Original Research Article

Evaluation of serum electrolyte status among newly diagnosed cases of pulmonary tuberculosis: an observational study

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Received: 22-12-2020 / Revised: 19-02-2021 / Accepted: 28-02-2021

Abstract

Introduction: In spite of newer modalities for diagnosis and treatment of TB, unfortunately, millions of people are still suffering and dying from this disease.Electrolyte disturbances have been reported in tuberculosis (TB) infection.**Aim:** To evaluate the serum electrolyte status among newly diagnosed cases of pulmonary TB. **Methods:** The present observational cross-sectional study was conducted on a sample of 60 newly diagnosed cases of pulmonary tuberculosis. This study focused on serum sodium, potassium and calcium levels in the patients under study and was the main outcome of this study. Serum sodium, potassium and calcium analysis was done using electrolyte analyzer.**Results:** The mean age of the study population came to be 58.24 years and the minimum and maximum age recorded were 21 years and 81 years respectively. Gender distribution showed male predominance with 46 (76.6%) males and 14 (23.3%) females. Mean sodium levels in the study sample came to be 132.45±7.2mmol/L, Mean potassium levels observed were 3.6±0.6 mmol/L and Mean levels of ionised calcium came to be 4.1±0.2mmol/L. Hyponatremia was observed in 30 (50%) cases, hypokalemia was observed in 27 (45%) and hypocalcemia constituted 21 (35%) among the patients diagnosed with pulmonary tuberculosis.**Conclusion**:Screening for serum electrolytes in pulmonary tuberculosis is essential.Early diagnosis and prompt management of these abnormalities are critical. Correction of these electrolyte imbalance could improve outcome of patient.

Keywords: Pulmonary tuberculosis, electrolyte imbalance, treatment, hyponatremia, hyokalemia.

Introduction

Tuberculosis (TB) is one of the most ancient diseases of mankind, with molecular evidence going back to over 17,000 years. It 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. For the past 40 years, treatment success in tuberculosis has been defined as the eradication of active infection whilst preventing resistance and recurrence, achieved through multidrug antimicrobial treatment. In spite of newer modalities for diagnosis and treatment of TB, unfortunately, millions of people are still suffering and dying from this disease. TB remains one of the top 10 causes of death worldwide. Millions of people continue to fall sick from TB each year.India has the highest burden of both tuberculosis (TB) and multidrug-resistant (MDR) TB based on estimates reported in Global TB Report 2016[2].India accounts for about 24% of the global prevalence, 23% of the global incident cases, and 21% of the global TB deaths. Taking into consideration the magnitude of the disease burden, the Government of India has announced its plan to eliminate TB by 2025 during the Union Budget 2017–2018[3,4].It is estimated that between the years 2000 and 2010, eight to nine million new cases emerged each year. The factors contributing to the resurgence of TB in the developing countries include co-infection with HIV, emergence of multidrug-resistant TB, inadequate treatment, malnutrition, overcrowding, armed conflict, and increasing numbers of displaced person[5].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[6].The lungs are the major site for Mycobacterium tuberculosis primary infection and tuberculosis (TB) disease.Clinical manifestations of TB include primary TB, reactivation TB, laryngeal TB, endobronchial TB, lower lung field TB infection, and tuberculoma. Pulmonary complications of TB can include hemoptysis, pneumothorax, bronchiectasis, extensive pulmonary destruction, malignancy, and chronic pulmonary aspergillosis.Electrolytes play a vital role in maintaining homeostasis within the body. Electrolyte imbalance can lead to impaired functions of heart, nervous system, muscular system, as well as lead to acid–base disorders. Decreased sodium electrolyte is the most common and frequent cause of electrolyte imbalance in all newly diagnosed tuberculosis patients.TB can induce electrolytes imbalance mainly hyponatremia via several mechanisms containing

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local invasion to the adrenal glands (adrenal insufficiency), local invasion to hypothalamus or pituitary gland, tubercular meningitis and inappropriate ADH secretion via pulmonary infection, and excessive loss of these ions since diarrhea, vomiting, and sweating are frequently seen in PTB[7-9].

Hyponatremia is considered as one of the most common and important electrolyte abnormalities.The prevalence of hyponatremia was fifteen to thirty percent among tuberculosis patients.Similarly other electrolytes imbalance like hypochloremia and hypokalemia and reduced bicarbonate levels are also seen in pulmonary tuberculosis patients. Hypercalcemia havealso been reported as one of the most common electrolyte imbalance in 25.7% of patients with TB.Hence this study is carried out with the objective to evaluate the serum electrolyte status among newly diagnosed cases of pulmonary TB which will be beneficial in preventing various complication and helpful for further appropriate treatment.

