Challenges and Outcome after Surgery of Spontaneous Supratentorial Haematoma

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ABSTRACT

Background: Spontaneous intra-cerebral haemorrhages (ICHs) account for 9-27% of all cerebrovascular strokes worldwide. **Objective:** The objective of this study was to assess the survival rates and functional outcomes following the surgical evacuation of spontaneous supratentorial ICH, as well as the factors that influence the outcome.

Patients and methods: This was a retrospective study for 50 cases of operated spontaneous ICH in our department for the last year admitted to Neurosurgery Department in Menoufia University Hospital complaining of spontaneous ICH. Cases were operated upon within a period of 24 h of presentation. Open craniotomy techniques were employed to evacuate hematomas from all patients. **Results:** The mean Modified Rankin Scale (mRS) after surgery and before leaving the hospital was 3.72 ± 0.91 ranged between 1 to 5 while after 6 months the mean improved to 3.2 after 6 months with a statistically significant difference ($p = 0.0013$). A statistically substantial associations was observed among mRS after surgery and initial Glasgow Coma Scale (GCS) and also postoperative GCS. There was a statistically significant correlations between mRS after 6 months of surgery and initial GCS and also with postoperative GCS and Coagulopathy.

Conclusions: Spontaneous supratentorial ICH evacuation and craniotomy in patients with good premorbid status and moderate to good GCS even with big sized hematoma regardless of the extent or location of the ICH, a favorable clinical outcome can be achieved through the combination of neurocritical care and surgery. Patients achieve a functional outcome that is suitable for the long term.

Keywords: Outcomes, Surgical Intervention, Spontaneous, Supratentorial intracerebral hemorrhage.

INTRODUCTION

Cerebrovascular strokes worldwide are caused by spontaneous intracerebral hemorrhages (ICHs), which account for 9-27% of all cases. Despite ongoing endeavours to enhance surgical intervention and create effective medical therapies, the indications for surgical treatment remain unclear and remain a subject of debate [1]. The underlying etiology of numerous ICH patients is challenging to ascertain at the time of presentation, and hypertension that is inadequately controlled is frequently observed in the majority of these cases [2].

The pathophysiology of primary ICH is defined by chronic high pressure, which results in hemorrhage from small perforating arteries, frequently at bifurcations. From larger vessels to smaller, more vulnerable ones, this pressure gradient is transmitted. Therefore, ICH is frequently observed in deep grey matter structures, with the basal ganglia being the most prevalent location, followed by the thalamus, cerebellum, and pons. Lobar ICH is regarded as a rare condition. Any patient who exhibits a severe headache, elevated systolic blood pressure, or a decreased level of consciousness should be suspected of having ICH [3].

In the initial phase of ICH, computed tomography (CT) of the brain is a swift and sensitive diagnostic instrument [4]. In addition to any intraventricular extension, mass effect, hydrocephalus, and early indications of herniation, the CT scan will also reveal the location and extent of the ICH [5].

MRI is capable of detecting hemorrhage with the same sensitivity as CT; however, in the acute context, it rarely offers additional information. An MRI can be detrimental due to the high risk of deterioration during the initial hours, as well as the time and transportation required. As an adjunctive instrument for identifying the underlying causes of ICH, such as cavernomas and tumors, delayed MRI is more effective [6].The CT angiogram is a diagnostic instrument that is highly sensitive for the detection of associated vascular abnormalities and contrast extravasation, which is commonly referred to as the "spot sign." Contrast extravasation during angiography is associated with an elevated mortality rate, which suggests that hemorrhage is still occurring. Extreme hypertension, depressed consciousness, and large hemorrhages increase the likelihood of contrast extravasation [7].

The most widely recognized surgical procedures for the removal of an ICH are craniotomy with open surgery, endoscopic evacuation, and stereotactic aspiration [8]. In theory, surgical hematoma drainage provides numerous advantages, including the prevention of cerebral herniation and mass effect. It is crucial to reduce the intracranial pressure and excitotoxicity in blood products [9].

