Original Article

Biochemical Aspects of Mild Head Injury: Detection and Diagnostic Value of Serum Neuron-Specific Enolase (NSE) and S100B Protein Levels: A Medicolegal View

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ABSTRACT:

Background: Traumatic brain injury (TBI) is a common public health problem. Mild TBI is any head injury with Glasgow Coma Scale (GCS) above 12. TBI comes to the forensic team's attention. Computed tomography (CT) is the investigation of choice in head injury being available relatively cheap and rapidly acquainted but less than 1 percent of head trauma patients have findings on CT brain and it does not predict the neuropsychiatric outcome of the mild TBI patients. Failure of diagnosis of head trauma patients and its management might be well-thought-out as a medicolegal negligence against the doctors. Biomarkers were proved to increase in brain insults such as strokes or even in trauma cases not involve head injuries. **Objectives:** The aim of this study was to assess how serum Neuron-Specific Enolase (NSE) and S100B protein levels, correlated to functional outcome and to compare the sensitivity and specificity of the 2 biomarkers in order to minimize the risk of medicolegal liabilities against the doctors and hospitals. **Patients and methods:** 50 patients with the diagnosis of mild TBI admitted to the ER of Benha University Hospital were enrolled, CT brain, serum levels of S100 B and NSE were detected. Meanwhile, 50 non trauma persons were enrolled and have the same managements. **Results**: Serum levels of S100B and NSE were noted to be elevated in trauma patients compared to the control group. **Conclusion:** S100B protein is more sensitive and specific than NSE as prognostic biomarker for the long-term outcome of mild head trauma and may serve as potential targets for treatment. Precise diagnosis and prediction of outcome may solve many medicolegal problems to doctors related to delay in interference or absence of facilities.

Keywords: Biomarkers - S100 – NSE — mild TBI - sensitivity and specificity - medicolegal view

I. Introduction

Structural or functional disruption of the brain caused by impact of an external force is called traumatic brain injury (TBI**) (**Sihong, 2024).

Traumatic brain injury is a major cause of morbidity and mortality across the globe at all ages. Even in minor head injuries with a good outcome, long term neuro-psychological deficits may occur (Zarei et al., 2024).

Head trauma account for almost 50% of all injuries and it is now one of the major problems confronted by almost 57 million people worldwide who are living with a neurological disorder caused by traumatic head injury (THI) (Alnaami et al., 2019).

About 12,000 Egyptians died each year because of various forms of trauma (El Shehaby et al., 2020). Although the Egyptian injuries are many times more than documented as a result of underreporting and misdiagnosis, trauma in Egypt is a significant load as it was the fifth leading cause of death in 2004 (Mahran et al.,2013; Abdelgeleel et al., 2019).

The Glasgow Coma Scale (GCS) is recognized as one of the most important neurological tools for assessing neurological function in patients with TBI. According to the Glasco coma scale (GCS), head injury is usually classified into mild, moderate and severe. Mild traumatic brain injury is any injury with GCS above 12 (chen et al., 2022).

In clinical practice, exact prediction of long-term consequence and neurological evaluation could aid clinically, permit early rehabilitation and assess medico legal responsibility of health care providers. An accurate evaluation of the Severity of CNS injury can help to predict outcomes and rationally help to decide when the application of aggressive therapeutic interventions would be appropriate (Bloomfield et al., 2007, Sheta et al., 2014).

Standard methods to predict the severity of initial brain injury and anticipate the onset of secondary injury have included the neurological examination, neuroimaging studies, intracranial pressure monitors, electro diagnostic testing, and transcranial dopplers. The standard tests have limited reliability in patients who are frequently given sedatives, analgesics, and muscle relaxants, or are stable enough to leave the ICU for frequent neuroimaging studies (Sheta et al., 2014).

Computed tomography (CT) is the investigation of choice in head injury being available, relatively cheap and rapidly acquainted but less than 1 percent of head trauma patients have findings on CT brain and it does not predict the neuropsychiatric outcome of the mild head injury patients and nearly 15% of mild TBI subjects have not returned to normal daily function one year after their injury (Sadighi, 2023).

Therefore, over the past 50 years, intensivists have searched for biological markers that can reliably reflect the severity of injury to predict outcomes or are sensitive enough to detect the early onset of secondary injury. The difficulties associated with the use of CSF markers have led investigators to search for an ideal serum marker that might be highly specific for brain injury, sensitive to minor injuries, appears rapidly in the serum and is easy to be measured with lab tests whose results could be available in a very short time (Ikeda et al., 2001).

