Surgical management of spontaneous intracerebral hemorrhage

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Background Spontaneous, nontraumatic intracerebral hemorrhage (ICH) remains a significant cause of morbidity and mortality throughout the world. Although ICH has traditionally lagged behind ischemic stroke and aneurysmal subarachnoid hemorrhage in terms of evidence from clinical trials to guide management, the past decade has seen a dramatic increase in studies of ICH intervention.

Aimof study The aim of the study is to assess the benefits of surgical evacuation of spontaneous ICH and the factors affecting the outcome.

Patients and methods The presented study includes 30 patients with spontaneous hypertensive ICH who had surgical evacuation in Al-Azhar University Hospitals and Matarya Teaching Hospital.

A history and examination, including an assessment of the baseline level of consciousness by the Glasgow coma scale (GCS) and of the neurological status, were obtained at the time of admission. The time of onset of symptoms was determined on the basis of interview of the patient, family, and witnesses.

Results There is a statistically highly significant relationship between GCS on admission (preoperative) and outcome (*P*=0.002, highly significant). GCS preoperative is significantly correlated with GCS postoperative, that is the better the GCS preoperative is, the better the GCS postoperative would be. There is a statistically highly significant relationship between volume of hematoma and outcome (*P*=0.01, highly significant). No statistically significant difference was detected between the outcome of cases with residual hematoma volume (≤20 ml) after surgical evacuation and cases with total hematoma evacuation (*P*=0.81, nonsignificant). No statistically significant difference was detected between the outcome of the diabetic and nondiabetic patients (*P*=0.86, nonsignificant). The best surgical results were obtained in patients who present early, with a hematoma size of 30–60 ml, and in patients with a GCS of above 10.

Conclusion Spontaneous ICH is a treatable condition provided that the patients receive appropriate care from trained staff to deal with such cases. The best candidates for ICH evacuation are those with hematoma volume 30–60 ml and GCS more than 10.

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Introduction

Spontaneous intracerebral hemorrhage (ICH) is defined as hemorrhage in the brain in the absence of immediate trauma. It can be divided into primary and secondary types [1].

Primary ICH occurs in the absence of a structural disease process and it accounts for 70–80% of cases and are caused by either chronic hypertension, which accounts for more than 50% of cases or amyloid angiopathy [2]. Secondary ICH is associated with an underlying condition such as vascular malformations, coagulopathy, tumors, or substance abuse [3].

The most common locations of cases of spontaneous ICH are basal ganglia (50% of cases) followed by subcortical white matter, cerebellum, and thalamus. Common neurological signs in cases of putaminal ICH are hemiparesis, hemisensory syndrome, homonymous hemianopsia, horizontal gaze palsy, aphasia (in dominant hemisphere), and hemineglect (in the nondominant hemisphere). Caudate hemorrhage represents ~5–7% of cases of ICH. The bleeding vessels are the perforating branches of the anterior and middle cerebral arteries. Ventricular extension into the frontal horn of the lateral ventricle is common with secondary hydrocephalus [4].

Computed tomography (CT) scan of the brain has a sensitivity and specificity that approaches 100% for acute ICH.

The management of ICH is controversial. Studies show that those who suffer ICH have a 30-day mortality rate of 35–44% and a 6-month mortality rate approaching 50%. The medical management includes control of blood pressure which is the most important factor in determining the rapid extension of ICH [5].

Medical control of intracranial pressure (ICP) with the use of osmotic diuretics; mannitol, which safely and effectively lowers the ICP. Other methods as hypocarbia and sedation with neuromuscular paralysis, all aim at decreasing the ICP [1]. The use of steroids is controversial [4].

The goal of the surgery is to reduce the mass effect and to remove potential neurotoxic factors and prevent their interaction with the surrounding normal brain tissue [1].

Patients and methods

The study was done prospectively in the Al-Azhar University Hospitals and Matarya Teaching Hospital on 30 cases admitted in the period between January 2017 and December 2017, suffering from spontaneous ICH. The study was carried out to study the outcome of surgical management [according to Glasgow outcome scale (GOS)] of such cases and factors favoring good or bad outcome such as the age, sex, vital signs (especially blood pressure), bleeding profile, Glasgow coma scale (GCS) preoperative, postoperative, volume, site, and depth of hematoma.

The study included

Inclusion criteria

The study was done on 30 cases suffering from supratentorial spontaneous ICH with hematoma volume equal to or more than 30 ml, GCS equal to or more than 8, age equal to or more than 18 years, with focal neurological deficit.

Exclusion criteria

The cases having signs or symptoms suggestive of underlying structural vascular abnormality such as arteriovenous malformation or aneurysm, terminal medical illness, coagulopathy accounting for the hemorrhage, traumatic ICH and pregnancy, with no available informed consent.

Preoperative assessment

All patients underwent complete general and neurological examination. Presenting symptoms/condition, GCS, sex as regards male to female ratio, age, blood pressure, and blood glucose level were observed. Associated medical history was also evaluated.

