

DOI: <https://dx.doi.org/10.18203/2320-1770.ijrcog20263992>

Original Research Article

A clinicoradiological profile in confirmed and probable cases of genital tuberculosis in a tertiary care centre

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Received: 26 August 2026

Revised: 14 October 2026

Accepted: 17 October 2026

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ABSTRACT

Background: Female genital tuberculosis (FGTB) is an important cause of infertility and chronic gynecological morbidity in tuberculosis-endemic regions. Diagnosis is often difficult because of nonspecific symptoms and the low sensitivity of conventional tests. This study evaluated the clinical, laboratory, radiological, histopathological, and hysteroscopic findings in women with suspected FGTB.

Methods: This hospital-based observational study included 70 women with clinically suspected FGTB. Participants underwent clinical assessment, microbiological investigations including mycobacterial culture and GeneXpert, histopathological examination of endometrial samples, pelvic ultrasonography, magnetic resonance imaging (MRI), and diagnostic hysteroscopy where indicated. Data were analyzed using descriptive statistics, and categorical variables were compared using the Chi-square or Fisher's exact test.

Results: Women aged 31-40 years formed the largest age group (44.3%), while 45.7% belonged to the lower socioeconomic group. Clinical suspicion of FGTB was recorded in 74.3% of participants, whereas microbiological confirmation was obtained in 32.9%. Histopathology showed the highest positivity (37.1%), followed by GeneXpert (32.9%) and mycobacterial culture (25.7%). Tubal thickening was the most common radiological finding on both ultrasonography and MRI. Hysteroscopy commonly showed periostial fibrosis, pale endometrium, intrauterine adhesions, hydrosalpinx, and pelvic adhesions. On integrated assessment, 32.9% of women had confirmed FGTB, 18.6% probable FGTB, 35.7% possible FGTB, and 12.8% had no evidence of FGTB.

Conclusions: FGTB remains difficult to diagnose using a single investigation. An integrated approach combining clinical assessment, histopathology, microbiological testing, imaging, and hysteroscopy may improve diagnostic confidence and facilitate earlier diagnosis.

Keywords: Female genital tuberculosis, Infertility, Hysteroscopy, Laparoscopy, Histopathology, GeneXpert, Tuberculosis diagnosis

INTRODUCTION

Tuberculosis (TB) remains a major global public health concern, particularly in low- and middle-income countries. Despite progress in diagnostic technologies and tuberculosis control strategies, the disease continues to cause substantial morbidity and mortality worldwide. FGTB is a clinically important form of extrapulmonary

tuberculosis that can affect reproductive health and contribute to infertility, menstrual abnormalities, chronic pelvic pain, and adverse reproductive outcomes. Its clinical presentation is often subtle or nonspecific, which may delay diagnosis until investigations for infertility or other gynecological problems are undertaken.^{1,2}

FGTB commonly involves the fallopian tubes and may also affect the endometrium, ovaries, cervix, and other

reproductive structures. The infection generally reaches the genital tract through hematogenous or lymphatic dissemination from another site of tuberculosis. Chronic inflammation may result in fibrosis, adhesions, tubal obstruction, and endometrial damage, potentially compromising fertility. Early recognition is therefore important to facilitate timely treatment and limit further reproductive tract damage.^{3,4}

Accurate diagnosis of FGTB remains challenging because the disease is frequently paucibacillary and its clinical manifestations overlap with those of other gynecological conditions. Conventional investigations, including acid-fast bacilli (AFB) microscopy and mycobacterial culture, may fail to detect the infection in some affected women. Molecular tests, including GeneXpert, can support rapid detection of *M. tuberculosis*; however, a negative result does not necessarily exclude FGTB. These limitations highlight the importance of interpreting microbiological findings alongside clinical and other diagnostic evidence.^{5,6}

The assessment of FGTB may involve microbiological testing, histopathological examination, imaging, and endoscopic evaluation. Ultrasonography and other imaging techniques can identify structural abnormalities, while hysteroscopy and laparoscopy may reveal endometrial changes, adhesions, tubal abnormalities, and other findings suggestive of genital tuberculosis. Because each modality provides different information, a combined diagnostic approach may be more informative than relying on a single investigation. Recent reviews and clinical studies have also examined the contribution of different diagnostic methods and the need to interpret findings in the context of the overall clinical presentation.^{7,8}

