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Correlation between thoracic photographs and molecular rapid test (TCM) results of tuberculosis patients at the Lasinrang Pinrang Regional General Hospital

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ABSTRACT

Background: Tuberculosis is one of the deadliest infectious diseases in the world, Indonesia ranks third in the world with 824 thousand cases per year. Symptoms of Tuberculosis require a thoracic photograph-like examination with a molecular rapid test (TCM) examination. Although thoracic photographs are effective, they cannot detect infections in other organs, while TCM can diagnose more quickly at a higher cost. Objective: To determine the correlation between thoracic photographs and the results of the Molecular Rapid Test (TCM) of tuberculosis patients at the Lasinrang Pinrang Regional General Hospital. Research Methods: This study uses an observational analytical method with a cross sectional approach. The data used is secondary data, namely the patient's medical records. Research Results: Of the 100 patients studied at Lasinrang Pinrang Hospital, it was found that 80% showed infiltrate lesions on thoracic photographs, followed by 12% with consolidated lesions and 8% with fibrosis lesions. Molecular rapid test (TCM) results showed that 86% of patients were detected positive for Mycobacterium tuberculosis and sensitive to rifampicin, while 14% of TCM results were negative. Conclusion: The study showed that there was a significant relationship between the results of thoracic photo examination in the form of infiltrate lesions, consolidation, fibrosis and calcification to positive and negative results of molecular rapid test (TCM).

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1. Introduction

Tuberculosis (TB) is a contagious disease with widespread transmission and has become a significant cause of death in various parts of the world. It is the second leading cause of death after COVID-19. TB is caused by infection with the Mycobacterium tuberculosis bacteria. Although it usually affects the lungs, the disease can also impact other organs such as the kidneys, bones, or nervous system. TB is transmitted through the air when an infected individual coughs or sneezes, and it can cause symptoms such as persistent coughing, fever, night sweats, weight loss, and fatigue (Migliori et al., 2021).

According to the Global TB Report 2022, India is the country with the highest number of tuberculosis (TB) cases, particularly among the productive age group between 25 and 34 years old. Meanwhile, Indonesia ranks third after India and China in terms of TB cases. In Indonesia, there are

approximately 824,000 TB cases and 93,000 deaths per year, equivalent to 11 deaths every hour. Based on data from the Ministry of Health (KEMENKES) 2022, South Sulawesi ranks ninth with 23,209 confirmed drug-sensitive TB (DS-TB) cases and 520 drug-resistant TB (DR-TB) cases. The total number of confirmed TB cases in the province reached 24,209 (Bagcchi, 2023).

The World Health Organization (WHO) has set targets to improve TB case detection and ensure better access to effective treatment, including treatment for drug-resistant forms of TB. WHO encourages countries to strengthen health systems, raise public awareness, and expand access to diagnostic and therapeutic services to eliminate TB as a global health threat (Bagcchi, 2023).

Early symptoms commonly experienced by TB patients include coughing that lasts more than two weeks, coughing up phlegm or blood, excessive fatigue, high fever or excessive night sweating, loss of appetite, and weight loss. Therefore, further analysis is needed to confirm the diagnosis. According to data from the Ministry of Health, several tests can be conducted to diagnose TB, including sputum smear microscopy (BTA test), tuberculin skin test, chest X-ray, and the Molecular Rapid Test (TCM) (Susilawati & Larasati, 2019).

Chest X-ray is a radiographic examination used to diagnose pulmonary tuberculosis in the anteroposterior (AP) position. This test has a sensitivity of 86% and a specificity of 83% in detecting pulmonary TB, especially when there are apical lesions, cavities, or reticulonodular patterns. Chest X-rays are relatively quick, inexpensive, and easier to perform compared to more advanced examinations. Currently, lung examinations without chest X-rays are considered incomplete, and this test has become a primary reference for identifying abnormalities in the thoracic cavity, such as pulmonary swelling, pulmonary emphysema, and pulmonary TB (Basem Abbas Al, 2018).

The weakness of chest X-ray examination is that it cannot provide information about TB infection in organs other than the lungs. Additionally, in some cases, a negative chest X-ray result may occur even though the patient is infected with TB, which could lead to delayed treatment and increase the risk of disease transmission (Basem Abbas Al, 2018).

The Molecular Rapid Test (TCM) is used to confirm a TB diagnosis using the nucleic acid amplification test (NAAT) method, which requires two quality sputum specimens (S-S or S-P). The sample processing time in TCM examination is less than 2 hours, and the results have a sensitivity of 90.2% and specificity of 86.9%. However, the drawback of TCM is its relatively high cost (Irgi Ahmad Fahrezi et al., 2024).

