



DIAGNOSIS OF TUBERCULOSIS BASED ON THE RESULTS OF MICROBIOLOGICAL EXAMINATION OF SURGICAL MATERIAL FROM PATIENTS WITH PULMONARY TUBERCULOSIS

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ABSTRACT

The accurate diagnosis of pulmonary tuberculosis (TB) remains a critical challenge, particularly in cases requiring surgical intervention. This study evaluates the effectiveness of microbiological examination of surgical specimens in confirming TB diagnosis. A comprehensive analysis was conducted on samples collected from patients undergoing pulmonary surgery due to suspected or confirmed TB. The microbiological methods employed included Ziehl-Neelsen staining, culture on Löwenstein-Jensen medium, and molecular diagnostics. Results demonstrated a significant correlation between microbiological findings and histopathological confirmation, underscoring the diagnostic value of surgical materials in complex or unclear TB cases. These findings highlight the importance of integrating microbiological analysis of surgical specimens into the diagnostic algorithm for pulmonary tuberculosis, especially in smear-negative or extrapulmonary manifestations.

ДИАГНОСТИКА ТУБЕРКУЛЕЗА НА ОСНОВАНИИ РЕЗУЛЬТАТОВ МИКРОБИОЛОГИЧЕСКОГО ИССЛЕДОВАНИЯ ОПЕРАЦИОННОГО МАТЕРИАЛА ОТ БОЛЬНЫХ ТУБЕРКУЛЕЗОМ ЛЕГКИХ

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ABSTRACT

Точная диагностика туберкулеза легких (ТБ) остается важнейшей проблемой, особенно в случаях, требующих хирургического вмешательства. В данном исследовании оценивается эффективность микробиологического исследования операционного материала для подтверждения диагноза туберкулеза. Был проведен комплексный анализ образцов, полученных от пациентов, перенесших операцию на легких в связи с подозрением или подтвержденным туберкулезом. Используемые микробиологические методы включали окраску по Цилю-



по Цию-Нильсену,
культура
Левенштейна-Йенсена,
молекулярная
диагностика,
туберкулез с
отрицательным
мазком.

Нильсену, посев на среду Левенштейна-Йенсена и
молекулярную диагностику. Результаты
продemonстрировали значительную корреляцию между
микробиологическими данными и гистопатологическим
подтверждением, что подчеркивает диагностическую
ценность хирургических материалов в сложных или
неясных случаях туберкулеза. Эти результаты
подчеркивают важность интеграции
микробиологического анализа хирургических образцов в
диагностический алгоритм туберкулеза легких, особенно
при отрицательных мазках или внелегочных проявлениях.

O'PKA SILI BILAN OG'RIGAN BEMORLARNING JARROHLIK MATERIALINI MIKROBIOLOGIK TUZISH NATIJALARI BO'YICHA TUBERKULYOZ DIGINOZI

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bo'yash, Lövenshteyn-
Yensen kulturasi,
molekulyar diagnostika,
surtma-salbiy sil.

ABSTRACT

O'pka tuberkulyozining (TB) aniq tashxisi, ayniqsa, jarrohlik aralashuvni talab qiladigan holatlarda hal qiluvchi muammo bo'lib qolmoqda. Ushbu tadqiqot sil kasalligi tashxisini tasdiqlashda jarrohlik namunalarini mikrobiologik tekshirish samaradorligini baholaydi. Sil kasalligiga shubha qilingan yoki tasdiqlanganligi sababli o'pkada jarrohlik amaliyoti o'tkazilayotgan bemorlardan olingan namunalar bo'yicha keng qamrovli tahlil o'tkazildi. Qo'llaniladigan mikrobiologik usullar Ziehl-Neelsen bo'yash, Lövenshteyn-Jensen muhitida ekish va molekulyar diagnostikani o'z ichiga oladi. Natijalar mikrobiologik topilmalar va gistopatologik tasdiqlash o'rtasidagi muhim korrelyatsiyani ko'rsatdi, bu murakkab yoki noaniq sil kasalligi holatlarida jarrohlik materiallarining diagnostik ahamiyatini ta'kidlaydi. Ushbu topilmalar jarrohlik namunalarining mikrobiologik tahlilini o'pka tuberkulyozi diagnostikasi algoritmiga, ayniqsa smear-salbiy yoki ekstrapulmoner ko'rinishlarda integratsiya qilish muhimligini ta'kidlaydi.

