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BIOLIFE RESEARCH ARTICLE

Identification of clinical and radiological predictors of outcome in head trauma patients in the emergency department

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ABSTRACT

The purpose of this investigation was to identify the clinical and radiological predictors of outcome including (age, GCS, RTS, GAP, CT finding, systemic injuries, mode of trauma and pupil reactivity) in patients with isolated head trauma presented to the Emergency Department at Alexandria Main University Hospital. Mortality rate is higher in older age group above of 60 (83%) it was highly significant (<0.001*). In patients having only tSAH (34% of total), 75 patients (62.5%) had poor outcome. patients had a GCS score 8 or less (72.72%) had GOS V score. Mortality rate is higher in patients with both dilated pupils (70%). There is a highly significant relation between hypotension and the outcome (p=<0.001*), 20%of patients were hypotensive when they presented in casualty, (78.5%) of them had poor prognosis. 81.25% of patients who had hypoxia at the time of presentation had unfavorable outcome. GAP and RTS score were high significantly associated with adverse outcome both of them with p value (<0.001*).

Keywords: *Traumatic brain injury, outcome, prediction.*

INTRODUCTION

Trauma is one of the leading causes of morbidity and mortality in young people across the world. (Bajracharya A et al, 2010) According to the World Health Organization (WHO), injuries kill 5 million people each year. Road traffic injuries claimed nearly 3,500 lives each day in 2011-about 700 more than in the year 2000-making it among the top 10 leading causes of death globally in 2011(Health Organization, 2013). In 2004, road traffic injuries were the ninth leading cause of death. However, with the trends of urbanization and motorization, road traffic injuries have increased dramatically worldwide and are now expected to become the fifth leading cause of death. Traumatic brain injury (TBI) is a major cause of disability and death affecting people during the most productive period of their lives. Every year, about 1.5 million affected people die and several millions receive emergency treatment.1 2 Most of the burden (90%) is in low and middle income countries. (Deepak Agrawal et al, 2011).

Traumatic Brain Injury can have a significant impact on social, physical and psychological functioning and may affect cognitive. They can vary from being quite severe or to being quite mild depending on the amount of damage. TBI usually results from accidents or from a blow to the head.

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Gunshot wounds can cause head injuries when the bullet penetrates the skull and enters your brain. This can damage the blood vessels and cause bleeding.

Vehicle accidents are common causes of traumatic head injuries. You may strike your head on the windshield, dashboard, or steering wheel. This can lead to open or closed brain injuries. You may also get a concussion or scalp injury in a vehicle accident. Violent shaking is a common cause of brain trauma in infants and young children. When a child is shaken, the brain violently strikes the skull. This produces swelling and bleeding in its tissue. Shaken baby syndrome can cause severe brain injury.

Falling and hitting your head can damage the skull, scalp, or brain. Falls may cause any type of head injury. Assault can lead to a head injury. Being kicked, punched, or struck in the head can cause a concussion, closed or open brain injury. Damage varies with the force of the assault.(Lee Macon and Elizabeth Boskey, 2012)

Traumatic brain injury (TBI) is a heterogeneous condition that comprises a broad spectrum of disorder. Accurate and early prognosis is important as it enables improved patient and relative counseling, outcome, prioritized rehabilitation goals and rationalized allocation of healthcare resources.
Multivariable analysis has identified age, clinical severity, computed tomography (CT), systemic insults (hypoxia and hypotension), pupil reactivity, GCS, RTS and GAP as predictors of outcome in individual patients.

Age is one of the strongest predictors of mortality and functional outcome which found that older age is associated with poorer outcome (Reeder KP et al; 1996). There is an association between a low score on the GCS and poorer outcome (Udekwu P et al; 2004).

The RTS provides a scored assessment of the physiology of the individual based upon the values in three indicators; respiratory rate, blood pressure and the GCS, values may range from 0 to 12(most affected to least affected).(Stocchetti N et al;2004)
The RTS correlates well with the probability of survival. It also used for assessing prognosis if the RTS on arrival is compared to the best RTS after resuscitation.

