To Prognosticate the Final Outcome in a Traumatic Brain Injury Patient based on their Electrolyte Changes

Dheeraj Kumar Raj[1], Pankaj Arora[2], J.P.Sharma[3], Puneet Malik[2], Amulya Aggarwal[1]

[1]Post Graduate Residents, Department of General Surgery, [2]Assistant Professor, Department of Neuro Surgery, [3]Professor, Department of General Surgery, Shri Guru Ram Rai Institute Of Medical And Health Sciences, Dehradun, Uttarakhand.

Introduction

Dyselectrolytemia is very common in head injuries patients and it is likely due to abnormality in serum sodium, potassium, calcium, phosphate, chloride. Serum Sodium is the most common and important electrolyte abnormality among these electrolytes. Proper management of dyselectrolytemia in such patient following a head injury is most important . Proper in time detection followed by appropriate treatment not only improves neurological status but also decrease morbidity and mortality. **Aims & Objective** : To prognosticate the final out come in a traumatic brain injury patient based on there electrolyte changes. **Material & Method** : A Hospital based Prospective type Cross Sectional Study . The study was conducted over a period of 18 month In our institute. This study includes all Traumatic Brain Injury patients without poly trauma who were admitted through Emergency as well as OPD . This study exclude patients with any co morbidity like diabetes mellitus, hypertension, thyroid derangement and poly trauma etc. **Observation & Results** : We observed significant difference of sodium, potassium, and chloride levels following TBI recorded at the time of admission, 24 hours, after 4 days, 8 days, 12 days and 16 days . There was positive correlation of hyponatremia, hypokalemia, hypochloremia, with outcome of the patient. **Conclusion** : we concluded that electrolyte imbalance following traumatic head injury is an important cause to look for in patient monitoring. Sodium potassium and chloride chief electrolyte of concern. Serum calcium and Phosphate levels also under goes notable changes.

Keywords*: Traumatic brain injury, serum electrolyte derangements.*

Introduction

Traumatic brain injuries (TBIs) is a leading cause of morbidity, mortality, disability and socio economic losses in India and in other developing countries. In India, over 1,00,000 people die due to road traffic accidents each year(1) and nearly 50-60% of them are hospitalized for brain injury.(2) Electrolyte derangements are common sequelae of traumatic brain injury. Dyselectrolytemia is very common in head injuries patients and it is likely due to abnormality in serum sodium, potassium, calcium, phosphate. It may be due to use of intravenous fluids, diuretics, syndrome of inappropriate ADH secretion and cerebral salt wasting. Serum Sodium is the most common and important electrolyte abnormality among these electrolytes, both hyponatremia and hypernatremia can occur. More so changes in potassium chiefly hypokalemia(3) and fluid content(4) are also encountered in clinical practice.(5) There are some different causes and among them most common being syndrome of inappropriate anti-diuretic hormone secretion (SIADH) (6), Cerebral salt wasting (CSW)(5) use of diuretics like Furosemide and Mannitol.(4) Age is another important factor that also greatly affects morbidity and mortality. Advancing age has poor outcome.(8) However, patients may deteriorate after initial improvement even after a week due to electrolyte disturbances chiefly sodium. (11) So proper management of dyselectrolytemia in such

Corresponding author :
Dr. Pankaj Arora
E-mail: parorafzr@yahoo.com

patient following a head injury is most important.[9] Apart from Sodium and Potassium, chloride is also is important electrolyte abnormality associated with a variety of clinical manifestations in patients with traumatic brain injury.[12] Initially from the development of tetany[13] to seizures all can happen following derangement in serum calcium. Abnormal responses of neurons to stimulation secondary to accumulation of intracellular calcium in traumatic brain injury are responsible for these features.[14] Abnormality in serum phosphate following a traumatic brain injury is also been observed. Serum phosphate is also a major intracellular anion and plays an important role in many biochemical pathways relating to normal physiologic functions, especially in maintaining muscle tone.[15,16] As Hypophosphatemia has been shown to be associated with muscle weakness, including weakness of respiratory muscles, and with respiratory infection. Proper in time detection followed by appropriate treatment not only improves neurological status but also decrease morbidity and mortality.[16]

Material & Method

A Hospital based Prospective type Cross Sectional Study . The study conducted over a period of 18 month. This study includes all Traumatic Brain Injury patients without poly trauma who were admitted through Emergency as well as OPD will be included in the study. This study exclude patients with any co morbidity like diabetes mellitus, hypertension, thyroid derangement etc.

The severity of TBI according to GCS score [with in 48hr] is as follow:

- Severe TBI=3-8
- Moderate TBI=9-12
- Mild TBI=13-15

The severity of head injury were assessed by Glasgow coma scale [GCS] and type of injury were assessed by head computed tomography [CT]. Serum electrolytes [serum sodium, potassium, calcium ,Chloride and phosphate], GCS, ESR, CRP were measured at time of admission in emergency before starting intravenous fluid and repeated at 24 hours, 4th, 8th, 12th, 16th days after resuscitation.

All patient received standard treatment as per institutional protocol for Traumatic Brain Injury.

