment of patients with symptoms suggestive of endometriosis is of great importance. Clinical examination has low capability in the diagnosis because of patient's pain and hence non-cooperation, obesity and lesions that are inaccessible to touch. Therefore, imaging techniques are mandatory to establish a diagnosis.¹⁰

In present study the demographic characteristics of 125 patients were identified which reported that the mean age of the patients to be 31.47 years, which is similar to the study reported by Abrao MS et al i.e. 33.8±6.1 years with the range of 18-45 years.¹⁰ In accordance with it, the mean age of 33 years is reported in the study by Jermy et al¹¹; Said TH described the median age 29 years¹² and 37.4 median age was accounted by Diantika et al for the patients with ovarian endometriosis.¹³ Like our study the patients present with the complaints of pelvic pain, secondary dysmenorrhea and infertility similarly in Theodoridis et al study, the main presenting symptoms being pelvic pain (47.6%), dyspareunia (25.7%), dysmenorrhea (23.8%), and menstrual disorders; 41.9% of the patients were symptom free who presented for annual health evaluation.¹⁴ Likewise in Siad study the patients who booked for TVS and Laparoscopy present with the complaints were dysmenorrhea (76.8%), dyspareunia (58.4%), pelvic pain (28.8%) and infertility (29.6%).¹²

In our study the diagnosis of endometriosis was positive in 99 cases on TVS and on laparoscopy 106 and negative in 26 cases on TVS and 19 on Laparoscopy. The true positive and true negative cases were found to be 77.6% and 13.6% respectively. In present study the sensitivity, specificity, PPV, NPV and accuracy of TVS was established to be 91.5%, 89.5%, 98%, 65.4%, and 91.7% in the diagnosis of endometriosis by taking laparoscopy as gold standard. Abrao et al stated in his study that TVS had sensitivity of 98% in the case where lesions were affecting the recto sigmoid junction and 95% for the retrocervical disease, with specificity for the two sites of 100 and 98%, respectively. These results when compared with the study carried out by Bazot *et al.* (2003) may be justified by the protocol used for carrying out TVUS, in which the patient performed mechanical cleansing of the lower bowel one hour before the procedure using a rectal enema as it removes fecal content and therefore reduces the artifacts and blind areas in the image making this frequently affected region more visible. Additionally, this preparation also makes identification of the bowel layers affected by the lesions more clearly by providing an image similar to that obtained using TRUS.¹⁰

The sensitivity, specificity, PPV, NPV and diagnostic accuracy of TVS in diagnosing endometriosis were 85.3%, 80.7%, 84.1%, 82.1% and 83.2%, respectively. Diantika, reported that the diagnostic advantages of TVS in endometriosis are because of the ease of detection of small foci of the disease, the ability

of detection of multiple lesions and non-affected by bowel movement.¹² Chapron et al. concluded that multifocal endometriosis of the bowel occurred in 39.1% while it was isolated in 20.6% of patients. Also, TVS has been recognized because of its ability to detect peritoneal lesions that might be a manifestation of endometriosis in patients whose pelvis has been classified as normal during laparoscopy and the increased knowledge regarding the various sonographic aspects of endometriosis.¹⁵ Vaginal endometriosis is diagnosed as the thickening of posterior or a lateral vaginal fornix more than 5 mm, with or without internal anechoic rounded cystic areas. In a meta-analysis including 10 studies, the pooled sensitivity and specificity of TVS was 57% and 99%, respectively. Among the various TVS techniques, SVG provided the highest sensitivity and specificity reaching 91% and 89%, respectively.¹⁶

Ultrasound was proven moderately good in the detection of endometriosis (sensitivity 78%, specificity 88%) in the study reported by Theodoridis et al.¹³ One more study demonstrated by Holland TK, validates that TVS is an accurate diagnostic tool for the assessment of females with suspected pelvic endometriosis. There was a high level of agreement between TVS and laparoscopy in assessing the severity of the disease with accuracy of TVS up to 94% in diagnosing cases of moderate and severe pelvic endometriosis. However, the sensitivity of diagnosis in minimal and mild pelvic endometriosis was relatively low, probably owing to small size of lesions in these cases.¹⁷ Bazot et al.¹⁸ described a group of 83 females with surgically proven deep pelvic endometriosis and stated that the sensitivity was 78.5% and specificity was 95.2% in detecting endometriosis sonographically. Also, Hudelist et al.¹⁹ in a systematic review observed the diagnostic accuracy of TVS in deep pelvic endometriosis and reported sensitivity of 91% and specificity of 98%. The same was also established by others in cases of deep endometriosis.²⁰ The wide range of variations of specificities (50–85%) and sensitivities (44–89%) in these studies might be attributed to variations in the prevalence of the diseases, the variety of methods used in performing the scan and variations in definitions of deep endometriosis.²¹

Conclusion

In conclusion, our results demonstrated that TVS appears to be a useful imaging method for the prediction of endometriosis with the high sensitivity and specificity. However, good training, ideal protocols, skills and

passion are prerequisites for the sonographer carrying out the examination. This would reduce the number of laparoscopies carried out on patients presenting with different symptoms of endometriosis and resulting in shorter, safer and cost-effective managements.