According to a systematic review of five randomized control studies that included a total of 305 patients, the combination of craniotomy and open surgery with the most effective medical therapy is associated with a nonsignificant increase in the likelihood of death or dependency. The odds ratio was 1.46 (95% CI: 0.87 to 2.45) when compared to the best medical therapy alone (surgery, n=114/147 [77.6%]; control, n=111/158 [70.2%]. The odds ratio (OR) of 0.90 (95% CI: 0.40 to 2.03) was observed in the remaining four trials, representing a modest nonsignificant decrease in mortality or dependency (surgery, 43/58 [74.1%]; control, 51/67 [76.1%])) after subtracting the largest trial, which was conducted prior to the introduction of

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CT brain images [10]. Our study aimed to estimate the functional outcome and rates of survival after surgical evacuation of spontaneous supratentorial intra cerebral hemorrhage and factors affecting the outcome.

PATIENTS AND METHODS

This was a retrospective study for 50 cases of operated spontaneous ICH in our department for the last year admitted to Neurosurgery Department in Menoufia University Hospital complaining of spontaneous ICH.

Exclusion criteria: Age less than 18 years old, posterior fossa hematoma, traumatic ICH, and associated diffuse subarachnoid hemorrhage.

Surgical procedures: All cases were admitted to the neuro-ICU at our Trauma and Emergency Department, where they were administered a loading dose of phenytoin and brain-dehydrating measures, including furosemide and mannitol. The interventions were performed within 24 hours of the patient's presentation. The techniques employed were open craniotomy. All patients underwent hematoma evacuation. The specialized sICH treatment team that is composed of highly trained neurosurgeons, implemented these interventions.

The patient was placed on an operating table and administered general anesthesia. The cranium was secured in a three-pin skull fixation device that was affixed to the table in order to maintain its position. The epidermis was prepared, cleansed with an antiseptic solution, and incised, typically behind the hairline, after the anesthesia and positioning were established. Then, the cranium was dissected, and the skin and musculature were taken off. Burr apertures were constructed using a specialized drill after the bone was exposed. The craniotome was able to enter through the burr openings. The dura mater was revealed by lifting and removal of the craniotomy membrane. The bone flap was retained for replacement at the conclusion of the procedure. The brain parenchyma was subsequently exposed by opening the dura mater. A passage was opened to evaluate the hematoma using surgical retractors. The cortex was gently separated with a self-retaining spatula following the smallest possible incision to avoid further injury to eloquent brain areas. The hematoma cavity was localized, and parts of the hematoma were removed with forceps, and attention was paid to prevent new bleeding in the margin zones. The hematoma was accessed via the shortest path possible.

The surgeons determined the surgical approach prior to the procedure. The dura mater was closed, and the bone flap was positioned, aligned, and secured after the hematoma was evacuated. In certain instances, an extraventricular drainage was either performed prior to or subsequent to the operation. A decompressive craniotomy was performed if deemed necessary. The principle of minimally invasiveness was strictly followed during all craniotomy hematoma evacuations, which were facilitated by an operative microscope. Subsequently, the skin was sutured.

Postoperative treatment: All patients received standard postoperative medical treatments, which included individual therapies, complications' prevention, blood pressure control, and intracranial pressure reduction. Mannitol was administered in a prescribed dosage that was based on the patients' clinical conditions**.**

Surgical outcome: The patients' surgical outcomes were assessed in terms of GCS, residual neurological deficits, residual hematoma, rebleeding, Glasgow Outcome Scale (GOS). Postoperative neurological and general examinations were administered to all cases.

Outcomes and data collection: Patients were monitored for a minimum of six months. The neurological functional status of survivors at six months post-ictus was the primary outcome assessed. The secondary outcomes encompassed mortality at 30 days and 6 months post-ictus, as well as complications. mRS was implemented to evaluate neurological functional status [11]**.**

Ethical considerations: The study was approved from The Research Ethics Committee, Menoufia University Hospital (approval code: 10/2024NEUS19). Written informed consents were obtained from all patients or their legal representatives prior to their inclusion in the study. The consent form detailed their agreement to participate and for the publication of data, with full assurance of confidentiality and privacy. This study adhered to the ethical guidelines outlined in the Declaration of Helsinki for research involving human participants.

Statistical analysis:

Spatial Plotting and Analysis (SPSS v26; IBM Inc., Armonk, NY, USA) was used for the statistical analysis. Frequency and percentage were used to represent qualitative data, whilst standard deviation (SD) and mean (Q) were used to report quantitative variables. For statistical purposes, a two-tailed P value ≤ 0.05 was considered significant. When there was a correlation between two samples from the same population, paired sample t-test was utilized to compare their means.

