AIM OF THE WORK

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The aim of this study is assessment of dependent predictors for recurrence of chronic subdural hematoma. This study focused on the following assumed predictors which are age, sex, bleeding tendency, postoperative position of the patient, pre-operative Glasgow Coma Scale score and post-operative Glasgow outcome scale score. Also this study discussed several radiological risk factors in CT brain as internal architecture of the hematoma, width of the hematoma, post-operative mid line shift, post-operative subdural air collection and bilateral chronic subdural hematoma.

PATIENTS

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This study is a prospective study done at the Alexandria main university hospital and was conducted on all patients operated for chronic subdural hematoma within one year starting from 1/9/2013 to 31/8/2014.

METHODS

METHODS

This study is a Prospective study on all patients operated for chronic subdural hematoma evacuation in Alexandria university hospital within one year starting from 1/9/2013 to 31/8/2014.

All patients signed an informed consent according to regulations of local ethics of Alexandria main university hospital.

Upon admission, all patients were subjected to thorough history taking with focus on intake of anticoagulants or antiplatelet therapy. Clinical examination was done with recording of the preoperative Glasgow Coma Scale score .The level of consciousness fell into either of two categories: (1) no or mild impairment in consciousness (GCS≥13) and (2) moderate to severe impairment in consciousness (GCS<13).

Routine laboratory investigations as CBC, liver enzymes (SGPT, SGOT) and renal function tests (blood urea and serum creatinine) were done to discover any associated morbidities that may cause bleeding tendency such as liver or renal dysfunctions. As well as screening for any bleeding tendency was done. Platelets count, platelet function test (if patient was on antiplatelet therapy), INR, prothrombin time and prothrombin activity were routinely done at time of admission.

If the international normalized ratio (INR) on admission was more than 1.5, vitamin K was administered intravenously. Prothrombin time (PT) and INR were rechecked and vitamin K was repeated if the PT/INR was still more than 1.5. If prothrombin activity was less than 70%, fresh frozen plasma was given till corrected. If platelet count was less than 100.000, platelets were given till corrected under hematological consultation.

If the patient was receiving antiplatelet or anticoagulant for whatever cause, these agents were immediately stopped and again were restarted after the surgical wound was healed.

ECG and ECHO were done for elderly patients to assess the cardiac risk before surgery and to determine whether the patient will be fit for general anesthesia or surgery will be done under local anesthesia.

Main diagnostic tool is CT brain for all patients. CT scanning was performed five times in every patient: preoperatively, 1–3 days to exclude residual subdural hematoma-, 7 days, 30 days, and 90 days after surgery.

All hematomas were classified into four types according to internal architecture, which corresponded to possible stages in the natural history of CSDH: homogeneous, laminar, separated, and trabecular types.

The homogeneous type was defined as a hematoma that exhibited homogeneous density. The laminar type was defined as a subtype of the homogeneous type that had a thin high-density layer along the inner membrane. The separated type was defined as a hematoma containing two components of different densities with a clear boundary lying between them; that is, a lower-density component located above a higher-density component. The trabecular type was defined as a hematoma with inhomogeneous contents and a high-density septum running between the inner and outer membrane on a low-density to isodense background. Again the hematoma was classified either it is unilateral or bilateral.

Radiologic measures of the CSDH space, including width of hematoma, mid-line shift, hematoma side, and hematoma type were taken before and after the procedure.

Postoperative CT brain will be analyzed for postoperative midline shift and postoperative subdural air collection. The post-operative subdural air fell into either of two categories: (1) no or little air (<5 ml) and (2) massive air (≥5ml). These measurements were determined at the maximum thickness at the level of the lateral ventricles. Preoperative midline shift and maximum hematoma thickness were determined based on CT scans obtained immediately before surgery.

The surgical procedure was burr hole drainage under general or local anesthesia according to the cardiac risk of the patient and other co-morbidities with irrigation and subcutaneous closed system drainage. Half of the patients were positioned flat in the postoperative period and the other half were kept in non-flat position with early mobilization. Whether residual hematoma was seen on CT scans of the brain, all drainage catheters were removed after 72 hours in both groups.

Postoperative condition was evaluated with Glasgow outcome scale score, obtained at the time of discharge, and classified as good recovery (score 1), moderate disability (score 2), severe disability (score 3), persistent vegetative state (score 4), and death (score 5). Favorable and unfavorable outcomes were defined as Glasgow outcome scale scores of 1–2 and 3–5, respectively. The latter classification was used as a measure of outcome after surgery.

All patients were followed-up for at least 3 months. Both clinical and radiological criteria were used to evaluate CSDH recurrence, with clinical hints further evaluated by brain CT scans. Clinical criteria included a change in mental status, worsening of the preexisting neurological or psychiatric illness, focal neurological deficit, and new-onset headache with or without neurological deficit. Radiological criteria included an increased volume of subdural fluid on the treated side compared with the volume measured 1 to 3 days post-surgery and the compression of the brain by subdural fluid observed on CT scans obtained within 3 months after surgery. Patients underwent re-operation if neurological symptoms recurred or the cerebral sulci were seen to be diffusely effaced by recurrent hematoma on CT scans. Those with no neurological deficit or with a small residual hematoma were followed-up as outpatients.

We treated bilateral hematoma as one case, and both sides received the same treatment.

RESULTS

RESULTS

This study was conducted on 40 patients; 33 males and 7 females. Their ages ranged between 40 and 80 years. The non-recurrence group was 28 males and 5 females and the recurrence group was 5 males and 2 females. Age and sex were not dependent risk factors for recurrence.

Table (1): Comparison between the two studied groups according to sex.

Sex	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
Male	28	84.8	5	71.4	33	82.5
Female	5	15.2	2	28.6	7	17.5
χ^2(^{FE}p)	0.720 (0.584)					

χ^2: Value for chi square
FE: Fisher Exact test

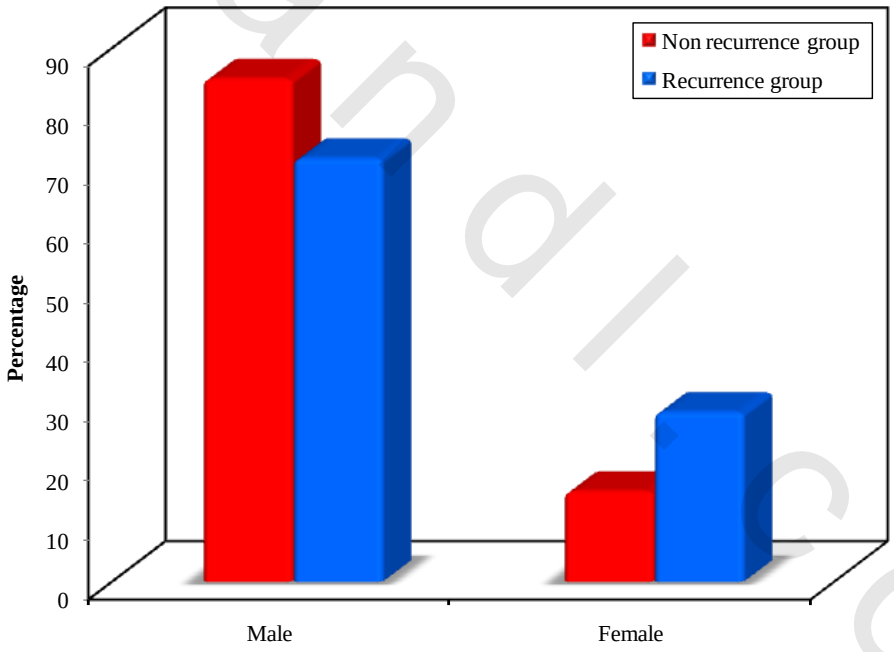


Figure (7): Comparison between the two studied groups according to sex.

Table (2): Comparison between the two studied groups according to age.

Age (Years)	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
40 – 50	3	9.1	0	0.0	3	7.5
50 – 60	10	30.3	2	28.6	12	30
60 – 70	13	39.4	3	42.9	16	40
70 – 80	7	21.2	2	28.6	9	22.5
χ^2(^{MC}p)	0.708 (1.000)					
Min. – Max.	40.0 – 80.0		50.0 – 80.0		40 – 80.0	
Mean ± SD.	68.2 ± 9.18		70.5 ± 6.5		69.3 ± 9.25	
t(p)	0.545 (0.589)					

χ^2: Value for chi square
MC: Monte Carlo test
t: Student t-test

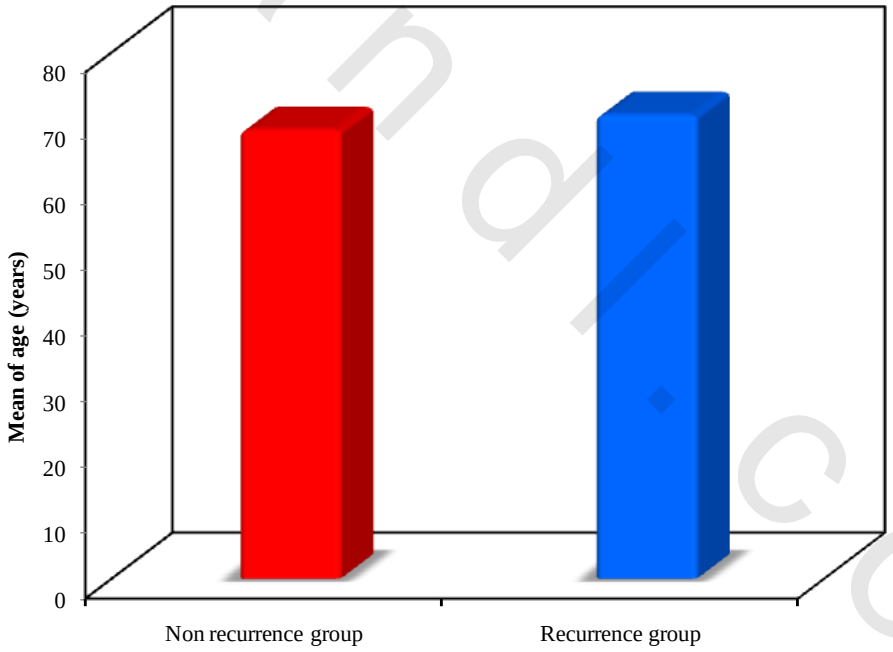


Figure (8): Comparison between the two studied groups according to age.

