D-DIMER AS A MARKER FOR PEDIATRIC TRAUMATIC BRAIN INJURY IN RELATION TO THE TIME OF LABORATORY ACQUISITION

By

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ABSTRACT

Background: *Traumatic brain injury (TBI) is one of the main causes of pediatric deaths and disability worldwide. Biomarkers for TBI could have many potential uses regarding quick diagnostic testing for proper and early management. Serum D-dimer has been proposed as a biomarker to aid in the diagnosis of brain injury in pediatric head trauma.*

Aim of the work: *Evaluate the accuracy of D-Dimer as a marker of brain injury in pediatric patients with head trauma in relation to time of lab acquisition.*

Patients and methods: *This is a prospective study carried out during the period from January 2019 to July 2021 on 40 children with TBI have been admitted to El Hussein university hospital - Al-Azhar University. The candidates were sequentially enrolled in the study then classified into three groups; Group I (mild cases) represented with 10 patients with head trauma without significant brain injury (no neuroimaging finding e.g., skull fracture, brain contusion or laceration, intra cerebral hemorrhage, subarachnoid hemorrhage, intra ventricular hemorrhage, extradural or subdural hematoma etc.) and their GCS was ≥ 13, Group II (moderate cases) represented with 21 patients had significant traumatic brain injury in neuroimaging and their GCS was >8 and Group III (severe cases) represented with 9 patients had significant traumatic brain injury in neuroimaging and their GCS was ≤8. Quantitative D-dimer was evaluated at 6, 12 and 24 hours of the head trauma. All candidates aged (> 1 m to ≤ 18 y) old, with isolated head trauma and referred to hospital within 6 hours from the onset of trauma were included in the study. Any patient with chronic neurological disease (e.g., ADEMS, CP, etc.), previous brain injuries, coagulopathy, anticoagulants administration, poly trauma patient and (neurosurgical intervention or died) before first blood sample were excluded from the study.*

Results: *There was statistically significant difference between the studied groups regarding D-dimer values versus the severity of trauma at 6 h, 12 h (P<0.001) and 24*

h (P=0.002). Regarding the values of D-dimer as a predictor of severity to differentiate mild from moderate and severe cases, at 6 h (cutoff value was ≥395 pg/µL), at 12 h (cutoff value was ≥303.5 pg/µL), and at 24 h (cutoff value was ≥157.5 pg/µL). The highest sensitivity and specificity of the D-dimer to predict the severity of head trauma in pediatrics was at the samples taken within 6h. There was no significant difference between D Dimer cutoff values at 6 and 12 hours. So, we can rely on the results of 6 and 12 hours.

Conclusion: We included that the early evaluation of D-dimer (within 6 hours) after head trauma strongly predicts the severity of TBI.

Keywords: TBI, D-dimer, Marker, Time of laboratory acquisition, pediatric

INTRODUCTION

The traumatic brain injury (TBI) is a leading cause of death and acquired disability among children and adolescents world-wide. Pediatric TBI remains a diagnostic, prognostic and therapeutic challenge to the clinician. Currently, physical examinations, Glasgow coma scale (GCS) and brain computed tomography (CT) are corner stone for evaluation of traumatic brain injury (**Mondello et al., 2016**) (**Derakhshanfar et al., 2013**).

Circulating biomarkers of brain damage can detect TBI and reduce the risk of radiation of CT scans. Many biomarkers can be used such as S100B, Ubiquitin C-terminal hydrolase (UCH-L1), Glial fibrillary acidic protein (GFAP) and myelin-basic protein (MBP) (**Mondello et al., 2016**).

D-dimer is detected in the blood within minutes of traumatic brain injury. Quantitative D-dimer was shown to accurately predict the absence of significant brain injury in pediatric patients following blunt head trauma. The time interval between injury and lab acquisition might confuse interpretation of D-dimer. The golden time for lab acquisition of D-dimers level as screening test in pediatric patients of TBI is still unknown (**Langness et al., 2018**) (**Swanson et al., 2010**).

Aims of the Work

To evaluate the accuracy of D-Dimer for prediction of brain injury in pediatric patients with head trauma in relation to time of measurement of D-dimer level.