Neuroradiological assessment

(1) Preoperative CT scan brain was done to all the cases.
(2) The hematoma volume was calculated using the modified ellipsoid method: $(A\times B\times C)/2$, where A is the largest diameter of the hematoma on axial CT scan slice (cm); B is the diameter perpendicular to A on the same slice; and C is the thickness of the hematoma on CT (cm), also counted as the number of axial cuts on CT multiplied by slice thickness (cm) (excluding the highest and lowest cuts visualizing the ICH).

Laboratory assessment

Routine preoperative and postoperative laboratory investigations were done: complete blood count, bleeding profile (prothrombin time, prothrombine concentration (PC), international normalized ratio, and partial thromboplastin time), liver and kidney function tests (alanine aminotransferase, aspartate aminotransferase, serum urea, serum creatinine), serum sodium, and potassium levels were assessed.

Surgical procedures

All cases were admitted to the neuro-ICU at our trauma and emergency department and given a loading dose of phenytoin and brain dehydrating measures such as mannitol and furosemide. Cases were operated upon within a period of 24 h of presentation.

Surgical outcome

All cases underwent postoperative general and neurological examination and the outcome of the operated patients was evaluated as regards GCS, residual neurological deficits, residual hematoma, rebleeding, and GOS.

Postoperative complications such as rebleeding, the need for a second operation for reevacuation of hematoma, and/or the need for decompression craniotomy/craniectomy were observed and recorded.

Postoperative ICU-related and coma-related complications, especially chest infection, wound infection, deep venous thrombosis, and pulmonary embolism were observed and recorded.

Radiological outcome

Postoperative CT scan brain was done to all the cases after 24 h or if any deterioration in conscious level.

Case presentation 1: A male patient of 44-year old smoker teacher from Cairo of not known diabetic or hypertensive presented to emergency room (ER) with vomiting followed by an attack of seizure. On examination the patient was in a post ictal state, good localize to pain with both upper limbs no gross weakness in both lower limbs. After stabilization and control of fits patient was aphasic brain CT shows left temporal hematoma. The patient was transferred to operation room (OR) where craniotomy and evacuation of hematoma were done with control of a bleeder. Postoperative patient was fully conscious with no gross weakness but suffered from intermittent attacks of seizures in the first week after surgery associated with receptive aphasia. After 4 weeks aphasia improved with less frequent seizures.

Case presentation 2: A female patient 58 years old housewife from Cairo known diabetic since 10 years controlled on oral hypoglycemics presented to ER by acute onset of vomiting and disturbed conscious level. On examination her GCS was 8/15 obvious right hemiplegia (in form that she localizes to pain only by her left hand). Brain CT shows left frontotemporal ICH. Primary resuscitation was done and then the patient was transferred to OR where craniectomy and evacuation of hematoma and bleeder control were done.

Postoperatively she regained conscious level gradually, over 48 h she became fully conscious, extubated, with improved right hemiplegia to become G4 motor power in both upper and lower limbs.

Results

Age

The age of the patients ranged between 18 and 72 years with a mean±SD of 53.822±13.2563 (Tables 1 and 2).

Sex distribution

Table 3

Association with diabetes mellitus and its relation with outcome

Table 4

Relationship between conscious level and average volume of hematoma

Table 5

Table 1 The range and mean age of patients

	N	Mean	SD	Median	Minimum	Maximum
Age (years)	30	53.833	13.2563	56.0	18.0	72.0

Table 2 The effect of age on the outcome

	Survival–death	*N*	Mean	SD	*P* value*
Age (years)	Survived	17	56.273	12.31242	0.09
	Died	13	57.923	14.07398	

No statistically significant difference was detected between the age of patients and the outcome (*P*=0.09, NS).**P* value is significant at the level of 0.05.

Table 3 Sex distribution and its relation with the outcome

	Survival–death					
	Survived		Died		Group total	
	Count	Row (%)	Count	Row (%)	Count	Row (%)
Sex						
Male	12	66.67	5	27.33	18	60.0
Female	5	41.67	7	58.33	12	40.0
Group total*	17	56.67	13	43.33	30	100.0

ICH is more common in men than in women; in our study the male : female ratio was 3 : 2. No statistically significant difference was detected between the sex of patients and the outcome (*P*=0.69, NS). **P* value=0.69 (NS). *P* value is significant at a level of 0.05.

Table 4 Diabetes mellitus as a risk factor

	Survival–death					
	Survived		Died		Group total	
	Count	Column (%)	Count	Column (%)	Count	Column (%)
DM						
No	9	52.9	4	30.7	13	43.3
Yes	8	47.1	9	69.3	17	56.7
Group total*	17	100.0	13	100.0	30	100.0

DM, diabetes mellitus. No statistically significant difference was detected between the outcome of the diabetic and nondiabetic patients (*P*=0.86, NS). **P* value=0.86 (NS). *P* value is significant at the level of 0.05.

Relationship between neurological state on admission and outcome

Table 6

Relationship between Glasgow coma scale preoperative and Glasgow coma scale postoperative

GCS preoperative is significantly correlated with GCS postoperative, that is the better the GCS preoperative is, the better the GCS postoperative would be (Pearson's correlation coefficient r=0.65, P <0.001 'two-tailed').

