Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/3vbza062

TO ESTIMATE PREVALENCE AND TYPE OF ELECTROLYTE ABNORMALITIES IN ADULT PATIENTS WITH NEW ONSET SEIZURES IN A TERTIARY CARE.

Dr Netravathi B Sajjan[1], Dr Pallavi Ashrit[2], Dr. Rajeshwari Patil[3*]

[1]Associate professor, Department of Biochemistry, Navodaya medical college, Raichur, Karnataka.
[2]Associate professor, Department of Biochemistry, Navodaya medical college, Raichur, Karnataka.
[3*]Assistant professor, Department of Biochemistry, BRIMS Medical college, Bidar.

***Corresponding Author:** Dr.Rajeshwari Patil
*Assistant professor, Department of Biochemistry, BRIMS Medical college, Udgir road Nawadgari, Bidar:585401

Abstract:

Introduction: Acute and/or severe electrolyte imbalances can manifest with rapidly progressive neurologic symptoms or seizures, which may be the sole presenting symptom. Rapid identification and correction of the underlying electrolyte disturbance are of crucial importance in the control of seizures and prevention of permanent brain damage. Hence this study was done to identify the electrolyte dysfunction associated with first episode of seizure and the determinants of these imbalances.

Objectives: 1.To estimate prevalence of electrolyte imbalances in patients presenting with first episode of seizures. 2. To identify determinants associated with electrolyte imbalances.

Materials and methods: A cross sectional descriptive study was conducted from September 2022 to August 2023 in 100 adult patients with first episode of seizure after obtaining ethical committee clearance and written informed consent. Details on socio - demographic data, presenting history of seizure, associated symptoms, past history on medical illness and trauma or alcohol intoxication was recorded in a pretested semi structured questionnaire from patients and attenders. Biochemical investigations like Complete Blood Picture (CBP), RBS, RFT, LFT, Serum electrolytes, Thyroid profile) and radioimaging (CT, MRI, EEG) were done. Statistical analysis was done by chi square test, t test and mann whitney u test with $P < 0.05$ considered as statistically significant.

Results: The most common type of seizure were generalized tonic clonic seizures (72%), followed by focal seizures (22%) and 6 % patients presented with status epilepticus. Electrolyte abnormality was seen in 28 (28%) patients. Most common electrolyte abnormality was hyponatremia seen in 75%, followed by hypocalcemia in 10.70%, hypomagnesemia in 10.70% and hypokalemia in 3.50% patients.

Conclusions: Effective management of seizures requires identification and treatment of the underlying primary disorder. Since neurological symptoms of electrolyte disorders are generally functional rather than structural, the neurologic manifestations of electrolyte disturbances are typically reversible.

Keywords: Electrolyte abnormality, first episode of seizure, tertiary care, determinants, adults.

Introduction: Seizure is a transient occurrence of signs/symptoms due to abnormal excessive or synchronous neuronal activity in the brain. Depending on the distribution of discharges, this abnormal brain activity can have various manifestations, ranging from dramatic convulsive activity to experiential phenomena not readily discernible by an observer.[1] Metabolic disturbances such as electrolyte imbalance, hypo-or hyperglycemia, renal failure, and hepatic failure may cause seizures at any age.[2]

Electrolyte disturbances may affect the brain among many other organs and tissues and need to be promptly recognized as they may lead to severe and life-threatening complications when overlooked or not appropriately treated.[3,4]

Electrolytes such as sodium (Na+), potassium (K+), chloride (Cl-), total carbon dioxide (TCo2), inorganic phosphate (PO42-), calcium (Ca2+), and magnesium (Mg2+) are crucial components of serum. The brain operates in an extraordinarily intricate environment which demands precise regulation of electrolytes. Tight control over their concentrations and gradients across cellular compartments is essential and when these relationships are disturbed neurologic manifestations may develop.[5]

Seizures are more frequently observed in patients with sodium disorders (especially hyponatremia), hypocalcemia, and hypomagnesaemia.[2,6] Hyponatremia as well as hypernatremia, hypocalcaemia, hypomagnesemia, hyperglycemia and other hyperosmolar states, hypoglycemia, thyrotoxic storm are important electrolyte and metabolic disturbances that can be complicated by generalised and multifocal seizures. Rapidly developing electrolyte imbalances are known to cause seizures than those abnormalities that occur gradually.[7]

Rapid identification and correction of the underlying electrolyte disturbance are of crucial importance in the control of seizures and prevention of permanent brain damage.[3,6,8] Hence this study was done to identify the electrolyte dysfunction associated with first episode of seizure and the determinants of these imbalances

Objectives:

- To estimate prevalence of electrolyte imbalances in patients presenting with first episode of seizures.
- To identify determinants associated with electrolyte imbalances.

