https://doi.org/10.3329/bjns.v13i2.74130

Original Article

Outcome Predictor of Spontaneous Supratentorial Intracerebral Hemorrhage Management

Reza AHMT[1], Karim R[2], Rashid MH[3], Sanaullah M[4], Quader M[5], Chowdhury SMNK[6], Sarker T[7], Hasan MM[8], Ahmed AU[9], Hossain K[10]

Conflict of interest: There is no Conflict of interest relevant to this paper to disclose.

Funding Agency: Was not funded by any institute or any group.

Contribution of Authors: Principle Investigator- Dr. Soumen Samadder

Manuscript preparation- Dr. Abul Hasan Md. Touhidur Reza, Dr. Md. Rabiul Karim, Dr. Mohammad Humayun Rashid

Data collection- Dr. Mohammad Sanaullah, Dr. Mahfujul Quader, Dr. Tapas Sarker, Dr. Ansar Uddin Ahmed, Dr. Md. Kamal Hossain

Editorial formatting - Dr. S. M. Noman Khaled Chowdhury, Dr. Md. Motasimul Hasan

Received: October 05, 2023
Accepted: November 02, 2023

Abstract:

Background: *Spontaneous intracerebral hemorrhage (SICH) is responsible for higher morbidity and mortality rates than ischemic stroke. Although SICH is less common than ischemic stroke. Identifying the predictors of outcome after spontaneous supratentorial intracerebral hemorrhage is crucial for a clinical decision-making framework and implementing efficient therapeutic measures.*

Aims: *The study aimed to analyze the clinical profile, assess the outcome, and identify the outcome prognosticators after supratentorial SICH in the Neurosurgery Department of a tertiary care hospital in the southeastern part of Bangladesh.*

Materials and Methods: *This prospective interventional study included 183 patients with computerized tomography (CT) evidence of supratentorial SICH above 18 years of age from the Department of Neurosurgery of Chittagong Medical College Hospital between September 2021 and February 2023.The variables analyzed were age, sex, comorbidities, Glasgow coma scale (GCS) score on admission, radiological features, treatment modality and outcome at 90-day. Glasgow outcome scale (GOS) score was used to assess the outcome. GOS score 4-5 was considered good outcome and GOS score 1-3 was considered as poor outcome.*

Results: *The mean age of the patients was 58.9±14.4 years and 52.5% were male. The 90-day mortality rate was 50.8% and 55.2% patients had poor outcomes. On bivariate analysis, higher age, comorbid CKD state, low GCS score, higher hematoma volume, midline shift, hydrocephalus and intraventricular hematoma (IVH) were associated with poor outcome. Independent predictors of poor outcome included a higher baseline age (OR: 1.07, 95% CI:1.02-1.11, p=0.002), lower GCS on admission (OR: 0.55, 95% CI: 0.39-0.76, p<0.001), and medical management (OR = 30.56, 95% CI = 7.15-130.69, P <0.001).*

Conclusions: *In conclusion, SICH is associated with high mortality and morbidity. Higher age, low GCS on admission and medical management independently predicted poor outcome in the present study. Patients with a lower age, higher GCS on admission and who were managed surgically were more likely to have a good outcome.*

Keywords: *Supratentorial intracerebral hemorrhage; Outcome; Prognostic factors; Surgery; Conservative treatment.*

Bang. J Neurosurgery 2024; 13(2): 96-103

1. Dr. Abul Hasan Md. Touhidur Reza, Assistant Registrar, Department of Neurosurgery, Chittagong Medical College Hospital, Chattogram.
2. Dr. Md. Rabiul Karim, Associate Professor and Head of the Department, Department of Neurosurgery, Chittagong Medical College Hospital, Chattogram.
3. Dr. Mohammad Humayun Rashid, Associate Professor and Head, Department of Neurosurgery, East West Medical College Hospital, Dhaka, Bangladesh.
4. Dr. Mohammad Sanaullah, Associate Professor, Department of Neurosurgery, Chittagong Medical College Hospital, Chattogram.
5. Dr. Mahfujul Quader, Associate Professor, Department of Neurospine Surgery, Chittagong Medical College Hospital, Chattogram.
6. Dr. S. M. Noman Khaled Chowdhury, Professor and Ex-Head of the Department, Department of Neurosurgery, Chittagong Medical College Hospital, Chattogram.
7. Dr. Tapas Sarker; Resident Surgeon (Neurosurgery), Kurmitola General Hospital, Dhaka.
8. Dr. Md. Motasimul Hasan, Associate Professor, Department of Endovascular & Stroke Surgery, Dhaka Medical College Hospital.
9. Dr. Ansar Uddin Ahmed, Medical Officer, Department of Neurosurgery, National Institute of Neurosciences & Hospital, Dhaka, Bangladesh.
10. Dr. Md. Kamal Hossain, Assistant Registrar, Department of Neurosurgery, Chittagong Medical College Hospital, Chattogram.

