Original Article

Evaluation of Role of Transabdominal and Transvaginal Ultrasound in Diagnosis of Female Genital Tuberculosis

Jai Bhagwan Sharma, Ashok Khurana[1], Smriti Hari[2], Urvashi Singh[3], RituYadav[4], Sona Dharmendra[5]

Professor, Department of obstetrics and Gynaecology, AIIMS, [1]Consultant Radiology and Ultrasonologist, [2]Professor, Department of Radiodiagnosis, AIIMS, [3]Professor, Department of Microbiology, AIIMS, [4]Senior Resident, Department of Obstetrics and Gynaecology, AIIMS, [5]PhD Scholar, Department of obstetrics and Gynaecology, AIIMS, New Delhi, India

Abstract

Background: Female genital tuberculosis (FGTB) is a common problem in developing countries causing significant morbidity, especially infertility. Radiological imaging, especially ultrasound, can help in diagnosis of FGTB with tubo-ovarian masses. **Aims:** The present study was performed to evaluate the role of ultrasound in diagnosis of FGTB and to see various findings of FGTB on ultrasound. **Study Setting and Design:** It was a prospective cross-sectional study over 4-year period between August 2015 and August 2019 in a tertiary referral center. **Subjects and Methods:** One hundred and seventy-five patients of infertility diagnosed to have FGTB on composite reference standard (CRS) of positive acid-fast bacilli on microscopy or culture of endometrial biopsy, positive polymerase chain reaction, positive GeneXpert, epithelioid granuloma on histology of endometrial biopsy, or definite or probable finding of FGTB on laparoscopy were subjected to transvaginal ultrasound by an experienced sonographer for various findings of FGTB. **Statistical Analysis:** Data analysis was carried out using STATA software 12.0. Comparison of categorical values was tested using Chi-square Fisher's exact test, with $P < 0.05$ being taken as significant. **Results:** Mean age, body mass index, parity, and duration of infertility were 28.9 years, 22.9 kg/m^2, 0.26, and 6.06 years, respectively. Menstrual dysfunction was common (44%). Diagnosis of FGTB was made by CRS. Ultrasound was normal in 112 (64%) cases and was abnormal in 63 (36%) cases. Various ultrasound findings were ovarian cyst (23.42%), tubo-ovarian masses (15.42%), unilateral or bilateral hydrosalpinx (13.71%), pyosalpinx (0.57%), adhesion (1.14%), adnexal fixity (6.28%), thin endometrium (24.57%), endometrial fluid (12.57%), endometrial calcification (1.7%), endometrial synechiae (4.57%), cornual synechiae (2.28%), impaired endometrial vascularity (21.71%), ascites (6.85%), and peritoneal or omental thickening (1.75%). **Conclusion:** Carefully performed ultrasound is a useful modality in diagnosis of FGTB, especially in adnexal masses.

Keywords: *Composite reference standard, female genital tuberculosis, tubo-ovarian masses, ultrasound diagnosis*

Introduction

Tuberculosis (TB) remains a major health problem globally with major burden in Africa and Asia.[1,2] Female genital tuberculosis (FGTB) is a type of extrapulmonary TB and a leading cause of infertility all over the world but especially in India accounting for about 10% cases of infertility.[3-5] FGTB may be

Received: 14-08-2021 **Revised:** 27-08-2021
Accepted: 09-09-2021 **Published:** 28-09-2021

Access this article online

Quick Response Code:

Website: www.jhrsonline.org

DOI: 10.4103/jhrs.jhrs_161_20

Address for correspondence: Dr. Jai Bhagwan Sharma, Department of Obstetrics and Gynaecology, All India Institute of Medical Sciences, Ansari Nagar, New Delhi - 110 029, India. E-mail: jbsharma2000@gmail.com

How to cite this article: Sharma JB, Khurana A, Hari S, Singh U, Yadav R, Dharmendra S. Evaluation of role of transabdominal and transvaginal ultrasound in diagnosis of female genital tuberculosis. J Hum Reprod Sci 2021;14:250-9.

asymptomatic in early stages but later causes menstrual disorders, especially oligomenorrhea and amenorrhea through its effect on endometrial atrophy and synechia formation (Asherman's syndrome), dysmenorrhea, abdominal or pelvic pain, and tubo-ovarian masses and infertility. It can cause infertility through tubal blockage, endometrial atrophy, synechia formation, and poor ovarian reserve.[3-7] It can also cause ascites and omental thickening and may resemble carcinoma ovary and may necessitate an unnecessary surgery.[8] Although gold standard in diagnosis of FGTB is detection of acid-fast bacilli on microscopy or culture of endometrial samplings or biopsy, they are positive in small percentage of cases and thus diagnosis is often missed.[9,10] Similarly, cartridge-based nucleic acid amplification test also called GeneXpert though highly specific has low sensitivity and may miss the diagnosis.[11] Epithelioid granuloma on histopathology is diagnostic but is positive in small percentage of cases.[3-5] Polymerase chain reaction (PCR) though highly sensitive has high false-positive rate so not recommended to start the treatment.[4,12] Diagnostic laparoscopy and hysteroscopy are useful diagnostic modalities to detect FGTB by demonstrating definite findings of TB such as beaded tubes, caseous nodules, and tubercles or probable findings of TB such as hydrosalpinx, pyosalpinx, abdominal and perihepatic adhesions, convoluted and hyperemic tubes, tubo-ovarian masses, and encysted ascites.[13,14] Radiological methods such as hysterosalpingography, ultrasound, computed tomography (CT) scan, magnetic resonance imaging (MRI), and positron emission tomography (PET) scan are more useful in TB tubo-ovarian masses.[15-17] Ultrasound, especially three dimensional (3D) and four dimensional, is an economical and useful modality in diagnosis of FGTB, particularly in tubo-ovarian masses, and can detect hydrosalpinx which appears as tubal dilatation with septa due to tubal mucosal thickening resembling cogwheel appearance.[18] Ultrasound also detects endometrial disease as thin, diffuse endometrial images with irregular borders accompanied by fluid accumulation in endometrial cavity.[19,20] We present the study on 175 cases of FGTB diagnosed on composite reference standard (CRS) (combination of various tests and laparoscopy) and role of ultrasound to detect tubal, ovarian, and endometrial diseases.