Table (3): Distribution of the studied cases according to clinical data in the non-recurrence group (n = 33).

Clinical data	No.	%
Causes of CSDH		
Unknown etiology	5	15.2
Minor trauma	20	60.6
Moderate to severe trauma	3	9.1
Post craniotomy	2	6.1
Shunting for hydrocephalus	2	6.1
Anticoagulant therapy	2	6.1
Antiplatelet therapy	5	15.2
Other Comorbidities		
Cerebrovascular disease	5	15.2
Psychiatric disease	3	9.1
Renal impairment	4	12.1
DM.	20	60.6
HTN.	18	54.5
Heart disease	12	36.4
Arrhythmias	5	15.2
Hepatic dysfunction	8	24.2
Trauma to surgery interval		
≥60 days	9	57.6
<60 days	14	42.4

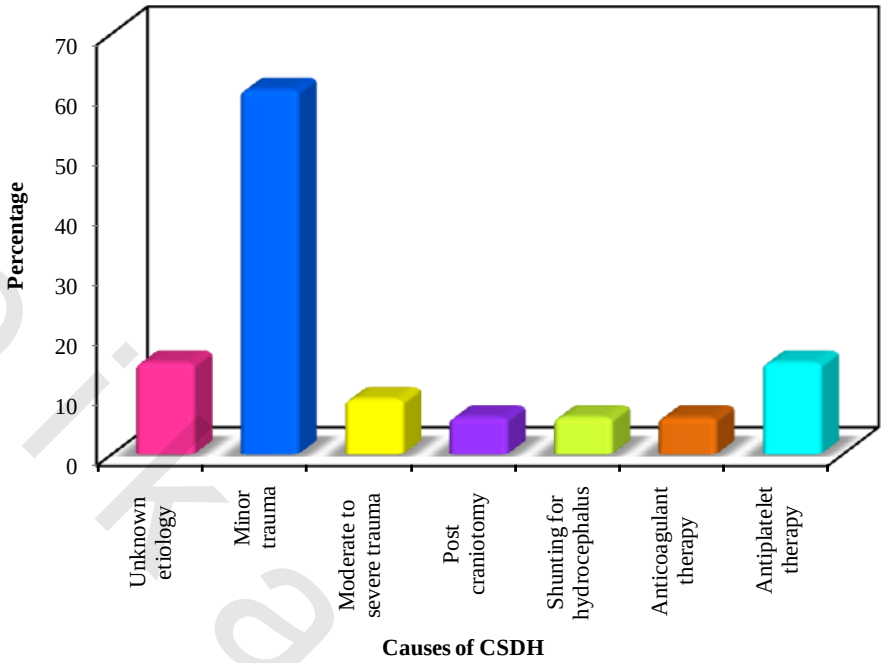


Figure (9): Distribution of the studied cases according to causes of CSDF in the non-recurrence group.

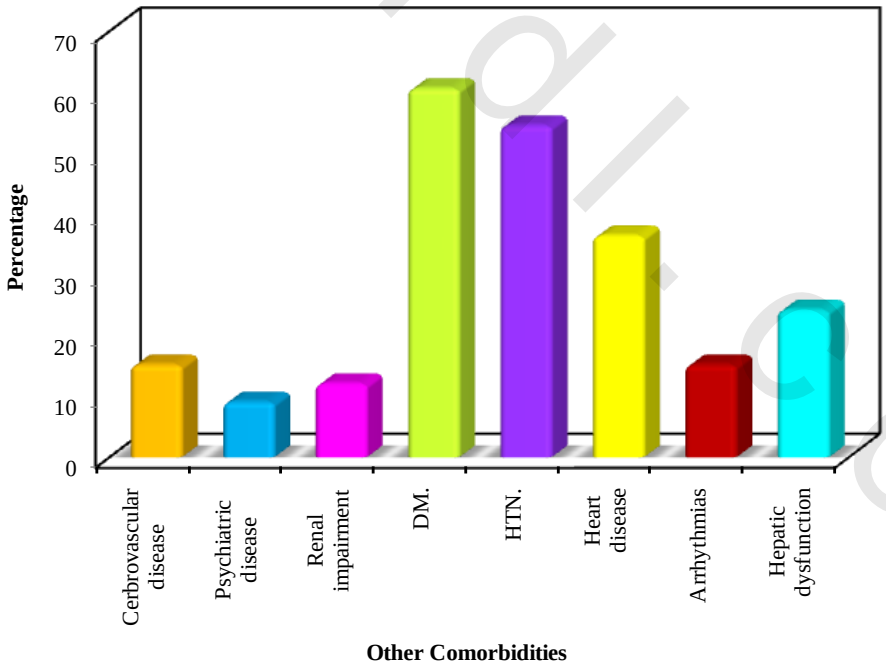


Figure (10): Distribution of the studied cases according to other comorbidities in the non-recurrence group.

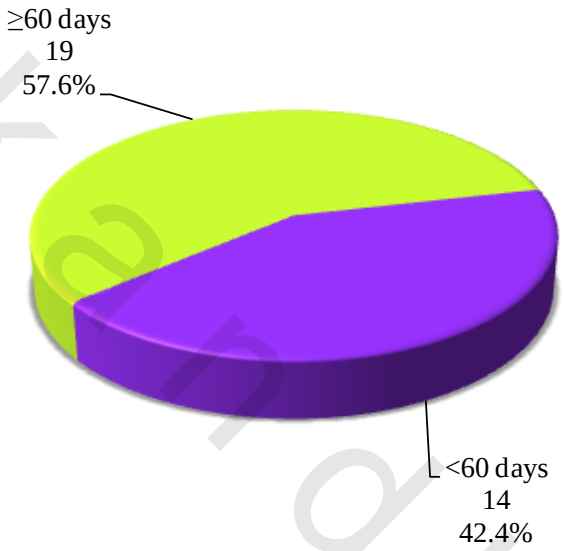


Figure (11): Distribution of the studied cases according to trauma to surgery interval in the non-recurrence group.

Table (4): Distribution of the studied cases according to clinical data in the recurrence group (n = 7).

Clinical data	No.	%
Causes of CSDH		
Unknown etiology	1	14.3
Minor trauma	3	42.9
Moderate to severe trauma	0	0.0
Post craniotomy	0	0.0
Shunting for hydrocephalus	0	0.0
Anticoagulant therapy	4	57.1
Antiplatelet therapy	3	42.9
Other Comorbidities		
Cerebrovascular disease	2	28.6
Psychiatric disease	1	14.3
Renal impairment	1	14.3
DM.	3	42.9
HTN.	2	28.6
Heart disease	3	42.9
Arrhythmias	1	14.3
Hepatic dysfunction	5	71.4
Trauma to surgery interval		
≥60 days	3	42.9
<60 days	4	57.1

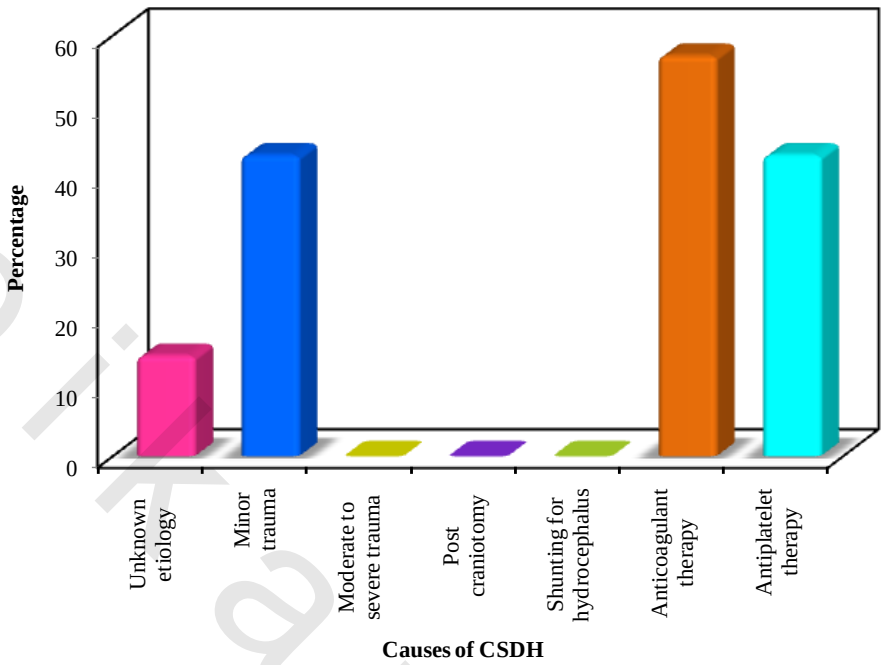


Figure (12): Distribution of the studied cases according to causes of CSDH in the recurrence group.