PATIENTS AND METHODS

This is a prospective study carried out during the period from January 2019 to July 2021 on 40 children with TBI has been admitted to El Hussein university hospital, Al-Azhar University. The candidates were sequentially enrolled in the study then

classified into three groups; **Group I (mild cases)** represented with 10 patients with head trauma without significant brain injury (no neuroimaging finding e.g., skull fracture, brain contusion or laceration, intra cerebral hemorrhage, subarachnoid hemorrhage, intra ventricular hemorrhage, extradural or subdural hematoma etc.) and their GCS was ≥13, **Group II (moderate cases)** represented with 21 patients had significant traumatic brain injury in neuroimaging and their GCS was >8 and **Group III (severe cases)** represented with 9 patients had significant traumatic brain injury in neuroimaging and their GCS was ≤8. Quantitative D-dimer was evaluated at 6, 12 and 24 hours of the head trauma.

Inclusion criteria:

All pediatric Patients aged (> 1 m to ≤ 18 y) old, with isolated head trauma and referred to hospital within 6 hours from the onset of trauma were included in the study.

Exclusion criteria:

Any patient with chronic neurological disease (e.g., ADEMS, CP, etc.), previous brain injuries, coagulopathy, anticoagulants administration, poly trauma patient and (neurosurgical intervention or died) before first blood sample were excluded from the study.

Methods:

All patients will be subjected to:

- **Full history taking:** name, age, weight, time from injury to presentation, associated injuries, mental status, presenting complaint, history of the presenting complaint, past medical history, birth and developmental history, drug history (including allergies), family and social history.

- **Full general and neurological examination:** including (vital data, general appearance, (GCS) Glasgow Coma Scale, (ISS) injury severity score, gait, if the child is ambulant, head, face and cranial nerves, limbs (tone, power and muscle function, co-ordination and movements, tendon reflexes, sensation), cerebellar signs.

- **Lab investigations:** For the standard trauma lab head panel, 0.8 mL of venous plasma samples was collected in ethylenediamine tetra-acetic tubes. The plasma had been separated and D-dimer had been measured using (ELISA) kits (NB 110–8376, Novus Biologicals) at (6, 12 and 24) hours and other routine laboratory investigations.

- **Imaging:** head CT scanning for all candidates and other imaging according to individual case scenario.

Ethical consideration:

1. A written informed consent was obtained from their legal guardians.

2. An approval by the local ethical committee was obtained before the study.

3. The researchers declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

4. All the data of the patients and results of the study are confidential & the patients have the right to keep it.

5. The patient has the right to withdraw from the study at any time.

6. The researchers received no financial support for the research, authorship, and/or publication of this article.

Statistics:

Data were analyzed using SPSS software, version 22.0 (IBM, Armonk, NY, USA) for Windows. Categorical data were presented as number and percentages using Fisher's exact tests, Shapiro-Wilks's test and ANOVA test. While non-parametric ones were presented as median and inter-quartile range (IQR), and analyzed by Mann Whitney U test or Kruskal Wallis test for 2 or 3 independent groups respectively. Non parametric correlations were assessed by Spearman's coefficient (rho). ROC curves were constructed to assess the validity of cutoff values D-dimer values with optimum sensitivity and specificity in prediction of mild from moderate and severe cases.

RESULTS

Our results were tabulated and demonstrated in the following tables and figures.

Table (1): Comparison of the studied groups regarding the demographic data

Variable		Group I (n=10)		Group II (n=21)		Group III (n=9)		Test of significance	P
Age (years)	Median (IQR)	2.0	(1.4-3.3)	6.5	(4.5-12.5)	11	(10.5-13)	KW= 17.8	<0.001 (HS)
	<3	7	70.0	1	4.8	0	0.0	FET= 20.0	0.001 (HS)
	3-<6	2	20.0	8	38.1	1	11.1		
	6-12	1	10.0	7	33.3	6	66.7		
	>12	0	0.0	5	23.8	2	22.2		
Sex	Male	6	60.0	13	61.9	7	77.8	FET= 0.86	0.74 (NS)
	Female	4	40.0	8	38.1	2	22.2		

This table showed that there was statistically significant difference between the studied groups regarding age. While there was no statistically significant difference between the studied groups regarding sex.

