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# Predictive Value of Vital Signs at Presentation in Individuals with Severe Traumatic Brain Injuries

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## ABSTRACT

**Background:** Throughout the world, traumatic brain injury (TBI) is a leading cause of mortality and morbidity. It can be brought on by a variety of factors, including falls from great heights, gunfire, and traffic accidents. The number of injuries being treated in the emergency room is rising, and in severe trauma cases, the fatality rate might be as high as 50%.

**Objective:** To improve the outcome of TBI patients by analyzing the vital signs at presentation and their role as a predictor to the outcome in patients with isolated TBI.

**Methods:** Prospective analytical study that included 110 adult traumatic patients presented to Emergency Department in Suez Canal University Hospital with severe TBI.

**Results:** Studying of the demographic data of both groups showed that most of cases 75 (68%) are males, while females were only 35 (32%). The average heart rate was higher (100 beat/min) in cases with bad outcome compared to (89 beat/min) in cases with good outcome. The mean respiratory rate was higher (22 breath/min) in cases with bad outcome compared to (20 breath/min) in cases with good outcome. Both mean systolic and diastolic blood pressure were lower in cases with bad outcome than in cases with good outcome. Measured oxygen saturation was much lower (mean 91.6 %) in cases with bad outcome at presentation compared to 95.9 % in cases with good outcome.

**Conclusion:** Tachycardia, tachypnea, hypotension and lower levels of oxygen saturation were evident in cases with bad outcome in sever TBI patients.

**Keywords:** Vital signs, Outcome, TBI.

## INTRODUCTION

Traumatic brain injury (TBI) is a form of acquired brain injury caused by rapid trauma to the head. TBI happens when the head strikes something suddenly and violently or when something pierces the skull and enters the brain tissue **(1).** It is one of the primary causes of mortality and morbidity worldwide **(2).** Secondary brain damage caused by malfunctioning neurons as a result of trauma-induced oxidative stress, ischemia, edoema, and inflammatory response is curable even though basic brain damage is irreversible **(3).**

The medical personnel are unable to handle all cases of injury during war conditions because of the rising number and variety of injuries that are being brought to the emergency room. The initial step in such a case is typically classifying and addressing the injuries according to their risk. We need a simple, quick, and reliable prognostic scale in order to complete this phase **(4)**.

Predicting the prognosis of critically sick trauma patients using widely accessible, easily obtainable, uncomplicated, and reproducible clinical data points is a key research target that has not yet been satisfactorily addressed. Vital signs can be used as markers of trauma severity and to identify individuals who need additional treatment and are at risk for bad outcomes because they are regularly measured in all cases at presentation and are simple to obtain quickly **(5)**.

## PATIENTS AND METHODS

The current prospective analytical trial included 110 adult trauma patients who had severe traumatic brain injuries and had gone to the Emergency Department, Suez Canal University Hospital. All patients included in the study were subjected to the following:

- Personal data: Name, age, sex, residence, phone number & mechanism of trauma.
- Vital signs at presentation: HR, RR, BP, temperature, oxygen saturation and random blood sugar
- Outcome: At 7 and 28 days, the 8-point Extended Glasgow Outcome Score was used. The 6-month outcome analysis did not include participants who withdrew their consent to the trial. Patients with GOSE 2-4 or death were considered to have a poor result (Table 1).

### Ethical approval:

Both the Institutional Review Board [IRB] and The Local Committee of Ethics approved the protocol of this research in the Department of Emergency Medicine, Faculty of Medicine, Suez Canal University.

Informed written consent was taken from all patients.



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***Statistical analysis***

Data coded and entered into the computer statistical program. All statistical analyses performed using the Statistical Package for Social Science (SPSS) version 20. Data presentation performed via tables and graphs. Qualitative data presented as number and percentage while quantitative data as mean ± Standard deviation. Parametric and non-parametric tests were used as required. P value ≤ 0.05 was considered as statistically significant.