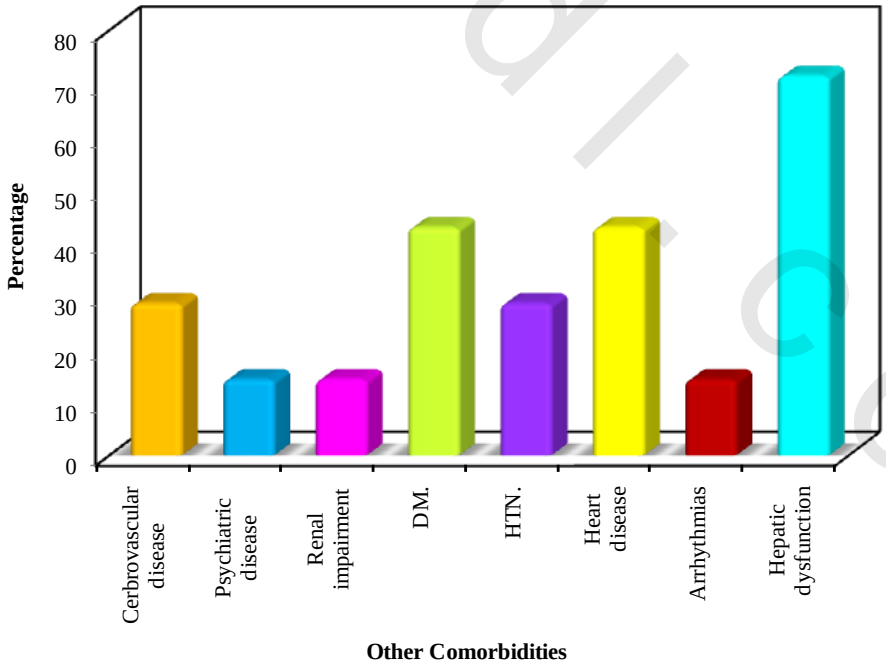


Figure (13): Distribution of the studied cases according to other comorbidities in the recurrence group.

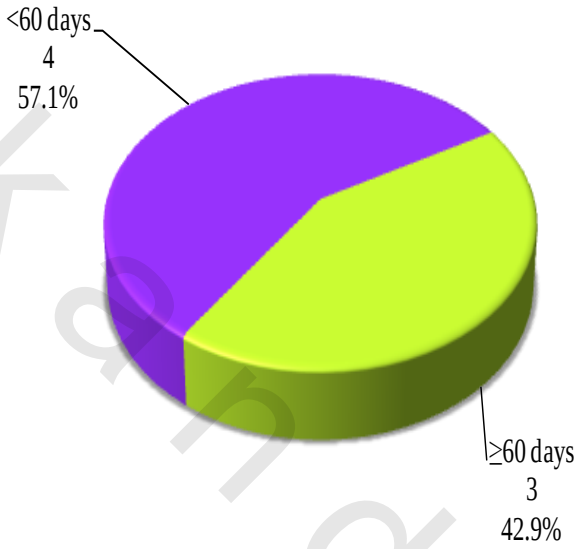


Figure (14): Distribution of the studied cases according to trauma to surgery interval in the recurrence group**.**

In the recurrence group three patients out of seven were taking anticoagulant therapy and four patients out of seven were taking antiplatelet therapy. Three patients were suffering from renal dysfunction and 5 patients were suffering from hepatic dysfunction. This indicates that bleeding tendency in those patients was dependent risk factor for recurrence. Other comorbidities were not of significant importance and did not affect the rate of recurrence in both groups.

Table (5): Comparison between the two studied groups according to clinical data.

Clinical data	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)		χ^2	^{FE}p
	No.	%	No.	%	No.	%		
Causes of CSDH								
Unknown etiology	5	15.2	1	14.3	6	15.0	0.003	1.000
Minor trauma	20	60.6	3	42.9	23	57.5	0.744	0.432
Moderate to severe trauma	3	9.1	0	0.0	3	7.5	0.688	1.000
Post craniotomy	2	6.1	0	0.0	2	5.0	0.447	1.000
Shunting for hydrocephalus	2	6.1	0	0.0	2	5.0	0.447	1.000
Anticoagulant therapy	2	6.1	3	57.1	6	15.0	11.819	0.005*
Antiplatelet therapy	4	12.1	4	57.1	8	20.0	7.316*	0.020*
Other Comorbidities								
Cerebrovascular disease	5	15.2	2	28.6	7	17.5	0.720	0.584
Psychiatric disease	3	9.1	1	14.3	4	10.0	0.173	0.552
Renal impairment	2	6.1	3	42.9	5	12.5	7.149*	0.030*
DM.	20	60.6	3	42.9	23	57.5	0.744	0.432
HTN.	18	54.5	2	28.6	20	50.0	1.558	0.407
Heart disease	12	36.4	3	42.9	15	37.5	0.104	1.000
Arrhythmias	5	15.2	1	14.3	6	15.0	0.003	1.000
Hepatic dysfunction	8	24.2	5	71.4	13	32.5	5.861*	0.027*
Trauma to surgery interval								
≥60 days	19	57.6	3	42.9	22	55.0	0.505	0.680
<60 days	14	42.4	4	57.1	18	45.0		

χ^2: Value for Chi square
FE: Fisher Exact test
*: Statistically significant at $p \leq 0.05$

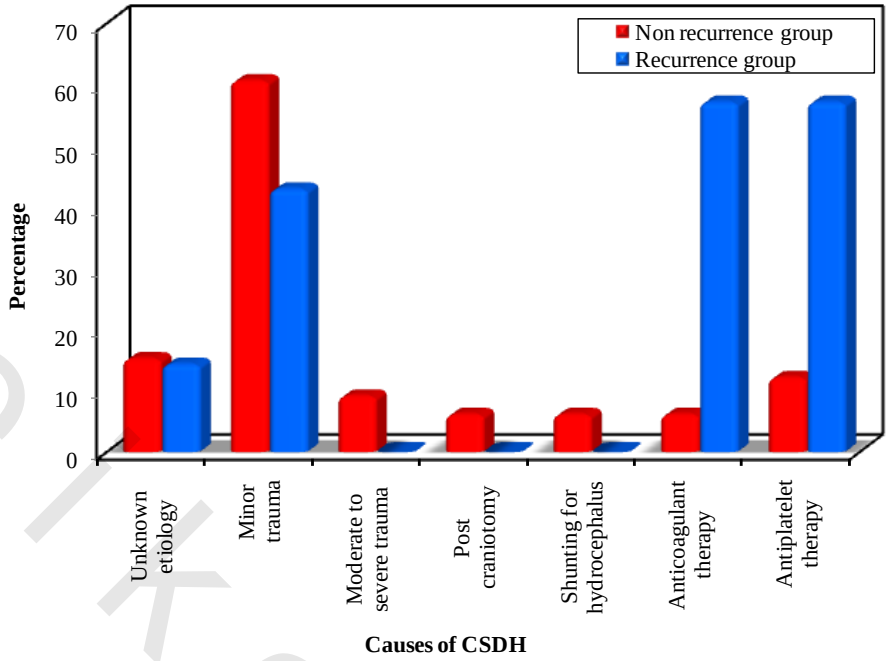


Figure (15): Comparison between the two studied groups according to Causes of CSDH.

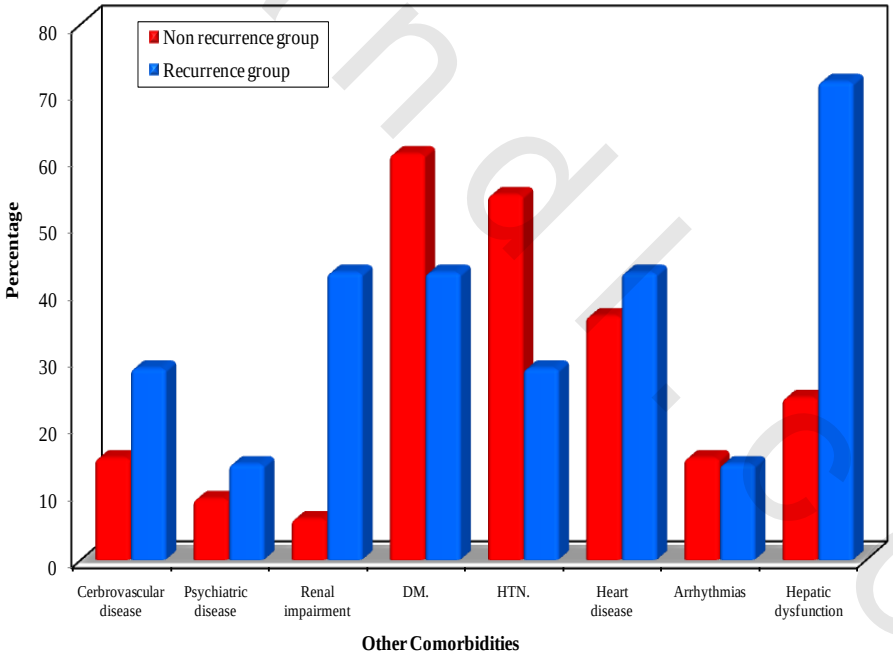


Figure (16): Comparison between the two studied groups according to Other Comorbidities**.**

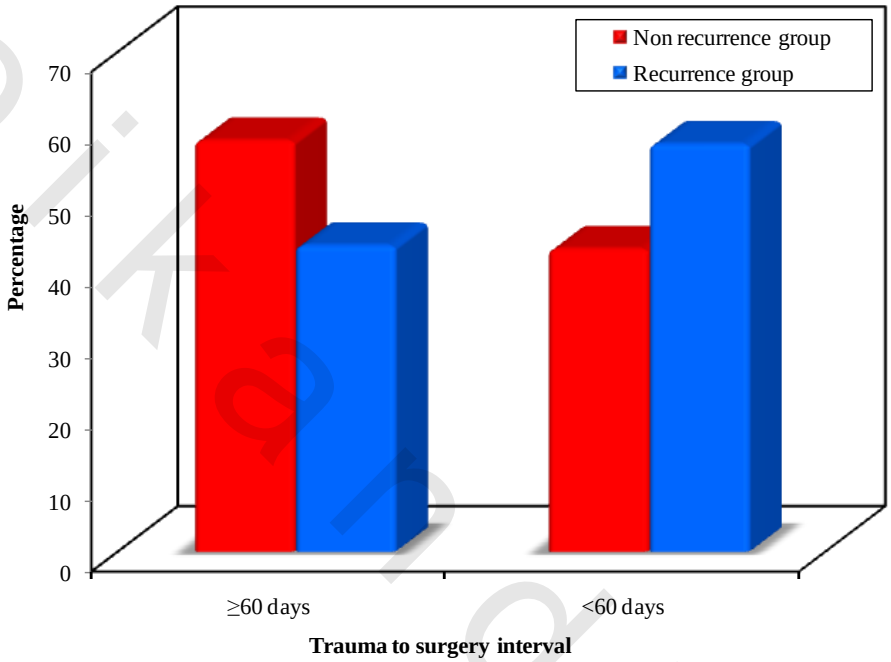


Figure (17): Comparison between the two studied groups according to trauma to surgery interval.

