ELECTROLYTE IMBALANCE IN TRAUMA PATIENTS FOLLOWING TRAFFIC ACCIDENTS TREATED AT CAN THO CITY GENERAL HOSPITAL IN 2023-2024

Pham Tuong Thien Ngan[1], Ha Quoc Huy, Doan Hoang Nguyen, Nguyen Huu Dat, Danh Nguyen Minh Tam, Nguyen Duc Tri, Dinh Thi Huong Truc, Nguyen Khanh*
Can Tho University of Medicine and Pharmacy
*Corresponding author: p2tnct2@gmail.com

ABSTRACT

Background: Electrolyte imbalance in trauma patients can lead to life-threatening conditions, impacting vital organ systems. Trauma is a significant global health concern, particularly in developing countries like Vietnam. Laboratory tests can help assess the severity of medical conditions in trauma patients. Objectives: To investigate electrolyte imbalances in trauma patients following traffic accidents in Can Tho City General Hospital from 2023 to 2024, examining their prevalence and connection to injury severity. Materials and methods: A prospective descriptive study of 384 patients Following Traffic Accidents Treated at Can Tho City General Hospital, from 2023 to 2024. Results: Most patients were older males with limb injuries. Potassium significantly affected ISS (p=0.007) but not sodium (p=0.269). Treatments varied by ISS, with surgery increasing for more severe injuries (p=0.035). Conclusion: Relationships were identified between potassium levels, trauma severity and treatments. Insights from this study can guide clinical practice and management of electrolyte imbalances in trauma.
Keywords: Trauma patients, traffic accidents, electrolyte imbalance, traumatic injuries.

I. INTRODUCTION

Trauma is one of the major health issues facing the world today, particularly in developing countries like Vietnam. Statistics indicate that traffic accidents are the leading cause of trauma globally, especially in Vietnam. According to a report from the Ministry of Health, traffic accidents were the primary cause of death in Vietnam in 2016 [1], affecting both men and women [2]. Numerous studies around the world have been conducted to identify prognostic factors related to the health status and mortality rates of trauma patients, including the presence of electrolyte imbalances. These imbalances disrupt the body's homeostasis and significantly affect the cardiovascular, musculoskeletal, nervous, digestive, and urinary systems, potentially leading to fatal consequences. Vincent W. Vanek reported that between 50 and 68 percent of trauma patients treated at St. Elizabeth Hospital Medical Center had hypokalemia, with or without clinical symptoms. The South Medical Journal also advocates for laboratory tests, such as blood counts, arterial pH, and blood potassium levels, to assess the severity of trauma in patients [3]. Nguyen Viet Quang's research on plasma sodium disorders in patients with traumatic brain injuries found that approximately 65 percent of these patients experience sodium imbalances and require early diagnosis and treatment [4]. Consequently, we initiated the study "Survey of Electrolyte Imbalance in Trauma Patients Following Traffic Accidents Treated at Can Tho City General Hospital in 2023-2024" to evaluate the relationship between accident severity, electrolyte imbalances, and treatment methods.

II. MATERIALS AND METHODS

2.1. Materials

All trauma patients treated at Can Tho City General Hospital from 2023 to 2024 due to traffic accidents were invited to participate in the study. The following situations were disregarded: patients under 15 years old, those who died in the emergency department or outside the hospital and those who died due to a combination injury or other adverse events unrelated to the injury during treatment.

2.2. Methods

- **Study design:** A prospective descriptive study.
- **Sample size:**

$$n = Z^2_{1-a/2} \frac{p(1-P)}{d^2}$$

Where n denotes the sample size, Z denotes the 95% confidence level, p denotes the disease rate, and d denotes the absolute precision. According to Beal's study of posttraumatic hypokalemia at North Memorial Medical Center [5], we chose d=0.05 and p=0.5.

The sample size that will be chosen is 384 patients.

- **The sampling method:** Convenience sampling.

- **Study variables and Methods of data collection:**

+ Patients who meet the criteria for sampling will undergo clinical examinations, injury classifications, laboratory tests, treatments and monitoring during hospitalization.

+ General patient data, including age, sex, residence, occupation and time to hospitalization after injury, were recorded. The clinical examinations classify trauma, including brain trauma, maxillofacial trauma, spinal cord trauma, chest trauma, abdominal trauma, limb trauma, soft tissue trauma and multiple traumas. The trauma of traffic accidents could be either left, right or both sides, depending on the accident situation.

+ 384 patients would be assessed for the severity of trauma using the ISS (Injury Severity Scoring System) (Table 2.1) based on clinical findings [6]. ISS scores are calculated from the AIS (Abbreviated Injury Scale), each region evaluated by AIS can score from (1) representing minor injuries to (6) corresponding to unsurvivable (Table 2.1). The ISS is calculated by combining the highest AIS score square from the three most severely injured areas. We classify ISS points into four groups corresponding to four levels of severity: mild, moderate, serious, severe (Table 2.1).