References

1. Benacerraf BR, Groszmann Y. Sonography should be the first imaging examination done to evaluate patients with suspected endometriosis. *Journal of Ultrasound in Medicine* 2012;31(4):651-3.
2. Guerriero S, Ajossa S, Garau N, Alcazar JL, Mais V, Melis GB. Diagnosis of pelvic adhesions in patients with endometrioma: the role of transvaginal ultrasonography. *Fertility and sterility* 2010;94(2):742-6.
3. Van Holsbeke C, Van Calster B, Guerriero S, Savelli L, Paladini D, Lissoni A, et al. Endometriomas: their ultrasound characteristics. *Ultrasound in Obstetrics & Gynecology* 2010;35(6):730-40.
4. Bazot M, Thomassin I, Hourani R, Cortez A, Darai E. Diagnostic accuracy of transvaginal sonography for deep pelvic endometriosis. *Ultrasound in obstetrics & gynecology* 2004;24(2):180-5.
5. Guerriero S, Ajossa S, Minguez J, Jurado M, Mais V, Melis G, et al. Accuracy of transvaginal ultrasound for diagnosis of deep endometriosis in uterosacral ligaments, rectovaginal septum, vagina and bladder: systematic review and meta-analysis. *Ultrasound in Obstetrics & Gynecology* 2015;46(5):534-45.
6. Said TH, Azzam AZ. Prediction of endometriosis by transvaginal ultrasound in reproductive-age women with normal ovarian size. *Middle East Fertility Society Journal*. 2014;19(3):197-207.
7. Holland TK, Cutner A, Saridogan E, Mavrelou D, Pateman K, Jurkovic D. Ultrasound mapping of pelvic endometriosis: does the location and number of lesions affect the diagnostic accuracy? A multicentre diagnostic accuracy study. *BMC women's health*. 2013;13(1):1.
8. Darai E, Thomassin I, Barranger E, Detchev R, Cortez A, Houry S, et al. Feasibility and clinical outcome of laparoscopic colorectal resection for endometriosis. *Am J Obstet Gynecol*.2005; 192: 394-400.
9. Meuleman C, Beks N, D'Hoore A, Van Cleynenbreughe L, D'Hooghe T. High pregnancy rate, improved pain, quality of life/sexuality and low recurrence rate after multidisciplinary radical laparoscopic resection of deep and colorectal endometriosis. *Eur J Obstet Gynecol Reprod Biol*.2005; 123(1): S9.
10. Abrao MS, Goncalves MOC, Dias JA, Podgaec S, Chamie LP, Blashalg R. Comparison between clinical examination, transvaginal sonography and magnetic resonance imaging for the diagnosis of deep endometriosis. *Hum Reprod*.2007; 22: 3092-3097.
11. Jermy K, Luise C and Bourne T. The characterization of common ovarian cysts in premenopausal women. *Ultrasound. Obstet. Gynecol* 001; 17: 140-4.
12. Said TH, Azzam AZ. Prediction of endometriosis by transvaginal ultrasound in reproductive-age women with normal ovarian size. *Middle East Fertil Soci J*2014; 19(3): 197-207.
13. Diantika M and Gunardi ER. The accuracy of transvaginal sonography to detect endometriosis cyst. *J Phys*. 2017; Conf. Ser. 884 012148.
14. Theodoridis TD, Zepiridis L, Mikos T, Grimbizis GF, Dinas K, Athanasiadis A. Comparison of diagnostic accuracy of transvaginal ultrasound with laparoscopy in the management of patients with adnexal masses. *Arch Gynecol Obstet* 2009; 280(5): 767–773.
15. Chapron C, Fauconnier A, Vieira M, Barakat H, Dousset B, Pansini V. Anatomical distribution of deeply infiltrating endometriosis: surgical implications and proposition for a classification. *Hum Reprod* .2003; 18: 157-161.
16. Bazot M, and Darai E. Diagnosis of deep endometriosis: clinical examination, ultrasonography, magnetic resonance imaging, and other techniques. *Fert n Stert*. 2017; 108(6): 886-894.
17. Holland TK, Yazbek J, Cutner A, Saridogan E, Hoo WI And Jurkovic D. Value of transvaginal ultrasound in assessing severity of pelvic endometriosis. *Ultrasound Obstet Gynecol* 2010; 36: 241–248.
18. Bazot M, Thomassin I, Hourani R, Cortier A, Darai E. Diagnostic accuracy of transvaginal sonography for deep pelvic endometriosis. *Ultrasound Obstet Gynecol* (2004); 24:180-185.
19. Hudelist G, English J, Thomas AE, Tinelli A, Singer CF, Keckstein J. Diagnostic accuracy of transvaginal ultrasound for non-invasive diagnosis of bowel endometriosis: systematic review and meta-analysis. *Ultrasound Obstet Gynecol*. 2011; 37: 257-263.
20. G. Hudelist, KH. Oberwinkler, CF. Singer F. Tuttlies G. Rauter O. Riter J. Keckstein Combination of transvaginal sonography and clinical examination for preoperative diagnosis of pelvic endometriosis. *Hum Reprod*. 2009; 24:1018-1024.
21. Dinulescu DM, Ince TA, Quade BJ, et al. Role of K-ras and Pten in the development of mouse models of endometriosis and endometrioid ovarian cancer. *Nat Med*. 2005;11:63–70