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ASSESSING RENAL AND LIVER FUNCTION IN HEAD TRAUMA PATIENTS: TEST RESULTS AND INSIGHTS

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ABSTRACT

Background: Common and severe TBI causes impairment. TBIs are most often caused by falls, car accidents, and suicides, which vary by age and area. TBI, liver, and renal function are studied to prevent and classify brain injury. Secondary injuries, Glasgow Coma Scale limits, oxidative stress, inflammatory cytokines, and congenital anomalies exacerbate TBI and liver and kidney function. Hepato-biliary ultrasounds and liver function testing improved TBI critical care.

Methods: The study included 40 healthy and 40 TBI patients per gender. Mental illness, seizures, and CNS infections were excluded. The serum was collected from all 7 mL blood samples after clotting. Small aliquots were taken for serum analysis. Biochemical tests included ALT, AST, Blood Urea, and Creatinine for liver and renal function. Statisticians calculated continuous variable standard deviation with SPSS Statistics 17 for Windows. A significance level of $P < 0.05$ was used for analysis.

Results: The results indicate that TBI patients in this study had significantly altered renal and liver function compared to the control group. Gender did not significantly influence clinical variables in TBI patients, and GCS scores were not strongly associated with the assessed clinical and biochemical factors. These findings provide insights into the paraclinical characteristics of TBI patients and their potential implications for patient management.

Conclusion: TBI variability and liver/renal function are the focus of this investigation. More research is needed to understand these changes and their treatment effects. Improved care and results require TBI patient renal and hepatic impairment studies. Research should explore the complex link between liver, kidney, and brain function to understand this disorder.

Recommendation: Understanding TBI requires investigating the complex liver, kidney, and brain relationship. This study may improve patient care and treatment. Hepatic and renal function monitoring in TBI patients is crucial for clinical management.

Keywords: Traumatic brain injury, renal function, Liver function, ALT, AST

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INTRODUCTION

Traumatic brain injury (TBI) is a common disorder that has serious consequences for those who suffer from it, frequently leading to permanent disability. It is acknowledged as a complicated illness [1]. One of the main causes of TBIs is falls, which dramatically raises the rates of morbidity and death. Other prevalent reasons include vehicle accidents and suicide, which vary by age group and region, with middle-aged people being most vulnerable. Drinking alcohol is a major factor in car crashes that cause fatalities or major injuries.

Comprehending the cause of brain damage is essential for both prevention and categorization. There are two forms of brain injuries: secondary injuries that arise from brain sickness and can cause damage to brain tissue, and direct head injuries that are defined by structural changes brought on by the force that produced them [2].

Free radicals, ion transport abnormalities, blood carrier imbalances, mitochondrial damage, inflammatory reactions, and oxygen deprivation in situations like low blood pressure and high intracranial pressure are among the many causes of secondary injuries [2].

The Glasgow Coma Scale (GCS) is frequently employed in the assessment of traumatic brain injury severity. It gauges the patients' level of consciousness and responsiveness [3]. However, the full level of TBI-related impairment may not always be reflected in GCS scores.

The ability of the liver to function is essential for TBI patients to recover. TBI patients are frequently associated with elevated liver enzymes, such as alanine aminotransferase (ALT) and aspartate aminotransferase (AST). The liver produces these enzymes, which can be signs of inflammation, cell death, or injury to the liver. However, it's not always evident what their clinical importance and specificity are in the broader community.

Both renal and brain impairment have been linked to oxidative stress and inflammatory cytokines. Under these conditions, nitro tyrosine—a reactive compound generated by the reaction of nitric oxide (NO) with reactive oxygen species (ROS)—has been found to be significantly elevated.

Uncommon congenital illnesses called urea cycle abnormalities can result in hyperammonemia, which can cause central nervous system (CNS) dysfunction, including altered brain edema, mental status, seizures, coma, and possibly even death [4].

An indicator of glomerular function that comes from organ metabolism is creatinine [5].
The aim of this study is to examine the usefulness of hepato-biliary ultrasound scans and liver function testing in evaluating renal and liver function in individuals suffering from traumatic brain injury. The relationships between these tests and the outcomes of patients in the intensive care unit (ICU) will also be investigated. By doing this, we intend to offer important new perspectives on the treatment and management of patients with head trauma who have abnormal liver and kidney function.

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METHODOLOGY

Study Design: The study was carried out from 'January 2023 to January 2024', using information gathered from the 'Sheikh Bhikhari Medical College' in 'Hazaribagh'.

Participants: 40 healthy people and 40 patients with traumatic brain injury (TBI) of both sexes participated in the study.

Ethical considerations: Informed consent was taken in written form from all the participants.

Exclusion Criteria: People who didn't meet these requirements were not allowed to participate in the study: Patients with seizures, mental health issues, and central nervous system infections.

Sample Collection and Processing:

- Blood samples weighing seven milliliters were taken from every patient and control subject.
- Blood samples were handled in the following ways:
  - After blood clotting, serum was extracted from the blood samples using centrifugation at 2000 rpm for 15 minutes.
  - For analysis, the serum samples were separated into tiny aliquots.
- The following biochemical tests were used to perform the Renal Function Test (RFT) and Liver Function Test (LFT):
  - Liver Function Test (AST and ALT).
  - Renal Function Test (Blood Urea and Creatinine).

Statistical Analysis: SPSS Statistics 17 for Windows was used to perform statistical analysis. Standard deviation was included in the mean presentation of continuous variables. A threshold of $P < 0.05$ was utilized for significance.

RESULTS

The demographic characteristics of the study population revealed that the average age of traumatic brain injury (TBI) patients was 41.37 years, spanning the ages of 18 to 75. There was no apparent distinction between this age distribution and the control group, which had an average age of 34.0 years (range 18-65 years). Interestingly, the control group had a higher proportion of females (58%) compared to TBI patients (36.5%).