The new simple trauma scoring system, the GAP scoring system, strongly predicts in- hospital mortality, it will lead to improve survival of trauma patients. (Champion HR, et al;1989)

Abnormalities in papillary reactivity indicate brain stem damage or compression and are strongly associated with poorer outcome. An injured brain is more vulnerable to systemic secondary insult (hypoxia and hypotension) than in a normal healthy brain.
About the structural abnormalities, the prognostic value of CT characteristics has been well documented. Evidence of subarachnoid hemorrhage has clear residual associations with GOS. Both evidence of midline shift and presence of a subdural hematoma are strongly associated with adverse GOS on univariate analysis. A common Glasgow outcome scale (GOS) was used to compare the outcome. Many variables were analyzed to predict prognosis, using GOS as dependent variable.

PATIENTS AND METHODS

This study will be conducted on all patients subjected to isolated head trauma and presenting to the Emergency Department at Alexandria Main University Hospital over a study period of 3 consecutive months from June to September 2014.

Study design:

Retrospective study will be conducted to collect data that include all isolated head injury who attended emergency department (ED) of Alexandria Main university hospital June to September 2014.

Tools of data collection:

Files of patients in emergency department (ED) of Alexandria Main University hospital during their attendance in the year 2013 were included in the study.

All individuals in this study were subjected to the following:

1. **History taking:**
   - Age.
   - Sex.
   - Mechanism of trauma.

2. **Clinical examination:**
   A. Primary survey including:
   - Airway.
   - Breathing.
   - Circulation.
   - Disability: Glasgow coma scale (GCS)
   - Exposure of the patient to detect other injuries.

   B. Secondary survey:
   - Full clinical examination of all body.
   - GAP score on admission after primary respiratory and hemodynamic stabilization
   - GCS on admission after primary respiratory and hemodynamic stabilization

- Revised trauma score on admission after primary respiratory and hemodynamic stabilization.

3. Radiological investigations:
Multislice CT brain.

4. Outcome evaluation
Using the following GOS score (Jennett B, Bond M ;1975) on discharge of the patients:

Glasgow outcome Scale (GOS), is a global scale for functional outcome that rates patient status into one of five categories: Dead, Vegetative State, Severe Disability, Moderate Disability or Good Recovery.

RESULTS

Throughout 3 months, 350 patients were included in the study.

Unfavorable outcome had statistic high significant (p value(<0.001*)) relationship with age of the patient.83% in patients above of 60.77% of patients with age above than 60 years had adverse outcome which was much higher than 20%in below 20 year age group and 35.6% in patients between middle age.

Table-1. Distribution of the studied cases according to demographic characteristics and mechanism of trauma

Variable	Number (%)
Sex	
Male	280 (80%)
Female	70 (20%)
Age	
>20	30 (8.57%)
20–40	245 (70%)
40-60	45 (12%)
60-80	30 (8.5%)
Mechanism of trauma	
ATR	
IlaF	270 (77%)
tluassA	
	50 (14%)
	30 (8.5%)
Total	**220**

In patients EDH (22.85% of total), only 35 patients (43.75%) had poor outcome. In patients having cerebral edema and midline shift (25.71% of total), 30 patient (50%) had poor outcome. In patients having only tSAH (34% of total), 75 patients (62.5%) had poor outcome. In patients having SDH (25% of total), 40 patients (44.44%) had poor outcome.

Table-2. Relation between age and outcome of head trauma

Prognostic factor	Subgroup	no	GOS					((	p	% of UO
			I (n =85)	II (n =50)	III (n = 40)	IV (n = 0)	V (n = 175)			
Age	<20	30	15			0	10	-	-	20
	20-40	245	100	5	20	-	80	-	-	32.6
	40-60	45	10	45		-	35	-	-	77.7
	60-80	30	5				25			83

Table-3. Relation between CT scan findings and outcome of the patients

			GOS					((	p	% of UO
			I (n =70	II (n =60)	III (n =30)	IV (n =10)	V (n =180)			
CT Finding	Midline shift	60	10	10		10	30	54.981*	<0.001*	50%
	EDH	80	20	15	10		35	8.501	0.075	43.75%
	SDH	90	10	20	20		40	37.559*	<0.001*	44.44%
	SAH	120	30	15			75	29.801*	<0.001*	62.5%
(((MCp)			98.804* (<0.001*)							

