

Comparative Study of Serum Magnesium, Calcium And Electrolyte Variation In Neurological Disorder

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ABSTRACT

Introduction: A neurological disorder is any disorder of the nervous system. Structural, biochemical or electrical abnormalities in the brain, spinal cord or other nerves can result in a range of symptoms.

Materials and methods: Retrospective study consists of 100 samples. The patients are referred to the Biochemistry laboratory recruited from OP Department of Neurology. Samples are collected for serum Mg, Calcium and Electrolytes

Result: Mean value of magnesium in neurological patients is **1.15mg%** and in control is **1.92mg%**. The magnesium level in neurological patients is markedly decreased compare with controls. Mean value of calcium in neurological patients is **8.1mg%** and in control is **9.07mg%**. Mean value of sodium in neurological patients is **132.02mg%** and in control is **138.31mg%**. Mean value of potassium in neurological patients is **3.39mg%** and in control is **4.18mg%**.

Conclusion: The outcome of the study show that serum magnesium and calcium is decreased whereas, there is no marked variation in sodium and potassium level.

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I. INTRODUCTION

A neurological disorder is a disorder of the nervous system. These disorders result from a wide range of pathophysiologies including traumatic injury of the central nervous system, neurodegeneration and neuroinflammation.⁽¹⁾

From a neurological standpoint, Magnesium plays an essential role in nerve transmission and neuromuscular conduction. In the nervous system Magnesium is important for an optimal nerve transmission and neuromuscular coordination, as well as serving to protect against excitotoxicity.⁽²⁾ Chronic neurological disorders will lead to a serious condition which will result in permanent nerve damage causing irreversible brain loss.⁽³⁾

Reducing serum Mg level to below 1 mmol/L increase neuromuscular excitability because Mg competitively inhibit entry of calcium into neurons. Mg deficiency leads to neurological disorders ranging from apathy to psychosis. Moreover, Mg has an effect on the regulation of synaptic plasticity.⁽⁴⁾ Acute Mg deficiency leads to metabolic encephalopathy and alteration of neuromuscular excitability such as Dementia and nervousness.⁽⁵⁾

Electrolyte disturbances are essentially always secondary processes. The neurologic manifestations of electrolyte disturbances are typically reversible.⁽⁶⁾ The brain operates in an extraordinarily intricate environment which demands precise regulation of electrolytes.⁽⁷⁾ Disorders of Na whether hypernatremia, hyponatremia all produce CNS depression with muscle weakness as the major clinical manifestation. Disorders of Mg and Calcium produce both central nervous system (CNS) and peripheral nervous system (PNS) manifestation. Hypomagnesemia and hypocalcemia can lead to weakness, muscle spasm and tetany.⁽⁸⁾ Seizures can be seen in cases with very low manifestation of Na, Mg, Ca, K. Intervention for neurological disorders include preventive measures, lifestyle, physiotherapy or other therapy, neurorehabilitation, pain management or a specific diet.⁽⁹⁾ The nervous system has two distinct part: the central nervous system and peripheral nervous system. The basic unit of the nervous system is the nerve cell. It consist of a large cell body and two types of nerve fibres:

- **Axon**: One elongated extension for sending messages as electrical impulses

- **Dendrites** : Usually many branches for receiving impulses.⁽¹⁰⁾

The signs of neurological disorders can vary significantly, depending upon the type of disorders as well as the specific area of the body that is affected. In some instances, experience emotional symptoms while in other physical symptoms may be the result.⁽¹¹⁾

MAGNESIUM DEFICIENCY AND NEUROLOGICAL SYMPTOMS

Mg deficiency has been associated with numerous clinical disorders worldwide . Abnormality in Mg metabolism caused by Mg deficiency also affects other electrolyte and enzymatic activities. Mg imbalance , is more likely to lead to unnecessary nerve and muscular excitation hyper function, manifested as migraine, chronic pain, epilepsy, Alzheimer ,Parkinson and stroke .⁽¹²⁾ This study aim to assess prevalence of serum sodium, potassium,calcium and magnesium disturbances in neurological disorders.