There is a compelling clinical need for real-time serum biochemical marker tests to aid in the diagnosis and severity stratification of head injury, particularly when access to neuroimaging techniques is limited. Research efforts have found the following 2 protein markers to be of some importance in the context of head injury: S-100B, and Neuron-specific enolase (NSE). S100B is a renal excreted protein concentrated in glial cells of the nervous system, it is called so because of its solubility in 100% saturated

ammonium sulfate at neutral pH. S100B is a marker of the primary injury that causes disruption of the blood-brain barrier through which brain-specific markers are released into the blood stream (Trnka et al., 2023).

Neuron-specific enolase (NSE) is the main glycolytic enzymes found in the cytoplasm of neurons and also can be found in small amounts on platelets and red blood cells. Specific enolase neurons are a marker of neuronal death, and they increase after head trauma at all severity degrees. Elevation of serum NSE levels is correlated to the increase in intracranial pressure (Susanti and Hidayat, 2019 & Metallinou, 2023).

The biomarkers S100B and NSE have both demonstrated their utility as diagnostic and prognostic markers, however, their correlation with outcomes remains unclear. A direct comparison of their respective diagnostic and prognostic values is yet to be established. Such a comparison would be helpful for researchers to prioritize which biomarkers to investigate in their forthcoming studies and for health policy-makers to make informed decisions.

The serum NSE and S100B as prognostic biomarkers for the long-term outcome of mild head trauma may assist as possible targets for treatment. Precise diagnosis and prediction of consequence may solve many medicolegal problems to doctors associated with delay in interference or absence of facilities. The failure of diagnosis of head trauma patients and its treatment might be considered a medicolegal negligence against the doctors.

The aim of this study was to assess how serum NSE and S100B, correlated to functional outcome and to compare the sensitivity and specificity of the 2 biomarkers after traumatic brain injury.

II. Patients and Methods

Patients:

This observational case-control study was conducted at the Emergency Department (ED) of the Benha University Hospital, between June, 2023, and December, 2023. Approval of the study protocol was obtained by the Benha faculty of medicine research ethics committee (Rc: 35-5-2023) prior to begin the study, and subjects or their legally authorized representatives were required to provide written informed consent prior to participation in the study. All participants were given thorough information about the study's goals and the data privacy was preserved. 50 TBI subjects and 50 non-TBI control subjects were included. The inclusion criteria for the mild TBI patients were based on the guidelines provided by the World Health Organization Collaborating Center for Neurotrauma Task Force, and the specific inclusion and exclusion criteria (Huang et al., 2024).

Glasgow Coma Scale (GCS) was evaluated on admission, within 24 hours of trauma, for all patients (Mcnett, 2007).

During the study period, 50 cases of both males and females, meeting the inclusion criteria listed below were included.

- Inclusion criteria (Borg et al., 2012):
  - Age: 6 - 60 years.
  - Egyptian individuals.
  - Subjects or their legally authorized representatives able to understand and willing to sign a written informed consent form.
  - Traumatic brain injury subjects admitted to the emergency department within 6 hours of the initial injury.
  - Initial Glasgow Coma Scale (GCS) score of 13 or more.
  - GCS score of 15 with witnessed loss of consciousness (LOC), or amnesia of the traumatic event.

- Complete patient record (including the age and sex of the patient).

♦ Exclusion criteria (Borg K. et al., 2012):

- Age: less than 6 or more than 60 years.
- Non-Egyptian individuals
- Subjects or their legally authorized representatives unable to understand or refuse to sign the written Informed Consent.
- Subjects with known history of neurological disease, neuropsychiatric disorders, alcohol or drug dependency, or known malignant melanomas.
- Subjects undergoing brain or spinal cord surgery within one month prior to the injury.
- Subjects with Polytrauma who had an evident injury to organs other than the brain.

Control Subjects:

They were patients who presented to the ED with a condition unrelated to head trauma, a GCS score of 15 without previous alteration of level of consciousness (LOC), or amnesia, 50 non-TBI subjects were enrolled. Control subjects provided written informed consent for study inclusion.