Subjects and Methods

Study design

It was a prospective observational study conducted in a tertiary referral center on 175 cases of FGTB in infertile patients from August 2015 to August 2019. Ethical approval was taken from the Institute Ethical Committee Ref. No: IEC/NP/-92/13.03.2015, RP-07/2015. The study was carried out in compliance with the ethical principles of the Declaration of Helsinki (Brazil, 2013), International Council on Harmonization Good Clinical Practice Guidelines (E6, 1996), and Ethical Guidelines for Biomedical Research on Human Participants (ICMR 2006). Written informed consent was taken from all the patients.

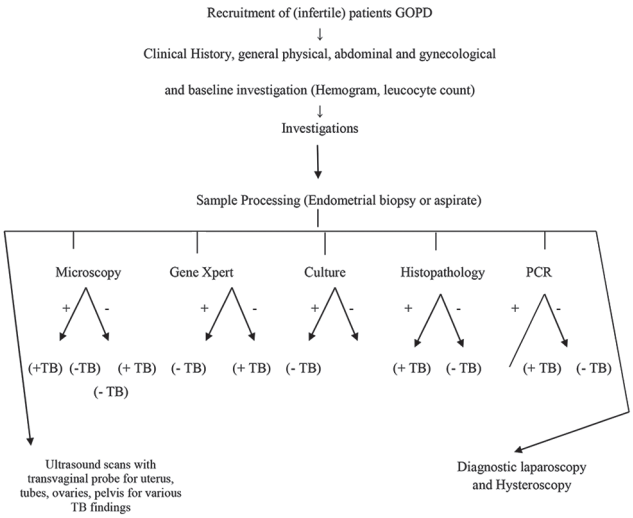
Study population

The methodology is shown in Flowchart 1.

Women with infertility attending the gynecological outpatient department of a tertiary referral center and found to have female genital TB on CRS were included. Patients with other causes of infertility, comorbidities, and malignancies and those not willing to participate were excluded from the study. Detailed history taking including menstrual history, present family history of TB, or antitubercular therapy was taken from all patients. General physical, abdominal, speculum, and bimanual examinations were performed in all the cases. Baseline investigations were done in all cases including total leukocyte count, hemoglobin, erythrocyte sedimentation rate (ESR), and Mantoux test.

Intervention

Premenstrual endometrial biopsy or aspirate was taken from all the participants from day 21 to 24 using no. 4 Karman's cannula. The sample was sent for acid-fast bacilli (AFB) microscopy, culture, PCR, GeneXpert, and for histopathology to detect epithelioid granuloma. Diagnostic laparoscopy with or without hysteroscopy was also performed in all cases for tubal patency as part of infertility and for diagnosis of FGTB. Positive PCR was not taken for diagnosis of FGTB but for performing laparoscopy. On laparoscopy, various definite findings of TB such as beaded tubes, caseous nodules, and tubercles



Flowchart 1: Methodology

were seen carefully in pelvic and abdominal cavity or probable findings of FGTB such as hydrosalpinx, pyosalpinx, convoluted and hyperemic tubes, tubo-ovarian mass, peritubal, pelvic, abdominal, and perihepatic adhesion, loculated ascites, and shaggy areas (white areas) in pelvic and abdominal cavity. Diagnosis of FGTB was made by CRS for higher pickup of FGTB by combination of either positive AFB on microscopy or culture of endometrial aspirate or biopsy, positive GeneXpert, positive epithelioid granuloma, and definite or probable findings of FGTB on laparoscopy. Ultrasound using 9–13 MH_Z transvaginal probe with 3D images was used in all patients with transvaginal probe with 3D and was used on all patients, and uterus, tubes, ovaries, pelvis, and abdomen were carefully visualized by ultrasound (using both transabdominal and transvaginal probes) for any TB lesions such as uterine size, endometrial thickness, endometrial fluid, fluid in pouch of Douglas, fallopian tube for any hydrosalpinx, tubo-ovarian masses, ovarian cysts, ascites, pelvic and abdominal lymphadenopathy, and peritoneal and omental thickening and omental caking. All patients diagnosed to have FGTB were started antitubercular therapy free of cost using directly observed treatment short-course strategy using four drugs isoniazid, rifampicin, pyrazinamide, and ethambutol for 2 months (intensive phase) followed by three drugs for 4 months (HRE) (continuous phase). All patients were followed up regularly in outpatient department for any adverse effect of drugs and for compliance. Liver function tests were done where indicated.

Statistical analysis

Data analysis was carried out using STATA software v 12.0 (Data analysis was carried out using statistical package SPSS IBM version 25.0 (Armonk, NY, IBM corp.). Continuous variables were tested for normality assumption using Kolmogorov–Smirnov test. Descriptive statistics such as mean, standard deviation, and range values were carried for normally distributed data. Comparison of two groups' means was tested using Student's *t* independent test. Categorical data were presented as frequency and percentage values. Comparison of categorical values was tested using Chi-square Fisher's exact test. $P < 0.05$ was taken as statistically significant.

