MEDICO RESEARCH CHRONICLES
ISSN NO. 2394-3971
DOI No. 10.26838/MEDRECH.2022.9.5.613
Contents available at www.medrech.com

GENERAL CHARACTERISTICS AND LABORATORY FINDINGS OF PATIENTS ADMITTED TO MEDICINE DEPARTMENT OF A TERTIARY CARE HOSPITAL WITH ELECTROLYTE IMBALANCE

Hossain MM[1], Mondal NM[2], Khan MM[3], Hasan MQ[4]
1. Associate Professor, Medicine, Enam Medical College, Savar, Dhaka, Bangladesh
2. Associate Professor Medicine, Enam Medical College & Hospital, Saver, Dhaka, Bangladesh.
3. Associate professor, Gastroenterology, Enam Medical College and Hospital, Saver, Dhaka, Bangladesh.
4. Associate Professor, Department of Neurology, Enam Medical College & Hospital, Savar, Dhaka, Bangladesh.

ARTICLE INFO

Article History
Received: August 2022
Accepted: October 2022
Key Words: Laboratory findings, electrolyte imbalance, risk of mortality

ABSTRACT

ORIGINAL RESEARCH ARTICLE

Introduction: Electrolyte imbalance (EI) is an independent predictor of mortality and has of great clinical importance because these disorders have been associated with an increased risk of morbidity and mortality. Thus, prompt diagnosis and treatment are crucial in the management of patients admitted to the medicine department. **Objective:** To assess the general characteristics and laboratory findings of patients admitted to the medicine department of a tertiary care hospital with electrolyte imbalance. **Materials and Methods:** This retrospective study was conducted on patients attending the medicine department of Enam Medical College Hospital, Savar, Bangladesh over a period of six months from January to June 2022. A total of 501 patients over 18 years of age who presented in the medicine department with different electrolyte disturbance was included in this study. After admission and clinical examinations, data were collected from the patients after having a written informed consent from them. **Results:** Among, 501 patients with electrolyte imbalance, 55% (n=275) were male and 45% (n=226) female. The mean age of patients was 59.28 ±16.79 years. The most common symptoms of the patients were dyspnoea (14.9%, n=75), fever (13.9%, n=70), and systemic deterioration (12.1%, n=61). Most and least frequent electrolyte imbalances were hyponatremia and hypermagnesemia, respectively. Confusion (14.1%), oedema (10.0%) and rales (9.0%) were most frequently seen in physical examination. ECG examinations revealed normal sinus rhythm in 62.2% of the patients, and most frequent pathological findings were tachycardia (23.5%) and atrial fibrillation (6.7%). Most frequent oncological diagnoses in these patients were lung and haematological malignancies.

Corresponding author
Hossain MM*

By physical, clinical, and laboratory examinations, sepsis was frequently diagnosed in 10.5% of the patients, pneumonia in 8.7%, and acute renal failure in 7.1%. All patients had at least one comorbid condition. **Conclusion:** Patients admitted to the medicine department with electrolyte imbalance require close evaluation and frequent laboratory draws depending on the duration and severity of underlying disease states. In our study, our patients were diagnosed with various oncological diseases (39.5%). These malignancies expose a major risk for electrolyte imbalances. Most patients undergoing therapy for the electrolyte abnormalities require longer hospital stays depending upon the severity and acuity of different electrolytes.

