Prognostic Factors Affecting Neurological Outcomes for Patients with Closed Traumatic Brain Injury

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Abstract

ABSTRACT: Traumatic brain injury (TBI) is a leading cause of morbidity and mortality worldwide. Due to its high incidence rate and often long-term sequelae, the TBI contributes significantly to increase costs of health care expenditures annually. Nurses' knowledge and practice play important roles in provision of supportive care to decrease TBI related morbidity and mortality**. Aim:** the aim of this study was to assess prognostic factors affecting neurological outcomes for patients with closed traumatic brain injury. **Study design:** Descriptive exploratory study. **Subject:** A purposive sample of 75 adult patients from both genders regardless their educational level admitted to neurological intensive care unit with moderate to severe closed traumatic brain injury (TBI) based on Glasgow coma scale assessment. Also, a convenient sample of all available nurses (30) working at neurological intensive care unit. **Setting** This study was carried out in neurological intensive care unit affiliated to Ain Shams University Hospitals, Cairo, Egypt. **Tools: (1)** Patients related factors tool, **Tools: (2)** Nurses related factors tool, **Tools: (3)** Intervention modalities related factors tool & **Tools: (4)** Neurological outcomes tools **Results:** advanced age (>=60), diagnosis with (Sub arachnoid, Intracerebral and Diffused brain injury), with odd ratio 4.428, 7.847 ,19.069 and 28.878 respectively as well as the presence of comorbidity with odd ratio 7.847 & CT brain results with odd ratio. 126,.144 and 2.818; are statistically significant predictors of poor prognosis and mortality. **Conclusion:** Advanced age (>=60), diagnosis with (Sub arachnoid, Intracerebral and Diffused brain injury), Presence of comorbidity & CT brain results, low mean arterial blood pressure, hyperthermia, hyperglycemia, elevated urea level, hyponatremia, hyperkalemia, acidosis, hypercapnia, hypoxia, mechanical ventilation, sedation, surgery and severe baseline GCS are statistically significant predictors of poor prognosis and mortality. **Recommendations:** Further studies are recommended to assess prognostic factors affecting neurological outcomes for patients with closed traumatic head injury.

Keywords: Prognostic Factors, Neurological Outcomes, Closed Traumatic Brain Injury

Introduction

Traumatic head injury (HI) is one of the major causes of disability, death and health related costs. Sixty-nine million individuals worldwide are estimated to sustain a TBI each year **(Dewan et al., 2018)**. It is unfortunate that Egypt occupies first place worldwide in the incidence of road accidents at a rate of 60 victims per day and that based on latest statistics carried out by the Egyptian Central Agency for Mobilization and Statistic Egyptian Central Agency 2016 **(Mohammad, 2018).**

Following the primary brain injury, metabolic and inflammatory alterations, oxidative stress and vasospasms trigger the secondary insult cascade, resulting in cerebral edema and intracranial hypertension **(Aytuluk & Topcu, 2020).** The severity of TBIs is typically categorized using the Glasgow Coma Scale and can range from: (a) mild; (b) moderate; to (c) severe. The TBI outcomes are often determined by using the Glasgow Outcome Scale, which categorizes gross neurobehavioral ranges of recovery: (a) dead; (b) vegetative state; (c) severe disability; (d) moderate disability; (e) good recovery **(Shehab et al., 2018).**

The primary goal in the management of TBI is to prevent a secondary insult by avoiding hypotension, hypoxia, intracranial hypertension and maintaining adequate cerebral blood flow. Cerebral edema causing increase intracranial pressure and can cause irreversible damage and, in some cases, be fatal. The primary goal of nursing management in traumatic head injury is to maintain adequate cerebral tissue perfusion. Nursing and medical management are overlapped, with the special focus on nurses' knowledge and practices. Intensive care unit (ICU) nurses are responsible

for the continuous monitoring and maintenance of physiological, psychosocial, injury prevention, and therapeutic environment values **(Aytuluk & Topcu, 2020).**