In the non-recurrence group 28 patients had a GCS more than 13 and 5 patients had a score less than 13 score. At time of discharge 25 patients were discharged with good recovery, 4 patients with mild morbidity, 1 patient with moderate morbidity, 1 patient vegetative and 1 patient died with severe post-operative complications. In the recurrence group 5 patients out of 7 had a GCS more than 13 at time of admission and 2 had a score less than 13. At time of discharge 2 patients were discharged with good recovery, 2 patients with mild morbidity,1 patient with moderate morbidity,1 patients at vegetative state and one patient died.

Pre-operative GCS score and post-operative Glasgow outcome scale score were not dependent risk factors for recurrence.

Table (6): Comparison between the two studied groups according to pre-operative Glasgow Coma Scale score.

	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
Pre-operative GCS score						
≥13	28	84.8	5	71.4	33	82.5
<13	5	15.2	2	28.6	7	17.5
χ^2(^{FE}p)	0.720 (0.584)					

χ^2: Value for chi square
FE: Fisher Exact test

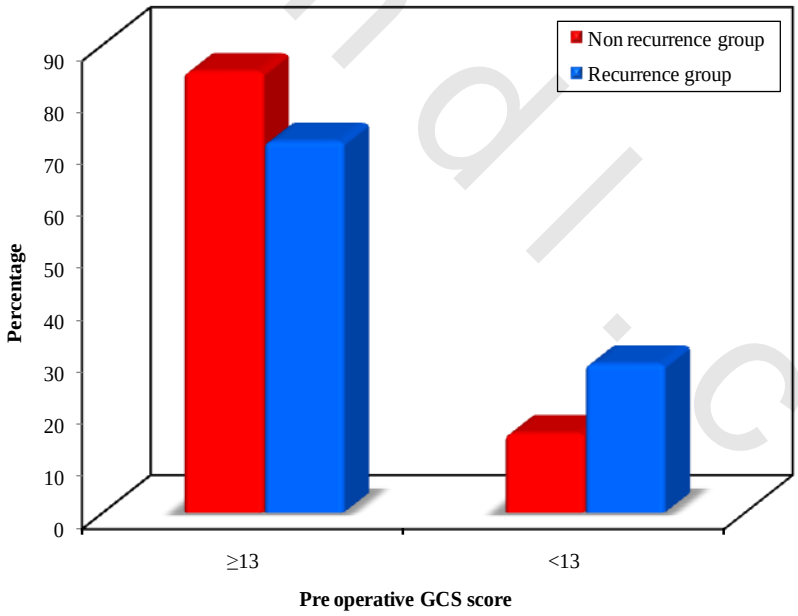


Figure (18): Comparison between the two studied groups according to Pre-operative GCS score.

Table (7): Comparison between the two studied groups according to post-operative Outcome Scale score.

	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
Post-operative outcome score						
Good recovery	25	75.8	2	28.6	27	67.5
Mild morbidity	4	12.1	2	28.6	6	15.0
Moderate morbidity	2	6.1	1	14.3	3	7.5
Vegetative state	1	3.0	1	14.3	2	5.0
Dead	1	3.0	1	14.3	2	5.0
χ^2(^{MC}p)	7.881 (0.062)					

χ^2: Value for chi square
FE: Fisher Exact test
MC: Monte Carlo test

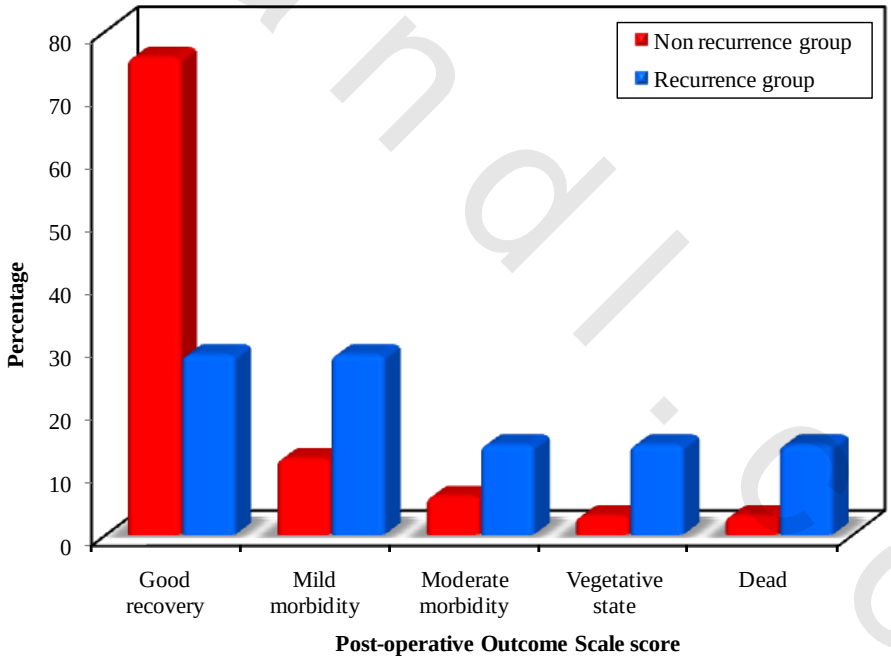


Figure (19): Comparison between the two studied groups according to post-operative outcome scale score**.**

Table (8): Distribution of the studied cases according to internal architecture of the hematoma in the non-recurrence group

Internal architecture of the hematoma	No.	%
Homogenous type	6	18.2
Separate type	7	21.2
Laminar type	9	27.3
Trabecular type	11	33.3

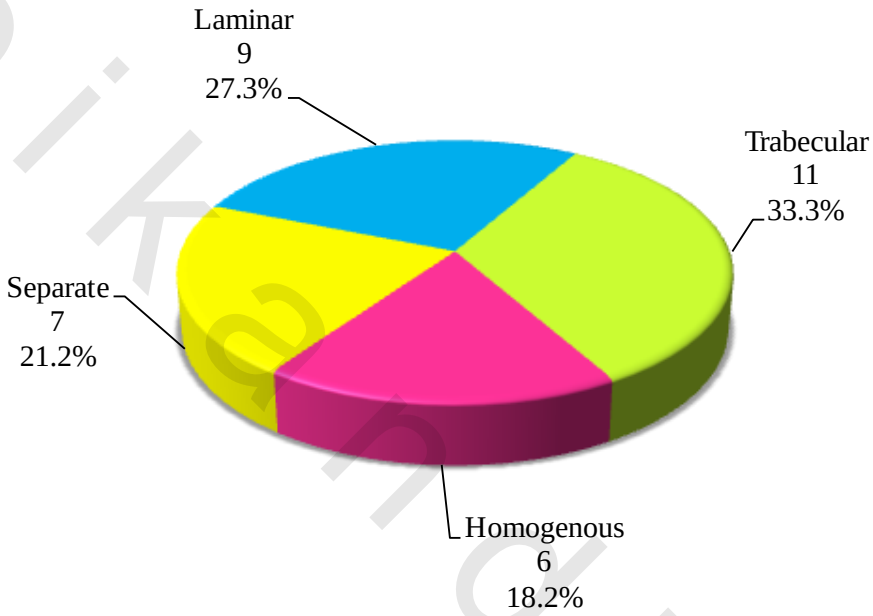


Figure (20): Distribution of the studied cases according to internal architecture of the hematoma in the non-recurrence group.

Table (9): Distribution of the studied cases according to internal architecture of the hematoma in the recurrence group

Internal architecture of the hematoma	No.	%
Homogenous type	0	0.0
Separate type	4	57.1
Laminar type	3	42.9
Trabecular type	0	0.0

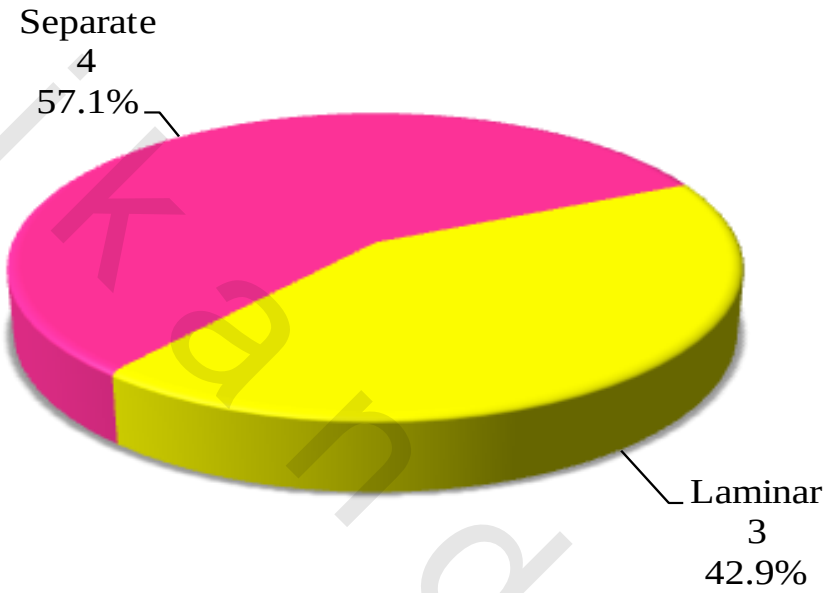


Figure (21): Distribution of the studied cases according to internal architecture of the hematoma in the recurrence group**.**

In the recurrence group, the hematoma density was of an important significance. Three patients out of 7 had a CSDH of the laminar type and 4patients had a CSDH of the separate type which indicate that homogenous and separate types were risk factors for recurrence.