**RESULTS**

This study comprised 110 patients who were hospitalised to the Critical Care Unit at Suez Canal University Hospital after presenting to the Emergency Room with severe TBI. 65 cases of them had bad outcome representing 59% of cases, most of them died (60 of the 65 cases with bad outcome). 45 cases of them had good outcome representing 41% of cases, most of them with upper good recovery (35 of the 45 cases with good outcome) (Table 2).

Studying of the demographic data of both groups showed that most of cases 75 (68%) were males while females were only 35 (32%). Interestingly, most of females had good outcome in comparison to males (25 of 35 females (71%) & 20 only of 75 males (27%)). The mean age was 42.7 years with no statistically significant difference between the 2 groups (Table 3).

According to vital data in both groups this study revealed the following (Table 4):

The average heart rate was higher (100 beat/min) in cases with bad outcome compared to 89 beat/min in cases with good outcome. The mean respiratory rate was higher (22 breath/min) in cases with bad outcome compared to 20 breath/min in cases with good outcome**.**

Both mean systolic and diastolic blood pressure were lower in cases, which had bad outcome than in cases with good outcome**.** No variation was noticed in measured temperature in both groups**.** Measured oxygen saturation was much lower (mean 91.6%) in cases with bad outcome at presentation compared to mean of 95.9% in cases with good outcome**.** No major variation in random blood sugar in both groups with only slight elevation in bad outcome group (Table 4).

**Table (1):** Extended Glasgow Outcome Score after TBI [5]

| points | Clinical condition |
|---|---|
| 1 | Death |
| 2 | Vegetative state |
| 3 | Lower severe disability |
| 4 | Upper severe disability |
| 5 | Lower moderate disability |
| 6 | Upper moderate disability |
| 7 | Lower good recovery |
| 8 | Upper good recovery |

Table (1) showed the classification of outcome in cases of TBI by extended Glasgow outcome score.

**Table (2):** Distribution of the studied cases according to outcome by EGOS (n = 110)

| Outcome by EGOS | No. | % |
|---|---|---|
| **Bad outcome** | **65** | **59.1** |
| Death | 60 | 54.5 |
| Vegetative state (VS) | 5 | 4.5 |
| **Good outcome** | **45** | **40.9** |
| Lower good recovery (GR-) | 10 | 9.1 |
| Upper good recovery (GR+) | 35 | 31.8 |

**Table (3):** Comparison between the two studied groups according to demographic data

| Demographic data | Total (n = 110) | | Bad outcome (n = 65) | | Good outcome (n = 45) | | Test of Sig. | p |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | | |
| **Sex** | | | | | | | | |
| Male | 75 | 68.2 | 55 | 84.6 | 20 | 44.4 | $\chi^2$= 19.779* | <0.001* |
| Female | 35 | 31.8 | 10 | 15.4 | 25 | 55.6 | | |
| **Age (years)** | 43.5 (29.0 – 55.0) | | 38.0 (26.0 – 50.0) | | 44.0 (33.0 – 55.0) | | U= 1187.50 | 0.094 |

IQR: Inter quartile range $\chi^2$: Chi square test **U:** Mann Whitney test
p: p value for comparing between the **two** studied groups *: Statistically significant at $p \leq 0.05$