Materials and Methods

The present observational cross-sectional study was conducted in the department of biochemistry. The sample of the study comprised of 60 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 detailed socio demographic, personal and clinical data was collected by the investigator by using specially designed and pretested performa. The study was carried out over a period of 6 months. The ethical clearance was obtained from Institutional ethical committee and an informed consent was obtained from the study participants.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 from the study.This study focused on serum sodium, potassium and calcium levels in the patients under study and was the main outcome of this study.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 and calcium levels were estimated at the beginning of the study and after completion of their treatment. Serum sodium, potassium and calcium analysis was done using electrolyte analyzer which is based on principle of ion selective electrode. Sodium concentration less than 136mmol/L was termed as hyponatremia and less than 115mmol/L as severe hyponatremia. Hypokalemia was defined as serum potassium levels < 3.5 mEq/L. Hypocalcemia was defined as serum calcium ion levels < 4.5 mg/dl. Estimation of sodium and potassium using Flame emission spectrophotometry method.

Statistical analysis

Statistical analysis was conducted using SPSS statistical version 21 software (SPSS Inc., Chicago, Illinois, USA). Continuous variables with a normal distribution were reported in terms of mean and standard deviation. Continuous variables with a skewed distribution were reported in terms of median, minimum, and maximum values.All values were analyzed by using Chi square test and odds ratio to check the association. The level of statistical significance was set at $p<0.05$.

Results

The present study included a total sample of 60 patients. The mean age of the study population came to be 58.24 years and the minimum and maximum age recorded were 21 years and 81 years respectively. Gender distribution showed male predominance with 46 (76.6%) males and 14 (23.3%) females.(Figure 1)

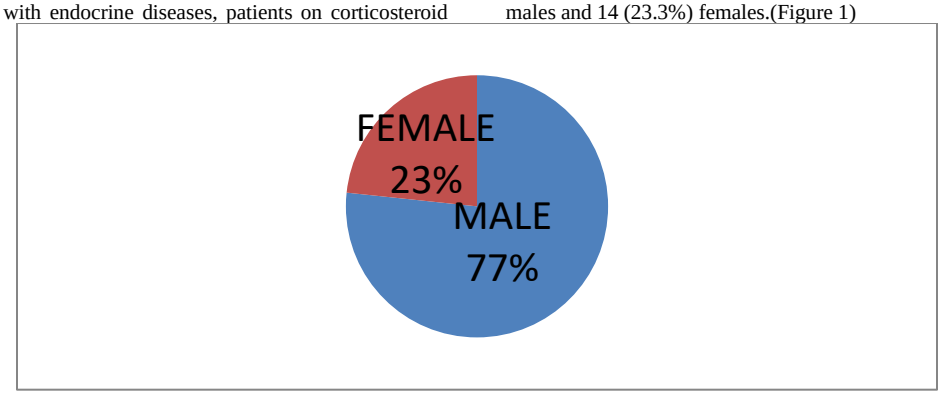

Fig 1:Gender distribution

Mean sodium levels in the study sample came to be 132.45±7.2mmol/L. The female's mean concentration of serum Na was 131.21 ± 4.9 while the male's mean concentration of serum Na was 134.2 ± 4.1 mmol/L (P >0.05). Hence,no significant relationship between gender and hyponatremia.(Figure 2)

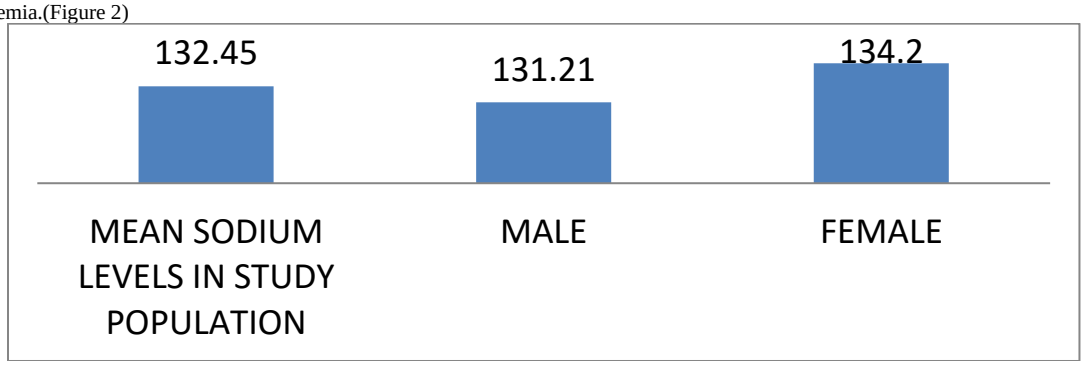

Fig 2:Mean sodium levels observed

Mean potassium levels observed were 3.6±0.6 mmol/L. The females mean serum potassium concentration was 3.4 ± 0.4, while in males mean potassium concentration was 4.1 ± 0.6 (P>0.05). Hence,no significant relationship between gender andhypokalemia.(Figure 3).Mean levels of ionised calcium came to be 4.1±0.2mmol/L. The females mean serum Ca concentration was 4.2 ± 0.6 while in males mean Ca which was 4.1 ± 0.6 (P>0.05).Hence,no significant relationship between gender and hypocalcemia. (Figure 3)

