

Dyselectrolytemia and Leucocytosis in Traumatic Brain Injury Patients

BalGopal Karmacharya¹, Sarthak Nepal², Madhav Acharya³, Silpa Sharma², Pranita Neupane²

¹Consultant, Neurosurgery Unit, Manipal Teaching Hospital, Nepal

²Intern, Manipal Teaching Hospital, Nepal

³Medical Officer, Manipal Teaching Hospital, Nepal

*Corresponding author: dr.balgopal@hotmail.com

Abstract Traumatic brain injuries are common. These constitute an important cause of morbidity and mortality in people of all age groups. Electrolyte disturbance and leucocytosis are commonly seen in patients with traumatic brain injuries. This study was done to find out the frequency of electrolyte disturbances and leucocytosis in patients with traumatic brain injuries. This was a descriptive study of all patients who were brought to the emergency room of Manipal Teaching Hospital. Demographic parameters, cause of injury, CT scan findings, severity of injury were noted in a proforma. Serum sodium and potassium level and total count was measured in blood samples taken from all patients in the emergency. There were 85 patients included in the study. Abnormal sodium level was found in 36.5% and abnormal potassium level was found in 10.6%. Similarly almost two thirds of patients had leucocytosis. Electrolyte disturbances should be measured and meticulously treated in patients with traumatic brain injuries.

Keywords: *traumatic brain injury*

Cite This Article: BalGopal Karmacharya, Sarthak Nepal, Madhav Acharya, Silpa Sharma, and Pranita Neupane, "Dyselectrolytemia and Leucocytosis in Traumatic Brain Injury Patients." *American Journal of Public Health Research*, vol. 3, no. 5A (2015): 99-101. doi: 10.12691/ajphr-3-5A-21.

to Manipal Teaching Hospital neurosurgery ward and neurosurgery ICU.

1. Introduction

Traumatic brain injury is the leading cause of morbidity and mortality globally. As brain plays a vital role in the regulation of sodium and water, electrolyte imbalance is common in traumatic brain injuries. Brain injuries cause these by cerebral salt wasting and syndrome of inappropriate secretion of antidiuretic hormone (SIADH) through alteration in ANP (atrial natriuretic factor) and BNP (brain natriuretic factor) levels. Electrolyte imbalance may be also iatrogenic by the use of steroids, mannitol and diuretics. Sodium is the most commonly involved electrolyte in this derangement. Both hypernatremia and hyponatremia may result from traumatic brain injuries. [1,2,3]. Similarly catecholamines release following head injuries may lead to hypokalemia and leucocytosis [4]. Higher WBC counts have been predictive of poor prognosis in patients with moderate and severe head injury patients.

The cause for the hypokalemia in TBI might be the catecholamine surge resulting in activation of the transmembrane sodium potassium pump which is mediated by the β_2 adrenergic receptors. This shifts potassium from the intravascular spaces into the cells leading to hypokalemia. Proper management of fluid and electrolytes in traumatic brain injury patients is paramount in brain injury patients and is also a difficult task. Timely detection and appropriate management improves neurological outcome [5]. So this study was carried out to find out the frequency of sodium and potassium abnormalities as well as leucocytosis in traumatic brain injury patients admitted

2. Methodology

2.1. Study Site

Manipal Teaching Hospital is the first private medical college hospital in Nepal. It is an 850 bedded hospital located in the mid-western part of the country and caters to a population of one million, mostly residing in the hilly areas of this part of Nepal.

2.2. Study Design

It was a prospective descriptive study. All patients who were admitted to the neurosurgery ward and neurosurgery intensive care unit with traumatic brain injury were taken for the study. Patients were enrolled from January 1, 2014 to August 30, 2014. Patients of all age groups were taken for the study. When patients were brought to the emergency, severity of trauma and level of consciousness was assessed with CT scan and GCS score. Their blood samples were taken and sent to Biochemistry lab for serum sodium and potassium levels and to the Pathology lab for complete blood counts. Normal serum sodium and potassium were considered between 135-145 mEq/L and 3.5-5.0 mEq/L respectively. Leucocytosis was considered when WBC count was more than 11000 cells/cc. All samples were sent from Emergency Department before admission to ward and ICU.