Methods:

Neurobiochemical assessment (Herrmann M., 2001)

In patients who fulfilled the inclusion criteria (no history of neurological or psychiatric disorder or alcohol or drug dependency), venous blood samples were taken at the first 24 hours after trauma. Blood was allowed to clot and was centrifuged (1000 rpm for 10 minutes) within 30 minutes after sampling. Serum was frozen at −80°C and stored for later analys

Protein S-100B and NSE were analyzed using luminescence immunometric assay (LIA) (Sangtec 100). This assay measures the B subunit of protein S-100 as defined by three monoclonal antibodies (SMST 12, SMSK 25, and SMSK 28). The detection limit of the kit is 0.020 µg/l and S-100B serum values range below 0.120 µg/l in 95% of healthy subjects (Herrmann et al., 2001).

Analysis of NSE is based on monoclonal antibodies which bind to the ã subunit of the enzyme. The sensitivity of the assay is reported to be below 1.0 µg/l and the upper limit of the reference range is 12.5 µg/l in 95% of healthy subjects. All biochemical analyses were performed on a fully automated LIA-mat System 300 (Herrmann et al., 2001).

Neuroradiological assessment

In all patients cranial CT was obtained at admission and at several follow up examinations depending on the clinical course. Brain CT evaluation was based on planar and volumetric measurements using the public domain NIH image program (developed at the US National Institutes of Health and available on the Internet at http://rsb.info.nih.gov/nihimage/).

All scans were evaluated by an experienced and trained neuroradiologist who was blind to the clinical and neurobiochemical data.

Outcome Measures (Borg K. et al., 2012):

The primary outcome measures were the baseline serum concentrations of biomarkers drawn from each enrolled subject.

A secondary outcome measure was the presence or absence of radiographic abnormality on initial CT scan. In particular, subjects were classified as CT positive if evidence of at least one of the following was demonstrated on the CT scan:

(i) Subdural hematoma (SDH).

(ii) Epidural hematoma (EDH).
(iii) Subarachnoid hemorrhage (SAH).
(iv) Cerebral contusion.
(v) Intracerebral hemorrhage (ICH).
(vi) Diffuse axonal injury (DAI).
(vii) Skull fissure\fracture.
(viii) Cerebral edema.
(ix) Pnemocephalus.

Subjects with signs of orbital or sinus fracture, scalp lacerations, or soft tissue injury but with none of the above signs of intracranial injury were classified as CT negative.

Statistical analysis and data interpretation

Data analysis was performed by SPSS software, version 25 (SPSS Inc., PASW statistics for windows version 25. Chicago: SPSS Inc.). Qualitative data were described using number and percent. Quantitative data were described using median (minimum and maximum) (interquartile range IQR) for non-normally distributed data and mean±Standard deviation for normally distributed data after testing normality using Kolmogrov-Smirnov test. Significance of the obtained results was judged at the (≤0.05) level.

1. Chi-Square test and Student t test were used to compare qualitative data between groups as appropriate.
2. Mann Whitney U test was used to compare between 2 studied groups for non-normally distributed data.
3. Receiver operating characteristics curve (ROC curve) was used to calculate validity (sensitivity & specificity) of continuous variables with calculation of best cut off point. Predictive values and accuracy are assessed using cross tabulation.

III. Results

A total of 50 TBI subjects that match our inclusion criteria and 50 age and gender-matched non-TBI control subjects were enrolled and classified as case and control groups. ***Table (1)*** shows the demographic criteria of the two studied groups. 18 of the subjects were classified as CT positive, and 32 were classified as CT negative. The following frequencies were observed with respect to specific abnormalities as detected on the CT scan: 2 subjects with SDH, 4 subjects with fissure fracture, 5 subjects with cerebral contusions, 3 subjects with EDH, and 1 subject with edema, pneumocephalus, intracerebral hemorrhage or depressed fracture as shown in *(Table 2 and Figure 1).* Of the 50 patients with traumatic brain injury, 23 were due to road traffic accident (RTA), 14 due to falls and 13 due to direct head trauma by a heavy object as shown in *(Table 3 and Figure 2).* S100B and NSE serum levels were noted to be elevated in trauma patients compared to the control group with statistically significant difference in S100 serum level and no statistically significant difference in NSE serum level as shown in *(Table 4 and Figure 3).* Receiver operating characteristics (ROC) curve of S100 and NSE in trauma and control subjects was demonstrated in *(Table 5 and Figure 4, 5).* Receiver operating characteristics ROC curve of S100 and NSE in differentiating cases that had positive or negative CT findings (ROC curve of S100 and NSE in predicting outcome) was demonstrated in *(Table 6 and Figure 6,7).*

Table (1) Demographic characteristics of the studied groups.