Table 1. Body Region Injury Severity Classification and Injury Severity Score (ISS) Calculation Method

Body region injury evaluation according to AIS	
Region	Level
(1) Head	(1) Minor
(2) Face	(2) Moderate
(3) Neck	(3) Serious
(4) Thorax	(4) Severe (High possibility of living)
(5) Abdomen	(5) Critical (Low possibility of living)
(6) Spine	(6) Unsurvivable
(7) Upper Limbs	
(8) Lower Limbs	
(9) Other	

ISS calculating method
ISS = a2 + b2 + c2
a,b,c are the 3 body regions with the highest AIS score.

0 - 8	Mild
9 - 15	Moderate
16 - 24	Serious
25 +	Severe

+ A total of 384 patients were undergo treatment using three methods: medical management, minor surgery and major surgery. Following treatment, patients will be monitored for recovery progress and evaluated for hospital stay duration.

+ Data was collected from the clinical features, paraclinical markers and biochemical blood tests such as haematology, electrolytes and biochemistry. The treatment methods and post-treatment observation of the participants were also documented; no interference occurred during the treatment phase.

- **Statistical analysis:** Data was encrypted and entered into the computer using EpiData 3.1 software and analyzed using SPSS 20.0 software to calculate statistical properties. Quantitative variables with non-normal distribution were expressed as median (interquartile range). A two-sample t-test was used to compare two independent samples ($p < 0.05$ was considered statistically significant). Conversely, Mann-Whitney statistics were utilized to compare the median values of two groups with a non-normal distribution. The Chi-square statistical test ($\chi 2$) was used to ascertain the difference in proportions between the two groups, with statistical significance set at $p<0.05$.

- **Ethical approval:** The gathered data was encrypted for security, maintained confidentially and exclusively used for research purposes. The medical ethics committee approved the research protocol and ethical aspects at Can Tho University of Medicine and Pharmacy and Can Tho City General Hospital (protocol code 23.108.SV/PCT-HĐĐĐ in 2023).

III. RESULTS

3.1. Baseline subject characteristics

General characteristic

Table 2. Demographic distribution of study participants by age, gender and occupation

General characteristics		Frequency (n)	Rate (%)
Age		30	7.8
	20 -< 30	58	15.1
	30 -< 40	64	16.7
	40 -< 50	74	19.3
	>= 50	158	41.1
	Average: 46.01 ± 17.2. Lower limit: 15		
Gender	Male	242	63
	Female	141	37
Residence	Can Tho	225	58.6
	Others	159	41.4
Occupation	Public employees	7	1.8
	Farmers	70	18.2
	Workers	50	13.0
	Pipils/students	12	3.1
	The elderly	61	15.9
	Others	184	47.9
Total		384	100.0

The study involved 384 participants, with the group aged 50 years and older representing the highest percentage at 41.4% and an average age of 46.01±17.2 years. Males made up the majority at 63%. A majority (58.6%) of the patients resided in Can

Tho City. Furthermore, a notable 15.9% of the participants identified as farmers and were more prone to injuries.
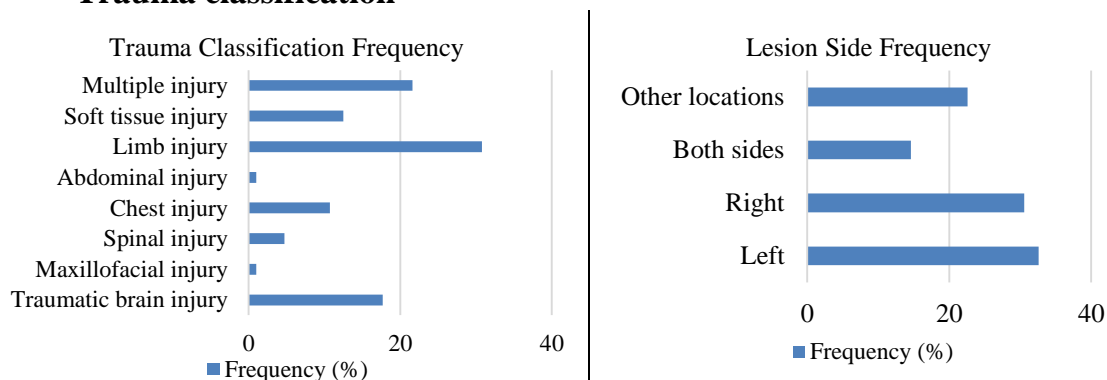
Trauma classification

Chart 1. Frequency and Rate of Trauma Classifications by Injury Type and Lesion Side

The predominant type of injury observed was limb injury, constituting 30.8% of cases, followed by multiple injuries at 21.6%, traumatic brain injury at 17.7%, soft tissue injury at 12.5%, chest injury at 10.7%, spinal injury at 4.7% and finally maxillofacial injury and abdominal injury at the lowest rate of 1%. The majority of traffic accident injuries were left-sided, accounting for 32.6% of cases, followed by right-sided injuries at 30.6%. Other locations accounted for 22.6% of cases. The lowest percentage was due to injuries on both sides, accounting for 14.6%.