Patients who received diuretics before coming to our Emergency, who had renal and endocrine problems were excluded from the study.

2.3. Study Variables

The following variables were taken for the study: age and sex of the patients, cause and severity of head injury, serum levels of sodium and potassium and white blood cell counts sent in blood sample taken at the emergency.

2.4. Data Management

All data were collected in a proforma and were entered in Microsoft Excel. The study variables were described in terms of frequencies and proportions.

2.5. Ethical Approval

Ethical approval for the study was taken from Institutional Review Committee of Manipal Teaching Hospital.

3. Results

3.1. Demographics

There were total of 97 patients but only 85 patients were included in this study. Twelve patients were excluded because of exclusion criteria. Sixty two patients (72.9%) were male and 23 patients (27.1%) were female. Thus male: female ratio of patients was 2.69:1. Twenty nine patients were from age up to 20 years, 28 patients were of age group 20-40, 13 patients were of age group 40-60 years and 15 were of age group above 60 years.

3.2. Mechanism of Traumatic Brain Injury

Majority of traumatic brain injuries were due to motor vehicle accidents (49 patients, 57.6%) followed by fall in 30 patients (35.3%) and others like assault and sports related injuries in 6 patients (7.1%).

3.3. Severity of Brain Injury

Forty five patients (52.9%) had mild head injuries, 27 patients (31.8%) had moderate head injuries and 13 patients (15.3%) had severe brain injuries.

3.4. CT Scan Findings

Thirty nine patients (45.9%) had fractures, 3 patients (3.5%) had brain edema, 10 patients (11.8%) had traumatic subarachnoid hemorrhage, 23 patients (27.1%) had extradural hematoma, 20 patients (23.5%) had contusions, 8 patients (9.4%) had pneumocephalus, and 17 patients (20%) had subdural hematomas.

3.5. Sodium Level

Fifty four patients (63.5%) had normal serum sodium level (135-145 mEq/L), 14 patients (16.5%) had hyponatremia and 17 patients (20%) had hypernatremia.

3.6. Potassium Level

Seventy six patients (89.4%) had normal serum potassium level (3.5-5 mEq/L), 8 patients (9.4%) had hypokalemia and 1 patient (1.2%) had hyperkalemia.

3.7. WBC Counts

Twenty four patients (28.2%) had normal white blood cells (WBC) count (4000-11000/cc) whereas 61 patients (71.8%) had increased WBC counts.

4. Discussions

Traumatic brain injuries are important cause for morbidity and mortality. It has wide ranging personal, emotional, financial implications for a person, a family, a society and a country as a whole.

The head injuries are more common in males. This is more in young people. This is because of more involvement of males in outside activities including motor vehicle accidents.

Similarly more productive age group of young and middle aged patients is involved in head injuries.

Coming to the causes for head injuries in our patients, road traffic accidents were the commonest cause (57.6%) followed by falls (35.3%). Our study was consistent with the study done by Choon Hong Kan et al [6] which shows road traffic injury as the most common cause of traumatic brain injury.

As in several studies, mild and moderate head injuries are commoner than severe head injuries. In our study, more than two thirds of head injuries were mild and moderate head injuries.

Common CT scan findings in patients with traumatic brain injuries include traumatic subarachnoid hemorrhages, extradural hemorrhage, subdural hemorrhage and contusions. There may be only fractures and pneumocephalus also. The study done by Aakash Bodhit et al [7] shows the similar common CT finding of head injuries as in our study.

Dyselectrolytemia are common after traumatic brain injury with the noticeable changes seen in serum sodium and potassium level. The incidence of sodium disorders was high (36.5%) in our study with 20% of the patients having hypernatremia and 16.5% having hyponatremia. The study done by Cerda et al [8] and Upadhyaya et al [9] revealed similar level of sodium disturbance which is consistent with ours. The result was varying with study by Adige et al [10] which shows very high incidence of sodium disorders (68%) where hyponatremia and hypernatremia was seen in 64% and 4% respectively. The reason that this study vary with our result may be due to the different descriptions available for hypo/hypernatremia focusing only on traumatic brain injury patients and not covering other brain injury patients and higher grade of brain injury.