Table-4. Relation between GCS score and outcome of head trauma

			GOS						MCp	%of UO
			I (n =120	II (n =50	III (n =5	IV (n =10	V (n =165			
GCS	Mild (13-15)	170	80	40			50	71.712*	<0.001*	29.41%
	Moderate (9-12)	70	20	10	5		35	23.485*	0.001*	50%
	Severe (3-8)	110	20			10	80	81.434*	<0.001*	72.72%

Table-5. Relation between pupillary reflex and outcome of head trauma

			GOS						P	%of UO
			I (n =170)	II (n =0)	III (n =0)	IV (n =30)	V (n =150)			
Pupil reactivity	Bil reactive	200	140				-			31
	Bilnon reactive	100				30	70	102.118*	<0.001*	70%
	Unil reactive	50	30				20			40%
								167.067*	<0.001*	
								6.680*	0.035*	
	(p)			168.824* (<0.001*)						

Table-6. Relation between hypotension and outcome of head trauma

			GOS						MCP	%of UO
			I (n =215)	II (n =5)	III (n =0)	IV (n =20)	V (n = 110)			
Hypotension	Present	70	15				55	52.828*	<0.001*	78.5%
	absent	280	190			20	70			25%

Table-7. Relation between hypoxia and outcome of head trauma

			GOS						MCP	%of UO
			I (n =85)	II (n =80)	III (n =0)	IV (n =10)	V (n =175)			
Hypoxia	Present	80	5			10	65	91.599*	<0.001*	81.25%
	absent	270	80	80			110			40.74%

Table-8. Distribution of the studied cases according to GAP score

			GOS						MCP	%of UO
			I (n =185)	II (n =42	III (n =5)	IV (n =0)	V (n =118)			
GAP score	Mild (19-24)	180	140	22			18	110.667*	<0.001*	10%
	Moderate(11-18)	70	25	10	5		30	27.469*	<0.001*	42%
	Severe(3-10)	100	20	10			70	85.736	<0.001*	70%