RESULTS

Our results showed that mean age was 58.36 ±10.53 years ranged between 35 to 72 years old and 30 (60%) of patients were above 60 years with a male dominance as male patients were 36 (72%). HTN was reported in 26 (52%) patients and 1 (36%) suffered from cardiac disease either IHD or AF or underwent CABAG. 10 (20%) had covid or post covid syndrome, while 6 (12%) came with history of previous stroke. Two (4%) had seizures, while 28 (56%) patients had disturbed conscious. 20 (40%) patients had advanced right hemi paresis or paralysis, while 30 (60%) showed left hemi paresis or paralysis. Regarding anticoagulant therapy in all studied group, 22 (44%) patients took marivan, while 14 (28%) patients took only aspirin, and two patient (4%) took aspirin + plavix. The average haematoma size was 68.32 ± 7.70 mm^3 ranged between 55 to 85 mm^3. Regarding site of hemorrhage, it was right parietal lobe in 24 (48%) patients, left parietal lobe in 10 (20%) patients, right frontal lobe in 6 (12%) patients, left frontal lobe in two (4%) patient and left subcortical with basal ganglia extension in 8 (16%) patients (Table 1).

Table (1): Demographic data, risk factors, clinical presentation and neurological manifestation, anticoagulant thereby, size and site of hemorrhage in of all studied patient

All studied group (N = 50)		
Age	**Mean± SD**	58.36± 10.53
	>60 y	30 (60%)
	<60 y	20 (40%)
Sex	**Male**	36 (72%)
	Female	14 (28%)
Risk factors	**Presented**	44 (88%)
	Not presented	6 (12%)
	HTN	26 (52%)
	Cardiac patient (IHD/AF/ previous CABG)	18 (36%)
	Covid /Post Covid Syndrome	10 (20%)
	Previous stroke	6 (12%)
Neurological manifestations	**Paresis or paralysis**	50 (100%)
Initial clinical presentation	**Disturbed conscious**	28 (56%)
	Fits	2 (4%)
Anticoagulant therapy	**Marivan**	22 (44%)
	Aspirin	14 (28%)
	Aspirin + Plavix	2 (4%)
	No Anticoagulant therapy	12 (24%)
Size of hematoma (ml)	**Mean ± SD**	68.32± 7.70
Site of hematoma (ml)	**Right parietal lobe**	24 (48%)
	Left parietal lobe	10 (20%)
	Right frontal lobe	6 (12%)
	Left frontal lobe	2 (4%)
	Left subcortical with basal ganglia extension (deep seated ganglionic hematoma)	8 (16%)

Data presented as mean ± SD or frequency (%), HTN: hypertension, IHD: ischemic heart disease, AF: atrial fibrillation, CABG: Coronary artery bypass graft surgery.

The average initial midline shift was 5.88 ± 1.56 mm ranged between 1 to 8 mm with median of 5 mm and 4 (16%) patients presented with IVH. According to mortality rate, 10 (20%) patients died within average of 7.5 days after surgery ranged between 0 to 13 days. Survived cases needed average of 5.92 ± 2.03 days to be fully conscious ranged between 4 to 11 days (Table 2).

Table (2): Initial midline shift, IVH and outcome in all studied group

All studied group (N = 25)	
Initial midline shift (mm)	5.88 ± 1.56
Presence of IVH	4 (16%)
Mortality rate	5 (20%)
Post-operative Survival time for dead cases	7.5 ± 4.82
Time to postoperative full conscious (Days)	5.92 ± 1.03

Data presented as mean ± SD or frequency (%), IVH: Intraventricular hemorrhage.

A statistically substantial difference was observed among mean GCS before and after surgery (p = 0.02) as it was 10.74 and improved to 12.56 before leaving hospital. Their initial GCS before surgery was 5 in 4 cases and 6 in 6 cases which worsen after surgery (Table 3).

Table (3): Analysis of outcomes after surgery and 6 months follow-up in all studied group

	Preoperative	Postoperative	T test	P value
Mean GCS	**10.74** ± 3.01	12.56 ±4.54	2.363	0.02

GCS: Glascow glaucoma scale.

The mean mRS after surgery and before leaving the hospital was 3.72 ± 0.91 ranged between 1 to 5, while after 6 months the mean improved to 3.2 after 6 months with a statistically substantial difference (p = 0.0013) (Table 4).

