

Effect of antitubercular treatment on serum electrolyte and bicarbonate among pulmonary tuberculosis patients in tertiary care Hospital: An observational study

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Abstract

Introduction: Tuberculosis is mainly associated with diarrhea, vomiting and profuse sweating leading to dehydration, electrolyte imbalance and acid base derangements. Treatment with anti tubercular drugs reduces the symptoms and balances the electrolytes. Hence, this study was carried out to assess the electrolyte imbalance among tuberculosis patients and to know the effect of anti tubercular treatment. This study was carried out to study the electrolyte imbalance among newly diagnosed tuberculosis patients and to know the effect of treatment with anti tubercular drugs in improving the electrolyte balance at BRIMS teaching Hospital Bidar.

Materials and Methods: This was observational study conducted in pulmonary Medicine OPD of Bidar Institute of Medical Sciences teaching hospital Bidar. 50 participants were enrolled in our study and assessed for demographic data, serum electrolytes and bicarbonate levels and compared with Tuberculosis patients before and after treatment.

Results: The electrolyte imbalance in terms of decrease in sodium, potassium chloride and bicarbonate values was significantly associate ($p < 0.001$) with tuberculosis. Treatment with antitubercular drugs (Streptomycin, Refampicin, Isoniazide) normalized sodium, potassium and bicarbonate levels significantly compared to values before treatment. The odds of having hyponatrimia and low bicarbonate level were 2.57 times as compared to after treatment of TB patients.

Conclusion: In our study, after treatment with antitubercular drugs, electrolyte levels returned to normal. Because of the high incidence of the electrolyte disturbances in tuberculosis patients, close monitoring and aggressive management are mandatory.

Keywords: Mycobacterium tuberculosis, Electrolytes, Cytochemical changes, Antitubercular drugs.

Introduction

Tuberculosis is an infectious disease caused by Mycobacterium tuberculosis. Tuberculosis typically affects all parts of the body especially lungs. The disease has become rare in developed countries, but is still a major public health problem in low- and middle-income countries.¹ It is estimated that between the years 2000 and 2010, eight to nine million new cases emerged each year. Around fifteen lakh people are affected from tuberculosis each year. In adults, tuberculosis is the second leading cause of death due to an infectious disease (after AIDS), with 95% of deaths occurring in low-income countries. Tuberculosis is a major problem of children in poor countries where it kills over 100,000 children each year.²

Electrolyte imbalance can lead to impaired functions of heart, nervous system, muscular system as well as it leads to acid-base derangements. Decreased sodium electrolyte is the most common and frequent cause of electrolyte imbalance in all newly diagnosed tuberculosis patients.³

Sodium concentration less than 136mmol/L was termed as hyponatremia and less than 115mmol/L as severe hyponatremia which is life threatening.⁴ The prevalence of hyponatremia was fifteen to thirty percent among tuberculosis patients.⁵ Similarly other electrolytes imbalance like hypochloremia and hypokalemia and reduced bicarbonate levels are also seen in pulmonary tuberculosis (PTB) patients. The electrolyte imbalance among tuberculosis may be attributed to adrenal insufficiency, tubercular meningitis, in appropriate ADH secretion via

pulmonary infection⁶⁻⁸ and excessive loss of these ions due to diarrhea, vomiting and sweating.⁹

The presentation of PTB are quite typical which include prolonged cough (lasting more than 2 weeks) and sputum production. Other symptoms include weight loss, anorexia, fatigue, shortness of breath, chest pain, moderate fever and night sweats. Haemoptysis (blood in sputum) is a characteristic sign present in about one third of patients.^{10,11} Diagnosing and initiating effective treatment in a patient early in the course of their TB disease, before they can infect many people, is considered the most effective preventive measure against TB. Effective treatment substantially reduces or eliminates disease transmission from smear-positive patients in less than one month after treatment initiation.

Electrolytes loss in TB can be attributed to diarrhea, vomiting and excessive sweating. This fluid and acid-base derangements can lead to acute renal failure,⁵ hence require appropriate management. Hence this study is carried out with the objective to evaluate the serum electrolyte status among newly diagnosed cases of pulmonary TB and the same patients followed up after anti-tubercular therapy of 3 months which will be beneficial in preventing various complication and helpful for further appropriate treatment.

