

## **AIM OF THE WORK**

The aim of the work were to study the role of emergency medicine in the management of acute traumatic extradural hematoma in terms of:

1. Stabilization phase in emergency medicine department.
2. Defining the role of CT scan in the diagnosis of EDH.
3. Determining the frequency and timing of enlargement of EDH.
4. Identifying which patients need only conservative management.
5. Identifying which patients will need surgical intervention

## **PATIENTS**

This prospective study included all patients with acute traumatic extradural hematoma presenting to the Emergency Department of Alexandria University Hospital for the period of 6 months between May<sup>1</sup> 2013 and November<sup>1</sup> 2013.

### **Inclusion criteria:**

1. Patients with isolated acute traumatic EDH either with isolated head trauma or poly-trauma.

### **Exclusion criteria:**

1. Patients with associated TBIs or other intracranial hematomas.
2. Patients with spontaneous non-traumatic EDH.
3. Patients with associated non-traumatic other intracranial lesions(e.g. tumors, arterio-venous malformations).
4. Patients with associated intoxication.

## METHODS

All patients were subjected to the following:

### 1. Primary survey:

All patients managed according to the Airway, Breathing, Circulation, Disability, Exposure (ABCDE) approach.

### 2. History:

All patients had thorough history taking with special emphasis on:

- Age, sex, mode of trauma, lucid interval, drug history.
- Duration from trauma till treatment.
- Past history of bleeding diathesis.

### 3. Clinical examination:

All patients had thorough trauma evaluation with special emphasis on:

- **Vital signs:** Blood pressure, Pulse rate, body temperature and respiratory rate.
- **Level of consciousness:** according to The Glasgow Coma Scale (GCS) score where the level of consciousness is assessed according to eye opening, verbal response and motor response.

The patients classified into three main groups according to the initial GCS score:

- Mild head injury (13-15).
- Moderate head injury (9-12).
- Severe head injury (3-8).

- **Pupils:** bilateral size and reaction to light.
- **Neurological examination:** cranial nerves, limbs (strength, tone, reflexes), motor examination, ataxia, seizures.

### 4. Laboratory investigations:

- Complete blood count (CBC) done for all patients.
- Coagulation profile, creatinine.
- Arterial blood gases as needed.

### 5. Radiological investigations:

- Plain X ray: skull (AP and lateral view).
- CT brain without contrast to detect:
  - Associated skull fracture.
  - Site and size of extradural hematoma.
  - Presence of brain herniation

- Presence of brain edema.
- Degree of midline shift.
- Signs of active hematoma bleeding.
- Associated intradural lesions.

**6. Other tests:**

- Cervical spine evaluation.
- Investigations were required for any associated injuries in poly-traumatized patients.

**7. Emergency medicine department care:**

- Airway management: airway adjuncts, suctioning, intubation using rapid sequence induction (RSI).
- Maintaining of adequate blood pressure: IV crystalloids, pressors.
- Reducing intracranial pressure (ICP) and brain edema.
- Increasing cerebral blood flow and venous drainage.
- Prevention of early post-traumatic seizures.
- Consulting a neurosurgeon immediately for EDH evacuation and repair.
- Consulting a trauma surgeon for other life-threatening injuries.

## RESULTS

Results of the present study are demonstrated in the following tables and figures:

### 1. Demographic characteristics of the studied patients (n=77):

The present study included 77 patients. They comprised 65 males (84.4%) and 12 females (15.6%). Male: female ratio was 5.4:1. Their ages ranged from 9 months-62 years with a mean  $\pm$ SD of  $26.43 \pm 14.06$  years (Table VIII).

**Table (VIII): Distribution of studied sample according to demographic data (n=77)**

	No.	%
<b>Sex</b>		
Male	65	84.4
Female	12	15.6
<b>Age (years)</b>		
<10	6	7.8
10 - <20	22	28.6
20 - <30	24	31.2
30 - <40	9	11.7
40 - <50	9	11.7
$\geq 50$	7	9.1
Min. – Max.	0.75 – 62.0	
Mean $\pm$ SD.	$26.43 \pm 14.06$	
Median	24.0	

### 2. Mechanism of injury in the studied patients (n=77):

The reported mechanisms of injury included road traffic accidents in 54 patients (70.1%), assaults in 11 patients (14.3%), falling from height in 7 patients (9.1%), local trauma in 5 patients (6.5%) (Table IX).

**Table (IX): Distribution of studied sample according to mechanism of injury (n=77)**

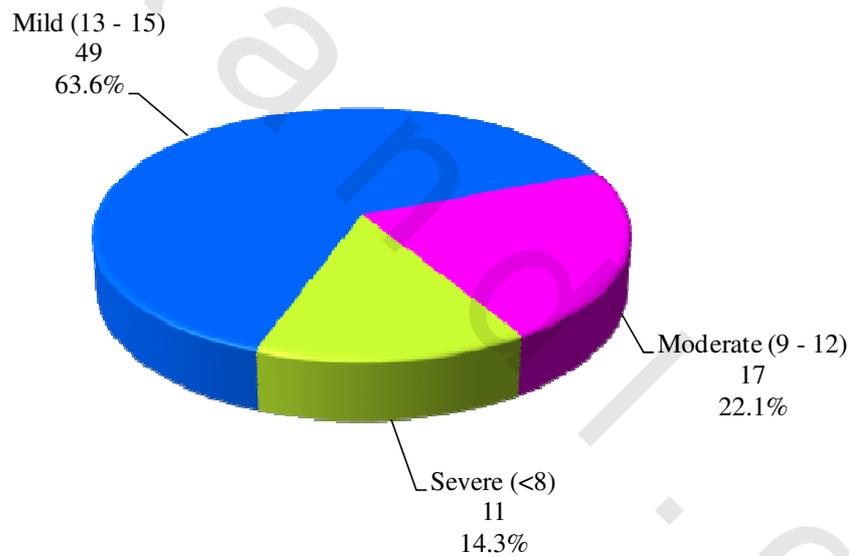
Mechanism of injury	No.	%
Road traffic accident	54	70.1
Assault	11	14.3
Falling down	7	9.1
Local trauma	5	6.5

### 3. GCS and severity of head injury in the studied patients (n=77):

GCS in the present study ranged from 3.0- 15.0 with a Mean of  $\pm$  SD.  $12.58 \pm 3.25$ . According to GCS, severity of traumatic brain injury was classified into severe in 11 cases (14.3%), moderate in 17 cases (22.1%) and mild in 49 cases (63.6%) (Table X;Fig.3).