Relationship between hematoma volume and outcome

Table 7

Relationship between residual hematoma volume and outcome

Table 8

Sites of hematoma

Table 9

Table 5 Conscious level (Glasgow coma scale) and average hematoma volume (ml)

Conscious level	Average volume of ICH (ml)
GCS 13–15	48
GCS 9–12	97.9
GCS 8	106.8

GCS, Glasgow coma scale; ICH, intracerebral hemorrhage.

Table 6 Neurological state and outcome

	Survival–death					
	Survived		Died		Group total	
	Count	Row (%)	Count	Row (%)	Count	Row (%)
GCS (preoperative)						
8	1	12.5	7	87.5	8	26.7
9–12	11	64.7	6	35.3	17	56.7
13–15	5	100.0	0	0.0	5	16.6
Group total*	17	56.7	13	43.3	30	100.0

GCS, Glasgow coma scale. There is a statistically highly significant relationship between GCS on admission (preoperative) and outcome (P=0.002, highly significant). *P value=0.002 (highly significant). P value is significant at the level of 0.05.

Table 7 Hematoma volume and outcome

	Survival–death					
	Survived		Died		Group total	
	Count	Row (%)	Count	Row (%)	Count	Row (%)
Volume of hematoma (ml)						
Moderate 30–60	5	100.0	0	0.0	5	16.6
Large 61–90	9	75.0	3	25.0	12	40.0
Extensive >90	3	23.1	10	76.9	13	43.4
Group total*	17	36.7	13	63.3	30	100.0

There is a statistically highly significant relationship between volume of hematoma and outcome (P=0.01, highly significant). *P value=0.01 (highly significant). P value is significant at the level of 0.05.

Table 8 Residual hematoma volume and outcome

	Survival–death					
	Survived		Died		Group total	
	Count	Row (%)	Count	Row (%)	Count	Row (%)
Residual hematoma						
No	11	68.7	5	31.3	16	53.3
10–20 ml	4	44.4	5	55.6	9	30.0
>20 ml	2	40.0	3	60.0	5	16.7
Group total*	17	56.7	13	43.3	30	100.0

No statistically significant difference was detected between the outcome of cases with residual hematoma volume (≤20 ml) after surgical evacuation and cases with total hematoma evacuation (P=0.81, NS). P value is significant at the level of 0.05. *P value=0.81 (NS). P value is significant at the level of 0.05.

Table 9 Sites of hematoma

Sites	*n* (%)
All basal ganglia	8 (26.7)
All basal ganglia and lobar	4 (13.3)
Lobar	7 (23.3)
Putaminal	6 (20.0)
Putaminal and lobar	3 (10.0)
Thalamic	2 (6.7)
Total	30 (100.0)

Table 10 Postoperative complications

Complications	Frequency	%
No	16	53.3
Chest infection	8	26.7
DVT, PE	3	10
Wound infection	3	10
Total	30	100.0

DVT, deep venous thrombosis; PE, pulmonary embolism. Most of these complications are ICU-related complications.

Postoperative complications

Table 10

Final outcome (Glasgow outcome scale)

Table 11

Group statistics

Table 12

The outcome (death and survival) was significantly correlated with the initial hematoma volume and GCS (preoperative and postoperative) but it is not affected by the residual hematoma volume (≤20 ml) (Figs 1–9).

Table 11 Final outcome (Glasgow outcome scale)

Outcomes	Score	Cases (*N*=30)	%
Died (D)	1	13	43.3
Persistent vegetative state	2	2	
Severe disability	3	5	56.7
Moderate disability	4	4	
Good recovery	5	6	

Table 12 Group statistics

Variables	Death	*N*	Mean	SD	*P* value*
Age (years)	No	17	56.273	12.31242	0.09
	Yes	13	57.923	14.07398	
GCS-preoperative	No	17	11.29	1.759428	0.01
	Yes	13	9.00	1.354006	
Size of hematoma (cm)	No	17	73.824	24.14859	0.002
	Yes	13	121.769	31.89607	
Residual hematoma volume (ml)	No	6	16.667	7.52773	0.43
	Yes	8	22.500	7.07107	
GCS postoperative	No	17	13.27	2.240	< 0.001
	Yes	13	4.06	2.693	

GCS, Glasgow coma scale. **P* value is significant at the level of 0.05.

Discussion

This study aims at discussing the outcome of surgical management of spontaneous intracerebral hematoma (according to the GOS) and factors favoring good or bad outcome especially age, sex, GCS preoperative and postoperative, volume, and site of hematoma and volume of residual hematoma.

The basal ganglia is the most common site of ICH, representing 50–60% of spontaneous ICH, and basal ganglia ICH is associated with 50% mortality rate [6]. In our study ICH occurred in basal ganglia in 55%.

The incidence of ICH increases above the age of 55 years [7]. In our study, the age ranged from 18 to 72 years with a mean age of 53.822 years.

ICH is more common in men than in women [8]. In our study, the male : female ratio was 3 : 2 (18 men and 12 women).