Intensive care unit (ICU) nurses are responsible for the continuous monitoring and maintenance of physiological values associated with traumatic head injury (THI). Therefore, nurses as health care team members are the best positioned to detect and prevent secondary brain injury. However, nurses vary in their practice, and little is known about how ICU nurses manage secondary brain injury. The importance of nursing team care in the specificity and complexity of the service provided to those patients, which characterize differentiated clinical conditions resulting from the severity of traumatic injuries. In neurological intensive care units, one of the main attributions of nursing routinely effected to the victims of TBI is the hemodynamic monitoring of the patient, with emphasis on the control of intracranial pressure and cerebral perfusion **(Oliveira, et al., 2018).**

Aim of the study:

The aim of this study was to assess prognostic factors affecting neurological outcomes for patients with closed traumatic brain injury through the following:

- Assess patients with closed traumatic brain injury related factors.
- Assess nurses' related factors regarding care for patients with closed traumatic brain injury.
- Assess interventional modalities related factors regarding care for patients with closed traumatic brain injury.
- Assess neurological outcomes for patients with closed traumatic brain injury.

Research questions:

In order to achieve the aim of this study, the following questions will be answered

1. What are patients with closed traumatic brain injury related factors?
2. What are nurses' related factors regarding care for patients with closed traumatic brain injury
3. What are interventional modalities related factors regarding care for patients with closed traumatic brain injury.
4. What are the neurological outcomes for patients with closed traumatic brain injury?

Subject and Methods

- **Study design**: Descriptive exploratory study.
- **Subject**: A purposive sample of 75 adult patients from both genders regardless their educational level admitted to neurological intensive care unit with moderate to severe closed traumatic brain injury (TBI) based on Glasgow coma scale assessment. Also, a convenient sample of all available nurses (30) working at neurological intensive care unit and willing to participate in the study.
- **Setting:** This study was carried out in Neurological intensive care unit affiliated to Ain Shams University Hospitals, Cairo, Egypt.

Tools applied

Tools were used by the researchers to collect the data for this study included:

Tool 1: **Patients related factors tool:** it consisted of two parts:

- 1st part concerned with demographic characteristics of patients. It included age and gender.
- 2nd part concerned with patients' medical data. It included medical diagnosis, co-morbid Factors, vital data, laboratory data (Arterial blood gases (ABG) parameters, serum electrolytes, renal and liver function), Glasgow coma scale and computed tomography (CT) result based on Marshall Classification of traumatic brain injury adopted from **Marshall et al., (1992)**.it was categorized as (diffuse injury I (no visible pathology), diffuse injury II, diffuse injury III (swelling), diffuse injury IV (shift), evacuated mass lesion V & non-evacuated mass lesion VI).

Tool 2: Nurses related factors tool, it consisted of three parts:

Part A: Demographic characteristics of nurses: it included the following (age, gender, educational level, previous training courses and years of experience).

Part B: Nurses knowledge assessment questionnaire: it was developed by the researchers based on review of recent related literatures **Baid, et al., (2016); Burns & Delgado, (2019**) to assess nurses' knowledge regarding care of patients with closed traumatic brain injury as: definition, causes, clinical manifestation, complication, diagnostic investigation and management (medical, surgical and nursing). It consisted of 30 closed ended questions. The correct

answer was given one grade, the incorrect answer was given zero, the total grade for the knowledge questionnaire was 30 grades. Then the mean of the total score for all nurses were calculated. The satisfactory level of knowledge was considered ≥ 90% when the total grades were ≥ 27 grades, while the unsatisfactory level of knowledge was considered < 90% when the total grades were <27grades.

Part C: Nurses' observational checklist: it was developed by the researchers based on the review of recent related literatures **Good & Kirkwood (2016); Booker (2015); Dutton & Finch (2018)** to assess nurses' practice regarding care of patients with closed traumatic brain injury: it included Glasgow coma scale assessment (three steps), patients positioning (five steps), medication administration (seven step), and measuring fluid balance (three step), measuring intracranial pressure ICP (15 step) & measuring central venous pressure CVP (20 step). It consisted of 53 steps. The step which was done correctly was given one grade, while the incorrect or not done step was given zero, the total grade for the practical check list was 53 grades, and the total scores for every nurse was calculated. Then the mean of the total score for all nurses were calculated. The satisfactory level of practice was considered ≥ 90% when the total grades were ≥ 47.7 grades, while the unsatisfactory level of knowledge was considered < 90% when the total grades were <47.7 grades.