**Table (X): Distribution of studied sample according to severity of head injury according to GCS (n=77)**

GCS	No.	%
Mild (13 - 15)	49	63.6
Moderate (9 - 12)	17	22.1
Severe (<8)	11	14.3
Min. – Max.	3.0 – 15.0	
Mean $\pm$ SD.	12.58 $\pm$ 3.25	
Median	15.0	



**Figure (3): Distribution of studied sample according to severity of head injury according to GCS**

### 4. Distribution of studied patients according to clinical signs (n=77):

The reported clinical signs in the present study include headache in 28 patients (36.4%), vomiting in 57 patients (74.0%), seizure in 19 patients (24.7%), disturbed level of consciousness in 30 patients (39.0%), focal neurological lesion in 11 patients (14.3%), pupillary changes ranged from bilateral equal reactive to light in 60 patients (77.9%) to one fixed one reactive in 8 patients (10.4%) and bilateral dilated non reactive in 9 patients (11.7%), irregular respiratory pattern in 13 patients (16.9%), bradycardia in 16 patients (20.8%), increased intracranial pressure (ICP) in 21 patients (27.3%), midline shift (MLS) in 21 patients (27.3%) (Table XI).

**Table (XI): Distribution of studied sample according to clinical signs (n=77)**

<b>clinical sign</b>	<b>No.</b>	<b>%</b>
Headache	28	36.4
Vomiting	57	74.0
Seizure	19	24.7
Lucid Interval	17	22.1
Disturbed Level Consciousness	30	39.0
Focal Neurological Lesion	11	14.3
Pupillary changes		
BERL	60	77.9
One FD, One Reactive	8	10.4
BD, Non Reactive	9	11.7
Irregular Respiratory pattern	13	16.9
Bradycardia	16	20.8
Intracranial pressure	21	27.3

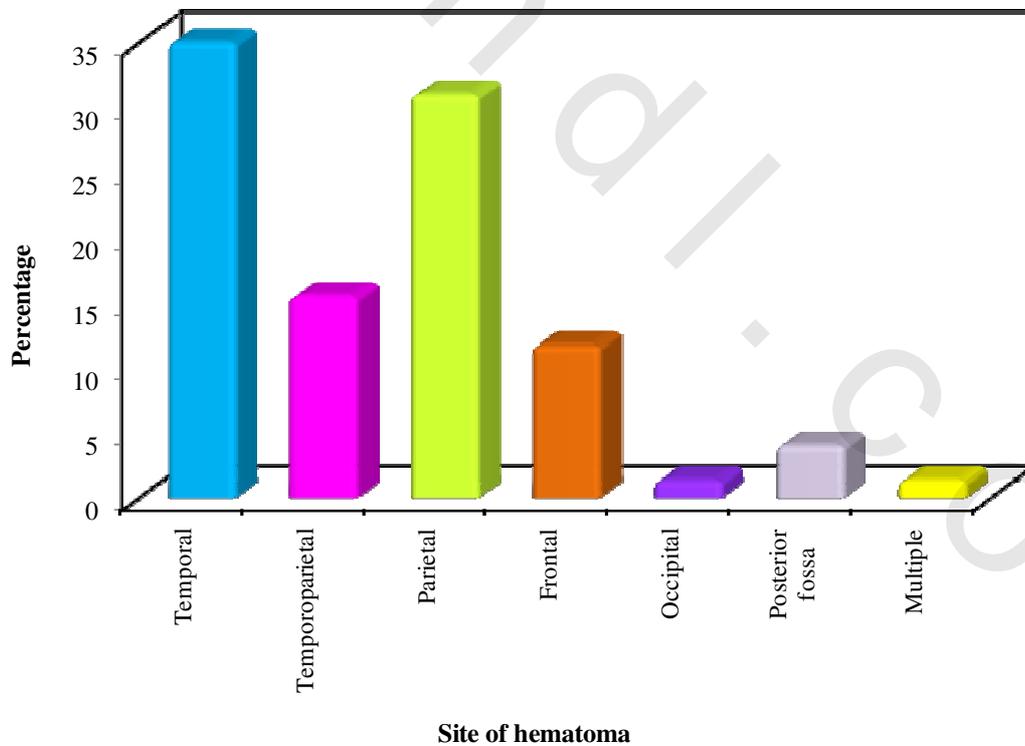
BERL=bilateral equal reactive to light, BD=bilateral dilated.

## **5. Distribution of studied sample according to CT findings (n=77)**

CT findings in the studied patients revealed a hematoma size ranging from (9.4-121.7 cm<sup>3</sup>). Site of hematoma was temporal in 27 patients(35%), parietal in 24 patients (31%) temporoparietal in 12 patients (15.5%), frontal in 9 patients(11.7%), 3 patients (4%) in the posterior fossa, occipital in one patient(1.3%), and multiple in one patient (1.3%). Seventy four (96%) patients had unilateral lesions while 3 (4%) patients had bilateral lesions. Skull fractures were reported in 48 patients (62.3%) (Table XII, Fig.4,5).

**Table (XII): CT findings (n=77)**

	<b>Number of cases</b>	<b>Percentage(%)</b>
<b>Site of hematoma</b>		
Temporal	27	35%
Temporoparietal	12	15.5%
Parietal	24	31.%
Frontal	9	11.7%
Occipital	1	1.3%
Posterior fossa	3	4%
Multiple	1	1.3%
Unilateral	74	96%
Bilateral	3	4%
<b>skull Fracture</b>	48	62.3
<b>Midline shift</b>	21	27.3



**Figure (4): Site of hematoma**

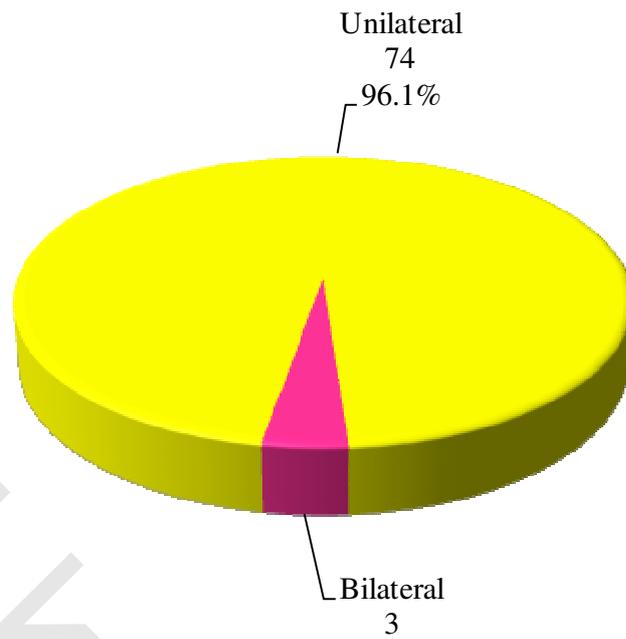


Figure (5): laterality of the hematoma

#### 6. Distribution of studied sample according to onset (n=77)

Delayed onset of extradural hematoma was reported in 3 patients (3.9%) (Table XIII; Fig. 6)

