

A Prospective Cross-Sectional Study to Assess the Electrolyte Imbalance in Leprosy Patients of Northern India

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Abstract

Original research Article

Objective: To evaluate the electrolyte imbalance in leprosy patients. **Methods:** The objective of the study was well explained to all participants in this study. The anonymity of patients was maintained by coding the sample. Blood samples were collected and the serum was separated within 30–45 min, aliquoted and stored at 20°C for further analysis. A total of 20 patients were included in the study. **Results:** The sodium level was insignificantly ($p>0.05$) higher among the patients of age <40 years (136.58 ± 4.60) than ≥ 40 (136.01 ± 4.51). The sodium level was insignificantly ($p>0.05$) higher among male patients (136.62 ± 4.50) than females (135.67 ± 4.58). The potassium level was insignificantly ($p>0.05$) higher among the patients of age <40 years (3.94 ± 0.82) than ≥ 40 (3.76 ± 0.67). The sodium level was insignificantly ($p>0.05$) higher among male patients (3.93 ± 0.67) than females (3.70 ± 0.82). The calcium level was insignificantly ($p>0.05$) higher among the patients of age <40 years (1.93 ± 0.55) than ≥ 40 (1.87 ± 0.73). The calcium level was insignificantly ($p>0.05$) lower among male patients (1.80 ± 0.67) than females (2.05 ± 0.61). **Conclusion:** This study found that there was no significant difference in serum electrolytes between the two age groups and male & female among the patients of leprosy.

Keyword: Leprosy, Electrolytes, Imbalance.

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INTRODUCTION

Leprosy is a chronic granulomatous infection due to *Mycobacterium leprae* (*M. leprae*) and *Mycobacterium lepromatosis*, affecting particularly peripheral nerves and skin (Ploemacher *et al.*, 2020) [1]. Leprosy remains a public health problem, especially in developing countries. It can cause permanent damage to the eyes, hands & feet and can be physically, psychologically, and socially devastating if not diagnosed and treated early (Barreto *et al.*, 2017) [2].

Diagnosis of leprosy is recognized if there is at least one of the 3 cardinal leprosy signs such as hypopigmented or erythematous macule with loss of sensation, thickening of the peripheral nerves with impaired function and acid-fast bacilli (AFB) found on

slit-skin smear examination. Histopathological examination is one of them among many examinations which can help to establish the diagnosis of leprosy especially for cases with atypical clinical manifestations. This examination also assists to rule out differential diagnoses, determine therapy & prognosis as well as useful for research purposes (Antunes *et al.*, 2012) [3].

Electrolyte imbalance is one of the most common clinical complications met in the setting of intensive care and is correlated with the poor prognosis. Critical disorders such as severe burns, trauma, sepsis, brain damage and heart failure as well as many other diseases lead to disturbances in fluid and electrolyte homeostasis. Electrolytes are essential for sustaining with good health in individuals. The major functions of electrolytes are to control osmosis of water between the

different compartments of the body, as co-factors for optimal activity of enzymes and maintain acid-base balance. Their imbalance in the body definitely results in electrolyte disorder ranging from osmotic imbalance, edema, hypertension, hormonal changes, confusion and loss of consciousness (Tortora and Derrick, 2014) [4].

Feasible mechanisms of the imbalance may include reduced perfusion to the kidney due to hypovolemia or hypotension, stimulation of hormonal systems such as renin-angiotensin-aldosterone system and vasopressin, and also tubular damage due to ischemic or renal damage, including insult caused by a myriad of medications used in the intensive care. The main electrolytes necessary to perform several functions are as follows: Sodium (Na⁺), Potassium (K⁺), Calcium (Ca²⁺), Magnesium (Mg²⁺), and Phosphates. Electrolytes are present in both extracellular (sodium and chloride) and intracellular (potassium, calcium, and phosphate, etc.) matrix in and around the cells and their concentration is mainly regulated by kidneys. Furthermore, there are some hormones that are involved in the regulation of water and electrolyte balance such as: aldosterone, ADH (antidiuretic hormone), and renin-angiotensin (Parthasarathi *et al.*, 2012) [5]. Therefore, the objective of this study was to evaluate the electrolyte imbalance in leprosy patients.

MATERIAL AND METHODS

The objective of the study was well explained to all participants in this study. The anonymity of patients was maintained by coding the sample. Permission for this study was obtained from the college ethical committee. Blood samples were collected and

the serum was separated within 30–45 min, aliquoted and stored at 20°C for further analysis. Serum analysis for Na⁺, and K⁺ and Ca⁺⁺ were estimated by the standard methods. A total of 20 patients were included in the study.

Statistical analyzes were done using the Statistical Package for the Social Sciences (SPSS for windows, version 20.0; SPSS Inc., Chicago, IL, USA). Data were presented using Mean±SD for all quantitative values. Unpaired t-test was used for comparisons. Statistical significance was determined as a p-value < 0.05 were considered statistically highly.

RESULTS

The sodium level was insignificantly (p>0.05) higher among the patients of age <40 years (136.58±4.60) than ≥40 (136.01±4.51). The sodium level was insignificantly (p>0.05) higher among male patients (136.62±4.50) than females (135.67±4.58) (Table-1).

The potassium level was insignificantly (p>0.05) higher among the patients of age <40 years (3.94±0.82) than ≥40 (3.76±0.67). The sodium level was insignificantly (p>0.05) higher among male patients (3.93±0.67) than females (3.70±0.82) (Table-2).

The calcium level was insignificantly (p>0.05) higher among the patients of age <40 years (1.93±0.55) than ≥40 (1.87±0.73). The calcium level was insignificantly (p>0.05) lower among male patients (1.80±0.67) than females (2.05±0.61) (Table-3).