Tool 3: Intervention modalities related factors tool: it was developed by the researches after reviewing the recent related literatures **Hill, (2020); Creed & Spiers (2020),** It included the following: position of patients (Head of bed at 30-degree), hyperosmolar therapy (Mannitol 20% and hypertonic saline 3%), sedation, mechanical ventilation and surgical intervention.

Tool 4: Neurological outcomes tools: It included the following:

A. Primary outcomes included the following

1. **Glasgow coma scale** adopted from **Advanced Trauma Life Support, 2018** (GCS score of ≤8 indicates severe head Injury, score of 9 to 12 indicates moderate head injury and GCS score of 13 to 15 indicates mild head Injury), it will be assessed on admission as (patients related factors) & at 2 weeks by the researchers.
2. **Karnofsky performance status Scale (KPS)** at 2 weeks (The Karnofsky Performance Scale Index adopted from **Altilio & Otis-Green, 1993; de Haan et al., 1993; O'Toole & Golden, 1991**. It is an assessment tool for functional impairment. It is used to assess the prognosis in most serious illnesses, the lower the Karnofsky score, the worse the likelihood of survival. treatment necessary and 10=Moribund; fatal processes progressing rapidly).

Karnofsky performance status Scale (KPS		
Condition	Value %	Level of functional capacity
Able to carry on normal activity and to work; no special care needed	100	No complaints; no evidence of disease
	90	Able to carry on normal activity; minor signs or symptoms of disease
	80	Normal activity with effort; some signs or symptoms of disease
Unable to work; able to live at home and care for most personal needs; varying amount of assistance needed	70	Cares for self; unable to carry on normal activity or to do active work
	60	Requires occasional assistance but is able to care for most personal needs
	50	Requires assistance and frequent medical care
Unable to care for self; requires equivalent of institutional or hospital care; diseases may be progressing rapidly	40	Disabled; requires special care and assistance
	30	Severely disabled; hospital admission indicated although death not imminent
	20	Very sick; hospital admission necessary; active supportive treatment necessary
	10	Moribund; fatal processes progressing rapidly
	0	Death

3. **Glasgow outcome scale (GOS) at 6 months** (Glasgow outcome scale is adopted from **Ward et al., 2017; McMillan et al., 2016; Jennett & Bond, 1975.** It is categorizing the outcomes of patients after traumatic brain injury as follows:

Glasgow outcome scale (GOS)	
1	Death
2	Persistent vegetative state: Minimal re sponsiveness
3	Severe disability: Conscious but disabled; dependent on others for daily support
4	Moderate disability: Disabled but independent; can work in sheltered setting
5	Good recovery: Resumption of normal life despite minor deficits

B. Secondary outcomes included the following (mortality rate, length of stay, complications as follow (decubitus ulcer (bedsore), pneumonia, deep venous thrombosis and/or pulmonary embolism, sepsis).

Validity and reliability: testing validity of the developed tools (Patients related factors tool, nurses related factors tool and intervention modalities related factors tool**)** were reviewed by a panel of five experts; three professors from critical care nursing staff at faculty of nursing Ain Shames University, Cairo, Egypt, one neurology physician (assistant professor) and one neurosurgery (lecturer) physicians at faculty of medicine Ain shames university, Cairo, Egypt to ascertain the tools face and content validity and relevancy. Testing reliability of the developed tools was done statistically by alpha-cronbach test was (0.8681) which indicate high reliability of the used tool.

Pilot study: the pilot study was carried out on 10% of the studied sample (3 nurses) and (8 patient) "who were later excluded from the study sample" to test the applicability, clarity and efficacy of the tools and to estimate the time needed for data collection. The research tools (Patients related factors tool, nurses related factors tool and intervention modalities related factors tool**)** were modified according to the results of the pilot study.

Protection of Human Rights: for ethical reasons, a primary permit was granted from the hospital director to apply this study. Also, at the initial interview, each nurse included in the study was informed about the aim of the study and its importance. The researchers emphasized that participation in the study is entirely voluntary. Anonymity and confidentiality were assured through coding the data. Oral approval consent was taken from each nurse who agreed to participate in the study; also, they were assured that they have the right to withdraw from the study at any time. As well as the obtained information will be used only for the purpose of the study. Regarding patients, the consent could not be taken as the patients were had deteriorated conscious level.