Table (XIII): Distribution of studied sample according to onset (n=77)

Onset	No.	%
Acute	74	96.1
Delayed	3	3.9

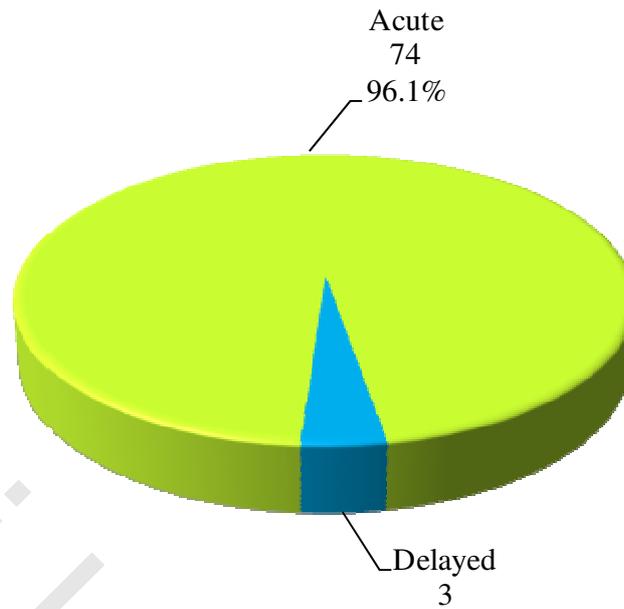


Figure (6): Distribution of studied sample according to onset

### 7. Management interventions & time for intervention in the studied patients (n=77)

Management interventions in the studied patients included conservative management in 46 patients (59.7%) and surgical management in 31 patients (40.3%), the time for intervention was  $\leq 4$  hours in 22 patients (71%) and  $> 4$  hours in 9 patients (29%) (Table XIV ;Fig 7,8).

Table (XIV): Management interventions & time for intervention in the studied patients:

	No.	%
<b>Definitive management</b>		
Conservative	46	59.7
Surgical	31	40.3
<b>Time of intervention (n = 31)</b>		
$\leq 4$ hours	22	71.0
$> 4$ hours	9	29.0
Min. – Max.	3.0 – 7.0	
Mean $\pm$ SD.	4.06 $\pm$ 1.0	
Median	4.0	

