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Research Paper

Role of GENEXpert MTB/RIF in the Diagnosis of Tuberculosis Experience of the Central Laboratory of CHU Hassan II in Fez

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ABSTRACT

Introduction

Tuberculosis (TB) remains a major infectious disease, causing millions of deaths annually. The GeneXpert MTB/RIF, based on real-time PCR, provides rapid and reliable diagnosis while also detecting rifampicin resistance.

Materials and Methods :

This article presents the experience of the central laboratory at CHU Hassan II in Fez in diagnosing tuberculosis over a 12-month period, from December 2023 to December 2024.

Results

Among 507 samples, 65 (12.8%) were TB-positive. The majority were sputum samples (53.8%), followed by cerebrospinal fluid and peritoneal fluid. No rifampicin resistance was detected.

Conclusion

The GeneXpert MTB/RIF is a high-performance tool with elevated sensitivity, including in extrapulmonary TB. Its implementation enables faster diagnosis and improved patient management.

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I. INTRODUCTION

Tuberculosis (TB) remains one of the leading causes of morbidity and mortality worldwide, despite considerable medical advancements and global control efforts [1]. In 2023, the World Health Organization (WHO) estimated that nearly 10.8 million people were affected by TB, resulting in 1.5 million deaths. Given the public health emergency, rapid and accurate diagnosis is crucial to limit transmission and improve treatment outcomes [2]. The GeneXpert MTB/RIF test, a revolutionary PCR-based technology, has emerged as a promising solution for rapid TB detection and rifampicin resistance [3].

This article explores its role in tuberculosis diagnosis based on the experience of the central laboratory at CHU Hassan II in Fez.

II. MATERIALS AND METHODS

This was a retrospective and analytical study conducted on all samples received at the central laboratory of CHU Hassan II for suspected TB (pulmonary and extrapulmonary) over a 12-month period (December 2023 to December 2024). The biological samples analyzed included sputum, pleural fluid, peritoneal fluid, cerebrospinal fluid, urine, biopsies, and pus.

All samples were transported under sterile and refrigerated conditions. They were processed using the GeneXpert system, a real-time PCR technique that detects Mycobacterium tuberculosis DNA and mutations conferring resistance to rifampicin in less than 120 minutes.

Inclusion Criteria:

- Adult and pediatric patients with clinical symptoms suggestive of pulmonary or extrapulmonary TB.
- Patients whose fluid cytology (pleural, peritoneal, CSF, etc.) was lymphocytic, supporting a TB diagnosis.

Exclusion Criteria:

- Patients showing no signs suggestive of TB.

Data Analysis:

Collected data were analyzed and presented as percentages and charts to assess the diagnostic performance of the GeneXpert test.

III. RESULTS

During the one-year study period, a total of 507 biological samples were received for suspected TB. Of these, 65 tested positive, yielding a positivity rate of 12.8%. These results highlight the relevance of GeneXpert in varied clinical settings.

Among the 65 patients:

- 27 (41.5%) were women
- 38 (58.5%) were men
- The average age was 43 years (range: 6–83 years)

The most common samples were sputum (35 cases, 53.8%), followed by CSF (10 cases, 15.4%), peritoneal fluid (5 cases, 7.7%), and fibro-aspiration fluid (5 cases, 7.7%).

Table 1 : Distribution of pulmonary and extrapulmonary TB cases with positivity rates

TB Form	Total	Positive Cases	Positivity Rate
Pulmonary TB	310	40	12.9%
Extrapulmonary TB	197	25	12.7%

Table 2 : Distribution of sample types with positivity rates

Sample Type	Total	Positive Cases	Positivity Rate
Sputum	293	35	11.9%
Pleural fluid	38	4	10.5%
Fibro-aspiration	17	5	29.4%
CSF	75	10	13.3%
Peritoneal fluid	24	5	20.8%
Pericardial fluid	9	2	22.2%
Articular fluid	2	1	50%
Lymph node biopsy	10	2	20%
Pus	32	0	0%
Urine	7	1	14.2%

Among the detected cases, the bacterial load was high in 2 cases (3.1%), moderate in 12 cases (18.5%), and low or very low in 21 cases (32.3%).