Materials and methods

A cross sectional descriptive study was conducted for a period from September 2022 to August 2023. The study was done on a total number of 100 patients admitted in medical wards and IMCU of a tertiary care hospital with new onset focal / generalised seizures after obtaining ethical committee clearance and patient's written informed consent.

Inclusion criteria:

- Adults of either sex
- All patients with first episode of focal or generalised seizures
- Age of onset of seizures > 18 years

Exclusion criteria:

- Patient refusal
- Past history of seizures
- Pregnant and lactating mothers

Sampling technique: Patients who fulfil inclusion and exclusion criteria were selected by purposive sampling method.

Sample size calculation:

Sample size was calculated using formula for finite population. Where, Z α is the standard normal deviate, 1.96 at 95% confidence interval.

As per previous study by Hosalli NK et al the prevalence of new onset seizure in patients attending tertiary care was 1.12%.

Hence P = Prevalence is 1.12%.

e = allowable error was 2%

N = study population (Patients with new onset seizures attending hospital in the past 1 year in General Medicine department was) = 1500

Sample size (n)= ((z^2 X p(100-p))/e^2)/(1+(z^2 X p(100-p))/(e^2 N))

Sample size(n)= ((〖(1.96)〗 ^2 X 1.12(100-1.12))/ 〖(2)〗 ^2)/(1+(〖(1.96)〗 ^2 X 1.12(100-1.12))/((〖2)〗 ^2 1500))

Sample size(n)required is=100

After approval from ethical committee of the institution 100 Patients were selected by convenience sampling method. Patients with past history of seizures were excluded. After Patients were stabilized, purpose of the study was explained in local language to both the patients and attenders and written informed consent was obtained. Details on socio - demographic data, presenting history of seizure, associated symptoms, past history on medical illness and trauma or alcohol intoxication was recorded in a pretested semi structured questionnaire from patients and attenders.

A detailed history was sought from the relatives about the type of seizure, duration, associated symptoms like fever ,headache, vomiting ,weakness of limbs or loss of consciousness, fall or head injury, alcohol intoxication or withdrawal were noted. Past history of medical illness or neurological illness was also elicited. Detailed examination especially nervous system, was done to find out any causative factors, focal neurological deficits or complications. Fundus examination was done by single ophthalmologist to look for papilledema, or retinopathy and the findings were recorded. Assessment of Biochemical parameters and haematological parameters was done using automated analyser Beckmenn coulter, Randox imola, Sensacore ST 200.

Basic blood investigations were done to find out metabolic problems like hyper- or hypoglycaemia, renal function, liver function and electrolyte imbalances which included estimation of serum sodium, potassium, calcium and magnesium. Arterial blood gas(ABG) analysis was done. Neuroimaging findings of patients were recorded (as an emergency all the patients underwent mainly CT brain, whereas MRI brain was done only if the CT is inconclusive or diagnosis is doubtful, whereas all patients underwent EEG in the interictal period). Patients were treated based on the type of seizures and the causative factor by the treating physician.

Statistical analysis:

Data were entered in the excel spread-sheet and variables were coded accordingly. The statistical analyses were performed using SPSS version 27 software. Data were presented as mean with Standard deviation for normal distribution/scale data and as frequency with proportion n(%) for categorical data. Chi square test was used to compare the frequencies between the groups. Unpaired‘t’ test was used to compare the means between two groups. Mann Whitney U test was used to compare the median values between the groups. $p<0.05$ were considered statistically significant.

Figure 1: Severity of electrolyte disorders based on serum concentration[2]

Table 1. Different degrees of the electrolyte disturbances that most frequently cause seizures.