In the assessment of renal and liver function markers, significant differences were observed between TBI patients and controls. Specifically:

- Kidney Function: TBI patients exhibited elevated levels of urea (7.12 ± 3.21 mmol/L) and creatinine (104.08 ± 44.42 mmol/L) compared to controls (4.875 ± 2.35 and 74.94 ± 19.28 mmol/L, respectively). These differences were highly significant ($p < 0.001$).

- Liver Function: TBI patients had significantly higher results on liver function tests, such as ALT and AST (40.95 ± 18.65 and 44.16 ± 24.80 U/L, respectively), than controls (23.02 ± 10.42 and 28.73 ± 10.55 U/L, respectively). Additionally, these variations were quite significant ($p < 0.001$).

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Table 1: Comparison of Renal and Liver Function Markers between TBI Patients and Controls

Variables	Range in TBI Patients	TBI (n=40)	Controls (n=40)	Range in Control	p-value
Urea, mmol/L	1.3-16	7.12 ± 3.21	4.87 ± 2.35	1.91-12.37	0.001
Creatinine, mmol/L	37.41-301.98	104.08 ± 44.42	74.94 ± 19.28	44.01-124.99	<0.001
ALT, U/L	10.12-76.05	40.95 ± 18.65	23.02 ± 10.42	9.05-50.98	<0.001
AST, U/L	8.34-95.47	44.16 ± 24.80	28.73 ± 10.55	15.07-54.98	0.001

The analysis of gender-related differences in TBI patients did not reveal significant variations in Glasgow Coma Scale (GCS) scores, age, urea levels, creatinine levels, ALT, or AST. The distribution of GCS scores across mild, moderate, and severe categories did not show significant gender-related differences ($p = 0.463$).

When examining the relationship among several factors and GCS scores in TBI patients, age, urea levels, creatinine levels, ALT, and AST did not exhibit significant differences among patients with mild, moderate, or severe TBI. These results suggest that GCS scores were not strongly associated with these clinical and biochemical variables ($p > 0.05$).

DISCUSSION

The study population's demographic characteristics highlighted that traumatic brain injury (TBI) is a condition that can affect individuals across various age groups and gender. The average age of TBI patients in this study was 40.37 years, with a wide age range from 18 to 75 years. Crucially, the age distribution did not differ substantially from that of the control group, which ranged in age from 18 to 65 and had an av. age of 34.0 years. An unexpected finding was that the control group had a higher proportion of females (58%) compared to TBI patients (36.5%).

These findings underscore the heterogeneity of TBI and suggest that it can affect individuals from different age groups and genders. Additionally, the lack of significant age differences between TBI patients and controls highlights the need for continued research into risk factors and prevention strategies, given the widespread occurrence of TBI-related incidents, such as falls, road accidents, and injuries related to alcohol consumption.

The assessment of paraclinical characteristics revealed significant differences in renal and liver function markers between TBI patients and controls.

TBI patients exhibited substantially elevated levels of urea (7.12 ± 3.21 mmol/L) and creatinine (104.08 ± 44.42 mmol/L) in comparison to controls (4.87 ± 2.35 and 74.94 ± 19.28 mmol/L, respectively). These differences were highly significant and indicate impaired kidney function in TBI patients. Urea and creatinine are key indicators of renal function, and their elevation suggests potential kidney dysfunction in TBI patients. Previous research has shown that urea cycle defects can

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lead to behavioral and cognitive changes, emphasizing the importance of monitoring kidney function in TBI patients [4].

Liver function tests, including ALT and AST, also demonstrated a noteworthy difference between TBI patients and controls. TBI patients had significantly higher levels of ALT (40.95 ± 18.65 U/L) and AST (44.16 ± 24.80 U/L) compared to controls (23.02 ± 10.42 and 28.73 ± 10.55 U/L, respectively). These results indicate liver impairment in TBI patients, and prior research has linked higher serum liver enzyme levels to liver dysfunction [6-9].

The persistent neuro-inflammatory and systemic inflammatory response linked to traumatic brain injury (TBI) may be the cause of the high liver enzyme levels in TBI patients. Elevated inflammatory cytokine levels in the serum may be a factor in "organ crosstalk," which could lead to hepato-cellular injury as a result of the inflammatory reaction. Notably, prior to patients being released from critical care, ALT and ALP levels did not revert to baseline normal values [10-12].

Overall, the results suggest that TBI patients in this study experienced significant alterations in renal and liver function, emphasizing the importance of monitoring these parameters in the clinical management of TBI patients. To clarify the processes behind these changes and their clinical significance in TBI patients, more investigation is required. Additionally, strategies to mitigate kidney and liver dysfunction in this population should be explored.

CONCLUSION

This study highlights the variability of traumatic brain injury (TBI) and the need of evaluating liver and renal function in TBI patients. The findings underscore the necessity of continued investigation to comprehend the mechanisms behind these modifications and their implications for clinical practice. Traumatic brain injury survivors had higher levels of diabetes, liver enzyme (LFT) concentrations, renal function (RFT), and electrolyte imbalances. To enhance the care and results of people with head trauma and aberrant liver and kidney function, strategies to lessen renal and liver malfunction in TBI patients should be investigated. For a more thorough knowledge of this complicated illness, future research should keep examining the complex link between liver, kidney, and brain function.

Recommendations: TBI and liver and renal function should be examined and treated simultaneously, says one study. TBI patients have substantial liver and renal function changes, requiring extensive investigation and therapy. Hyperglycemia, LFT, RFT, and electrolyte abnormalities are more common in TBI survivors with liver and renal problems, making research for better care and outcomes crucial.

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