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Evaluation of Liver Function in Pulmonary Tuberculosis Patients Undergoing Anti-Tuberculosis Drug Therapy at Pasar Rebo Regional General Hospital

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ABSTRACT
Tuberculosis (TB) remains a major public health concern in Indonesia, and its treatment using anti-tuberculosis drugs (ATDs) may cause hepatotoxicity, potentially affecting liver function. Monitoring liver function is therefore essential to identify possible adverse effects during ATD therapy. This study aimed to evaluate liver function in pulmonary tuberculosis patients undergoing ATD therapy at Pasar Rebo Regional General Hospital and to analyze the associations between patients' age, gender, and liver function parameters. This research employed an analytical observational design with a cross-sectional and retrospective approach using medical record data from 136 pulmonary tuberculosis patients selected through a total sampling technique. Liver function was assessed based on serum levels of aspartate aminotransferase (AST/SGOT), alanine aminotransferase (ALT/SGPT), and bilirubin. The data were analyzed using the Chi-Square test to determine the statistical associations between demographic characteristics and liver function parameters. The results showed that most respondents were young adults aged 18–40 years (37.5%) and male (60.3%). Regarding liver function, 59.6% of patients had normal AST levels, 76.5% had normal ALT levels, and 50.7% had normal bilirubin levels. Statistical analysis revealed significant associations between age and AST ($p = 0.029$), ALT ($p = 0.004$), and bilirubin levels ($p = 0.028$). Gender was also significantly associated with AST ($p = 0.028$) and ALT levels ($p = 0.000$), but not with bilirubin levels ($p = 0.889$). These findings indicate that age and gender are important demographic factors associated with variations in liver function among pulmonary tuberculosis patients receiving ATD therapy. Therefore, regular monitoring of liver function, particularly through AST, ALT, and bilirubin examinations, is recommended to support the early detection of potential hepatotoxicity and improve the safety of tuberculosis treatment.
Keyword: *Pulmonary Tuberculosis; Anti-Tuberculosis Drugs; Liver Function; SGOT; SGPT*

Introduction

Tuberculosis (TB) is a long-lasting infectious illness that continues to be a worldwide public health crisis and is the second leading cause of mortality following Human Immunodeficiency Virus (HIV) infection (Ramatillah et al., 2023). It is a persistent communicable disease brought about by the bacterium *Mycobacterium tuberculosis*. The illness primarily targets the lungs but can also affect other organs, including the kidneys, bones, and brain (Duko et al., 2020). According to a 2024 report by the World Health Organization (WHO), there were an estimated 10.8 million new tuberculosis (TB) cases worldwide in 2023. In the Southeast Asian region, the TB burden is extremely high and significantly

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contributes to global statistics. Indonesia and the Philippines are the two main countries that greatly impact global TB trends. Indonesia is responsible for about 10% of all global TB cases, while the Philippines contributes roughly 6.8%. This suggests that both nations encounter significant obstacles in controlling TB. Specifically, in 2023, it was estimated that there were about 1 million new TB cases in Indonesia and around 737 thousand cases in the Philippines, making Southeast Asia one of the primary focus regions in the global TB elimination strategy (WHO, 2024). Specifically in Indonesia, TB cases in 2023 were estimated to reach approximately 1 million new cases. This figure makes Indonesia one of the countries with the highest TB burden in the world. The high number of cases reflects various ongoing challenges, such as delayed diagnosis, non-adherence to treatment, and high rates of transmission within communities.

The DKI Jakarta Health Office (2023) reported that tuberculosis cases were more common in men, with 33,787 instances (56%), compared to women, who had 26,176 cases (44%). Regionally, the largest number of cases was found in East Jakarta (16,040 cases), followed by West Jakarta (12,667), South Jakarta (11,278), Central Jakarta (10,007), and the fewest in the Thousand Islands (46 cases). In 2022, Pasar Rebo Regional General Hospital (RSUD Pasar Rebo) documented a total of 403 tuberculosis (TB) cases in its service area. Among these, 251 cases were pulmonary TB, which is the most prevalent and infectious type of tuberculosis.

