



Original Article

A Five-Year Analysis of Secondary Infections and Antimicrobial Resistance in Post-Tuberculosis Patients at a Tertiary Care Hospital in Bangladesh

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Abstract

Background: Pulmonary tuberculosis (PTB) remains a major public health concern in Bangladesh, with post-treatment complications and antimicrobial resistance posing significant challenges for patient management. This study aimed to investigate the microbial infection patterns, demographic characteristics, and antimicrobial resistance trends in post-PTB patients over a five-year period in Cumilla, Bangladesh.

Methods: This observational study was conducted from January 2010 to December 2014 at the Department of Internal Medicine, BSMMU. A total of 166 post-PTB patients aged 20 years and older were enrolled. Data on demographics, clinical characteristics, and comorbidities were collected using a structured questionnaire. Standard Culture and Sensitivity (C&S) tests were performed on sputum samples using the Kirby-Bauer disk diffusion method. Data were analyzed using SPSS version 25, applying descriptive statistics and chi-square tests to evaluate associations between demographic variables and microbial patterns.

Results: The majority of participants were male (66.27%) and aged between 51-70 years (60.25%). Most participants were farmers (40.96%) with a monthly income between 5000 and 10000 BDT (51.81%). Comorbid conditions included COPD (36.14%), diabetes (25.30%), and hypertension (20.48%). Elevated inflammatory markers were evident with a mean WBC count of 11036.34 ± 4770.48 and ESR of 31.42 ± 12.15 . The highest antimicrobial sensitivity was observed for Levofloxacin (33.73%) and Ciprofloxacin (26.51%), while significant resistance was noted against Cefixime (48.19%), Cefuroxime (46.99%), and Azithromycin (42.17%).

Conclusion: This study underscores the high burden of comorbidities and significant antimicrobial resistance among post-PTB patients. There is a pressing need for integrated care strategies and continuous surveillance of antimicrobial susceptibility to inform tailored treatment protocols. Effective management of multidrug-resistant TB requires localized epidemiological data and comprehensive healthcare approaches.

Keywords: Pulmonary Tuberculosis, Antimicrobial Sensitivity, Antimicrobial Resistance

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Introduction

Tuberculosis (TB) remains a profound global health challenge, accounting for approximately 10 million new cases and 1.5 million deaths annually, ranking it among the top ten causes of mortality worldwide. In Bangladesh, TB continues to pose a substantial public health burden, particularly affecting populations in rural areas and urban slums where healthcare infrastructure is often insufficient to meet community needs.¹ Socioeconomic factors such as poverty, overcrowded living conditions, and limited access to healthcare services further aggravate the spread of TB, creating significant obstacles to effective disease management and treatment. Despite the introduction of multiple TB control initiatives, Bangladesh continues to grapple with challenges in ensuring early diagnosis, timely initiation of treatment, and comprehensive disease management, especially in underserved rural communities. The National Tuberculosis Control Program (NTP) leads the country's response to TB through an integrated network of public and private healthcare facilities. However, issues such as underreporting, suboptimal implementation of infection control practices, and delays in diagnostic and therapeutic interventions continue to undermine the effectiveness of these efforts.² Research has emphasized the need for stronger implementation of TB infection control protocols and enhanced training for healthcare providers to boost the efficacy of control measures in Bangladesh. Post-tuberculosis (PTB) complications, encompassing a spectrum of pulmonary and extrapulmonary issues, present considerable clinical challenges for individuals who have completed TB treatment. Residual lung damage, persistent respiratory complications, and ongoing inflammation leave PTB patients highly vulnerable to secondary infections. Studies have highlighted prevalent complications among PTB patients, such as bronchiectasis, chronic pulmonary aspergillosis, and recurrent bacterial infections, underscoring the critical need for continuous monitoring and management of these individuals. The emergence of multidrug-resistant pathogens complicates the management of secondary infections, making it essential to implement targeted antimicrobial therapies based on localized epidemiological data.^{3,4} Research on healthcare-seeking behavior among TB patients in rural Bangladesh has revealed significant delays in diagnosis and treatment, often driven by economic constraints and a lack of awareness, which further fuel the persistence and spread of the disease. Localized epidemiological data play a pivotal role in enabling healthcare providers to customize treatment approaches according to population-specific needs. Community-based TB treatment initiatives in Bangladesh have shown success in enhancing treatment enrollment and adherence, minimizing diagnostic delays, and improving cure rates.⁵ These programs highlight the effectiveness of decentralized care models in addressing regional disparities and strengthening TB control efforts. In conclusion, although notable progress has been made in

TB control within Bangladesh, significant hurdles persist, particularly in addressing post-tuberculosis complications and managing secondary infections. Despite the relatively extensive healthcare infrastructure, further improvements are needed to tackle these ongoing challenges effectively. The implementation of robust infection control measures, improved healthcare worker training, and the application of localized epidemiological data are vital for advancing TB management and improving patient outcomes. Continued research and increased healthcare investment are critical to consolidating gains in the fight against TB and mitigating the long-term health impacts associated with the disease.