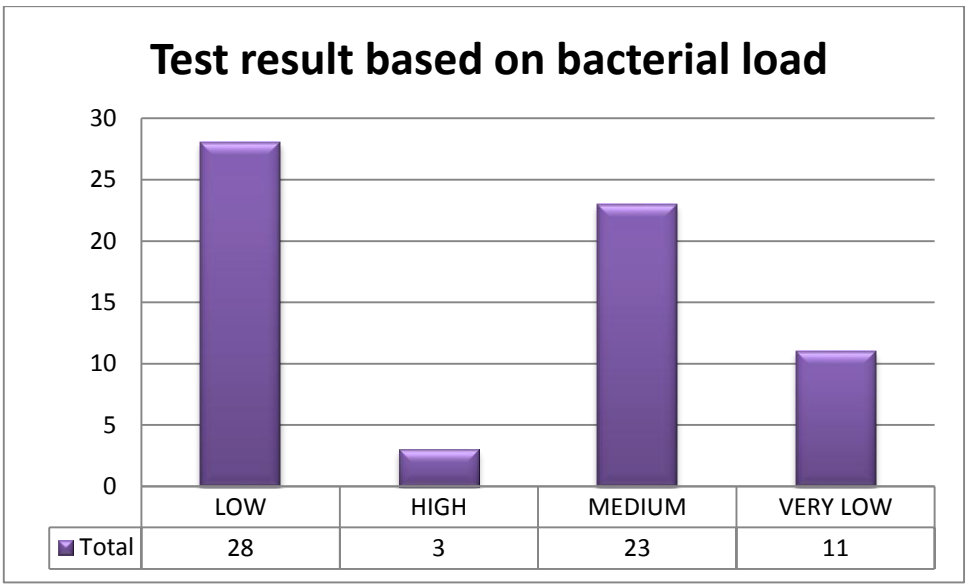

Figure 1 . MTB/RIF test results based on the detected bacterial load.

Rifampicin resistance was absent in 58 cases (89.2%), while in 7 cases (10.8%), resistance was indeterminate.

IV. DISCUSSION

The GeneXpert MTB/RIF test, which rapidly detects *Mycobacterium tuberculosis* and its resistance to rifampicin, represents a major advancement in the diagnosis of tuberculosis (TB). Its speed is one of its main advantages, as it provides results in less than two hours—much faster than traditional methods such as culture, which can take several weeks. This rapid turnaround improves clinical management, enables earlier treatment, and reduces the risk of transmission [4].

In terms of sensitivity, several recent studies have shown that GeneXpert is particularly effective for pulmonary tuberculosis. A study conducted by Salazar et al. (2023) revealed that the test has a sensitivity of 92.4% and a specificity of 98.2% for pulmonary TB cases in adult patients [5]. This level of accuracy surpasses that of conventional tests such as microscopy, which are often less sensitive, especially in cases with low bacterial loads. Moreover, the test is capable of detecting paucibacillary forms of tuberculosis, which may go unnoticed with Ziehl-Neelsen microscopy [3].

One of the key strengths of the GeneXpert test is its ability to detect rifampicin resistance, a crucial factor in the management of multidrug-resistant tuberculosis (MDR-TB). This feature allows for the immediate initiation of second-line treatment, thereby preventing the spread of resistant strains within the community [6].

A recent study by Zhang et al. (2022) showed that GeneXpert has a sensitivity of 96% and a specificity of 99% for detecting rifampicin resistance. This represents a significant improvement over traditional culture methods, which can take several weeks to identify resistance—a delay during which tuberculosis may continue to spread [7]. Rapid detection not only enables the prompt initiation of appropriate treatment, but also helps reduce the number of secondary resistance cases, thereby contributing to the overall management of MDR-TB in high-incidence countries [8].

The GeneXpert test has also proven effective in low-resource countries, where healthcare infrastructure is often limited. Its ease of use, combined with minimal technical training requirements, makes it particularly well-suited for peripheral health facilities and rural areas [9]. It does not require complex bacterial culture or sophisticated laboratory equipment, which is a major advantage in settings where access to such resources is limited. A recent study in South Africa revealed that the introduction of GeneXpert in community clinics led to a significant reduction in diagnostic delays and improved tuberculosis screening rates in rural areas. Indeed, the WHO recommends the use of GeneXpert as a first-line diagnostic method in countries with a high TB burden, particularly in areas where rifampicin resistance is a major concern [2][10].

Although the GeneXpert MTB/RIF test is known for its high sensitivity and specificity in diagnosing tuberculosis—especially pulmonary TB—its use in extrapulmonary forms presents certain challenges. Low bacterial loads in sites such as lymph nodes, bones, or the nervous system can lead to false-negative results. However, studies have shown that the GeneXpert test offers higher sensitivity than microscopy for the diagnosis of extrapulmonary tuberculosis, supporting its value as a first-line diagnostic tool in these cases [11].

V. CONCLUSION

GeneXpert MTB/RIF represents a major advance in rapid TB diagnosis due to its speed, accuracy, and ability to detect rifampicin resistance. It is a valuable tool in high-TB-burden countries and in managing MDR-TB. However, its cost and limited performance in some extrapulmonary forms underscore the importance of complementary diagnostic methods.

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