Pulmonary tuberculosis, also called pulmonary TB, is the most common type of TB.It is also the most contagious because it spreads when someone who has it coughs, sneezes, or talks, and releases tiny droplets into the air. Pulmonary TB is the main target of TB control programs because it plays a big role in spreading the disease in the community. To treat pulmonary tuberculosis, the usual approach is to use first-line anti-Tuberculosis drugs.This treatment includes four medicines: Isoniazid (H), Rifampicin (R), Pyrazinamide (Z), and Ethambutol (E). This combination is known by the abbreviation HRZE. Isoniazid stops the bacteria from making mycolic acid, which is a key part of the cell wall that helps the bacteria survive. Rifampicin stops the RNA polymerase enzyme from working, which stops the production of RNA. Pyrazinamide changes into pyrazinoic acid, which stops important functions in the bacterial cell. Ethambutol stops the enzyme arabinosyltransferase from working, which messes up the bacteria's cell wall building process (Peloquin and Davies, 2021). The group of medicines including isoniazid, rifampicin, pyrazinamide, and ethambutol is often used together to treat tuberculosis. However, liver damage caused by drugs is a serious problem when treating tuberculosis, and it can make patients stop taking their medicine, lead to treatment not working, or cause the bacteria to become resistant to the drugs. Taking medications for tuberculosis can sometimes cause liver damage, and the severity of this damage can be different for each person. In some less severe cases,

the liver enzymes ALT and AST become higher, but the patients don't notice any symptoms. In more serious situations, this condition can cause inflammation of the liver, known as acute hepatitis, and in some cases, it can lead to liver failure.When the liver stops working properly, it can be very dangerous to a person's life (Zhao et al., 2020).

Toxic effects on the liver from anti-tuberculosis drugs (OAT) often happen within two months of starting treatment, and they most commonly occur during the first two weeks. This condition is hard to predict because a lot of things can affect when it happens. Several things can make someone more likely to experience liver damage while being treated for tuberculosis.These include a person's weight, how fast their body breaks down the drug isoniazid (INH), their age, gender, overall health, using other medicines at the same time, and drinking alcohol (Soedarsono & Riadi, 2020; Zeleke et al., 2020). The signs of liver damage, which is called hepatotoxicity, can include pain in the abdomen, feeling sick, throwing up, and a yellow color in the skin or the whites of the eyes, known as jaundice. Earlier research found that after three months of taking anti-tuberculosis drugs, the total bilirubin levels in the participants went up by 0.23 mg/dL. Other results show that 7.9% of people with tuberculosis have liver damage, which happens because of the medicines used to treat tuberculosis. (Kumar et al., 2020) (Siregar et al., 2024) (Molla et al., 2021).

Methods

This study employed an analytical observational research design with a cross-sectional approach and retrospective data collection. The research was conducted at Pasar Rebo Regional General Hospital, Jakarta, using secondary data obtained from the medical records of patients diagnosed with pulmonary tuberculosis who received anti-tuberculosis drug (ATD) therapy. The study population consisted of all pulmonary tuberculosis patients undergoing ATD treatment during the study period. A total of 136 patients were included as research respondents. The sampling technique used was total sampling, in which all patients who met the research criteria were included in the study. Data collection focused on patients' sociodemographic characteristics, particularly age and gender, as well as laboratory parameters related to liver function. Liver function was evaluated based on serum levels of aspartate aminotransferase (AST/SGOT), alanine aminotransferase (ALT/SGPT), and bilirubin. AST levels were categorized as normal (≤40 U/L) and abnormal (>40 U/L), while ALT levels were classified as normal (≤56 U/L) and abnormal (>56 U/L). Bilirubin levels were categorized as normal (0.2–1.2 mg/dL) and abnormal (>1.2 mg/dL). Data analysis consisted of univariate and bivariate analyses. Univariate analysis was conducted to describe the distribution of respondents' characteristics and liver function parameters using frequency distributions and percentages. Bivariate analysis was performed using the Chi-Square statistical test to examine the associations between age, gender, and liver function parameters. Statistical significance was determined at a p-value of less

than 0.05. The results were used to identify demographic factors associated with changes in liver function among pulmonary tuberculosis patients receiving ATD therapy.

Result and Discussion

1.1 Result

Univariate Analysis

Table 1 Respondent's Age

Age	f	%
Young adulthood (18–40 years)	51	37.5
Middle adulthood (41–60 years)	40	29.4
Older adulthood (>60 years)	45	33.1
Total	136	100.0

Based on the table above, it is known that the majority of respondents were in the young adult age group (18–40 years), totaling 51 respondents (37.5%). The elderly group (>60 years) consisted of 45 respondents (33.1%), while the middle-aged adult group (41–60 years) comprised 40 respondents (29.4%).

Table 2 Respondent's gender

Gender	f	%
Male	82	60.3
Female	54	39.7
Total	136	100.0

Based on the table above, it is known that the majority of respondents were male, totaling 82 individuals (60.3%), while there were 54 female respondents (39.7%).