Table (10): Comparison between the two studied groups according to internal architecture of the hematoma.

Internal architecture of the hematoma	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
Homogenous	7	21.2	0	0.0	7	17.5
Separate	6	18.2	4	57.1	10	25.0
Laminar	9	27.3	3	42.9	12	30.0
Trabecular	11	33.3	0	0.0	11	27.5
χ^2(^{MC}p)	6.851* (0.043*)					

χ^2: Chi square test
MC: Monte Carlo test
*: Statistically significant at $p \leq 0.05$

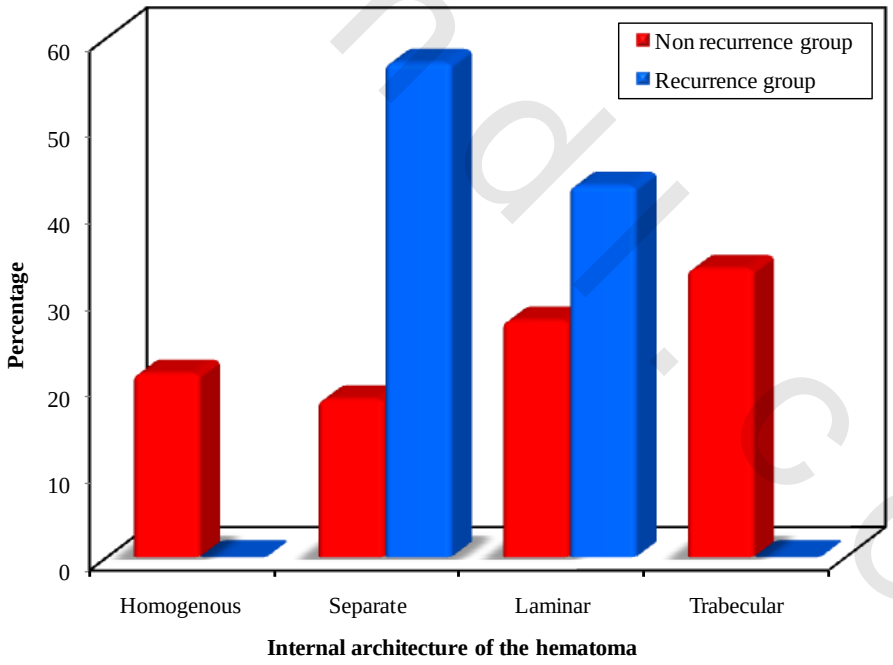


Figure (22): Comparison between the two studied groups according to internal architecture of the hematoma**.**

Table (11): Comparison between the two studied groups according to width of the hematoma.

Width of hematoma	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
≥2cm	8	25.0	5	71.4	13	33.3
<2cm	24	75.0	2	28.6	26	66.7
χ^2(^{FE}p)	5.571* (0.030*)					

χ^2: Chi square test
FE: Fisher Exact test
*: Statistically significant at p ≤ 0.05

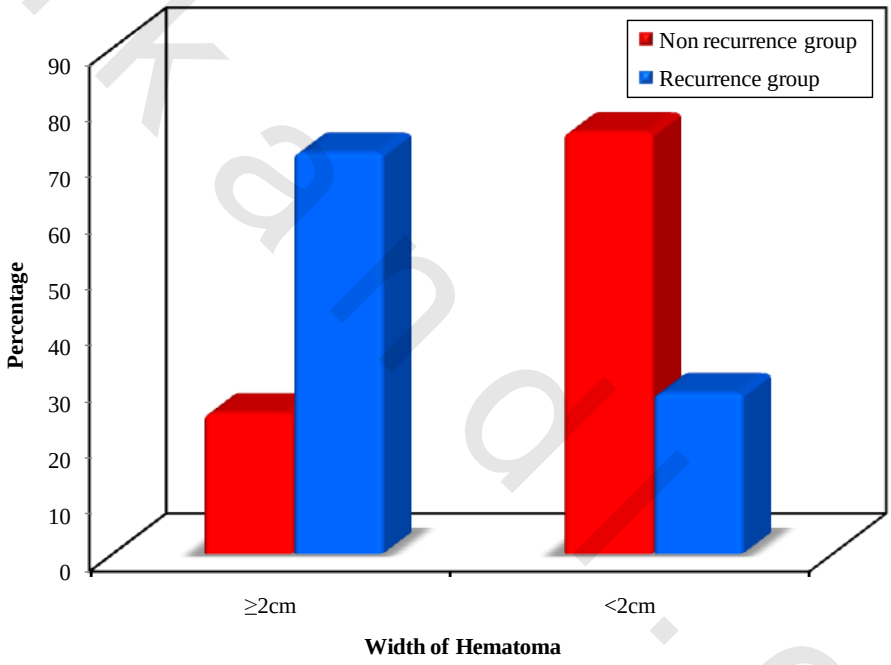


Figure (23): Comparison between the two studied groups according to width of the hematoma**.**

Table (12): Comparison between the two studied groups according to post-operative mid line shift.

Post-operative mid line shift	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
Mid line shift ≥5mm	11	33.3	6	85.7	17	42.5
Mid line shift <5mm	22	66.7	1	14.3	23	57.5
χ^2(^{FE}p)	6.484* (0.029*)					

χ^2: Chi square test
FE: Fisher Exact test
*: Statistically significant at p ≤ 0.05

Figure (24): Comparison between the two studied groups according to post-operative mid line shift.

Table (13): Comparison between the two studied groups according to post-operative subdural air collection.

Post-operative subdural air	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
No air or little	25	75.8	2	28.6	27	67.5
Massive air	8	24.2	5	71.4	13	32.5
χ^2(^{FE}p)	5.861* (0.027*)					

χ^2: Value for chi square
FE: Fisher Exact test
*: Statistically significant at $p \leq 0.05$

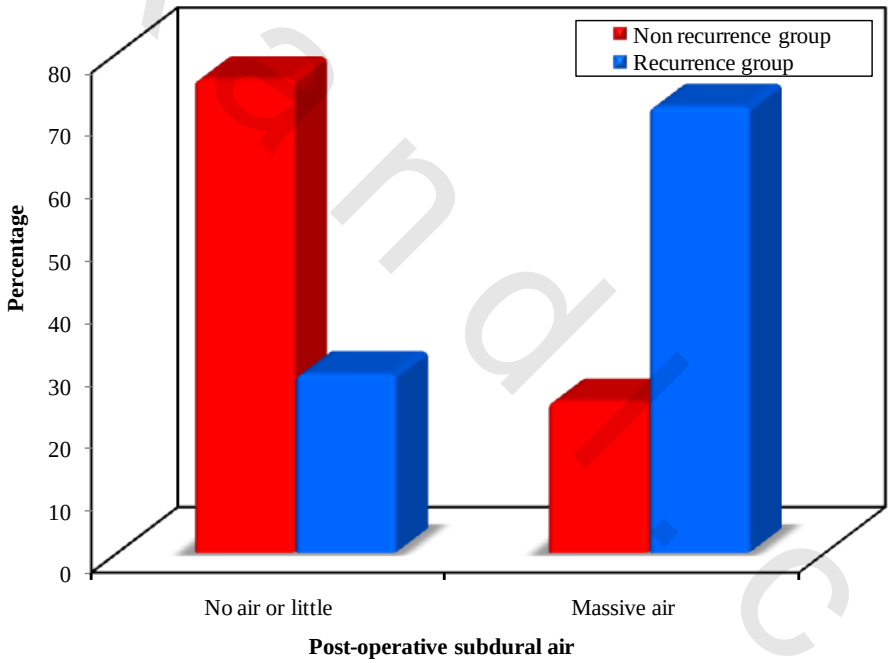


Figure (25): Comparison between the two studied groups according to post-operative subdural air collection.

In the recurrence group 5 patients out of 7 had a hematoma thickness more than 2 cm and 6 patients out of 7 had a mid-line shift more than 5 ml. This indicates that width of the hematoma and post-operative mid-line shift are dependent predictors for recurrence of CSDH. Twelve patients out of 33 had a subdural air collection in the no-recurrence group and 5 patients out of 7 had a subdural air collection in the immediate post-operative CT brain scans. This indicated that subdural air collection in the post-operative CT brain is a dependent predictor for recurrence of CSDH.

Table (14): Summary of variables of post-operative subdural space in the post-operative CT brain in both studied groups.

Variables of post-operative subdural space	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
Maximum width of the subdural space						
≥10 mm	8	25.0	5	71.4	13	33.3
< 10 mm	24	75.0	2	28.6	26	66.7
χ^2(^{FE}p)	5.571* (0.030*)					
Subdural air collection						
No or little air	25	75.8	2	28.6	27	67.5
Massive air	8	24.2	5	71.4	13	32.5
χ^2(^{FE}p)	5.861* (0.027*)					
Maximum midline shift						
≥5 mm	11	33.3	6	85.7	17	42.5
<5 mm	22	66.7	1	14.3	23	57.5
χ^2(^{FE}p)	6.484* (0.029*)					

χ^2: Value for chi square
FE: Fisher Exact test
*: Statistically significant at $p \leq 0.05$

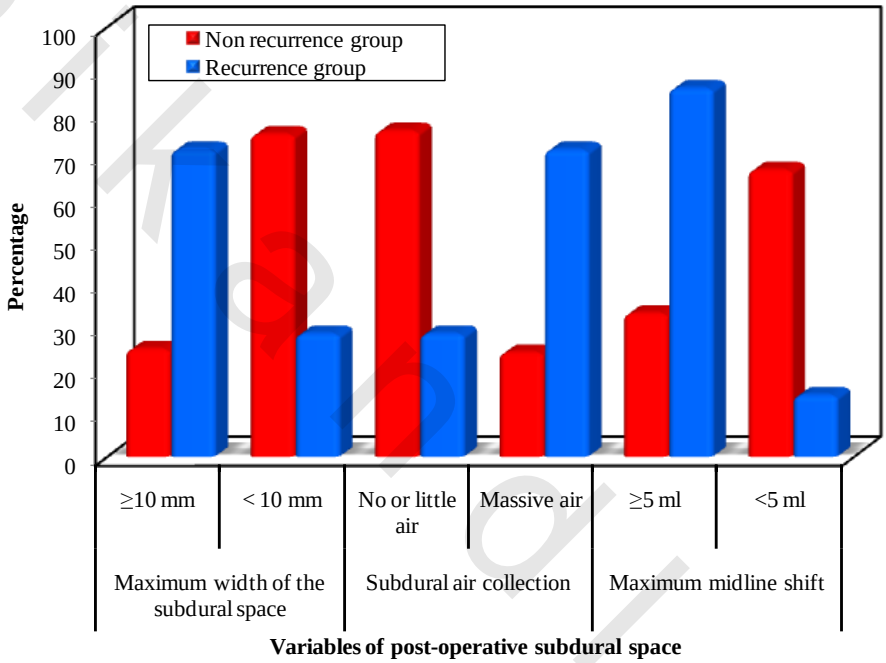


Figure (26): Summary of variables of post-operative subdural space in the post-operative CT brain in both studied groups.

