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Original Article

Clinical Profile, Surgical Management, and Outcomes of Spontaneous Supratentorial Intracerebral Hemorrhage: A Prospective Study

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ABSTRACT

Introduction: Spontaneous intracerebral hemorrhage (ICH) is a severe subtype of stroke caused by non-traumatic bleeding into the brain parenchyma and is associated with high morbidity and mortality. Surgical procedures such as decompressive craniectomy, decompressive craniectomy with hematoma evacuation, and endoscopic evacuation are used in selected patients to reduce mass effect and improve outcomes. The aim of this study was to evaluate the clinical profile, risk factors, surgical management, complications, and outcomes of patients with spontaneous supratentorial intracerebral hemorrhage.

Materials and Methods: This prospective observational study was conducted in the Department of Neurosurgery at Mamata Medical College and Super Specialty Hospital, Khammam, from July 2024 to June 2025. Sixty patients with spontaneous supratentorial intracerebral hemorrhage were included. All patients were resuscitated and managed in the intensive care unit. Clinical parameters, hematoma volume, preoperative Glasgow Coma Scale (GCS), postoperative complications, and functional outcomes assessed using the Modified Rankin Scale (mRS) were analyzed.

Results: Most patients were aged 61–70 years (55%) with male predominance (70%). Hypertension was the most common risk factor. Weakness or hemiplegia was the most frequent presenting symptom (38.4%). Mean hematoma volume and preoperative GCS were comparable among surgical groups (p=0.86 and p=0.773). Mortality (mRS 6) occurred in 36.7% of patients.

Conclusion: Spontaneous intracerebral hemorrhage carries high morbidity and mortality. Preoperative neurological status and hematoma characteristics significantly influence outcomes. Early diagnosis and appropriate surgical intervention may improve survival in selected patients.

Keywords: *Spontaneous intracerebral hemorrhage; decompressive craniectomy; hematoma evacuation; Glasgow Coma Scale; Modified Rankin Scale.*

INTRODUCTION

Spontaneous intracerebral hemorrhage (ICH) is defined as non-traumatic bleeding into the brain parenchyma that may extend into the ventricular system or subarachnoid space (1,2). It represents one of the most severe forms of stroke and is associated with high morbidity and mortality. Intracerebral hemorrhage is the second most common subtype of stroke after ischemic stroke, accounting for approximately 10–20% of all stroke cases worldwide (2,3). The incidence of ICH increases with age and is particularly common in individuals with long-standing hypertension and other vascular risk factors. Despite advances in neurocritical care and neurosurgical techniques, the overall prognosis of intracerebral hemorrhage remains poor compared to other stroke types.

Globally, intracerebral hemorrhage contributes significantly to neurological disability and mortality. Epidemiological studies have reported that the mortality rate ranges from 30% to 50% within the first month, and nearly half of the deaths occur within the first 48 hours after the hemorrhagic event (3,4). Among survivors, long-term neurological deficits are common, and only a minority of patients regain functional independence (4). The poor outcome of intracerebral hemorrhage is largely due to the rapid expansion of hematoma, increased intracranial pressure, and secondary brain injury mechanisms including perihematomal edema, inflammation, and disruption of neural pathways (5).

The most common underlying cause of spontaneous intracerebral hemorrhage is chronic hypertension, which leads to degenerative changes in small penetrating cerebral arteries and predisposes them to rupture (6). Other important causes include cerebral amyloid angiopathy, vascular malformations, anticoagulant therapy, and coagulation disorders (5). The clinical presentation depends on the location and size of the hematoma and may include sudden headache, vomiting, altered consciousness, and focal neurological deficits. Early diagnosis using neuroimaging techniques such as computed tomography (CT) plays a crucial role in determining the management strategy and predicting patient outcomes.

Management of spontaneous intracerebral hemorrhage includes both medical and surgical approaches. Medical management focuses on stabilization of the patient, control of blood pressure, management of intracranial pressure, and prevention of secondary brain injury (7). However, in patients with large hematomas or neurological deterioration, surgical evacuation of the hematoma may be necessary to reduce mass effect and prevent further brain damage. Surgical procedures used in the management of intracerebral hemorrhage include decompressive craniectomy, open evacuation of hematoma, and minimally invasive techniques such as endoscopic evacuation (8).

