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Original Article

Biochemical and Hematological Biomarkers in Multi Drug Resistant Tuberculous Cases in Bahawal Victoria Hospital Bahawalpur

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ABSTRACT

Objective: To identify hematological and biochemical alterations in patients infected with multidrug-resistant tuberculosis (MDR-TB)

Methodology: A cross-sectional analytical study was conducted in Pulmonology Department of Quaid-e-Azam Medical College Bahawalpur from 20-04-24 to 30-09-25.. Total number of 133 patients diagnosed as MDR-TB were included. Haematological parameters including haemoglobin levels, whereas, biochemical variables including serum urea, creatinine, alanine aminotransferase and glucose were analysed. Demographic features included age gender body mass index, smoking and other associated medical conditions like diabetes mellitus, hepatitis, hypertension and HIV were observed.

Results: Results were analysed using SPSS version 26. Mean values of different demographic features were obtained. Similarly, mean, SD, and p values of different haematological and biochemical parameters were analysed. Serum glucose was found to be significantly raised in elderly patients ($p<0.003$). serum urea was also significantly raised in elderly patients ($p< 0.0001$) and in males as compared to females ($p < 0.003$). serum ALT and creatinine values were found to be insignificant in our study. Our results revealed that BMI was significantly different ($p<0.003$) among young patients (age <45 years). Haemoglobin to be significantly lower in females ($p< 0.001$).

Conclusion: Haematological and biochemical abnormalities are common in MDR-TB patients and can help in diagnosis and monitoring treatment response. Second-line anti-tubercular drugs may cause adverse effects such as liver and kidney dysfunction, hyperuricemia, and increased creatinine and urea levels. Regular laboratory monitoring is essential to detect complications early and improve treatment adherence.

Keywords: COPD, Depression, Prevalence, Risk factors

Introduction

Tuberculosis (TB) remains one of the leading causes of death among infectious diseases worldwide.[1] Multidrug resistance (MDR-TB) refers to the resistance of *Mycobacterium tuberculosis* to both isoniazid (INH) and rifampicin (RMP), the two most potent first-line anti-tubercular drugs.[2] Although anti-tuberculosis treatment itself may influence haematological parameters, alterations in peripheral blood indices are often considered important indicators for diagnosis, prognosis, and monitoring the response to treatment in patients with multidrug-resistant tuberculosis (MDR-TB).[3] Therefore, these abnormalities are commonly examined during detailed clinical evaluations.

In addition, significant abnormalities in peripheral blood and bone marrow may also occur in patients with HIV. Diabetes mellitus (DM) significantly increases the risk of developing tuberculosis (TB)[4] Diabetic patients[5] with TB require careful management during anti-tubercular therapy due to a higher risk of adverse drug reactions. The association between diabetes and TB is particularly evident in younger individuals.[6] A low BMI at the initiation of RR-TB treatment is associated with a greater risk of poor treatment outcomes, particularly higher mortality.[7]

Anemia in tuberculosis is multifactorial, caused by infections or micronutrient deficiencies.8 Effective management requires identifying its underlying cause.[9] This study aimed to assess the haematological and biochemical profiles of MDR-TB patients before and during second-line treatment. Furthermore, the emergence of resistance to first-line drugs (FLDs) and second-

line drugs (SLDs) used in the treatment of tuberculosis (TB) has become a major public health concern in Pakistan and a significant barrier to effective TB control.[10] Regions with inadequate TB control programs often report higher rates of drug-resistant TB. Appropriate and effective initial treatment is widely recognized as a key measure for preventing the development of drug resistance.[11] Therefore, it is essential to examine patient characteristics and contributing factors, including age, gender, BMI, smoking, addictions, and comorbidities like diabetes anaemia that may play a role in the development of resistance.

Moreover, information regarding the pretreatment evaluation of patients with multidrug-resistant tuberculosis (MDR-TB) in Pakistan is scarce.[12] This study reports the clinical characteristics of these patients, the comorbidities detected during treatment of MDR-TB, and the adverse drug reactions (ADRs) observed after treatment initiation, emphasizing the challenges involved in their management at Directly Observed Treatment Short-course (DOTS-Plus) sites. This study was conducted to determine the levels of urea, creatinine, glucose and haemoglobin in patients with MDR-TB who are receiving treatment at Bahawal Victoria Hospital Bahawalpur.

Methodology

A cross-sectional analytical study was designed at Pulmonology Department QAMC in collaboration with Department between 20-04-24 to 30-09-25. A total of 133 pulmonary TB patients comprised of 83 males and 50 females of age between 14- 85 years were included. Written consents were taken from each patient on a Performa. Body mass index (BMI) was obtained by measuring their weight in kilograms and height in meters. Other demographic features like history of smoking, addiction prior HIV Hepatitis infections and Diabetes were observed by taking detailed history and were noted on written Performa. Different haematological parameters of both patients and control group were immediately analyzed after collecting 5 ml of blood. The haematological analyser (swelab alfa) was used for haemoglobin estimation. Biochemical investigation include serum urea alanine aminotransferase glucose and creatinine were analyzed on chemistry analyzer (Cobos C 303). MDR-TB cases confirmed by culture or identified as RR using GeneXpert were included. Whereas, patients who were not Rifampicin Resistant, were excluded from the study.

Results

A total number of 133 patients of MDR-TB patients including 83 males (62.4%) and 50 (37.6%() females. All the patients were of age between 14-85 years and were divided into <45years 73(54.9%) >45years 60 (45.1%). 97 (72.9%) of the total patients had no previous comorbid condition, whereas, 26 (19.5%) were known to have Diabetes Mellitus. Similarly, 8 (6.0%) were having Hepatitis infection and only one patient was known hypertensive and one patient was HIV positive. Other behavioural conditions including 45 (33.8%) were smokers, 03(2.3%) were taking Naswar, and one was known addict.