Results

It was a prospective study conducted over 175 cases of FGTB from August 2015 to August 2019 from a tertiary referral center, AIIMS, New Delhi diagnosed by CRS. The characteristics (clinical feature and baseline investigation with numbers and percentage) of patients are shown in Table 1.

The age ranged between 21 and 37 years with mean being 28.9 ± 4.7 years, body mass index ranged from 17.3 to 32.4 kg/m^2 with mean being 22.9 ± 3.7 kg/m^2, while the parity ranged from 0 to 3 with mean being 0.26 ± 0.12. There was history of TB contact in 67 (38.28%) cases while history of Bacillus Calmette–Guérin vaccination was obtained in 140 (80%) cases. All the patients had infertility with primary infertility in 130 (74.4%) cases and secondary infertility was seen in 45 (25.6%) cases. The duration of infertility ranged from 2 to 14 years with mean being 6.06 ± 2.8 years. Normal menstrual pattern was seen in 98 (56.0%) cases while abnormal menstruation was observed in 77 (44%) cases with heavy menstrual bleeding in 3 (1.74%), dysmenorrhea in 17 (9.71%), oligomenorrhea in 26 (14.85%), and hypomenorrhea in 27 (15.42%) cases and amenorrhea in 4 (2.28%) cases. Other symptoms were weight loss (16.57%), anorexia (17.14%), fever (13.14%), dyspareunia (5.14%), vaginal discharge (29.14%), abdominal or pelvic pain (18.85%), and abdominal or pelvic lump (18.85%). Pallor was seen in 22 (12.57%), lymphadenopathy in 7 (4.0%), abnormal vaginal discharge in 28%, and adnexal mass or tenderness in 18.85%. In baseline investigations, anemia (Hb <11 g/dl) was seen in 32 (18.28%) cases. The mean ESR was 32.10 ± 12.78 mm in the 1st h. The mean leukocyte count was 5725 ± 2787 per cubic mm. Infectious Mantoux test (>10 mm) was seen in 76 (43.42%) cases. X-ray chest showed old healed lesions of TB in 8 (4.57%) cases, while mediastinal lymphadenopathy was seen in 9 (5.14%) cases.

Various methods of diagnosis of FGTB including various tests and their number and percentages are shown in Table 2.

Endometrial biopsy showed positive AFB on microscopy/culture in 9(5.14%), positive PCR was seen in 147 (84%) cases, positive gene Xpert was seen in 31 (17.7%) cases while epithelioid granuloma on histopathology of endometrial biopsy was seen in 22 (12.57%) cases. Definite findings of TB on laparoscopy were seen in 77 (44%) cases while probable findings of FGTB were seen in 98 (56%) cases.

Various ultrasound (transabdominal or transvaginal) findings of FGTB including their numbers and percentage are shown in Table 3. The findings of FGTB on ultrasound are shown in Flowchart 2.

Ultrasound was normal in 112 (64%) cases. On routine ultrasound, abnormalities were detected in 33 (18.85%) cases but when detailed ultrasound by an experienced ultrasonologist with special interest in FGTB was performed, the abnormalities were

Table 1: Characteristic, clinical features and baseline investigations (*n*=175)

Characteristics	Number	Percentage
Age		
Range	21-37	
Mean±SD	28.9±4.7	
Body Mass Index		
Range	17.3-32.4	
Mean±SD	22.9±3.7	
Parity		
Range	0-3	
Mean±SD	0.26±0.12	
History of TB contact	67	38.28
History of BCG	140	80
Type of infertility		
Primary infertility	130	74.4
Secondary infertility	45	25.6
Duration of infertility		
Range	2-14	
Mean±SD	6.06±2.8	
Menstrual pattern		
Normal menstrual pattern	98	56
Menstrual dysfunction	77	44
i) Heavy periods	3	1.74
ii) Dysmenorrhoea	17	9.71
iii) Oligomenorrhoea	26	14.85
iv) Hypomenorrhoea	27	15.42
v) Amenorrhoea	4	2.28
Weight loss	29	16.57
Anorexia	30	17.14
Fever	23	13.14
Dyspareunia	9	5.14
Vaginal discharge	51	29.14
Abdominal or pelvic pain	33	18.85
Abdominal or pelvic lump	33	18.85
Pallor	22	12.57
Lymphadenopathy	7	4.0
Abnormal discharge on speculum examination	49	28
Adnexal mass or tenderness on bimanual examination	33	18.85
Investigation		
Hb <11gm/dl	32	18.28
ESR (mm/hr) Mean±SD	32.10±12.78	
Mean±SD leucocyte count (per cubic ml)	5725±2787	
Infectious Mantoux test (>10mm)	76	43.42
Old healed lesions	8	4.57
Mediastinal lymphadenopathy	9	5.14

Table 2: Diagnosis of FGTB (*n*=175)

Test	*n*	Percentage
AFB on microscopy or culture of endometrial biopsy	9	5.14
Positive PCR	147	84
Positive Gene expert	31	17.71
Epithelioid granuloma on histopathology	22	12.57
Definite finding of tuberculosis on laparoscopy	77	44
Probable finding of tuberculosis on laparoscopy	98	56

detected in 63 (36%) cases. Various abnormalities were bilateral ovarian cysts in 18 (10.28%) cases with simple cyst in 6 (3.42%) and complex cyst in 12 (6.85%) cases. Figure 1a-b shows transvaginal scan showing an enlarged ovary with solid and cystic areas and fluid levels in a case of FGTB. Left ovarian cyst was seen in 12 (6.85%) (simple in 2.85% and complex in 4%) cases while right ovarian cyst was seen in 11 (6.28%) (simple in 2.85% and complex