Table (1): Clinical and outcome in studied groups

Variable		Group I (n=10)		Group II (n=21)		Group III (n=9)		Test of significance	P
GCS	Mean ±SD	14.9	±0.3	12.0	±1.54	7.2	±1.09	ANOVA=90.8	<0.001 (HS)
	≤8	0	0.0	0	0.0	9	100.0	FET= 47.8	<0.001 (HS)
	9-12	0	0.0	15	71.4	0	0.0		
	13-15	10	100.0	6	28.6	0	0.0		
ISS	Median (IQR)	2.0	(1-2.5)	9.0	(8-12)	30.0	(29-42.5)	KW= 32.2	<0.001 (HS)
	<9	10	100.0	9	42.9	0	0.0	FET= 43.02	<0.001 (HS)
	9-14	0	0.0	12	57.1	0	0.0		
	>14	0	0.0	0	0.0	9	100.0		
Duration of admission (d)	Median (IQR)	----	----	3.0	(2-5)	22.0	5-31	Z_{MWU}= 2.33	0.019 (S)
Short term complications	Non	10	100.0	18	85.7	0	0.0	FET= 29.98	<0.001 (HS)
	Yes (1-2)	0	0.0	3	14.3	2	22.2		
	Yes (> 2)	0	0.0	0	0.0	7	77.8		
Long term morbidity	No	10	100.0	19	90.5	0	0.0	FET= 28.1	<0.001 (HS)
	Yes	0	0.0	2	9.5	9	100.0		
Mortality	Survived	10	100.0	21	100.0	5	55.6	FET= 10.5	0.001 (HS)
	Died	0	0.0	0	0.0	4	44.4		

ISS = Injury Severity Score

This table showed that there was statistically significant difference between the studied groups regarding, ISS, Duration of admission, long term morbidity and Mortality. There was statistically significant difference between mild, moderate and severe regarding the severity according to GCS. While there was no statistically significant difference between the studied groups regarding sex.

Table (2): Follow up of D-Dimer values among the studied groups (by pg/µL)

Variable	D Dimer (6h)	D Dimer (12 H)	D Dimer (24 H)	P value	Significant pairs (Adjusted P)
Median	2173.5	900.0	329.0	61.5 (<0.001)	6h versus 12 h (<0.001) 6 h versus 24 h (<0.001) 12 h versus 24 h (=0.001)
IQR	325-4165	280-2540	152.5-873.5		
Minimum	50.0	50.0	50.0		
Maximum	6358.0	5894.0	2985.0		

This table showed that there was a highly statistically significant difference between all studied groups at different time.

Table (3): **Correlation between the studied groups and D-dimer values**

Variable	Group I (n=10)		Group II (n=21)		Group III (n=9)		KW	P
	Median	IQR	Median	IQR	Median	IQR		
D-dimer 6 h (pg/µL)	199	125-325	2230	801.5-2933	5296	4305-6025	28.2	<0.001 (HS)
D-dimer 12 h (pg/µL)	Mild (n=10)		Moderate (n=21)		Severe (n=8)		26.9	<0.001 (HS)
	172.5	50-293.8	1060	378.5-2064	3992.5	3007.5-4573.8		
D-dimer 24 h (pg/µL)	Mild (n=10)		Moderate (n=21)		Severe (n=2)		12.04	0.002 (S)
	143	50-288.5	520	210-940.5	2300	1940-2660		

This table showed that: There was a statistically significant difference between the studied groups regarding D-dimer values.
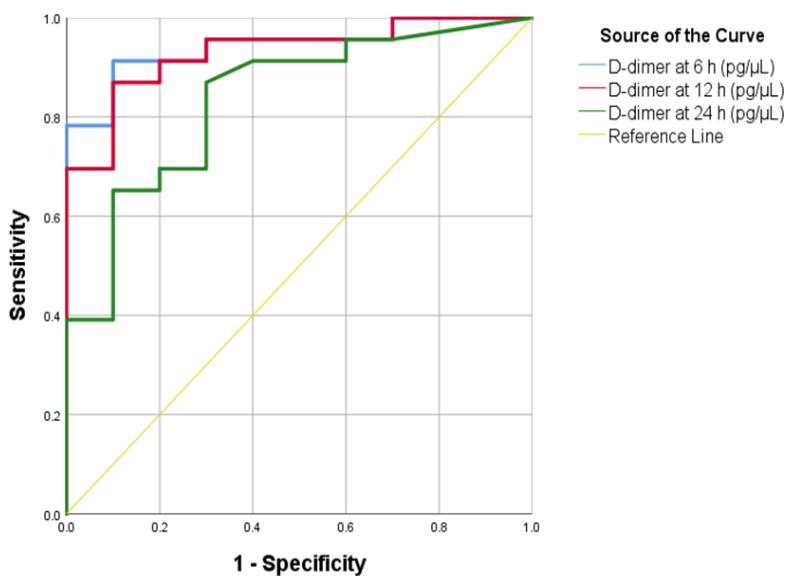