II. MATERIALS AND METHODS

Retrospective study consists of 100 samples

SOURCE OF DATA

The patients that are referred to the Biochemistry laboratory recruited from OP Department of Neurology in Holy Cross Hospital, Kottiyam diagnosed with neurological disorders.

INCLUSION CRITERIA

- Diagnosed neurological patients
- Age group between 40-80.
- Patients with migraine , seizures, chronic pain.

EXCLUSION CRITERIA

- Patients with group less than 20 and greater than 80.
- Patients with chronic kidney disease , osteoporosis.
- Patients undertaking drugs that influence serum magnesium calcium and electrolytes in neurological disorders.

SAMPLE COLLECTION

SAMPLE:-Serum

3-5 ml of whole blood is collected in tubes containing clot activator from each of the subjects . Collected samples were then send to the biochemistry laboratory for examination of magnesium, calcium, sodium, and potassium. Blood samples were allowed to clot for 10 minutes and centrifuged in 3000rpm for 10 minutes. Serum was separated and the parameters were analysed using fully automated VITROS 250.

DETERMINATION OF MAGNESIUM

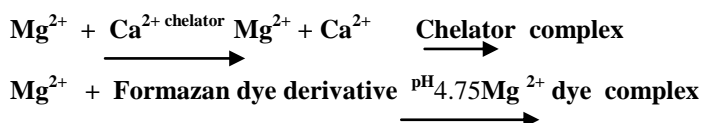
Instrument used: VITROS 250

PRINCIPLE OF THE PROCEDURE

The VITROS Magnesium slides method is performed using the VITROS Magnesium slides and the VITROS chemistry product calibrator kit 1 on VITROS chemistry systems. The VITROS Mg slides is a multilayer , analytical element coated on a polyester support.

A drop of patient sample is deposited on the slide and is evenly distributed by the spreading later to the underlying layers. The Mg (both free and protein bound) from the sample then react with the formazan dye derivative in the reagent layer. The high Mg affinity of dye dissociate Mg from binding protein. The resulting Mg dye complex causes a shift in the dye absorption maximum . The amount of dye complex formed is proportional to the Mg concentration present in the sample and is measured by reflection density.

REACTION SEQUENCE



SPECIMEN REQUIREMENT

Specimen recommended

- Serum
- Plasma: Heparin

BIOLOGICAL REFERENCE

1.6-2.3 mg%

DETERMINATION OF CALCIUM

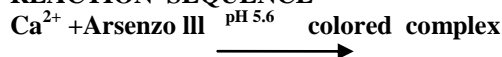
Instrument used : VITROS 250

PRINCIPLE FOR THE PROCEDURE

The VITROS calcium slides method is performed using the VITROS Ca slides and the VITROS chemistry products calibrator kit of VITROS chemistry systems. The VITROS Ca slide is a multilayered ,analytical element coated on a polyester support

A drop of patient sample is deposited on the slide and is evenly distributed by the spreading later to the underlying layers. The bound Calcium is dissociated from binding proteins, allowing the calcium to penetrate through the spreading layer into the underlying reagent layer. Therefore the Calcium forms a complex with Arsenzo 3rd dye , causing a shift in the absorption maximum. After incubation, the reflection density of the colored complex is measured Spectrophotometrically . The amount of coloured complex formed is proportional to the calcium concentration in the sample.

REACTION SEQUENCE



SPECIMEN REQUIREMENT

Specimen recommended

- Serum
- Plasma: Heparin

BIOLOGICAL REFERENCE

8.4 – 10.2 mg / dl

DETERMINATION OF SODIUM AND POTASSIUM

Instrument used –VITROS 250

PRINCIPLE FOR PROCEDURE

The VITROS Na⁺/K⁺ slide method is preferred using VITROS Na⁺/K⁺ slides and the VITROS chemistry products calibrator kit 2 on VITROS chemistry system. The VITROS Na⁺ slide is a multilayered Analytical element coated on a polyester support that uses direct potentiometry for measurement of Na ions . The slide consist of 2-ion selective electrodes, each containing methyl monensin(an ionophore for Na) a reference layer and a silver layer and a silver chloride layer coated on a polyester support.

