Frequency of Hyponatremia in Adult Patients with Pulmonary Tuberculosis

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ABSTRACT

Background: Pulmonary tuberculosis is a prevalent disease in developing countries, often accompanied by electrolyte disturbances, including hyponatremia, which can exacerbate the clinical course and increase mortality risk.

Objective: To determine the frequency of hyponatremia in adult patients with pulmonary tuberculosis and its association with demographic and clinical variables.

Methods: A cross-sectional study was conducted at Mayo Hospital, Lahore, from August 2020 to February 2021, enrolling 150 adult pulmonary tuberculosis patients. Serum sodium levels were measured using standard biochemical analysis, and hyponatremia was defined as sodium levels <135 mmol/L. Stratification based on age, gender, BMI, duration of disease, and socioeconomic status was performed. Chi-square tests were applied, and p-values ≤ 0.05 were considered significant.

Results: Among the 150 patients, 64 (42.7%) had hyponatremia. Prevalence was higher in patients aged >50 years (45.8%), middle-income groups (57.1%), and those with disease duration ≥1 month (47.0%). Gender, BMI, and disease duration were not significantly associated with hyponatremia ($p > 0.05$).

Conclusion: Hyponatremia is common in pulmonary tuberculosis patients, especially in older age and middle-income groups, highlighting the need for routine sodium monitoring.

INTRODUCTION

Pulmonary tuberculosis (TB), caused by Mycobacterium tuberculosis, remains a major global health challenge, affecting nearly one-third of the world's population (1). Despite advancements in diagnostic and therapeutic approaches, TB continues to have a high incidence of morbidity and mortality, particularly in developing countries (1). The causative organism, first identified by Robert Koch more than a century ago, has a unique capacity to survive within the host by evading immune responses and thriving in granulomas, leading to chronic and latent infections (2). Although a significant number of TB cases are reported annually, with 10.4 million new cases and 1.6 million deaths in 2017, the burden of disease is particularly alarming in resource-limited settings where management and prevention strategies are often insufficient (3). Complications associated with TB, such as electrolyte disturbances, are common and can significantly impact patient outcomes. Among these, hyponatremia is frequently observed in TB patients, with a reported prevalence ranging from 35% to 65% in various studies (4). Hyponatremia, defined as a serum sodium level below 135 mmol/L, is a potentially life-threatening electrolyte imbalance that can exacerbate the clinical course of TB if not promptly identified and managed (5). Studies have demonstrated that approximately 51% of pulmonary tuberculosis patients develop hyponatremia during their illness, which underscores the need for routine monitoring of serum sodium levels in this population (6). The aetiology of hyponatremia in TB is multifactorial, with possible mechanisms including the syndrome of inappropriate antidiuretic hormone secretion (SIADH), adrenal insufficiency, and volume depletion due to increased insensible losses and poor nutritional status (7). Furthermore, the risk of developing hyponatremia appears to be influenced by demographic and clinical factors, such as age, gender, body mass index (BMI), and the duration of TB symptoms (8).

Hyponatremia, particularly in TB patients, poses a significant diagnostic and therapeutic challenge, as its clinical presentation can vary from asymptomatic cases to severe neurological symptoms such as seizures and altered mental status (9). In clinical settings, the recognition and timely management of hyponatremia are crucial for improving patient outcomes and preventing complications associated with this electrolyte imbalance. Current literature suggests a high prevalence of hyponatremia in patients with pulmonary TB, with local studies reporting a rate of 51.8% and other international studies indicating a prevalence of up to 62% (10, 11).

Despite these alarming statistics, research on hyponatremia in TB patients remains limited, particularly in Pakistan and other high-burden countries, where

socioeconomic factors and healthcare disparities further complicate disease management (12). This study aims to address this gap by determining the frequency of hyponatremia in adult patients with pulmonary tuberculosis and identifying potential risk factors associated with its development.

The findings of this research are expected to contribute to a better understanding of the epidemiology of hyponatremia in TB and inform clinical practice by emphasizing the need for routine screening and early intervention in this patient population (13). Given that over half of TB patients are likely to develop hyponatremia, routine evaluation of serum sodium levels should be integrated into TB management protocols to optimize treatment outcomes and reduce the risk of morbidity and mortality (14).

