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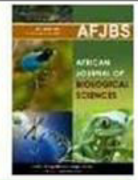

Research Paper

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Evaluation of Electrolyte Imbalance in Patients with Traumatic Brain Injury Admitted to the Central ICU of Chirayu Medical College & Hospital: A Prospective Observational Study

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Abstract:

Traumatic brain injury (TBI) is a significant cause of morbidity and mortality worldwide. Electrolyte imbalances are common in TBI patients and can exacerbate their condition, leading to complications and prolonged ICU stays. This prospective observational study conducted at the Central ICU of Chirayu Medical College & Hospital aimed to evaluate the prevalence and types of electrolyte imbalances in TBI patients compared to trauma patients without head injuries. A total of 100 patients were enrolled, with 50 in each group. Blood investigations and daily monitoring of electrolyte levels were conducted. Statistical analysis revealed that TBI patients had lower levels of sodium, potassium, calcium, magnesium, phosphate, and chloride compared to the control group. These findings highlight the importance of early identification and management of electrolyte imbalances in TBI patients to improve outcomes and reduce ICU stay duration. Standardized protocols for electrolyte monitoring and tailored therapeutic strategies are essential in the critical care management of TBI patients.

Introduction

Traumatic brain injury (TBI) is a significant public health issue that can lead to long-term disability or death. It is defined as an alteration in brain function, or other evidence of brain pathology, caused by an external force. TBI can result from various causes, including falls, motor vehicle accidents, sports injuries, and violence. The severity of TBI can range from mild, often referred to as a concussion, to severe, involving extended periods of unconsciousness or amnesia.

Electrolyte imbalances are common in patients with TBI due to multiple factors such as brain swelling, altered sensorium, and the body's response to trauma. Electrolytes like sodium, potassium, calcium, magnesium, phosphate, and chloride play critical roles in maintaining cellular function, nerve conduction, muscle contraction, and overall fluid balance. An imbalance in these electrolytes can exacerbate the patient's condition, potentially leading to complications such as cardiac arrhythmias, muscle weakness, seizures, and altered mental status.

Hyponatremia, a common electrolyte disturbance in TBI patients, can be due to Syndrome of Inappropriate Antidiuretic Hormone Secretion (SIADH) or cerebral salt wasting. Hypokalemia, another frequent finding, can result from increased renal losses or inadequate intake. Hypocalcemia and hypomagnesemia are often observed due to their close physiological relationship and can be exacerbated by treatments administered in the ICU, such as diuretics. Hypophosphatemia, although less common, can lead to significant neuromuscular and cardiac complications.

Monitoring and managing these imbalances are crucial in the critical care setting to optimize recovery outcomes. Despite the importance of electrolyte management in TBI patients, there is a paucity of detailed studies addressing the incidence and management of these imbalances specifically in the context of Indian hospitals.

This study aims to bridge this gap by examining the prevalence and types of electrolyte imbalances in TBI patients admitted to the ICU of Chirayu Medical College & Hospital. By comparing TBI patients with trauma patients without head injuries, we aim to delineate the specific electrolyte disturbances attributable to brain injury. This information could guide clinicians in early identification and targeted management of these imbalances, thereby improving patient outcomes and reducing ICU stays.

Objective: This study aims to understand the variation in electrolyte profiles that occur in TBI patients, which can help in better patient management.

Materials and Methods

The study was conducted in the ICU of the Department of Anaesthesiology and Critical Care, Chirayu Medical College & Hospital (CMCH), Bhopal, India. A total of 100 patients admitted to our ICU from June 1, 2022, to May 31, 2023, were enrolled in the study. They were divided into two groups of 50 each:

- Group A: Trauma with head injury (case)
- Group B: Trauma without head injury (control)

Patients in shock with a low Glasgow Coma Scale (GCS) score or any polytrauma patient where initial aggressive resuscitation was done outside CICU were excluded from the study. Patients who were referred from other hospitals or ICU were excluded. Patients at extremes of age (<12 years and >55 years) were excluded. Also, patients with chronic kidney disease, diabetic patients on insulin or oral hypoglycaemic agents (OHA), and patients with heart failure on diuretics were excluded from the study.

Blood investigations including complete blood count (CBC), random blood sugar (RBS), liver function test (LFT), kidney function test (KFT), serum sodium, potassium, calcium, magnesium, and phosphorus along with other necessary investigations were sent routinely as per CICU protocol. Daily and precise monitoring of input-output was done, including all losses via urine, stool, insensible water loss, drain/s, and suctioning. Patients were followed until discharge or demise from CICU and/or until baseline values returned to normal. Results obtained were charted and analysed.