A drop of patient sample and a drop of VITROS reference fluid on separate halves of the slide results in migration of both fluids towards the center of the paper bridge. A stable liquid junction is formed to the sample electrode . Each electrode produces an electrochemical potential in response to the activity of Na⁺/K⁺ . The potential difference between the 2 electrode is proportional to the Na⁺ / K⁺ concentration in the sample.that connects the reference electrode

SPECIMEN REQUIREMENT

SPECIMEN RECOMMENDED

- Serum
- Plasma: Heparin

BIOLOGICAL REFERENCE

Na⁺ **136 – 150 mmol/L**



K⁺ **3.5 - 5.1mmol/L**



III. RESULT

SEX WISE DISTRIBUTION

SEX	INCIDENCE	PERCENTAGE
MALE	22	44%
FEMALE	28	56%

Table: 1

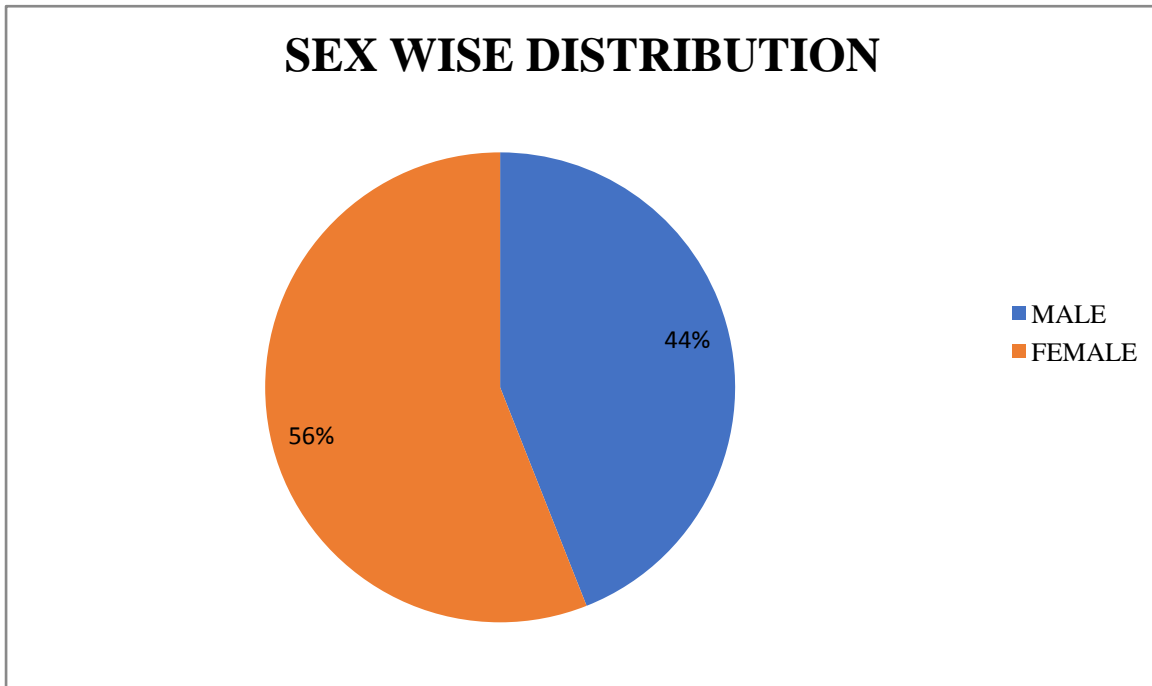


Figure : 1

The figure shows that 56% females and 44% males are affected with neurological disorders.