Table-1: Comparison of sodium with age and gender

Age and gender	Sodium in Mmol/L (Mean±SD)	p-value ¹
Age in years		
<40	136.58±4.60	0.16
≥40	136.01±4.51	
Gender		
Male	136.62±4.50	0.15
Female	135.67±4.58	

¹Unpaired t-test

Table-2: Comparison of potassium with age and gender

Age and gender	Potassium in Mmol/L (Mean±SD)	p-value ¹
Age in years		
<40	3.94±0.82	0.12
≥40	3.76±0.67	
Gender		
Male	3.93±0.67	0.17
Female	3.70±0.82	

¹Unpaired t-test

Table-3: Comparison of calcium with age and gender

Age and gender	Calcium in Mmol/L (Mean±SD)	p-value ¹
Age in years		
<40	1.93±0.55	0.19
≥40	1.87±0.73	
Gender		
Male	1.80±0.67	0.08
Female	2.05±0.61	

¹Unpaired t-test

DISCUSSION

Leprosy is a chronic infectious disease caused by *Mycobacterium leprae* that affects the skin and peripheral nerves, leading to progressive physical disability and deformities if not diagnosed and treated early (Santos *et al.*, 2015) [6].

Despite a significant reduction in its global prevalence since the World Health Organization (WHO) implemented the free multidrug therapy program in 1995, leprosy remains a major cause of morbidity owing to its associated long-term disabilities and sequelae⁴ in an estimated 2 million people worldwide (Raposo *et al.*, 2018) [7].

The WHO goal is to reduce leprosy disabilities to a target of less than 1 per million population through the strengthening of strategies for the prevention and reduction of deformities (World Health Organization, 2016) [8].

These strategies include the early recognition and prioritization of individuals with leprosy with characteristics associated with physical disability and the main focus of control programs and rehabilitation centers is to prevent and manage physical impairment to improve quality of life (Santos *et al.*, 2016) [9].

Although clinical features such as multibacillary (MB) leprosy and leprosy reactions are considered to predispose patients to physical disability and deformity, there are no systematic analyses assessing the strength of this evidence (Rodrigues *et al.*, 2017; Haefner *et al.*, 2017) [10, 11].

Sodium is the major cation with the normal serum concentration of sodium is 135–148 mmol/L, and the daily requirement of sodium is 5–10 g/day (Satyanarayana and Chakrapani, 2006) [12].

Potassium is an intracellular electrolyte, and the normal serum concentration of potassium is 3.5–5.0 mEq/L, and the daily requirement of potassium is 3–4 g/day (Satyanarayana and Chakrapani, 2006) [12].

Nutritional assessment of leprosy patients and their families must form the part of the initial evaluation to identify specific deficiencies for index cases as well as at risk contacts. The main difficulty in analyzing the

available literature in this context is the use of different tools as biomarkers of nutritional status by different researchers. The most widely used is body mass index (BMI). Among the serum markers, serum albumin, iron, transferrin, zinc, vitamin A, and vitamin E have been used. Rao *et al.*, found decreased levels of vitamin A, vitamin E, and zinc in patients with lepromatous leprosy compared to healthy controls. They also found an association between undernutrition and the development of deformities. Diffey *et al.*, (2000) [13] reported that cured leprosy index cases with deformity were more undernourished than index cases without deformity.

Calcium (Ca²⁺) is the abundant among minerals in the body. The total content of the calcium in an adult human is 1–1.5 kg, and the normal concentrations of calcium are 4.5–5.5 mEq/L (Waugh *et al.*, 2006) [14].

In the present study, the sodium level was insignificantly ($p>0.05$) higher among the patients of age <40 years (136.58±4.60) than ≥40 (136.01±4.51). The sodium level was insignificantly ($p>0.05$) higher among male patients (136.62±4.50) than females (135.67±4.58).

In a study by Jindal *et al.*, (2022) [15], two-thirds of the patients had low hemoglobin, with 18 (36%) having low serum iron. However, hemoglobin levels less than 10 g/dl were observed in eight (16%) patients. Serum albumin and cholesterol were low in 14 (28%) and 31 (62%) subjects, respectively. CRP was raised in 14 (28%) patients.

The potassium level was insignificantly ($p>0.05$) higher among the patients of age <40 years (3.94±0.82) than ≥40 (3.76±0.67). The sodium level was insignificantly ($p>0.05$) higher among male patients (3.93±0.67) than females (3.70±0.82) in this study.

In this study, the calcium level was insignificantly ($p>0.05$) higher among the patients of age <40 years (1.93±0.55) than ≥40 (1.87±0.73). The calcium level was insignificantly ($p>0.05$) lower among male patients (1.80±0.67) than females (2.05±0.61).

Food shortage worsens the often already inadequate intake of micro and macronutrients. Nutritional deficiencies impair the immune system and thus the defense of the body against infections (Wintergerst *et al.*, 2007) [16]. The risk of contracting subclinical *M. leprae* infection is not necessarily increased by food shortage, but it could facilitate the progression from infection to the clinical presentation of leprosy.

In a study by Nigam *et al.*, (1979) [17], serum calcium was found to be significantly decreased in lepromatous leprosy (Ca=8.42±/0.7 mg%, P less than 0.001) and dimorphous leprosy (Ca=8.68±/0.94 mg%, P less than 0.05) while it was normal in tuberculoid leprosy (Ca=9.14±/2.12, P less than 0.05). The decrease in serum magnesium level was highly significant in all clinical types of leprosy (Mg=1.08±/0.29, P less than 0.001).

CONCLUSION

This study demonstrated that there was no significant difference in serum electrolytes between two age groups and male & female among the patients of leprosy.

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