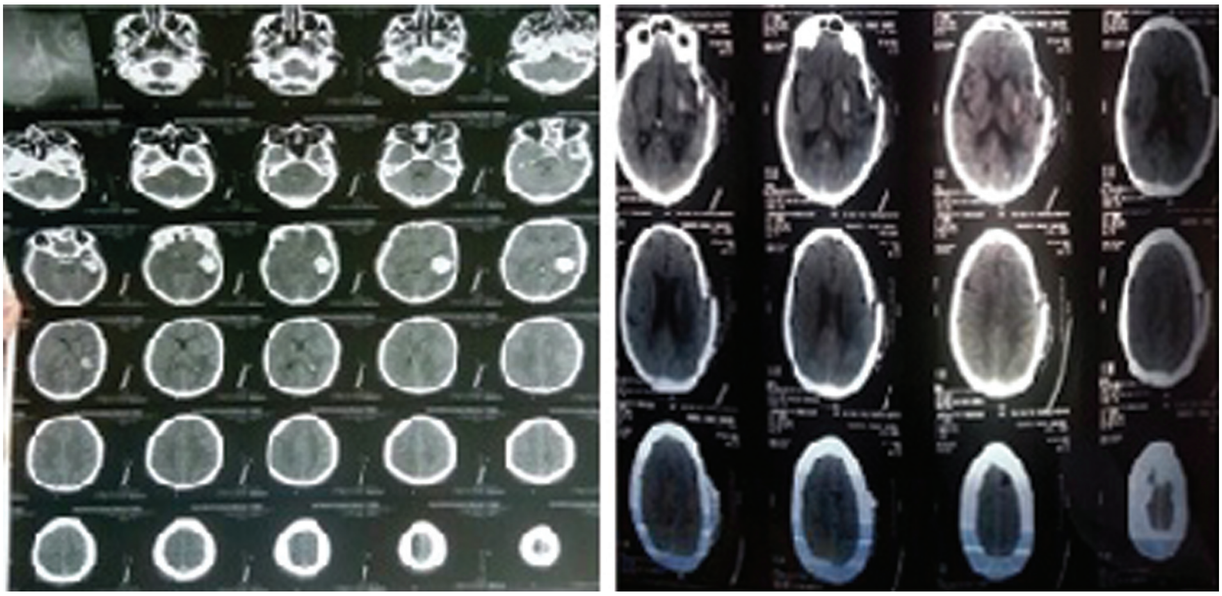
In putaminal ICH, 62% of the patients experience smooth gradual deterioration with only 30% exhibiting their maximal deficit at onset. The clinical presentation of putaminal hemorrhage may vary from relatively minor pure motor hemiparesis to profound weakness, sensory loss, etc. [9]. In our study most of the patients presented with disturbed conscious level; this may be due to the large size of the hematoma.

Due to the fact that deep areas of the brain, such as basal ganglia are less able to accommodate large volumes. The conscious level of the patient on admission was related to the size of the hematoma in our study, as the larger the volume of the hematoma, the worst the conscious level [10].

In our study the average volume of the hematoma in patients with GCS ranging from 13 to 15 was 48 cm^3, for GCS 9–12 was 97.9 cm^3, and for GCS 8 it was 106.8 cm^3. This means that in most cases, the larger the volume of the hematoma, the worst the conscious level on admission. Consequently the prognosis is affected, in relation to both the conscious level and the size of the hematoma.

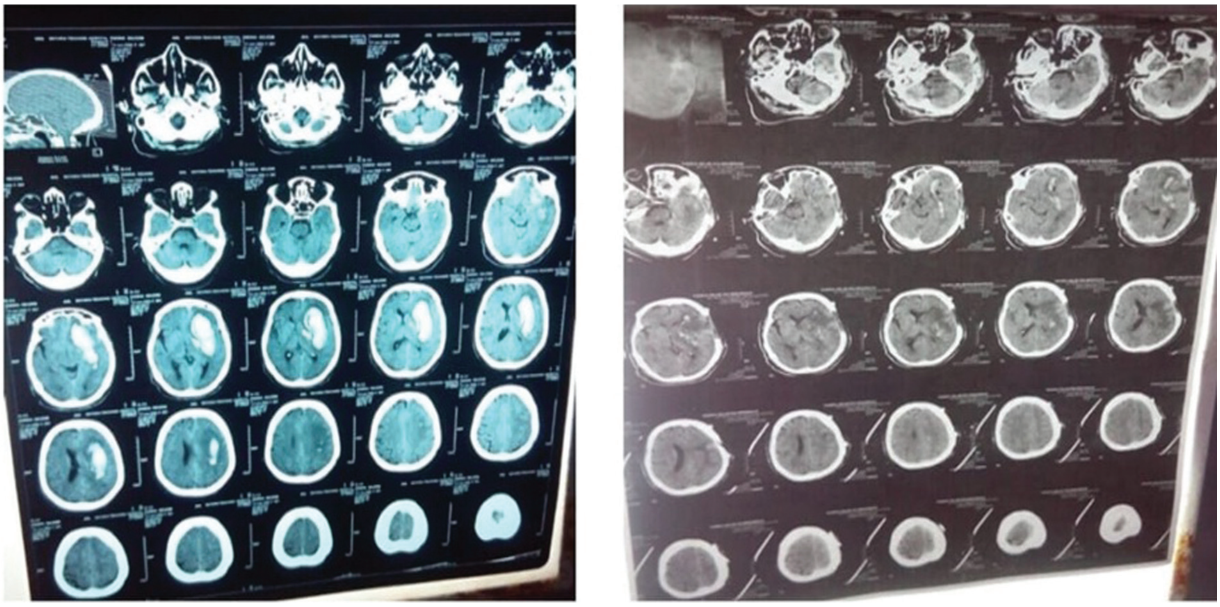
A statistical analysis showed that the GCS score on admission was significantly higher in the favorable outcome group than that in the poor outcome group (*P*=0.029) [11]. The factors influencing the prognosis were GCS before surgery and the incidence of