Materials and Methods

Source of Data: This observational study was conducted in Pulmonary Medicine OPD of Bidar Institute of Medical Sciences and teaching hospital, Bidar. The detailed socio

demographic, personal and clinical data was collected by the investigator by using specially designed and pretested performa. The study was carried out from May 2016 to May 2017 at BRIMS teaching Hospital, Bidar. Sample Size was calculated using the formula¹² $(Z_{1-\alpha/2} \cdot SD)/d$, Where $Z_{1-\alpha/2}$ = is standard normal variate (at 5% type 1 error ($P < 0.05$)) it is 1.96. SD = Standard deviation of variable. Value of standard deviation can be taken from pilot study. d = Absolute error or precision, the electrolyte imbalance in tuberculosis patients at 5% of type of 1 error and standard deviation, based on previously done studies. Sample size was calculated to be 50.

50 newly diagnosed cases of pulmonary tuberculosis who were confirmed by chest physician on clinical examination along with sputum smear examination by Z-N staining technique and chest X-ray. The same group of patients were followed up after they were treated with anti tubercular drugs for a period of 3 months.

Exclusion Criteria: Based on clinical history and examination, patients with diabetes mellitus, intestinal infection and severe malnutrition, pregnant women, women using contraceptive, patients with liver disease, patients with endocrine diseases, patients on corticosteroid therapy, HIV, renal diseases, on anti-diuretics, with any other acute /chronic illness were excluded.

Under aseptic conditions, 10ml of venous blood samples of patients were collected at the initiation of the study and after 3 months of the treatment. Serum sodium, potassium, chloride and bicarbonate levels were estimated at the beginning of the study and after completion of their treatment. Serum sodium, potassium, chloride and bicarbonate analysis was done using electrolyte analyzer which is based on principle of ion selective electrode.

Ethical Clearance: The ethical clearance was obtained from Institutional ethical committee of BRIMS before commencement of the study and informed consent was obtained from the study participants.

Statistical Analysis

All values were analyzed by using Chi square test and odds ratio to check the association. The level of statistical significance was set at $p < 0.05$. Data is expressed as Mean \pm SD. Odds ratio was used to estimate the risk.

Results

Majority of the patient were in the age group of 14-78 years mean age being 52 ± 13.6 years [Table 1] Mean age of females was slightly more (53.1 ± 14.3) than that of male but the difference was statistically insignificant. In newly diagnosed tuberculosis patients, there was a significant ($p < 0.001$) decrease in sodium, potassium, chloride and bicarbonate values compared to after treatment. Treatment with antitubercular drugs normalized sodium, potassium and bicarbonate levels significantly compared to values before treatment.

Mean sodium value was significantly ($p < 0.001$) lower in the newly diagnosed patients. After anti-tuberculosis treatment for 3 months, mean sodium value was significantly ($p < 0.001$ compared to before treatment) increased and was found to be within normal limits (136-146 mmol/L).

Our findings revealed that there was a significant decrease in sodium (124mmol/L Vs 140.4mmol/L), potassium levels (3.4mmol/L Vs 4.2mmol/L), chloride levels (97.7mmol/L Vs 101.9mmol/L) and bicarbonate values (19.4 Vs 20.6mmol/L) in tuberculosis patients. Treatment with antitubercular drugs normalized sodium (137.4mmol/L Vs 124mmol/L), potassium (4.1mmol/L Vs 3.4mmol/L) chloride (107.7mmol/L Vs 97.7mmol/L) and bicarbonate levels (21.7mmol/L Vs 19.4mmol/L) significantly compared to values before treatment.

The mean chloride value was significantly ($p < 0.001$) lowered in newly diagnosed TB cases. After treatment with anti-tubercular drugs, these levels returned to normal levels. The mean serum potassium value was significantly ($p < 0.001$) lower in tuberculosis patients. Treatment with anti-tuberculosis drugs, serum sodium levels were increased significantly. Similarly, the mean serum bicarbonate value was also decreased significantly ($p < 0.001$) in newly diagnosed TB cases. After treatment bicarbonate levels returned to normal levels.

