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ORIGINAL ARTICLE

Association of Respiratory Tract Infections causing Alterations in Lung Parenchyma and Pulmonary Vasculature with Body Electrolyte Imbalance

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ABSTRACT

Aim: The assessment of serum electrolytes at the time of initial presentation of the patient with respiratory tract infection possibly causing lung parenchyma and pulmonary vasculature damage and serial monitoring during the stay could be beneficial in order to determine when and how to take remedial action when necessary.
Methodology: A non-probability sampling was done on 139 subjects with suspected respiratory tract infection. For confirmation, culture, MTB PCR, COVID-19 testing was done to diagnose the nature of infection. Serum electrolytes were tested on chemical analyses Alinity instrument.
Results: Most common infections found were COVID-19 and bacterial (n=59) collectively in a co-morbid state. Mycobacterium tuberculosis and fungal infections were also found in (n=8) each. Electrolytes imbalance was markedly observed in high prevalence amongst Tuberculosis and COVID-19 patients but also showed significant association with other respiratory investigated infections.
Conclusion: A robust association of electrolyte imbalance was found in all cases presented with upper or lower respiratory tract infections.
Keywords: Respiratory tract infections, electrolyte imbalance, Covid-19, MTB, Sodium, Potassium

INTRODUCTION

Respiratory infections are a significant cause of illness and mortality in the developing world, and their prevalence is increasing, particularly with chronic respiratory disease[1]. Numerous demographic, clinical, and laboratory variables are associated with respiratory infection prognosis and severity[2]. The most common co-morbidities related with illness severity are hypertension and diabetes mellitus. Similarly, decreased lymphocyte, increased serum ferritin and platelet counts; interleukin-10 (IL-10) levels and interleukin-6 (IL-6); abnormal coagulation parameters such as increased D-dimer levels; alterations in cardiac and muscle injury parameters; and abnormal liver and kidney function biomarkers were all associated with severe disease and poor outcome in lower and upper respiratory tract infection[3].

On the other hand, numerous acute and chronic adult respiratory illnesses have been increasing in prevalence throughout the world. Acute diseases such as pneumonia and influenza are classified as acute; chronic diseases such as chronic obstructive pulmonary disease (COPD) and asthma are classified as chronic; occupational lung diseases such as byssinosis, asbestosis, and coal worker's pneumoconiosis are classified as occupational lung diseases; and other parenchymal lung diseases such as immune-related lung diseases are classified as chronic [4]. But each year, respiratory diseases alone, primarily pneumonia and influenza, claim approximately 4 million lives globally. They are the top causes of disease and death among children under the age of five. Acute respiratory infections are responsible for at least 6% of global disability and death and for 20% to 40% of all pediatric hospitalizations[3,14].

The death rate from acute respiratory infections alone is tenfold that of the worldwide median death rate from all causes in portions of the developing world[5]. Tuberculosis (TB) caused by Mycobacterium has a major part of respiratory infection[6]. According to WHO 2013 projections, eliminating the disease by 2050 would require a substantial increase to at least a 15% yearly decline in cases. Although the pipeline for new medications is longer than it has been in decades and a new antibiotic, bedaquiline, has been approved for use in the treatment of multidrug-resistant tuberculosis, many novel compounds will be required to effect a paradigm shift in how tuberculosis is treated. Additionally, the global spread of multidrug-resistant tuberculosis jeopardizes global TB control efforts and jeopardizes the lives of hundreds of thousands of individuals[6,7].

The order of additional confirmation by bacterial culture, molecular testing, and imaging is dictated by the differential diagnosis of respiratory infections, which is primarily based on physical examination and history. For the objective of swiftly diagnosing any potentially life-threatening respiratory conditions (multi-lobar pneumonia, tuberculosis), multiple additional tests are typically undertaken at the same time. On the other side, coughing and long-term dyspnea may be beneficial. There was some renal involvement in people with respiratory infections or a long hospital stay in some cases. Patients with respiratory tract infections are more likely to experience acute kidney damage, electrolyte abnormalities and hematuria as renal involvement. However, none of the studies included in this review particularly examined the status of electrolyte imbalances and their impact on survival and illness severity in connection with lung infection and found that lower sodium, potassium, and calcium levels were associated with severe disease. This study has focused on any disturbance in electrolyte imbalance during respiratory infection which will help prognosis of upper and lower respiratory tract infection.