Electrolyte disturbance	Mild	Moderate	Severe
Hyponatremia	130-134 mEq/L	125-129 mEq/L	<125 mEq/L
Hypernatremia	145-149 mEq/L	150-169 mEq/L	≥170 mEq/L
Hypocalcemia	1.9-2.2 mEq/L		<1.9 mEq/L
Hypercalcemia	2.5-3 mEq/L	3-3.5 mEq/L	3.5-4 mEq/L
Hypomgnesemia	0.8-1.6 mEq/L		<0.8 mEq/L

Results: In this study, majority of patients belong to the age group 41-60 years (65 %), followed by the age group 20 – 40 years (22 %) with mean age as 49.65 years. Majority were males (67%).The most common type of seizure were generalized tonic clonic seizures (72%), followed by focal seizures (22%) and 6% patients presented with status epilepticus. Fever, head ache, vomiting and post-ictal confusion were seen in 12%, 6%, 10% and 15% of patients respectively. Hepatic failure, hepatitis, focal deficit and other comorbidities (includes hypertension, tuberculosis, diabetes mellitus) were present in 3%, 12%, 29% and 58% respectively. (Shown in table 1)

Table 1: Distribution of patients as per variables assessed

PARAMETERS	Sub- group	Frequency	Percentage
Age in years	< 20 years	1	1
	20– 40 years	22	22
	41 - 60 years	65	65
	>60 years	12	12
Age (years) Mean±SD/ range		49.65 ± 15.3 years/ 18-71 years	
Sex	Female	33	33
	Male	67	67
Type of seizure	Generalised Tonic Clonic Seizure	72	72
	Focal seizure	22	22
	Status epilepticus	6	6
Associated Symptoms	Fever	12	12
	Headache	6	6
	vomiting	10	10
	Post ictal confusion	15	15
	None	22	22
Hepatobiliary disorders	None	85	85
	Hepatitis	12	12
	Hepatic failure	3	3
Focal deficit	Absent	71	71
	present	29	29
Comorbidities	Yes	58	58
	No	42	42

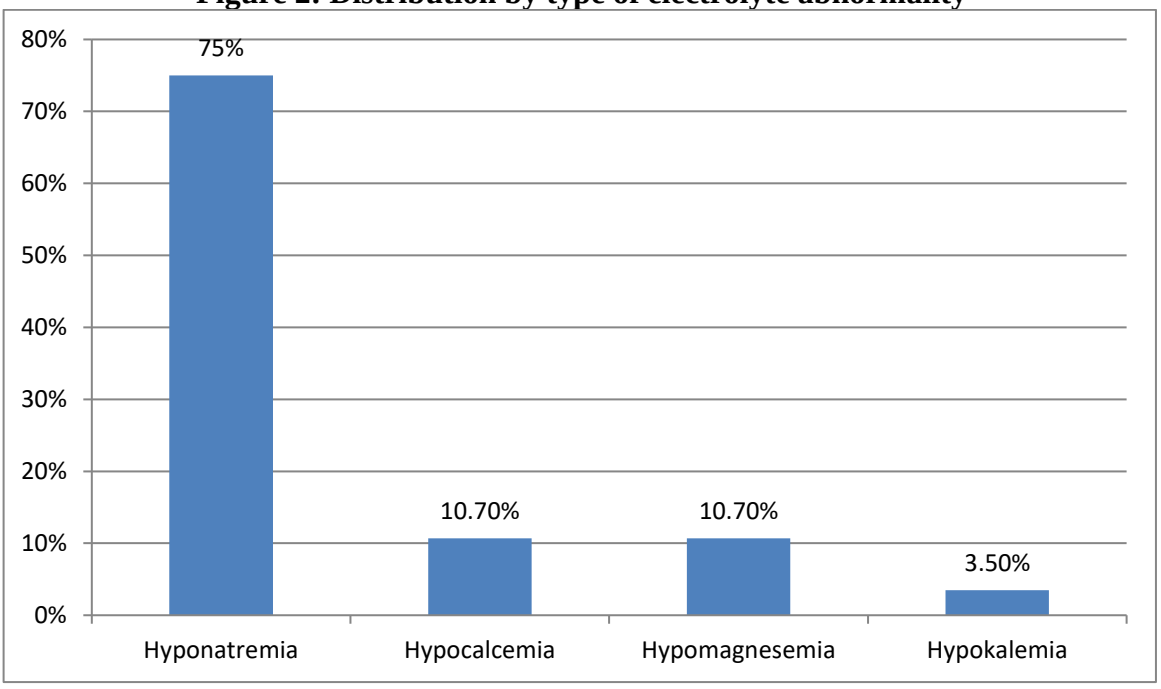
EEG shows diffuse slowing in 30% patients and focal spikes and sharp waves in 23% patients. CT/ MRI findings were abnormal in 43% patients. Aetiology identified was metabolic in 44%, CVD related in 22%, Alcohol related in 10%, Infectious in 12%, ICSOL in 6% and Unknown in 6% patients. Electrolyte abnormality was present in 28% patients. (Shown in table 2)