Variables	Case group N=50	Control group N=50	Test of significance
Age / years			
>18 18-60	15(30.0%) 35(70.0%)	10 (20.0%) 40(80.0%)	X^2=1.33 P=0.248
(Mean±SD)	28.10±15.05	30.2±10.14	t=2.1 p=0.415
Sex:			
Males Females	26(52.0%) 24(48.0%)	28(56.0%) 22(44.0%)	X^2=0.161 P=0.688
GCS:			
14 15	15(30.0%) 35(70.0%)	18(36.0%) 32(64.0%)	X^2=0.407 P=0.523

N= Number of subjects SD=Standard Deviation X^2=Chi-Square test, t= Student t test

Table (2): last CT Findings among studied cases.

CT Scan Results	Number	Percentage %
Last CT (Findings)		
ICH	1	2.0
depressed fracture	1	2.0
fissure	4	8.0
EDH	3	6.0
Contusion	5	10.0
SDH	2	4.0
Pnemocephalus	1	2.0
Cerebral Edema	1	2.0
Last CT (Negative or Positive)		
Negative	32	64.0
Positive	18	36.0

CT scan: Computerized Tomography; ICH: Intacranial Haemmorage EDH: Epidural Hemorrhage. SDH: Subdural Hemorrhage

(3): Cause of head injury among studied cases

Cause of injury	Number	Percentage %
Direct	13	26.0
Fall	14	28.0
RTA	23	46.0

RTA: Road Traffic Accident

Table (4): Comparison of S100, NSE between studied groups in venous blood samples taken at the first 24 hours after admission.

Variables	Cases group (N=50)	Control group (N=50)	Test of significance
	Median (range) (IQR)	Median (range) (IQR)	
S100B	5.4 (0.80-127.2) (2.4-107.63)	3.75 (0.8-25.0) (1.58-6.03)	Z=2.38 P=0.017*
NSE	6.15 (1.5-27.9) (3.5-8.4)	5.65 (1.5-11.7) (3.5-7.83)	Z=0.762 P=0.446

*N= Number of subjects IQR: InterQuartile Range ZMWU: Z value of Mann Whitney U test *: signific*

Table (5): validity of S100, NSE in differentiating cases from control group

Biochemical Marker Area Under Curve	AUC (95% CI)	P value	Cut off point	Sensitivity	Specificity
S100	0.638 (0.528-0.748)	0.017*	≤4.20	60.0%	56.0%
NSE	0.544 (00.430-0.658)	0.446	≤4.95	62.0%	40.0%

*AUC: Area Under Curve, *: significant S100=S100 Protein NSE=Neuron Specific Enolase*

Table (6): validity of S100, NSE in differentiating cases with positive from negative CT findings (predicting outcome)

Variables	AUC (95%C)	P value	Cut off point	Sensitivity	Specificity
S100B	0.945 (0.528-0.748)	0.001*	≤11.15	94.4%	95.1%
NSE	0.737 (0.582-0.892)	0.002*	≤4.95	77.8%	42.7%

*AUC: Area Under Curve, *: Significant S100=S100 Protein NSE=Neuron Specific Enolase*

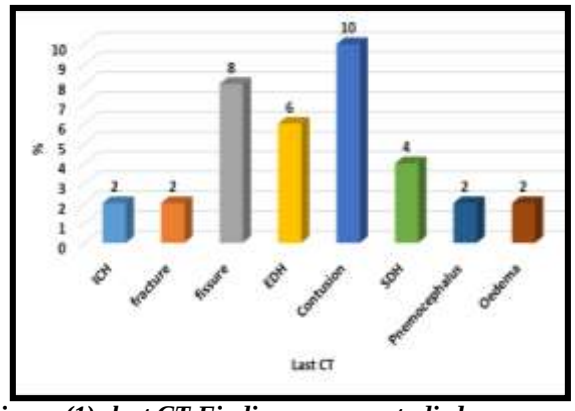

Figure (1): last CT Findings among studied cases.
CT scan: *Computerized Tomography*
ICH: *Intacranial Haemmorage*
EDH: *Epidural Hemorrhage*
SDH: *Subdural Hemorrhage*