There was a significant decrease in BMI among patients under 45 years A significant difference in hemoglobin concentration was observed in the females as compared to males (P = 0.001). blood glucose level was also significantly raised (129mg/dl) in elderly patients >45 years (p < 0.003). similarly, blood urea was also raised in elderly (p<0.0001) males (p<0.003). our results revealed no significant raise in serum creatinine level in both gender (p< 0.316).

Table I: Population characteristics of Drug-resistant Pulmonary TB.(n=133)

		N	%
Age (years)	≤45	73	54.9%
	>45	60	45.1%
Sex	Male	83	62.4%
	Female	50	37.6%
H/o previous treatment	New	59	44.4%
	Previously treated FLD	74	55.6%
Medical Condition	None	97	72.9%
	Diabetes mellitus	26	19.5%
	Hepatitis	08	6.0%
	Hypertension	01	0.8%
	HIV/ AIDS	01	0.8%
Behavioural Conditions	None	84	63.2%
	Smoking	45	33.8%
	Naswar	03	2.3%
	Drugs addiction	01	0.8%
Resistance category	RR-TB	52	39.1%
	MDR-TB	40	30.1%
	Pre-XDR-TB	36	27.1%
	Indeterminate	05	3.8%

Table II: Comparison between age-groups ≤45 and >45 years.					
	Age (years)				*P**
	≤45		>45		
	Mean	SD	Mean	SD	
Body mass index (Kg/m2)	18.0	3.5	19.9	3.7	0.003
Hemoglobin (g/dl)	11.7	1.7	12.2	1.8	0.159
Blood glucose (mg/dl)	103	71	156	129	0.003
Alanine transaminase (u/l)	29	21	24	16	0.107
Blood urea (mg/dl)	19.2	6.9	30.5	17.0	<0.0001
Serum creatinine (mg/dl)	0.6	0.1	1.8	7.5	0.175
**Student sample t test; Two-tailed P ≤0.05 taken significant.*					

Table III: Comparison between male and female.					
	Gender				*P**
	Male		Female		
	Mean	SD	Mean	SD	
Body mass index (Kg/m2)	19.4	3.6	18.0	3.8	0.038
Hemoglobin (g/dl)	12.4	1.8	11.1	1.4	<0.001
Blood glucose (mg/dl)	133	103	117	107	0.398
Alanine transaminase (u/l)	29	21	24	15	0.143
Blood urea (mg/dl)	27.0	15.8	19.8	7.0	0.003
Serum creatinine (mg/dl)	1.5	6.4	0.6	0.1	0.310

Discussion

Patients with type 1 diabetes mellitus are more susceptible to TB than those with type 2 diabetes mellitus, possibly due to longer disease duration and difficulty in controlling hyperglycaemia.[13] The risk of TB is also higher among insulin-dependent patients especially those requiring high insulin doses.[14] In contrast to these observations our results show increased blood glucose level in elderly patients e.g. 129mg/dl (p< 0.003), sounds poor glycaemic control is strongly associated with an increased likelihood of developing tuberculosis.

Furthermore, a BMI below 18.5 kg/m² was identified as an independent risk factor for delayed sputum culture conversion within the first 3 months among MDR-TB patients.[15] This is in contrast to emerging evidence suggests that overweight and obesity may contribute to the risk of MDR-TB, especially among Asian populations, highlighting the need to consider metabolic and nutritional factors in TB control strategies. [16]

I addition to that, among individuals with anemia, tuberculosis creates an additional health burden. Anemia can increase a person's vulnerability to infectious diseases, including tuberculosis, by weakening the immune system.[17] Hematological parameters are important in guiding treatment strategies and influencing patient outcomes. Evaluating infectious diseases through hematological markers is essential for improving treatment success, survival, and quality of life. Hence, this study found significant differences in blood parameters reported that anemia is the most common abnormality and risk factor in all forms of tuberculosis.[18]

Moreover, an increase in blood levels of urea, uric acid, creatinine, and albumin can indicate impaired kidney function, certain medications used in treatment, such as the nephrotoxic drug Kanamycin, may accumulate in the proximal tubules of the kidneys, reduce the glomerular filtration rate, and subsequently influence creatinine levels.[19] However, our study showed no significant raise in serum creatinine levels among patients of all age groups (P<0.175) and both gender (p<0.31) whereas, there is significant raise in blood urea level among elderly >45 years old patients (p<0.0001) and in male patients (p<0.003).[20]

Alanine aminotransferase (ALT) levels were significantly higher (P < 0.05) in both the TB and TB-HCV patient groups.[21] whereas, in our study ALT was not significantly raised p<0.107 in patients aged <45 years or >45 years, or in males and females p<0.143.

The study found that the high occurrence of MDR-TB patients with co- morbidities like diabetes, anemia and malnutrition underscores the need for thorough screening of comorbidities before starting anti-TB therapy. Furthermore, hematological findings in MDR-TB patients

highlight the importance of investigating related abnormalities to exclude infectious and metabolic co-infections prior to treatment initiation.

Conclusion

Hematological and biochemical abnormalities are common in multidrug-resistant tuberculosis (MDR-TB) and can aid in diagnosis as well as in monitoring treatment response. MDR-TB therapy, particularly second-line anti-tubercular drugs, often causes adverse biochemical changes that affect liver and kidney function, including drug-induced hyperuricemia and increased serum creatinine and urea levels. These complications may prolong treatment and increase hospitalization if not identified early. Regular laboratory monitoring of hematological parameters, renal and liver function tests, and serum electrolytes is therefore essential. Early detection and proper management of adverse drug reactions can reduce morbidity and mortality, minimize complications, and improve patient adherence to MDR-TB treatment.

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