Figure (1): **ROC curve for the performance of D-dimer in differentiating (group I) from (group II and group III) cases**

Table (4): Diagnostic accuracy of the performance of D-dimer in differentiating (group I) from (group II and group III) cases at different time

Variable	Cutoff (pg/μL)	Sens%	Spec%	PPV%	NPV%	AUC	SE	95%CI
D-dimer 6 h	≥395	91.3%	90%	95.5%	81.8%	0.943	0.039	0.86-1.0
D-dimer 12 h	≥303.5	91.3%	80%	91.3%	80%	0.930	0.044	0.84-1.0
D-dimer 24 h	≥157.5	87%	70%	87%	70%	0.835	0.075	0.69-0.98

PPV (positive predictive value), NPV (negative predictive value)

This table showed the prediction of the performance of D-dimer in differentiating (group I) from (group II and group III) cases, D-dimer cutoff value at 6 h was ≥395 pg/μL, at 12 h was ≥303.5 pg/μL and at 24 h was ≥157.5 pg/μL. As mentioned in table the best cutoff value of D-dimer was at 6h (highest sensitivity and specificity).

Table (5): Pairwise comparisons of the studied markers

Pairwise comparisons of the studied markers	P value
D-dimer 6 h- D-dimer 12 h	0.33 (NS)
D-dimer 6 h - D-dimer 24 h	**0.031 (S)**
D-dimer 12 h - D-dimer 24 h	**0.043 (S)**

This table showed that no significant difference between D Dimer cutoff values sensitivity and specificity at 6and 12 hours. So, we can rely on the results of 6 and 12.

DISCUSSION

Traumatic brain injury (TBI) is one of the main causes of pediatric deaths and disability worldwide (**Marzano et al. 2021**).

D-dimer was considered by few researchers a valuable marker in TBI, where it is still under research and studying if it has definite relationship with TBI patients (**Marzano et al. 2021**).

This study aimed to evaluate the accuracy of D-Dimer for prediction of brain injury in pediatric patients with head trauma in relation to time of lab acquisition.

Our study showed that there was statistically significant

difference between the studied groups regarding the severity according to ISS [<9 (47.5%), 9-14 (30%),>14(22.5%)] and GCS [mild (25%), moderate (52.5%) and sever (22.5%)] (p < 0.001).

According to **Langness et al. (2018)** who classified candidates into 4 groups according to CT scan:

1. **TBI:** defined as intracranial hemorrhage or contusion, cerebral edema, traumatic infarction, diffuse axonal injury, shearing injury or depressed skull fracture by ≥ the bone thickness.

2. **Clinically-important TBI (ciTBI):** defined as TBI resulting in death, neurosurgical intervention, intubation more than 24 h or hospital admission more than 2 nights.

3. **Isolated skull fracture:** defined as a nondisplaced skull fracture in the absence of any TBI findings.

4. **No head injury:** defined as no injury identified on cranial cross-sectional imaging. And noted that GCS and ISS average correlated with injury severity groups where [No TBI the GCS was (14.4 ± 1.8), ISS was (4.6 ± 5.5), Isolated skull fracture the GCS was (14.4 ±

1.9), ISS was (9.8 ± 4.9), Clinically important TBI (ciTBI) the GCS was (12.0 ± 4.5), ISS was (20.5 ± 9.8), TBI the GCS was (14.8 ± 1.1), ISS was (12.8 ± 5.3) with (p < 0.001) for both.

Where, **Youssef et al. (2015)** found a statistically significantly higher GCS was detected among survivors on days 1 and 7, indicating the value of GCS as a prognostic indicator for TBI.

Also, **Foaud et al. (2014)** demonstrated that the GCS showed a significant difference between survivors and non-survivors in 1st, 3rd and 14th day.