AGE WISE DISTRIBUTION

Table :2

Age	Number of patients	Percentage
41 -50	8	13%
51-60	16	44%
61-70	17	28%
71-80	9	15%

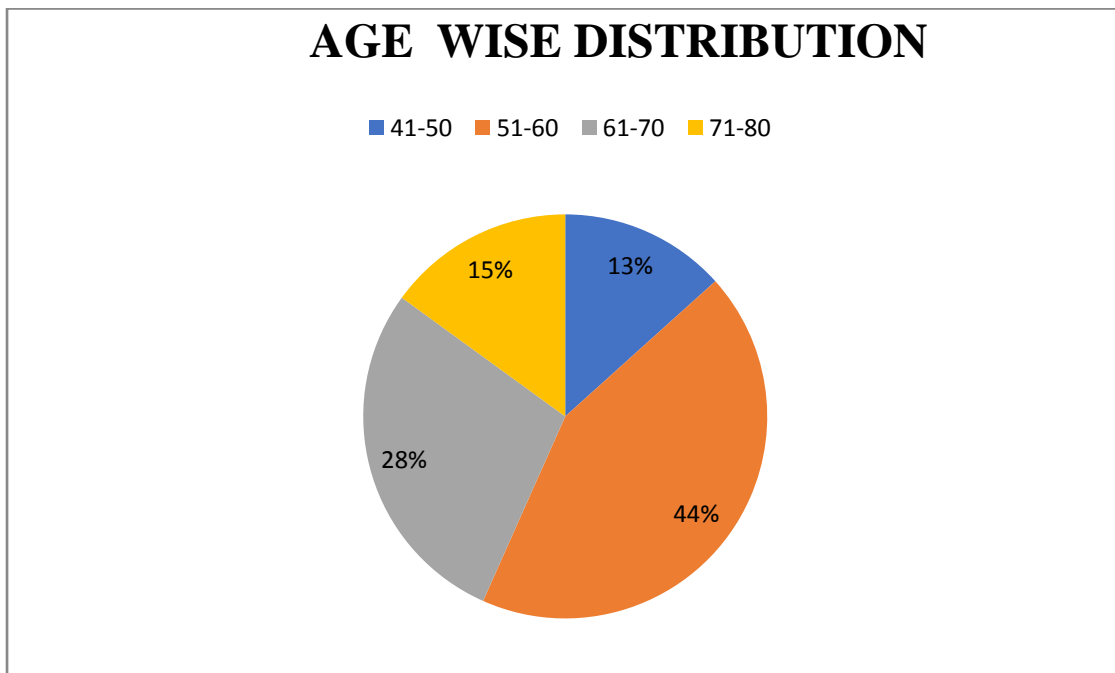


Figure : 2

The figure shows that the incidence of age group between 41-50 is 13% , 51-60 is 44%, 61-70 is 28%, and 71-80 is 15%.