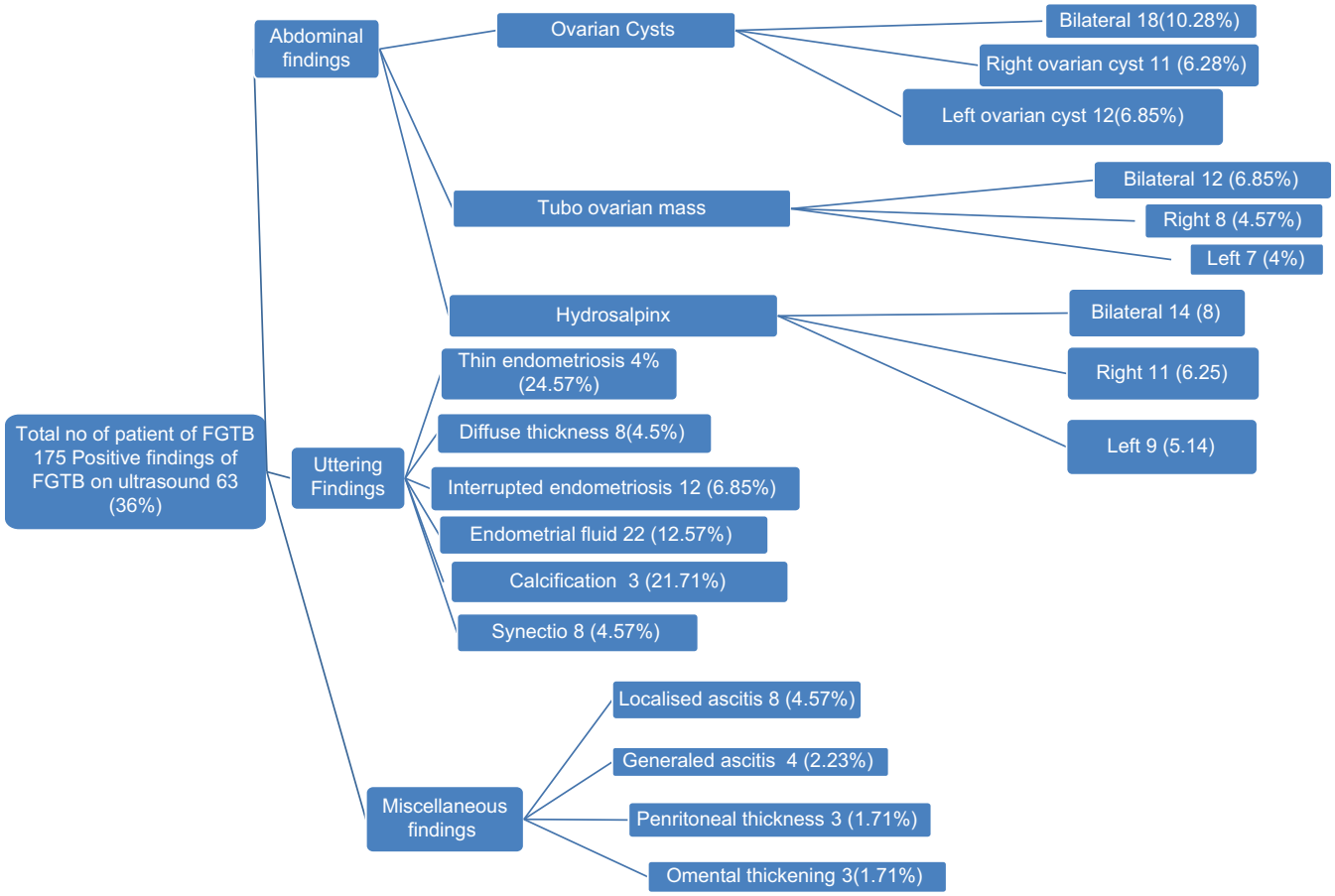
Table 3: Various ultrasound (trans-abdominal or trans-vaginal) finding in FGTB (*n*=175)

Ultrasound finding	Number	Percentage
Normal findings on routine ultrasound	112	64
Abnormal ultrasound finding	63	36
Adnexal findings (Tubes and ovaries)		
Bilateral ovarian cysts	18	10.28
Simple	6	3.42
Complex with septae	12	6.85
Left ovarian cyst	12	6.85
Simple	5	2.85
Complex	7	4
Right ovarian cyst	11	6.28
Simple	5	2.85
Complex	6	3.42
Bilateral tubo-ovarian mass	12	6.85
Simple	5	2.85
complex	7	4
Right tubo-ovarian mass	8	4.57
Simple	3	1.71
complex	5	2.85
Left tubo-ovarian mass	7	4
Simple	3	1.71
complex	4	2.28
Bilateral hydrosalpinx	14	8
Right sided hydrosalpinx	11	6.28
Left sided hydrosalpinx	9	5.14
Unilateral pyosalpinx	1	0.57
Bilateral pyosalpinx	0	0
Tubo-ovarian mass adherent posterior to uterus	2	1.14
Unilateral Tubo-ovarian abcess	1	0.57
Adnexal fixity		
unilateral	7	4
bilateral	4	2.28
Vertical course of interstitial extent of tube		
unilateral	5	2.85
bilateral	3	1.71
Uterine finding		
Normal uterus with normal endometrium and myometrium	112	64
Thin endometrium	43	24.57
Diffuse variable thickening	8	4.57
Interruption in endometrial extent	12	6.85
Endometrial fluid	22	12.57
Calcification in endometrium	3	1.71
Bands or synechiae in endometrium	8	4.57
Inhomogeneous endometrium	12	6.85
Cornual obliteration	7	4
T shaped cavity	12	6.85
Uterine extensive scars	6	3.42
Oligemic myometrial cyst	6	3.42
Sub endometrial calcification	2	1.14
Incidental fibroid uterus	7	4

Contd...