Swanson et al. (2010) showed that the GCS strongly correlated with brain injury in CT (p < 0.001).

This study showed that 30 patients had significant traumatic brain injury (8 patients (20%) with skull fracture, 6 patients (15%) with subdural hematoma, 2 patients (5%) with subarachnoid hemorrhage, 1 patient (2.55%) with intracerebral hemorrhage, 3 patients (7.5%) with extradural hematoma and 10 patients (25%) with mixed lesions). Where 10 patients (25%) had no significant brain injury in neuroimaging after head trauma.

According to **Langness et al. (2018)** Head injuries were broadly classified into 4 groups (as mentioned before) according to attending radiologist final CT scan report and the patient's clinical course into: TBI was identified in 77 (11.6%), Clinically-important TBI (ciTBI) was identified in 116 patients (17.5%), Isolated skull fracture: was identified in 61 (9.2%) and No head injury: was identified in 409 (61.7%).

According to **Abd El-Twab et al. (2013)** who reported that the cases in the favorable group had the following findings; 4 cases had subdural hemorrhage (17.4%), 6 cases had subarachnoid hemorrhage (26.1%) and 13 cases had intracranial hemorrhage (56.5%). while among the unfavorable group there were; 2 cases had subdural hemorrhage (8.7%), 2 cases had subarachnoid hemorrhage (8.7%), 14 cases had intracranial hemorrhage (60.9%) and 5 cases had interventricular hemorrhage (21.7%).

The present study showed that the median of D Dimer value at (6h) was 2173.5 pg/μL, at (12 h) was 900.0 pg/μL and at (24 h) was 329.0 pg/μL. There was statistically significant difference between the studied groups regarding D-dimer values versus the time. Also, there was statistically significant difference between the studied groups regarding D-dimer values versus the severity. Median of D-dimer at 6 h was statistically lower among mild than moderate and severe (199; 2230; 5296 pg/μL) P<0.001. Median of D-dimer at 12 h was statistically lower among mild than moderate and severe (172.5; 1060; 3992.5 pg/μL) P<0.001. Median of D-dimer at 24 h was statistically lower among mild than moderate and severe (143; 520; 2300 pg/μL) P=0.002.

According to **Langness et al. (2018)** who reported that Low plasma D-dimer predicts the absence of ciTBI for pediatric patient with suspected TBI and D-dimer level may significantly limit the number of unnecessary computed tomography scans of the head (CTH). He found that the D-dimer correlates with injury severity. Average D-dimer was significantly higher in the patients with ciTBI (4059 ± 1287 pg/μL) than the patients with TBI (2870 ± 1633 pg/μL), skull fracture (2458 ± 1769 pg/μL) or no injury (1531 ± 1791 pg/μL) (p <0.005). His results demonstrated that cases with d-dimer level <100 pg/μL had no significant brain injury and no need for neuroimaging.

According to **Foaud et al. (2014)** who stated that the changes

in the mean values of D-dimer among non-survivors and survivors at 1st, 3rd, and 14th day recorded as follow; the non-survivors was (27.9±13.6 µ/L, 9.9±5.3 µ/L and 1.4±0.6 µ/L at 1st day, 3rd day, 14th day respectively), while in the survivors were (4.2±2.4µ/L, 2±1.1 µ/L and 0.79 ±0.41 µ/L at 1st day, 3rd day, 14th day respectively). D-dimer time measurements showed significant decline within both non-survivors and survivors (p <0.001).

According to **Swanson et al. (2010)** that showed the level of D-dimer was strongly predicted brain injury (p < 0.001).

This study showed that in prediction of the performance of D-dimer in differentiating (group I) from (group II and group III) cases, regarding D-dimer at 6 h cutoff value was ≥395 pg/µL, [Sensitivity was 91.3%, specificity was 90%, PPV was 95.5%, NPV was 81.8%, AUC was 0.943], at 12h cutoff value was ≥303.5 pg/µL, [Sensitivity was 91.3%, specificity was 80%, PPV was 91.3%, NPV was 80%, AUC was 0.930], and at 24h, cutoff value was ≥157.5 pg/µL, [Sensitivity was 87%, specificity was 70%, PPV was 87%, NPV was 70%, AUC was 0.835]. Ability of D dimer to diagnosis cases was most accurate at D-dimer 6 h (the highest sensitivity and specificity).