Several studies have investigated the effectiveness of surgical intervention in improving outcomes in patients with intracerebral hemorrhage. The STICH trial demonstrated that early surgery did not show a clear overall benefit compared with conservative treatment in all patients, although certain subgroups such as patients with superficial lobar hemorrhages may benefit from surgical intervention (9). More recent studies have suggested that minimally invasive and endoscopic techniques may offer advantages such as reduced surgical trauma and shorter hospital stay while achieving comparable or improved functional outcomes (10). However, the optimal surgical strategy and patient selection criteria remain subjects of ongoing debate.

Although multiple surgical techniques are available for the management of spontaneous intracerebral hemorrhage, there is still no clear consensus regarding the most effective surgical approach. Previous studies have mainly compared surgery with conservative management, while limited data are available comparing different surgical procedures such as decompressive craniectomy, decompressive craniectomy with hematoma evacuation, and endoscopic evacuation in terms of neurological recovery and patient outcomes. Therefore, further clinical studies are necessary to evaluate the effectiveness of these surgical techniques and determine the best treatment strategy.

The aim of the present study is to evaluate the surgical management and outcomes of patients with spontaneous intracerebral hemorrhage undergoing different surgical procedures and to assess their impact on neurological recovery and overall patient outcome.

MATERIALS AND METHODS

Study Design

The present study was designed as a prospective observational study conducted to evaluate the etiological factors and outcomes associated with various surgical modalities in patients diagnosed with spontaneous intracerebral hemorrhage. The study aimed to analyze the clinical characteristics, surgical management strategies, and postoperative outcomes among patients presenting with spontaneous supratentorial intracerebral hemorrhage.

The study was conducted in the Department of Neurosurgery at Mamata Medical College and Super Specialty Hospital, Khammam from July 2024 to June 2025. All eligible patients presenting with spontaneous intracerebral hemorrhage and fulfilling the study criteria were evaluated and included in the study.

Study Population and Sample Size

A total of 100 patients diagnosed with spontaneous supratentorial intracerebral hemorrhage were included in the study. Patients admitted during the study period who satisfied the inclusion criteria were enrolled consecutively. All patients were initially resuscitated, clinically evaluated, and investigated, and subsequently managed in the intensive care unit (ICU) after admission. Appropriate neurosurgical intervention was performed depending on the clinical condition of the patient and radiological findings.

Inclusion Criteria

- Patients fulfilling the following criteria were included in the study:
- Patients admitted with spontaneous supratentorial intracerebral hemorrhage confirmed by neuroimaging.

- Patients undergoing surgical management, including decompressive craniectomy, craniotomy with evacuation of hematoma, or endoscopic evacuation of hematoma.
- Patients or their legally authorized guardians who provided valid informed consent for participation in the study.

Exclusion Criteria

- Patients meeting the following criteria were excluded from the study:
- Patients with traumatic intracerebral hemorrhage.
- Patients with intracerebral hemorrhage secondary to malignancy.
- Patients or guardians who refused to provide informed consent for participation in the study.
- Patients with pure intraventricular hemorrhage without parenchymal involvement.

Study Tools and Investigations

All patients included in the study were evaluated using a structured clinical proforma designed to record relevant demographic, clinical, and radiological details. A detailed clinical history was obtained, and a comprehensive neurological examination was performed at the time of admission. Neurological status was assessed using the Glasgow Coma Scale (GCS) to determine the level of consciousness and severity of neurological impairment.

Radiological evaluation was performed using computed tomography (CT) scan of the brain, which served as the primary diagnostic modality to confirm intracerebral hemorrhage. The CT scan was used to determine the location, size, and extent of the hematoma, as well as to identify intraventricular extension or mass effect. Additional laboratory investigations including complete blood count, coagulation profile, renal function tests, and other relevant biochemical parameters were carried out as part of the routine evaluation.

Surgical Management

Based on the clinical condition of the patient, neurological status, and radiological findings, appropriate surgical intervention was undertaken. The surgical modalities included decompressive craniectomy, craniotomy with evacuation of hematoma, and endoscopic evacuation of hematoma. The choice of surgical procedure depended on factors such as hematoma size, location, level of consciousness, and presence of mass effect.

Data Collection

Data were collected prospectively for each patient using a predesigned case record form. Information regarding demographic characteristics such as age and gender, clinical presentation, and associated risk factors including hypertension, smoking, and other comorbidities was recorded. Neurological status at admission was assessed using the Glasgow Coma Scale (GCS). Radiological findings including the location and extent of hemorrhage were documented. Details regarding the type of surgical procedure performed, postoperative neurological status, and duration of intensive care unit stay were also recorded.