Table 3 SGOT/AST level

SGOT/AST level	f	%
Normal SGOT (AST) ≤ 40U/L	81	59.6
Abnormal SGOT (AST) > 40U/L	55	40.4
Total	136	100.0

Based on the table above, it is known that the majority of respondents had normal SGOT/AST levels, totaling 81 individuals (59.6%), while 55 respondents (40.4%) had abnormal SGOT/AST levels.

Table 4 SGPT/ALT level

SGPT/ALT level	f	%
Normal SGPT (ALT) ≤ 56 U/L	104	76.5
Abnormal SGPT (ALT) > 56 U/L	32	23.5
Total	136	100.0

Based on the table above, it is known that the majority of respondents had normal SGPT/ALT levels, totaling 104 individuals (76.5%), while 32 respondents (23.5%) had abnormal SGPT/ALT levels.

Table 5 Bilirubin level

Bilirubin level	f	%
Normal 0.2-1.2mg/Dl	69	50.7
Abnormal >1.2mg/Dl	67	49.3
Total	136	100.0

Based on the table above, it is known that 69 respondents (50.7%) had normal bilirubin levels, while 67 respondents (49.3%) had abnormal bilirubin levels.

Bivariate Analysis

Table 6 Bivariate Analysis of Age on Liver Function Based on SGOT

Age		SGOT/AST level		Total	P-Values
		Normal (AST) ≤ 40U/L	Abnormal (AST) > 40U/L		
Young adulthood (18–40 years)	f	30	21	51	0,029
	%	22.1%	15.4%	37.5%	
Middle adulthood (41–60 years)	f	30	10	40	
	%	22.1%	7.4%	29.4%	
Older adulthood (>60 years)	f	21	24	45	
	%	15.4%	17.6%	33.1%	
Total	f	81	55	136	
	%	59.6%	40.4%	100.0%	

Based on the table above, it is known that in the young adult group, there were 30 respondents (22.1%) with normal SGOT levels and 21 respondents (15.4%) with abnormal SGOT levels. The Chi-Square test results showed a p-value of 0.029 ($p < 0.05$), indicating that there is a statistically significant association between age and liver function, as measured by SGOT/AST levels, among pulmonary tuberculosis patients undergoing anti-tuberculosis drug (OAT) therapy at Pasar Rebo Regional General Hospital.

Table 7 Bivariate Analysis of Age on Liver Function Based on SGPT

Age		SGPT/ALT level		Total	P-Values
		Normal (ALT) ≤ 56 U/L	Abnormal (ALT) > 56 U/L		
Young adulthood (18–40 years)	f	41	10	51	0,004
	%	30.1%	7.4%	37.5%	
Middle adulthood (41–60 years)	f	36	4	40	
	%	26.5%	2.9%	29.4%	
Older adulthood (>60 years)	f	27	18	45	
	%	19.9%	13.2%	33.1%	
Total	f	104	32	136	
	%	76.5%	23.5%	100.0%	

Based on the table above, it is known that the young adult group consisted of 41 respondents (30.1%) with normal SGPT levels and 10 respondents (7.4%) with abnormal SGPT levels. The Chi-Square test results showed a p-value of 0.004 ($p < 0.05$), indicating that there is a statistically significant association between age and liver function, as measured by SGPT/ALT levels, among pulmonary tuberculosis patients undergoing anti-tuberculosis drug (OAT) therapy at Pasar Rebo Regional General Hospital.

Table 8 Bivariate Analysis of Age on Liver Function Based on Bilirubin

Age		Bilirubin level		Total	P-Values
		Normal 0.2-1.2mg/Dl	Abnormal >1.2mg/Dl		
Young adulthood (18–40 years)	f	32	19	51	0,028
	%	23.5%	14.0%	37.5%	
Middle adulthood (41–60 years)	f	21	19	40	
	%	15.4%	14.0%	29.4%	
Older adulthood (>60 years)	f	16	29	45	
	%	11.8%	21.3%	33.1%	
Total	f	69	67	136	

	%	50.7%	49.3%	100.0%

Based on the table above, it is known that in the young adult group, there were 32 respondents (23.5%) with normal bilirubin levels and 19 respondents (14.0%) with abnormal bilirubin levels. The Chi-Square test results showed a p-value of 0.028 (p<0.05), indicating that there is a significant association between age and liver function based on bilirubin levels in pulmonary tuberculosis patients undergoing anti-tuberculosis drug (OAT) therapy at Pasar Rebo Regional General Hospital.