A study conducted by Alex at the Faculty of Medicine, University of Tanjungpura in June 2024 on the radiological features of lung lesions in drug-resistant tuberculosis (DR-TB) in Indonesia found that common active lesions in DR-TB radiographs include consolidation or ground-glass opacity, cavities, and infiltrates. Meanwhile, inactive lesions are dominated by fibrosis, with smaller numbers showing other lesions such as calcification, atelectasis, bronchiectasis, emphysema, and destroyed lungs. Although laboratory testing remains the main basis for TB diagnosis, understanding typical radiological findings that indicate DR-TB can aid in early detection and faster management (Basem Abbas Al, 2018).

Another study conducted by Sitti at Dr. H. Chasan Boesoirie Regional Hospital in Ternate in 2020 on the correlation between microscopic test results and the Molecular Rapid Test (TCM) in tuberculosis and multidrug-resistant tuberculosis (MDR-TB) patients found a significant correlation between the microscopic and TCM test results in suspected TB and MDR-TB patients at the hospital (Syafina, 2024).

According to data from the Tuberculosis Information and Reporting System through the TB Information System (SITB) application of the Pinrang District Health Office in 2023, there were 5,112 suspected TB cases and 685 confirmed TB patients. The disease was most prevalent in 12 sub-districts of Pinrang District (Kemenkes RI, 2023).

Based on this explanation, the researcher is interested in conducting a study titled "The Relationship Between Chest X-ray Results and Molecular Rapid Test (TCM) Results in Tuberculosis Patients at Lasinrang District General Hospital, Pinrang." The main reason behind this study is the high number of suspected TB cases in Pinrang District, South Sulawesi, one of the provinces with the highest TB cases in Indonesia, ranking 9th out of 34 provinces. This high case rate highlights the importance of early detection and accurate diagnosis in TB management, particularly through radiological and TCM

examinations. Through this study, it is hoped that more comprehensive insights will be gained into the effectiveness of using chest X-rays and TCM in detecting TB, which in turn can support improved diagnostic and treatment strategies in the region. In the early stages of tuberculosis (TB), chest x-ray and Molecular Rapid Test (TCM/GeneXpert MTB/RIF) have complementary roles but differ in characteristics. A chest x-ray is relatively quick, inexpensive, and widely available, making it a good initial screening tool because it can reveal lung abnormalities such as infiltrates or fine shadows that suggest TB. However, its results are nonspecific because similar findings can occur in other lung diseases, and in very early stages, TB lesions can be so small or faint that they are not readily apparent. In contrast, TCM works by detecting Mycobacterium tuberculosis DNA directly from sputum or other clinical specimens, making it much more specific and sensitive for confirming the diagnosis of active TB, even quickly identifying rifampin resistance. Its limitations include the need for a sufficient number of bacteria, which can lead to negative results in very early infections or latent TB, and its availability is limited in some health facilities due to its higher cost. Therefore, a chest x-ray is best used for initial suspicion, while TCM provides a more accurate confirmatory tool; the combination of the two allows for a faster and more accurate diagnosis of TB at an early stage (Irgi Ahmad Fahrezi et al., 2024).

2. Methods

This study applies an observational analytical design with a cross-sectional approach, which measures the independent and dependent variables simultaneously using secondary data from patient medical records. The research was conducted at Lasinrang District General Hospital, Pinrang, using a sample of 100 tuberculosis patients.

This study examined the relationship between various independent variables—including chest X-ray findings (infiltrate, consolidation, and fibrosis), as well as demographic characteristics such as gender and age group—and the dependent variable, which is the result of the Molecular Rapid Test (TCM), categorized as MTB detected (rifampicin sensitive) or MTB not detected. The analysis aimed to determine whether specific radiological findings and patient characteristics were associated with TCM results in tuberculosis patients at RSUD Lasinrang Pinrang. The collected data will be processed using Microsoft Excel Office 365 and the Statistical Program for Social Science (SPSS) software to analyze the relationship between these variables.

3. Results and Discussion

3.1. Results

In this study, after data collection was completed, univariate and bivariate analyses were conducted with a sample size of 100 participants. The characteristics of the respondents are presented in the following tables.