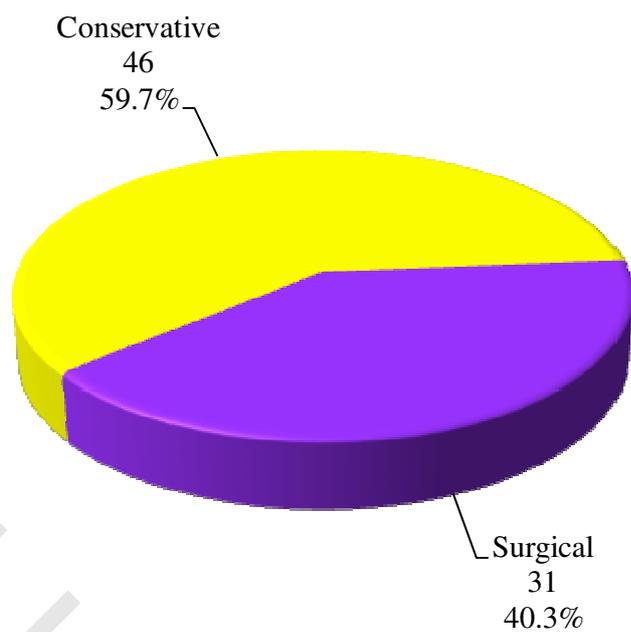


Figure (7): Definitive management

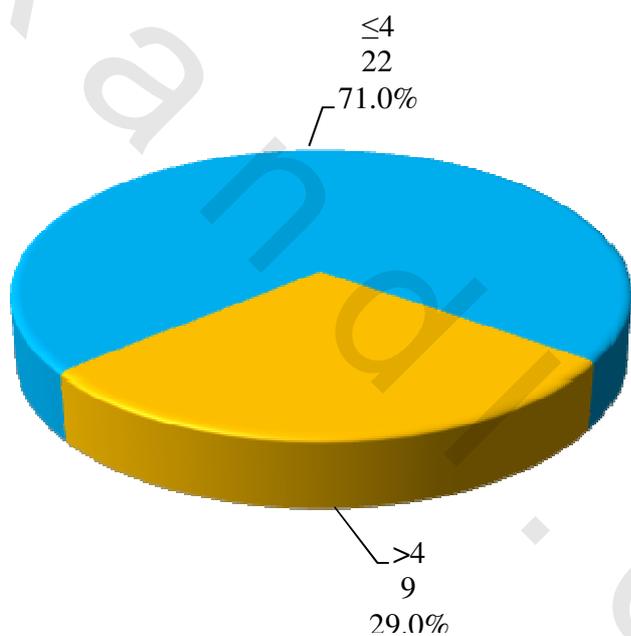


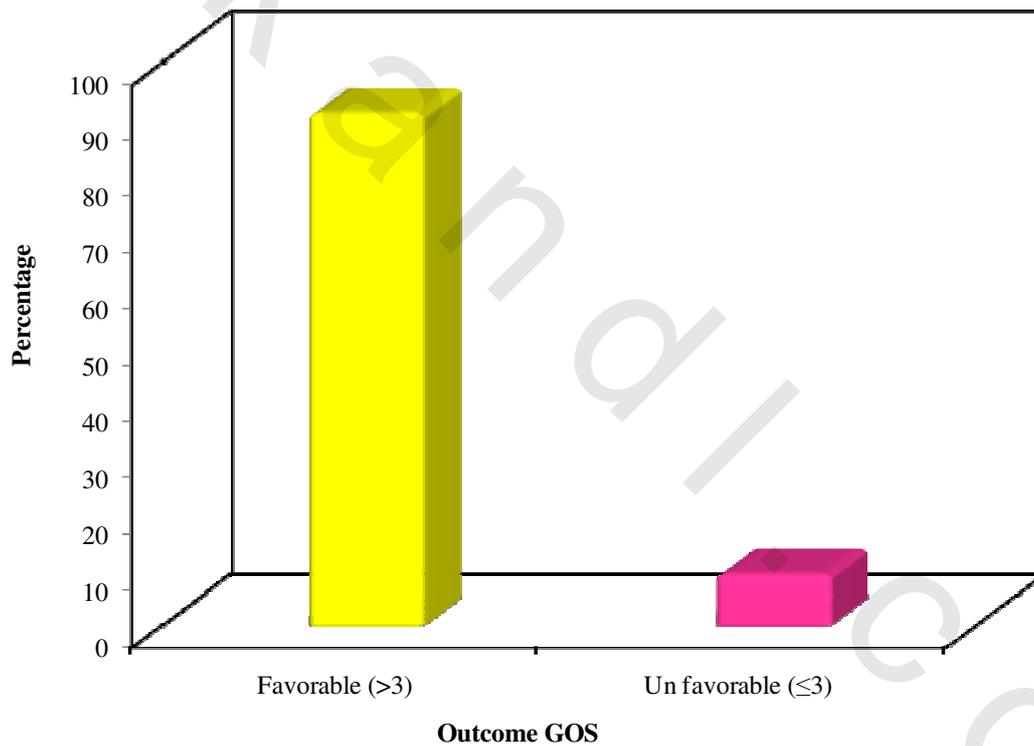
Figure (8): Time of intervention

**8. Reported outcome in the studied patients(n=77):**

The reported outcome in the studied patients had shown a GOS $\leq$  3 in 7 patients (9.1%) and GOS >3 in 70 patients (90.9%) (Table XV; Fig. 9).

**Table (XV): Distribution of studied sample according to outcome (n=77)**

	No.	%
<b>Outcome by GOS</b>		
Favorable (>3)	70	90.9
Un favorable ( $\leq$ 3)	7	9.1
Min. – Max.	<b>1.0 – 5.0</b>	
Mean $\pm$ SD.	<b>4.52 <math>\pm</math> 0.85</b>	
Median	<b>5.0</b>	



**Figure (9): Distribution of studied sample according to outcome**

**9. Mortality rate in the studied patients(n=77):**

The reported mortality rate in the studied patients was 3 out of 77 studied patients(3.9%). The non survivor cases included 34 years old male patient with multiple hematomas, the second case was 22 old man presented with post-arrest, GCS= 3 and PFEDH, the third case presented with large parietal hematoma and multiple traumatic injuries (Table XVI).

**Table (XVI):Distribution of studied sample according to mortality rate (n=77)**

	No.	%
<b>Mortality Rate</b>		
Survivors	74	96.1
Non Survivors	3	3.9

**10. Associated injuries in the studied patients(n=77):**

The associated injuries in the studied patients included long bone in13 patients (16.9%), abdominal injuries in 11 patients (14.3%), chest injuries in 8 patients (10.4%), maxillofacial injuries in 10 patients (13.0%), and multiple in one patient(1.3%) (Table XVII; Fig. 10).

**Table (XVII): Distribution of studied sample according to associated injuries (n=77)**

	No.	%
<b>Associated Injuries</b>		
No	34	44.2
Long bone#	13	16.9
Abdominal	11	14.3
Chest injuries	8	10.4
Maxillofacial	10	13.0
Multiple injuries	1	1.3

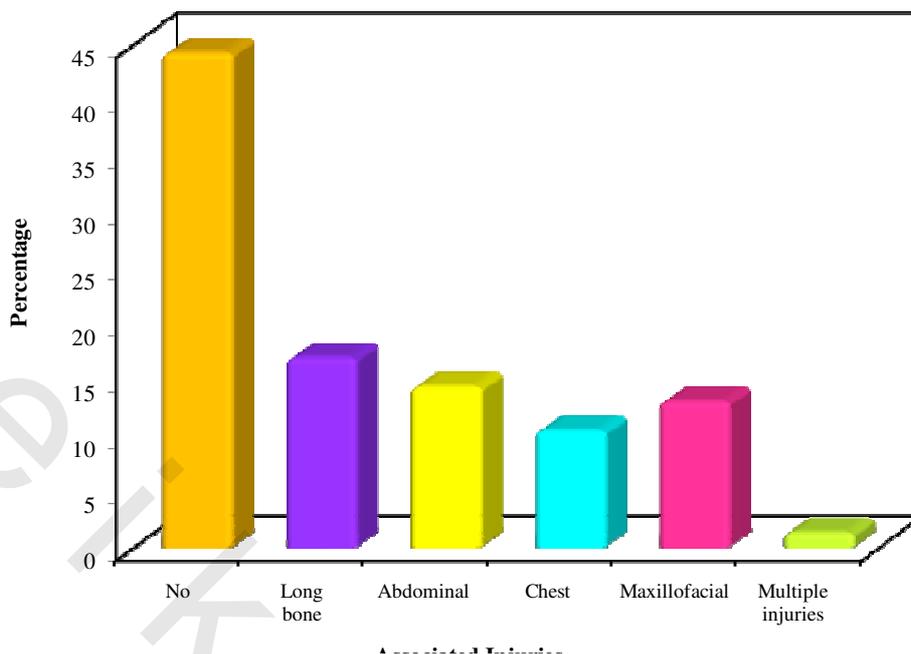


Figure (10): Distribution of studied sample according to associated injuries

**11. Reported cases that had received phenytoin & mannitol:**

Medical interventions in the studied cases had shown that 20 patients (26%) and 22 patients (28.6%) had received phenytoin and mannitol respectively (Table XVIII).

Table (XVIII): Reported cases that had received phenytoin & mannitol

	No.	%
<b>Drug</b>		
Phenytoin	20	26.0
Mannitol	22	28.6

**12. Relation between outcome with demographic data:**

Comparison between patients with GOS > 3 and GOS ≤ 3 had shown that patients with GOS > 3 had significantly younger age (26.70 ± 14.52 vs. 43.71 ± 8.38; p= 0.026) However, comparison between sex distribution in both outcome groups didn't reveal statistically significant differences (p=0.298) (Table XIX).

**Table (XIX): Relation between outcome with demographic data**

	Outcome GOS				Test of sig.	p
	Favorable (>3) (n = 70)		Un Favorable (≤3) (n = 7)			
	No.	%	No.	%		
<b>Sex</b>					$\chi^2 = 0.987$	FE p = 0.298
Male	60	85.7	5	71.4		
Female	10	14.3	2	28.6		
<b>Age (years)</b>					t = 12.532	0.026
Min. – Max.	0.75 – 62.0		11.0 – 35.0			
Mean ± SD	26.70 ± 14.52		43.71 ± 8.38			
Median	24.0		45.0			

$\chi^2$ : Chi square test  
 FE: Fisher Exact test  
 t: Student t-test

**13. Relation between outcome with Hematoma size:**

Regarding the relation between outcome of the patients and size of the hematoma, it was found that unfavorable outcome was associated with larger sizes of hematoma (Table XX).