Field work:

Assessment phase:

Extensive reviewing of recent related literature and theoretical knowledge of various aspects of the study using books, articles, periodicals, magazines and internet was done to develop data collection tools.

Implementation phase:

Data collection for the studied patients and nurses took about 11 months started from December 2020 to October 2021, 3 days/ week during the morning and afternoon shifts; collecting data consumed long time due to pandemic SARS-CoV-2 (Covid- 19) and most of the ICUs were used as a quarantine unit. After following the quarantine universal precautions by the researches, they assessed the studied patients who fulfilled the selection criteria on admission, after 2 weeks in the hospital and after 6 months at out-patient clinics or by telephone. In order to fill out the study tools; **tool (1) (Patients related factors tool) part A** & **B** were collected on admission from the patients' medical records.

As for **tool 3: Intervention modalities related factors,** it was assessed by the researcher throughout the patient stayment during their care in the neurological intensive care unit. For patients outcomes, **tool 4: Neurological outcomes;** the **Glasgow coma scale (GCS)** and **Karnofsky status scale** were assessed by the researchers after 2 weeks of patient admission and after 6 month, **Glasgow outcome scale (GOS)** and secondary outcomes (mortality rate & complications) were assessed by the researchers during patients follow up in the outpatients clinics or by telephone for those who didn't comply to their follow-up.

Regarding the studied nurses, **tool (2): Nurses related factors, Part A** & **Part B;** they were given as a self-administered tool to assess nurses' demographic characteristics and level of knowledge regarding care of patients with closed traumatic brain injury and it took about 20

minutes for each nurse. As for studied nurses' level of practice assessment regarding care of patients with closed traumatic brain injury, the researcher observed those nurses during their routine care all over the shift using **tool (2) Part C** Nurses' observational checklist**.**

Statistical analysis:

The data analyses were carried out using Statistical Packages for Software Sciences (SPSS) version 21 Armonk, New York, IBM Corporation. Univariate logistic regression analysis was employed to determine the significant independent predictor associated with the outcome for patient with closed traumatic brain injury. The adjusted odds ratio (OR) and its 95% confidence interval (95% CI) were reported along with the p-value. A two-sided significance level of 0.05 was used to indicate statistical significance. Qualitative categorical variables are described by percentage and proportions.

Results

Table 1 clarified that, 38.7% of the studied patients their age ranged from 18 to 40 years old and 32% of them were ≥ 60 years old. Regarding their gender, 58.7% of them were males.

Table 2 showed that, 24% of the studied patients had subarachnoid hemorrhage and 14.7% of them had diffused brain injury. As for co-morbid diseases among the studied patients, 24.0% of them were hypertensive. In relation to CT brain results, the current result revealed that, 30.7% of the patients had diffused injuries IV.

Continue Table (2) revealed that, 22.7% of the studied patients had low mean arterial blood pressure and 17.3% of them had hyperthermia, while 81.3% of the patients had normal blood glucose level and 90.7% had normal Potassium level.

As for interventional modalities, **Table (3)** illustrated that, 38.7% of the patients were placed at 30-degree position, 46.7% of them received Mannitol therapy and 60% of them were on a mechanical ventilation.

Regarding demographic characteristics of the studied nurses, **Table 4** showed that 50% of the nurses, their ages ranged from 30 to less than 40 years old and 86.7% of them were females. In addition to 40% of the studied nurses were diploma and 63.3% of them had an experience more than 5 years. Moreover, none of the studied nurses received training courses regarding care of patients with TBI.

Figure 1 showed that, 56.7% of the studied nurses had satisfactory level of knowledge and 43.3% of them had satisfactory level of practice regarding care of patients with closed traumatic brain injury.

Table (5) reflected that **(62.7%)** of the studied patients had severe GCS on admission and 42.7% of them had severe GCS after 2 weeks. As for Karnosky scale, it was found that **22.7%** of the studied patients were very sick needs hospital admission necessary and only 2.7% of them died after 2 weeks from admission. In addition to, 24.0% of the studied patients had moderate disability and 22.7% of them died after 6 months.