MEAN VALUE OF MAGNESIUM IN NEUROLOGICAL DISORDER

Table 3

SUBJECTS	MEAN VALUE(mg%)
CASE	1.15
CONTROLS	1.92

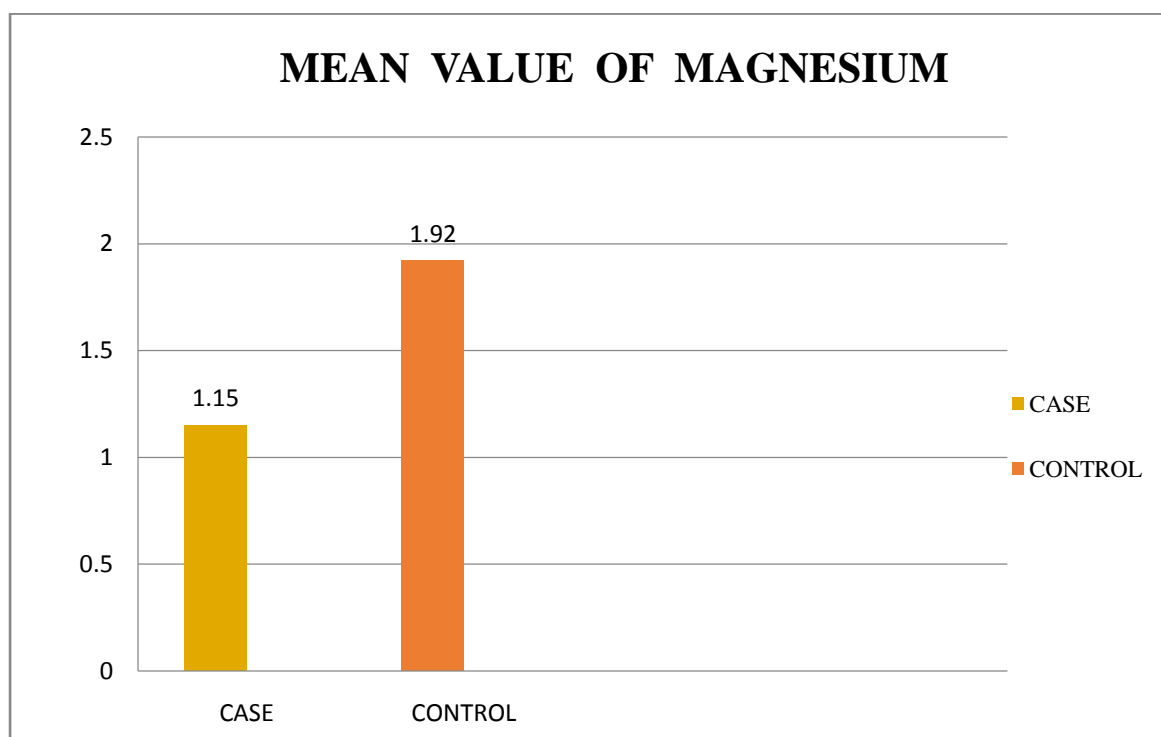


Figure :3

The figure shows mean value of magnesium in case is 1.15mg% and control is 1.92mg%.

MEAN VALUE OF CALCIUM IN NEUROLOGICAL DISORDER

SUBJECTS	MEAN VALUE (mg%)
CASE	8.1
CONTROL	9.07

Table :4

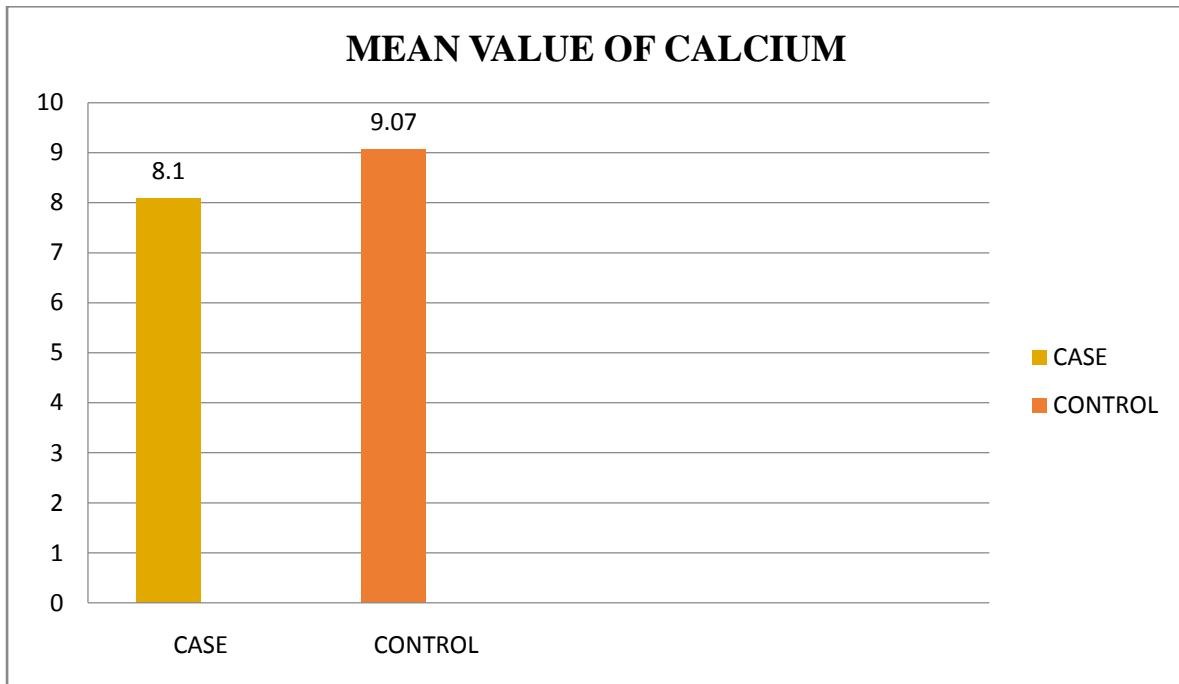


Figure :4

The figure shows mean value of calcium in case is 8.1mg% and in control is 9.07mg%.