The hyponatremia seen among newly diagnosed TB patients was 72%, the odds of having hyponatremia was 2.57 higher among newly diagnosed TB patients than among the treated TB cases. Hypokalemia, seen among newly diagnosed TB patient was 48%. The odds being 0.9. Hypochloremia seen among newly diagnosed TB patient was 24% the odds being 0.3. Low serum bicarbonate among newly diagnosed TB patient was 72%. The odds being 2.57. (Table 2)

Table 1: Patient distribution based on age and gender

Gender	No. of patients	Mean Age \pm SD (Years)
Male	17 (34%)	50.9 \pm 12.3
Female	33 (66%)	53.1 \pm 14.3
Total	50	52.3 \pm 13.6

Table 2: Serum electrolyte levels

S. No	Electrolytes (mmol/L)	Before treatment		After treatment		Chi square	P Value	Odds ratio
		Mean±SD	Hypo	Mean±SD	Hypo			
1	Serum Sodium	124.0±2.17	36 (72%)	137.4±2.05	0 (0%)	53.35	< 0.001	2.57
2	Serum Potassium	3.4±0.7	24 (48%)	4.1±0.4	2 (5%)	25.155	<0.001	0.9
3	Serum Chloride	97.7±8.4	12 (24%)	101.7±5.7	3 (6%)	6.352	0.01	0.3
4	Serum Bicarbonate	19.4±2.17	36 (72%)	21.7±2.0	18 (36%)	4.24	< 0.001	2.57

Discussion

In the present study, 50 newly diagnosed pulmonary tuberculosis patients were enrolled who were receiving anti-tubercular treatment for the last 3 months in pulmonary medicine outpatient department. The decrease in serum electrolyte levels among newly diagnosed cases may be attributed to symptoms like vomiting and diarrhea associated with tuberculosis. Prevalence of Hyponatremia among tuberculosis patients was higher in our study as compared to other studies where hyponatremia ranged from 20-40%.¹³⁻¹⁴ The issue can be attributed to age and type of underlying diseases. Furthermore the electrolyte imbalance can be observed under diseases like neoplasm, pulmonary diseases etc.

Our findings reveal that the mean age of the females was higher as compared to mean age of males. This can be attributed to health seeking behavior among the genders. Gender-related problems are more difficult to assess and may need a combination of epidemiological research (population-based prevalence survey) and social science research on health seeking behavior. Alternatively, at the time of diagnosis, smear-positive patients could be requested to bring in all other household members for sputum smear examination. In the absence of gender bias, one would expect the female/male ratio among smear positive household members to be approximately equal to that among index patients. This may apply in particular to spouses, who are likely to share possibly confounding characteristics (such as approximate age) with the index patient. Thus, if in the majority of cases the index patient in double-positive couples is the husband, gender bias, or within the health system, can be suspected.¹⁵

In this study, among tuberculosis patients hyponatremia was found to be improved after treatment. The observed significant lower mean values of serum sodium level in the patients may be attributable to vomiting and dehydration as coated in previous studies where clinical symptoms like vomiting and diarrhea among tuberculosis patients leads to hyponatremia.¹⁶

A study by SS Warke et al (2004)¹⁷ conducted on patients in India evaluated the effect of treatment of antitubercular drugs on blood pH, electrolytes and osmolality, found mean value of serum Na⁺ concentration found to be 134 mmol/L which was increased after treatment and reached to 143 mmol/L. Similarly Chloride level was increased 4 month post treatment suggesting the decrease in reabsorptive capacity of uriniferous tubules towards chloride ions in tuberculosis.

A study survey done on 110 patients in south western Nigeria to assess the electrolytes imbalance among tuberculosis patients who are receiving treatment. This study suggested that initiation of treatment on TB patients seems to bring about improvement in hyponatremia, hyperkalemia, hypochloremia and hypercarbonemia.¹⁸

Conclusion

The significant hyponatraemia and hypochloridaemia among tuberculosis patients in our study is attributable to loss of these ions from vomiting and dehydration. Hypokalaemia observed may be attributed to the loss of K⁺ by dehydration through urine, and vomitus. Significant hypocarbonaemia seen in the pulmonary tuberculosis patients can be attributed to the body's compensatory mechanism to maintain electrochemical neutrality due to the plasma levels of Na⁺ and especially chloride. Treatment with antitubercular drugs, electrolyte levels returned to normal. Because of the high incidence of the electrolyte disturbances in tuberculosis patients, close monitoring and aggressive management are mandatory.

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