Regarding the complication for the studied patients **Table (6)** Revealed that 86.7% of the studied patients had length of stay more than 2 weeks, 30.7% of them had sepsis as a secondary complication and 25.3% had died.

By testing the patients related factors as a prognostic factor for patients with closed traumatic head injury, **Table (7)** showed that advanced age ((>=60), diagnosis with (Sub arachnoid, Intracerebral and Diffused brain injury), with odd ratio 4.428, 7.847 ,19.069 and 28.878 respectively as well as the presence of comorbidity with odd ratio 7.847 & CT brain results with odd ratio .126,.144 and 2.818; are statistically significant predictors of poor prognosis and mortality.

It was obvious from continued **Table (7)** that low mean arterial blood pressure, hyperthermia, hyperglycemia, elevated urea level, hyponatremia, hyperkalemia, acidosis, hypercapnia, hypoxia, mechanical ventilation, sedation, surgery and severe baseline GCS are statistically significant predictors of poor prognosis and mortality with odd ratio 3.717, 10.756, 8.218, 16.000, 14.184, 14.184, 16.000, 18.959, 4.000, 3.552, 6.612,.172 and 2.818 respectively.

Table no.1: Frequency distribution of Demographic characteristics of the studied patients (n=75).

Demographic characteristics		No	%
Age	18-<40	29	38.7
	40-<60	22	29.3
	>=60	24	32.0
Gender	Male	44	58.7
	Female	31	41.3

Table no.2: Frequency distribution of medical data of the studied patients (n=75).

Medical data			No	%
Diagnosis		Extradural	22	29.3
		Subdural	12	16.0
		Sub arachnoid	18	24.0
		Intracerebral	12	16.0
		Diffused brain injury	11	14.7
Comorbidity	**Diabetes Mellitus**	Yes	15	20.0
	Hypertension	Yes	18	24.0
	Chronic Obstructive Pulmonary Disease	Yes	4	5.3
	Liver disease	Yes	1	1.3
	Renal impairment	Yes	6	8.0
CT brain results		Diffused injuries I	10	13.3
		Diffused injuries II	21	28.0
		Diffused injuries III swelling	21	28.0
		Diffused injuries IV shift	23	30.7
MAB		Normal	47	62.7
		Low	17	22.7
		High	11	14.7
Body temperature		Normal	58	77.3
		Hypothermia	4	5.3
		Hyperthermia	13	17.3
Blood glucose		Normal	61	81.3
		Hypoglycemic	6	8.0
		Hyperglycemic	8	10.7
Urea		Normal	69	92.0
		Abnormal	6	8.0
Ammonia		Normal	74	98.7
		Abnormal	1	1.3
Na		Normal	68	90.7
		Hypo	1	1.3
		Hyper	6	8.0
K		Normal	68	90.7
		Hypo	1	1.3
		Hyper	6	8.0
Ph		Normal	59	78.7
		Acidosis	16	21.3
Co_2		Normal	65	86.7
		Low	6	8.0
		High	4	5.3
O_2		Normal	53	70.7
		Abnormal	22	29.3

Table no.3: Frequency distribution of the interventional modalities related factors (n=75).

Interventional modalities		N	%
Position at 30 degrees	Yes	29	38.7
	No	46	61.3
Hyper osmolar therapy	No	8	10.7
	Mannitol	35	46.7
	Hypertonic saline	32	42.7
Mechanical ventilation	No	30	40.0
	Yes	45	60.0
Sedation	No	37	49.3
	Yes	38	50.7
Surgery	No	41	54.7
	Yes	34	45.3

Table no.4: Frequency and percentage distribution of demographic characteristics of the studied nurses (n=30).