**Table (XX): Relation between GOS outcome with Hematoma size**

	Outcome GOS		Z	p
	Favorable (>3) (n = 70)	Un Favorable (≤3) (n = 7)		
<b>Hematoma size</b>				
Min. – Max.	9.40 – 111.20	32.60 – 121.7		
Mean ± SD	26.50 ± 24.62	67.36 ± 32.64	3.394*	0.001*
Median	15.60	62.70		

Z: Z for Mann Whitney test  
 \*: Statistically significant at  $p \leq 0.05$

#### 14. Relation between outcome with skull fracture:

Regarding the relation between outcome of the patients and presence of skull fracture, it was found that skull fracture was associated more with unfavorable outcome than in favorable outcome group (Table XXI).

**Table (XXI): Relation between outcome with skull fracture**

	Outcome GOS				$\chi^2$	FE p
	Favorable (>3) (n = 70)		Un Favorable ( $\leq$ 3) (n = 7)			
	No.	%	No.	%		
<b>Skull fracture</b>						
Absent	29	41.4	0	0.0	4.652	0.041*
Present	41	58.6	7	100.0		

$\chi^2$ : Chi square test

FE: Fisher Exact test

\*: Statistically significant at  $p \leq 0.05$

#### 15. Relation between outcome with onset:

Regarding the relation between outcome of the patients and onset of hematoma it had shown that unfavorable outcome was associated with delayed onset (Table XXII).

**Table (XXII): Relation between outcome with onset**

	Outcome GOS				$\chi^2$	FE p
	Favorable (>3) (n = 70)		Un Favorable ( $\leq$ 3) (n = 7)			
	No.	%	No.	%		
<b>Onset</b>						
Acute	70	100.0	4	57.1	2.012	0.027
Delayed	0.0	100.0	3	42.9		

$\chi^2$ : Chi square test

FE: Fisher Exact test

**16. Relation between outcome with laterality of the hematoma:**

Regarding the relation between outcome of the patients and laterality of the hematoma, it was found that unfavorable outcome was associated with bilateral EDH (Table XXIII).

**Table (XXIII):Relation between outcome with laterality**

	Outcome GOS				$\chi^2$	FE p
	Favorable (>3) (n = 70)		Un Favorable ( $\leq$ 3) (n = 7)			
	No.	%	No.	%		
<b>CT findings</b>						
Unilateral	70	100.0	4	57.1	2.012	0.027
Bilateral	0	0.0	3	42.9		

$\chi^2$ : Chi square test  
FE: Fisher Exact test

**17. Relation between outcome with the site of the hematoma:**

Comparison between outcome with site of the extradural hematoma it had revealed that unfavorable outcome was associated with hematomas in the posterior fossa and multiple hematoma sites (Table XXIV).

**Table (XXIV):Relation between outcome with site of the hematoma**

	Outcome GOS				$\chi^2$	MC p
	Favorable (>3) (n = 70)		Un Favorable ( $\leq$ 3) (n = 7)			
	No.	%	No.	%		
<b>CT findings</b>						
Parietal	23	32.9	1	14.3	12.298	0.021
Temporal	25	35.7	2	28.6		
Frontal	9	12.8	0	0.0		
Posterior fossa	0	0.0	3	42.8		
Temporoparietal	12	17.1	0	0.0		
Occipital	1	1.5	0	0.0		
Multiple	0	0.0	1	14.3		

$\chi^2$ : Chi square test  
MC: Monte Carlo test

**18. Relation between GCS with incidence of seizures:**

Regarding the relation between incidence of seizures and GCS and trauma severity, it was found that only one patient had seizures in the mild head trauma group, and all patients with severe head trauma had post traumatic seizures except one (Table XXV).

**Table (XXV): Relation between GCS with seizures**

	GCS						$\chi^2$	MC p
	Mild (13 – 15) (n=49)		Moderate (9 – 12) (n=17)		Severe (<8) (n=11)			
	No.	%	No.	%	No.	%		
<b>Seizure</b>								
Negative	48	98.0	9	52.9	1	9.9	56.251*	<0.001*
Positive	1	2.0	8	47.1	10	90.1		

$\chi^2$ : value for Chi square

MC: Monte Carlo test

\*: Statistically significant at  $p \leq 0.05$

**19. Relation between GCS with vomiting:**

Regarding the relation between incidence of vomiting and GCS and trauma severity, it had shown that vomiting was associated more with severe and moderate head injuries than mild head trauma (Table XXVI).

**Table (XXVI):Relation between GCS with vomiting.**

	GCS						$\chi^2$	MC p
	Mild (13 – 15) (n=49)		Moderate (9 – 12) (n=17)		Severe (<8) (n=11)			
	No.	%	No.	%	No.	%		
<b>Vomiting</b>								
Negative	19	38.8	1	5.9	0	0.0	11.708*	MC p =0.002*
Positive	30	61.2	16	94.1	11	100.0		

$\chi^2$ : value for Chi square

MC: Monte Carlo test

\*: Statistically significant at  $p \leq 0.05$

**20. Relation between outcome and pupillary changes:**

Comparison between outcome of the patients and pupillary changes, it had shown that unfavorable outcome was associated with abnormal pupillary reaction (Table XXVII; Fig.11).