Patient outcomes were assessed during the postoperative period using standardized outcome measures including the Glasgow Outcome Scale (GOS) and the Modified Rankin Scale (mRS) to evaluate functional recovery and neurological outcome.

Ethical Clearance

Prior to the commencement of the study, ethical approval was obtained from the Institutional Ethics Committee of Mamata Medical College and Super Specialty Hospital, Khammam. Written informed consent was obtained from all patients or their legally authorized guardians before inclusion in the study. The study was conducted in accordance with the ethical guidelines for biomedical research involving human subjects, and confidentiality of patient information was strictly maintained throughout the study.

Statistical Analysis

All collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 23.0. Continuous variables such as age, Glasgow Coma Scale score, and duration of ICU stay were expressed as mean ± standard deviation. Categorical variables such as gender distribution, risk factors, and types of surgical procedures were presented as frequencies and percentages. Appropriate statistical tests including Chi-square test, Student's t-test, and analysis of variance (ANOVA) were used for comparison between groups. A p-value of less than 0.05 was considered statistically significant.

RESULTS:

Table 1: Incidence of Spontaneous Intracerebral Hemorrhage According to Age Group

Age Group (Years)	Frequency (n)	Percentage (%)
Below 40	3	5.0
41–50	2	3.3

51–60	15	25.0
61–70	33	55.0
Above 70	7	11.7
Total	60	100

The majority of patients in the present study belonged to the 61–70 years age group (55%), followed by 51–60 years (25%). Only a small proportion of patients were observed in younger age groups, indicating that spontaneous intracerebral hemorrhage was more common among elderly individuals in the study population.

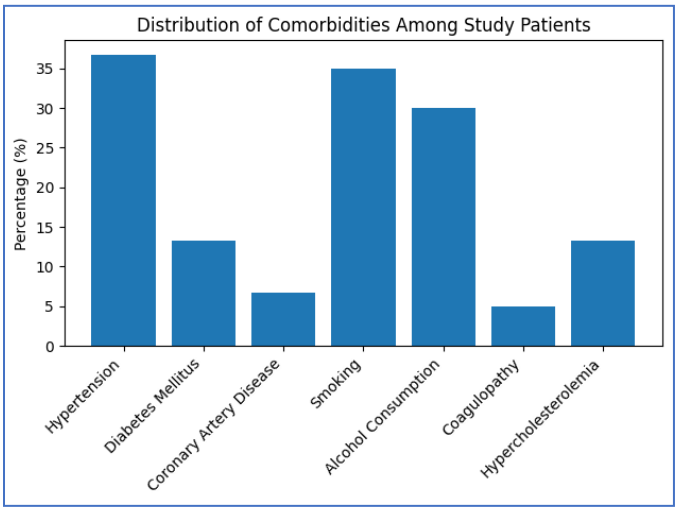

Figure 1: Distribution of Comorbidities Among Study Patients

The figure 1 illustrates the distribution of comorbid conditions among patients with spontaneous intracerebral hemorrhage. Hypertension (36.7%) was the most common comorbidity, followed by smoking (35.0%) and alcohol consumption (30.0%). Diabetes mellitus and hypercholesterolemia were present in 13.3% of patients each. Coronary artery disease (6.7%) and coagulopathy (5.0%) were observed less frequently.