Table 3: Contd...

Ultrasound finding	Number	Percentage
Miscellaneous		
Loculated ascites with septation	8	4.57
Generalized ascites	4	2.28
Peritoneal thickening	3	1.71
Omental thickening	3	1.71



Flowchart 2: : Findings of FGTB on ultrasound

in 3.42%) cases; bilateral tubo-ovarian mass was seen in 12 (6.85%) (simple in 2.85% and complex in 4%) cases. Right tubo-ovarian mass was seen in 8 (4.57%) (simple in 1.71% and complex in 2.85%) cases while left tubo-ovarian mass was seen in 7 (4%) (simple in 1.71% and complex in 2.28%) cases. Figure 2 (A, B, C): TVS showing distended tube and vertical course of interstitial extent of tube in a case of FGTB. Bilateral hydrosalpinx with tubal dilatation with septa showing cog wheel appearance was seen in 14 (8%) cases while right sided hydrosalpinx was seen in 11 (6.28%) and left-sided hydrosalpinx was seen in 9 (5.14%) cases. Unilateral pyosalpinx was seen in only 1 (0.57%) case while mass adherent to the posterior surface of the uterus was seen in 2 (1.14%) cases and unilateral tubo-ovarian abscess was seen in 1 (0.57%) case. Unilateral adnexal fixity was seen in 7 (4%) while bilateral fixity was seen in 4 (2.28%) cases. Vertical course of interstitial extent of tube was seen on one side in 5 (2.85%) [Figure 3a-c] cases and on both sides in 3 (1.71%) cases. Various uterine findings on ultrasound were normal uterus with normal looking endometrium and myometrium in 112 (64%) cases, thin endometrium in 43 (24.57%) cases, interruption in endometrial extent in 12 (6.85%), ovarian Koch's with solid and cystic areas, endometrial fluid in 22 (12.57%) [Figure 4a-d], diffuse variable thickening of endometrium in 8 (4.57%), calcification in endometrium in 3 (1.71%), subendometrial calcification in 2 (1.14%), bands or synechiae in endometrium in 8 (4.57%), homogeneous endometrium in 12 (6.85%), cornual obliteration

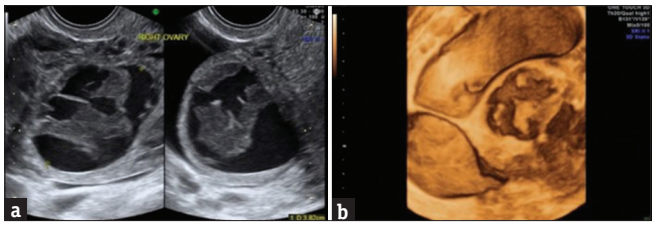


Figure 1: (a and b) Transvaginal ultrasound showing ovarian cyst with solid and cystic areas and fluid levels in a case of FGTB

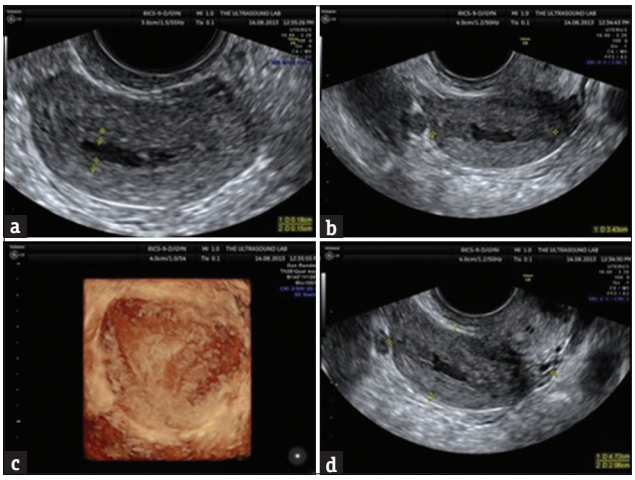


Figure 3: (a-d) Transvaginal ultrasound showing thin endometrium, free endometrial fluid and interruption in endometrial extent in case of FGTB

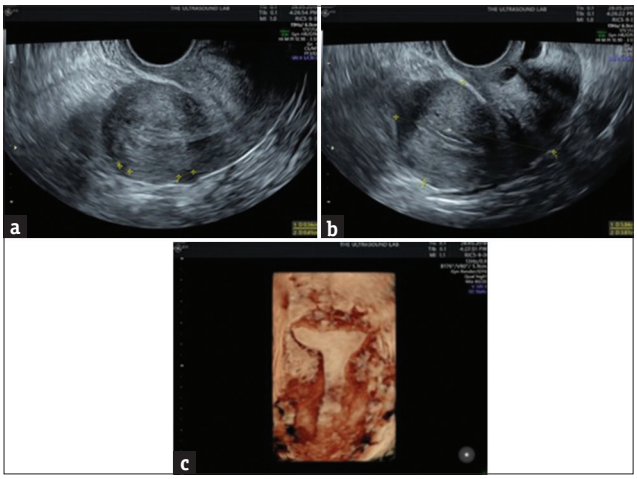


Figure 5: (a-c) TVS showing distorted "T" shaped uterine cavity in a case of FGTB

or amputation in 7 (4.1%) [Figure 5a-c], T-shaped uterine cavity in 12 (6.85) [Figure 6a-c], uterine extensive scars in 6 (3.42%), impaired endometrial vascularity in 38 (21.71%), and myometrial cyst in 6 (3.42%). Incidental fibroid was seen in 7 (4%) cases. Other miscellaneous findings were loculated ascites with septation in 8 (4.57%), generalized ascites in 4 (2.28%), peritoneal thickening in 3 (1.71%), and omental thickening in 3 (1.71%) cases. Many patients had more than one finding.