Introduction. Tuberculosis (TB) continues to be one of the most serious infectious diseases globally, with pulmonary TB being the most common and transmissible form. Despite advancements in diagnostic tools, the accurate identification of *Mycobacterium tuberculosis* in clinical settings remains a challenge, particularly in cases with negative sputum smears or atypical radiographic findings. In such scenarios, surgical intervention is often necessary for both diagnostic and therapeutic purposes. The examination of surgical specimens provides an



opportunity to perform comprehensive microbiological, histological, and molecular analyses, offering a definitive diagnosis in otherwise ambiguous cases. Surgical materials, including lung tissue and lymph nodes obtained through lobectomy, wedge resection, or biopsy, can yield critical diagnostic information when subjected to microbiological examination. These methods not only confirm the presence of the pathogen but also assist in differentiating TB from other granulomatous diseases, malignancies, or fungal infections. Given the rise of drug-resistant strains and the importance of early and accurate diagnosis, optimizing the use of surgical samples for microbiological testing is of increasing relevance.

Literature Review. The role of microbiological methods in diagnosing pulmonary TB is well established, with traditional techniques such as Ziehl-Neelsen (ZN) staining and culture on Löwenstein-Jensen (LJ) medium remaining the cornerstone of TB identification [1]. However, the sensitivity of these methods is significantly lower in patients with paucibacillary disease or those who are smear-negative [2]. In such instances, surgical specimens provide an alternative source for diagnosis, especially when sputum and bronchial washings fail to confirm TB.

Several studies have highlighted the diagnostic value of surgical materials in TB. For instance, Luks et al. demonstrated that microbiological and histopathological examination of lung resection specimens substantially improved diagnostic accuracy in smear-negative TB cases [3]. Similarly, Park et al. found that among patients undergoing thoracic surgery for undiagnosed pulmonary lesions, TB was confirmed in a significant proportion through culture and polymerase chain reaction (PCR) analysis of the resected tissue [4]. Advances in molecular diagnostics, such as nucleic acid amplification tests (NAATs), have further increased the diagnostic yield of surgical specimens. The GeneXpert MTB/RIF assay, for example, has been successfully applied to tissue samples, providing rapid detection and resistance profiling [5]. Nonetheless, challenges remain in low-resource settings, where access to these technologies is limited, reinforcing the importance of traditional microbiological methods in such contexts.

Moreover, histopathological features alone may not be sufficient to distinguish TB from other granulomatous diseases, making microbiological confirmation essential. Studies have shown that while granulomas and caseous necrosis are suggestive of TB, similar patterns can be observed in fungal infections or sarcoidosis, necessitating culture or molecular confirmation [6]. Overall, the integration of microbiological analysis of surgical material into the diagnostic workflow significantly enhances the reliability of TB diagnosis, particularly in complex cases where non-invasive methods are inconclusive.

Methodology. This retrospective descriptive study was conducted at a tertiary care hospital specializing in thoracic surgery and infectious diseases. The study included patients who underwent pulmonary surgery (lobectomy, segmentectomy, or wedge resection) from January 2020 to December 2023 due to suspected or confirmed pulmonary tuberculosis with inconclusive non-surgical diagnostic results (e.g., smear-negative sputum, non-diagnostic imaging).

Sample Collection:

Surgical specimens (lung tissue or lymph nodes) were collected under sterile conditions during operative procedures. Each sample was divided into two parts: one for histopathological analysis and the other for microbiological examination.

Microbiological Examination:



- The microbiological assessment included:
- Ziehl-Neelsen (ZN) staining for acid-fast bacilli (AFB)
- Culture on Löwenstein-Jensen (LJ) medium,
- Molecular testing (GeneXpert MTB/RIF) when available.

Culture-positive cases were further evaluated for drug susceptibility using conventional proportion methods on LJ medium.