This is comparable to what in found with **Langness et al. (2018)** who stated that the D-dimer levels drawn within 6h were significantly more accurate than those drawn at later times with an AUC of 0.8202 ± 0.0198 compared to 0.8020 ± 0.0204 (p < 0.0001) and 0.7616 ± 0.2340 (p < 0.0001) for the <12h and <48h groups, respectively. A D-dimer level drawn <6 h after injury was used for all subsequent analysis. D-dimer threshold values of <100, <500, <750 and <1000 pg/µL were analyzed to determine the rate of missed head injuries and negative predictive value (NPV). For all patients, there were no missed head injuries and 100% NPV for the presence of TBI or ciTBI on head CT when the D-dimer threshold was set to <100 pg/µL. Using <100 pg/µL as a threshold value for a negative screening test would have avoided 97 head CTs in this series, representing 18.5% of all CTs for suspected TBI. So, in this series, a low D-dimer was able to predict the absence of TBI and ciTBI on head CT with high accuracy and sensitivity. Out of 108 patients with a D-dimer <100 pg/µL, none had evidence of TBI on head CT and all patients with a ciTBI had a D-dimer >900 pg/µL.

According to **Berger et al. (2015)** who investigated the increment of D-dimer levels in children with traumatic brain injury (TBI), specifically mild abusive head trauma. They reported in both the retrospective and prospective cohorts, median (25th–75th percentile) D-dimer was significantly higher in cases vs. controls. An ROC demonstrated an area under the curve (AUC) of 0.91 (95% CI: 0.83 – 0.99) in the prospective cohort. At a cut-off value of 0.59µg/L, the sensitivity and specificity for identification of a case was 90% and 75%, respectively.

According to **Swanson et al. (2010)** ROC curve analysis suggested that a cut off of 500 pg/µL predicts brain injury (area under curve = 0.77) had 94% negative predictive value (p < 0.001) for brain injury on head CT.

The current study showed that no significant difference between D Dimer cutoff values sensitivity and specificity at 6 and 12 hours. So, we can rely on the results of 6 and 12 hours.

This agrees with **Langness et al. (2018)** D-dimer was observed to have better accuracy in predicting the absence of ciTBI when drawn within 6 hours of injury. The number of missed ciTBI for a D-dimer <750 pg/µL increased from 0 to 2 when obtained 6-12 hours after injury and increased to 11 when obtained >24 hours after injury. The consequence of even a single missed ciTBI can be devastating. The vast majority of patients in their study were able to have a D-dimer drawn within 6 hours, suggesting broad applicability for pediatric trauma patients.

CONCLUSION

We concluded that the early evaluation of D-dimer (within 6 hours) after head trauma strongly predicts the severity of TBI.

RECOMMENDATIONS

We recommended early lab acquisition of D-dimer in children with TBI (within 6h) from head trauma to evaluate further management.

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تحليل ال (دي دايمر) كمؤشر لمدى إصابة الدماغ الصادمة لدى الأطفال وعلاقته بتوقيت أخذ العينة

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مقدمة البحث:

تعــد إصــابة الــراس الصــادمة واحدة مــن اهــم أسـباب الوفــاة والاعاقــة للأطفــال وقيــاس نسـبة المؤشــرات الحيويــة فــي إصابة الــراس الصــادمة لــدى الأطفــال لــه استخدامات واعـدة فـي سـرعة التشـخيص وان قيــاس نسـبة ال (دي دايمــر) الــذي يعــد واحــد مــن هذه المؤشرات الحيوية وربما يساعد في تشخيص الاصابة.

الهدف من البحث:

تقيــيم دقــة تحليــل ال (دي دايمــر) كمؤشـر لمـدى إصابة الراس الصادمة لدى الأطفال وعلاقته بتوقيت اخذ العينة.

مواد وطرق البحث:

تــم إجــراء هــذا البحــث بوحــدة العنايــة المركــزة للأطفــال فــي مستشـفى الحسـين الجـامعي - جامعـة الازهـر وذلــك فـي الفتـرة مـن ينـــاير 2019 وحتـــى يوليـــو 2021 علـــى أربعــين طفــلا مصــاب

بإصابة الـراس الصـادمة وقـد اسـتوفوا معـايير الانـدماج والاقصـاء وتم تقسيمهم إلى ثلاث مجموعات.