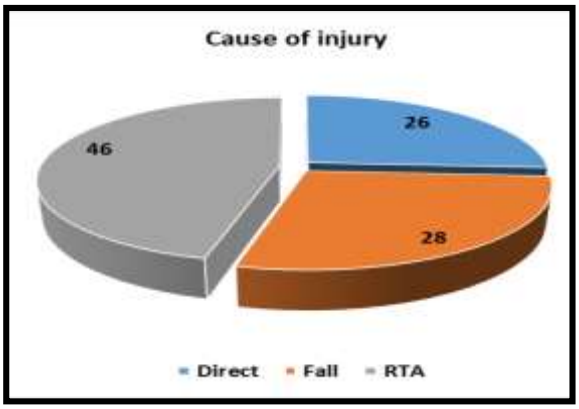

Figure (2): Causes of head injury among studied cases.
RTA: *Road Traffic Accident*

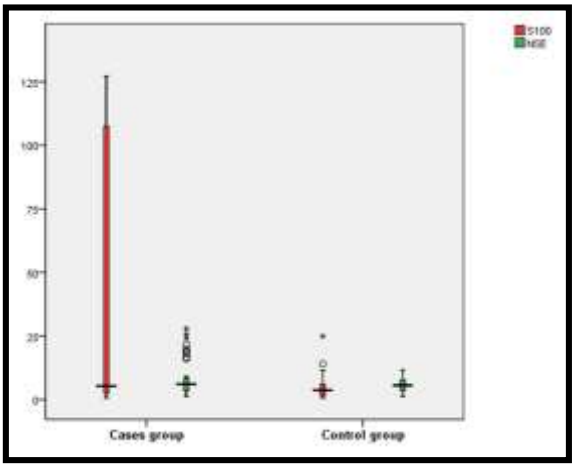

Figure (3): Comparison of S100, NSE between studied groups.

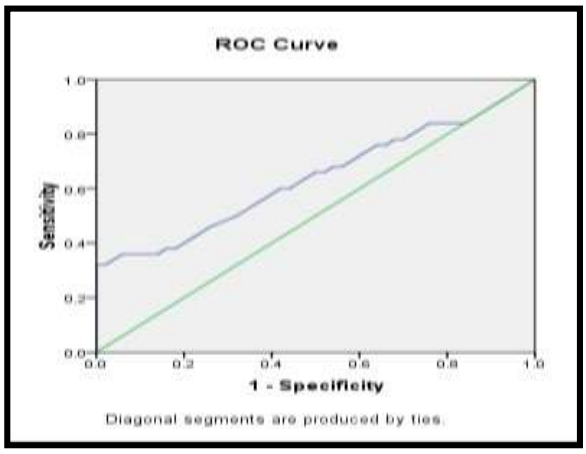

Figure (4): ROC curve of S100 in studied groups

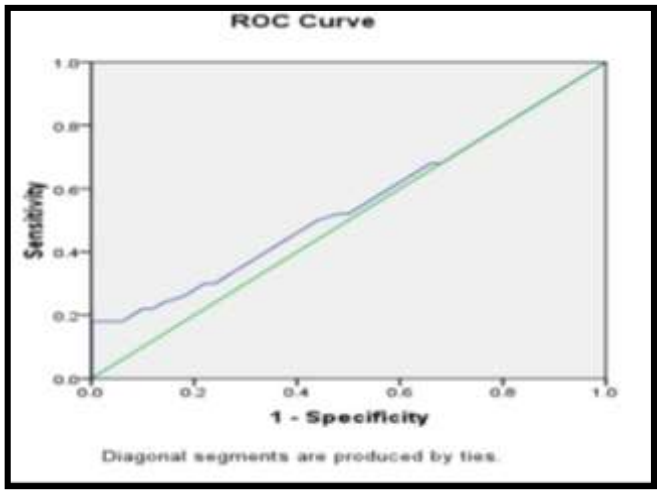

Figure (5): ROC curve of NSE in trauma and control subjects

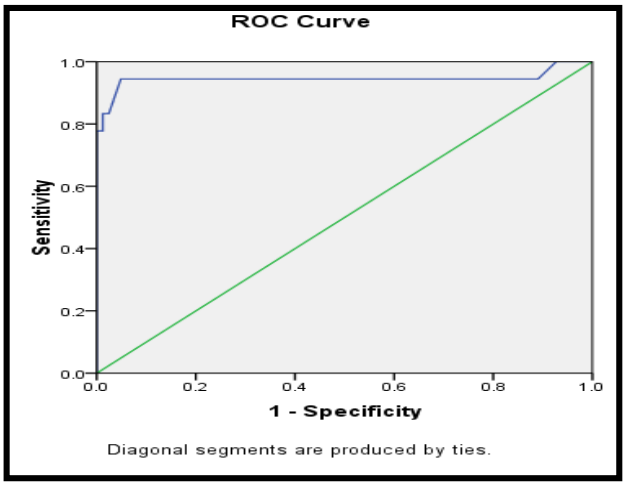

Figure (6): ROC curve of S100 in differentiating cases with positive from negative CT findings (ROC curve of S100 in predicting outcome)