Diagnostic algorithms have been proposed to integrate clinical assessment with laboratory and procedural findings. Nevertheless, the diagnostic performance of individual investigations may vary according to the type of specimen, disease presentation, and criteria used to classify a case as confirmed or probable FGTB. Composite assessment is particularly relevant when conventional microbiological confirmation is unavailable despite clinical or radiological suspicion. Studies evaluating diagnostic algorithms and newer laboratory approaches provide a basis for examining how complementary investigations can contribute to clinical decision-making.^{9,10}

Although diagnostic methods have improved, the evaluation of suspected FGTB remains complex in routine clinical practice. Studies have assessed microbiologically confirmed disease, the diagnostic challenges associated with FGTB, and the performance of samples obtained from different pelvic sites. However, the relative contribution of clinical assessment, microbiological investigations, histopathology, radiological imaging, and hysterolaparoscopic findings may differ across patient populations and clinical settings. Further evaluation of

these modalities within a defined hospital-based cohort may help clarify their complementary diagnostic roles.^{11,12}

Evidence from systematic reviews and studies of composite reference standards further supports the need to assess diagnostic findings collectively rather than in isolation. Evaluating multiple modalities within the same patient cohort may help identify the information each investigation contributes to the diagnosis of suspected FGTB. Therefore, the present hospital-based observational study was undertaken to evaluate the diagnostic utility of clinical assessment, microbiological investigations, histopathological examination, radiological imaging, and hysterolaparoscopic evaluation in women with suspected FGTB. The study aims to contribute to a more comprehensive diagnostic approach and support appropriate clinical management.^{13,14}

METHODS

Study design and setting

This hospital-based observational study was conducted in the Department of Obstetrics and Gynecology, Teerthanker Mahaveer Medical College and Research Centre (TMMC and RC), Moradabad, Uttar Pradesh, India, from April 2024 to October 2025. The study included women presenting with clinical features suggestive of FGTB during the study period. The study was designed and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations for observational research.

Study population

A total of 70 consecutive women with clinically suspected FGTB were enrolled after fulfilling the predefined eligibility criteria. Participants were recruited consecutively to minimize selection bias. Women presenting with infertility, menstrual disturbances, chronic pelvic pain, recurrent pregnancy loss, or other clinical features suggestive of genital tuberculosis were considered eligible for evaluation.

Inclusion criteria

Women with clinical suspicion of FGTB, including those presenting with infertility, chronic pelvic pain, menstrual disturbances, or recurrent pregnancy loss requiring evaluation for FGTB, were included in the study. Women who provided written informed consent for participation were also eligible for enrolment.

Exclusion criteria

Women with active pulmonary tuberculosis who had already completed anti-tubercular treatment, patients diagnosed with gynecological malignancy, pregnant

women, and women who were unwilling to participate in the study were excluded.

Clinical assessment

A comprehensive clinical evaluation was performed for all participants. Demographic characteristics, socioeconomic status, menstrual history, infertility status, previous history of tuberculosis, family history of tuberculosis, and constitutional symptoms were recorded using a standardized clinical proforma. All participants underwent complete general physical examination followed by detailed gynecological examination.

Diagnostic evaluation

All enrolled women underwent a standardized multimodal diagnostic work-up.

Microbiological evaluation

Endometrial samples obtained during the premenstrual phase were subjected, wherever indicated, to AFB smear microscopy, mycobacterial culture, and GeneXpert MTB assay.

Histopathological examination

Endometrial biopsy specimens were examined histopathologically for characteristic features suggestive of FGTB, including granulomatous inflammation and other compatible pathological findings.

Radiological evaluation

Radiological investigations included pelvic ultrasonography for all eligible participants and MRI whenever clinically indicated. Hysterosalpingography was performed selectively in infertile women after excluding active pelvic infection.

Hysteroscopic evaluation

Diagnostic hysteroscopy and laparoscopy were performed in women with persistent clinical suspicion or inconclusive non-invasive investigations. Characteristic findings including periostial fibrosis, pale endometrium, intrauterine adhesions, hydrosalpinx, beaded fallopian tubes, pelvic adhesions, and caseous deposits were documented. Targeted biopsy specimens were obtained whenever indicated.

Study outcome

The primary study outcome was the diagnosis of FGTB based on a composite assessment of clinical findings, microbiological investigations, histopathological examination, radiological imaging, and hysteroscopic observations. Based on the integrated diagnostic evaluation, patients were classified as

confirmed FGTB, probable FGTB, possible FGTB, or no evidence of FGTB, according to the institutional diagnostic criteria adopted for the study.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics software (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean $\pm$ SD or median with interquartile range (IQR), as appropriate according to data distribution. Categorical variables were presented as frequencies and percentages.