Figure-1. Relation between age and poor outcome of head trauma

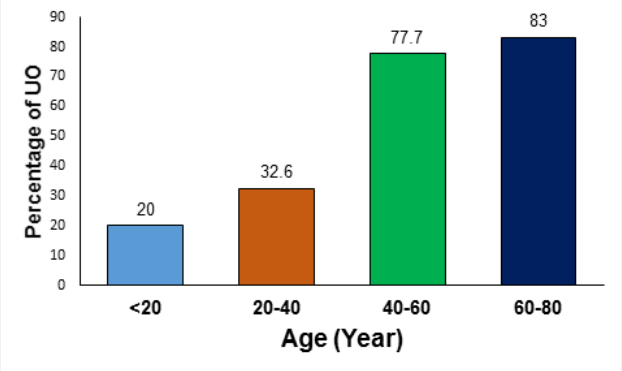


Figure-2. Relation between CT scan findings and poor outcome of the patients

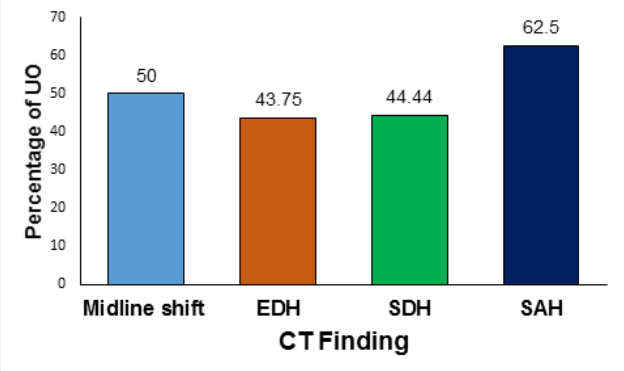


Figure-3. Relation between GCS score and poor outcome of head trauma

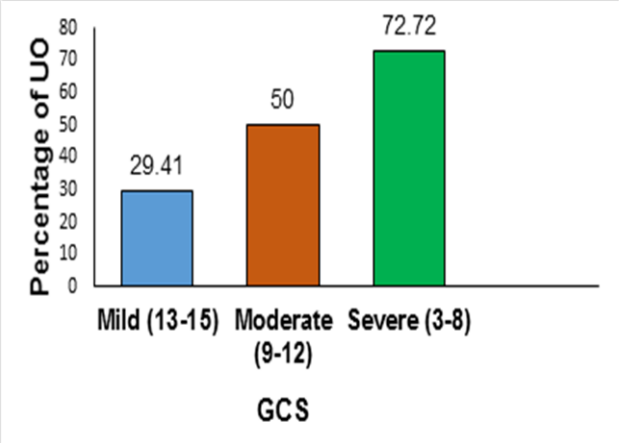


Figure-4. Relation between pupillary reflex and poor outcome of head trauma

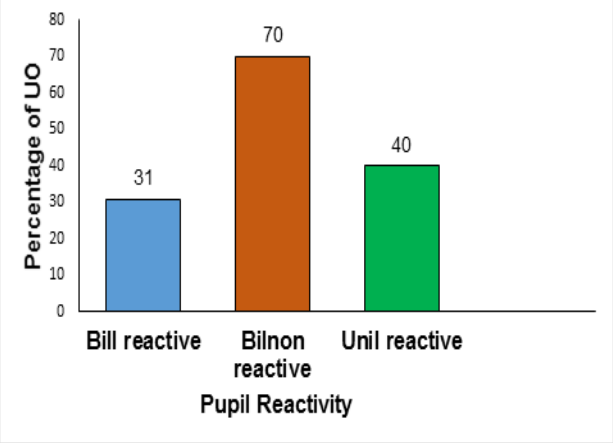


Figure-5. Relation between hypotension and poor outcome of head trauma

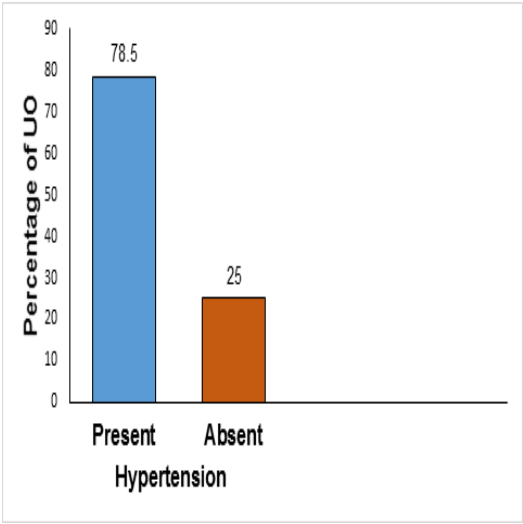


Figure-6. Relation between hypoxia and poor outcome of head trauma

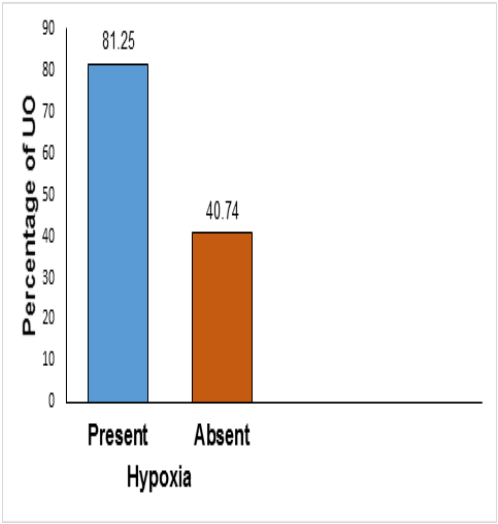


Figure-7. Relation between GAP score and poor outcome of head trauma

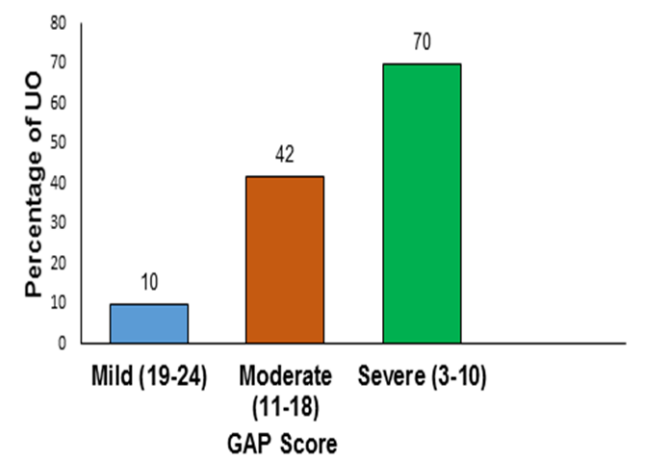
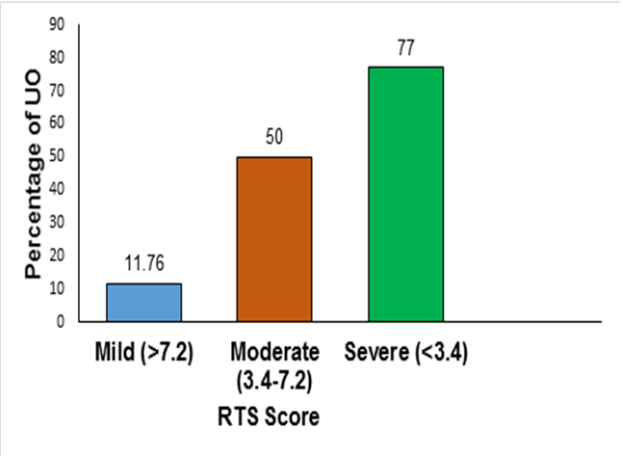