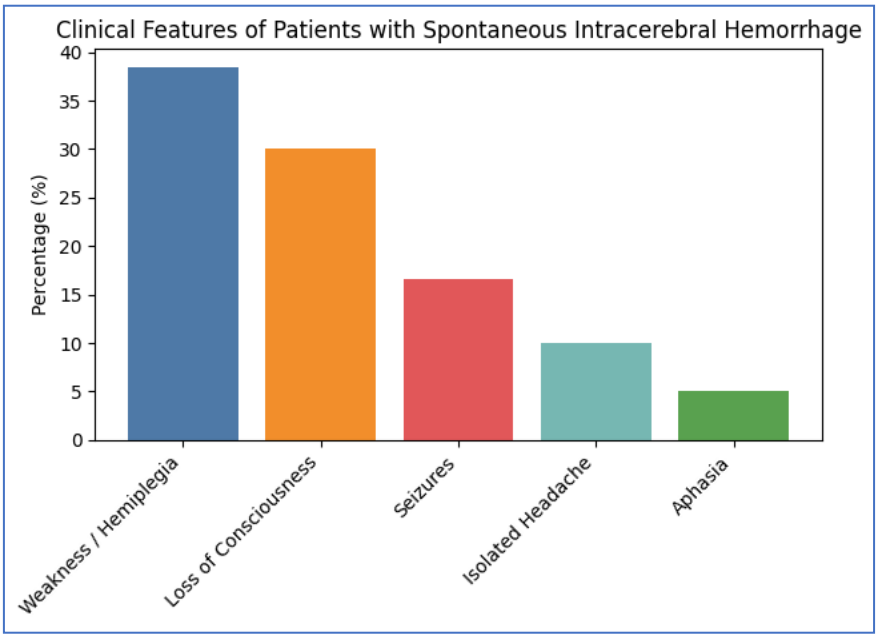

Figure 2: Distribution of Clinical Features Among Study Patients

In the present study, the most common clinical presentation was weakness and hemiplegia, observed in 23 patients (38.4%), followed by loss of consciousness in 18 patients (30.0%). Seizures were reported in 10 patients (16.6%), while isolated headache was observed in 6 patients (10.0%). Aphasia was the least common clinical feature, seen in 3 patients (5.0%). These findings indicate that focal neurological deficits and altered consciousness were the predominant clinical manifestations of spontaneous intracerebral hemorrhage in the study population.

Table 2: Distribution of Outcomes According to Surgical Modality

Outcome Category	Decompressive Craniectomy (n)	Craniotomy with Evacuation of Hematoma (n)	Endoscopic Evacuation of Hematoma (n)
Category 1	12	5	12
Category 2	10	6	4
Category 3	6	6	6

Table 2 shows the distribution of patient outcomes according to the different surgical modalities used in the study. In Category 1, the highest number of patients was observed in both the decompressive craniectomy and endoscopic evacuation groups (12 patients each), while 5 patients underwent craniotomy with evacuation of hematoma. In Category 2, 10 patients belonged to the decompressive craniectomy group, followed by 6 patients in the craniotomy with evacuation group and 4 patients in the endoscopic evacuation group. In Category 3, the distribution was equal across all three surgical modalities with 6 patients each. These findings indicate a relatively comparable distribution of outcomes among the different surgical procedures performed in the present study.

Table 3: Distribution of ICH Volume Among Different Surgical Modalities

ICH Volume (ml)	Decompressive Craniectomy (DC)	DC + Evacuation of Hematoma	Endoscopic Evacuation
30–60	3	5	4
60–90	15	9	8
>90	7	5	4
Total	25	19	16
Mean ± SD	77.68 ± 17.71	76.89 ± 24.44	74.06 ± 21.14

Table 3 shows the distribution of intracerebral hemorrhage (ICH) volume among the different surgical modalities. Most patients in all three groups had an ICH volume between 60–90 ml, with 15 patients in the decompressive craniectomy group, 9 patients in the DC with evacuation group, and 8 patients in the endoscopic evacuation group. A smaller number of patients had hematoma volumes between 30–60 ml and greater than 90 ml. The mean hematoma volume was 77.68 ± 17.71 ml in the decompressive craniectomy group, 76.89 ± 24.44 ml in the DC with evacuation group, and 74.06 ± 21.14 ml in the endoscopic evacuation group. This indicates that the baseline hematoma volumes were comparable among the three surgical groups.

Table 4: Surgeries Performed Depending on Preoperative GCS

Preoperative GCS	Decompressive Craniectomy (DC)	DC + Evacuation of Hematoma	Endoscopic Evacuation
6–8	5	8	6
9–11	12	6	5
12–15	8	5	5
Total	25	19	16
Mean ± SD	10.84 ± 2.42	10.21 ± 3.32	10.10 ± 2.90

In the present study, the majority of patients across all surgical groups had a preoperative Glasgow Coma Scale (GCS) score between 9 and 11. The mean preoperative GCS score in the decompressive craniectomy group was 10.84 ± 2.42, while in the decompressive craniectomy with evacuation group it was 10.21 ± 3.32, and in the endoscopic evacuation group it was approximately 10.10 ± 2.90. Statistical analysis using one-way ANOVA showed no significant difference in preoperative GCS among the three surgical groups ($p = 0.77$), indicating that the baseline neurological status of patients was comparable across the treatment groups.