Table 2: Distribution by diagnostic evaluation

PARAMETERS	Sub- group	Frequency	Percentage
Type of EEG abnormality	None	43	43
	Diffuse slowing	30	30
	Focal spikes and sharp waves	27	27
CT/ MRI brain	Abnormal	43	43
	Normal	57	57
Etiology	Metabolic	44	44
	CVD related	22	22
	Alcohol related	10	10
	Infectious	12	12
	ICSOL	6	6
	Unknown	6	6
Electrolyte abnormality	Present	28	28
	Absent	72	72

Electrolyte abnormality was seen in 28 (28%) patients. Most common electrolyte abnormality was hyponatremia seen in 75% (21 out of 28 patients) of patients with electrolyte imbalance, followed by hypocalcemia in (3 out of 28)10.70%, hypomagnesemia in 10.70% (3 out of 28) and hypokalemia in 3.50% patients(1 out of 28). (shown in figure 2)

Figure 2: Distribution by type of electrolyte abnormality



Random blood sugar was significantly less in patients with electrolyte abnormalities (126±10.1) when compared to patients without (142±11.4) with P<0.05. Serum creatinine was significantly more in patients with electrolyte abnormalities (2.5±1.7) when compared to patients without

(1.2±1.3) with P<0.05. EEG findings show abnormality in significantly more patients with electrolyte abnormality (71.4%) when compared to patients without (31.9%). ABG analysis was found to be abnormal in significantly more patients with electrolyte imbalance (46.4%) when compared to patients without electrolyte imbalance (13.9%). (shown in table 3)

Table 3: Determinants of electrolyte abnormality

Variables	Sub group	Electrolyte abnormality absent (n=72)	Electrolyte abnormality present (n=28)	Chi-square value/ t test value	P Value
Mean age ± SD		48.1±16.56	51.2±17.2	0.4	P >0.05
Gender	Female (33)	23 (31.9%)	10 (35.7%)	0.129	P >0.05
	Male (67)	49 (68.1%)	18 (64.3%)		
Type of seizure	GTCS (72)	56 (77.8%)	16 (57.1%)	4.6	P >0.05
	Focal (22)	12 (16.6%)	10 (35.7%)		
	SE (6)	4 (5.6%)	2 (7.1%)		
Focal deficit	Present (29)	20 (27.8%)	9 (32.1%)	0.18	P >0.05
	Absent (71)	52 (72.2%)	19 (86.4%)		
CT/MRI brain findings	Abnormal (46)	31 (43.1%)	15 (53.6%)	0.89	P >0.05
	Normal (54)	41(56.9%)	13(46.4%)		
EEG findings	Abnormal (43)	23(31.9%)	20(71.4%)	12.83	P <0.05
	Normal (57)	49 (68.1%)	8 (28.6%)		
Mean RBS ± SD		142±11.4	126±10.1	6.49	P <0.05
Mean serum creatinine ± SD		1.2±1.3	2.5±1.7	4.11	P <0.05
Mean BUN ± SD		32±13.4	35.6±14.32	1.18	P >0.05
Hepatobiliary disorders	Yes (15)	10 (13.9%)	5(17.9%)	0.249	P >0.05
	No (85)	62(84.1%)	23(82.1%)		
ABG analysis	Abnormal (23)	10(13.9%)	13(46.4%)	12.05	P <0.05
	Normal (77)	62(84.1%)	15(53.6%)		

Discussion: The nervous system's proper function relies on its electrical excitability, which is sustained by a voltage gradient across neuronal and glial membranes through metabolically driven ion pumps. Any disruption in electrolyte gradients across cell membranes can directly and indirectly influence neuronal excitability and synchronization, potentially triggering abnormal neuronal discharges that contribute to epileptiform activity, thereby increasing the risk of seizures. Thus this study was taken upto identify various electrolyte abnormalities and its determinants.[10,2]

In this study, majority of patients (n = 65) belong to the age group of 41-60 years (65 %), followed by the age group of 20 – 40 years (22 %) with mean age as 49.65 years. Similarly in study by Satyavamsi Gadde et al, out of 45 patients majority of patients (60%) belong to the age group 41-60 years.[11] In study by Fatima et al, age category of 41–60years (59.8%) had a majority of patients (n=73), followed by the age group 20–40 years (21.3%).[7] Our study results are in concordance with the other study, which shows that new onset seizures are more prevalent in middle age group patients, as the derangement starts at that age if not managed early at a reversible phase may lead to irreversible condition.