**Table (4):** Comparison between the two studied groups according to vital signs "clinical" at presentation

| | Total (n= 110) | Bad outcome (n= 65) | Good outcome (n= 45) | Test of Sig. | p |
|---|---|---|---|---|---|
| **HR (beat/min)** Mean ± SD. | 95.32 ± 16.42 | 100.23 ± 16.24 | 88.22 ± 14.03 | t= 4.027* | <0.001* |
| **RR (breath/min)** Mean ± SD. | 22.45 ± 4.29 | 23.77 ± 4.58 | 20.56 ± 2.98 | t= 4.137* | <0.001* |
| **Systole BP (mmHg)** Mean ± SD. | 117.73 ± 19.14 | 113.85 ± 21.84 | 123.33 ± 12.61 | t= 2.877* | 0.005* |
| **Diastole BP (mmHg)** Mean ± SD. | 73.18 ± 13.34 | 72.31 ± 15.39 | 74.44 ± 9.67 | t= 0.893 | 0.374 |
| **Temp (ºc)** Mean ± SD. | 37.11 ± 0.15 | 37.11 ± 0.17 | 37.11 ± 0.12 | t= 0.116 | 0.908 |
| **Saturation (%)** Mean ± SD. | 93.36 ± 4.59 | 91.62 ± 4.55 | 95.89 ± 3.32 | U= 600.0* | <0.001* |
| **RBS (mg/dl)** Mean ± SD. | 101.77 ± 18.47 | 104.23 ± 23.44 | 98.22 ± 4.90 | U= 1412.50 | 0.760 |

SD: Standard deviation; t: Student t-test; U: Mann Whitney test
p: p value for comparing between the studied groups; *: Statistically significant at $p \leq 0.05$.

## DISCUSSION

The biggest cause of mortality and permanent impairment in people under the age of 40 around the world is TBI. The death rate in cases of severe trauma might be as high as 50%. Over the past few years, this rate has decreased from 80% in 1950 to 20% [6]. An essential research objective that has not yet been adequately attained is outcome prediction in critically sick trauma patients utilising widely available, easily obtained, straightforward, and reproducible clinical data points. Neutrophil to lymphocyte ratio (NLCR) is a straightforward, independent technique for assessing outcomes and systemic inflammation in trauma patients [4].

In this study, 110 patients with severe traumatic brain injuries who were admitted to Suez Canal University Hospital's Intensive Care Unit were also present at the Emergency Department. 65 cases of them had bad outcome representing 59% of cases, most of them died (60 of the 65 cases with bad outcome). 45 cases of them had good outcome representing 41% of cases, most of them with upper good recovery (35 of the 45 cases with good outcome).

Studying of the demographic data of both groups showed that most of cases 75 (68%) are males while females were only 35 (32%). Interestingly, most of females had good outcome in comparison with males (25 of 35 females (71%) & 20 only of 75 males (27%)). The mean age was 42.7 years with no statistically significant difference between the 2 groups. Men are more likely to sustain a TBI than women are, according to epidemiological studies, which consistently showed a higher prevalence in men [7, 8]. According to their gender, there were 32 male patients and 16 (33.3%) female patients in **Kayabas & Sahin** [9], (32.67%) were females and (67.33%) were males in **Hosomi *et l.*** [10], (64%) of patients were males and (36%) were females with mean age of 52.38 ± 1.65 years in a study by **Ragaee *et al.*** [11]. the gender distribution, with a higher percentage of males (61.1%) than females in **Prinosa *et al.*** [12]. **Mehmood *et al.*** [13] revealed that the majority of TBI patients were males (84.7%) and most were between the ages of 19 and 40 (67.5%). Patients' median ages were 39 and 80% of them were men in a study by **Gupta *et al.*** [14]. Previous studies using sizable samples (> 10,000 patients in various trauma centers) gathered from national registries and showing that males had a greater mortality rate following TBI in comparison to girls of the same age [15, 16]. This is in agreement with the results of our study. **Hosomi *et al.*** [10] found that even after controlling for factors including age, the severity of the injury, and medications, males still had a greater death risk than females across all age groups. Male mortality was higher than female mortality (12.2% vs. 18.2%), and the difference was statistically significant ($p<0.01$) in a study by **Saadat *et al.*** [17].