Demographic characteristics	N (30)	%
Age (Years)		
18< 30	12	40
30 <40	15	50
40≤60	3	10
Mean ± SD 31±8.6		
Gender		
Male	4	13.3
Female	26	86.7
Education		
Diploma nurse	12	40
High institute nurse	8	26.7
Bachelor nurse	10	33.3
Training courses		
Yes	0	0
No	30	100
Years of experience		
< 5	11	36.7
≥ 5	19	63.3

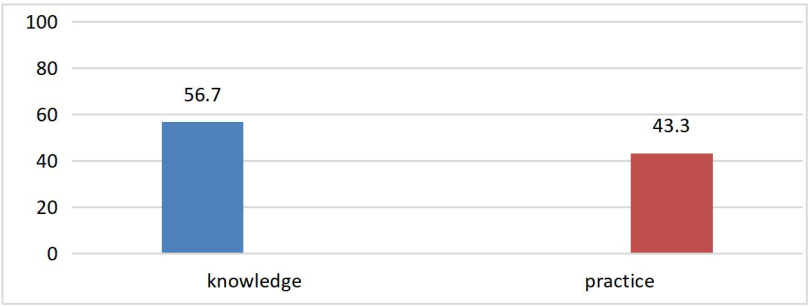

Figure (1): Percentage distribution of satisfactory level of total nurses' knowledge and practice regarding care of patients with closed Traumatic Brain Injury (n=30).

Table (5): Frequency distribution of primary neurological outcomes the studied patients (n=75)

Glasgow coma scale (GCS)				
	GCS on admission		**GCS after 2 weeks**	
	No	%	No	%
Mild	0	0.0	20	26.7
Moderate	28	37.3	23	30.7
Severe	47	**62.7**	32	**42.7**
Karnofsky after 2 weeks				
	No		%	
Able to carry on normal activity	5		6.7	
Normal activity with effort	7		9.3	
unable to carry on normal activity	6		8.0	
Requires occasional assistance	7		9.3	
Requires considerable assistance	8		10.7	
Disabled; requires special care	5		6.7	
Severely disabled	6		8.0	
Very sick; hospital admission necessary	17		**22.7**	
fatal processes progressing rapidly	12		**16.0**	
Death	2		2.7	
Glasgow outcome scale (GOS) at 6 months				
	No		%	
Good recovery	15		20.0	
Moderate disability	18		**24.0**	
Severe disability	13		17.3	
Persistent vegetative state	12		16	
Death	17		**22.7**	

Table (6): Frequency distribution of secondary neurological outcomes of the studied patients (n=75)

Secondary neurological outcomes		N	%
Length of hospital stay	< 2 weeks	10	13.3%
	> 2 weeks	65	**86.7%**
Complications	No	14	18.7%
	Ulcer	4	5.3%
	Pneumonia	19	25.3%
	DVT	8	10.7%
	Pulmonary embolism	7	9.3%
	Sepsis	23	**30.7%**
Mortality	No	56	74.7%
	Yes	19	**25.3%**

Table no.7: Univariate logistic regression analysis for poor prognosis and mortality

	B	P value	Odds ratio	95% C.I. for odds ratio	
				Lower	Upper
Age					
Age (40-<60)	.978	.096	2.658	.841	8.402
Age (>=60)	1.488	.012	4.428	1.395	14.059
Diagnosis					
Extradural	.208	.578	.813	.391	1.689
Subdural	.751	.406	2.118	.360	12.460
Sub arachnoid	2.060	.008	7.847	1.732	35.543
Intracerebral	2.948	.001	19.069	3.205	113.441
Diffused brain injury	3.363	.001	28.878	4.163	200.325
Presence of comorbidity	2.050	.007	7.847	1.732	35.543
CT brain results					
Diffused injuries II	-2.073	.004	.126	.031	.506
Diffused injuries III swelling	-1.937	.007	.144	.035	.591
Diffused injuries IV shift	1.036	.030	2.818	1.105	7.183
Mean arterial blood pressure (MAB)					
Low	1.313	.030	3.717	1.132	12.204
High	.586	.286	1.797	.612	5.278
Body temperature					
Hypothermia	1.839	.016	6.293	1.405	28.196
Hyperthermia	2.375	.000	10.756	2.908	39.775
Blood glucose					
Hypoglycemia	1.007	.159	2.739	.674	11.122
Hyperglycemia	2.106	.003	8.218	2.029	33.290
Abnormal urea level	2.773	.000	16.000	5.160	49.609
Na					
Hyponatremia	2.652	.005	14.184	2.241	89.790
Hypernatremia	1.797	.082	6.032	.796	45.727
K					
Hypokalemia	1.797	.082	6.032	.796	45.727
Hyperkalemia	2.652	.005	14.184	2.241	89.790
Ph (acidosis)	2.773	.000	16.000	5.160	49.609
CO2					
Low	.835	.300	2.305	.476	11.172
High	2.942	.001	18.959	3.403	105.632
Hypoxia	1.386	.005	4.000	1.531	10.449
Position at 30 degrees	.267	.564	1.306	.527	3.236
Hyper osmolar therapy					
Mannitol	.143	.847	1.153	.270	4.920
Hypertonic saline	.871	.246	2.390	.549	10.406
Mechanical ventilation	1.267	.009	3.552	1.372	9.194
Sedation	1.889	.000	6.612	2.413	18.120
Surgery	-1.758	.001	.172	.064	.466
Severe baseline GCS	1.036	.030	2.818	1.105	7.183