Table (4): Analysis of outcomes after surgery and 6 months follow-up in all studied group

		Post-operative	6 months postoperative	fisher	P value
Mean mRS		3.72	3.2	21.719	0.0013
mRS score	**0 no residual symptoms**	0 (0%)	2 (4%)		
	1 no significant disability	2 (4%)	4 (8%)		
	2 slight disability	0 (0%)	10 (20%)		
	3 moderate disability	18 (36%)	20 (40%)		
	4 Moderate to severe disability	20 (40%)	4 (8%)		
	5 severe disability	10 (20%)	0 (0%)		
	6 dead	0	10 (20%)		

mRS: Modified Rankin Scale.

A statistically substantial associations were observed among mRS after surgery and initial GCS and also postoperative GCS, while no statistically significant correlation between mRS after surgery and (age, clot size and midline shift). There was a statistically significant correlations between mRS after 6 months of surgery and initial GCS and also with postoperative GCS and coagulopathy. While, there was no statistically significant correlation between mRS after 6 months of surgery and age, sex, IHD/AF, previous stroke, site of haematoma (superficial or deep), clot size and midline shift (Table 5).

Table (5): Correlations between mRS after surgery and after 6 months of surgery and other patients' properties

	mRS after surgery	
	R	P value
Age	0.1637	0.4342
Clot size	0.2731	0.1865
Midline shift	0.0794	0.7059
Initial GCS	0.7099	<0.0001
Postoperative GCS	0.7267	<0.0001
After 6 months of surgery		
Age	0.2332	0.2619
Sex	0.1403	0.5036
IHD/AF	0.2951	0.1521
previous stroke	0.2424	0.2430
Coagulopathy	0.3967	0.0496
Site of hematoma (superficial or deep)	0.0557	0.7914
Clot size	0.1838	0.3791
Midline shift	0.2242	0.2813
Initial GCS	0.8835	<0.0001
Postoperative GCS	0.8538	<0.0001

GCS: Glascow glaucoma scale, IHD: ischemic heart disease, AF: atrial fibrillation.

DISCUSSION

As long as patients get the right treatment from qualified personnel, spontaneous ICH can be cured. Haematoma with a volume of 30–60 ml and a GCS higher than 10 are ideal candidates for ICH evacuation [12]. Prolonged ventilation may be necessary for patients with severe primary brain damage or herniation who have poor GCS upon admission and pupillary inequality. The majority of these individuals will either pass away or go into a vegetative state [13].

Our results showed that mean age was 58.36 ± 10.53 years ranged between 35 to 72 years old and 15 (60%) of patients were above 60 years with a male dominance as male patients were 18 (72%). The patients' ages ranged from 30 to 80 years, with an average age of 59.52 ± 12.61 years. According to the research conducted by **Lamichhane *et al.*** [13], twelve of these patients were older than seventy years, while twenty-eight were younger. The gender breakdown of the patients who participated was as follows: 52.5% females and 47.5% males.

In the present study, regarding site of hemorrhage, it was right parietal lobe in 24 (48%) patients, left parietal lobe in 10 (20%) patients, right frontal lobe in 6 (12%) patients, left frontal lobe in two (4%) patients and left basal of ganglia in 8 (16%) patients. In contrast to **Alkhadrawy *et al.*** [12] study where there were 50% mortality rate and 50-60% of spontaneous cases, the basal ganglia was the most prevalent location of ICH. In 55% of the individuals we looked at, ICH was located in the basal ganglia.

In the present study, the mean of initial GCS before surgery was 10.74 ± 3.01 ranged from 5 to 12. After surgery and before leaving the hospital the mean GCS was 12.56 ± 4.54 ranged from 9 to 13. In **Lamichhane *et al.*** [13] study, the majority of the patients presented with GCS between 9 and 12 (52.5%) followed by 27.5 % of patients with poor GCS (< 8) and remaining 20 % with good GCS (13-15).

In the present study regarding mortality rate, 10 (20%) patients died within average of 7.5 days after surgery ranged between 0 to 13 days. their initial GCS before surgery was 5 in four cases and 6 in 6 cases, which was worsen after surgery. Survived cases needed average of 5.92 ± 2.03 days to have a significant improvement in conscious level ranged between 4 to 11 days. According to **Hessington *et al.*** [1], higher rates were noted in individuals aged 65 years and older (p = 0.020), with a total death rates reaching 13.0% at 30 days and 17.9% at 6 months. The 30-day death rate was 12.9% in patients with deep-seated ICH and 13.1% in individuals with lobar ICH (p = 0.972).