**Table (XXVII): Relation between outcome and pupillary changes**

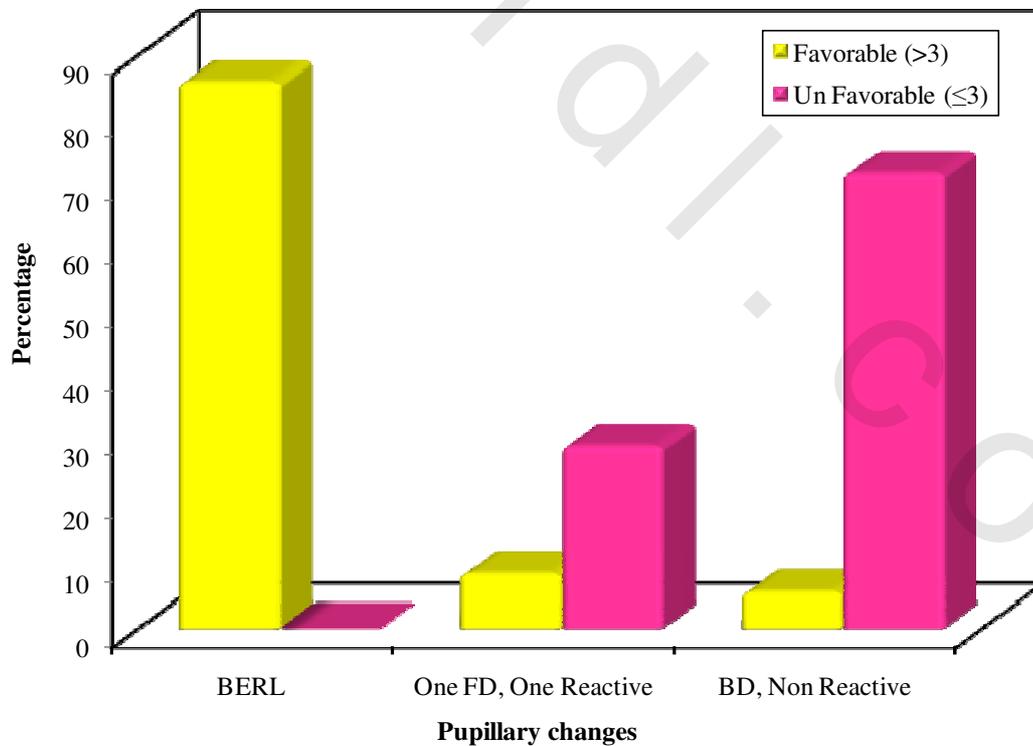
	Outcome GOS				$\chi^2$	MC <sub>p</sub>
	Favorable (>3) (n = 70)		Un Favorable (≤3) (n = 7)			
	No.	%	No.	%		
<b>Papillary changes</b>						
BERL	60	85.7	0	0.0	24.148*	<0.001*
One FD, One Reactive	6	8.6	2	28.6		
BD, Non Reactive	4	5.7	5	71.4		

BERL=bilateral equal reactive to light, BD=bilateral dilated.

$\chi^2$ : value for Chi square

MC: Monte Carlo test

\*: Statistically significant at  $p \leq 0.05$



**Figure (11): Relation between outcome and pupillary changes**

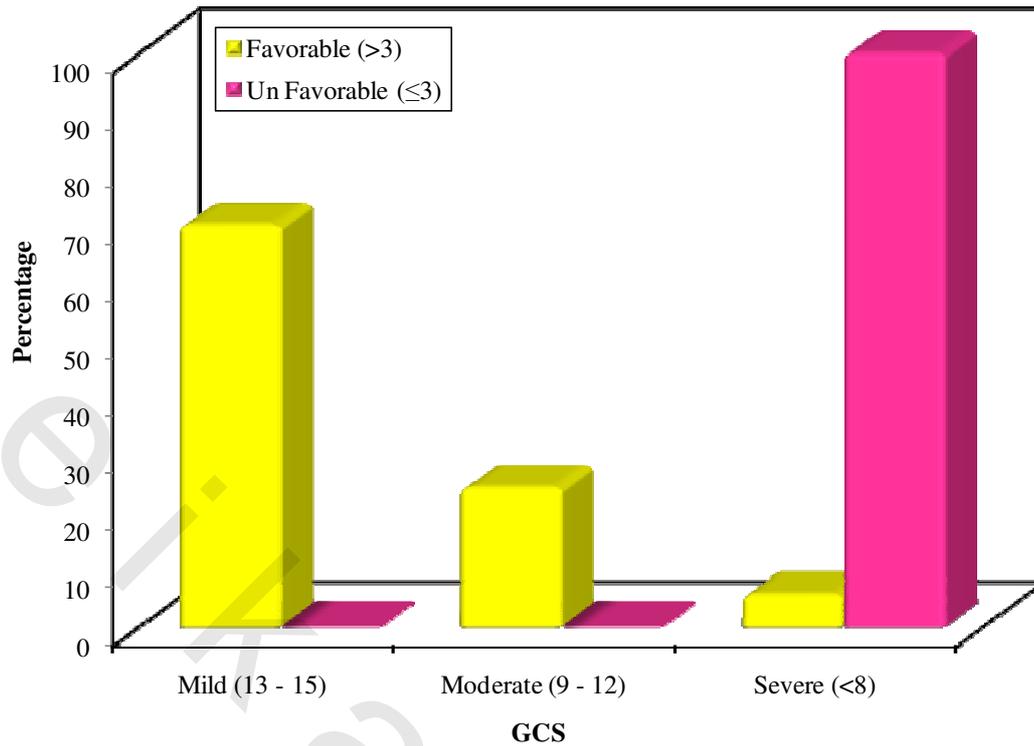
**21. Relation between outcome and severity of head injury according to GCS:**

In respect to the relation between outcome and GCS and trauma severity, it was found that patients with favorable outcome had significantly higher GCS when compared with patients with unfavorable outcome (Table XXVIII; Fig. 12).

**Table (XXVIII): Relation between outcome and severity of head injury according to GCS**

	Outcome GOS				$\chi^2$	Test of sig.
	Favorable (>3) (n = 70)		Un Favorable ( $\leq$ 3) (n = 7)			
	No.	%	No.	%		
<b>GCS</b>						
Mild (13 - 15)	49	70.0	0	0.0	28.135*	<0.001*
Moderate (9 - 12)	17	24.3	0	0.0		
Severe (<8)	4	5.7	7	100.0		
Min. – Max.	7.0 – 15.0		3.0 – 7.0		Z = 4.649*	<0.001*
Mean $\pm$ SD.	13.26 $\pm$ 2.53		5.86 $\pm$ 1.35			
Median	15.0		6.0			

$\chi^2$ : value for Chi square  
 MC: Monte Carlo test  
 Z: Z for Mann Whitney test  
 \*: Statistically significant at  $p \leq 0.05$



**Figure (12): Relation between outcome and severity of head injury according to GCS.**

**22. Relation between outcome and midline shift (MLS):**

Regarding the relation between outcome and midline shift shown by CT, it had shown that unfavorable outcome was associated with high degrees of MLS (Table XXIX).

