Diagnostic Performance of Transvaginal Sonography Compared with Laparoscopy in Detecting Pelvic Pathologies among Subfertile Women

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ABSTRACT

Background: Subfertility affects a significant proportion of couples, with female pelvic pathologies, including polycystic ovaries, ovarian cysts, endometriosis, and peritubal adhesions, being major contributors. Transvaginal sonography (TVS) is widely used as a non-invasive diagnostic tool, while laparoscopy remains the gold standard. This study aimed to compare the diagnostic performance of TVS with laparoscopy in detecting pelvic pathologies among subfertile women. **Methods & Materials:** A cross-sectional analytical study was conducted on 66 subfertile women aged 18-45 years at BIRDEM General Hospital, Dhaka, from January 2023 to June 2024. Associations between TVS and laparoscopic findings were assessed using Fisher's exact test, with p-values <0.05 considered statistically significant. All analyses were performed using SPSS version 26. **Results:** The majority of participants were aged 26-35 years (75.8%), housewives (87.9%), and had primary subfertility (69.7%). Irregular menstrual cycles were common (60.6%), with 43.9% being overweight and 21.2% having thyroid disorders. Polycystic ovaries were the most frequently detected abnormality by both TVS (53.1%) and laparoscopy (56.1%). Ovarian cysts and endometriosis showed comparable detection rates, while peritubal adhesions were detected only by laparoscopy. TVS demonstrated high diagnostic performance for PCOS (sensitivity 94.6%, specificity 100%, accuracy 97%), endometriosis (sensitivity 72.7%, specificity 98.2%, accuracy 93.9%), and ovarian cysts (sensitivity 71.4%, specificity 96.2%, accuracy 90.9%). Sensitivity was low for peritubal adhesions (0%) and tubo-ovarian masses (40%). **Conclusion:** TVS is a reliable, non-invasive diagnostic tool for detecting polycystic ovaries, ovarian cysts, and endometriosis in subfertile women. Laparoscopy remains essential for diagnosing peritubal adhesions and subtle pelvic pathologies. TVS can serve as an initial screening modality, with laparoscopy reserved for confirmation or cases that are inconclusive.

Keywords: *Subfertility, Transvaginal Sonography, Endometriosis, Pelvic Adhesions*

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INTRODUCTION

The female reproductive system is an integral part of fertility, which includes the uterus, fallopian tubes, and ovaries, along with peritoneal structures [1,2]. The uterus is the site of implantation of the embryo, the fallopian tubes are involved in the trapping of the ovum, fertilisation, and then transport to the uterine cavity, and the ovaries secrete oocytes and hormones, which are vital for ovulation and preparing the endometrium [2,3]. Abnormalities in the structure and function, such as fibroids in the uterus, endometriosis, blockage in the fallopian tubes, or cysts in the ovaries, can impair fertilisation or implantation, and hence it is critical to evaluate them in subfertile women [4,5]. Infertility is a significant public health challenge worldwide, and it is estimated that 10 to 15 per cent of the world's population of reproductive age is affected by this problem [6,7]. In the Asian continent, especially in the South Asian region, subfertility is a major problem because of sociocultural as well as clinical reasons, and hence there is a significant requirement for the evaluation of structural causes of subfertility, such as tubal and uterine abnormalities [7,8]. In Bangladesh, studies done in the hospital setting revealed that structural pelvic abnormalities are common among subfertile women, thereby highlighting the importance of the need for efficient diagnostic tools for the evaluation of subfertile women [5,8]. Another imaging modality used in the initial evaluation of subfertile women is transvaginal sonography, which is non-invasive and readily available. Hasan et al. found that transvaginal sonography had high sensitivity and specificity in diagnosing polycystic ovaries, adenomyosis, and congenital uterine anomalies but had lower sensitivity in diagnosing hydrosalpinx and peritubal adhesions, which were better diagnosed using laparoscopy [9]. Transvaginal sonography is useful in the real-time examination of the uterus and ovaries, is cost-effective, and is safer than invasive techniques [10]. In contrast, diagnostic laparoscopy is the gold standard in the comprehensive evaluation, especially in the diagnosis of tubal occlusion, peritubal adhesions, and subtle endometriosis [4, 11]. Laparoscopy enables direct visualisation and simultaneous therapeutic intervention, but this invasive procedure requires anaesthesia. Previous studies have either concentrated on specific pathologies or compared TVS with other diagnostic modalities, such as hysterosalpingogram or hysteroscopy, rather than providing a general comparison between TVS and laparoscopy in various pelvic pathologies [12,13]. The comprehensive evaluation of TVS's diagnostic capabilities is important in order to take appropriate clinical decisions and avoid unnecessary invasive procedures. This study is unique as it compares transvaginal sonography with diagnostic laparoscopy in the detection of pelvic pathology among subfertile women. By establishing the correlation of the results of transvaginal sonography with those of diagnostic laparoscopy, this research will be able to identify the advantages of using transvaginal sonography. This study aims to evaluate the diagnostic performance of transvaginal sonography compared with laparoscopy in detecting pelvic pathology among subfertile women.