Figure 1



Preoperative and postoperative brain CT of one case included in the study. CT, computed tomography.

Figure 2

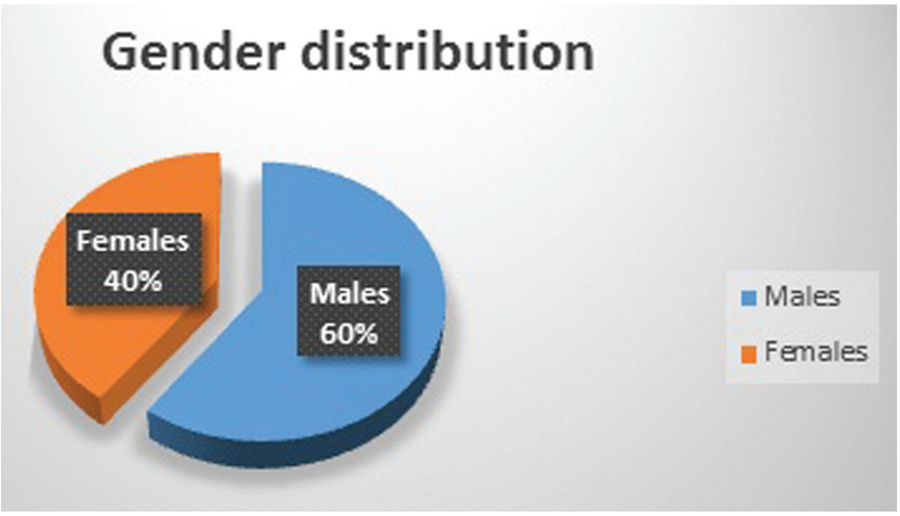


Preoperative and postoperative brain CT of the second patient. CT, computed tomography.

postoperative complications, volume of hematoma, and duration between ictus and surgery [12]. We have demonstrated in our study that all patients (five patients) with GCS 13–15 survived, 11 (64.7%) out of 17 patients with GCS 9–12 survived, and one (12.5%) patient out of eight patients with GCS 8 survived. There was a statistically highly significant relationship between GCS on admission (preoperative) and outcome (*P*=0.002, highly significant). *P*-value is significant at the level of 0.05.

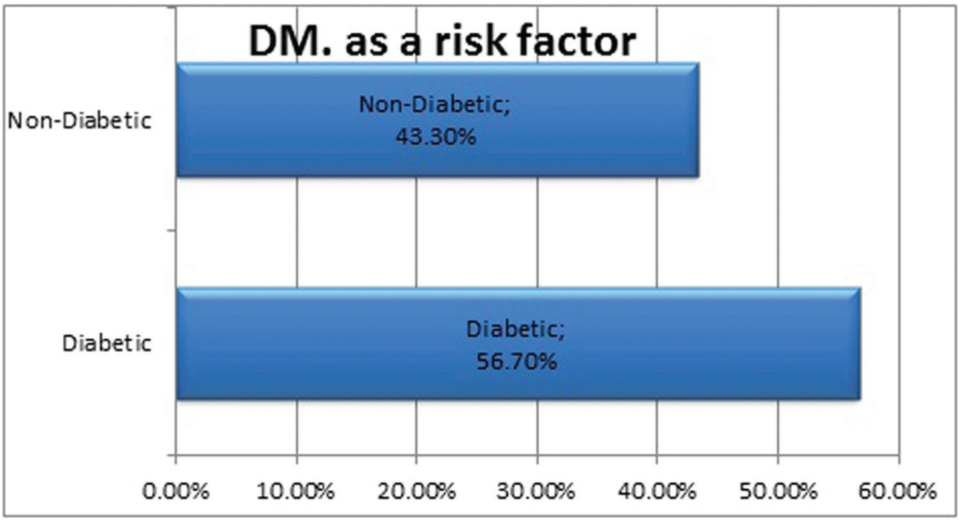
As regards the volume of the hematoma and the outcome, for those with moderate ICH (30–60 cm^3) all patients survived, those with large (61–90 cm^3) nine (75.0%) out of 12 patients survived and for those with extensive ICH (>90 cm^3), three (36.7%) out of 13 patients survived. There was a statistically highly significant relationship between volume of hematoma and outcome (*P*=0.01, highly significant). *P*-value is significant at the level of 0.05.