Figure-8. Relation between RTS score and poor outcome of head trauma



In this study, the mean GCS score was 10.61 .110 patients had a GCS score 8 or less (31.42%). 80of those patients (72.72%) had GOS V score. 70patientshad GCS score 9-12 (20%), and 35 of them had GOS V score (50%). 170 patients had GCS score 13 or 15 (48.57%) and 50 of them had GOS V score (29.41%).

Normal papillary reflex was associated with good outcome. Unfavorable outcome was found in 70% in patients with both dilated pupils and 40% in patients with anisocoria. Thus association of abnormal papillary reflex with adverse unfavorable outcome was statistically highly significant p value <0.001).

There is a highly significant relation between hypotension and the outcome (p=<0.001*).

20%of patients were hypotensive when they presented in casualty, (78.5%) of them had poor prognosis .While in patients who had normal blood pressure (80%) only 25% had poor prognosis

81.25% of patients who had hypoxia at the time of presentation had unfavorable outcome, as compared to 40.74% in non-hypoxic patients. So hypoxia was significantly associated with adverse outcome with p value <0.001.

180 patients had a GAP score 19-24 (51.42%). 18 of those patients (10%) had GOS V score. 70 patients had GCS score 11- 18 (20%), and 30 of

them had GOS V score (42.85%). 100 patients had GCS score 3-10 (28.57%) and 70 of them had GOS V score (70%). So GAP score was significantly associated with adverse outcome with p value (<0.001*).

170 patients had a RTS score (>7.2) (48.57%). 20 of those patients (11.76%) had GOS V score. 70 patients had GCS score (3.4-7.2) (20%), and 35 of them had GOS V score (50%). 110 patients had RTS score (<3.4) (31.42%) and 85 of them had GOS V score (77.27%). So RTS score was significantly associated with adverse outcome with p value <0.001*

DISCUSSION

The present study was conducted on 350 patients subjected to head trauma and presenting to the Emergency Department at Alexandria University Hospital within 24 h after trauma.

Regarding age, this study showed that the young adult group in the third decade of life was the most age group affected (71%) and mean age of 38 years. This was in agreement with the study done by (Moamena El-Matbouly;2013) Traumatic Brain Injury in Qatar: Age Matters—Insights from a 4-Year Observational Study This was a retrospective review of all TBIs admitted to the trauma TBI was incidentally higher among adults (21–30 yrs, 34%) and middle age group (31–40, 21%).

The possible explanation for the higher frequency of head injury in youth is that the second and third decades of human life are the most active decades in life and thus people in these decades are vulnerable to trauma.

In this study Unfavorable outcome had statistic high significant (p value(<0.001*)) relationship with age of the patient.71% of patients with age above than 40 years had adverse outcome which was much higher than 16%in below 18 year age group and 34% in patients between age group 5-19years.

This was in agreement with the study done by Hukkelhoven CW et al (2003). Patient age and outcome following severe traumatic brain injury: an analysis of 5600 patients.

Proportions of mortality and unfavorable outcome increased with age: 21 and 39%, respectively, for patients younger than 35 years and 52 and 74%, respectively, for patients older than 55 years. Regarding sex, this study revealed that males (80%) were involved in head trauma more than females. Between death/vegetative state and conscious survivalgroups, gender did not significantly differ (p=0.553). This was in agreement with the study done by (London School of Hygiene, 2008),

Predicting outcome after traumatic brain injury:

Practical prognostic models based on large cohort of international patients: More of the patients were men (81%).