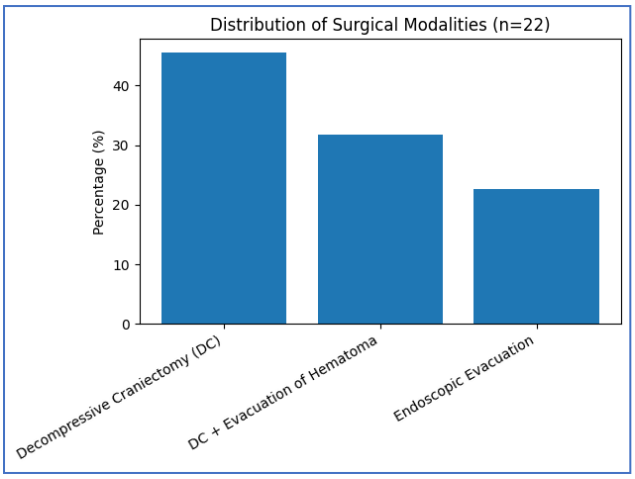

Figure 3: Distribution of Patients According to Surgical Modality (n = 22)

The distribution of surgical modalities among the patients is shown in the figure 3. Decompressive craniectomy was the most commonly performed procedure, accounting for 10 patients (45.5%). This was followed by decompressive craniectomy with evacuation of hematoma, performed in 7 patients (31.8%). Endoscopic evacuation of hematoma was the least frequently performed procedure, observed in 5 patients (22.7%). These findings indicate that decompressive craniectomy was the most commonly utilized surgical intervention in the present study population.

Table 5: Distribution of Modified Rankin Scale (mRS) at Discharge

mRS Score	Number of Patients (n)	Percentage (%)
0	2	3.3
1	6	10.0
2	9	15.0
3	7	11.7
4	6	10.0
5	8	13.3
6 (Death)	22	36.7
Total	60	100

The distribution of functional outcomes at discharge based on the Modified Rankin Scale (mRS) is illustrated in Figure 6. In the present study, the highest proportion of patients had an mRS score of 6 (death), observed in 22 patients (36.7%). Moderate to severe disability was noted in several patients, with mRS score 5 in 8 patients (13.3%), mRS score 4 in 6 patients (10.0%), and mRS score 3 in 7 patients (11.7%). Better functional outcomes were observed in a smaller proportion of patients, with mRS score 2 in 9 patients (15.0%), mRS score 1 in 6 patients (10.0%), and mRS score 0 in 2 patients (3.3%) at the time of discharge. These findings indicate that a considerable proportion of patients experienced severe disability or mortality following spontaneous intracerebral hemorrhage, while a smaller number achieved favorable functional recovery.

Table 6: Postoperative Complications According to Surgical Modality

Complications	Decompressive Craniectomy (DC)	DC + Evacuation of Hematoma	Endoscopic Evacuation
Wound Infection	2	1	0
Rebleeding	2	4	3
Pneumonia	2	3	1
CSF Leak	1	3	2
Total	7	11	6

Table 7 shows the distribution of postoperative complications according to the surgical modality. In the decompressive craniectomy group, a total of 7 complications were observed, including wound infection, rebleeding, pneumonia, and CSF leak. The DC with evacuation of hematoma group showed the highest number of complications (11 cases), while 6 complications were observed in the endoscopic evacuation group. Rebleeding was the most common complication across the surgical modalities, followed by pneumonia and CSF leak, whereas wound infection was relatively less frequent.

DISCUSSION

Spontaneous intracerebral hemorrhage (ICH) is one of the most severe forms of stroke and is associated with high mortality and long-term disability. Despite improvements in neurocritical care and neurosurgical techniques, the optimal management strategy for spontaneous ICH remains controversial, particularly regarding surgical intervention. The present study was conducted to evaluate the clinical profile, surgical management, complications, and outcomes of patients with spontaneous supratentorial intracerebral hemorrhage undergoing different surgical procedures including decompressive craniectomy, decompressive craniectomy with evacuation of hematoma, and endoscopic evacuation of hematoma.