Multiple analyses of the impact of biological sex on the outcome of TBI have produced contradictory findings, possibly as a result of the clinical studies' relatively low representation of women and girls, the lack of data on hormonal status, and the vastly different outcome measures that were used for comparison, including return to work, bacteremia, and mortality [15]. But according to multiple other studies, women had a worse prognosis and a lower six-month survival rate than men do [18, 19]. Another study revealed that women's outcomes are worse for injuries of comparable severity [20]. A study by **Kayabas &Sahin** [9] gender did not find difference in a statistically significant way between the patient groups who died and those who survived. The overall patient death rate was 35.41%. **Gupte *et al.*** stated that TBI heterogeneity as well as variations in TBI severity and patient age, race, and physical condition could be responsible for these conflicting results [15]. Additionally, most studies that looked at sex differences in TBI-related mortality included cases of injuries to other body parts [21, 22].

The mean heart rate was higher (100 beat/min) in cases with bad outcome compared to 89 beat/min in cases with good outcome. The mean respiratory rate was higher (22 breath/min) in cases with bad outcome compared to 20 breath/min in cases with good outcome. Both mean systolic and diastolic blood pressure were lower in cases, which had bad outcome than in cases with good outcome. No variation was noticed in measured temperature in both groups. In individuals with TBI, blood pressure readings greater than 135 mmHg and less than 90 mmHg were linked to a bad prognosis. Higher death rates were linked to DBPs under 50 mmHg. Mortality rates increased for RRs greater than 25 breaths per minute and lower than 10 breaths per minute. Death rates in TBI patients were significantly impacted by heart rates between 70 and 120 beats per minute [17]. Hypotension following TBI is a substantial secondary insult that has been linked to unfavorable outcomes [23]. The results that were best were those with SBP levels between 135 mmHg and 90 mmHg. SBP levels were linked to both worse outcomes and better outcomes. The prevention of SBP of 90 mmHg is the main goal of the current guidelines for the management of BP in TBI. Dysautonomia, which is characterised by variations in PR and RR, is a result of traumatic brain damage (TBI). About 10% of individuals who survive with severe TBI develop dysautonomia, which is more likely to have a worse result [24]. A poor prognosis in TBI patients is linked to both an increase and a drop in RR outside of the normal range. Similar conclusions have been made about the link between HR and mortality in

TBI patients. Even after 12 hours following a serious head injury, heart rate variability may be a useful supplement for predicting a patient's prognosis and a sign of impending brain death [25].

No major variation in random blood sugar in both groups with only slight elevation in bad outcome group. Patients with head injuries did not frequently have admission random blood sugar (RBG) of less than 200 mg/dl, and there was no statistically significant relationship between admission RBG and both injury severity and discharge prognosis [26].

Some authors dispute the link between hyperglycemia and a bad prognosis in TBI and contend that elevated blood sugar levels are temporary and typically indicate a body's response to injury [27].

According to other researchers, patients with hyperglycemia had a worse prognosis and a direct correlation between the severity of a brain injury and admission plasma blood glucose levels [28, 29]. **Liu-DeRyke *et al.*** [30] shown that the strongest predictive value for predicting outcome is peak random blood sugar within the first twenty-four hours following injury and admission. In patients who have experienced a TBI, a high blood glucose level is a predictor of early mortality and a worse result [31, 32].

**Danisman *et al.*** [33] demonstrated that blood sugar levels of greater above 300 mg/dl are related to death. There is debate concerning the link between hyperglycemia and a worse result for TBI patients. According to several researchers, severely ill individuals with hyperglycemia typically have low Glasgow Coma Scale (GCS) scores, more comorbidities, and a worse prognosis. The likelihood of mortality, ICU stay, GCS arrival, hospital stay, and ISS can all be predicted by hyperglycemia [26, 31]. Stress brought on by catecholamine production can raise blood sugar levels after a severe TBI. In patients with TBI, hyperglycemia is a stress reaction and metabolic reflection that has been linked to increased ischemic brain damage, edoema, septic complications, cell death, and high mortality [26, 31].

## CONCLUSION

Tachycardia, tachypnea, hypotension and lower levels of oxygen saturation were evident in cases with bad outcome in sever TBI patients.

**Conflict of interest:** The authors of this research stated that there were no potential conflicts of interest associated with it.

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