The normal value taken in to the consideration in this study are as follow –

Electrolyte	**Normal Value [range]**
S. Sodium	135-145 mEq/l
S. Potassium	3.5-5.5 mEq/l
S. Calcium	8.6-10.3 mg/dl
S. Phosphorous	2.5-4.5 mg/dl
S. Chloride	96-106 mmol/l
C Reactive Protein	0-3 mg/l
ESR	0-20 mm/hr

Statistical data analysis – In order to establish correlation between electrolytes and outcome in the present study, we used chi square test.

Findings

DISTRIBUTION TABLE 1 CORRELATION OF PATIENT OUTCOME WITH SODIUM

Electrolyte	Improved	Expired	Deteriorated	Lama
Hypernatremia [60] (30%)	23	24	10	3
Normal sodium[114](43.%)	95	14	4	1
Hyponatremia [26](13%)	22	2	2	0
Total [200]	140	40	16	4

Hyponatremia is present in 26(13%) patients, hypernatremia present in 60(30%) patients and normal sodium level present in 114(43.5%) patients**.** We found that hypernatremia is more related to poor outcome (i.e) of the patient. *[p=<0.05]*

TABLE 2 CORRELATION OF PATIENT OUTCOME WITH POTASSIUM

Electrolyte	Imporoved	Expired	Deteriorate	LAMA
Hypokalemia [55]	18	25	12	0
Hyperkalemia [21]	21	3	1	0
Normal potassium[120]	101	12	3	4
Total patients [200]	140	40	16	4

Hypokalemia present in 55(27.5%) patients, hyperkalemia present in 25(12.5%) patient and normal potassium level present in 120(60%) patients. hypokalemia is more related to poor out come of patients. . *[p=<0.05]*

TABLE 3 CORRELATION OF PATIENT OUTCOME WITH CALCIUM

Electrolyte	Improved	Expired	Deteriorate	LAMA
Hypocalcemia [50]	24	25	1	0
Hypercalcemia [15]	14	0	1	0
Normal calcium [135]	102	15	14	4
Total [200]	140	40	16	4

50(25%) patients has hypocalcemia, 15(12.5%) patient has hypercalcemia and rest 135(67.5%) patients has normal calcium level. We observed that Hypocalcemia is more related to poor outcome of the patient. . *[p=<0.05]*

TABLE 4 CORRELATION OF PATIENT OUTCOME WITH PHOSPHATE

Electrolyte	Imporoved	Expired	Deteriorate	LAMA
Hypophosphatemia [70]	45	20	4	1
Hyperphosphatemia [20]	8	5	6	1
Normal phosphate [110]	87	15	6	2
Total [200]	140	40	16	4

Hypo-phosphatemia present in 70(35%) patients, hyper-phosphatemia present in 20(10%) patient and normal potassium level present in 110(55%) patients. very little role of this electrolyte in the outcome of patient. . *[p=<0.05]*

TABLE 5 CORRELATION OF PATIENT OUTCOME WITH CHLORIDE

Electrolyte	Improved	Expired	Deteriorate	LAMA
Hypochloremia [16]	10	5	1	0
Hyperchloremia [54]	24	28	1	1
Normal chloride [130]	106	7	14	3
Total [200]	140	40	16	4

67(28%) patients has Hypochloremia, 12(5%) patient has hyperchloremia and rest 161(67%) patients has normal chloride level, hyperchloremia more related to poor out come of patients. *[p=<0.05]*

TABLE 6: CORRELATION OF PATIENT OUTCOME WITH CRP LEVELS

Electrolyte	Imporoved	Expired	Deteriorate	LAMA
Low CRP	--	--	--	--
High CRP [170]	116	35	15	4
Normal CRP [30]	24	5	1	0
Total [200]	140	40	16	4

Patients have raise level of C-reactive protein are 170 in number,25 patients has normal level CRP. *[p=<0.05]*

Discussion

We measured serum electrolytes such as serum sodium, potassium, calcium, chloride and phosphate ESR, CRP and GCS at time of admission in emergency before starting intravenous fluid and repeated at 24 hours, 4th, 8th, 12th, 16th days after resuscitation.

SODIUM –In present study out of 200 patients. Hyponatremia is present in 26[13%] patients,

hypernatremia present in 60[30%] patients and normal sodium level present in 114[43.5%] patients.

- **Hyponatremia** present in 26[13%] patients, out of these 22 were improved, 2 patients deteriorates and 2 patients are expired.

- **Hypernatremia** present in 60[30%] patients, out of these 23 patients were improved, 10 patients deteriorated and 24 patients were expired.

- **Normal sodium** level seen in 114 [77%] patients, out of these 95 were improved, 4 patients were deteriorated and 14 patients were expired.

We found that hypernatremia is more related to poor outcome of the patients.

Elhassan et al studied 210 patients of TBI in this study, Authors found that there was an association between hypernatremia and poor outcome after TBI.[19]

POTASSIUM—out of 200 patients, hypokalemia present in 55[27.5%] patients, hyperkalemia present in 25[12.5%] patient and normal potassium level present in 120[60%] patients.