Table 9 Bivariate Analysis of Gender and Liver Function Based on SGOT

Gender		SGOT/AST level			P-Values
		Normal SGOT (AST) ≤ 40U/L	Abnormal SGOT (AST) > 40U/L	Total	
Male	f	55	27	82	0,028
	%	40.4%	19.9%	60.3%	
Female	f	26	28	54	
	%	19.1%	20.6%	39.7%	
Total	f	81	55	136	
	%	59.6%	40.4%	100.0%	

Based on the table above, it is known that there were 55 male respondents (40.4%) with normal SGOT levels and 27 respondents (19.9%) with abnormal SGOT levels. Among the female respondents, 26 individuals (19.1%) had normal SGOT levels, while 28 individuals (20.6%) had abnormal SGOT levels. The Chi-Square test results showed a p-value of 0.028 (p<0.05), indicating that there is a statistically significant association between sex and liver function based on SGOT/AST levels in pulmonary tuberculosis patients undergoing anti-tuberculosis drug (OAT) therapy at Pasar Rebo Regional General Hospital.

Table 10 Bivariate Analysis of Gender and Liver Function Based on SGPT

Gender		SGPT/ALT level			P-Values
		Normal SGPT (ALT) ≤ 56 U/L	Abnormal SGPT (ALT) > 56 U/L	Total	
Male	f	72	10	82	0,000
	%	52.9%	7.4%	60.3%	
Female	f	32	22	54	
	%	23.5%	16.2%	39.7%	
Total	f	104	32	136	
	%	76.5%	23.5%	100.0%	

Based on the table above, it is known that there were 72 male respondents (52.9%) with normal SGPT levels and 10 respondents (7.4%) with abnormal SGPT levels.

Meanwhile, among female respondents, 32 (23.5%) had normal SGPT levels and 22 (16.2%) had abnormal SGPT levels. The Chi-Square test results showed a p-value of 0.000 ($p < 0.05$), indicating that there is a significant association between sex and liver function based on SGPT/ALT levels in pulmonary tuberculosis patients undergoing anti-tuberculosis drug (OAT) therapy at Pasar Rebo Regional General Hospital.

Table 11 Bivariate Analysis of Gender and Liver Function Based on Bilirubin

Gender		Bilirubin level		Total	P-Values
		Normal 0.2-1.2mg/dL	Abnormal >1.2mg/dL		
Male	f	42	40	82	0,889
	%	30.9%	29.4%	60.3%	
Female	f	27	27	54	
	%	19.9%	19.9%	39.7%	
Total	f	69	67	136	
	%	50.7%	49.3%	100.0%	

Based on the table above, it is known that there were 42 male respondents (30.9%) with normal bilirubin levels and 40 respondents (29.4%) with abnormal bilirubin levels. Among the female respondents, there were 27 individuals (19.9%) with normal bilirubin levels and 27 individuals (19.9%) with abnormal bilirubin levels. The Chi-Square test results showed a p-value of 0.889 ($p > 0.05$), indicating that there was no statistically significant association between sex and liver function based on bilirubin levels among pulmonary tuberculosis patients undergoing anti-tuberculosis drug (OAT) therapy at Pasar Rebo Regional General Hospital.

1.2 Discussion

Based on the research findings, the age distribution of respondents indicates that the young adult age group (18–40 years) constituted the largest group, with a total of 51 respondents (37.5%). These findings indicate that pulmonary tuberculosis patients undergoing Anti-Tuberculosis Drug (ATD) therapy at Pasar Rebo Regional General Hospital are predominantly from the productive-age group. A dense work environment and the high frequency of interactions with many people are among the factors that increase the risk of tuberculosis among the productive-age population. Individuals within this age range generally have high mobility due to their involvement in various work-related, educational, and other social activities, thereby increasing the likelihood of coming into contact with people infected with tuberculosis. This condition raises the risk of exposure to Mycobacterium tuberculosis compared with age groups whose activities are more limited (Andira et al., 2024).