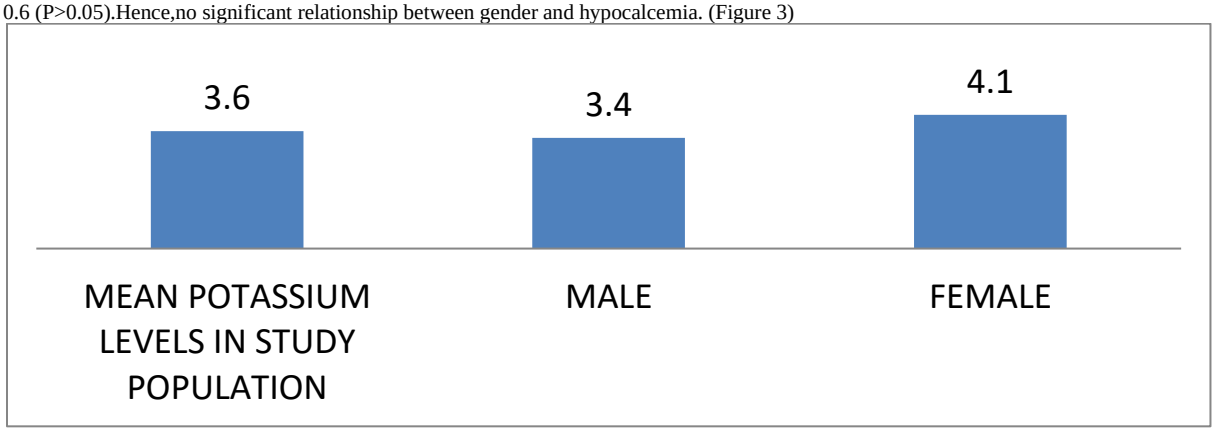

Fig 3: Mean potassium levels observed

Hyponatremia was observed in 30 (50%) cases, hypokalemiawas observed in 27 (45%) and hypocalcemia constituted 21 (35%) among the patients diagnosed withpulmonary tuberculosis.(Figure 4)