- **Hypokalemia** is present in 55 patients, out of these 18 patients were improved, 25 patients expired and 12 patients deteriorated.

- **Hyperkalemia** present in 25 patient out of which 21 patients were improved, 3 patients were expired, 1 patient were deteriorated .

- **Normal potassium** level was present in 120 patients, out of these 101 patients were improved, 12 patients were expired and 3 patients were deteriorated and 4 gone LAMA.

- **We concluded that hypokalemia is more related to poor out come of patients.**

Suman et al found that %], Hypokalemia [21.58%], Hyperkalemia [17.77%], they concluded that Hypokalemia is second most electrolyte abnormality after Hypernatremia for poor outcome of patient.[17]

CALCIUM –in present study out of 200 patient with traumatic brain injury, 50[25%] patients has hypocalcemia, 15[12.5%] patient has hypercalcemia and rest 135[67.5%] patients has normal calcium level.

- **Hypocalcemia** present in 50 patients out of these 24 patients were improved, 25 patients expired and 1patients deteriorated.

- **Hypercalcemia** present in 15 patients, out of which 14 patients were improved, and 1 patient was deteriorated.

- **Normal calcium** level seen in 135 patients, out of these 102 patients were improved, 15 were expired, 14 patients were deteriorated and 4 patients went LAMA.

We observed that Hypocalcemia is more related to poor outcome of the patient.

Gupta et al compared all electrolyte values in two groups taking head injury patient and concluded that Calcium levels under goes minute notable changes.[20]

Mirza et al [2013] studied the calcium level in TBI and concluded that serum calcium levels show little derangements.[18]

Suman et al obseved in there study that hypocalcaemia present in 11.4% of total patients studied which was more related to poor outcome.[17]

PHOSPHOROUS - out of 200 patients, hypophosphatemia present in 70[35%] patients, hyperphosphatemia present in 20[10%] patient and normal potassium level present in 110[55%] patients.

- **Hypophosphatemia** - present in 70 patients out of which 45 patients were improved, 20 patients were expired,4 patients were deteriorated and 1 patient were gone LAMA.

- **Hyperphosphatemia -** present in 20 [10%] patients out of these 8 patients were improved, 5 patients expired and 6 patients deteriorates 1 patient were gone LAMA.

- **Normal phosphorous** level seen in 110 patients, out of these 87 patients were improved, 15 expired and 6 patients were deteriorates 2 patients were gone LAMA.

Our study conclude that there is very little role of this electrolyte in the outcome of patient, hypophosphatemia more related to poor outcome.

Suman et al. They concluded that there is no significant role of this electrolyte in the outcome of patients.[17]

CHLORIDE - In present study out of 240 patient with traumatic brain injury, 67[28%] patients has hypochloremia, 12 [5%] patient has hyperchloremia and rest 161[67%] patients has normal chloride level.

- **Hypochloremia** present in 16 [8%] patients out of these 10 patients were improved, 5 patients expired and 1 patient deteriorated.

- **Hyperchloremia** present in 54 patients out of these 24 patients were improved, 28 patients expired and 1 patients deteriorated 1 patient gone LAMA.

- **Normal chloride** seen in 130 patients, out of these 106 patients were improved, 7 were expired and 14 patients were deteriorated, 3 patients gone LAMA.

This study concluded that hyperchloremia more related to poor outcome of patients.

C REACTIVE PROTEIN – in the present study 200 patients of traumatic brain injury included. Patients have raise level of C-reactive protein are 170 in number, 25 patients has normal level CRP.

High CRP seen in 170 patients, out of these, 116 were improved, 35 were expired and 15 were deteriorated 4 patients gone LAMA.

Normal CRP seen in 30 patients, out of these 24 patients were improved, 5 patients expired and 1 patient was deteriorated.

Our study concluded that raised level of C-reactive protein more related to poor outcome of patients.

Naghibi et al In the female group, raised CRP level was positively correlated with the length of ICU stay and the duration of mechanical ventilation.[23]

Zolin et al found that high CRP level was significantly correlated with the length of ICU stay and the duration of mechanical ventilation.[24]

ESR--in the present study include 200 patients of traumatic brain injury .165 patients have raise level of ESR and 35 patients has normal level.

ESR -

High ESR seen in 165 patients, out of these, 111 were improved, 36 were expired and 14 were deteriorated 2 patients gone LAMA.

Normal ESR seen in 35 patients, out of these 29 patients were improved,4 patients expired and 2 patient was deteriorated 2 patients gone LAMA.

Our study concluded that raised level of ESR more related to poor out come of patients.

Conclusion

We suggests that electrolyte imbalance following traumatic head injury is an important cause to look for in patient monitoring.

Sodium, Pottasium and Chloride are the chief electrolyte of concern.

Serum calcium and Phosphate levels under goes minute changes. Based on CT scan findings several traumatic brain injuries associated with various electrolytes derangements are of important concern especially with in first 24 hours after resuscitation.

We recommend serum Sodium, potassium and chloride along with CRP levels should be included in the work up of the patient as a predictor of prognosis and should be monitored and corrected from time to time.

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