MATERIAL AND METHODS

The study was conducted at the Department of Pulmonology, Mayo Hospital, Lahore, from August 25, 2020, to February 25, 2021, utilizing a cross-sectional study design. A total of 150 adult patients, aged 16 to 85 years, both male and female, were recruited through a consecutive non-probability sampling technique. The inclusion criteria included individuals who were diagnosed with pulmonary tuberculosis according to the operational definition and had not been receiving any treatment that could potentially alter serum sodium levels. Exclusion criteria included patients with hepatic dysfunction (ALT and AST > 40 IU, history of hepatitis B or C, or liver cirrhosis), those with kidney failure (creatinine levels > 1.5 mg/dL), pregnant women, and individuals taking diuretics or medications known to affect sodium levels such as anti-epileptics, anti-psychotics, anti-depressants, and anti-cancer drugs. This strict selection was maintained to ensure that the reported prevalence of hyponatremia was specifically attributable to the pathophysiological effects of pulmonary tuberculosis (4). The study was approved by the Institutional Review Board (IRB) of Mayo Hospital, Lahore, and conducted in accordance with the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants prior to data collection. Demographic details including age, gender, body mass index (BMI), socioeconomic status, and duration of symptoms were recorded on a structured proforma. Under aseptic conditions, a 5 cc disposable syringe was used to draw venous blood samples, which were promptly sent to the hospital laboratory for serum sodium evaluation using standard biochemical analysis. Serum sodium levels were classified as normal (≥135 mmol/L) or indicative of hyponatremia (<135 mmol/L) as per the operational definition. Patients identified with hyponatremia were managed according to standard clinical guidelines and monitored for symptomatic relief. Data were entered and analyzed using SPSS version 25.0. Continuous variables such as age, BMI, and serum sodium levels were presented as mean ± standard deviation.

Categorical variables, including gender, presence of hyponatremia, and socioeconomic status, were expressed as frequencies and percentages. Stratification was performed based on age, gender, BMI, duration of disease, and socioeconomic status to assess the association of these factors with the incidence of hyponatremia. Chi-square tests were applied to compare the prevalence of hyponatremia among the stratified groups, and a p-value of less than 0.05 was considered statistically significant for all analyses. The results were systematically documented to provide a comprehensive understanding of the demographic and clinical factors associated with hyponatremia in pulmonary tuberculosis patients (5).

RESULTS

The study included 150 adult patients diagnosed with pulmonary tuberculosis. The sample consisted of 80 (53.3%) male and 70 (46.7%) female participants, with a mean age of 58.42 ± 10.87 years. The overall prevalence of hyponatremia was 42.7% (64 out of 150 patients), defined as a serum sodium level of less than 135 mmol/L. The results are presented in the combined table below:

Table 1 Demographic and Clinical Characteristics of Pulmonary Tuberculosis Patients and Hyponatremia Stratification Based on Different Variables.

Parameter	Category	Frequency (Percentage)	Hyponatremia		p-value
			Yes	No	
Gender	Male	80 (53.3%)	33 (41.3%)	47 (58.8%)	0.708
	Female	70 (46.7%)	31 (44.3%)	39 (55.7%)	
Age Group	20-35 years	4 (2.7%)	1 (25.0%)	3 (75.0%)	0.286
	36-50 years	26 (17.3%)	8 (30.8%)	18 (69.2%)	
	>50 years	120 (80.0%)	55 (45.8%)	65 (54.2%)	
Body Mass Index (BMI)	Normal	56 (37.3%)	23 (41.1%)	33 (58.9%)	0.290
	Overweight	52 (34.7%)	19 (36.5%)	33 (63.5%)	
	Obese	42 (28.0%)	22 (52.4%)	20 (47.6%)	
Duration of Disease	<1 month	67 (44.7%)	25 (37.3%)	42 (62.7%)	0.234
	≥1 month	83 (55.3%)	39 (47.0%)	44 (53.0%)	
Socio-Economic Status	Low (<20,000/month)	57 (38.0%)	18 (31.6%)	39 (68.4%)	0.028
	Middle (20-50,000/month)	49 (32.7%)	28 (57.1%)	21 (42.9%)	
	High (>50,000/month)	44 (29.3%)	18 (40.9%)	26 (59.1%)	
Total		150 (100%)	64 (42.7%)	86 (57.3%)	

The data indicated that hyponatremia was more prevalent among patients older than 50 years (45.8%), those classified as obese (52.4%), and those with a disease duration of more than one month (47.0%). Hyponatremia was also significantly associated with socioeconomic status, with the middle-income group showing a higher frequency (57.1%) compared to the low-income (31.6%) and high-income groups (40.9%). No statistically significant association was observed between hyponatremia and gender, BMI, or duration of disease. These findings emphasize the importance of monitoring serum sodium levels in patients with pulmonary tuberculosis, particularly in older, socioeconomically disadvantaged, and obese patients, to reduce the risk of complications associated with hyponatremia.