The objective of the study was to correlate serum electrolytes such as serum sodium, chloride, potassium, calcium and magnesium levels in subjects with upper and lower respiratory tract infections.

MATERIALS & METHODOLOGY

This was a cross-sectional descriptive study which was conducted on patients visited a tertiary care hospital pulmonology department after permission from Ethical Review Board.
Sample collection: Non probability sampling technique was used for recruitment of patients, 139 patients were selected with suspected respiratory tract infection.

Demographic features (Gender and age), Infection type (Upper respiratory, lower respiratory), culture of sputum for confirmation infection type either bacterial or viral, GeneXpert for

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Mycobacterium tuberculosis confirmation and base line laboratory investigation of electrolytes including sodium and potassium [8].

Inclusion and Exclusion criteria

- All patients with respiratory tract infections including COVID-19 (confirmed by IgG testing) without age and gender restriction were included
- Only HIV positive and Cancer patients were excluded for this study.

Blood Sample collection: Blood samples was taken 2–3 hours after breakfast. The cubital veins of each subject were pierced and syringed into a lithium heparin container[9].

Sputum sampling: Patients' first morning sputum samples were taken. Sterilized wide-mouth containers were used to collect samples. The patients were asked to provide deep sputum samples but not saliva. The samples were tested for saliva, mucus, blood, and mucoid material[10].

Sample Processing: Electrolytes were performed on Alinity[11], Sputum culture was performed by inoculating sputum on blood, chocolate and MacConkey agar[12]. AFB was tested by GeneXpert [13]. COVID-19 was tested by IgG testing[14].

Data analysis: The data was imported into SPSS version 23.0 and evaluated. Demographic data was stratified and presented in tables and graphs. Aside from the study objectives, all other relevant data was considered[15].

RESULTS

Majority of patients from total 139 were male and aged between 10 to 40 years.

Table 1: Demographic characteristics

Demographic Characteristics		Participants (n)
Gender	Male	128
	Female	11
Age Groups (Years)	< 10 years	12
	11 to 40	98
	41 to 75	29

Frequency of infection prevalence is given in the following table. Bacteria was the most common single pathogenic factor in this study, 33 patients were affected by bacterial pathogen and the most common bacterial pathogen found was *Staphylococcus aureus*. MTB was revealed in total 8 patients and all were having pulmonary TB confirmed by Sputum test. Fungal infection was also found in 8 patients with 1 *Aspergillus Spp* and 7 *candida albican*. Collectively, the second most prevalent infection was COVID-19 which was found in 27 individuals, whereas in total 59 were affected with COVID-19 + bacterial infection in co-morbidity state.

Table 2: Frequency of infection type

Diseases	Prevalence
Bacterial Infection including MTB	41
COVID-19	27
Fungal Infection	8
Flu	13
COVID-19 +Bacterial infection	59
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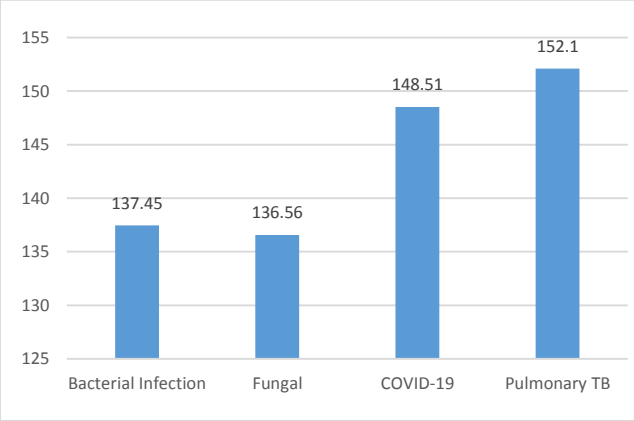
Table 3: Average values of serum electrolytes in selected infections