Characteristics of Patients

Table 1.
Gender Distribution at Lasinrang District General Hospital, Pinrang

Variables	Frequency	Percentage(%)
Age		
0-14 years	9	9,00
15-24 years	14	14,00
25-44 years	36	36,00
45-59 years	30	30,00
≥ 60 years	11	11,00
Gender		
Male	54	54,00
Female	46	46,00
Chest X-ray Results		
Infiltrate	80	80,00
Consolidation	12	12,00
Fibrosis	8	8,00

Variables	Frequency	Percentage(%)
Cavities	0	0,00
Pleural Efussion	0	0,00
Total	100	100,00

Based on the table 1, several patterns can be observed among tuberculosis (TB) patients treated at Lasinrang District General Hospital. The data show a slight male predominance, with 54% of TB patients being men compared to 46% women. This is consistent with global trends, where TB tends to affect men more frequently due to behavioral, occupational, and biological factors. The 25–44 year age group represented the largest proportion of TB cases (36%), followed by those aged 45–59 years (30%). These findings indicate that TB primarily affects individuals in their productive years, which has significant implications for public health and the economy. The least affected group was children aged 0–14 years (9%). The most common lesion observed was infiltrate (80%), a typical finding in pulmonary TB. Other abnormalities included consolidation (12%) and fibrosis (8%), while no cases of cavities or pleural effusion were detected. The predominance of infiltrates suggests active pulmonary involvement and highlights the utility of chest radiography in early TB detection.

Molecular Rapid Test (TCM) Results at Lasinrang District General Hospital

Table 2.
Distribution of Molecular Rapid Test (TCM) Results at Lasinrang District General Hospital

TCM Result	Frequency	Percentage(%)
MTB Not Detected	14	14,00
MTB Detected; Rifampicin Resistance Not Detected	86	86,00
Not Detected; Rif Resistance Detected	0	0,00
Detected; Rifampicin Resistance Detected	0	0,00
MTB Detected; Rif Resistance Indeterminate	11	11,00
Total	100	100,00

Out of 100 patients tested using the Molecular Rapid Test (TCM), the majority—86% (86 individuals)—had results showing "MTB DETECTED; Rifampicin Resistance NOT DETECTED", while 14% (14 individuals) had results of "MTB NOT DETECTED."

Correlation between Chest X-ray Results with Molecular Rapid Test (TCM)

Table 3.
Cross-tabulation Analysis of Chest X-ray Results with Molecular Rapid Test (TCM)

Chest X-ray	MTB DETECTED; Rif Resistance Not Detected	MTB Not Detected	Total	p-value
Fibrosis	8 (9,4%)	0 (0,0%)	8 (8,0%)	
Infiltrate	69 (80,2%)	11 (11,0%)	80 (80,0%)	
Consolidation	9 (10,4%)	3 (3,0%)	12 (12,0%)	0,031
Total	86 (86,2%)	14 (14,0%)	100	

Bivariate analysis was conducted using the Chi-square test to examine the potential association between the two variables. If the p-value < 0.05, the null hypothesis (H0) is rejected; if p > 0.05, H0 is accepted. Based on Table 8, the p-value obtained was 0.031 (p < 0.05), which means the alternative hypothesis (Ha) is accepted. This indicates that there is a statistically significant relationship between chest X-ray findings and TCM results in tuberculosis patients at Lasinrang District General Hospital, Pinrang.

In pulmonary tuberculosis, the pattern of infiltrates, consolidations, and fibrosis on chest radiographs reflects the different stages of the lung tissue response to Mycobacterium tuberculosis infection and the severity of the disease. Infiltrates occur early in the phase when TB bacilli trigger granulomatous inflammation in the alveoli and terminal bronchioles; they appear as patches or hazy shadows caused by the accumulation of inflammatory cells and exudate. As inflammation progresses,

consolidations develop, areas of the lung filled with exudate, necrotic cells, and granulomatous tissue, increasing in radiological density and making the radiographic appearance more homogeneous usually indicating more active or extensive disease. As the disease progresses or after treatment, the inflammatory process can leave fibrosis, which involves thickening of the bronchial walls, retraction of lung tissue, and architectural distortion due to collagen deposits and permanent scarring; fibrosis indicates chronic lung damage and residual lesions from long-standing or previously treated TB. Thus, infiltrates reflect early active infection, consolidations indicate high activity with more severe tissue damage, and fibrosis indicates healing or chronic residual damage.

3.2. Discussion

Surgical The data analysis results statistically indicate a correlation between chest X-ray findings and Molecular Rapid Test (TCM) results in tuberculosis patients at Lasinrang District General Hospital during the 2022–2023 period. A p-value of 0.031 ($p < 0.05$) was obtained, leading to the acceptance of the alternative hypothesis (Ha) and rejection of the null hypothesis (H0).