**Table (XXIX): Relation between outcome and midline shift**

	Outcome by GOS				$\chi^2$	FE p
	Favorable (>3) (n = 70)		Un Favorable (≤3) (n = 7)			
	No.	%	No.	%		
<b>Midline shift</b>						
Absent	56	80.0	0	0.0	20.533*	<0.001*
Present	14	20.0	7	100.0		

$\chi^2$ : Chi square test

FE: Fisher Exact test

\*: Statistically significant at  $p \leq 0.05$

**23. Relation between outcome and time of intervention:**

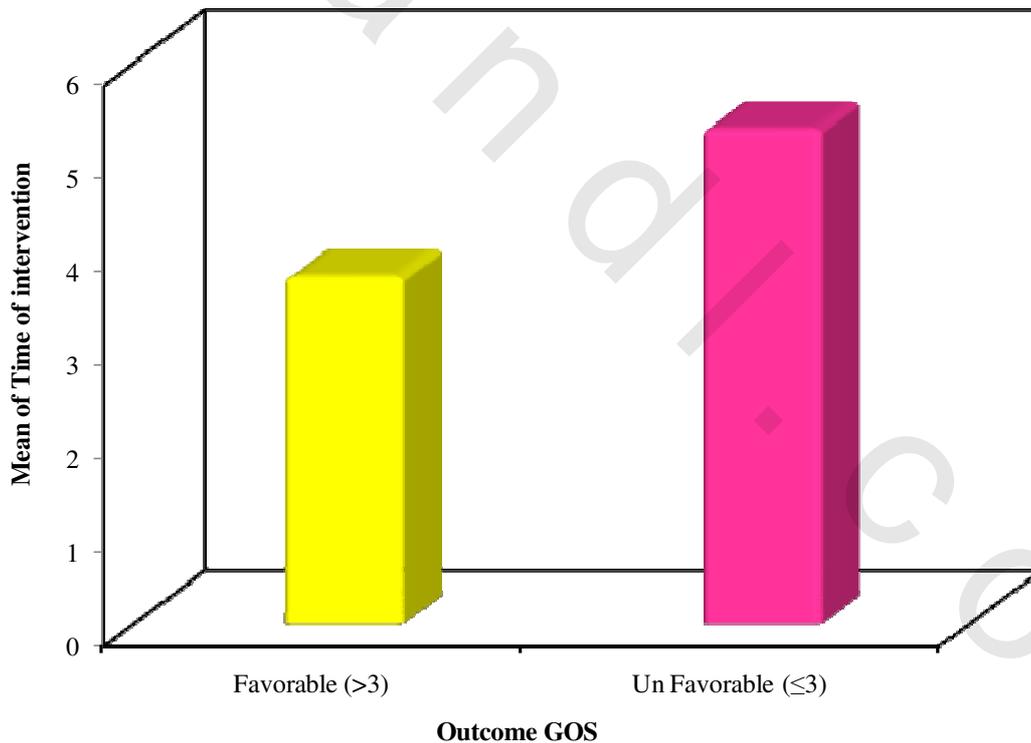
Regarding the relation between outcome and time of intervention, it had shown that favorable outcome was associated with least time for intervention (Table XXX; Fig.13).

**Table (XXX): Relation between outcome and time of intervention**

	Outcome GOS		t	P
	Favorable (>3) (n = 24)	Un Favorable (≤3) (n =7)		
<b>Time of intervention</b>				
Min. – Max.	3.0 – 5.0	4.0 – 7.0		
Mean ± SD.	3.71 ± 0.69	5.29 ± 0.95	4.885*	<0.001*
Median	4.0	5.0		

t: Student t-test

\*: Statistically significant at  $p \leq 0.05$



**Figure (13): Relation between outcome and time of intervention**

**24. Relation between outcome and medical interventions:**

Regarding the relation between outcome of the patients and effect of mannitol, it was found that most patients received mannitol had favorable outcome (Table XXXI).

**Table (XXXI): Relation between outcome with medical interventions**

	Outcome GOS				$\chi^2$	FE p
	Favorable (>3) (n = 70)		Un Favorable (≤3) (n = 7)			
	No.	%	No.	%		
<b>Phenytoin</b>	13	65	7	35	21.945*	<0.001*
<b>Mannitol</b>	20	91	2	9	19.250*	<0.001*

$\chi^2$ : Chi square test

FE: Fisher Exact test

\*: Statistically significant at  $p \leq 0.05$

**25. Relation between outcome with definitive management:**

In the present study, all patients managed conservatively had GOS > 3 (Table XXXII; Fig. 14).

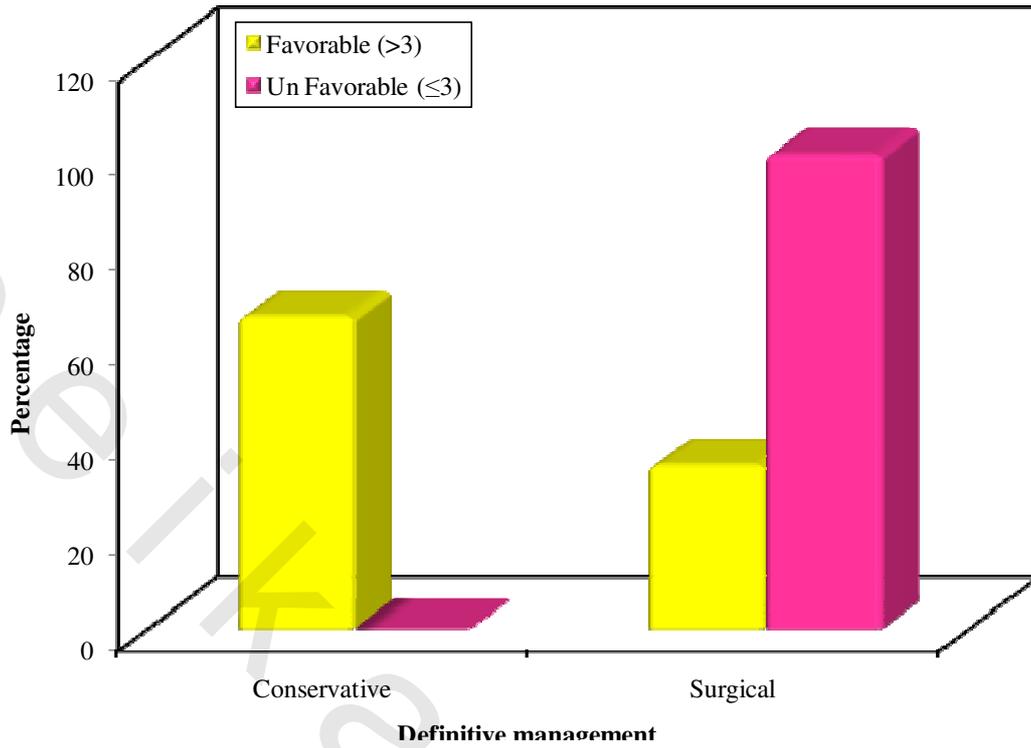
**Table (XXXII): Relation between outcome with definitive management :**