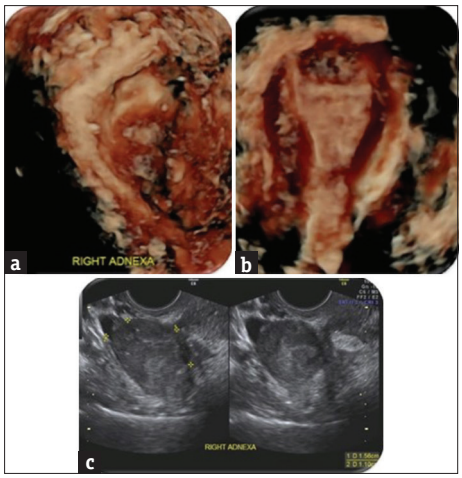


Figure 2: (a-c) Transvaginal ultrasound showing distended tube and vertical course of interstitial extent of tube in a case of FGTB

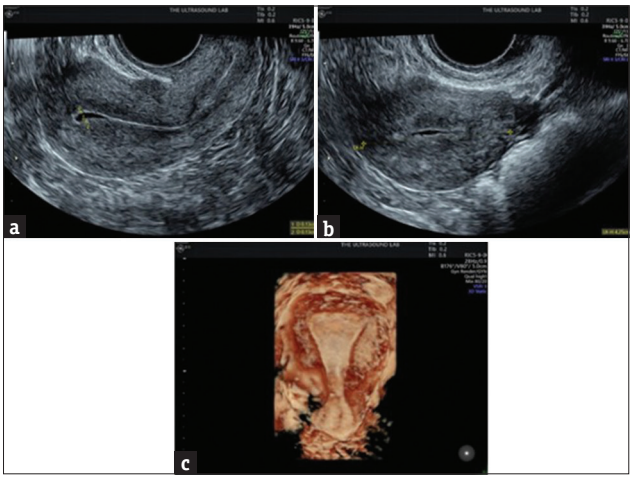


Figure 4: (a-c) TVS showing cornual obliteration (amputation) with endometrial synechiae in a case of FGTB

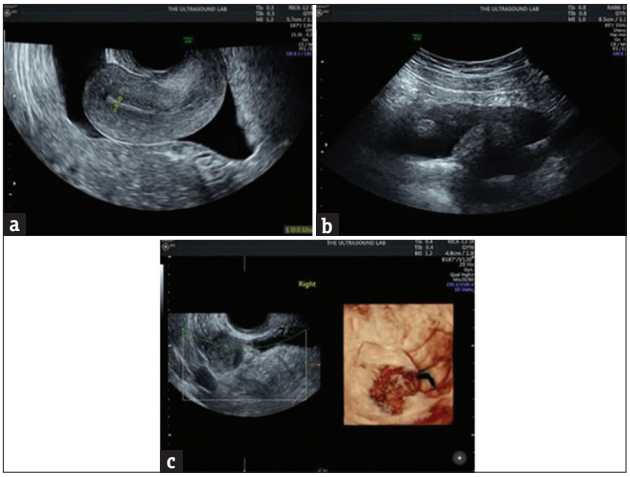


Figure 6: (a-c) Transvaginal ultrasound showing encysted ascites (loculated ascites) with thin septae in a case of FGTB

Discussion

FGTB remains an important cause of infertility in India and its diagnosis is often delayed due to its