Five patients out of 33 had bilateral CSDH in the no-recurrence group and 4 patients out of 7 had a bilateral hematoma in the recurrence group. This indicates that bilateral hematoma is dependent predictor for recurrence.

Table (15): Comparison between the two studied groups according to Bilaterality of the hematoma.

Bilateral CSDH	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
Bilateral	5	15.2	4	57.1	9	22.5
Unilateral	28	84.8	3	42.9	31	77.5
χ^2(^{FE}p)	5.840* (0.034*)					

χ^2: Value for chi square
FE: Fisher Exact test
*: Statistically significant at $p \leq 0.05$

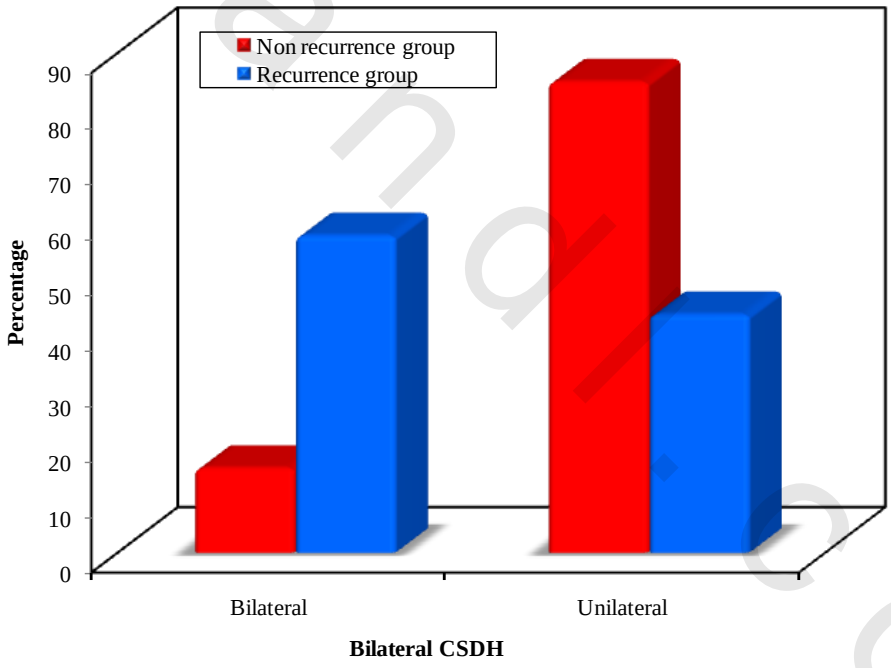


Figure (27): Comparison between the two studied groups according to Bilaterality of the hematoma**.**

In the non-recurrence group 18 patients were positioned in non-flat position in the post-operative period and 15 patients were kept in flat position. In the recurrence group 4 patients were kept in non-flat position and 3 patients were kept flat. There was no important significance between the two comparison groups. Post-operative position was not dependent predictor for recurrence.

Table (16): Comparison between the two studied groups according to the post-operative position.

Post-operative position	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
Non flat	18	54.5	4	57.1	22	55.0
Flat	15	45.5	3	42.9	18	45.0
χ^2(^{FE}p)	0.016 (1.000)					

χ^2: Value for chi square
FE: Fisher Exact test

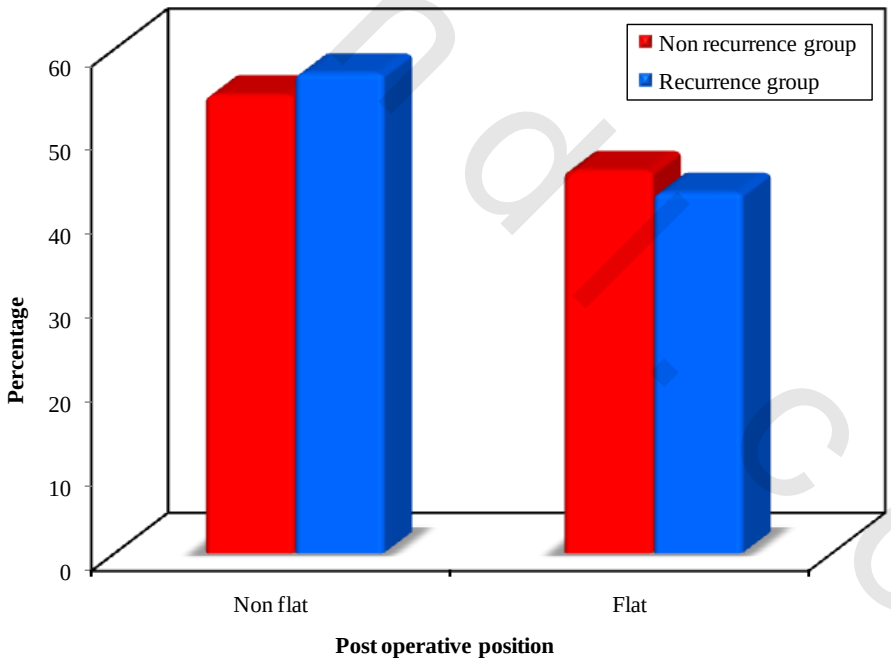


Figure (28): Comparison between the two studied groups according to the post-operative position.

There was not significant importance between the two studied groups as regard the post-operative drainage volume. Post-operative drainage volume was not dependent risk factor for recurrence.

Table (17): Comparison between the two studied groups according to post-operative complications.

Post-operative complications	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
Superficial wound infection	3	21.4	1	25.0	4	22.2
Subdural empyema	1	7.1	0	0.0	1	5.6
Acute subdural bleeding	2	14.3	1	25.0	3	16.7
Non improvement of the neurological deficit	4	28.6	1	25.0	5	27.8
Massive Subdural air collection	8	24.2	5	71.4	5.861*	0.027*
Uncontrolled seizures	2	14.3	1	25.0	3	16.7
Intracerebral hematoma	2	14.3	0	0.0	2	11.1
$\chi^2(^{MC}p)$	2.366 (0.974)					

χ^2: Value for Chi square
MC: Monte Carlo test

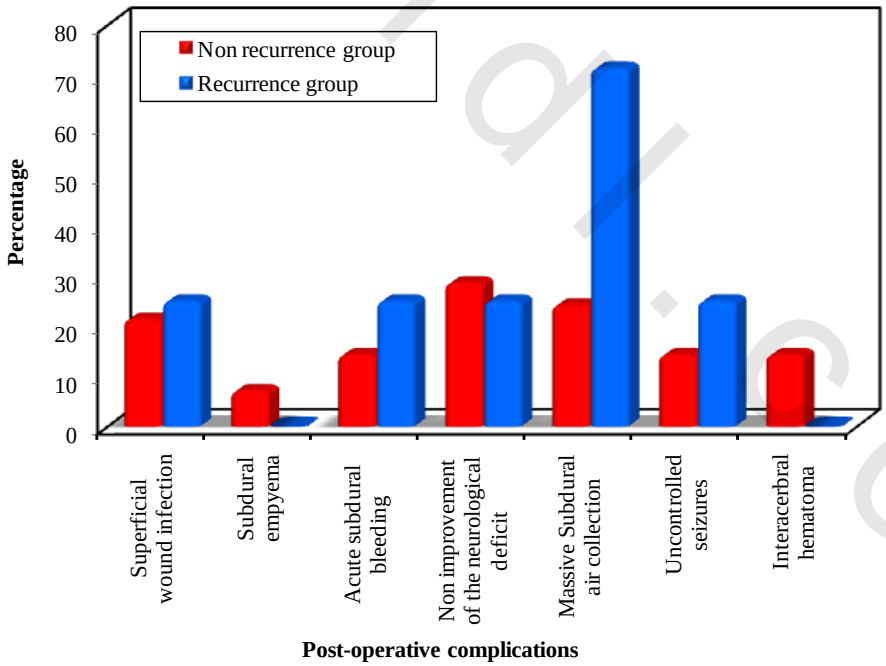


Figure (29): Comparison between the two studied groups according to post-operative complications.

Type of anesthesia used in the evacuation of the CSDH was determined according to the cardiac risks and other comorbidities in every patient. Type of anesthesia either general or local was not a risk factor for recurrence.

Table (18): Comparison between the two studied groups according to type of anesthesia used in the evacuation of the hematoma.