Associations between categorical variables were evaluated using the Chi-square test or Fisher's exact test whenever expected cell frequencies were less than five. Effect estimates were expressed as odds ratios (ORs) with 95% confidence intervals (CIs), wherever applicable. A two-sided $p < 0.05$ was considered statistically significant. Results are presented according to the STROBE recommendations for observational studies.

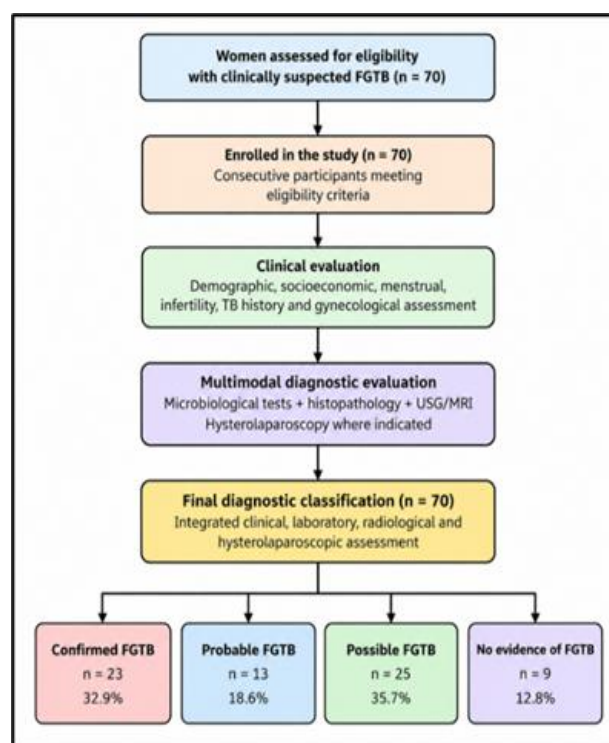


Figure 1: STROBE flow diagram of study participants.

*Flow diagram showing participant enrolment, multimodal diagnostic evaluation, and final classification of women with suspected FGTB.

RESULTS

A total of 70 women with clinically suspected FGTB were included in the analysis. All participants completed the planned clinical, microbiological, histopathological, radiological, and hysteroscopic evaluations according to the institutional diagnostic protocol.

Demographic characteristics

The demographic characteristics of the study participants are presented in Table 1. Women aged 31-40 years constituted the largest age group (31/70, 44.3%), followed by those aged 20-30 years (24/70, 34.3%). Participants aged >40 years accounted for 14.3%, whereas only 7.1% were ≤20 years of age. The observed age distribution was statistically significant ($\chi^2=17.94$, $p=0.0004$).

Table 1: Demographic characteristics of study participants, (n=70).

Age group (in years)	N	Percent (%)
≤20	5	7.1
20-30	24	34.3
31-40	31	44.3
>40	10	14.3
Total	70	100

Socioeconomic status

As shown in Table 2, the majority of participants belonged to the lower socioeconomic class (45.7%), followed by the middle (37.1%) and upper (17.2%) socioeconomic groups. The distribution was statistically significant ($\chi^2=8.91$, $p=0.011$).

Table 2: Socioeconomic distribution of study participants, (n=70).

Socioeconomic class	N	Percent (%)
Lower	32	45.7
Middle	26	37.1
Upper	12	17.2
Total	70	100

Clinical, radiological and microbiological findings

Clinical suspicion of FG TB was recorded in 52 women (74.3%), whereas radiological abnormalities were identified in 31 (44.3%). Microbiological confirmation was achieved in 23 participants (32.9%). The difference among these diagnostic approaches was statistically significant ($\chi^2=11.60$, $p=0.003$) (Table 3).

Table 3: Clinical, radiological and microbiological findings.

Diagnostic parameters	N	Percent (%)
Clinical suspicion	52	74.3
Radiological evidence	31	44.3
Microbiological confirmation	23	32.9

Laboratory investigations

Histopathological examination demonstrated the highest positivity rate (37.1%), followed by GeneXpert (32.9%) and mycobacterial culture (25.7%). Histopathology and

mycobacterial culture showed statistically significant findings ($p<0.001$) (Table 4).

Table 4: Laboratory investigations among study participants, (n=70).

Investigations	Positive n (%)	Negative n (%)	P value
Histopathology	26 (37.1)	44 (62.9)	<0.001
Mycobacterial culture	18 (25.7)	52 (74.3)	<0.001
GeneXpert	23 (32.9)	47 (67.1)	-

*GeneXpert positivity is reported according to the institutional diagnostic records.

