

Serum Electrolyte Imbalances in Head Injury Patients: An Institutional Analysis

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Abstract: *Traumatic brain injury is an important cause of mortality and morbidity in all age group of patients. Electrolyte imbalance is common in patients with traumatic brain injury patients. Aim of this study is to estimate the prevalence of electrolyte disturbance in head injury patients. This is a prospective study carried out at RIMS, Ranchi, Jharkhand. Total 210 patients included in this study during 9 months period. We measured the serum level of sodium, potassium, and calcium and GCS score and CT reports of every patient daily and data collected in TBI proforma and analysed for the results. Abnormal sodium level was found in 39.03% patients, abnormal potassium level was found in 31.80% patients, and abnormal calcium level was found in 20% patients. Hyponatremia, hypokalemia and hypocalcemia are more common than hypernatremia, hyperkalemia and hypercalcemia in head injury patients. Patients with severe head injury had abnormal sodium and potassium level as compared to mild and moderate head injury. Electrolyte disturbances should be measured at regular interval and meticulously treated in traumatic brain injury patients to increase the survival of patients.*

Keywords: Traumatic brain injury (TBI), hyponatremia, hypokalemia, hypocalcemia, Glasgow coma scale (GCS) score

1. Introduction

Traumatic brain injury (TBI) is a leading cause of morbidity and mortality and socioeconomic losses in developing countries like India. About 50 – 60% of the road traffic accident patients are hospitalised for traumatic brain injury (1). Patients of TBI have high risk of electrolyte derangements, it will affect management and outcome of patients. It is likely due to use of diuretics, fluids, syndrome of inappropriate antidiuretic hormone secretion and cerebral salt wasting. Hyponatremia is a common electrolyte disturbance following TBI (2). Rapid correction of hyponatremia may lead to neurological symptoms (3, 4). Potassium is present in high concentration intracellular as compare to extracellular, small change in potassium can severely affect nerve conduction, muscle contraction and rhythm of heart (5). Serum calcium is also an important electrolyte abnormality in TBI patients associated with muscle spasm, cardiac arrhythmia, heart failure and neuromuscular irritability (6). Both hypocalcaemia and hypercalcaemia can occur. TBI can lead to electrolyte disturbances which may be critical for survival of patients. There are some different causes and among them most common is SIADH (7). Other causes are use of diuretics like mannitol and furosemide, cerebral salt wasting syndrome (8,9). Detection at appropriate time and adequate management improves neurological outcome (10). This study was designed to know the serum derangements of different electrolytes in patients of head injury and to analyse its effect on treatment and outcome of the patients.

2. Materials and Methods

The patients of TBI who were admitted to neurosurgery department of RIMS, Ranchi, Jharkhand for a period of nine

months from January 2017 to September 2017 were taken for the study. It was a type of prospective study after the institutional ethical approval and written informed consent. Patients of all age groups with TBI were taken for this study. The patients not willing to take part in study, patients with end organ failure, diabetes mellitus, diabetes insipidus and patients with chronic diuretic therapy were excluded from the study.

At the time of admission the level of consciousness was assessed with GCS score. CT skull of head was also done at the time of admission to assess the types of head injury, and the blood samples were sent to Biochemistry department for serum sodium, serum potassium, and serum calcium at the time of admission and after 24 hours of admission following resuscitation. The estimation of serum sodium and serum potassium was done in an electrolyte machine by ion selective electrode method. Normal serum sodium was considered between 135 -145 mEq/L, normal serum potassium level was between 3.5- 5 mEq/L and normal reference range for calcium was considered between 9-10.8 mg/dl. The variables taken for the study were age, sex, cause, GCS, serum level of sodium, potassium, and serum calcium of the patients. All data were noted in proforma and were entered in excel sheet.

3. Results

There were total of 210 patients were included in our study and were managed in our department of neurosurgery. 157 (74.76%) patients were male and 53 (25.23%) were female and male to female ratio of patients was 3:1. 58 (27.61%) patients belong to age less than 18 years, 122 (58.09%) patients were from age 20 to 50 years and 30 (14.28%) patients belong to age more the fifty years (**Table 1**).

Most common mechanism of TBI in our study were due to road traffic accident (56.67%), followed by fall from height which contributes 56 (26.67%), others like assault contributes 31 (14.76%) and sports related injuries in 4 (1.90%) {**Table 2**}. Out of 210 patients 93 (44.28%) patients had mild TBI, 69 (32.85%) patients had moderate head injuries and 48 (22.85%) patients had severe head injuries (**Table 4**). Most common CT scan finding in our study were fracture of skull 44 (21%) patients, followed by extradural hematoma 43 (20.47%) patients, subdural hematoma 39 (18.57%) patients, subarachnoid hemorrhage 31 (14.76%) patients, diffuse axonal injuries 30 (14.28%), and 23 (10.95%) patients had contusions (**Table 3**).