Differences in the prevalence rate of hypo/hypernatremia among patients with different brain injuries might be due to the kind of drugs received, or difference in the day for measuring sodium serum level than the primary brain injury. The likely cause of hyponatremia might be CSWS (cerebral salt wasting syndrome) or syndrome of inappropriate antidiuretic hormone secretion (SIADH). Hyponatremia may also be caused by the activity of the brain natriuretic factor (BNF) which is a potent diuretic, natriuretic, vasodilating agent and also inhibitor of aldosterone, renin, and vasopressin.

The most common causes for hypernatremia in TBI include diabetes insipidus as 15-30% of TBI patients have

hypothalamic-pituitary dysfunction and use of osmotic diuretics like mannitol. In our study 9.4% of the patients had hypokalemia, and 1.2% of the patients had hyperkalemia. Compared to the incidence of abnormalities in sodium level, the incidence of potassium disorders was low (10.6%).

The cause for leucocytosis may be due to role of catecholamines and steroids. Catecholamines increase the leukocyte count by release of the marginated cells into the circulating pool whereas corticosteroids increase the neutrophil count by releasing the cells from the storage pool in the bone marrow into the blood and by preventing regress from the circulation into these tissues.

In our study, 71.8% of the patients had leucocytosis and 28.2% of the patients had normal WBC count. This reveals strong association with traumatic brain injury in our study.

5. Conclusion

Electrolyte disturbances and leucocytosis in patients with traumatic brain injuries are common. About one tenth have abnormal potassium level, about one third of them have abnormal sodium level and about two third have leucocytosis. Electrolyte disturbances should be measured and meticulously treated in patients with traumatic brain injuries.

Declaration of Conflicting Interests

The authors declare that there is no potential conflicts of interest with respect to the research, authorship and /or publication of this article.

Funding

The authors received no financial support for the research, authorship and/or publication of this article.

References

- [1] Costa KN, Nakamura HM, Cruz LR, Miranda LS, Santos-Neto RC et al. Hyponatremia and brain injury: absence of alterations of serum brain natriuretic peptide and vasopressin. *Arq Neuropsiquiatr.* 2009. Dec ; 67(4):1037-44.
- [2] Isotani E, Suzuki R, Tomita K. Alterations in plasma concentrations of natriuretic peptides and antidiuretic hormone after subarachnoid hemorrhage. *Stroke.* 25 Nov; (11):2198-203.
- [3] Lath R. Hyponatremia in neurological diseases in ICU. *Indian J Crit Care Med.* 9:47-51.
- [4] Gürkanlar D, Lakadamyali H, Ergun T, Yılmaz C, Yücel et al. Predictive value of leucocytosis in head trauma. *Turk Neurosurg.* 2009 Jul; 19(3):211-5.
- [5] Ishizaki T, Momota H, Kuwahara K, Tanooka A, Morimoto S. A. case of symptomatic traumatic cerebral vasospasm associated with hyponatremia. *No Shinkei Geka* 1999 Nov; 27: 1031-6. [Articlein Japanese].
- [6] Choon Hong Kan, Mohd Saffari, Teik Hooi Khoo. Prognostic Factors of Severe Traumatic Brain Injury Outcome in Children Aged 2-16 Years at a Major Neurosurgical Referral Centre. *Malays J Med Sci.* 2009 Oct;16(4): 25-33.
- [7] Aakash Bodhit et al. Hyperglycemia And Leukocytosis As Predictors Of Abnormal Head CT Following Concussion. *Neurology* April 8, 2014 vol. 82 no. 10 Supplement P5. 301.
- [8] Cerda-Esteve M, Ruiz-Gonzalez A, Gudelis M, Goday A, Trujillano J et al. Incidence of hyponatremia and its causes in neurological patients. *EndocrinolNutr.* 2010; 57(5): 182-6.
- [9] Upadhyaya A, Jaber BL, Madias NE. Incidence and prevalence of hyponatremia. *Am J Med.* 2006Jul; 119(7 Suppl 1):S30-5.
- [10] Usha S Adiga, Vickneshwaran V, Sanat Kumar Sen. Electrolyte derangements in traumatic brain injury. *Basic Research Journal of Medicine and Clinical Sciences* ISSN 2315-6864 Vol. 1(2) p. 15-18 September 2012.