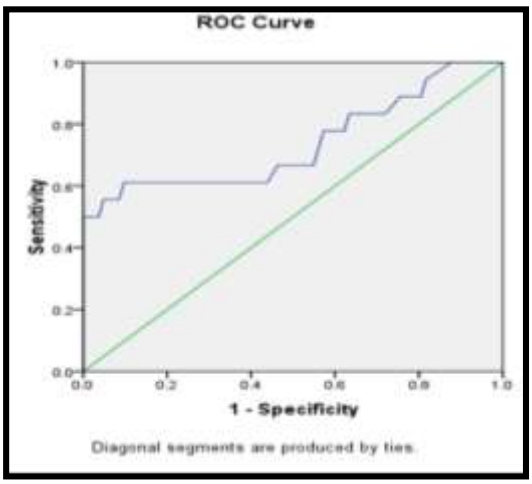

Figure (7): ROC curve of NSE in differentiating cases with positive from negative CT findings (ROC curve of NSE in predicting outcome)

IV. Discussion

Traumatic brain injury (TBI) is a major cause of death and lifelong disability, (TBI) comes to the forensic team's attention and raises questions about causation and prognosis. It was found that the workup is incomplete and the forensic team is able to reach a new understanding of the individual's prognosis and treatment (Esterov et al., 2022).

Moreover, precise diagnosis and prediction of outcome may solve many problems of medicolegal importance as the impact of malpractice on doctors due to delay in interference or absence of facilities (Sheta et al., 2014).

In clinical practice, precise prediction of long-term outcome and neurological assessment can help clinically, permit early rehabilitation and evaluate medico legal responsibility of health care providers. An accurate evaluation of the Severity of CNS injury can help to predict outcomes and rationally help to decide when the application of aggressive therapeutic interventions would be appropriate (Bloomfield et al., 2007, Sheta et al., 2014).

Mild traumatic brain injury, also known as concussion, has been defined as a minor head injury with a GCS score of 13 to 15. Loss of consciousness and post traumatic amnesia occur variably. The CT scan and MRI may be normal or show minor abnormalities (Mcnett M., 2007).

Advancements in neuroscience have led to changes in legal policy in the past. Every scientific advancement brings with it new challenges for the legal system. What evidence is admissible in court? (McBride W R et al., 2023)

Biomarkers have been thoroughly studied for their diagnostic role in mild traumatic brain injury (mTBI): to allow accurate diagnosis, improve patient management and reduce medical costs (Kulbe and Jeddes, 2016).

We aimed, in this work, to study the possibility of using an alternative method such as S100B and NSE serum levels to predict the presence of an intracranial pathology and thus decreasing the number of patients exposed to unnecessary imaging radiation. For medicolegal aspects, this study was designed to reduce the risk of medicolegal negligence & liability against the doctors.

In this study, S100 B and NSE serum levels were noted to be elevated in trauma patients compared to the control group with statistically significant difference in S100 serum level and no statistically significant difference in NSE serum level. Trnka et al., (2023) also supported in their study the potential of using S100B protein to assess the prognosis of patients with TBI and reported that it was statistically significant for predicting good clinical condition 1 month after trauma.

In systematic review and meta-analysis of the prognostic value of serum NSE in traumatic brain injury patients, Cheng et al., (2014) found that unfavorable outcome and mortality were significantly associated with greater NSE concentrations. In addition, serum NSE had moderate discriminatory ability to predict mortality and neurological outcome.

On another hand, Uzan et al., (1995) reported elevated serum levels of NSE in their experimental trauma model and reported a significant correlation with the long-standing outcome.

According to a systematic review performed by Papa et al., (2015) on athletes with mild head trauma, there was no significant correlation between the increased level of NSE and mild brain injuries.

Going hand in hand with our work, Waterloo et al., (1997) and Ingebrigtsen et al., (1999) reported elevated serum levels of S100 beta protein in minor head injuries.

Mercier et al., (2016) in their metaanalysis and Saidi et al., (2019) Stated that the elevated levels of S100B are caused by releasing from injured brain cells and it is the continuous release from injured brain tissue that leads to the protein being detectable beyond the expected half-life.