MEAN VALUE OF ELECTROLYTES IN NEUROLOGICAL DISORDER

SUBJECTS	MEAN VALUE (mmol/l)	
	Na	K
CASE	132.02	3.39
CONTROL	138.3	4.18

Table : 5

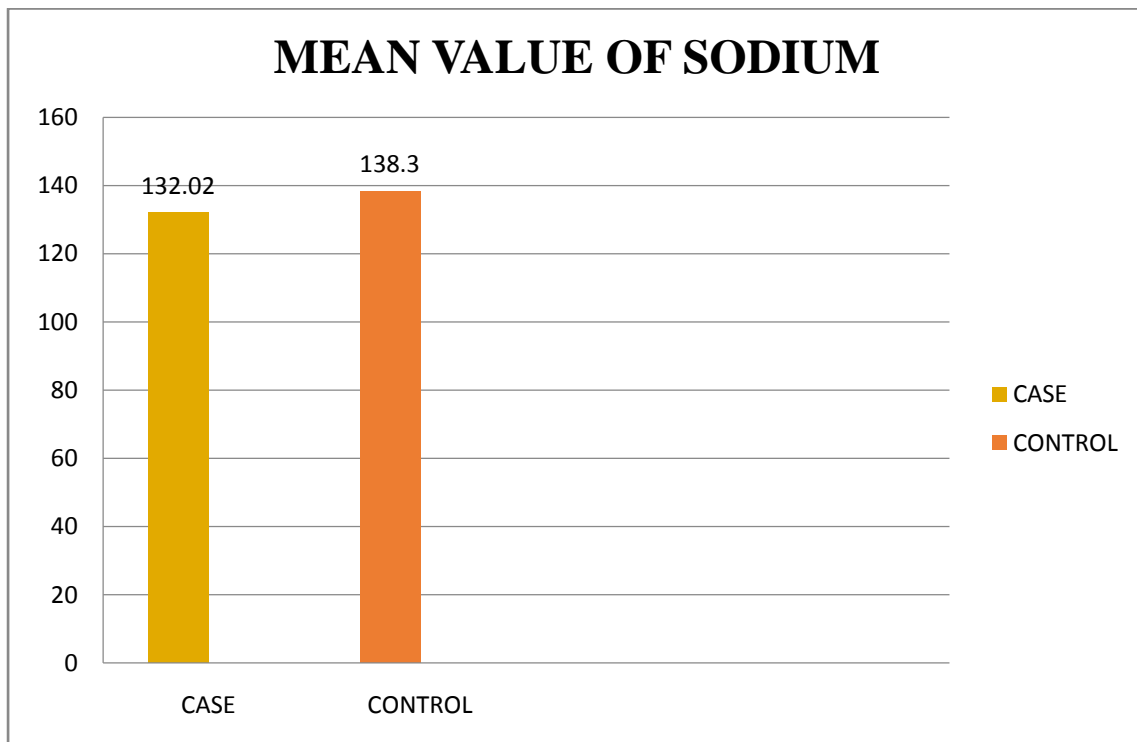


Figure :5

The figure shows the mean value of sodium in case is 132.02mg% and in control is 138.3mg% .