METHODS & MATERIALS

This cross-sectional analytical study was carried out over 18 months from January 2023 to June 2024 at the Department of Obstetrics and Gynaecology, BIRDEM General Hospital in Dhaka. The study population consisted of subfertile women aged 18-45 who attended the department

and were chosen purposefully based on availability and predetermined eligibility criteria. Women with primary or secondary subfertility were eligible, but couples who had not cohabitated for at least 12 months, those with confirmed male factor subfertility, and patients with absolute or relative contraindications to laparoscopy were excluded. A predesigned semi-structured questionnaire was used to collect information from 66 participants regarding their sociodemographic, gynaecological, and obstetric histories, followed by general and systemic examinations. Body mass index was computed by standard formulae, and menstrual cycle patterns were noted. Transvaginal sonography using a 7.5 MHz vaginal probe was done for all participants on day 9 of the menstrual cycle to assess uterine anatomy and adnexal structures for uterine anomalies, ovarian cysts, and features suggestive of polycystic ovaries. This was followed by diagnostic laparoscopy in the post-menstrual phase under general anaesthesia after standard pre-anaesthetic workup. Intraoperative assessment was done for the uterus, bilateral ovaries and fallopian tubes, pouch of Douglas, and ovarian fossae, with chromopertubation using methylene blue dye to diagnose tubal patency. Data collected was checked for completeness and consistency, then entered and analysed using SPSS version 26. Descriptive statistics were presented as frequencies, percentages, and mean ± standard deviation, and inferential analysis, including Fisher's exact test, was run to assess the correlation between transvaginal sonographic and laparoscopic findings; a p-value of less than 0.05 was considered significant.

RESULTS

Table I shows that most participants were aged 26–35 years (75.8%), with a mean age of 29.1 ± 3.9 years. The majority were housewives (87.9%) and had primary subfertility (69.7%). Irregular menstrual cycles were observed in 60.6%. Mean BMI was 24.7 ± 2.9, with 43.9% overweight. Thyroid disorder (21.2%) was the most common comorbidity.

Table I
Baseline Characteristics of the Study Population (*n* = 66).

Variable	Category	n (%)
Age group (years)	≤25	14 (21.2)
	26-35	50 (75.8)
	>35	2 (3)
	mean ± SD	29.1 ± 3.9
Educational qualification	Primary	1 (1.5)
	SSC	4 (6.1)
	HSC	37 (56.0)
	Graduate and above	24 (36.4)
Occupation	Housewife	58 (87.9)
	Working woman	8 (12.1)
Type of subfertility	Primary	46 (69.7)
	Secondary	20 (30.3)
Menstrual cycle	Regular	26 (39.4)
	Irregular	40 (60.6)
BMI category (kg/m²)	<25	37 (56.1)
	≥25	29 (43.9)
	mean ± SD	24.7 ± 2.9
Comorbidities	Diabetes mellitus	12 (18.2)
	Hypertension	5 (7.6)
	Thyroid disorder	14 (21.2)

Table II reveals that polycystic ovaries were the most common pathology, detected by TVS in 53.1% and by laparoscopy in 56.1% of women. Ovarian cysts (18.2% vs 15.2%) and endometriosis (13.6% vs 12.1%) showed comparable detection rates, while peritubal adhesions (4.5%) were identified only by laparoscopy.

Table II
Pelvic Pathologies Detected by TVS and Laparoscopy (*n* = 66).