Address of Correspondence: Dr. Abul Hasan Md Touhidur Reza, Assistant Registrar, Department of Neurosurgery, Chittagong Medical College Hospital, Chittagong;Phone:+8801711020357; E-mail address: drtouhidur.reza@gmail.com; Orcid Id: 0009-0000-8573-5652.

ntroduction:

Hemorrhagic stroke is generally associated with higher morbidity and mortality rates than ischemic stroke. Spontaneous supratentorial intracerebral hemorrhage (SICH) accounts for over 85% of hemorrhagic strokes [1]. SICH is an acute onset cerebrovascular event that results from non trauma induced bleeding into the brain parenchyma and is supported by a history of chronic hypertension, advanced age and deep location [2].

Deep hemorrhages, account for about two-thirds of cases of SICH, occur in the internal capsule, basal ganglia or brainstem and more likely result from deep perforator arteriopathy. About 5–10% of ICH occurs in the cerebellum. The remainder is lobar hemorrhage located in cortico-subcortical areas, often near or reaching the cerebral convexities, of which ~40% are due to arteriosclerosis alone, ~40% to arteriosclerosis and amyloid angiopathy and the remaining ~20% to amyloid angiopathy alone. SICH above the tentorium cerebelli is supratentorial SICH [3].

The initial management of all patients with SICH consists of medical management and hemodynamic stabilization of the patient, followed by either surgical or conservative treatment. The focus of medical management is blood pressure control, DM control, reduction of intracranial pressure, anticoagulation reversal and prevention of seizures. Small hematoma or minimal neurological deficit generally do well by medical treatment alone. Surgical intervention may be resorted to if the patient is deteriorating rapidly and immediate surgery is needed to either reduce intracranial pressure or relive local compression of neural structures. The indications for surgery for SICH should be considered in patients with moderate or large lobar hemorrhage, deep large hemorrhage and progressive neurological deterioration. There is no evidence of proper timing of surgery, but some study stated that optimal timing of surgery for patients with SICH was from 12 to 48 hours [4].

Still there is no proven medical or surgical treatment for SICH that could increase the survival or improve the quality of life for survivors. However, although surgical treatments have demonstrated equivocal results, the surgical decompression for SICH is still widely accepted as potentially life-saving, because an increase hematoma volume and edema occurs in 30% of the hospitalized patients and the surgical evacuation of hematoma can reduce the mass effect which is an important preventive measure to improve clinical outcome[5].

Existing randomized controlled trials have not established a clinical benefit for surgical evacuation in SICH patients. In the STICH trial, a multicenter trial that used clinical equipoise as an inclusion criterion, a subgroup analysis suggested a surgical benefit only in superficial lobars, although not in deep-seated SICH [6]. A worse outcome following surgery than the best medical management was seen in comatose patients with deep-seated SICH. In the follow-up STICH II trial, a small but significant improvement was observed following surgery for lobar SICH evacuated within 21 hours after the onset of symptoms [7].

Recently, another study concluded from a retrospective analysis of 123 cases of ICH that neither mortality nor long-term functional outcome differed between patients operated for lobar or deep-seated supratentorial SICH. At long-term follow-up, most SICH survivors had a favorable clinical outcome. They stated that combining surgery and neurocritical care could result in good clinical outcomes, regardless of SICH location[8].

The study site (CMCH) is the 2nd largest tertiary hospital in Bangladesh and has experienced significant improvement in the quality of care for SICH patients in the last decade. Contemplating this background, this study aimed to analyze the clinical profile, assess the functional outcome and identify the outcome prognosticators after supratentorial SICH is managed in CMCH.