Validity of S100, and NSE predicting outcome in our results shows that sensitivity and specificity of S-100B are 94.4%, 95.1% respectively and those of NSE are 77.8%, 42.7%. Rodriguez et al., (2016) in their study documented the sensitivity and specificity of NSE to be 75% and 66.1% respectively. Herrmann et al., (2001) found that the initial S-100β level obtained from TBI subjects presenting with predominantly minor head injuries predicted adverse neuropsychological outcomes after 2 weeks and after 6 months and that S-100β was a better predictor of both short-term and long-term outcome than NSE or intracranial pathology as detected on the CT scan.

Our results are consistent with those of Biberthaler et al., (2006) who studied a sample of 1,309 patients with minor head

injuries and found that serum S100B levels have a sensitivity of 99.7% and can enable the avoidance of CT in 28% of patients with minor head injuries.

Elevated levels of S-100 β have been found in patients after minor and major head injury. In patients with mild head injury (GCS 13-15) where initial computed tomography (CT) scans of their brain do not exhibit any abnormality, S-100 β levels have been found to be high, especially in the golden hour following trauma. Elevated levels of S-100 β in serum following head injury have also been associated with impaired cognition score (Sahu et al., 2017)

In their results, Zarei et al., (2024) stated that S100B is superior to NSE for both prognostic and diagnostic purposes in TBI patients. Although neither biomarker has shown promising diagnostic performance in detecting abnormal CT findings, they have displayed acceptable outcome prediction capabilities, particularly with regard to mortality.

Biomarker NSE As an isoenzyme of enolase enzyme involved in glycolysis, NSE was thought to be a relevant marker of neuronal injury. However, it has also concurrently evolved as a marker for neuro-endocrine malignancies such as small cell lung cancer and neuroblastoma and hence its specificity for neural tissues injury is doubtful (Sahu et al., 2017).

Müller et al., (2007) found that Determination of serum S100B cannot replace the clinical examination or use of CT for patients with minor head injury, but adding S100B measurement to the clinical evaluation might support selection of patients for CT scanning.

Calcagnile et al., (2012) found that the clinical use of S100B within the existing guidelines for management of mild head injuries is safe and effective, without additional risk factors and with normal S100B levels within 3 hours of injury, can safely be discharged from the hospital. The same was concluded by Thaler et al., (2015) who found Levels of S100B below 0.105 ug/L can accurately predict normal CT findings after mild head injury.

Ananthaharan et al., (2018) found that the implementation of the updated Scandinavian guidelines for acute management of adult patients with mild head injury at the Emergency Department resulted in 31.3% of the cases being discharged directly after the primary assessment without further observation or CT examinations. Correct use of S100B contributed to approximately 20% of the total number of discharges.

Žurek et al., (2011) also supported the claim of the potential to use S100B protein as an indicator of injury severity and prediction of condition. Moreover, the prognostic value of the S100B collected 12–36 h after trauma is also supported by Thelin et al. (2017).

In contrast to our work, Wijanarko et al., (2021) in their study pointed to changes in S100B levels in the form of decreased levels 3 h of trauma.

V. Conclusion

The consequences of brain injury, to the patient, the family and the healthcare providers are common and ethical and moral dilemmas arise. So, the clinician should be honest and direct in conveying diagnostic and prognostic information. We therefore assure that; precise diagnosis and prediction of outcome may solve many medicolegal problems of importance to doctors related to delay in interference or absence of facilities. The aim of the study is not to replace CT in the diagnosis of TBI, but to point out the possibility of additional diagnostic options, such as the S100B and NSE protein as early markers of TBI because it is simple, safe (prevent unnecessary CT scans, which are currently recommended for patients with mild head injury, and thus reduce radiation exposure), less expensive (save precious

healthcare resources) and effective for patients, without additional risk factors and with normal S100B levels within 3 hours of injury, can safely be discharged from the hospital. The current study demonstrates that S-100*β*, and NSE are present and elevated in the sera of mild injured TBI subjects relative to non-TBI subjects. S100 protein is more sensitive and specific than NSE as prognostic biomarker for the long-term outcome of mild head trauma and may serve as potential targets for treatment. Our findings clearly indicate that S100B protein levels are an accurate tool for ruling out intracerebral injuries.