2022, www.medrech.com

INTRODUCTION

Electrolyte imbalance (EI) is an independent predictor of mortality, and the prevalence and incidence of EI in the medicine inpatient department are of great clinical importance because these disorders have been associated with an increased risk of mortality [1]. Thus, prompt diagnosis and treatment are crucial in the management of patients admitted the hospital [2]. Although dysnatraemias and dyskalaemias are commonly shown in hospitalized patients [3], little is so far known on the prevalence of this imbalance [6]. Recently, age-related differences in EI have been reported in the emergency department [5]. EI in addition, this is often associated with systemic diseases [5,6]. Imbalances in every electrolyte must be considered in a combined and associated fashion, and examinations must aim to clarify the clinical scenario for an effective and successful treatment. Most of important and prevailing electrolyte imbalances are hypo- and hyper-states of sodium, potassium, calcium, and magnesium. The kidney is a principally responsible organ for retention and excretion of electrolytes and fluid in healthy individuals [7]. But, other mechanisms like hormonal interactions of antidiuretic hormone, aldosterone, and parathyroid hormone, and other factors such as physiological stress also play important roles in regulating fluid and electrolyte balance in the organism. Studies about the clinical prevalence of electrolyte imbalances often report that these disorders are frequently seen in elderly and critically ill patients, and occur in the progression of diseases such as diabetes mellitus, acute or chronic renal failures, severe cardiovascular events like myocardial infarctions, etc [8,9]. In this study we evaluated the general characteristics and other laboratory abnormalities of patients admitted to our medicine inpatient department, and diagnosed as having electrolyte imbalance. Literature data generally focused on imbalances of specific electrolytes, and the majority of the studies recruited patients of a specific disease or risk group. To our knowledge, only three studies focused on electrolyte imbalances in emergency department patients, and two of them conducted with elderly patients [10]. To summarize, disturbances in electrolyte balances are mathematically measurable biochemical parameters in the bloodstream that determines the clinical manifestations of interactions between metabolic events such as sepsis, hormones, vascular events,medications, hydration deficiencies, and renal physiology [11,12,13,14,15].

MATERIALS AND METHODS

The retrospective study was conducted on patients attending the medicine department of Enam Medical college Hospital, Savar, Bangladesh over a period of six months from January to June 2022. A total of 501 patients over 18 years of age who presented with

Download the article from www.medrech.com

electrolyte imbalance are included in the study. After admission and clinical examinations, data were collected from the patients with electrolyte imbalance after written informed consent was obtained. Demographic and clinical parameters of the patients included date of birth, complaints, vital signs, electrocardiographic (ECG) findings, physical examination findings, pathologic signs, oncological disease and metastatic state if any, drugs used, diagnosis, serum electrolyte levels, and discharge information from the ED. Complete information of demographic and clinical parameters was recorded. The data was stastically analysed on SPSS version 20 (Chicago, IL). Categorical data was analysed using Pearson's Chi square and Fisher's exact test.

RESULTS

In the 501 patients with electrolyte imbalance, 55% (n=275) were male and 45% (n=226) female. The mean age of patients was 59.28 ±16.79 years. The most common symptoms of the patients were dyspnoea (14.9%, n=75), fever (13.9%, n=70), and systemic deterioration (12.1%, n=61). Most and least frequent electrolyte imbalances were hyponatremia and hypermagnesemia, respectively. The distribution of electrolyte imbalances in our study population is presented in Table-1. Confusion (14.1%), oedema (10.0%) and rales (9.0%) were most frequently seen in physical examination. ECG examinations revealed normal sinus rhythm in 62.2% of the patients, and most frequent pathological findings were tachycardia (23.5%) and atrial fibrillation (6.7%). Some patients also had chronic diseases, which were treated with drugs. The most frequent comorbidity was malignancies, which are seen in 39% (n=195) of the patients. Most frequent oncological diagnoses in these patients were lung and haematological malignancies. By physical, clinical and laboratory examinations, sepsis was frequently diagnosed in 10.5% of the patients, pneumonia in 8.7%, and acute renal failure in 7.1%. All patients had at least one comorbid disease. The frequencies of prevalent symptoms, findings of physical examinations, ECG patterns, comorbidities and diagnoses are summarized in (Table 2-6).

Table 1: Distribution of electrolyte imbalance (N=501)

Electrolytes	Imbalance	Number	patients
Na+	Hyponatremia	302	60
	Hypernatremia	26	5
K+	Hypokalemia	78	15
	Hyperkalemia	41	8
Ca++	Hypocalcemia	257	51
	Hypercalcemia	21	4
Mg++	Hypomagnesemia	26	5
	Hypermagnesemia	6	1

Sodium imbalances are particularly important in patients who need intensive care because both hypo- and hypernatremia are associated with increased mortality in these patients regardless of age, gender and diagnoses.

Download the article from www.medrech.com

Table 2: Most frequent symptoms of the patients

Symptoms	Number	patients
Dyspnea	75	14.9
Fever	70	13.9
Systemic deterioration	61	12.1
Abdominal pain	50	9.9
Weakness	49	9.7
Angina pectoris	20	3.9
Vomiting	19	3.7
Syncope	16	3.1
Diarrhea	14	2.9

Table 3: Most frequent findings in physical examinations of the patients.