Histopathology:

Parallel histopathological evaluation included hematoxylin and eosin staining to identify granulomatous inflammation with or without caseous necrosis.

Inclusion Criteria

Adults (≥ 18 years) with a clinical and radiological suspicion of TB.

Undergoing thoracic surgery after non-confirmatory non-invasive diagnostic efforts.

Exclusion Criteria:

Patients with a confirmed preoperative diagnosis of malignancy.

Inadequate or contaminated samples.

Data were analyzed using SPSS v.26. Descriptive statistics were used for baseline characteristics; sensitivity and specificity were calculated by comparing microbiological findings to the final clinical and histopathological diagnosis.

Results. A total of 78 patients (45 males, 33 females; mean age 42.6 ± 13.8 years) were included. Indications for surgery included persistent pulmonary infiltrates, hemoptysis, and non-resolving cavitary lesions. Among them:

ZN staining detected AFB in 31 (39.7%) specimens.

Culture on LJ medium was positive in 49 (62.8%) cases.

GeneXpert MTB/RIF was performed in 38 patients and detected MTB in 28 (73.7%) of them, including 5 cases with rifampicin resistance.

Histopathological examination revealed caseating granulomas in 59 (75.6%) samples, and non-specific inflammation or fibrosis in the remaining.

Comparison with final diagnosis showed

ZN stain sensitivity: 52.5%, specificity: 100%

Culture sensitivity: 83.1%, specificity: 100%

GeneXpert sensitivity: 87.5%, specificity: 100% (for available cases).

Drug susceptibility testing identified 6 cases (12.2%) of multidrug-resistant TB (MDR-TB) among culture-positive patients.

Discussion. This study confirms the value of microbiological examination of surgical material in diagnosing pulmonary tuberculosis, especially in smear-negative or diagnostically challenging cases. Our results align with earlier studies showing that surgical specimens can significantly improve diagnostic sensitivity when conventional sputum-based methods fail [3], [4]. The higher sensitivity of culture (62.8%) and GeneXpert (73.7%) over ZN staining (39.7%) supports prior findings that conventional microscopy alone may underestimate TB in surgically resected tissue [7]. While ZN staining remains rapid and specific, its low sensitivity highlights the need for complementary tests [8]. The use of GeneXpert MTB/RIF enabled rapid detection of rifampicin resistance, crucial for initiating timely second-line treatment. This aligns with the



WHO's recommendation to expand molecular testing to extrapulmonary and tissue-based samples when available [9].

Histopathology continues to play a vital role, particularly when microbiological results are negative. However, as noted by Mukhopadhyay and Gal, granulomatous inflammation is not pathognomonic for TB and must be interpreted cautiously alongside microbiological data [6]. The presence of MDR-TB in 12.2% of cases further underscores the importance of culture-based drug susceptibility testing. These results are consistent with national trends reporting rising drug resistance in surgical TB cases [10]. Overall, this study reinforces the integration of microbiological evaluation of surgical materials into routine diagnostic pathways. Especially in resource-limited settings where diagnostic delays are common, combining traditional and molecular methods enhances early and accurate TB detection, guiding effective treatment.

Conclusion. The findings of this study underscore the critical role of microbiological examination of surgical materials in the diagnosis of pulmonary tuberculosis, particularly in patients with inconclusive non-invasive test results. While histopathological evaluation remains essential, its diagnostic accuracy is significantly enhanced when combined with microbiological methods such as Ziehl-Neelsen staining, culture on Löwenstein-Jensen medium, and molecular assays like GeneXpert MTB/RIF. Among these, culture and GeneXpert demonstrated superior sensitivity and contributed to the early detection of drug-resistant strains, including multidrug-resistant tuberculosis. In clinical practice, especially in high TB-burden and resource-limited settings, integrating microbiological analysis of surgical specimens into diagnostic algorithms can lead to timely, accurate diagnosis and appropriate therapeutic interventions. This approach is particularly valuable in smear-negative and diagnostically complex cases, where traditional sputum analysis falls short. Future efforts should focus on improving access to rapid molecular diagnostics and enhancing laboratory capacity to maximize the diagnostic utility of surgical samples in tuberculosis management.

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