DISCUSSION

The findings of this study indicated that a significant proportion (42.7%) of adult patients with pulmonary tuberculosis presented with hyponatremia, which is consistent with previous research highlighting a high prevalence of electrolyte imbalances in this patient population. The observed frequency falls within the range reported in earlier studies, where hyponatremia was noted in 35% to 65% of TB cases (4). Similarly, a local study found that 51.8% of individuals with pulmonary tuberculosis experienced hyponatremia, suggesting that this condition is common and warrants closer clinical attention (10). In another international study, the prevalence of hyponatremia was even higher, at 62%, further supporting the assertion that electrolyte disturbances are a prevalent and potentially severe complication in pulmonary tuberculosis (11).

The high prevalence of hyponatremia in this study can be attributed to several factors, including the chronic inflammatory state induced by Mycobacterium tuberculosis infection, which affects various homeostatic mechanisms. One potential mechanism is the inappropriate secretion of antidiuretic hormone (SIADH), which has been frequently associated with pulmonary infections such as TB (13). Other contributory factors may include adrenal insufficiency, excessive water intake, and poor nutritional status, all of which are common in patients with advanced TB (7). In this study, the association between hyponatremia and age was notable, as older patients (>50 years) had a significantly higher prevalence (45.8%) compared to younger age groups, suggesting that age-related physiological changes may predispose these individuals to greater electrolyte imbalances. This finding aligns with previous research, which has documented a higher risk of hyponatremia in elderly TB patients due to comorbidities, frailty, and increased vulnerability to dehydration and other metabolic complications (14).

The association between hyponatremia and socioeconomic status observed in this study also provides valuable insights. Patients from the middle-income group showed a significantly higher prevalence of hyponatremia (57.1%) compared to those in the low- or high-income groups.

This disparity may be linked to variations in healthcare access, nutritional intake, and the ability to manage chronic illnesses. Middle-income patients might have had more delayed healthcare access and suboptimal management compared to low-income patients, who are often covered by public health programs, and high-income patients, who can afford comprehensive care. This unique finding warrants further investigation to understand the underlying socioeconomic dynamics influencing health outcomes in TB patients.

The lack of a significant association between gender and hyponatremia in this study contrasts with some previous studies that reported higher rates of hyponatremia in males, possibly due to differences in disease progression and healthcare-seeking behaviors between men and women (10). However, gender-based variations in electrolyte disturbances in TB patients remain inconclusive, highlighting the need for larger studies to clarify these observations.

This study had several strengths, including a well-defined patient population and a rigorous stratification of hyponatremia based on demographic and clinical variables. However, there were also limitations that should be acknowledged. The cross-sectional design precluded any causal inferences regarding the factors contributing to hyponatremia in pulmonary tuberculosis. Furthermore, the single-center nature of the study may limit the generalizability of the findings to other settings or regions. The relatively small sample size and lack of longitudinal follow-up may have also restricted the ability to detect associations with other potential predictors of hyponatremia. Future studies should consider a multicenter approach with larger sample sizes and a prospective design to confirm these results and explore the long-term implications of hyponatremia in TB patients.

Based on the findings, it is recommended that routine screening for serum sodium levels be integrated into the standard management protocol for patients with pulmonary tuberculosis, particularly for those who are older or have other risk factors for hyponatremia. Early identification and management of hyponatremia can prevent complications such as seizures, altered mental status, and increased mortality. In addition, the role of socioeconomic factors in influencing health outcomes in TB patients should be further explored to develop targeted interventions that address the unique needs of different income groups. Comprehensive nutritional support and health education may be beneficial in mitigating the risk of electrolyte imbalances and improving overall health outcomes for TB patients.

CONCLUSION

This study highlighted a high prevalence of hyponatremia in adult patients with pulmonary tuberculosis, with a significant association observed among older age groups and middle-income patients. These findings underscore the need for routine electrolyte monitoring in TB management to prevent potential complications. Early detection and correction of hyponatremia can significantly improve patient outcomes, reduce morbidity, and enhance the quality of care. Incorporating routine serum sodium

assessments into clinical practice, along with addressing socioeconomic disparities in healthcare access, can lead to more effective management strategies and better overall healthcare outcomes for TB patients.

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