Figure 3



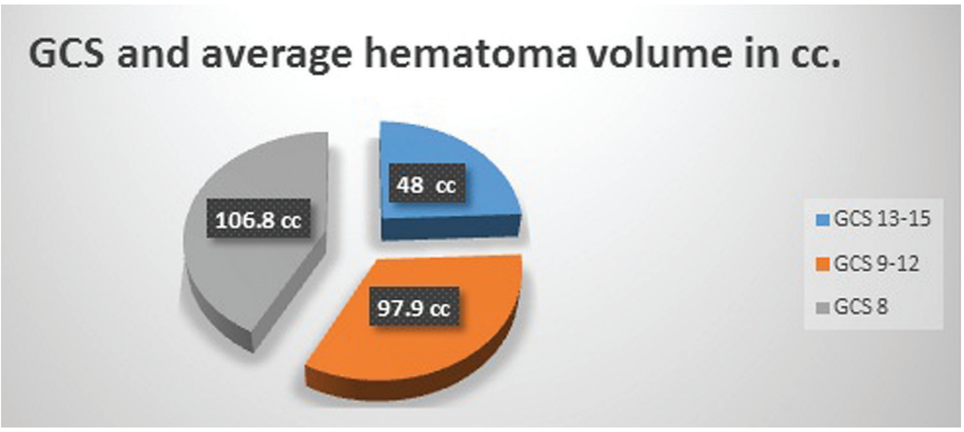
Sex distribution.

Figure 4



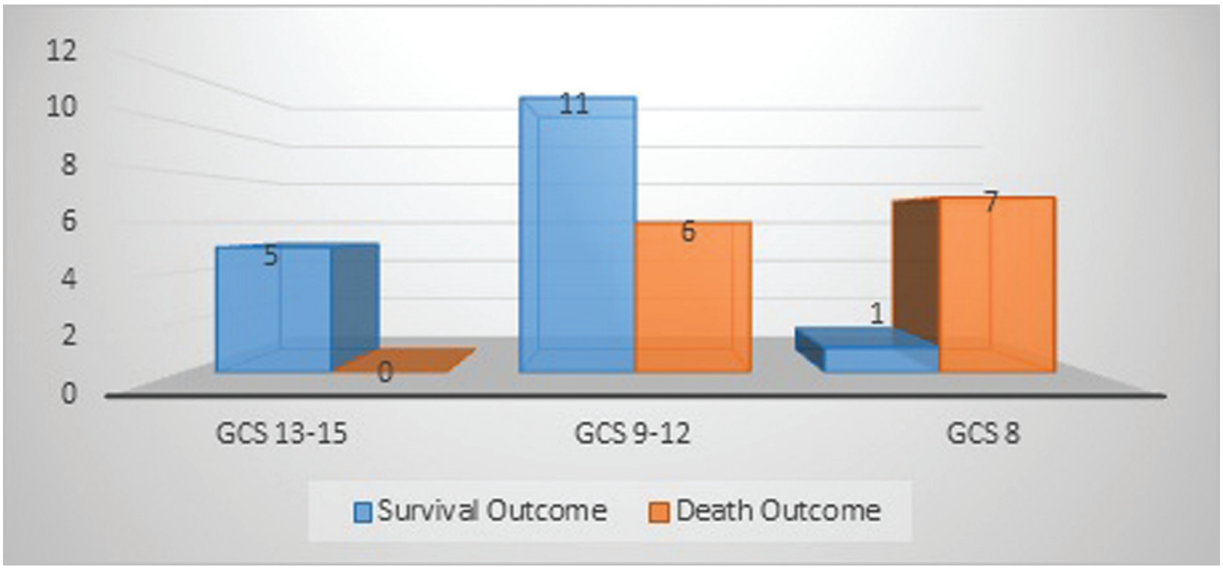
Shows the association with diabetes mellitus ().