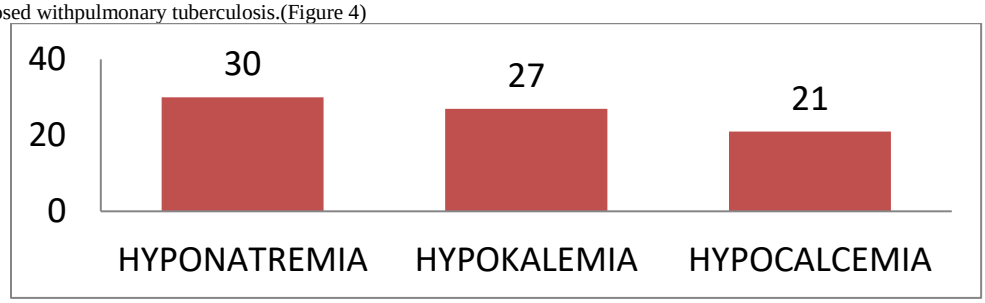

Fig 4: Number of cases with electrolyte imbalance in study population

Discussion

Tuberculosis (TB) is one of the most ancient diseases of mankind. In spite of newer modalities for diagnosis and treatment of TB, unfortunately, people are still suffering, and worldwide it is among the top 10 killer infectious diseases. There may be a number of metabolic disturbances arising owing to the disease and due to effect of drugs used in treatment, which can decrease levels of Na and K levels and thus disturb the electrolyte balance. Presence of coexisting metabolic disorder may cause severe health abnormalities and even death. Thus, early diagnosis and prompt management of these abnormalities are critical.The present study included a total sample of 60 patients. The mean age of the study population came to be 58.24 years with male predominance with 46 (76.6%) males. In the present study, mean Na, K, and ionized Ca measured in patients with pulmonary tuberculosis. We did not observe any significant relationship between gender and hyponatremia, hypokalemia and hypocalcemia in the present study.In the present stduy,Hyponatremia was observed in 30 (50%) cases diagnosed with pulmonary tuberculosis.In previous studies, the prevalence of hyponatremia among inpatients, especially the ones who admitted in respiratory wards, was reported in a various range (2.48%-60%).This variation can be related to the type of diseases and age. Lee P et al reported a case of PTB with refractory hyponatremia due to SIADH[8].Mean sodium levels in the present study sample came to be 132.45±7.2mmol/L. Goli et al. found that mean serum Na and K in patients with exacerbation were 132±5.65 and 3.29±0.96 mEq/l, respectively. They reported that decreased Na level can occur in patients secondary to water retention in presence of other comorbidities such as heart or renal failure. Moreover, hyponatremia can occur as a result of different drug therapy, or syndrome of inappropriate antidiuretic hormone secretion[10,11].Das et al. reported a significant decrease in serum Na and K in patients with COPD (133±6.86, 3.39±0.96 mEq/l, respectively) than in healthy participants (142±2.28, 4.52±0.02 mEq/l, respectively, P<0.05) [12].In the present study, hypokalemia was observed in 27 (45%) cases in pulmonary tuberculosis patients. This can be explained as in the stress situation due to severe/chronic illness there is increased catabolism of protein leading to the movement of K^+ from the intercellular compartment to the plasma and consequently excreted in the urine, sweat and vomitus without any compensatory replacement through food due to anorexia a common feature of pulmonary tuberculosis[13].Mean potassium levels observed were 3.6±0.6 mmol/L. Harshavardhan and Chikkaho-nnaiah in a study on 100 patients with COPD found that levels of Na and K in patients were 131.7±5.07 and 3.3081±3.3126 mEq/l, respectively, whereas in healthy participants were 138.66±3.82 and 3.8740±3.6003 mEq/l, respectively.They concluded that the patients with acute exacerbation of COPD showed seriously decreased Na and K levels.Hypokalemia in patients with COPD may be attributed to long-standing steroid therapy and subsequent metabolic alkalosis [14].Terzano et al. found that among 67 patients hospitalized for type 2 respiratory failure, decreased Na level occurred in 11 patients, decreased levels of Na, chloride, and K occurred in 10 patients, and decreased chloride level occurred in seven patients[15]. Gopal Purohit et al conducted a prospective study in 172 patients, to evaluate & compare electrolyte imbalance in Pulmonary TB, HIV & HIV-PumonaryTB patients. Theirstudy showed Hyponatremia, Hypokalemia,hypochloremia in Pulmonary TB patients. Hyperkalemia in HIV patients &

Hyperchloremia in HIV-PTB were seen. Strict Monitoring of serum electrolytes in PTB, HIV-PTB, and HIV is thus recommended, as early detection and treatment will enhance the quality of life of patients[16]. Lingraj Patil,Naga et al reported that the electrolyte imbalance in terms of decrease in sodium, potassium chloride and bicarbonate values was significantly associated with tuberculosis. Treatment with antitubercular drugs (Streptomycin,Rifampicin, 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. Thus, 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[17].A study by SS Warke et al, 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[18].Treatment of multidrug-resistant tuberculosis (MDR-TB) with second-line injectable drugs may result in an electrolyte imbalance. Electrolyte imbalances have been reported since the early use of capreomycin. In a study by Soeroto AY et al, they reported that After the first month of MDR-TB treatment, there was a significant decrease in mean serum potassium (4.0 ± 0.4 mEq/L to 3.7 ± 0.5 mEq/L,) in the kanamycin-based group and (4.1 ± 0.5 mEq/L to 3.2 ± 0.6 mEq/L,) in the capreomycin-based group. Serum potassium levels were significantly lower in the capreomycin-based group than in the kanamycin-based group (3.2 ± 0.6 mEq/L vs 3.7 ± 0.5 mEq/L,). Their findings emphasize the importance of routine monitoring of serum potassium, magnesium, and calcium during MDR-TB treatment, and that more attention should be paid when treatment is given using the capreomycin-based regimen. Moreover, their study supported the 2018 World Health Organization treatment guideline recommend-ations for removal of kanamycin and capreomycin from the MDR-TB regimens[19]. Similarly Amalia et al[20] and Rahmawati et al [21],also demonstrated lower serum potassium levels in the capreomycin-based group than in kanamycin-based group.

Conclusion

Screening for serum electrolytes in pulmonary tuberculosis is essential. Presence of coexisting metabolic disorder may cause severe health abnormalities and even death. Thus, early diagnosis and prompt management of these abnormalities are critical. Correction of these electrolyte imbalance could improve outcome of patient.

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Conflict of Interest: Nil

Source of support:Nil