Type of anesthesia	Non recurrence group (n = 33)		Recurrence group (n = 7)		Total (n = 40)	
	No.	%	No.	%	No.	%
General anesthesia	20	60.6	5	71.4	25	62.5
Local anesthesia	13	39.4	2	28.6	15	37.5
χ^2(^{FE}p)	0.289 (0.691)					

χ^2: Value for chi square
FE: Fisher Exact test
*: Statistically significant at $p \leq 0.05$

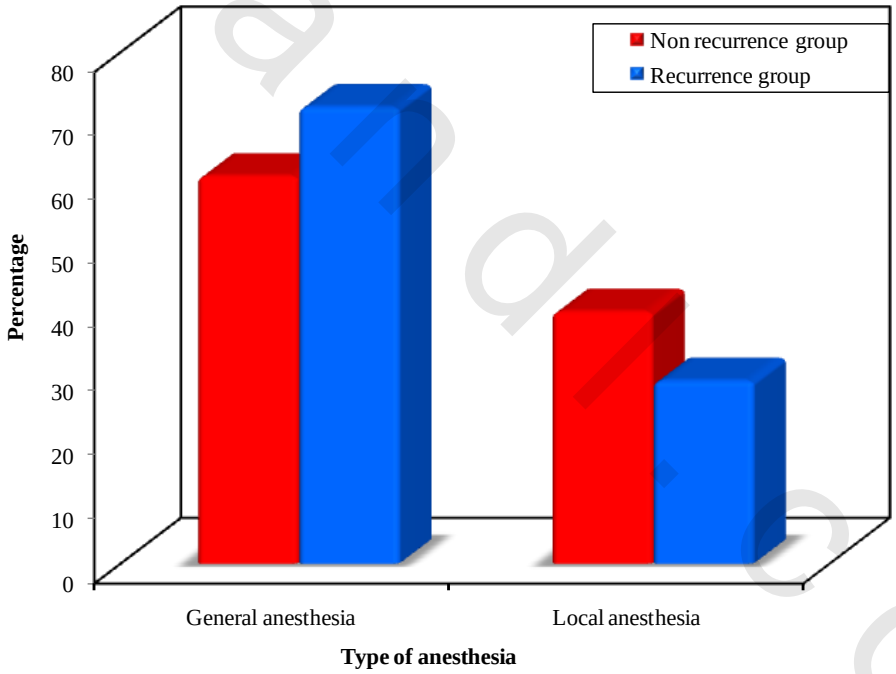
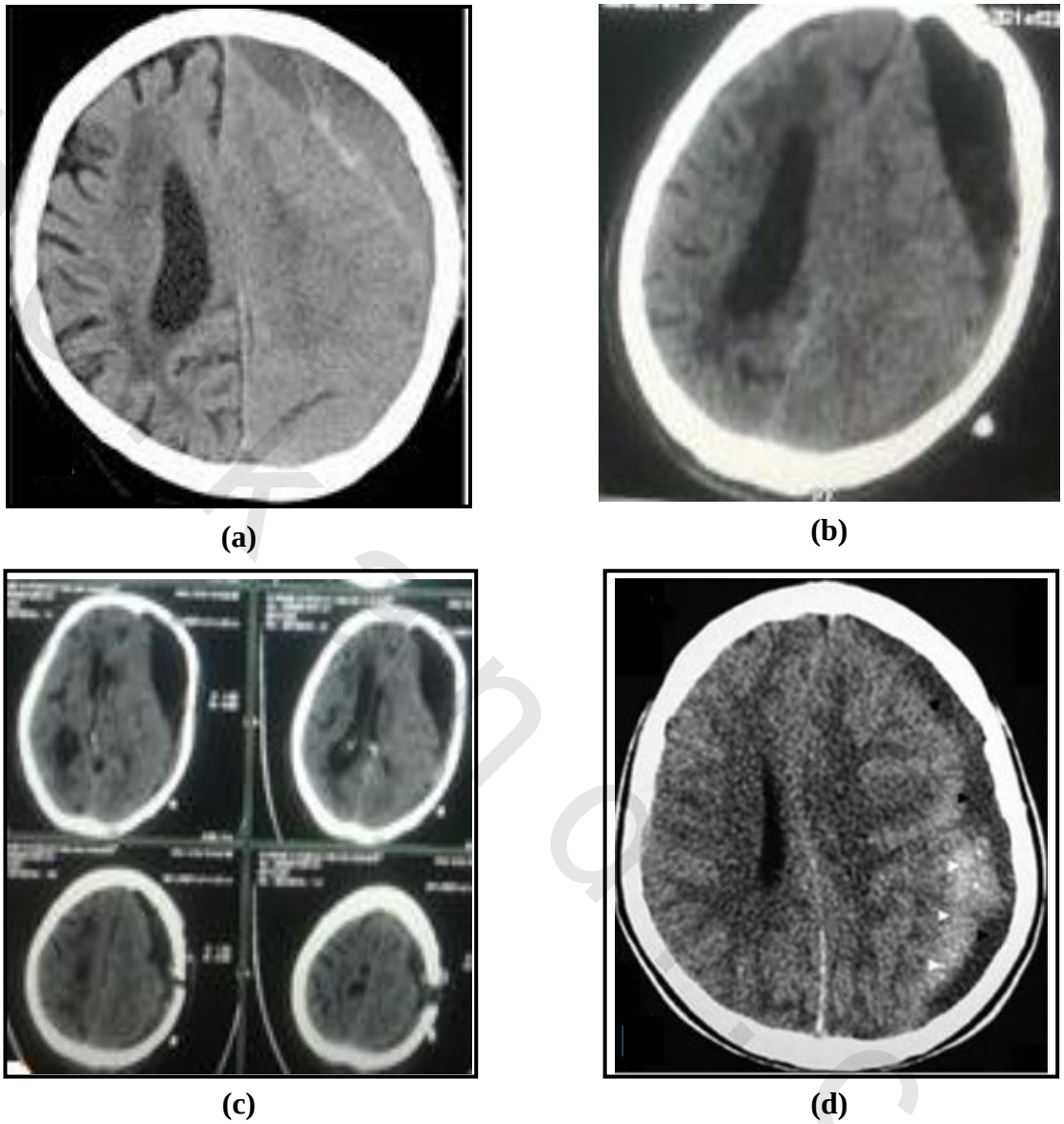


Figure (30): Comparison between the two studied groups according to type of anesthesia used in the evacuation of the hematoma.

ILLUSTRATIVE CASES

Case 1

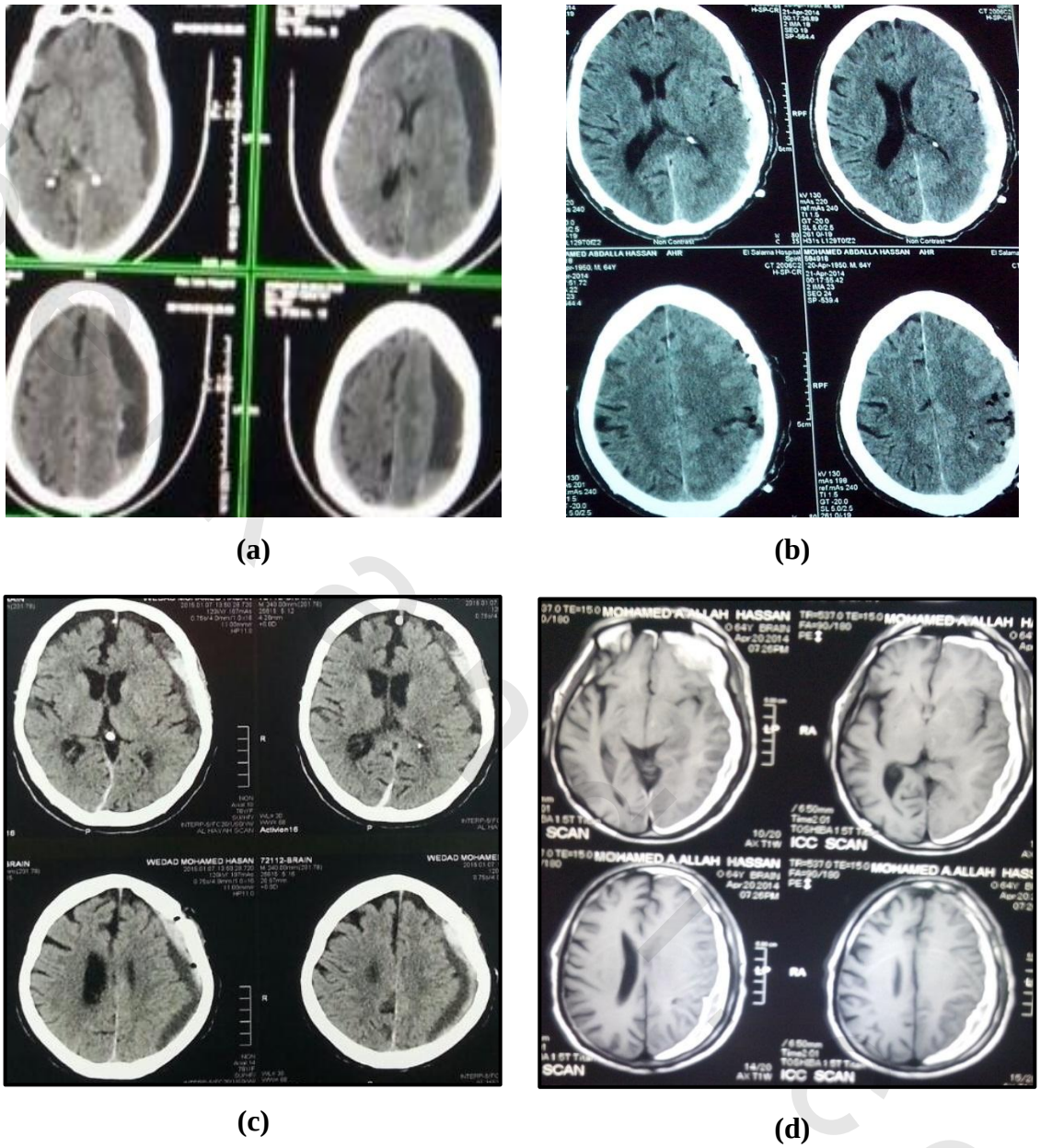


(a) **(b)**

(c) **(d)**

Figure (31): CT images. (a) Initial CT with a left-sided chronic subdural hematoma of the laminar type in 69 years male patient on oral anticoagulant. (b, c) CT brain done after evacuation of the CSDH using one bur hole and subcutaneous closed system drainage showing massive subdural air collection and large mid-line shift. Subdural air resolved gradually with flat head position and adequate fluid intake. (d) CT brain done 2 months after discharge of the patient because of recurrence of the symptoms (headache and right hemiparesis) showing recurrent CSDH.