Pelvic pathology	TVS n (%)	Laparoscopy n (%)
Normal findings	7 (10.6)	2 (3.1)
Endometriosis	9 (13.6)	8 (12.1)
Peritubal adhesion	0 (0.0)	3 (4.5)
Tubo-ovarian mass	3 (4.5)	2 (3)
Ovarian cyst	12 (18.2)	10 (15.2)
Polycystic ovaries	35 (53.1)	37 (56.1)

Table III demonstrates high confirmation rates of TVS findings by laparoscopy for PCOS (94.6%) and endometriosis (88.9%), followed by ovarian cysts (83.3%) and tubo-ovarian masses (66.7%). TVS failed to detect peritubal adhesions. Statistically significant associations between TVS and laparoscopic findings were observed for all pathologies except peritubal adhesions (p = 1.00).

Table III
Cross-tabulation of TVS versus Laparoscopy Findings by Pathology (*n* = 66).

Pathology	TVS positive confirmed by laparoscopy n (%)	TVS false positive n (%)	p-value*
Endometriosis	8/9 (88.9)	1/9 (11.1)	<0.0001
Peritubal adhesion	0/3 (0.0)	0 (0)	1.00
Tubo-ovarian mass	2/3 (66.7)	1/3 (33.3)	<0.0001
Ovarian cyst	10/12 (83.3)	2/12 (16.7)	<0.0001
PCOS	35/37 (94.6)	0/35 (0)	<0.0001

Table IV shows that TVS had good diagnostic performance for endometriosis, with a sensitivity of 72.7%, specificity 98.2%, and overall accuracy 93.9%. In contrast, TVS failed to detect peritubal adhesions (0% sensitivity), although specificity was 100%, and overall accuracy remained high at 96%.

Table IV
Diagnostic Accuracy of TVS for Endometriosis and Peritubal Adhesion (*n* = 66).

Diagnostic parameter	Endometriosis n (%)	Peritubal adhesion n (%)
Sensitivity	8/11 (72.7)	0/3 (0)
Specificity	54/55 (98.2)	63/63 (100)
Positive predictive value	8/9 (88.9)	-
Negative predictive value	54/57 (94.7)	63/66 (96)
Accuracy	62/66 (93.9)	63/66 (96)

Table V shows that TVS had low sensitivity for detecting tubo-ovarian masses (40%) but very high specificity (98.4%) and accuracy (93.9%). For ovarian cysts, TVS demonstrated better sensitivity (71.4%), high specificity (96.2%), and good overall accuracy (90.9%).

Table V
Diagnostic Accuracy of TVS for Adnexal Masses (*n* = 66).

Diagnostic parameter	Tubo-ovarian mass n (%)	Ovarian cyst n (%)
Sensitivity	2/5 (40)	10/14 (71.4)
Specificity	60/61 (98.4)	50/52 (96.2)
Positive predictive value	2/3 (66.7)	10/12 (83.3)
Negative predictive value	60/63 (95.2)	50/54 (92.6)
Accuracy	62/66 (93.9)	60/66 (90.9)

Table VI presents excellent diagnostic performance of TVS for polycystic ovarian syndrome, with high sensitivity (94.6%), perfect specificity (100%), positive predictive value (100%), negative predictive value (93.5%), and overall accuracy of 97%.

Table VI
Diagnostic Accuracy of TVS for Polycystic Ovarian Syndrome (*n* = 66).

Diagnostic parameter	n (%)
Sensitivity	35/37 (94.6)
Specificity	29/29 (100)
Positive predictive value	35/35 (100)
Negative predictive value	29/31 (93.5)
Accuracy	64/66 (97)