Methods

This observational study was conducted at the Department of Internal Medicine, BSMMU, over a five-year period from January 2010 to December 2014. A total of 166 patients who had successfully completed treatment for Pulmonary Tuberculosis (PTB) were enrolled in the study. Eligibility criteria required participants to be 20 years of age or older and willing to provide informed consent. Individuals under 20 years or those unwilling to participate were excluded from the study. To evaluate antimicrobial sensitivity and resistance patterns, standard Culture and Sensitivity (C&S) tests were performed on sputum samples from all participants. The tests were conducted in the hospital's microbiology laboratory using the Kirby-Bauer disk diffusion method, adhering to standard guidelines for antimicrobial susceptibility testing. Demographic and baseline clinical information was collected using a structured questionnaire. This included data on age, gender, socioeconomic status, smoking history, duration of TB treatment, and any existing comorbidities. All collected data were systematically compiled and analyzed using SPSS software version 25. Descriptive statistics were applied to summarize demographic characteristics, clinical profiles, and microbial patterns. Additionally, chi-square tests were conducted to determine associations between various demographic variables and microbial infection patterns, with statistical significance set at $p < 0.05$.

Results

Table 1 illustrates the distribution of baseline characteristics. Most participants (31.33%) were aged between 61-70 years, followed by 28.92% in the 51-60 age group. The majority were male (66.27%). In terms of occupation, farming was predominant (40.96%), while private jobs (31.33%) and housewives (22.89%) followed. Regarding socioeconomic status, over half of

the participants (51.81%) had a family income ranging from 5000 to 10000 BDT per month. Table 2 highlights the clinical characteristics and comorbidities among participants. Chronic Obstructive Pulmonary Disease (COPD) was the most prevalent condition, affecting 36.14% of participants. Diabetes was present in 25.30%

of participants, while 20.48% had hypertension. Smoking was reported by 18.07% of participants, and edema was observed in 3.61%. Table 3 presents the biochemical parameters of the study participants. The mean white blood cell (WBC) count was 11036.34 ± 4770.48 , and the mean platelet count was 196528.00 ± 72250.40 . The erythrocyte sedimentation rate (ESR) averaged 31.42 ± 12.15 . Hemoglobin levels showed a mean of $11.17 \pm 1.47\%$, and random blood sugar (RBS) was 7.27 ± 0.61 mmol/L. Differential counts revealed that neutrophils comprised $71.21 \pm 7.35\%$, while lymphocytes accounted for $18.80 \pm 5.66\%$. Table 4 outlines the antimicrobial sensitivity patterns. The highest sensitivity was observed with Levofloxacin (33.73%), followed by Ciprofloxacin (26.51%) and Meropenem (20.48%). Amikacin and Chloramphenicol demonstrated moderate sensitivity rates of 19.28% and 13.25%, respectively. Notably, no sensitivity was observed for Amoxicilay, Erythromycin, Azithromycin, Gentamycin, or Cefixime. Table 5 details the antimicrobial resistance patterns. The highest resistance was observed for Cefixime (48.19%) and Cefuroxime (46.99%), followed by Azithromycin (42.17%) and Amoxicilay (40.96%). Significant resistance was also recorded for Gentamycin (27.71%) and Ciprofloxacin (20.48%).

Table 1: Distribution of baseline characteristics among the participants (n=166)

Baseline Characteristics	Frequency	Percentage
Age		
≤40	28	16.87%
41-50	20	12.05%
51-60	48	28.92%
61-70	52	31.33%
>70	18	10.84%
Sex		
Male	110	66.27%
Female	56	33.73%
Occupation		
Private Job	52	31.33%
Housewife	38	22.89%
Farmer	68	40.96%
Others	8	4.82%
Family Income		
<5000	24	14.46%
5000-10000	86	51.81%
10000-20000	48	28.92%
>20000	8	4.82%

Table 2: Distribution of participants by observable clinical characteristics and comorbidities (N=166)

Variables	Frequency	Percentage
Chronic Obstructive Pulmonary Disease	120	36.14%
Smoking	60	18.07%

Hypertension	68	20.48%
Diabetes	84	25.30%
Edema	12	3.61%

Table 3: Mean±SD biochemical parameters among the participants (N=166)

Biochemical Parameters	Mean±SD
WBC	11036.34 ± 4770.48
Platelet	196528.00 ± 72250.40
ESR	31.42 ± 12.15
Hb (%)	11.17 ± 1.47
RBS	7.27 ± 0.61
DC-Neutrophils	71.21 ± 7.35
DC-Lymphocytes	18.80 ± 5.66

Table 4: Antimicrobial sensitivity pattern among the participants (N=166)

Sensitivity to antibiotics	Frequency	Percentage
Amoxicilin	12	7.23%
Amoxicilay	0	0.00%
Amikacin	32	19.28%
Erythromycin	0	0.00%
Azithromycin	0	0.00%
Cotimoxazole	10	6.02%
Chloramphenicol	22	13.25%
Gentamycin	0	0.00%
Levoflaxacin	56	33.73%
Ciprofloxacin	44	26.51%
Cephadrine	12	7.23%
Cefuroxime	12	7.23%
Cefixime	0	0.00%
Ceftriaxone	10	6.02%
Imipenam	12	7.23%
Meropenam	34	20.48%
Netilmycin	12	7.23%
Colistin	22	13.25%