Case 2



(a) **(b)**

(c) **(d)**

Figure (32): CT and MRI images. (a) Initial CT with a left-sided fronto-pariatal chronic subdural hematoma of the separate type in 60 years male patient with hepatic dysfunction and on oral anticoagulant with history of mitral valve replacement since 5 years. (b) CT brain done after evacuation of the CSDH using tow bur holes and subcutaneous closed system drainage showing complete evacuation of the hematoma with no subdural air collection and no mid-line shift. (c,d) CT and MRI brain done 3 months after discharge of the patient because of recurrence of the symptoms (headache and right hemiparesis) showing recurrent CSDH.

Case 3

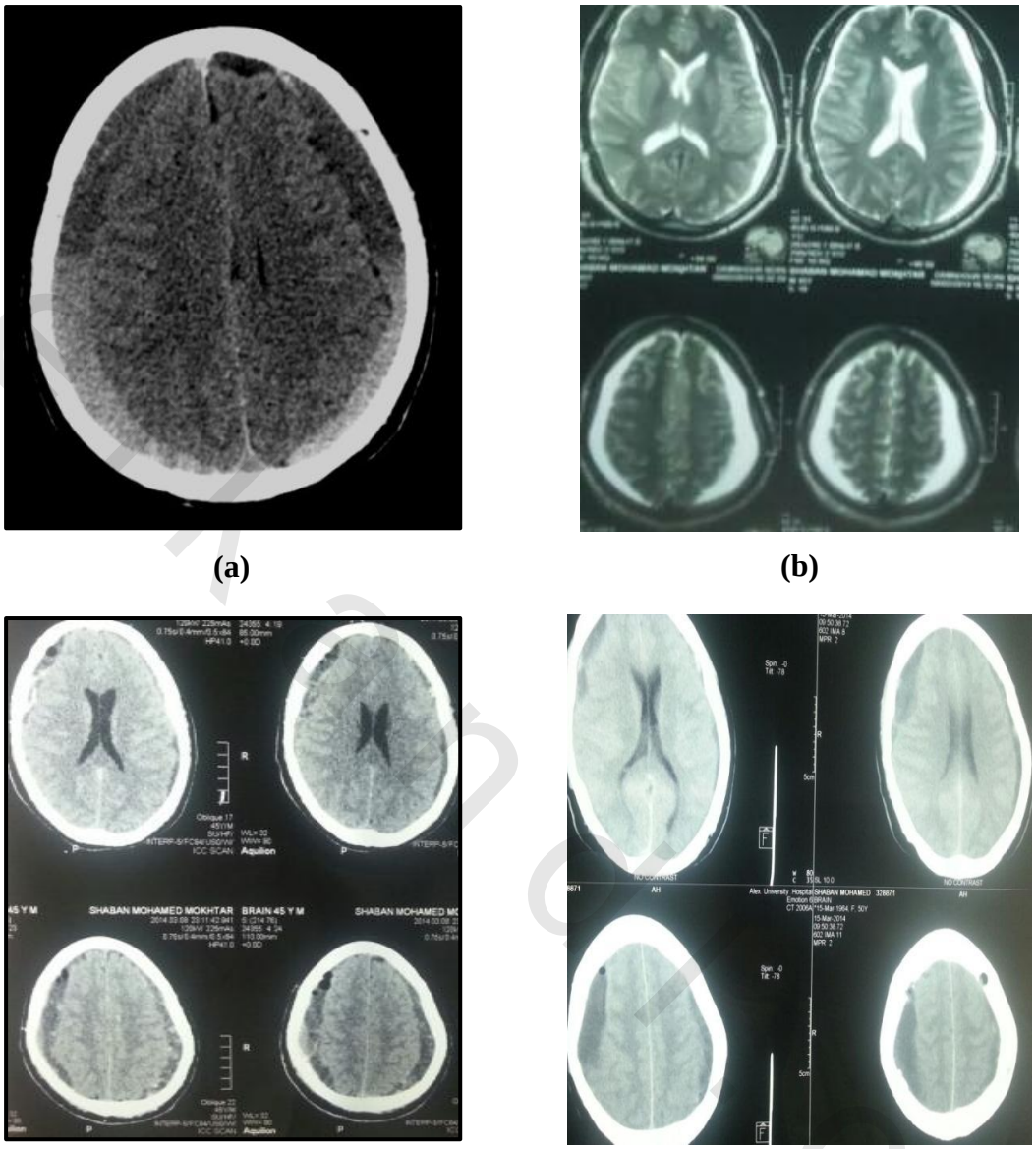
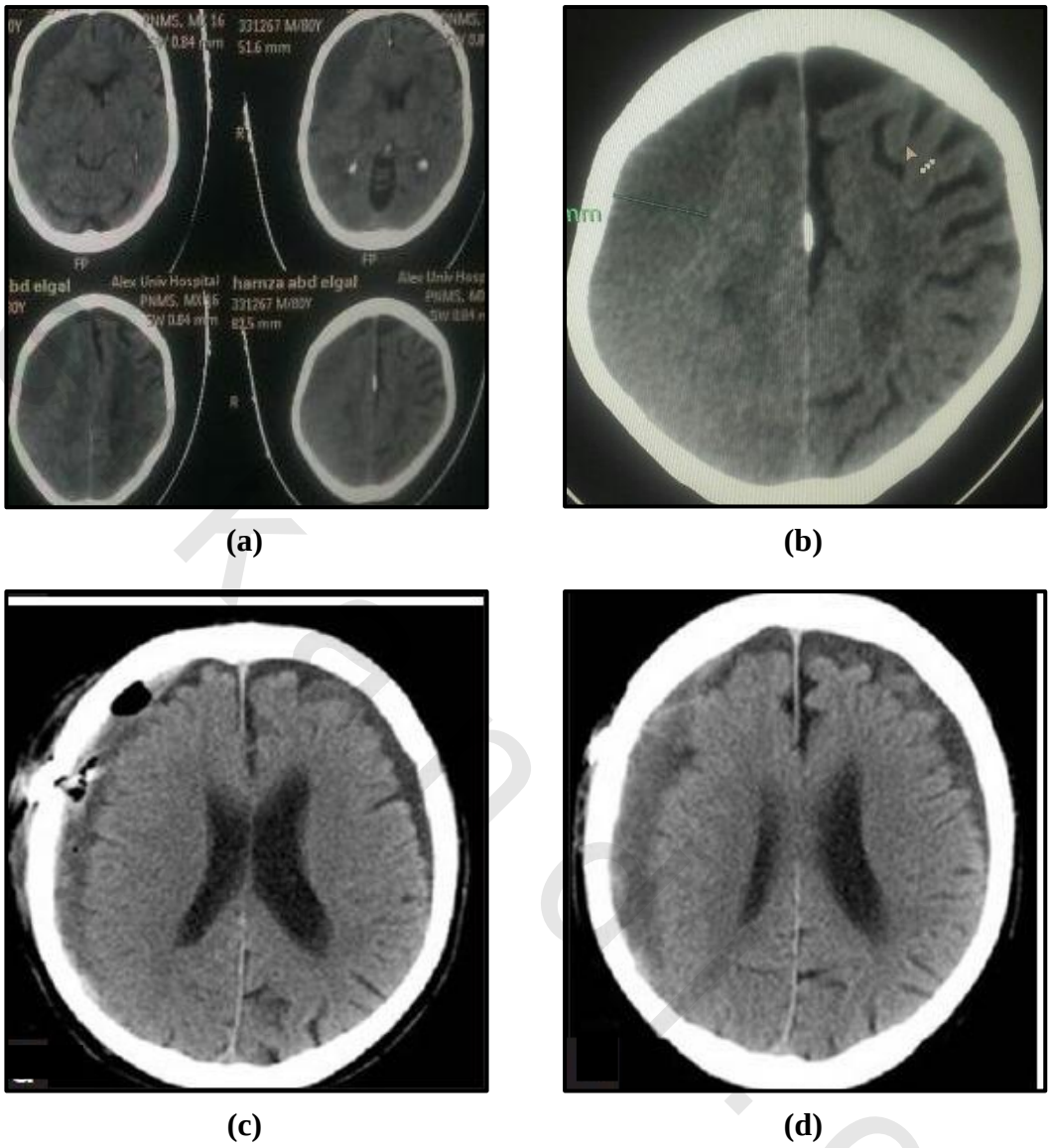


Figure (33): CT and MRI images. (a,b) Initial CT and MRI brain showing bilateral chronic subdural hematoma of the separate type in 58 years male patient on antiplatelet therapy. (c) CT brain done after evacuation of the CSDH using tow bur holes and subcutaneous closed system drainage on each side showing evacuated bilateral hematomas with improvement of the symptoms (disturbed sensorium with GCS 13 and bilateral hemiparesis. (d) CT brain done 1 months after discharge of the patient because of recurrence of the symptoms (right hemiparesis) showing recurrent right parietal CSDH.

Case 4



(a) **(b)**

(c) **(d)**

Figure (34): CT images. (a,b) Initial CT showing right fronto-pariatal CSDH of the separate type in 70 years male patient on antiplatelet therapy. (c) CT brain done after evacuation of the CSDH using tow bur holes and subcutaneous system drainage on showing evacuated hematoma, decreased mid-line shift and small frontal subdural air with improvement of the symptoms (left hemiparesis). (d) CT brain done 3 months after discharge of the patient because of recurrence of the symptoms (left hemiparesis) showing recurrent right parietal CSDH.