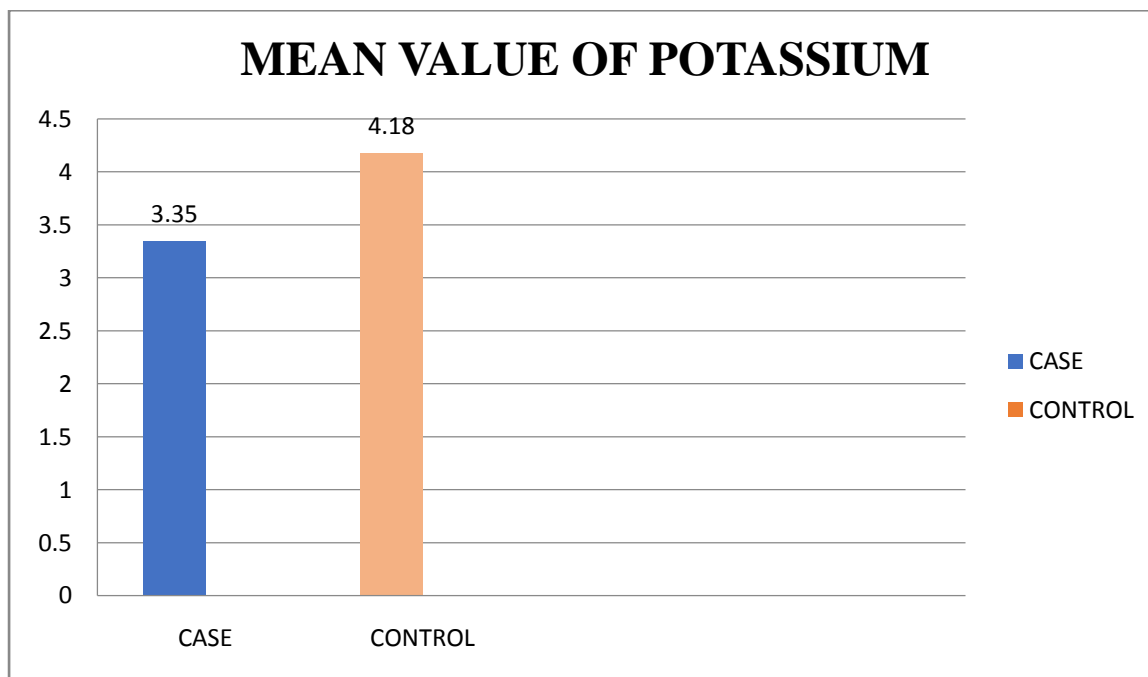


Figure :6

The figure shows the mean value of potassium in cases is 3.35mg% and in control is 4.18mg%

IV. DISCUSSION

The study was conducted to evaluate the variation of serum magnesium , calcium and electrolytes in neurological disorder. The study participants were mainly the individuals under the treatment in neurological department. The present study included 100 subjects comprising of 50 neurological patients as cases and 50 healthy subjects as control. Based on this study , out of 50 cases , **44%** were females and **56%** were males . This shows that neurological disease was prevalent among females than in males . Out of the total cases **16%** belongs to age group 41-50, **32%** belongs to age group 51-60 , **34%** belongs to age group 61-70 , **18%** belongs to age group 71-80. There is no prevalence in the age based on neurological disease.

Mean value of magnesium in neurological patients is **1.15mg%** and in control is **1.92mg%** . The magnesium level in neurological patients is markedly decreased compare with controls. Mean value of calcium in neurological patients is **8.1mg%** and in control is **9.07mg%** . There is a mild decrease of calcium level is seen in neurological disorder. Decreased magnesium level potentiate glutamatergic neurotransmission , leading to a supportive environment for excitotoxicity , which lead to oxidative stress and neuronal cell death . Abnormal glutamatergic neurotransmission leads to neurological disease. Decrease in calcium initiates action potential leading to increased excitability of nerve which results in neurological disease.

Mean value of sodium in neurological patients is **132.02mg%** and in control is **138.31mg%**. Mean value of potassium in neurological patients is **3.39mg%** and in control is **4.18mg%**. Here the electrolyte level in neurological disorder have no marked variation . Impaired osmoregulation may cause neurological disorder . This result was similar to the study conducted by Diringer M where it states that serum magnesium , calcium and electrolyte will be decreased in neurological disorders.

V. CONCLUSION

- The outcome of the study show that serum magnesium and calcium is decreased whereas, there is no marked variation in sodium and potassium level.
- Estimation of serum magnesium is seen as a better marker than serum electrolytes in neurological disorder .
- Estimation of serum magnesium should be included along with other routine parameters in neurological disorders.

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