Discussion

Traumatic brain injury (TBI) is a major health problem in the world and a main cause of morbidity and mortality in young populations. Prognostic assessment in TBI is entrenched deeply in clinical care **(Chen et al., 2021).** The purpose of this study was to assess prognostic factors affecting neurological outcomes of patients with closed traumatic brain injury.

Regarding the demographic characteristics of the patients in the present study, this result revealed that more than one third of the studied patients their age ranged from 18 to 40 years old. It may be due to the proportion of young adult persons more liable to traumatic head injury due to work. This result This is contradicted with **Lan et al., (2020),** who found that 49% of the studied sample their age ranged between 30-49 years old.

Regarding the gender of studied patients, the existing study result exposed that, more than half of the patients were male, the incidence of trauma is higher in men than in women because males who are the responsible family income. This result is in agreement with **Turgeon et al. (2017)** in study entitled "Prognostication in critically ill patients with severe traumatic brain injury: the TBI-Prognosis multicenter feasibility study" and found that, most patients were male (80%).

In relation to comorbid disease associated with traumatic head injury the current studied revealed that one fifth of the studied patients had diabetes mellites. This result is similar to **Lenell et al., (2019)** in a study entitled " Clinical outcome and prognostic factors in elderly traumatic brain injury patients receiving neuro intensive care" and found that 16 % of the studied patients had DM.

Regarding CT brain results, the current result reveals that, 28% of the patients had diffused injuries II, this result goes in the same line with **Lenell et al., (2019)** who found that about one third of the studied sample had diffused injuries II in a study aimed to examine outcome in a larger group of elderly TBI patients receiving NIC and to identify demographic and treatment related prognostic factors. In relation mean arterial blood pressure, the result showed that more than one fifth of the studied patients had hypotension and more than one quarter of them had hypoxia these results may be due to the effect of brain injury. These results are similar to **Gómez et al., (2018)** who found that, more than one quarter and one third of studied patients had hypoxia and hypotension respectively, in a study entitled " Final outcome trends in severe traumatic brain injury: a 25-year analysis of single center data"

According interventional modalities of TBI, the current study shows that, more than two fifths of the studied patients were treated surgically, this result is similar to **Prasad et al., (2018)** in a study entitled "Outcome of traumatic brain injury in the elderly population: a tertiary center experience in a developing country" and found that one quarter of the patients were underwent surgery.

Regarding demographic characteristics of the nurses, the current study revealed that, two fifths of the studied nurses their age were less than 30 years old. This may be due to the newly graduated nurses are assigned to work in critical care settings also, most of the studied nurses were female. This may be due to nursing education for males start recently. This goes in the same line with **Shehab et al., (2018)** results who found that most nurses were females and more than two thirds of them had 20-30 years old. As regard to years of experience, this study showed that about two thirds of the studied sample had more than five years of experience and all of them hadn't attend any training courses regarding care of patients with traumatic brain injury, This result is in accordance with **Oyesanya, and Snedden, (2018)** who revealed that, about one third of the studied nurses had more than six years of experiences in a study entitled " Pediatric nurses' perceived knowledge and beliefs of evidence-based practice in the care of children and adolescents with moderate-to-severe traumatic brain injury".