Figure 5



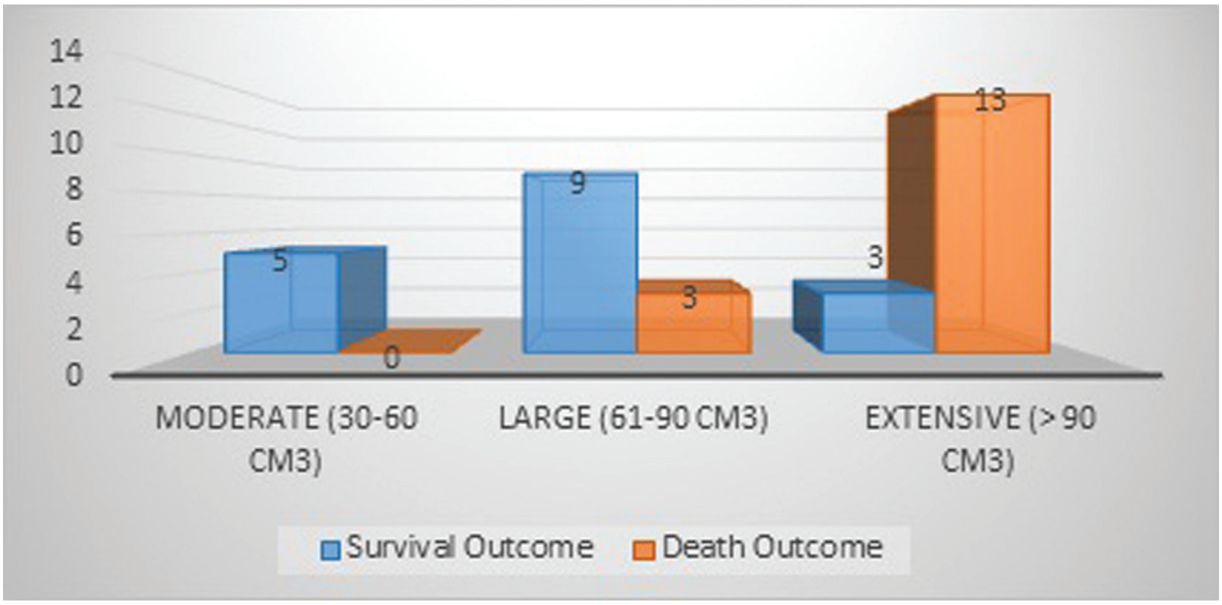
Shows the conscious level (GCS) and average hematoma volume (ml). GCS, Glasgow coma scale.

Figure 6



Shows the relationship between neurological state on admission and outcome. GCS, Glasgow coma scale.

Figure 7

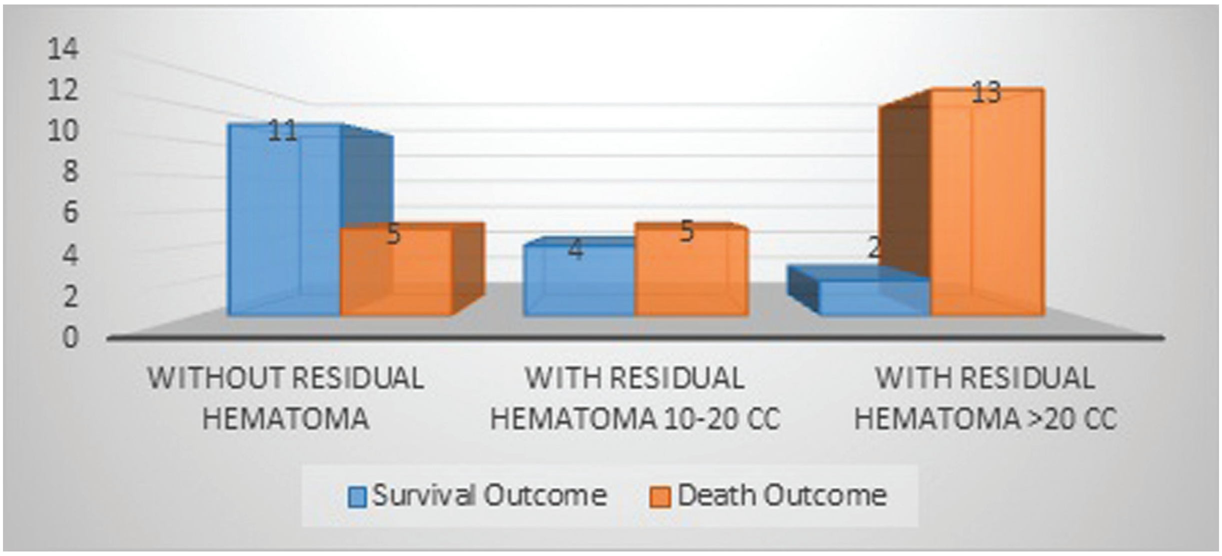


Shows the relationship between the volume of hematoma and outcome.

Diabetes mellitus (DM) is a weak risk factor for ICH [13]. We have demonstrated in our study that eight out of 17 patients with DM survived and nine out of 13 patients without DM survived. There is no statistically significant difference detected between the outcome of the diabetic and nondiabetic patients (P=0.86, nonsignificant).