	Outcome GOS				$\chi^2$	FE p
	Favorable (>3) (n = 70)		Un Favorable (≤3) (n = 7)			
	No.	%	No.	%		
<b>Definitive management</b>						
Conservative	46	65.7	0	0.0	11.426*	0.001*
Surgical	24	34.3	7	100.0		

$\chi^2$ : Chi square test

FE: Fisher Exact test

\*: Statistically significant at  $p \leq 0.05$



**Figure (14): Relation between outcome with definitive management**

### Selected cases

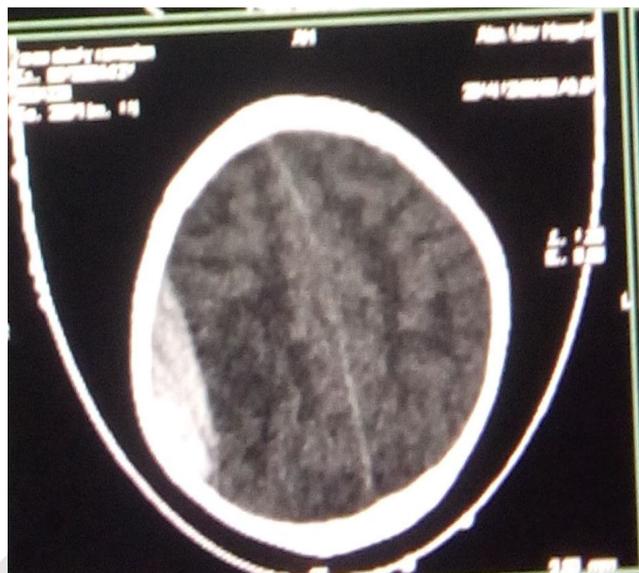


Preoperative



Postoperative

**Figure (15):** Case 1: A 40 years old male patient presented with right temporal extradural hematoma sized 45 ml and GCS of 10 and managed by surgical route.



Preoperative



Postoperative

**Figure (16): Case2:** A 23 years old female patient presented with right parietal extradural hematoma sized 40 ml and GCS of 13 and managed by surgical evacuation.

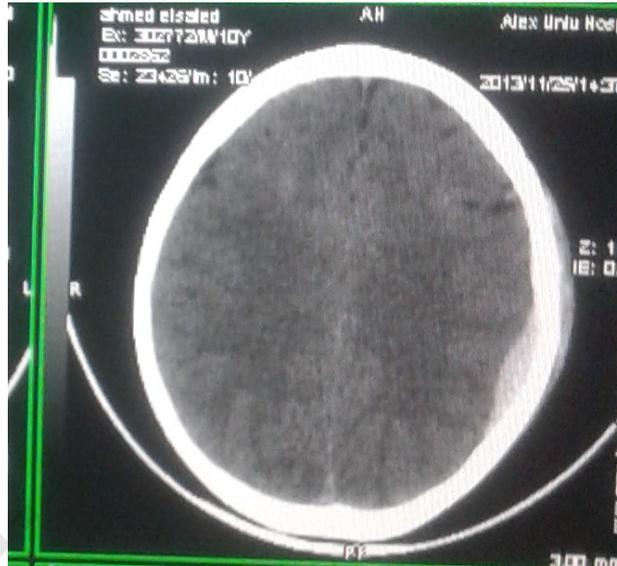


Preoperative

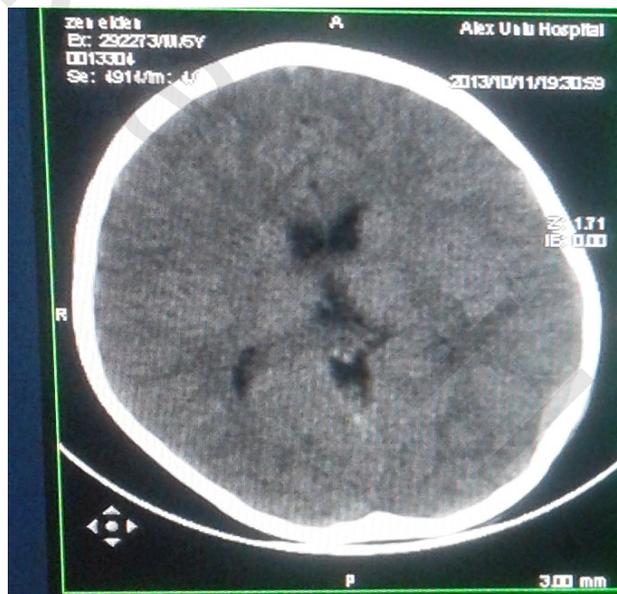


Postoperative

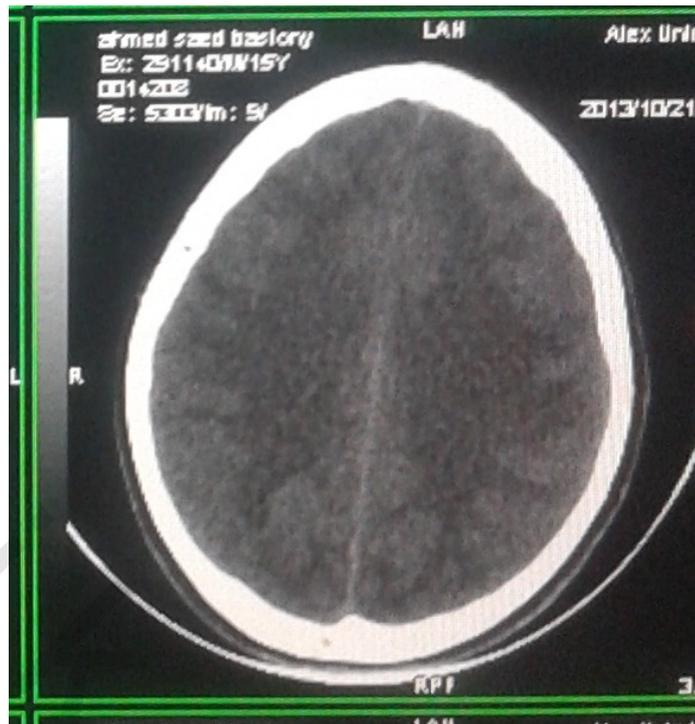
**Figure (17): Case 3:** A 26 years old male presented with right frontal extradural hematoma managed surgically.



**Figure (18):** Case 4: a 25 male patient presented with left parietal extradural hematoma sized 15 ml and GCS 15 managed conservatively by follow up.



**Figure (19):** Case5:A 33years old female patient presented with left occipital extradural hematoma sized 10ml managed consevatively by follow up.



(A)



(B)

**Figure (20):** (A) First CT scan and GCS 15. (B) 4 hours later with GCS 12, managed surgically.