This male predominance is probably due to higher physical activity by men and also because men are more involved in outdoor activities and traffic accidents and also they are more prone to violence and assault. This may also be attributed to the fact that the females, most often, are confined to house work and they drive vehicles less frequently and more carefully than males.

Motor vehicle accident was the most common cause of head trauma, which contributed to 71% of the total. Mode of injury whether road traffic accident, history of fall or assault did not affect the outcome of head trauma.

This is in agreement with study (Agrawal A et al; 2014) Characteristics of patients who died from traumatic brain injury in two rural hospital emergency departments in Maharashtra, India, 2007-2009. Persons working near or along busy roads struck by vehicles accounted for 80.9% of all TBI cases.

Regarding CT finding, The prognostic value of CT characteristics has been well documented, in this study there is a high significant relation between CT finding and outcome of head injury p value (=<0.001*).

This is in agreement with the study done by (Gupta Prashant K1 et al; 2011) CT Scan Findings and Outcomes of Head Injury Patients: A Cross-Sectional Study: CT scan has detected and precisely localized the parenchymal damage of brain and effectively predicted the functional outcome.

In this study in patients having only cerebral edema and midline shift (25.71% of total), 30 patient (50%) had poor outcome. In patients having tSAH (34% of total), 75 patients (62.5%) had poor outcome. In patients having SDH (25% of total), 40 patients (44.44%) had poor outcome in all of them (p value =<0.001*), In patients EDH (22.85% of total), only 35 patients (43.75%) had poor outcome (p=<0.075) and this in agreement with(George K. C et al ;2011), Neurological outcome in patients with traumatic brain injury and its relationship with computed tomography patterns of traumatic subarachnoid hemorrhage: Two hundred fourteen patients (32%) had traumatic SAH on admission CT. The mortality rate was significantly greater and a 6-month unfavorable outcome was significantly more frequent in patients with traumatic SAH. Multivariate analysis showed that the maximum thickness (mm) of traumatic SAH was independently associated with neurological outcome (OR 0.8, 95% CI 0.7–0.9) and death (OR 1.3, 95% CI 1.2–1.5

In this study, the mean GCS score was 10.61.GCS score one of the most important factors in predicting the outcome of head injury (p =<0.001*).And this agree with Molly McNett; 2007), A Review of the Predictive Ability of Glasgow Coma Scale Scores in Head-Injured Patients: Bishara and associates (1992) reported statistically significant relationships (r= .45; p<.0001) between admission GCS scores and outcome.

Also agree with (Lu HY1; 2015) Predicting long-term outcome after traumatic brain injury using repeated measurements of glascgow coma scale and data mining methods: GCS score as the most influential attributes both in mortality and functional outcome prediction models.

In our study, 110 patients had a GCS score 8 or less (31.42%). 80of those patients (72.72%) had GOS V score. 70 patients had GCS score 9- 12 (20%), and 35 of them had GOS V score (50%). 170 patients had GCS score 13 or 15 (48.57%) and 50 of them had GOS V score (29.41%).

This agree with (Miguel Rodríguez MD; 2013) Predicting Mortality from Head Injury: Experience of Sancti Spíritus Province, Cuba: the parameters most strongly associated with mortality were GCS =8.

In our study hypoxia is significantly associated with the outcome. Hypoxia, being one of the preventable secondary brain insults, greatly affected outcome in patients with severe head injury.

This is agreement with (Asher SR; 2013) et al Survival advantage and PaO2 threshold in severe traumatic brain injury: Hypoxemia can adversely affect outcome after traumatic brain injury (TBI).

In the present study, 81.25% of patients who had hypoxia at the time of presentation had unfavorable outcome, as compared to 40.74% in non-hypoxic patients. So hypoxia was significantly associated with adverse outcome with p value <0.001.

In the present study hypotention.There is a highly significant relation between hypotension and the outcome (p=<0.001*).

20 %of patients were hypotensive when they presented in casualty, (78.5%) of them had poor prognosis .While in patients who had normal blood pressure (80%) only 25% had poor prognosis.