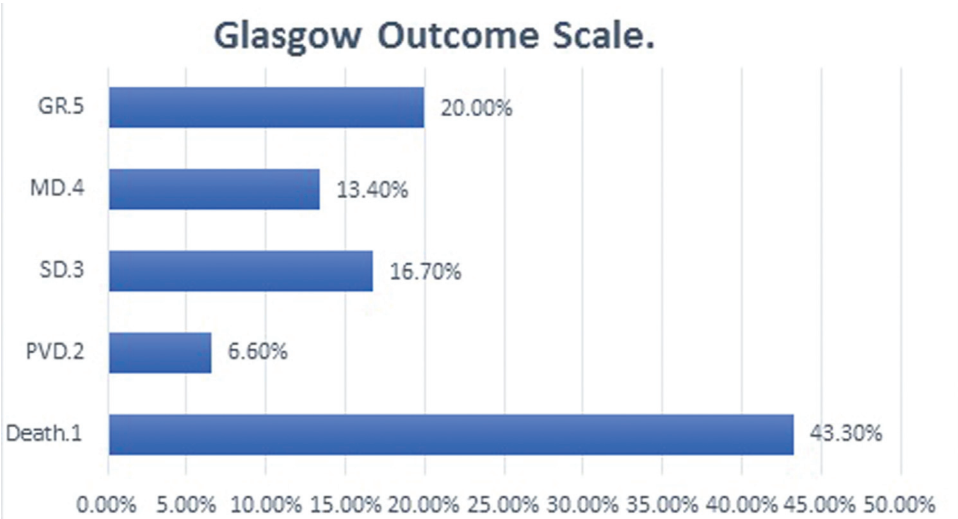
The recommendations for inpatient care necessitates initial monitoring and management of ICH patients should take place in an ICU with physician and nursing neuroscience intensive care expertise [14]. This is a major problem encountered not only in our hospital, but all over the country as we do not have any specially trained nursing staff with special expertise in managing ICH patients. ICH patients are managed in the emergency department, with medical cases managed by the internal medicine physicians and surgical cases managed by neurosurgeons. In our study we encountered postoperative complications (chest infection, deep venous thrombosis, pulmonary embolism, and wound infection) in 46.7% of patients.

Figure 8



Shows the relationship between the volume of residual hematoma and outcome.

Figure 9



Glasgow outcome scale.

As regards the best choice of management, that is medical versus surgical management, a study conducted by Kaya and colleagues compared the conservative medical treatment with open craniotomy for putaminal hemorrhage of more than 30 cm^3. The surgical group had a 34.0% mortality at 6 months compared with 63.1% mortality in the medically treated group [15]. In our study, the limit for evacuation was hematoma larger than 30 cm^3. When hypertensive putaminal hematomas with a volume of 30 cm^3 or higher are operated, the results are superior to the medical treatment.

The patients who benefit most from surgical treatment, with respect to functional status, are the ones in stupor or semicoma without herniation signs on admission, indicating that those patients are good candidates for surgery; furthermore, surgery is a life-saving measure in patients with herniation signs [15]. This was clear in our study as the best prognosis was in patients with higher GCS. The mortality rate in patients who presented with GCS 13–15 was 0.00%, compared with 35.3% in patients with GCS 9–12, and 87.5% in patients with GCS 8. This shows that the worst the conscious level on admission, the worst the prognosis (GCS preoperative was significantly correlated with GCS postoperative, i.e. the better the GCS preoperative is, the better the GCS postoperative would be (Pearson correlation coefficient r=0.65, P<0.001 'two-tailed'), though even with less than favorable conscious level on admission with signs of herniation, these patients has to be operated upon for the purpose of brain decompression as it is a life-saving method.

The STICH trial found that patients with hematomas extending to within 1 cm to the cortical surface had a trend toward a more favorable outcome with surgery within 96 h, although this finding did not reach statistical significance [16].

In our study, we have demonstrated that 11 out of 16 patients without any residual hematoma in follow-up CT scan survived (68.7%) and five died (31.3%), while four out of nine patients with residual hematoma less than or equal to 20 ml survived (44.4%) and five (55.6%) died. No statistically significant difference was detected between the outcome of cases with residual hematoma volume (≤20 ml) after surgical evacuation and cases with total hematoma evacuation (*P*=0.81, nonsignificant). *P*-value is significant at the level of 0.05.More than 20% of patients will experience a decrease in the GCS score of more than 2 points between the prehospital emergency medical services assessment and the initial evaluation in the emergency department [17]. Among those patients with prehospital neurological decline, the GCS score decreases by an average of 6 points and the mortality rate is 75%. Furthermore, within the first hour of presentation to a hospital, 15% of patients demonstrate a decrease in the GCS score of more than 2 points [18].

The risk for early neurological deterioration and the high rate of poor long-term outcomes underscores the need for aggressive early management [19]. In our study, most patients presented early, usually before 10 h of presentation, which renders the outcome well.

Most patients that die from ICH do so during initial acute hospitalization, and these deaths usually occur in the setting of withdrawal of support due to presumed poor prognosis [20]. We found this is true, treating these patients with neglect considering them hopeless cases is a major cause of the low care the ICH patients receive [21].

Conclusion

The final conclusion for this study is spontaneous ICH is a treatable condition provided that the patients receive appropriate care from trained staff to deal with such cases. The best candidates for ICH evacuation are those with hematoma volume 30–60 ml, GCS more than 10, or has progressive decline in GCS or neurological state. We do not have to evacuate the hematoma totally as in our study no statistically significant difference was detected between the outcome of cases with residual hematoma volume (≤20 ml) after surgical evacuation and cases with total hematoma evacuation (*P*=0.81, nonsignificant). The timing of hematoma evacuation is controversial, but in our study we found that early evacuation in the first 6 h is of great benefit as it allows us to immediately decompress the brain and remove the hematoma before releasing more toxic products to the surrounding neural tissue. Patients with spontaneous ICH need special ICU care. The cause of death in many cases was related to perioperative complications rather than the hematoma or the operation. The ICH patients need properly trained physicians and nursing staff to deal with their condition.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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