VI. Recommendations

1. Traumatic brain injury is a major cause of morbidity and mortality across the globe at all ages. The aim of the study is not to replace CT in the diagnosis of TBI, but to point out the possibility of additional diagnostic options, such as the S100B and NSE protein as early markers of TBI because it is simple, noninvasive and cheap. Also, further studies on another useful biomarker for early management of head trauma cases should be done.
2. Advancements in our understanding of TBI related biomarkers promise to make it possible to characterize the severity of TBI with greater accuracy, improve our understanding of staging within both the injury process and the recovery process, and help us develop quantifiable metrics representative of reversal and recovery from a brain injury following trauma. This may help reducing the risk of medicolegal negligence & liability against the doctors.
3. In criminal crimes, head trauma is the highest cause of death. Various attempts have been conducted to find alternative substitutes for the internal examination (autopsy) which received much rejection from the public. Studies on use of biomarkers to determine the cause of death could be done.
4. Furthermore, despite their promise, most of them might not be appropriate for use within legal or policy-making systems at this time. Such data could be vulnerable to misuse, and could even result in the abuse of the legal system for unwarranted gain. Courts will be tasked with the challenge of determining the admissibility of related scientific evidence throughout this process.

- **Conflicts of interest:** The authors of the study declared that there are no conflicts of interest.

VII. Limitations

Despite the known possibility of using S100B protein or NSE for its prognostic potential, there are several limitations to our present study.

- First, the sample size is not large enough to adequately evaluate the predictive value of biomarkers as it was a single-center study. Hence, we suggest future larger multicenter stuies.
- Second, the pathological process after TBI is relatively complex, multidimensional and there are many differential metabolites in the blood.
- Third, biomarkers levels are time-dependent factor.
- Fourth, serum of trauma patients with TBI cannot fully reflect the pathological process of brain tissue injury in the early stage, which may bias the hyper-acute assessment.

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الجوانب البيوكيميائيه لإصابات الرأس البسيطه : تقييم الأهميه التشخيصيه لإنزيم neuron specific enolase و بروتين S100B من الناحيه الطبيه الشرعيه.

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الخلفية العلمية: تعد الإصابات بالرأس من الإصابات الشائعه المرتبطه بالوفيات والاعتلال في العالم. حتى الإصابات الطفيفة يمكن ان تؤدي الي بعض الاضرار العصبية والنفسية. و تمثل اصابات الرأس البسيطة أهمية للمجتمع الطبي الشرعى.

الهدف من الدراسة: محاولة تقييم الاهميه السريريه والطبيه الشرعيه ل انزيم إنولاز الخاص بالخلايا العصبية و بروتين S100B كدلالات بيولوجيه قد تنتج عن معلومات تفيد في التشخيص اذا تم اضافته الي بروتوكولات التعامل مع إصابات الرأس للتنبؤ بوجود عطب داخلي بالمخ وعن طريقها يتم تشخيص وعلاج بعض الإصابات وأيضا يمكن حل العديد من المشاكل الطبيه الشرعيه والأخطاء المهنيه الموجهه ضد الأطباء.

الأشخاص: هذه الدراسة متجانسة وإستباقية أجريت بمستشفيات بنها الجامعية في الفترة من يونيو 2023 حتي ديسمبر 2023.

النتائج : في الفترة المذكورة تم إستقبال عدد 50 مريضا تتراوح أعمارهم بين 6 و 60 عاما بقسم الطوارئ بمستشفيات جامعة بنها. ويعانون من إصابة بسيطة بالرأس حيث تراوحت درجة وعيهم من 13-15 علي مقياس جلاسكو للغيبوبة وكان سبب إصابة الرأس حوادث مرورية في 23 مريضا وسقوط من علو في 14 مريضا وإصابة مباشرة في 13 مريضا وقد أظهر التصوير بالاشعة المقطعية وجود عطب مخي له علاقة بإصابة الرأس في 18 حالة فقط وكان التصوير سلبيا في 32 حاله. في حين كانت نسبة إنزيم إنولاز الخاص بالخلايا العصبية إيجابيا في 18مريضا بحساسية تبلغ 77% وتخصصية 42%. وكذلك وجد أن بروتين S100B إيجابيا في 18مريضا بحساسية تبلغ 94% وتخصصية95%.

الخلاصة: يعد قياس نسبة بروتينS100B اكثر دقه من انزيم إنولاز الخاص بالخلايا العصبية ويعتبر مؤشر جيد للنتائج في حالات إصابه الرأس البسيطه و يصلح كبديل للتنبؤ بوجود عطب داخلي بالمخ كما أنه من الممكن أن يقيم درجه إصابه الجهاز العصبي وبإستخدامه يتم تقليل المشاكل الطبيه الشرعيه ضد الأطباء .

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