Findings in physical examinations	Number	patients
Confusion	71	14.1
Edema	50	10
Ral	45	9
Oliguria-anuria	32	6.3
Defense	22	4.3
Paresis	21	4.1
Ronchi	19	3.7
Ascites	14	2.7
Icterus	11	2.1

Table 4: Most frequent ECG patterns of the patients

ECG patterns	Number	patients
Normal sinus rhythm	312	62.2
Tachycardia	118	23.5
Atrial fibrillation	34	6.7
Atrioventricular block	18	3.5
Bradycardia	9	1.7
Spiked T	6	1.1
ST segment change	6	1.1

Table 5: Most frequent comorbidities of the patients

Comorbidities	Number	patients
Malignancy	195	39
Hypertension	152	30
Diabetes mellitus	102	20.3
Coroner artery disease	67	13.3
Chronic renal failure	50	10

Download the article from www.medrech.com

Congestive heart failure	40	8
Chronic obstructive pulmonary disease	34	6.77
Cerebrovascular disease	18	3.5

Table 6: Most frequent diagnoses of the patients

Diagnose	Number	patients
Sepsis	53	10.5
Pneumonia	44	8.7
Acute renal failure	36	7.1
Cerebrovascular disease	36	7.1
Acute coronary syndrome	31	6.1
Urinary tract infection	30	6
Diarrhea	21	4.1
Encephalopathy	21	4.1
Gastrointestinal bleeding	20	4

Download the article from www.medrech.com

Table 7: Electrolyte imbalances according to chronic diseases

Electrolyte Imbalance	Malignancy		CAD		HT		DM		CRF		CHF		COPD		CVD	
	(*n*=184) %		(*n*=65) %		(*n*=150) %		(*n*=101) %		(*n*=49) %		(*n*=40) %		(*n*=34) %		(*n*=18) %	
Hypernatremia	10	5	5	8	7	5	6	6	2	4	4	10	2	6	2	11
Hyponatremia	115	63	47	72	95	63	57	71	25	51	27	68	20	59	8	44
Normal	59	32	13	20	48	32	38	23	22	45	9	23	12	35	8	44
Hypermagnesemia	2	1	0	0	3	2	1	1	1	2	0	0	0	0	0	0
Hypomagnesemia	14	8	5	8	5	3	4	4	6	12	0	0	0	0	0	0
Normal	168	91	60	92	142	95	96	95	42	86	40	100	34	100	18	100
Hyperkalemia	8	4	12	18	18	12	12	12	8	16	9	23	4	12	0	0
Hypokalemia	45	24	7	11	25	17	14	12	5	10	4	10	1	3	3	17
Normal	131	71	46	71	107	71	75	76	36	73	27	68	29	85	15	83
Hypercalcemia	7	4	0	0	6	4	3	3	2	4	0	0	1	3	1	6
Hypocalcemia	119	65	26	40	70	47	49	48	23	47	21	53	18	53	10	56
Normal	58	32	39	60	74	49	49	48	24	49	19	48	15	44	7	39

Download the article from www.medrech.com

Electrolyte imbalances according to chronic diseases of the patients are presented in Table 7. According to this table all electrolytes were lower than their normal levels in chronic disease states.