Radiological findings

The radiological findings are summarized in Tables 5 and 6. On ultrasonography, tubal thickening was the most frequent abnormality (41.4%), followed by ovarian collection (25.7%) and tubo-ovarian mass (21.4%). MRI similarly demonstrated tubal thickening as the predominant finding (44.3%), followed by ovarian collection (27.1%), tubo-ovarian collection (22.8%), and pelvic lymphadenopathy (20.0%). The distribution of MRI findings was not statistically significant ($\chi^2=7.19$, $p=0.066$).

Beaded fallopian tubes, pelvic adhesions, and tubercles/caseous deposits, reflecting the characteristic pelvic involvement associated with FG TB.

Hysterolaparoscopic findings

Diagnostic hysterolaparoscopy identified periostial fibrosis as the most common finding (35.7%), followed by pale endometrium (31.4%), intrauterine adhesions (25.7%), hydrosalpinx (22.8%), beaded fallopian tubes (20.0%), pelvic adhesions (18.6%), and tubercles/caseous deposits (12.9%) (Table 7). Multiple findings were observed in several participants.

Table 5: Ultrasonographic findings, (n=70).

Findings	N	Percent (%)
Tubal thickening	29	41.4
Ovarian collection	18	25.7
Tubo-ovarian mass	15	21.4
No significant abnormality	8	11.5

Table 6: MRI findings, (n=70).

Findings	N	Percent (%)
Tubal thickening	31	44.3
Ovarian collection	19	27.1
Tubo-ovarian collection	16	22.8
Pelvic lymphadenopathy	14	20.0

Table 7: Hysteroscopic findings, (n=70).

Findings	N	Percent (%)
Periostial fibrosis	25	35.7
Pale endometrium	22	31.4
Intrauterine adhesions	18	25.7
Hydrosalpinx	16	22.8
Beaded fallopian tubes	14	20.0
Pelvic adhesions	13	18.6
Tubercles/caseous deposits	9	12.9

*Multiple findings were recorded in individual participants; therefore, percentages do not total 100%.

Table 8: Final diagnostic classification, (n=70).

Final diagnosis	N	Percent (%)
Confirmed FGFB	23	32.9
Probable FGFB	13	18.6
Possible FGFB	25	35.7
No evidence of FGFB	9	12.8
Total	70	100

DISCUSSION

FGTB continues to represent a significant diagnostic challenge because of its nonspecific clinical presentation, paucibacillary nature, and the absence of a single diagnostic test that reliably identifies all cases. The present study evaluated the diagnostic utility of clinical assessment, microbiological investigations, histopathological examination, radiological imaging, and hysteroscopic evaluation in women with suspected FGTB. The findings highlight the importance of interpreting complementary diagnostic information rather than relying on an individual investigation.^{2,3}

The majority of study participants belonged to the 31-40-year age group, and nearly half belonged to the lower socioeconomic group. The predominance of women in the reproductive age group may be related to the identification of FGTB during infertility evaluation and investigations for other reproductive problems. Although the socioeconomic distribution describes the characteristics of this cohort, the association between socioeconomic status and delayed healthcare-seeking cannot be established from these findings alone. Previous literature has emphasized the importance of considering genital tuberculosis in women undergoing infertility evaluation.^{3,8}

Clinical suspicion was present in 74.3% of participants, whereas microbiological confirmation was obtained in 32.9%. This difference may reflect the paucibacillary nature of FGTB and the variable diagnostic yield of genital tract specimens. Clinical features such as infertility, menstrual disturbances, and chronic pelvic pain may help identify women who require further investigations. Previous reviews have described similar diagnostic challenges and emphasized that laboratory results must be interpreted in the context of the clinical presentation.^{5,10}

Among the laboratory investigations, histopathological examination showed the highest positivity rate (37.1%), followed by GeneXpert (32.9%) and mycobacterial culture (25.7%). Histopathological examination may identify tissue changes suggestive of tuberculosis, whereas molecular testing provides rapid evidence of *M. tuberculosis* and culture can provide microbiological confirmation. The diagnostic yield of these methods may vary with specimen quality, bacillary load, and the criteria used to classify cases. WHO guidance on tuberculosis diagnosis and laboratory practice guidelines support the appropriate use and interpretation of diagnostic investigations.^{16,17}

Radiological imaging provided supportive information in the present study, with tubal thickening being the most frequent abnormality on both ultrasonography and MRI. These abnormalities may reflect chronic inflammation and structural damage, although they are not specific to tuberculosis and can occur in other pelvic conditions. Imaging should therefore be interpreted alongside clinical, laboratory, and histopathological findings. Reviews of genital tuberculosis have similarly highlighted the limitations of relying on any single clinical or diagnostic feature.^{2,3}