Methods:

This Single institutional study ethics approval was granted by the local institutional ethics board. Written informed consent was obtained from all patients or guardians. This was a prospective interventional study conducted in the Department of Neurosurgery, Chattogram Medical College and Hospital, Chattogram, Bangladesh from September 2021 till February 2023. Consecutive sampling technique was applied where all patients with a diagnosis of Supratentorial ICH confirmed by CT Scan, admitted in the Neurosurgery department, CMCH during study

period was included in the study based on certain inclusion criteria: 1. Diagnosed as spontaneous supratentorial ICH by non contrast CT; 2. Age> 18 years; Exclusion criteria were: 1. Patients with traumatic ICH, subarachnoid hemorrhages, hemorrhagic transformation of a recent ischemic stroke, hemorrhage inside a space occupying lesion, infratentorial hemorrhage; 2. Refusal to participate in the study.

A pre-designed case record form including questionnaire and checklist was used to collect data. All relevant data were noted in the pretested data sheet. For each eligible patient; age, sex, setting of living, comorbidity, risk factors, severity of stroke and radiological parameters at admission was collected. Well oriented conscious patients (GCS>12) with hematoma volume < 30 ml or midline shift <1 cm and without neurological evidence of hydrocephalus will be treated conservatively. Patients/ Guardian who will not give consent for surgery also selected for conservative therapy. Unconscious patients or decreased consciousness level (GCSd"12), hematoma volume > 30ml or midline shift >1 cm, thalamic or basal ganglia bleeds with intraventricular extension and significant hydrocephalus was treated surgically.

Data were recorded in the form of an Excel worksheet. After completion of data collection, they were fed into SPSS version 23 for processing analysis. Continuous data were expressed as mean ± standard deviation (SD) for normally distributed data or median and 25%–75% interquartile range for non-normally distributed data. Categorical variables were presented as percentages (%) or proportions. The study population was divided into 90-day poor and good outcome by GOS score. Between these groups, continuous and categorical variables were analyzed. Student's *t*-tests were used to analyze normally distributed continuous variables, while Mann–Whitney's U-test was used for no normally distributed continuous variables. Categorical variables were compared using the Chi-square test. Variables with $P < 0.05$ on univariate analysis for good outcome 90-day after SICH were included in multivariate logistic regression analysis to determine the independent predictors of 90-day functional outcome. Results were reported as OR together with a 95% CI. $P < 0.05$ was considered statistically significant.

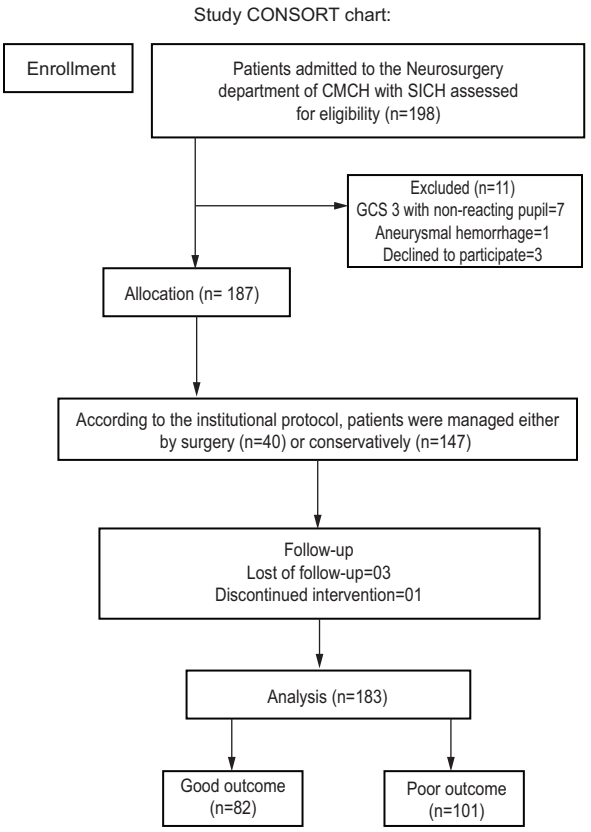

Figure 1: *Patient CONSORT diagram.*

Results:

A total of 198 patients were screened and 187 of them were found to full fill the eligibility criteria for the study. Four patients were lost to follow-up and reset of the 183 patients were included in the final analysis. Results and observations of the present study are described in the following tables and charts. The mean age of the patients was 58.9±14.4 years and their ages ranged between 20-90 years. There was a male preponderance 52.5% with a male-to-female ratio of 1.1:1

Table-I

Demographic characteristics of the patients (n=183)

Characteristics		Frequency (%)
Age		
	Mean ±SD	58.9±14.4
	Range	20.0-90.0
Sex		
	Female	87 (47.5)
	Male	96 (52.5)

Data were expressed as frequency (%) if not mentioned otherwise. SD: Standard deviation.

Table-II
Baseline clinical characteristics of the patients (n=183)

Characteristics	Frequency (%)
Comorbidity	
Hypertension	160 (87.4)
Diabetes mellitus	46 (25.1)
Ischemic heart disease	13 (7.1)
Chronic kidney disease	16 (8.7)
Interval[a] hours Median (IQR)	36.0 (20.0-72.0)
Presenting symptoms	
Altered consciousness	153 (83.6)
Vomiting	106 (57.9)
Seizure	16 (8.7)
Limb weakness	175 (95.6)
Examination findings	
DBP, mmHg. Median (IQR)	100.0 (90.0-100.0)
SBP, mmHg. Median (IQR)	160.0 (140.0-170.0)
GCS, Median (IQR)	10.0 (8.0-13.0)

Data were expressed as frequency (%) if not mentioned otherwise [a]From symptom onset to admission; IQR: Interquartile range; GCS: Glasgow Coma Scale

In this study, Hypertension was the most frequent comorbidity 87.4%, followed by diabetes mellitus 25.1%. The median interval from symptoms onset to admission was 36 hours. The most frequently reported symptom at presentation was limb weakness 95.6%, followed by an altered level of consciousness 83.6%, vomiting 57.9% and seizure 8.7%. Summary measures of the vital parameters are shown in Table 2.

Summary measures of radiological parameters are shown in Table 3. The median interval from symptom onset to CT scan was around 14 hours. The median hematoma volume was 28.9 ml and most of the hematomas were deep seated 79.8%. Intraventricular extension of hematoma and hydrocephalous was present in 51.9% and 18% of the patients respectively. Midline shift was present in 66.7% of the patients.

Table-III
Baseline radiological findings of the patients (n=183)

Characteristics	Frequency (%)
Interval[a] hours Median (IQR)	14.0 (7.0-23.3)
Hematoma volume, ml Median (IQR)	28.9 (13.6-51.4)
Location of hematoma	
Lobar	37 (20.2)
Deep	146 (79.8)
Ventricular extension	95 (51.9)
Hydrocephalous	33 (18.0)
Midline shift	122 (66.7)

Data were expressed as frequency (%) if not mentioned otherwise [a]From symptom onset to CT scan; IQR: Interquartile range.

Table-IV
Treatment modalities used for the patients (n=183)

Characteristics	Frequency (%)/ Median (IQR)
Management	
Conservative	144 (78.7)
Surgery	39 (21.3)
Interval[a] hours median (IQR)	33.0 (23.0-48.0)
Type of surgery (n=39)	
Craniotomy and evacuation of ICH	30 (76.9)
Decompressive Craniectomy and evacuation of ICH	4 (10.3)
Only decompressive craniectomy	2 (5.1)
External ventricular drainage	3 (7.7)

[a]From symptom onset to surgery.

In this study, 78.7% were managed conservatively. 21.3% underwent surgical management and the most frequent surgical technique was craniotomy and evacuation of ICH (76.9%). The median interval from symptom onset to surgery was 33 hours.

Table-V
Postoperative complications in the surgical patients (n=39)

Complications	Frequency	Percent
Chest infection	6	15.4
Wound infection	2	5.1
Bedsore	2	5.1
Rebleeding	1	2.6

The postoperative complications in patients managed surgically were chest infection (15.4%), wound infection (5.1%), bed sore (5.1%) and rebleeding (2.6%) (Table 5).