DISCUSSION

Being crucial to the functioning of every cell in the body, the electrolytes are tightly regulated which involves considerable energy in order for the homeostasis to be maintained. For the sustenance of the normal physiological functioning of the muscles and nerves the electrolyte gradients are precisely controlled between the intracellular and extracellular compartments of the body. Apart from their regulation of acid-base balance of the body fluids; maintenance of the osmotic pressure of the body fluids by regulation of water balance, the electrolytes help to preserve the normal neuromuscular irritability by maintaining a state of equilibrium on account of their relative proportion in the ECF and ICF. Electrolyte gradients are controlled precisely between intra- and extracellular compartments for sustaining the normal physiological functions of the muscles and nerves. The main responsible organ for this regulation is the kidney, but other mechanisms like hormonal activities of antidiuretic hormone, aldosterone and parathyroid hormone are also involved in this process. The disorders of these systems may deteriorate the electrolyte balances and results in emergencies [15]. Our study center provides tertiary health services in its region as a university-based hospital, and particularly deals with clinically advanced diseases and complicated patients. Disorders of the systems responsible for maintaining the stability of the electrolytes (like kidneys, hormonal activities of antidiuretic hormone, aldosterone and parathyroid hormone) may deteriorate the balance in electrolytes and result in emergencies. Therefore, we particularly investigated electrolyte imbalances in our patients carefully, with an awareness of clinical importance of this entity. We determined sodium imbalance in 65% of our patients, and 60% of them had hyponatremia. This rate of sodium imbalance was defined in accordance with the literature data. The second most frequent imbalanced electrolyte was calcium in our patients. Calcium has many functions in intracellular enzymatic pathways, and also plays a role in cellular damage and cell death [16]. We determined hypo and hypercalcemia in 51% and 4% of our patients, respectively. Confusion was the most frequent finding in physical examinations, and this supposed to be a result of hypocalcaemia in our patients. The malignancy rate was as high as 39%, and the prevailing diagnoses were cancers of the lung and gastrointestinal system (23% each). The high rates of oncological diagnoses resulted in high frequencies of calcium balance disorders. Compared these ECG findings according to the higher and lower levels of calcium, we found that hypocalcaemic patients had more tachycardia, bradycardia and atrial fibrillation, and hypercalcaemic patients had more atrioventricular blocks, spiked T waves and ST segment changes. The rates of these differences between the imbalance groups were statistically significant. The third most frequent imbalance was in the level of potassium. We found the incidence of hypo- and hyperkalaemia was 15% and 8% respectively in our patients. By checking physical examination findings, we found that hypokalaemia was characterized by confusion, paresis, and aphasia. Although the clinical signs and symptoms cannot be attributed to a single disorder of electrolyte imbalances, it is meaningful to determine the physical aspects of hemodynamic changes of electrolyte levels in bloodstream. Hyperkalaemia is a rare condition, but we found it in 8% of our patients. Williams et al [17] reported that potassium secretion from thrombocytes and leukocytes in severe thrombocytosis and leucocytosis may cause pseudo-hyperkalaemia. We determined that the first three of most frequent diagnoses were sepsis, infections, and renal failure, and

Download the article from www.medrech.com

concluded that these clinical conditions, particularly renal failure, might have caused hyperkalaemia in our patients. The least frequent electrolyte imbalances were hypo- and hypermagnesemia, which were determined in 5% and 1% of our patients, respectively. Hypomagnesaemia is known to have a high prevalence rate, but its diagnosis may be intrigued by some factors. First, it has nonspecific manifestations and frequently overlooked. Second, magnesium level is not examined "routinely" in blood test [18]. Third, patients may be hypomagnesaemic, even with a normal serum magnesium level. And finally, magnesium deficiencies are generally masked by other electrolyte deficiencies. In the emergency department, approximately 3-6% of the adult patients have Hyponatraemia and the incidence of hospital associated Hyponatraemia has been reported to be 10%-30% depending on the patient population with severe Hyponatremia accounting for 1% of patients. As has been noted previously such patients have longer stay in the hospital with increased risk of death than the patients with normal serum sodium levels, overall, the mortality of Hyponatremia ranges from 3% to 29%. Leading causes of Hyponatremia in the patients of emergency department are the use of diuretics and syndrome of inappropriate antidiuretic hormone secretion [19,20].

CONCLUSION

Patients admitted to the emergency department with electrolyte imbalance requires close evaluation and frequent laboratory draws depending on the duration and severity of underlying disease states. The symptomatic improvement or signs of the disease state, but also to track the rate of correction (and prevent overcorrection). In our study, our patients were diagnosed with various oncological diseases (39.5%). These malignancies expose a major risk for electrolyte imbalances. Most patients undergoing therapy for the electrolyte abnormalities require longer hospital stays depending upon the severity and acuity of different electrolytes. Patients with milder symptoms respond to the early treatment of electrolyte abnormalities and may be considered for discharge from the department of emergency with close follow-up. The data generated will provide more information for the consultants in the emergency department and will contribute in reducing mortality rates in the emergency department. Therefore, we were aware of electrolyte imbalances in patients admitted to the ED, particularly in those with underlying oncological diseases. Hence our frequencies may not truly reflect the actual prevalence of each electrolyte's imbalance in the general population. Conflict of Interest There was not any conflict of interest.