In this study, majority were males (67 %). Similarly in study by Satyavamsi Gadde et al females were14 (30%) and males were 31 (70%). This could be due to life style of males. [11]

In this study the most common type of seizure were generalized tonic clonic seizures (72%), followed by focal seizures (22%) and 6 % patients presented with status epilepticus. In study by Fatima et al, the most common type of seizure was generalized tonic-clonic seizures (GTCS) (73.8%), followed by focal seizures (21.3%). About 4.9% of patients presented with status epilepticus.[12] In study by Satyavamsi Gadde et al GTCS is present in 33 members (73.34%). Focal

seizure is present in 10 members (22.21%)Status epilepticus is present in 2 members (4.45%).[11] In study by Nitesh Suresh Chhajed et al, common seizure type was generalized tonic-clonic seizure (47.53 %) followed by complex partial seizure (17.90 %), secondary generalized seizures (13.58 %), secondary partial seizure (10.49 %), myoclonic (6.79 %) and status epilepticus (3.70 %).[12] This result corroborates with previous studies of Mohanta et al. [13] and Dhadke et al.[14]

The reason for generalized seizure preponderance may be related to the literacy level of the bystanders and knowledge, attitude and practice about the disease. People in this area usually consider the obvious tonic-clonic movements as seizures and other forms of seizures are not given importance which could be the probable cause for this disparity incidence of seizure type.

Fever, head ache, vomiting and post ictal confusion were seen in 12%, 6%, 10% and 15% of patients respectively. Hepatic failure, hepatitis, focal deficit and other comorbidities (includes hypertension, tuberculosis, diabetes mellitus) were present in 3%, 12%, 29% and 58% respectively.

In this study EEG shows diffuse slowing in 30 patients and focal spikes and sharp waves in 23 patients. CT/ MRI findings were abnormal in 43 patients. In study by Hosalli N K et al, about 14 % had an abnormal EEG record while the rest 31% (n=31) had a normal EEG record.[9] In study by Nitesh Suresh Chhajed et al, Abnormal CT brain findings were noted in 58 patients (35.8 %) and abnormal EEG patterns were noted in 29 patients (17.9 %).[12]

In this study aetiology identified was metabolic in 44, CVD related in 22, Alcohol related in 10, Infectious in 12, ICSOL in 6 and unknown in 6 patients. Electrolyte abnormality was present in 28 patients. In study by Satyavamsi Gadde et al, Metabolic abnormalities were most common cause of seizures, seen in 21 patients (46.67%) out of which hyperglycemia was the most common cause seen in 9 patients, followed by uremia in 5 patients, electrolyte abnormalities as independent cause in 5patients and hypoglycaemia in 2 patients. The second most common cause of seizures, in their study was found to be cerebrovascular diseases in 11 patients; CNS infections were the 3rdmost common cause of seizures, seen in 6 patients. Alcohol related, ICSOL and idiopathic were other cause of seizures.[11]Our study findings were similar with the other studies.

In the current study, electrolyte abnormality was seen in 28 (28%) patients. Most common electrolyte abnormality was hyponatremia seen in 75% (21 out of 28 patients) of patients with electrolyte imbalance, followed by hypocalcemia in (3 out of 28)10.70%, hypomagnesemia in 10.70% (3 out of 28) and hypokalemia in 3.50% patients(1 out of 28). In study by Satyavamsi Gadde et al, out of 45 patients, 13 patients had electrolyte disturbances, of which the most common abnormality observed was hyponatremia, seen in10 patients. Other abnormalities were hypocalcaemia in 1 patient, hypomagnesemia in 1 patient, hypokalemia in 1 patient. In study by Fatima et al, hyponatremia, which was observed in 30patients (91%), was the most frequent electrolyte abnormality. Hypocalcemia, hypomagnesemia, and hypokalemia were the next most prevalent electrolyte abnormalities, observed in decreasing order, by Nardone et al, Castilla-Guerra L et al, riggs JE el al and Victor M et al. They stated that Seizures occurring in patients with sodium disorders, hypocalcemia, and hypomagnesemia are usually generalized tonic-clonic, but also focal (partial) seizures or other seizure types may be present.[2,3,6,15]