3.2. Electrolyte imbalance in trauma patients following traffic accidents: principal findings

Correlation Between Electrolyte Imbalance and Trauma Severity

Table 3. Distribution of Plasma Sodium Volume Across Different Injury Severity Scores (ISS) with Chi-Square Test Results

ISS	Plasma Natri Volume			P (Chi square)
	Hyponatremia	Normal	Hypematremia	
Mild	19	128	4	
Moderate	22	107	7	0.440
Serious	16	49	3	
Severe	4	24	1	
Total19	61	308	15	384

We conducted a Chi-square test for the blood electrolyte concentration variables and found that the variations in blood potassium and sodium levels were not related to the severity of trauma (p = 0.440) and (p = 0.103), respectively.

Table 4. Distribution of Plasma Potassium Volume Across Different Injury Severity Scores (ISS) with Chi-Square Test Results

ISS	Plasma Kali Volume			P (Chi square)
	Hypokalemia	Normal	Hypekalemia	
Mild	79	71	1	
Moderate	75	61	0	0.103
Serious	46	22	0	
Severe	17	11	1	
Total19	217	165	2	384

Correlation between Trauma Severity and Treatment Methods

Table 5. Distribution of Medical Treatments by ISS Levels and Statistical Significance

Remedy	ISS level			
	Mild	Mild moderate	Severe	Extreme severe
Internal treatment	100	69	37	11
Minor surgery	2	1	1	0
Surgery	49	66	30	18
Total	151	136	68	29
P (Chi square)	0.035			

Among the 384 patients hospitalized due to accidents, 217 received medical management for various trauma severities, 4 underwent minor surgery and 163 required major surgery. Specifically, in the medical management group, there were 100 mild, 69 moderate, 37 severe and 11 very severe trauma cases. The minor surgery group had no very severe trauma patients, while the major surgery group included 49 mild, 66 moderate, 30 severe and 18 very severe trauma cases.

IV. DISCUSSION

4.1. Baseline subject characteristics

General characteristics

Among the 384 patients, the recorded average age was 46.01 ± 17.2 years. The group of patients over 50 years old predominated, consistent with findings from other studies indicating that older adults are at higher risk of severe injury and complications following traffic accidents due to factors such as frailty and pre-existing health conditions, according to Febres et al [7]. According to Mannocci et al [8], males and adolescents are at higher risk of traffic accident injuries, as males tend to participate in traffic more frequently and are at higher. Our study results also show a similar trend, with males accounting for 63% and the age group of 50 and above having the highest proportion (41.1%).

Trauma classification

Upper limb injuries were the most common type of trauma from traffic accidents, accounting for 30.8% of cases, followed by multiple organ injuries (21.6%), traumatic brain injuries (17.7%) and chest injuries (10.7%). These findings are consistent with previous studies, such as Fekadu [9], which identified the vulnerability of limbs in collisions as a common cause of upper limb injuries. Le Xuan Quy's research indicated high incidences of traumatic brain and limb injuries in emergency cases [10]. Overall, limb and multiple traumas are the most common injuries in traffic accidents. Regarding injury sides, the study found nearly equal proportions of left and right side injuries, with fewer bilateral injuries. Singh et al [11] also reported high proportions of left and right side injuries but lower bilateral injuries.

4.2. Electrolyte imbalance in trauma patients following traffic accidents: principal findings: Principle findings

Relation between electrolyte imbalance and accident severity

In this study, we evaluated the relationship between electrolyte imbalances, specifically blood potassium and sodium levels and the Injury Severity Score (ISS). We found that variations in blood potassium levels had a significant negative impact on ISS, while sodium levels did not show a statistically significant correlation. Higher potassium

levels were associated with lower ISS scores (p = 0.007), suggesting that increased potassium may mitigate trauma severity, contrasting with Smith et al [12] who found low potassium linked to higher severity. Our findings emphasize the importance of managing potassium levels in trauma patients, supported by Kocik et al [13] who noted potassium's critical role in trauma outcomes. Further research is needed to clarify sodium's role in trauma severity and to develop comprehensive electrolyte management guidelines.

Relation between accident severity and treatment methods

We analyzed data from 384 trauma patients and categorized treatment methods based on injury severity (ISS). Most mild cases were managed medically, while minor surgeries were less common across all ISS levels, aligning with existing trauma care research. As ISS increased, the need for surgery also rose.

Our findings mirror Smith *et al.* [14], where medical management was predominant in mild to moderate cases. However, minor surgery rates were lower than in Brown *et al.* [15], likely due to differences in hospital practices. The Chi-square test (p = 0.035) confirmed a significant variation in treatment distribution across ISS levels.

V. CONCLUSION

The study found that higher blood potassium levels were significantly linked to lower trauma severity (ISS scores), while sodium levels showed no significant correlation. This underscores the need to monitor potassium levels in trauma patients. Additionally, treatment distribution varied significantly with trauma severity. Patients with more severe injuries based on ISS were more likely to require surgical intervention, while those with milder cases primarily received medical management. In summary, the study highlights the association between potassium and trauma severity, as well as the link between injury severity and treatment. These insights can aid clinical decision-making, though further research is needed to refine electrolyte management guidelines for trauma patients.

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