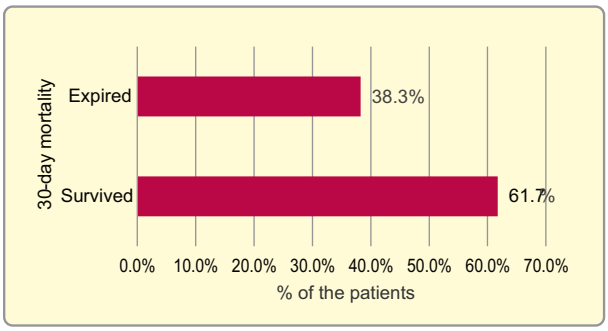

Figure 2: *Distribution of the patients based on their 30-day mortality*

Out of 183 analyzed patients with SICH, 61.7% survived at least 30 days post ictus and 30-day mortality rate was 38.3% (Figure 2)

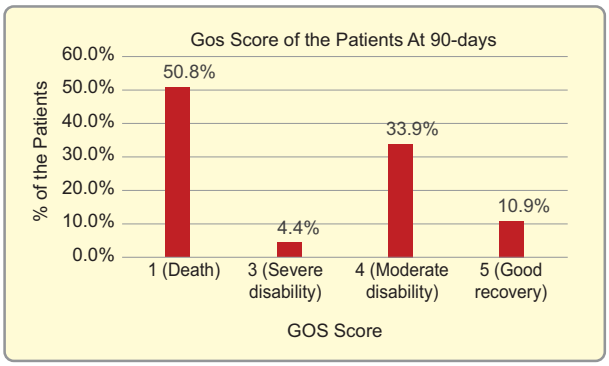

Figure 3: *Distribution of the patients based on their 90-day GOS score*

At the final follow-up (90-day) out of 183 patients, 10.9% patients had a GOS score of 5 (indicating good recovery) and 33.9% patients had recovery with GOS score of 4 (moderate disability). Other than 50.8% patients who expired (GOS score 1) before the 90-day follow-up, another 4.4% patients were found to have a GOS score of 3 (severe disability) (Figure 3).

A multivariate binary logistic regression analysis was performed using the variables which had a significant association with outcome in univariate analysis, with the 90 day poor outcome as the dependent variable (Table 8). Age, initial GCS score and the management procedure were found to have independent association with 90-day outcome. After adjustment for age, initial GCS, hematoma volume and other independent variables, patients who were managed conservatively were 30 times high chance of having 90-day poor outcome than the patients who were managed surgically (OR = 30.56, 95% CI = 7.15-130.69, P<0.001).

Table-VI

Management procedure and outcome in different baseline GCS category (n=183)

Baseline GCS	Management	Outcome		P value
		Good	Poor	
<8 (n=41)	Conservative (n=33)	0 (0)	33 (100)	<0.001*
	Surgical (n=8)	3 (37.5)	5 (62.5)	
8-12 (n=84)	Conservative (n=53)	12 (22.6)	41 (77.4)	<0.001*
	Surgical (n=31)	23 (74.2)	8 (25.8)	
>12 (n=58)	Conservative (n=58)	44 (75.9)	14 (24.1)	NA
	Surgical (n=0)	0 (0)	0 (0)	

Data were expressed as frequency (%) or median (IQR). *Chi-square test.
NA: Not applicable

Table 6 depicts that, majority of Patients who had GCS<8 and >12 were treated conservatively. Higher proportion of the patients with baseline GCS 8-12 who have managed surgically have good outcome than the patients who have managed conservatively (74.2% versus 22.6%).

Table-VII

Management procedure and outcome in different baseline hematoma volume category (n=183)

Baseline hematoma volume (ml)	Management	Outcome		P value
		Good	Poor	
<30 (n=95)	Conservative (n=92)	46 (50.0)	46 (50.0)	0.570*
	Surgical (n=3)	2 (66.7)	1 (33.3)	
30-50 (n=40)	Conservative (n=25)	9 (36.0)	16 (64.0)	0.022*
	Surgical (n=15)	11 (73.3)	4 (26.7)	
>50ml(n=48)	Conservative (n=27)	1 (3.7)	26 (96.3)	<0.001
	Surgical (n=21)	13 (61.9)	8 (38.1)	

Data were expressed as frequency (%) or median (IQR). *Chi-square test.