In this study, random blood sugar was significantly less in patients with electrolyte abnormalities (126±10.1) when compared to patients without (142±11.4) with $P<0.05$. Serum creatinine was significantly more in patients with electrolyte abnormalities (2.5±1.7) when compared to patients without (1.2±1.3) with $P<0.05$. EEG findings show abnormality in significantly more patients with electrolyte abnormality (71.4%) when compared to patients without (31.9%). ABG analysis was found to be abnormal in significantly more patients with electrolyte imbalance (46.4%) when compared to patients without electrolyte imbalance(13.9%)

Conclusions: Electrolyte disturbances are essentially always secondary processes. Effective management of seizures requires identification and treatment of the underlying primary disorder. Since neurological symptoms of electrolyte disorders are generally functional rather than structural, the neurologic manifestations of electrolyte disturbances are typically reversible. This study shows

the prevalence of electrolyte abnormality in 28 (28%) patients. Most common electrolyte abnormality was hyponatremia seen in 75%, followed by hypocalcemia in 10.70%, hypomagnesemia in 10.70% and hypokalemia in 3.50% patients. Random blood sugar was significantly less, Serum creatinine was significantly more and abnormal EEG findings, ABG analysis were seen in significantly more patients with electrolyte abnormality when compared to patients without electrolyte abnormality.

References:

1. Dhadke VN, Dhadke SV, Dawar A. Clinical profile of seizure disorder in hospitalized patients. Int J Adv Med [Internet]. 2017 Jan. 2 [cited 2023 Jan. 28];3(2):275-81. Available from: https://www.ijmedicine.com/index.php/ijam/article/view/176.
2. Nardone R, Brigo F, Trinka E. Acute Symptomatic Seizures Caused by Electrolyte Disturbances. J Clin Neurol. 2016 Jan;12(1):21-33.
3. Riggs JE. Neurologic manifestations of electrolyte disturbances. Neurol Clin. 2002 Feb;20(1):227-39, vii. doi: 10.1016/s0733-8619(03)00060-4. PMID: 11754308.
4. Dhadke VN, Dhadke SV, Dawar A. Clinical profile of seizure disorder in hospitalized patients. Int J Adv Med [Internet]. 2017 Jan. 2 [cited 2023 Jan. 28];3(2):275-81. Available from: https://www.ijmedicine.com/index.php/ijam/article/view/176.
5. Diringer M. Neurologic manifestations of major electrolyte abnormalities. Handb Clin Neurol. 2017;141:705-713.
6. Castilla-Guerra L, del Carmen Fernández-Moreno M, LÓpez-Chozas JM, Fernández-Bolaños R. Electrolytes disturbances and seizures. Epilepsia 2006;47:1990-1998.
7. Aizaz Fatima, Mohammed Imran Khan and Surya Tiwari. "The study of correlation between electrolyte imbalance and seizures in critically ill patients", *Asian Journal of Pharmaceutical and Clinical Research*, 2024;17(1):157–159.
8. Kunze K. Metabolic encephalopathies. J Neurol. 2002;249:1150–1159. doi: 10.1007/s00415-002-0869-z. [DOI] [PubMed] [Google Scholar].
9. Hosalli NK, Vasudevan MS, Jalageri MI. Study of clinical and etiological profile of new onset seizure in adults reporting to tertiary care centre, Mysore. Int J Adv Med 2022;9:322-9.
10. Schwartzkroin PA, Baraban SC, Hochman DW. Osmolarity, ionic flux, and changes in brain excitability. Epilepsy Res. 1998;32:275–285.
11. Satyavamsi Gadde, V. Rama Mohana Rao, S. Krishna Mohana Rao, K.V. Chalapathi Rao. A study on dyselectrolytemia in patients with first episode of seizures. Int. J. Heal. Clin. Res. [Internet]. 2022Jan.17 [cited 2023 Jan.28];5(2):1067-70. Available from: https://ijhcr.com/index.php/ijhcr/article/view/5185.
12. Nitesh Suresh Chhajed, Sanjay Pandharinath Patil. Study of clinical profile of new onset seizure in adult patients at a tertiary care center. MedPulse International Journal of Medicine. December 2021; 20(3): 203-207.
13. Mohanta SK, Naik M, Murmu M. Study of serum magnesium and calcium levels in patients with new onset seizures. JMed Sci Clin Res. 2019;7(3):1320-6.
14. Dhadke VN, Dhadke SV, Dawar A. Clinical profile of seizure disorder in hospitalized patients. Int J Adv Med. 2016;3:275-81.
15. Victor M, Ropper AH, Adams RD. Adams and Victor's Principles of Neurology. 7th ed. New York (NY): McGraw-Hill; 2011.