Based on the research findings, the distribution of respondents by gender showed that the majority of pulmonary tuberculosis patients undergoing Anti-Tuberculosis Drug (ATD) therapy at Pasar Rebo Regional General Hospital were male, totaling 82 patients (60.3%). Furthermore, epidemiological data indicate that the highest prevalence of pulmonary tuberculosis (TB) by sex is found among males, at 0.38%, equivalent to 168,439 cases. The consistency of these findings suggests that the predominance of male patients in this study is not merely a local phenomenon, but also reflects the pattern of tuberculosis occurrence observed across various studies and national data. The high incidence of tuberculosis among men can be influenced by various behavioral and lifestyle factors associated with an increased risk of infection. According to Handayani (2023), men tend to pay less attention to their health and are more likely to engage in habits that are risk factors for TB, such as smoking. Furthermore, Tutuhatunewa and Hardia (2024) explain that men are more susceptible to TB because they have a higher tendency to smoke and consume alcohol. These habits can weaken the immune system, thereby increasing susceptibility to Mycobacterium tuberculosis infection. A weakened immune response makes the body less effective at fighting bacteria that enter the respiratory tract, resulting in a greater risk of both infection and disease progression.

Based on the research findings, it was found that the majority of respondents had SGOT/AST levels within the normal range, totaling 81 individuals (59.6%), while 55 respondents (40.4%) had abnormal SGOT/AST levels. These findings indicate that most patients with pulmonary tuberculosis undergoing Anti-Tuberculosis Drug (ATD) therapy at Pasar Rebo Regional General Hospital still had relatively good liver function based on the SGOT/AST parameter. The results suggest that although the patients were receiving ATD therapy, which is known to have the potential to cause hepatotoxic effects, most of them had not yet experienced an increase in SGOT levels beyond the normal range. Nevertheless, the results of this study indicate that more than half of the respondents still had normal SGOT levels. Hepatotoxicity is primarily associated with isoniazid (INH), rifampicin (RIF), and pyrazinamide (PZA) among first-line anti-tuberculosis drugs (ATDs), rather than with all ATD components. Ethambutol (E) is not considered a major hepatotoxic drug; therefore, in certain patients whose metabolism efficiently processes INH/RIF/PZA, the liver remains able to tolerate the associated metabolic burden (Banjuradja and Singh, 2020).

Based on the study results, it was found that the majority of respondents had SGPT/ALT levels within the normal range, totaling 104 individuals (76.5%), while 32 respondents (23.5%) had abnormal SGPT/ALT levels. These findings indicate that most patients with pulmonary tuberculosis undergoing Anti-Tuberculosis Drug (ATD) therapy at Pasar Rebo Regional General Hospital still had good liver function based on the SGPT/ALT parameter. The high proportion of respondents with normal SGPT levels in this study suggests that the liver function of most patients was still able to adapt to the metabolic process of Anti-Tuberculosis Drugs (ATDs). This condition can be explained by the occurrence of pharmacokinetic tolerance, which refers to changes in the drug distribution and metabolism processes following repeated use over a certain period.

Based on the research findings, it was found that 69 respondents (50.7%) had normal total bilirubin levels, while 67 respondents (49.3%) had abnormal total bilirubin levels. These results indicate that the proportion of patients with normal bilirubin levels was slightly higher than that of patients with abnormal bilirubin levels. The finding that more than half of the respondents still had normal bilirubin levels suggests that hepatic excretory function in the majority of patients remained well preserved despite undergoing anti-tuberculosis drug (OAT) therapy. This indicates that the liver was still able to process and excrete bilirubin effectively, thereby preventing excessive accumulation of bilirubin in the blood.

Conclusion

Based on the results of the study on the Evaluation of Liver Function in Pulmonary Tuberculosis Patients Undergoing Anti-Tuberculosis Drug Therapy at Pasar Rebo Regional General Hospital, it can be concluded that the patient characteristics were predominantly young adults and male. The evaluation of liver function based on SGOT/AST and SGPT/ALT levels showed that most patients remained within the normal range, while bilirubin levels demonstrated a relatively balanced proportion between the normal and abnormal categories. Further analysis indicated that age had a significant effect on liver function based on SGOT/AST, SGPT/ALT, and bilirubin levels. In addition, sex also had a significant effect on liver function based on SGOT/AST and SGPT/ALT levels; however, it did not show a significant effect on bilirubin levels in pulmonary tuberculosis patients undergoing anti-tuberculosis drug therapy at Pasar Rebo Regional General Hospital.

Recommendations

This study only analyzed age and gender, so other factors that may affect liver function, such as treatment duration, nutritional status, body mass index, alcohol consumption, smoking habits, comorbidities, and the use of other medications, were not analyzed. The study was also conducted at a single hospital with a sample size of 136 patients, so the findings cannot yet be widely generalized. Future researchers are therefore advised to examine other factors that may affect liver function in patients with pulmonary tuberculosis. In addition, prospective studies with larger sample sizes could be conducted to obtain a more comprehensive picture of changes in liver function during anti-tuberculosis drug therapy.

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