DISCUSSION

This study evaluated the efficacy of transvaginal sonography (TVS) compared with laparoscopy in the detection of pelvic pathology in sub-fertile women, and also outlined the demographic and clinical profiles of the patients. It was observed that most women were in the age group of 26-35 years (75.8%), with a mean age and SD of 29.1 ± 3.9 years. This pattern follows the findings that the late reproductive period, when the fertility potential becomes known, was the most frequent time for seeking investigation for fertility problems [14]. Approximately 69.7% had primary sub-fertility, which makes it consistent with the findings in the rest of the world that have documented primary infertility to be the most frequent problem faced by women [15]. In the present study, the majority of the subjects showed irregular menstrual cycles (60.6%), thus emphasizing that ovulatory malfunction is a leading cause of subfertility. However, similar correlations have been shown between irregular menstrual cycles and infertility in previous epidemiological surveys [16]. In our study, the mean BMI observed was 24.7 kg/m². Moreover, the study has the highest percentage (43.9%) recorded for overweight according to their BMI. These observations correlate with the fact that increased BMI has a negative impact on the reproductive processes and that ovulatory disorders are commonly observed among the subjects suffering from increased BMI [17]. In this study with impaired thyroid status (the highest observed percentage: 21.2%), thyroid abnormalities have already been known to be commonly associated with impaired fertility due to their negative impact on ovulation and implantation [18]. With respect to pelvic pathology detection, it was found that in the case of abnormal findings, such as "polycystic ovaries," TVS (53.1%) and laparoscopy (56.1%) nearly agreed. Thus, it may be concluded that TVS for pelvic pathology detection is very effective. The diagnostic accuracy of TVS for "polycystic ovarian syndrome" was found to be very good, as assessed by results

such as sensitivity (94.6%), specificity (100%), and accuracy (97%), compared to the previously established ultrasound diagnostic accuracy of over 90% [19, 20]. In this study, ovarian cysts were identified in 18.2% of cases using TVS and 15.2% of cases using laparoscopy. The parameters of TVS for diagnosing ovarian cysts showed high sensitivity at 71.4% and high specificity at 96.2% for ovarian cyst identification. This is similar to past findings, which showed TVS had high specificity for diagnosing benign ovarian cystic conditions. The findings had sensitivities ranging from 70% to 80% [21]. The high positive predictive value of TVS (83.3%) for diagnosing ovarian cysts is further positive evidence for its use. Endometriosis was diagnosed in 13.6% of patients by TVS and 12.1% by laparoscopy. The study also revealed that TVS had 72.7% sensitivity, 98.2% specificity, and 93.9% accuracy for diagnosing endometriosis. These results are consistent with previously published figures showing that TVS had moderate sensitivity and high specificity for diagnosing ovarian endometriomas and other pelvic endometrioses [7,22]. The high specificity indicates that ultrasound findings were probably accurate. Peritubal adhesions were diagnosed exclusively by laparoscopy in 4.5% of cases, with TVS demonstrating 0% sensitivity but 100% specificity to detect the condition. This reflects one of the significant limitations of TVS, as adhesive and peritoneal disease cannot be reliably detected by ultrasound. This has been a similar conclusion from other reports comparing imaging modalities against laparoscopy for tubal pathology assessment [23,24]. Normal pelvic findings were also reported more frequently on TVS, 10.6% versus 3.1% on laparoscopy, reflecting that occult pelvic pathology may be evident on laparoscopy that is not apparent on non-invasive imaging [10]. In tubo-ovarian masses, TVS showed a low sensitivity of 40% but high specificity of 98.4%, with a total accuracy of 93.9%. These findings agree with a number of reports suggesting that, although TVS is very specific in adnexal masses, sensitivity may be poor for complex inflammatory lesions [25]. The negative predictive value was high at 95.2%, suggesting that, in most instances, a negative finding on TVS would reliably exclude significant tubo-ovarian pathology. In general, the outcome of the present investigation lends credence to the efficacy and non-invasive nature of the procedure for assessing the pathology, PCOS, and the majority of the cases of endometriosis associated with ovarian pathology in the subgroup of the population suffering from subfertility. The role of the laparoscope still cannot be circumvented for the detection and diagnosis of peritubal adhesions and minor pelvic abnormalities.

LIMITATIONS

This study was limited to a small sample size, single-center study design, which might affect the generalizability. TVS operator dependency and inability to blind the examiners during the study might affect the accuracy.

CONCLUSION

Transvaginal sonography resulted in high diagnostic accuracy regarding common pelvic pathologies, especially polycystic ovaries, ovarian cysts, and endometriosis, in subfertile women. Although TVS is a good and non-invasive first-line diagnostic modality, laparoscopy is still a must for peritubal adhesions and subtle pelvic abnormalities. Both techniques are complementary for better assessment of pelvic pathology in subfertility.

RECOMMENDATIONS

Future studies might focus on larger, multicenter studies to validate the diagnostic accuracy of tvs across diverse populations. Comparative studies incorporating advanced imaging modalities, such as 3D ultrasound or MRI, alongside laparoscopy, could improve the detection of subtle pelvic pathologies.

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