In the present study, the majority of patients belonged to the 61–70 years age group (55%), followed by the 51–60 years age group (25%). This finding is consistent with earlier epidemiological studies demonstrating that the incidence of intracerebral hemorrhage increases with advancing age due to progressive vascular changes and the higher prevalence of hypertension in elderly individuals (11,12). Similar age distributions were reported by Feigin et al. and van Asch et al., who observed that intracerebral hemorrhage occurs more frequently in older populations and is associated with poorer prognosis (13).

Gender distribution in the present study showed male predominance, with 42 males (70%) and 18 females (30%). Similar findings have been reported in several previous studies showing a higher incidence of intracerebral hemorrhage among males (12,14). This increased prevalence among males may be attributed to lifestyle-related risk factors such as smoking, alcohol consumption, and uncontrolled hypertension.

Hypertension was identified as the most common comorbidity (36.7%), followed by smoking and alcohol consumption. These findings are consistent with previous literature identifying hypertension as the most important modifiable risk factor for spontaneous intracerebral hemorrhage (15). Chronic hypertension leads to degenerative changes in small penetrating arteries, making them susceptible to rupture and hemorrhage. Several studies have shown that effective blood pressure control significantly reduces the risk of intracerebral hemorrhage (16).

The clinical presentation in the present study was consistent with the typical manifestations of intracerebral hemorrhage. Weakness or hemiplegia was the most common presenting symptom (38.4%), followed by loss of consciousness (30%) and seizures (16.6%). Similar observations were reported by Qureshi et al., who noted that focal neurological deficits and altered consciousness are common presenting features in patients with intracerebral hemorrhage (17).

The mean intracerebral hemorrhage volume was comparable across the three surgical groups. The mean hematoma volume was 77.68 ± 17.71 ml in the decompressive craniectomy group, 76.89 ± 24.44 ml in the decompressive craniectomy with evacuation group, and 74.06 ± 21.14 ml in the endoscopic evacuation group, with no statistically significant difference ($p = 0.86$). This indicates that baseline hematoma severity was similar across treatment groups. Similar findings were reported by Mendelow et al., who demonstrated that hematoma volume significantly influences prognosis but may not necessarily determine the choice of surgical modality when patient characteristics are comparable (18).

Preoperative neurological status assessed using the Glasgow Coma Scale (GCS) is an important predictor of outcome. In the present study, the mean preoperative GCS was 10.84 ± 2.42 in the decompressive craniectomy group, 10.21 ± 3.32 in the decompressive craniectomy with evacuation group, and approximately 10 in the endoscopic evacuation group, with no significant difference between groups ($p = 0.77$). Similar observations were reported by Broderick et al., who identified admission GCS as a strong predictor of mortality and functional outcome in intracerebral hemorrhage (19).

Functional outcome in the present study was assessed using the Modified Rankin Scale (mRS) at discharge. The results showed that 22 patients (36.7%) had an mRS score of 6, indicating mortality, while a substantial proportion of patients had moderate to severe disability. These findings are consistent with previous studies demonstrating high mortality and disability rates in spontaneous intracerebral hemorrhage (20). Hemphill et al. reported mortality rates ranging from 30% to 50%, particularly among patients with large hematoma volumes or low GCS scores at presentation (21).

Postoperative complications observed in the present study included wound infection, rebleeding, pneumonia, and cerebrospinal fluid (CSF) leak, with rebleeding being the most common complication. The highest number of complications occurred in patients undergoing decompressive craniectomy with hematoma evacuation. Similar complication patterns have been reported in earlier studies evaluating surgical outcomes in intracerebral hemorrhage (22). Minimally invasive approaches such as endoscopic evacuation of hematoma have gained increasing attention as alternatives to conventional surgical techniques. Previous studies have reported that minimally invasive surgery may reduce surgical trauma, operative time, and hospital stay while achieving comparable outcomes (23). However, the optimal surgical technique remains controversial and patient selection remains critical for achieving favorable outcomes.

Overall, the findings of the present study emphasize the importance of early diagnosis, appropriate surgical selection, and careful management in improving outcomes among patients with spontaneous intracerebral hemorrhage.

CONCLUSION

The present study evaluated the clinical profile, surgical management, complications, and outcomes of patients with spontaneous intracerebral hemorrhage. The majority of patients were elderly males, and hypertension was identified as the most common risk factor. Weakness or hemiplegia was the most frequent presenting symptom.