Significantly, higher proportion of the patients with baseline hematoma volume 30-50 ml and >50 ml who have managed surgically have good outcome than the patients who have managed conservatively.

Table-VIII

Logistic regression analysis with a 90 day poor outcome as the dependent variable

Variables	OR	95% CI for OR		P value
		Lower	Upper	
Age, years	1.065	1.023	1.108	0.002
CKD absent vs. present	1.800	0.082	39.397	0.709
Altered level of consciousnessabsent vs. present	1.056	0.189	5.905	0.951
GCS on admission (per point)	0.550	0.399	0.759	<0.001
Hematoma volume, ml	1.011	0.980	1.042	0.490
Ventricular extensionAbsent vs. present	1.550	0.583	4.124	0.380
Hydrocephalous absent vs. present	1.935	0.394	9.515	0.416
Midline shift absent vs. present	2.419	0.732	7.995	0.148
Management Surgical vs. Conservative	30.558	7.145	130.689	<0.001

OR: Odds ratio; CI: Confidence interval

Discussion:

The clinical impact of SICH appears disproportionately higher in low and middle-income versus high-income countries, both as a proportion of all strokes and in absolute incidence rates. SICH is arguably the deadliest form of acute stroke with, high mortality, morbidity and no or minimal trend toward improvement over more recent eras. The present study investigated the association of different clinical, radiological and therapeutic factors with the outcome of SICH to determine whether any of these factors could predict the prognosis.

A total of 187 patients with SICH were enrolled in the Department of Neurosurgery, CMCH. Out of them, four patients were lost to follow-up. 90-day mortality and functional ability data were available for rest of the 183 patients. Only 21.3% underwent surgical management and rest of the patients were managed conservatively 78.7%, even though some of them had fulfilled the criteria for surgical management. The study demonstrated that patients with a GCS score 8-12 and patient with a baseline hematoma volume >30 ml benefited from the surgical intervention. Overall the age, initial GCS score and the management procedure were found to have independent association with 90-day outcome in the present study.

Out of the 183 patients with SICH 90-day mortality was 50.8% in the present study. Higher mortality in the present study might be attributable to providing appropriate patient specific care. The mortality rate at 90 days was 42% in the study of Hegde et al [9].

One of the most consistent predictors of poor outcomes, in almost all published series, has been a GCS of less than 8. Indian studies to have reported similar findings with Bhatia et al. [9] and Hegde et al. [10] reporting a fatality of 72.9% and 65% respectively with poor GCS on admission. In the present study, median GCS was 7 in the patients with poor outcome, compared to 9 in the patients with good outcome and GCS was an independent predictor of poor 90-day outcomes.

At the final follow-up, only 10.9% patients had a GOS score of 5 (indicating good recovery), another 33.9% and 4.4% patients had recovery with moderate and severe disability, respectively, which agreed with the studies of Hegde et al. [9] and Bhatia et al. [10] where most of the survivors were disabled at the time of discharge and at the 30-day follow-up respectively.

Predictors of outcome in early studies of SICH included age, ICH location, electrocardiographic abnormalities and history of hypertension. More recent studies have also identified lesion size, level of consciousness, midline shift, blood pressure or pulse pressure, kidney dysfunction, IVH, pupillary abnormality and the need for ventilatory support during a hospital stay, as factors influencing outcome [10]. A review of these studies reveals considerable variability in the factors identified which interacts strongly with each other. In the present study, binary logistic regression was performed to assess independent predictors of poor outcomes. Higher age of the patient, lower GCS on admission and medical management were independent predictors of mortality, while the volume of hematoma, intraventricular extension and midline shift failed to reach statistical significance. Medical management had the highest odds of death at 30.56 in the current study.

In the present study, age ranged between 20-90 years, with a mean age of 58.9±14.4 years, which agreed to the previous studies conducted in India [10] and Pakistan [11]. This study reported that the patients mean age of 63.7±12.9 years with poor outcomes compared the patients mean age of 52.8±14.0 years with good outcome. So, advanced age and unfavorable outcomes correlated significantly. Several authors have shown that older adults with acute SICH experienced the worse outcomes compared with their younger counterparts, including death, dependency and overall quality of life [10-13]. In the present study, male and female representation was almost equal and gender had no influence on the 90-day outcome.