- **المجموعـة الأولـى (إصـابات بسـيطة):** عشـر حـالات مـن الأطفـال الـذين تمـت اصـابتهم بصـدمة بـالراس ولـم يتـأثر الدماغ بها ولم تظهر اثارها بالأشعة المقطعية

- **المجموعـة الثانيـة (إصـابات متوسـطة):** واحـد وعشـرون حالـة مـن الأطفـال الـذين تمـت اصـابتهم بصـدمة بـالراس وتـأثر الـدماغ بـالآتي (كسـر بالجمجمـة او تهتـك بـالمخ او نزيـف بـالمخ او نزيـف تحـت أحـد السـحايا الـخ) وظهـر أثـر ذلـك فـي الاشـعة المقطعيـة وكـان تقيـيمهم علـى مقيـاس جلاسكو للغيبوبة أكثر من ثمانية.

- **المجموعـة الثالثـة (إصـابات شـديدة):** تسـع حـالات مـن الأطفـال الـذين تمـت اصـابتهم بصـدمة بـالراس وتـأثر الـدماغ بـالآتي (كسـر بالجمجمـة او تهتـك بـالمخ او نزيـف بـالمخ او نزيـف تحـت أحـد السـحايا الـخ) وظهـر أثـر ذلـك فـي الاشـعة المقطعيـة وكـان تقيـيمهم علـى مقيـاس جلاسـكو للغيبوبـة اقـل من او يساوي ثمانية.

وخضعت جميع الحالات الى ما يلي:

- التاريخ المرضي كامل.

- الفحص الإكلينيكي الشامل.

- ملاحظة العلامات الخاصة بوجود إصابة عصبية.

وقد تم عمل التحاليل والاشعات الاتية لجميع الحالات:

- قيـاس نسـبة ال (دي دايمــر) فـي الـدم خـلال اول سـت سـاعات مــن الإصــابة ثـم اثنــي عشـرة سـاعة مـن الإصــابة ثـم أربــع وعشـرين سـاعة مـن الاصـابة وأيضـا قيـاس بـاقي التحاليـل الروتينيــة للمــريض كصــورة الـدم الكاملـة وغيرهـا مــن التحاليل الازمة.

- عمـل الاشـعة المقطعيـة لجميـع الحـالات فـور الوصـول الـى غرفـة الطـوارئ بالمستشـفى وعمـل بـاقي الاشـعة حسـب مـا تقتضيه كل حالة.

نتائـج البحث:

في هـذه الدراسـة ظهـرت فـروق ذات دلالـة إحصــائية بـين المجمـوعتين فيمـا يتعلـق بنسـبة ال (دي دايمــر) بالمقارنـة بشـدة الإصـابة عنـد سـت سـاعات واثنـي عشـر سـاعة وأربـع وعشـرين سـاعة واظهـرت أيضـا هـذه الدراسـة ان أفضـل وقـت لأخـذ العينـة هـو ان يكـون خـلال السـت سـاعات الأولـى مـن الإصـابة حيـث اعلـى نسـبة حساسـية وخصوصية وأيضـا يمكـن اخـذ العينـة خـلال الاثنـا عشـر سـاعة الأولـى بعـد الإصـابة حيـث لـم تظهـر فـروق ذات دلالة إحصائية بينهما.

الاستنتاج:

استناداً إلى نتائج دراستنا نخلص إلى أن:

أفضــل توقيــت لســحب تحليــل ال (دي دايمــر) يكــون خــلال الســت ســاعات الأولــى مــن الإصــابة وذلــك لتشــخيص مــدى شــدة الإصابة (إصابة الراس الصادمة).

توصيـات البحـث:

استناداً إلى نتائج دراستنا نوصي بالتالي:

أفضــل توقيــت لأخــذ عينــة ال (دي دايمــر) هــو ان يكــون خــلال الســت ســاعات الأولــى مــن الإصــابة وأيضــا يمكــن اخــذ العينــة خــلال الاثنــا عشــر ســاعة الأولــى بعــد الإصــابة حيــث لــم تظهر فروق ذات دلالة إحصائية بينهما.