The mean hematoma volume and preoperative Glasgow Coma Scale scores were comparable among the surgical groups, indicating similar baseline severity. Rebleeding was the most common postoperative complication observed. Functional outcome assessment using the Modified Rankin Scale showed that a considerable proportion of patients experienced severe disability or mortality.

The study indicates that preoperative neurological status and hematoma characteristics play a major role in determining patient outcomes, and appropriate surgical intervention may improve survival in selected patients. However, spontaneous intracerebral hemorrhage continues to be associated with high morbidity and mortality, emphasizing the importance of early diagnosis, optimal management strategies, and effective control of risk factors such as hypertension.

REFERENCES

1. Qureshi AI, Tuhrim S, Broderick JP. Spontaneous intracerebral hemorrhage. N Engl J Med. 2001;344:1450-1460.
2. van Asch CJ, Luitse MJ, Rinkel GJ, et al. Incidence, case fatality, and functional outcome of intracerebral hemorrhage. Lancet Neurol. 2010;9:167-176.
3. Feigin VL, Lawes CM, Bennett DA, et al. Worldwide stroke incidence and early case fatality. Lancet Neurol. 2009;8:355-369.
4. Hemphill JC, Greenberg SM, Anderson CS, et al. Guidelines for the management of spontaneous intracerebral hemorrhage. Stroke. 2015;46:2032-2060.
5. Keep RF, Hua Y, Xi G. Intracerebral hemorrhage: mechanisms of injury and therapeutic targets. Lancet Neurol. 2012;11:720-731.
6. Fisher CM. Pathological observations in hypertensive cerebral hemorrhage. J Neuropathol Exp Neurol. 1971;30:536-550.
7. Mayer SA, Rincon F. Treatment of intracerebral hemorrhage. Lancet Neurol. 2005;4:662-672.
8. Steiner T, Al-Shahi Salman R, Beer R, et al. European Stroke Organisation guidelines for intracerebral hemorrhage management. Int J Stroke. 2014;9:840-855.
9. Mendelow AD, Gregson BA, Rowan EN, et al. Early surgery versus conservative treatment in spontaneous intracerebral hemorrhage (STICH trial). Lancet. 2005;365:387-397.
10. Du Y, et al. Long-term outcomes of stereotactic aspiration and endoscopic evacuation for intracerebral hemorrhage. Ann Transl Med. 2021;9:1073.
11. Kase CS, Mohr JP, Caplan LR. Intracerebral hemorrhage. Lancet. 2000;356:531-536.
12. Broderick JP, Brott T, Tomsick T. Intracerebral hemorrhage more than twice as common as subarachnoid hemorrhage. J Neurosurg. 1993;78:188-191.
13. Feigin VL, Lawes CM, Bennett DA, Anderson CS. Stroke epidemiology. Lancet Neurol. 2003;2:43-53.
14. Qureshi AI, Tuhrim S, Broderick JP. Spontaneous intracerebral hemorrhage. N Engl J Med. 2001;344:1450-1460.
15. Fisher CM. Hypertensive cerebral hemorrhage. J Neuropathol Exp Neurol. 1971;30:536-550.
16. Ariesen MJ, Claus SP, Rinkel GJ. Risk factors for intracerebral hemorrhage. Stroke. 2003;34:2060-2065.
17. Qureshi AI, Mendelow AD, Hanley DF. Intracerebral haemorrhage. Lancet. 2009;373:1632-1644.
18. Mendelow AD, Gregson BA, Rowan EN. Early surgery vs conservative treatment in intracerebral hemorrhage. Lancet. 2005;365:387-397.
19. Broderick JP, Adams HP, Barsan W. Guidelines for management of spontaneous intracerebral hemorrhage. Stroke. 1999;30:905-915.
20. van Asch CJ, Luitse MJ, Rinkel GJ. Incidence and outcome of intracerebral hemorrhage. Lancet Neurol. 2010;9:167-176.
21. Hemphill JC, Bonovich DC, Besmertis L. The ICH score: a simple clinical grading scale. Stroke. 2001;32:891-897.
22. Gregson BA, Broderick JP, Auer LM. Individual patient data analysis of surgical trials in intracerebral hemorrhage. Stroke. 2012;43:1496-1504.
23. Wang WZ, Jiang B, Liu HM. Minimally invasive craniopuncture therapy vs conservative treatment for intracerebral hemorrhage. Stroke. 2009;40:1669-1677.