This is agreement with (TumulChowdhury, 2014) Pre-hospital and initial management of head injury patients: Hypotension is a major secondary brain insult and studies have demonstrated that a single episode of hypotension dramatically worsens the outcome. Also agreed with (Hyun Soo Oh et al ;2006) Comparisons of the Prognostic Predictors ofTraumatic Brain Injury According to Admission Glasgow Coma Scale Scores-Based on 1- and 6-month AssessmentsThe best predictor of 6-month functional disability was sBP.

Regarding papillary reflex, Normal pupillary reflex was associated with good outcome. Unfavorable outcome was found in 70% in patients with both dilated pupils and 40% in patients with anisocoria. Thus association of abnormal pupillary reflex with adverse unfavorable outcome was statistically highly significant (p value <0.001).

Its agreement with,(Hoffmann M et al ;2012) Pupil evaluation in addition to Glasgow Coma Scale components in prediction of traumatic brain injury and mortality: Pupil reactivity and size were significantly correlated (r(s) = 0.56, P < 0.001).

Regarding the GAP score, in this study the mean GAP score was16.2. 180 patients had a GAP score 19-24 (51.42%). 18 of those patients (10%) had GOS V score. 70 patients had GCS score 11- 18 (20%), and 30 of them had GOS V score (42.85%). 100 patients had GCS score 3-10 (28.57%) and 70 of them had GOS V score (70%).

This is in agreement with the study done by(Yutaka Kondo et al;2011), Revised trauma scoring system to predict in-hospital mortality in the emergency department: Glasgow Coma Scale, Age, and Systolic Blood Pressure score: The range of the GAP scores was determined for each risk category to match the range of predicted risk of death using the derivation data set: severe (high risk: 3 to 10 points), moderate (intermediate risk: 11 to 18 points) and mild (low risk: 19 to 24 points). A total of 1,409 (10.3%) of the patients were assigned to the high-risk group and had an observed mortality rate of 74.2%. A total of 2,044 (14.9%) of the patients were assigned to the intermediate-risk group and had an observed mortality rate of 21.4%. A total of 10,238 (74.7%) of the patients were assigned to the mild-risk group and had an observed mortality rate of 1.8%, the GAP scoring system more accurately predicts mortality risk categories.

Our study show that 170 patients had a RTS score (>7.2) (48.57%). 20 of those patients (11.76%) had GOS V score. 70 patients had GCS score (3.4-7.2) (20%), and 35 of them had GOS V score (50%). 110 patients had GCS score (<3.4) (31.42%) and 85 of them had GOS V score (77.27%).

And this was in agreement with (S C Ohaegbulam;2007).Using the Revised Trauma Score to Predict Outcome in Severely Head Injured Patients in a Developing Nation – A Pilot Study: Only one patient with RTS of less than 5.6 survived (4.093). Twelve patients survived (31.6%). Five patients (13.1%) with RTS greater than 5.6 died. The results in this study revealed that though the weighted RTS was effective in determining mortality outcome in head injured patients.

Also in this study we found that the RTS score was significantly associated with adverse outcome with p value <0.001*.

This was agreed with (Jaspal Singh; 2011), Evaluation of trauma and prediction of outcome using TRISS method: The revised trauma score (RTS) ranged from 2.746 to 7.8408.There was a graded increase in mortality with decreasing RTS score.

CONCLUSION

Accurate prediction of long-term outcome at baseline is important for several purposes. It may support clinical decision-making and provide realistic and evidence-based expectations to relatives (counseling) and caregivers.

- Head trauma commonly affects the young adult males in their productive age group.
- Older age group associated with the worse outcome after head trauma.
- Road traffic accidents are the most common cause of head trauma.
- There is a great association between a low score on the GCS and poorer outcome.
- The RTS correlates well with the probability of survival.
- The GAP scoring system,it strongly predicts in-hospital mortality.
- With regard to prognostic features bilaterally absent pupil reaction had a positive predictive value for a poor outcome and patients who had bilaterally reactive pupils made a significantly better outcome.

- The presence of hypotension nearly doubles the mortality from head injury and worsens the outcome of the patients who Survive.
- Hypoxia has been documented to significantly worsen outcomes in patients with traumatic brain injury (TBI).
- Patients with tSAH have a higher mortality.

Conflict of Interests:

The authors declare that there is no conflict of interests regarding the publication of this paper.

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