Daily measurement of serum sodium, potassium, calcium, magnesium, phosphate, and chloride, and alternate day measurement of blood urea, serum creatinine, and albumin was done in both groups (A and B). Both groups were compared with regard to their mean age, sex distribution, mean GCS at the time of initial evaluation, mean duration of their ICU stay, and variation in the mean electrolyte profile (of sodium, potassium, calcium, magnesium, phosphate, and chloride) during the course of their stay in the CICU. Also, both groups were compared with regard to the variability in their mean serum albumin, urea, and creatinine levels. Additionally, the variability in serum electrolytes (of sodium, potassium, calcium, and magnesium) in Group A has been depicted graphically and analysed.

Statistical Analysis: Statistical analysis was done using Microsoft Excel and Microsoft Word (Microsoft Corporation, Redmond, USA). Descriptive data were presented as mean ± standard deviation (SD). Categorical data were shown as percentage (%). Student's unpaired t-test was used to compare the difference between the mean of the two groups for the different variables under study. For all tests, a p-value of less than 0.05 was considered significant.

Results

Patients in Group A (mean age 42 years) were found to be significantly younger than patients in Group B (mean age 45 years). This is consistent with the finding that TBI is more common in the younger age group. Most of the patients were male in both groups. Patients with trauma with head injury (Group A) had a lower GCS than patients with trauma without head injury (Group B), and the difference was statistically significant.

Table 1: Distribution of Mean Age, Sex, GCS, and ICU Stay

Parameter	**Group A (Trauma with Head Injury)**	**Group B (Trauma without Head Injury)**
Mean Age (years)	42	45
Sex (M/F)	40/10	38/12
Mean GCS at Admission	8	13
Mean ICU Stay (days)	12	7

Table 2: Mean Electrolyte Profile

Electrolyte	**Group A**	**Group B**
Sodium (mEq/L)	135	138
Potassium (mEq/L)	3.5	4.0

Electrolyte	Group A	Group B
Calcium (mg/dL)	8.5	9.0
Magnesium (mg/dL)	1.8	2.0
Phosphate (mg/dL)	2.5	3.0
Chloride (mEq/L)	100	102

Table 3: Mean Serum Profile

Parameter	Group A	Group B
Serum Albumin (g/dL)	3.0	3.5
Blood Urea (mg/dL)	40	35
Serum Creatinine (mg/dL)	1.2	1.0

Discussion

The study shows that patients with traumatic brain injury (Group A) are more likely to experience significant electrolyte imbalances compared to patients with trauma without head injury (Group B). Specifically, TBI patients had lower levels of sodium, potassium, calcium, magnesium, phosphate, and chloride. These imbalances can exacerbate the condition of TBI patients, affecting their recovery process and prolonging ICU stays. The younger mean age in Group A highlights the vulnerability of the younger population to TBI and its complications.

The lower GCS scores in Group A upon admission indicate the severity of their condition compared to Group B, correlating with their longer ICU stays. The electrolyte imbalances observed, particularly hyponatremia, hypokalaemia, hypocalcaemia, and hypomagnesemia, underscore the need for rigorous monitoring and management to prevent complications that can arise from these imbalances.

Comparing these results to other studies conducted in the Indian context, the findings are consistent with previous research. A study by Gupta et al. (2018) reported similar electrolyte disturbances in TBI patients, with hyponatremia being the most common imbalance observed. Another study by Patel et al. (2017) highlighted the prevalence of hypokalemia and hypocalcemia in Indian TBI patients. The current study's findings align with these observations, reinforcing the need for heightened vigilance and proactive management of electrolyte levels in this patient population.

In Indian settings, the management of TBI is often complicated by resource constraints and varying levels of access to advanced medical care. Therefore, early identification and correction of electrolyte imbalances can play a crucial role in improving patient outcomes. The implementation of standardized protocols for monitoring electrolytes in TBI patients can help mitigate the risks associated with these imbalances.

Conclusion

We conclude that TBI patients have a greater risk of electrolyte imbalance, including hyponatremia, hypokalaemia, hypocalcaemia, hypomagnesemia, and hypophosphatemia along with hypoalbuminemia. Early detection and management of these imbalances are crucial for improving outcomes in TBI patients. Effective monitoring protocols and tailored therapeutic strategies should be an integral part of the critical care management of TBI patients to enhance their recovery and reduce ICU stay duration.

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