In relation nurses' knowledge regarding care of patients with traumatic brain injury the current study showed that, more than half of the studied nurses has satisfactory level of total knowledge, this result may be due the years of experience of the studied nurses were more than five years which reflected on their knowledge. This result is in contradicted with **Ahmed et al., (2017)** who revealed that, less than one third of the studied nurses had satisfactory total knowledge regarding trauma

patients during golden hour. According nurses' practices, the result revealed that, more than two fifths of them had satisfactory level of total practice, this may be due to the majority of them were diploma nurse. This result is not consistent with **Shehab et al., (2018)** who found that, nurse's level of practice in caring of traumatic brain injury patients was unsatisfactory before the implementation of the program.

As regard primary neurological outcomes of the studied patients, the result showed that, about two thirds of the studied patients had severe GCS on admission and two fifths of them had severe GCS after 2 weeks. This prognosis may be due to the effect of interventional modalities on brain injury. This is in agreement with **Khan et al., (2018),** who found that, more than three quarters of the studied patients had severe GCS on admission in a study entitled " Factors affecting functional outcome after decompressive craniectomy performed for traumatic brain injury: a retrospective, cross-sectional study".

Concerning the Glasgow outcomes scale at 6 months, the current result showed that, one fifth of them had good recovery, about one quarter of the studied patients had moderate disability and more than one fifth of them died after 6 months. This poor prognostic events may be due to the complications of traumatic brain injury This result goes in the same line with **Lenell et al., (2019)** who found that, 18% of the studied patients were good recovery 17% of them died.

In relation secondary neurological outcomes of the studied patients, the current study revealed that, about one third of the studied patients had sepsis as complication of traumatic brain injury, this may be associated with the co-morbid disease. This result is in disagreement with **Shepetovsky et al., (2021)** who found that 10% of patients had infection associated with persistent fever, raised inflammatory parameters, and/or local swelling or pus. Regarding mortality as a secondary outcome of TBI, it was found that more than one quarter of the studied patients died, this may be associated with co-morbid disease also post trauma complications. The result is similar to **Lenstra et al., (2021)** who found that inpatient mortality was 30% in a study entitled " The association of early electrocardiographic abnormalities with brain injury severity and outcome in severe traumatic brain injury"

Considering the prognostic factor for patients with closed traumatic head injury, the result showed that, the advanced age (>=60), diagnosis with (sub arachnoid, intracerebral and diffused brain injury), presence of comorbidity & CT brain results are statistically significant predictors of poor prognosis and mortality. These results explain the poor effect of aging, severity of trauma and co-morbidity that may lead to poor prognosis and increase mortality rate. These results go in the same line with **Chen et al., (2021),** who used univariate logistic regression analysis, which revealed statistically significant variables related patients' age, age ≥65 years, comorbidities, and incidence of necessary brain surgery.

Using univariate logistic regression analysis, the researchers identified the following statistically significant variables: mean arterial blood pressure, hyperthermia, hyperglycemia, elevated urea level, hyponatremia, hyperkalemia, acidosis, hypercapnia, hypoxia, mechanical ventilation, sedation, surgery and severe baseline GCS which are considered predictors of poor prognosis and mortality. These results are similar to **Chen et al., (2021) & Zhao et al., (2019),** who found that, there were statistically significance variables which had an effect on patient's prognosis.

Conclusion

Advanced age (>=60), diagnosis with (Subarachnoid, Intracerebral and Diffused brain injury), Presence of comorbidity & CT brain results, low mean arterial blood pressure, hyperthermia, hyperglycemia, elevated urea level, hyponatremia, hyperkalemia, acidosis, hypercapnia, hypoxia, mechanical ventilation, sedation, surgery and severe baseline GCS are statistically significant predictors of poor prognosis and mortality. More than half of the studied nurses had satisfactory level of knowledge and more than one third of them had satisfactory level of practice regarding care of patients with closed traumatic brain injury.

Recommendation

- Further studies are recommended to assess prognostic factors affecting neurological outcomes for patients with closed traumatic head injury.

- In-service training courses should be provided to nursing staff working in the neurological intensive care unit in order to keep them of updating knowledge and practice regarding care of patients with closed traumatic brain injury.

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