In the present study, mRS distribution in all studied group after surgery varied from 1 to 5 with median of 4 as 1 means no significant disability in two (4%) patients while 18 (36%) patients showed grade 3 moderate disability, 20 (40%) patients showed grade 4 moderate to severe disability and 10 (20%) showed grade 5 severe disability. mRS distribution in all studied patients after 6 months of surgery varied between 0 to 6 with median of 3 as 0 grade means no residual symptoms in two (4%) patients while 4 (8%) patients showed grade 1 no significant disability, 10 (20%) patients showed grade 2 slight disability, 20 (40%) patients showed grade 3 moderate disability and 10 (20%) showed grade 6 which means dead cases. In the same line **Hessington *et al.*** [1] reported that all patients had a median mRS of 4.0 (IQR2–5). A favorable outcome was attained by 50 (40.7%) of the included patients at the follow-up, while 73 (59.3%) had a poor outcome. The outcome was favorable for 51.0% of the survivors, and the proportion did not differ based on the location of the ICH (mRS 0–3: 48.0% in deep ICH vs. 54.1% in lobar ICH; p = 0.552). Although, this distinction was not statistically significant (p = 0.136), 43 survivors (86.0%) with deep-seated ICH and 35 (72.9%) with lobar ICH experienced focal neurological deficits, including weakness or paralysis in an arm and/or limb, at long-term follow-up.

In the present study, the mean mRS after surgery and before leaving the hospital was 3.72 ± 0.91 ranged between 1 to 5 while after 6 months the mean improved to 3.2 after 6 months with a statistically significant difference (p = 0.0013). Of all included patients in **Lamichhane *et al.* [13]** study, at the follow-up, 20 patients (50%) experienced a favorable outcome (mRS 1 to 3), while 20 patients (50%) experienced an unfavourable outcome (mRS 4 to 6). Patients with deep-seated hematomas, those over the age of 70, those with poor GCS, hematoma volumes exceeding 100 ml, patients undergoing decompressive craniectomy, involvement of the dominant hemisphere, presence of co-morbidities, and pupillary inequality exhibited a significantly higher rate of dismal/unfavorable outcomes ($p < 0.05$).

In the current study, a statistically substantial difference was noticed among mean GCS before and after surgery (p = 0.02) as it was 10.74 ± 3.01 and improved to 12.56 ± 4.54 before leaving hospital. In **Hessington *et al.* [1]** study, the median mGCS score increased to 6.0 (IQR 5–6; p = 0.008) at discharge, and this improvement was observed in both lobar and deep-seated ICH patients. At six months following surgery, 51 patients (82.3%) in the deep ICH group and 50 patients (82.0%) in the lobar ICH group were still alive. At the final follow-up, which spanned from 8 to 89 months, 25 patients (20.3%) had passed away. There was no significant difference between the deep and lobar ICH groups [deep, 12/62 (19.4%); lobar, 13/61 (21.3%); p = 0.965].

In the current study, a strong negative associations was observed among mRS after surgery and initial GCS and also postoperative GCS, while no statistically significant correlation between mRS after surgery and age, clot size and midline shift. There was a statistically significant correlations between mRS after 6 months of surgery and initial GCS and also postoperative GCS, while no statistically significant correlation between mRS after 6 months of surgery and age, clot size and midline shift.

Limitations: Several limitations of the current study are present, such as it was single-institution nature and comparatively small sample sized. In addition, the follow-up period of three months was comparatively brief, and there was a dearth of information regarding medical management, which could have been beneficial. Therefore, in order to evaluate the long-term prognosis for functional outcomes in ICH patients, an extended follow-up period is required. Furthermore, there is a possibility that there may be a minor variation in clinical decisions regarding surgical evacuation among neurosurgeons who are treating patients, which could introduce a degree of selection bias.

CONCLUSION

Despite the presence of larger hematomas (more than 50 ml), craniotomy and evacuation of spontaneous supratentorial ICH are advantageous for patients with good premorbid status and moderate to good GCS, resulting in improved long-term functional outcomes. Regardless of the extent or location of the ICH, a favorable clinical outcome can be reached by combining neurocritical care with surgery.

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