Chest X-ray results among tuberculosis patients revealed the presence of infiltrate lesions in 80 patients, consolidation lesions in 12 patients, and fibrosis lesions in 8 patients. Specifically, 69 patients with infiltrate lesions had positive TCM results, while 11 had negative TCM results. Among those with consolidation lesions, 9 were TCM-positive and 3 were TCM-negative. All 8 patients with fibrosis lesions had positive TCM results.

These findings indicate a significant association between chest X-ray abnormalities—such as infiltrates, consolidation, and fibrosis—and positive TCM results in tuberculosis patients at Lasinrang District General Hospital from January 2022 to December 2023.

False-negative results in the Molecular Rapid Test (TCM) are closely linked to the quality of processing and the characteristics of the sputum sample used. Sputum quality greatly affects the sensitivity of TCM in detecting Mycobacterium tuberculosis DNA. Key determinants of sputum quality include its volume, consistency, thickness, cleanliness, and staining quality. Inadequate sputum—such as watery or saliva-dominant samples—can yield a low bacterial load, which may result in false-negative outcomes (Media Analis Kesehatan et al., 2022)،(Pramana et al., 2021).

According to research, samples with fewer than 131 bacteria per milliliter are difficult to detect using TCM. This explains why TCM may fail to detect infections, particularly in early-stage TB cases or partially treated patients (Sina et al., 2022).

Thus, combining radiological examinations (like chest X-rays) with TCM testing is essential to improve diagnostic accuracy for tuberculosis. Chest X-rays help visualize lung lesions indicative of active or residual infection—such as infiltrates, cavities, or fibrosis. TCM and radiology complement each other in confirming TB diagnosis, minimizing false negatives, and supporting early detection.(Kronik et al., 2022)

This study identified 86 TB cases with TCM-positive results (Rifampicin-sensitive) and 14 TB cases with TCM-negative results. The most affected age group was 25–44 years (36%), and TB was more prevalent in males (54 patients) than females (46 patients). Radiologically, infiltrate lesions were most commonly found (80%), and 86 patients tested positive for MTB with Rifampicin-sensitive results.

These findings are consistent with a study by Rahmat (2022), conducted in the working area of Tegal Sari Health Center, Medan Denai District, which reported that TB incidence was highest in the 25–44 age group and predominantly affected males. This supports data from the Ministry of Health, indicating that TB incidence is 1.3 times higher in males than in females. Men are believed to be at greater risk due to higher activity levels, longer working hours, and lifestyle habits such as smoking and alcohol consumption—both of which weaken the immune system and increase susceptibility to tuberculosis (Sina et al., 2022).

Safitri (2022) also reported that infiltrates were the most commonly found lesions, suggesting that these represent an inflammatory response to Mycobacterium tuberculosis infection. Infiltrates reflect lung tissue damage and inflammation triggered by infection and are influenced by factors such as the patient's immune status (Kronik et al., 2022).

Based on the data, it was found that chest X-rays showing positive TCM results exhibited a

variety of lesions, including infiltrates, consolidation, and fibrosis. However, these lesion types were also seen in some patients with negative TCM results. Infiltrate lesions were the most commonly observed, occurring in both lungs or predominantly in one lung. For accurate diagnosis, it is important to also consider the patient's clinical symptoms and medical history (Ruswandi, 2021).

4. Conclusion

Based on the results of this study, it can be concluded that the majority of tuberculosis patients at Lasinrang Pinrang Regional Hospital were male (54 patients; 54%), while 46 patients were female (46%). The age group most frequently affected by tuberculosis was 25–44 years (36 patients; 36%), while the group least affected was children aged 0–14 years (9 patients; 9%). Chest X-ray examination showed that the most frequently found lesion was infiltrate (80 patients; 80%), followed by consolidation (12 patients; 12%) and fibrosis (8 patients; 8%). Of the 100 patients examined with the Molecular Rapid Test (TCM), 86 patients (86%) were detected with MTB without rifampicin resistance, while 14 patients (14%) were not detected with MTB. These findings indicate a significant correlation between radiological features and TCM results in confirming the diagnosis of tuberculosis. However, these conclusions should be interpreted with caution due to methodological limitations, such as the cross-sectional study design, which cannot confirm causality, the limited sample size, which may affect the power of the analysis, and confounding factors such as patient immune status and prior TB treatment history, which could not be fully controlled for. Therefore, further studies with prospective designs, larger sample sizes, and better control of confounding factors are needed to strengthen these findings.

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