Parameters	Bacterial Infection	Fungal	COVID-19	Pulmonary TB	*P*-value
Sodium (mmol/L)	137.45	136.56	148.51	152.10	<0.05
Potassium (mmol/L)	3.89	3.81	5.76	6.54	<0.05
Chloride (MEq/L)	105.49	104.56	121.01	113.01	<0.05
Calcium (mg/L)	7.98	8.21	8.01	7.35	<0.05
Magnesium (mg/L)	2.24	2.21	2.79	3.31	<0.05

Average values with standard deviation of electrolytes were measured and their relationship with selected type of infectious respiratory diseases are given in Table 3.

Figure 1: Average sodium values in all infections



Above given table 3 and figure 1 showed COVID-19 and MTB has strong association with variation of electrolytes and value of p is less than 0.05. The electrolyte readings were compared to the levels of infection in each of the infections. Almost all infections were shown to have a statistically significant relationship with electrolyte levels.

It was observed as showed in Table 3 that COVID 19 and Tuberculosis are two important infections that can lead to severe or lethal variations of electrolytes as compared to other infections like Fungal and bacteria other than Mycobacterium. Significant variations of serum electrolytes were observed in all respiratory infections.

DISCUSSION

Electrolyte and fluid balance is an essential part of maintaining homeostasis, as well as protecting cell function, tissue perfusion, and the acid-base balance of the body[16]. Fluid and electrolyte balance is critical in a wide range of medical problems[17,18].

Electrolyte abnormalities are common in a wide range of conditions. In order to give an efficient and successful treatment, the electrolyte imbalances of each patient must be taken into account in conjunction with one another. The most common electrolyte disorders are low or high sodium, potassium, calcium, and magnesium levels[19].

Staphylococcus aureus was shown to be the most common bacterial pathogen in this investigation, with most of the 33 patients being infected by the bacteria. A total of eight patients tested positive for MTB, all of whom had pulmonary TB, as determined by a sputum test. 8 patients had fungal infections, including 1 Aspergillus Spp and 7 candida albican. COVID-19 was the second most common infection, found in 27 people alone and in 59 people who also had a bacterial infection as a co-morbidity. But in a study influenza B virus and Mycoplasma pneumoniae were the most often found co-infecting agents. According to the results of a regression analysis, the proportion of mixed illnesses and the occurrence of infections caused by multiple pathogens are correlated linearly, determining the incidence of infectious pathogens in children with ARTI. Multiple infections can be estimated by detecting a single pathogen. Pathogens in ARTI-infected children showed a linear relationship, according to the results of this study[20].

Electrolyte imbalance can be found in a variety of respiratory diseases. A common complication of pneumonia is hyponatremia, which can worsen clinical outcomes and increase the need for MV, ICU, and other hospital services. Clinical diagnosis of electrolyte abnormalities in patients with COPD exacerbations is difficult because of the frequency, variety of etiologies, and potential consequences for prognosis[21].

It was discovered, as shown in Table 3, that COVID 19 and tuberculosis are two major illnesses that might cause severe or

deadly electrolyte changes when compared to other infections such as fungal and bacterial other than Mycobacterium. All respiratory infections had significant electrolyte abnormalities, which were found in all of the cases.

CONCLUSION

It was concluded that the prevalence of altered electrolyte balance is high in patients suffering from respiratory tract infections. The diagnosis of electrolyte disturbances with infectious diseases is one of the challenges for the clinicians because of its frequency, various etiologies, and implications for prognosis and management. The prompt diagnosis is important and should be ensured by early serum electrolytes analysis in all such subjects in order to reduce morbilty and mortality. Further reaearch work is required to conclude the subsidizing factors associated with electrolyte imbalance. A large prospective study involving great sample size of subjects with respiratory infections possibly causing alterations in pulmonary vasculature and lung parenchyma is recommended to determine which infectious agents cause more electrolytes imbalance.

Conflict of interest: Nil

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