Among 210 patients 128 (60.95%) patients normal serum sodium level, hyponatremia seen in 53 (25.23%) patients and 29 (13.80%) had hypernatremia. Hypokalemia observed in 44 (20.95%) patients, hyperkalemia in 23 (10.95) patients and 143 (68.09%) patients had normal potassium level. Hypocalcaemia were present in 31 (14.76%) patients, hypercalcaemia in 11 (5.23%) patients and in 168 (80%) patients no change in serum calcium level (**Table 5**). Out of 48 severe injured patients 46 (95.83%) had abnormal sodium level, 33 (68.75%) patients had abnormal potassium level and 19 (39.58%) had abnormal calcium level (**Table 6**).

Table 1: Demographic characteristics

		Number of patients	Percentage of patients
Age	< 18 years	58	27.61
	18- 50 years	122	58.09
	>50 years	30	14.28
Sex	Male	157	74.76
	female	53	25.23

Table 2: Mode of traumatic brain injury

Mechanism of injury	Number of patients	Percentage of patients
RTA	119	56.67
Fall from height	56	26.67
Assault	31	14.76
Sports related injury	4	1.90

Table 3: CT scan findings

NCCT finding	Number of patients	Percentage of subject
Fracture	44	21
EDH	43	20.47
SDH	39	18.57
SAH	31	14.76
DAI	30	14.28
Contusion	23	10.95

Table 4: Severity of head injury

Severity of head injury	No. of patients	Percentage
Mild (GCS14-15)	93	44.28
Moderate (GCS 9-13)	69	32.85
Severe (GCS <9)	48	22.85

Table 5: Incidence of electrolyte imbalance

Electrolyte imbalance	No of cases	Percentage
Hyponatremia	53	25.23
Hypernatremia	29	13.80
Hypokalemia	44	20.95
Hyperkalemia	23	10.95
Hypocalcaemia	31	14.76
hypercalcaemia	11	5.23

Table 6: Relationship of sodium, potassium and calcium abnormalities with severity of head injury

Electrolyte imbalance	Mild TBI	Moderate TBI	Severe TBI
Hyponatraemia	9	17	27
Hypernatraemia	3	7	19
Hypokalaemia	9	13	22
Hyperkalaemia	7	5	11
hypocalcaemia	5	9	17
hypercalcaemia	6	3	2

4. Discussion

Head injuries are common cause of morbidity and mortality. Electrolyte derangements are common in patients with TBI (12).The head injuries are common in males and in the younger people because of more involvement of male young in outside activities. RTA were the most common mechanism of head injury (56.53%), followed by fall from height (26.7%). Mild head injuries are commoner than moderate and severe head injuries, in our study it contributes 44.3% followed by moderate head injuries (32.85%).

Most common electrolyte imbalances are serum sodium and potassium levels following a head injury. Pharmacological therapy like diuretics and resuscitation by fluid are mainly responsible for these electrolyte derangements (13). The incidence of hyponatraemia is 25.23% which was high as compare to study done by Nobuhiro Moro et al (14). Hyponatremia may develop as a result of SIADH and cerebral salt wasting (CSW) syndrome in TBI patients, brain natriuretic peptide may also responsible for hyponatraemia (15). Incidence of hypernatraemia was 13.80%. The cause for hypernatremia could be diabetes insipidus, hypothalamic pituitary dysfunction and use of mannitol, but in severe head injury patients the incidence 65.51% which was high as compared to study done by Das et al (63.15%) Rochdi et al (30.23%),Umberto Maggiore et al (51.5%). Potassium was the second most common electrolyte derangements following serum sodium levels. The incidence of hypokalaemia was 20.95% which was less in comparison to study of Beal AL et al (27.5%) but higher in compared to study done by Das et al (12.35%) (16) but in severe head injury patients the incidence of hypokalemia was 50%. Patients with severe head injury are at high risk of hypokalemia, it might be due to an increase in urinary loss caused by brain trauma. Patients with severe TBI are at risk of polyuresis due to syndrome of inappropriate antidiuretic hormone and cerebral salt wasting syndrome. In our study high serum potassium level was found in 10.95% of patients which was lower than incidence of hypokalemia (20.95%). These changes might be due to the high catecholamine secretions following severe head trauma, with resultant beta2- adrenergic stimulation of the Na-K pump (17). In our study we had more patients with hypocalcaemia (14.76%) than hypercalcemia (5.23%). Serum calcium changes leads to a variety of clinical manifestations like tetany, convulsions and muscle spasm (18). Accumulation of intracellular calcium render an abnormal responses of neurons to stimulation in severe TBI are responsible for these features (19).

A shift of electrolytes from extracellular compartment to intracellular compartment and electrolyte loss through polyuresis in traumatic brain injury plays a role in electrolyte imbalances. The levels of sodium, potassium and calcium should be measured routinely in all patients with head injury and especially in patients with severe head injury because imbalances in level of these electrolytes are likely to remain undetected for a longer time.

5. Conclusion

Patients with traumatic brain injury are often accompanied by electrolyte abnormalities especially the hyponatremia and hypokalemia are common. Polyuresis due to SIADH, CSW and uses of osmotic diuretics like mannitol, hypernatremia due to diabetes insipidus may occur but lower in incidence than hypernatremia. All types of electrolyte abnormalities are seen more in severe type of head injury patients. Therefore the electrolyte imbalance in traumatic brain injury patients is an important factor for prognosis, so early diagnosis and adequate management of electrolyte abnormalities are essential to decrease the mortality and morbidity.

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