Diagnostic hysteroscopy provided additional information in women with suspected FGTB. Periostial fibrosis was the most common finding, followed by pale endometrium, intrauterine adhesions, hydrosalpinx, beaded fallopian tubes, and pelvic adhesions. These abnormalities may reflect chronic inflammation and fibrosis affecting the reproductive tract. Hysteroscopy permits direct visualization of pelvic structures and may facilitate targeted sampling when indicated. A published case series has also described hysteroscopic and laparoscopic findings in women with subfertility and tuberculosis.^{4,15}

A strength of the present study is assessment of multiple diagnostic modalities within the same patient cohort using an institutional protocol. This approach reflects clinical practice, where findings from laboratory investigations, imaging, histopathology, and endoscopic evaluation may need to be considered together. Research evaluating composite reference standards in FGTB highlights the importance of defining diagnostic criteria carefully when comparing the contribution of different investigations.^{14,18}

The interpretation of diagnostic results also requires consideration of the broader evidence on tuberculosis. Published reviews discuss the biological and clinical complexity of tuberculosis, while research on molecular testing has evaluated the performance of Xpert MTB/RIF in extrapulmonary disease. These sources provide useful context for interpreting the results of microbiological and molecular investigations in suspected FGTB.^{19,20}

Several limitations should be acknowledged. The study was conducted at a single tertiary care centre and included

a relatively small sample, which may limit the generalizability of the findings. Furthermore, sensitivity, specificity, predictive values, receiver operating characteristic analysis, and multivariable regression were not available from the reported results because a uniform microbiological reference standard was not available for all participants. Future multicentre prospective studies using larger cohorts and clearly defined reference standards are needed to validate these observations.^{13,14}

The findings have practical implications for the evaluation of women with suspected FGTB in tuberculosis-endemic settings. Dependence on a single investigation may be insufficient when the disease presents with nonspecific symptoms or microbiological confirmation is not obtained. A diagnostic strategy combining clinical assessment with laboratory testing, imaging, histopathology, and endoscopic evaluation may help clinicians interpret discordant findings and determine whether further investigations are warranted. Reviews of extrapulmonary tuberculosis describe the diagnostic difficulties that can arise when disease occurs outside the lungs.^{21,22}

The wider epidemiological context also remains important because tuberculosis continues to be a global public health concern. WHO global tuberculosis reports provide information on the burden of disease and the continuing need for effective detection and diagnosis. These reports support the broader public health relevance of improving diagnostic assessment, although they do not independently establish the performance of any particular FGTB diagnostic method.^{23,24}

Additional reviews of extrapulmonary tuberculosis provide background on its clinical presentation and management. The present study adds institution-based observations on the contribution of complementary diagnostic modalities in women with suspected FGTB; further prospective research is needed to determine how consistently these findings apply across different clinical settings.^{25,26}

CONCLUSION

FGTB remains a diagnostically challenging condition because of its nonspecific clinical presentation and the limited sensitivity of individual diagnostic investigations. In the present study, clinical assessment identified the highest proportion of suspected cases, whereas histopathological examination, GeneXpert, radiological imaging, and hysterolaparoscopic evaluation provided complementary diagnostic information that improved overall diagnostic confidence.

The findings demonstrate that no single diagnostic modality is sufficient for establishing or excluding the diagnosis of FGTB. Instead, an integrated multimodal approach combining clinical evaluation, microbiological investigations, histopathology, radiological imaging, and hysterolaparoscopy offers a more comprehensive and

reliable strategy for diagnosing women with suspected disease.

Early recognition through a multidisciplinary diagnostic pathway may facilitate timely initiation of anti-tubercular therapy, reduce diagnostic delay, and potentially improve reproductive outcomes, particularly among women presenting with infertility and chronic gynecological symptoms in tuberculosis-endemic settings. Further large-scale, multicenter prospective studies are warranted to validate these findings and to establish standardized evidence-based diagnostic algorithms for FGTB.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee of Teerthanker Mahaveer University, Moradabad (TMU-IEC), vide Ref. No. TMU/IEC/2024-25/PG/18.

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Cite this article as: Jain S, Sharad N, Lalwani A, Agrawal S. A clinicoradiological profile in confirmed and probable cases of genital tuberculosis in a tertiary care centre. *Int J Reprod Contracept Obstet Gynecol* 2026;15:4448-54.