REFERENCES:

1. Arampatzis S, Funk GC, Leichtle AB, Fiedler GM, Schwarz C, Zimmermann H, et al. Impact of diuretic therapy-associated electrolyte disorders present on admission to the emergency department: a cross-sectional analysis. BMC Med 2013; 11:83–9.
2. Funk GC, Lindner G, Druml W, Metnitz B, Schwarz C, Bauer P, et al. Incidence and prognosis of dysnatremias present on ICU admission. Intensive Care Med 2010; 36(2):304–11.
3. Balci AK, Koksal O, Kose A, Armagan E, Ozdemir F, Inal T, et al. General characteristics of patients with electrolyte imbalance admitted to emergency department. World J Emerg Med 2013;4(2):113–6.
4. Lindner G, Pfortmüller CA, Leichtle AB, Fiedler GM, Exadaktylos AK. Age-related variety in electrolyte levels and prevalence of dysnatremias and dyskalemias in patients presenting to the emergency department. Gerontology 2014;60(5):420–3 [Epub 2014 May 20].
5. Marti G, Schwarz C, Leichtle AB, Fiedler GM, Arampatzis S, Exadaktylos AK, et al. Etiology and symptoms of severe hypokalemia in emergency department

Download the article from www.medrech.com

patients. Eur J Emerg Med 2014;21(1):46–51.

6. Najeeb Q, Ruqaya A, Sajad H, Sabiya M, Ruhi A. Electrolyte abnormalities in patients admitted in emergency department of tertiary care institute: a cross sectional study. Int J Med Sci Public Health 2014;3(11):1368–71.
7. Bockenkamp B, Vyas H. Understanding and managing acute fluid and electrolyte disturbances. *Current Paediatrics*. 2003; 13:520–528. [Google Scholar]
1. Ito H, Fujimaki H, Inoue J, Shiraki M. Disorders of fluid and electrolyte metabolism in elderly diabetics. *Nihon Ronen Igakkai Zasshi*. 1989; 26:233–239. [PubMed] [Google Scholar]
2. Goldberg A, Hammerman H, Petcherski S, Zdorovyak A, Yalonetsky S, Kapeliovich M, et al. Prognostic importance of hyponatremia in acute ST-elevation myocardial infarction. *Am J Med*. 2004; 117:242–248
8. Singal BM, Hedges JR, Succop PA. Efficacy of the stat serum electrolyte panel in the management of older emergency patients. *Med Decis Making*. 1992; 12:52–59.
9. Mahowald JM, Himmelstein DU. Hypernatremia in the elderly: relation to infection and mortality. *J Am Geriatr Soc*. 1981; 29:177–180. [PubMed] [Google Scholar]
10. Sonnenblick M, Algur N. Hypernatremia in the acutely ill elderly patients: role of impaired arginine-vasopressin secretion. *Miner Electrolyte Metab*. 1993; 19:32–35. [PubMed] [Google Scholar]
11. Solini A, Zamboni P, Passaro A, Fellin R, Ferrannini E. Acute vascular events and electrolytes variations in elderly patients. *Horm Metab Res*. 2006; 38:197–202. [PubMed] [Google Scholar]
12. Clark BA, Shannon RP, Rosa RM, Epstein FH. Increased susceptibility to thiazide-induced hyponatremia in the elderly. *J Am Soc Nephrol*. 1994; 5:1106–1111. [PubMed] [Google Scholar]
13. Miller PD, Krebs RA, Neal BJ, McIntyre DO. Hypodipsia in geriatric patients. *Am J Med*. 1982; 73:354–356. [PubMed] [Google Scholar]
14. Bilezikian JP. Etiologies and therapy of hypercalcemia. Endocrinol Metab Clin North Am 1989; 18: 389–414.
15. Williams ME, Rosa RM, Epstein FH. Hyperkalemia. Adv Intern Med 1986; 31: 265–291.
16. Whang R, Hampton EM, Whang DD. Magnesium homeostasis and clinical disorders of magnesium deficiency. Ann Pharmacother 1994; 28: 220–226.
17. Harring, TR., Deal, NS. and Kuo, DC. 2014. Disorders of sodium and water balance. Emerg Med Clin North Am., 32:379-401
18. Olsson, K., Ohlin, B. and Melander, O. 2013. Epidemiology and characteristics of hyponatremia in the emergency department. Eur J Intern Med., 24:110-116.

Download the article from www.medrech.com