In this study, arterial hypertension was the most frequent comorbidity 87.4%, followed by diabetes 25.1% and 8.7% had preexisting CKD. In bivariate analysis, CKD was associated with poor outcome in the present analysis. However, diabetes was not associated with the 90-day poor outcome in the present study. Although diabetes is associated with worse functional recovery in most ischemic stroke patients, whether the same is true of patients with SICH is unclear. In a prospective study of Chinese patients' diabetes was not associated with an increased risk of mortality or functional outcome after SICH [14].

A subgroup analysis of the STICH data was attempted by Gregson et al. [15] to pool all available original data from all available surgical trials to carry out an individual patient data meta-analysis. The meta-analysis concluded that the outcome is better if surgery is done within 8 hours of ictus, the volume of haematoma is 20–50 ml, the GCS is between 9 and 12, patient is aged between 50 to 69 years and the hematoma is superficial with no IVH. In the present study, none of the patients with GCS >12 were operated and 90-day mortality was significantly higher in the medically managed group than in the surgically managed group (56.9% versus 28.2%, p=0.001). Multiple trials and studies have tried to address the role of surgery in primary SICH. Medical management had the highest odds of death at 4.67 in a recent study [9,15]. However, patients who had functional dependency had significantly lower GCS (GCSd"8: n=34, 82.9%) than the patients who were functionally independent among the survivor mentioned in other articles conducted by Rashid MH et al.[16].

The volume of hematoma is also an important predictor of mortality in SICH. However, in the present study, it failed to be an independent predictor of poor outcome as very few patients in the present study with hematoma volumes <30 ml were operated, which agreed with the study of Hegde et al. [9]. This bias could be explained by the fact that smaller hematomas present with better GCS on presentation and family members often refuse surgical intervention and option for conservative management after considering the risk/ benefit ratio of surgery. In the present study, a total of 88 patients had hematoma volumes >30 ml. Of these, 36 were managed surgically and 52 were managed conservatively. Poor outcome was 33.3% in the surgical group and 80.8% in the medically managed group. These patients tend to have a higher mortality and overall poor outcome than their surgical counterparts.

The strength of the present study was its prospective nature. The study would provide more insight into the presentation and 90-day outcome of patients with SICH. The present study findings might help physicians to recognize patient specific predictive factors for poor outcomes and identify those patients who are likely to suffer early mortality after SICH regardless of surgical intervention. Such early prognostication has significant consequences for decision making, the counseling of family members and by avoiding futile treatment, resource utilization.

Conclusion:

Our investigation showed that age, GCS score at admission and management procedure were the independent predictors of the 90-day outcome following spontaneous SICH. Patients with a lower age, higher GCS on admission and who were managed surgically were more likely to have a good outcome and higher age, low GCS on admission and medical management independently predicted poor outcome in the present study.

Limitation of the study:

In our study, patients were selected from a single tertiary level center, and it is only generalizable to those who present to a hospital for care. Patients with smaller hematomas and better GCS were managed conservatively in comparison to their surgical cohort. Outcome was measured at 90 days, which is a short duration to assess functional outcome in SICH after surgery. As a tertiary level Government hospital,

for all critical patients, we could not provide neuro-critical care support. The outcome assessment is restricted to GOS. Other important parameters, including cognitive disability etc. have not been assessed. Further study covering these limitation may add value to the management of supratentorial ICH management strategy.

Conflict of Interest: None to disclose.

Reference:

1. Elliott, J. and Smith, M., 2010. The acute management of intracerebral hemorrhage: a clinical review. Anesthesia & Analgesia, 110(5), pp.1419-1427.
2. Ziai, W.C. and Carhuapoma, J.R., 2018. Intracerebral hemorrhage. Continuum: Lifelong Learning in Neurology, 24(6), pp.1603-1622.
3. McGurgan, I.J., Ziai, W.C., Werring, D.J., Salman, R.A.S. and Parry-Jones, A.R., 2021. Acute intracerebral haemorrhage: diagnosis and management. Practical Neurology, 21(2), pp.128-136.
4. Gondowardojo, Y.R.B., Argie, D., Adam, A., Ratnasari, N.L.M.N. 2018. Clinical, radiological features, and surgical management of spontaneous intracerebral hemorrhage patients in East Nusa Tenggara Indonesia. Bali Medical Journal 7(2): 426 430. DOI:10.15562/bmj.v7i2.637
5. Rendevski, V., Stojanov, D., Aleksovski, B., Mihajlovska-Rendevska, A., Chaparoski, A., Ugurlar, D., Aleksovski, V., Baneva, N. and Gjorgoski, I., 2017. Surgical outcome in patients with spontaneous supratentorial intracerebral hemorrhage. Acta facultatismedicaeNaissensis, 34(4), pp.265-273.
6. Mendelow, A.D., Gregson, B.A., Fernandes, H.M., Murray, G.D., Teasdale, G.M., Hope, D.T., Karimi, A., Shaw, M.D.M. and Barer, D.H., 2005. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial intracerebral haematomas in the International Surgical Trial in Intracerebral Haemorrhage (STICH): a randomised trial. The Lancet, 365(9457), pp.387-397.
7. Mendelow, A. D., Gregson, B. A., Rowan, E. N., Murray, G. D., Gholkar, A., Mitchell, P. M., & STICH II Investigators., 2013. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial lobar intracerebral haematomas (STICH II): a randomized trial. Lancet (London, England), 382(9890), pp.397–408.
8. Hessington, A., Tsitsopoulos, P.P., Fahlström, A. and Marklund, N., 2018. Favorable clinical outcome following surgical evacuation of deep-seated and lobar supratentorial intracerebral hemorrhage: a retrospective single-center analysis of 123 cases. Acta neurochirurgica, 160, pp.1737-1747.
9. Hegde, A., Menon, G. and Kumar, V., 2019. Surgery for spontaneous intracerebral hemorrhage–A comparative study with medical management in moderate to large sized hematomas. Clinical neurology and neurosurgery, 184, p.105415.
10. Bhatia, R., Singh, H., Singh, S., Padma, M.V., Prasad, K., Tripathi, M., Kumar, G. and Singh, M.B., 2013. A prospective study of in-hospital mortality and discharge outcome in spontaneous intracerebral hemorrhage. Neurology India, 61(3), p.244.
11. Rehman, W.A. and Anwar, M.S., 2017. Surgical outcome of spontaneous supra tentorial intracerebral hemorrhage. Pakistan journal of medical sciences, 33(4), p.804-807.
12. Rådholm, K., Arima, H., Lindley, R.I., Wang, J., Tzourio, C., Robinson, T., Heeley, E., Anderson, C.S. and Chalmers, J., 2015. Older age is a strong predictor for poor outcome in intracerebral haemorrhage: the INTERACT2 study. Age and Ageing, 44(3), pp.422-427.
13. Van Asch, C.J., Luitse, M.J., Rinkel, G.J., van der Tweel, I., Algra, A. and Klijn, C.J., 2010. Incidence, case fatality, and functional outcome of intracerebral haemorrhage over time, according to age, sex, and ethnic origin: a systematic review and meta-analysis. The Lancet Neurology, 9(2), pp.167-176.
14. Wang, Q., Wang, D., Liu, M., Fang, Y., You, C., Dong, W., Chang, X., Lei, C., Zhang, J. and Chen, Y., 2015. Is diabetes a predictor of worse outcome for spontaneous intracerebral hemorrhage? Clinical neurology and neurosurgery, 134, pp.67-71.
15. Gregson, B.A., Broderick, J.P., Auer, L.M., Batjer, H., Chen, X.C., Juvela, S., Morgenstern, L.B., Pantazis, G.C., Teernstra, O.P., Wang, W.Z. and Zuccarello, M., 2012. Individual patient data subgroup meta-analysis of surgery for spontaneous supratentorial intracerebral hemorrhage. Stroke, 43(6), pp.1496-1504.
16. Rashid, M. H., Hossain, M. N., Hossain, M. S., Eva, I. Z., Habib, R., Mamun, A. A. and Ahmed, U. U. (2021) "The relationship between modified Graeb score and intraventricular hematoma volume with Glasgow outcome scale and modified Rankin scale in intraventricular hemorrhage of brain: a comparative study", *International Journal of Research in Medical Sciences*, 9(11), pp. 3256–3262. doi: 10.18203/2320-6012.ijrms20214049.