paucibacillary nature.[3-6] FGTB causes infertility through its effect on fallopian tubes (tubal blockage), uterus (endometrial atrophy and Asherman's syndrome), and ovaries (decreased ovarian reserve).[4-7] The gold standard in diagnosis of FGTB are positive AFB culture, positive GeneXpert, or epithelioid granuloma on histology of endometrial biopsy, but these are positive in small percentages of cases.[9,10] PCR is highly sensitive but has high false-positive rate.[12] PCR, though highly sensitive, has high false positive rates. (12) Endoscopy (Laparoscopy & Hysteroscopy) are useful modalities in diagnosis of FGTB but are invasive, needing general anesthesia and expertise and may be associated with complications.[13,14] Radiological methods are especially useful in tubo-ovarian masses. Hysterosalpingography though useful in detecting uterine and tubal disease can sometimes flare up the disease and is avoided in active TB.[15] CT scan, MRI, and PET scan can better detect tubo-ovarian masses and help to differentiate between TB and ovarian cancer but are more expensive.[4,16,17] Ultrasound is economical as compared to CT scan and MRI and can pick up FGTB findings if performed by an experienced ultrasonologist with special interest and expertise in detecting subtle changes of FGTB. Three- and fourth-dimensional scans are even more useful in diagnosis subtle changes of FGTB.[18-20] Although ultrasound is more useful in abdominal tuberculous peritonitis where it can detect tuberculous ascites with incomplete septation, lattice type of ascites (fibrous band in ascitic fluid), loculated ascites, thickened band or adhesion, omental thickening, and peritoneal thickening, it can also be helpful in detection of simple and complex tubo-ovarian masses.[21] In pelvic TB, it can detect hydrosalpinx as tubal dilatation with septa due to tubal mucosal thickening resembling cogwheel appearance.[18] It can also detect unilateral or bilateral pyosalpinx.[22] Abdominopelvic TB can cause incompletely septated ascites, particulate ascites, loculated ascites, thickened peritoneum or omentum, adnexal masses, adhesions, tubo-ovarian abscess, or complexes.[23-25] Ultrasound, especially transvaginal scan, is particularly useful in detecting tubal disease (hydrosalpinx, pyosalpinx, and tubo-ovarian mass) and uterine disease (Asherman's syndrome and endometrial atrophy).[26,27] In the present study on 175 cases of FGTB detected on CRS (combination of AFB on microscopy of culture of endometrial biopsy, GeneXpert, epithelioid granuloma on histology of endometrial biopsy, and definite or probable finding of FGTB on laparoscopy), abnormal ultrasound was observed mainly in tuberculous tubo-ovarian masses. We observed abnormal ultrasound in 36% cases when scan was done by a consultant sonologist with special expertise and interest in FGTB as compared to only 18.85% when routine scan was done by residents. Various findings of FGTB were ovarian cyst (bilateral in 10.28%, left sided in 6.85%, and right sided in 6.28%), tubo-ovarian masses (bilateral in 6.85%, right sided in 4.57%, and left sided in 4%), hydrosalpinx (bilateral in 8%, right sided in 6.28%, and left sided in 5.14%), unilateral pyosalpinx (0.57%), adherent tubo-ovarian masses to uterus (1.14%), and tubo-ovarian abscess in (0.57%) cases with adnexal fixity (4% unilateral and 2.28% bilateral) and vertical course of interstitial extent of tube (unilateral in 2.85% and bilateral in 1.75%) cases. Various uterine findings were thin endometrium (24.57%), interruption in endometrial extent (6.85%), endometrial fluid (12.57%), calcification (1.75%), synechiae (4.57%), cornual obliteration or amputation (2.28%), and T-shaped distorted and shrunken uterine cavity and incidental fibroid (4%). We also found loculated ascites in 4.57% cases, peritoneal thickening in 1.75% case and omental thickening in 1.71% cases of FGTB. Our results are similar to ultrasound study conducted by Khurana and Suhi[20] whom study showed role of ultrasound in FGTB showing the spectrum of findings such as interruption in endometrial extent, endometrial fluid, calcifications, bands or adhesions, thin endometrium or diffuse variable thickening, cornual obliteration, vertical course of interstitial extent of tube, impaired endometrial vascularity, oligemic myometrial cyst, tubal fluid, loculated peritoneal fluid, tubo-ovarian masses, and adnexal fixity.

In the present study, we observed a high prevalence of ovarian cysts (23.42%) and tubo-ovarian masses (15.42%) in FGTB cases. It may be due to referral of difficult and untreatable cases of FGTB to this apex institute from all over country, especially from high prevalent areas like Bihar which might have increased the prevalence of ovarian cysts and tubo-ovarian masses in the present study. The ovarian cysts and tubo-ovarian masses in FGTB are accumulation of fluid in and around ovaries and fallopian tubes due to adhesions in FGTB and may not be true cysts.

Ultrasound and other radiological modalities can also be used for follow-up of patients of FGTB with tubo-ovarian masses after antitubercular therapy as the mass should disappear or significantly decrease in size after Anti-tubercular therapy (ATT) for 6 months.[28] Sometimes, multidrug-resistant TB (MDR-TB) can also be present in FGTB either as primary disease or as a part of MDR-TB at other places, especially pulmonary MDR-TB with tubo-ovarian masses where ultrasound can be useful modality for initial diagnosis and for

follow-up of the patients after treatment of MDR-TB.[29] Hence, ultrasound, especially transvaginal three- and four-dimensional scan, is useful in diagnosis and follow-up of patients with FGTB, especially with adnexal masses, but should be performed by an experienced sonologist with special expertise and interest in FGTB to pick up the subtle findings of FGTB.

However, ultrasound like any other radiological methods has its limitations. Alone it cannot be used for diagnosis of FGTB. The gold standard for diagnosis of FGTB remains microbiological methods such as positive AFB on microscopy or culture of endometrial biopsy, positive GeneXpert, positive PCR, and histopathological evidence of epithelioid granuloma on endometrial biopsy. CRS should be used for identifying more cases of FGTB by combining various microbiological, pathological methods with laparoscopy and hysteroscopy. Ultrasound is more useful in tuberculous tubo-ovarian masses, although FGTB cannot be diagnosed by ultrasonography alone.

Conclusions

The findings of the present study definitely raise high index of suspicion of FGTB on demonstration of ovarian cysts, tubo-ovarian masses, and hydrosalpinx which can then be confirmed with molecular or histological diagnosis or endoscopic assessment.

However, larger multicentric studies are recommended to confirm the findings of the present study.

Acknowledgment

The author is thankful to Central TB Division, Ministry of Health and Family Welfare and residents of Obstetrics and Gynecology, department of AIIMS for their help.