Table 5: Antimicrobial resistance pattern among the participants (N=166)

Resistance to antibiotics	Frequency	Percentage
Amoxicilin	22	13.25%
Amoxicilay	68	40.96%
Amikacin	34	20.48%
Erythromycin	24	14.46%
Azithromycin	70	42.17%
Cotimoxazole	0	0.00%
Chloramphenicol	34	20.48%
Gentamycin	46	27.71%
Levoflaxacin	12	7.23%
Ciprofloxacin	34	20.48%
Cephadrine	22	13.25%
Cefuroxime	78	46.99%
Cefixime	80	48.19%
Ceftriaxone	68	40.96%
Imipenam	22	13.25%

Meropenam	10	6.02%
Netilmycin	0	0.00%
Colistin	0	0.00%

Discussion

The age distribution revealed that most participants were between 51 and 70 years, with a notable male predominance (66.27%). This observation aligns with global trends where TB incidence is higher among older adults and males.¹ Similar age and gender patterns have been reported in studies from Taiwan and Australia, reinforcing age and gender as significant risk factors for TB worldwide.⁶ Occupationally, a significant portion of participants were farmers (40.96%), followed by individuals in private jobs (31.33%) and housewives (22.89%). This distribution reflects the rural setting of the study and highlights the vulnerability of agricultural workers to TB, a pattern similarly observed in studies from Turkey and Bangladesh.⁷ Economically, over half of the participants reported a family income between 5000 and 10000 BDT per month, underscoring the financial challenges faced by TB patients in this region—consistent with findings from studies conducted in Pakistan and Rajshahi, Bangladesh. Clinically, 36.14% of participants presented with Chronic Obstructive Pulmonary Disease (COPD), 25.30% with diabetes, 20.48% with hypertension, 18.07% were smokers, and 3.61% experienced edema. These comorbid conditions are frequently associated with TB and significantly influence treatment outcomes. Studies from Iran and South India similarly report high rates of diabetes and hypertension among COPD patients, highlighting the importance of integrated care approaches for TB and chronic diseases.⁸ Biochemical analysis revealed a mean WBC count of 11036.34 ± 4770.48 , platelet count of 196528.00 ± 72250.40 , and ESR of 31.42 ± 12.15 , consistent with other studies indicating elevated inflammatory markers among TB patients—often reflecting ongoing immune responses and secondary infections.^{9, 10} The mean hemoglobin level was $11.17 \pm 1.47\%$, indicating anemia, which is frequently observed in TB patients due to chronic inflammation and nutritional deficiencies.¹¹ The mean RBS level of 7.27 ± 0.61 mmol/L suggests impaired glucose metabolism, likely due to coexisting diabetes. Antimicrobial sensitivity patterns showed the highest sensitivity to Levofloxacin (33.73%) and Ciprofloxacin (26.51%), while resistance was notably high for Cefixime (48.19%), Cefuroxime (46.99%), and Azithromycin (42.17%). These results are in line with prior studies highlighting high resistance rates to cephalosporins and macrolides among TB patients.¹² Research conducted in Shandong, China, and Nepal similarly reported elevated resistance rates to ceftriaxone, ciprofloxacin, imipenem, and amikacin, underscoring the challenge of managing multidrug-resistant TB.¹³ The observed resistance patterns underscore the urgent need for ongoing surveillance of antimicrobial susceptibility and the prudent use of

antibiotics to prevent the rise of drug-resistant TB strains. The findings from this study are consistent with global and regional trends, highlighting the complex interaction between demographic factors, comorbidities, and antimicrobial resistance in post-PTB infection management. The high prevalence of comorbidities combined with significant antimicrobial resistance emphasizes the necessity for comprehensive care strategies that integrate TB treatment with chronic disease management. Utilizing localized epidemiological data to tailor treatment protocols can improve patient outcomes and inform public health strategies. Continuous surveillance and judicious antibiotic use, guided by sensitivity patterns, are crucial for combating the growing threat of drug-resistant TB. The comparative analysis with existing research underscores the need for targeted interventions and robust policy measures to address these ongoing challenges effectively.

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

Conclusion

The findings of this study emphasize a considerable burden of comorbid conditions, including COPD, diabetes, and hypertension, which complicate the effective management of TB. The study also reveals alarmingly high levels of antimicrobial resistance, particularly against commonly prescribed antibiotics such as cefixime and cefuroxime. These results underscore the urgent need for integrated care strategies that address both TB and associated chronic conditions. The implementation of continuous antimicrobial resistance surveillance and judicious use of antibiotics are essential to combat the rising threat of multidrug-resistant TB. Tailoring treatment protocols based on localized epidemiological data can significantly improve patient outcomes. Strengthening healthcare infrastructure, enhancing healthcare worker training, and promoting community-based interventions are critical steps toward more effective TB management. Continued research and targeted policy interventions will be vital in addressing the challenges posed by post-TB complications and antibiotic resistance.

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