Data availability statement

Nil

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. WHO. Global Tuberculosis Report. Geneva: World Health Organisation; 2019.
2. Guidelines for programmatic Management of Tuberculosis preventive Treatment in India. Central TB Division, Ministry of Health and Family Welfare, Government of India. 2021.
3. Sharma JB. Current diagnosis and management of female genital tuberculosis. J Obstet Gynaecol India 2015;65:362-71.
4. Sharma JB, Sharma E, Sharma S, Dharmendra S. Female genital tuberculosis: Revisited. Indian J Med Res 2018;148:S71-83.
5. Grace GA, Devaleenal DB, Natrajan M. Genital tuberculosis in females. Indian J Med Res 2017;145:425-36.
6. Sharma JB, Roy KK, Pushparaj M, Gupta N, Jain SK, Malhotra N, *et al.* Genital tuberculosis: An important cause of Asherman's syndrome in India. Arch Gynecol Obstet 2008;277:37-41.
7. Malhotra N, Sharma V, Bahadur A, Sharma JB, Roy KK, Kumar S. The effect of tuberculosis on ovarian reserve among women undergoing IVF in India. Int J Gynaecol Obstet 2012;117:40-4.
8. Sharma JB, Jain SK, Pushparaj M, Roy KK, Malhotra N, Zutshi V, *et al.* Abdomino-peritoneal tuberculosis masquerading as ovarian cancer: A retrospective study of 26 cases. Arch Gynecol Obstet 2010;282:643-8.
9. Nurwidya F, Handayani D, Burhan E, Yunus F. Molecular diagnosis of tuberculosis. Chonnam Med J 2018;54:1-9.
10. Munne KR, Tandon D, Chauhan SL, Patil AD. Female genital tuberculosis in light of newer laboratory tests: A narrative review. Indian J Tuberc 2020;67:112-20.
11. Sharma JB, Kriplani A, Dharmendra S, Chaubey J, Kumar S, Sharma SK. Role of Gene Xpert in diagnosis of female genital tuberculosis: A preliminary report. Eur J Obstet Gynecol Reprod Biol 2016;207:237-8.
12. Bhanu NV, Singh UB, Chakraborty M, Suresh N, Arora J, Rana T, *et al.* Improved diagnostic value of PCR in the diagnosis of female genital tuberculosis leading to infertility. J Med Microbiol 2005;54:927-31.
13. Sharma JB, Roy KK, Pushparaj M, Kumar S, Malhotra N, Mittal S. Laparoscopic findings in female genital tuberculosis. Arch Gynecol Obstet 2008;278:359-64.
14. Sharma JB, Roy KK, Pushparaj M, Kumar S. Hysteroscopic findings in women with primary and secondary infertility due to genital tuberculosis. Int J Gynaecol Obstet 2009;104:49-52.
15. Sharma JB, Pushparaj M, Roy KK, Neyaz Z, Gupta N, Jain SK, *et al.* Hysterosalpingographic findings in infertile women with genital tuberculosis. Int J Gynaecol Obstet 2008;101:150-5.
16. Sharma JB, Karmakar D, Hari S, Singh N, Singh SP, Kumar S, *et al.* Magnetic resonance imaging findings among women with tubercular tubo-ovarian masses. Int J Gynaecol Obstet 2011;113:76-80.
17. Sharma JB, Karmakar D, Kumar R, Shamim SA, Kumar S, Singh N, *et al.* Comparison of PET/CT with other imaging modalities in women with genital tuberculosis. Int J Gynaecol Obstet 2012;118:123-8.
18. Madjid TH, Ardhi I, Permadi W, Susiarno H, Krisnadi SR, Wirakusumah FF, *et al.* Correlation of clinical features, laboratory finding, and pelvic ultrasonography of pulmonary tuberculosis women with infertility. Int J Gen Med 2019;12:485-9.
19. Shah HU, Sannananja B, Baheti AD, Udare AS, Badhe PV. Hysterosalpingography and ultrasonography findings of female genital tuberculosis. Diagn Interv Radiol 2015;21:10-5.
20. Khurana A, Suhi G. Ultrasound in female genital tuberculosis: A retrospective study. Ultrasound Obstet Gynecol 2013;42:1-47.
21. Tongsong T, Sukpan K, Wanapirak C, Sirichotiyakul S, Tongprasert F. Sonographic features of female pelvic tuberculous peritonitis. J Ultrasound Med 2007;26:77-82.
22. Gascon J, Aeren P. Large bilateral tubercular hydrosalpinx in a young women with genitourinary malformation: A case report. J Med Case Rep 2014;8:176.
23. Yapar EG, Ekici E, Karasahin E, Gökmen O. Sonographic features of tuberculous peritonitis with female genital tract tuberculosis. Ultrasound Obstet Gynecol 1995;6:121-5.
24. Uzunkoy A, Harma M, Harma M. Diagnosis of abdominal tuberculosis: Experience from 11 cases and review of the literature. World J Gastroenterol 2004;10:3647-9.
25. Malik A, Saxena NC. Ultrasound in abdominal tuberculosis.

Abdom Imaging 2003;28:574-9.
26. Kurjak A, Cherrenak FA. Donald School Textbook of Ultrasound in Obstetrics and Gynecology. 4th ed. New Delhi: Jaypee The Health Sciences; 2017. p. 929-43.
27. Sharma JB. Female Genital Tuberculosis Textbook of Gynaecology. 1st ed. New Delhi: Avichal Publishing Company; 2018. p. 378-91.
28. Sharma JB, Singh N, Dharmendra S, Singh UB, Vanamail P, Kumar S, *et al*. Six months versus nine months anti-tuberculous therapy for female genital tuberculosis: A randomized controlled trial. Eur J Obstet Gynecol Reprod Biol 2016;203:264-73.
29. Sharma JB, Kriplani A, Sharma E, Sharma S, Dharmendra S, Kumar S, *et al*. Multi drug resistant female genital tuberculosis: A preliminary report. Eur J Obstet Gynecol Reprod Biol 2017;210:108-15.