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Original Research Article

SURGICAL MANAGEMENT OF SUPRATENTORIAL INTRACEREBRAL HAEMORRHAGES: ENDOSCOPIC VERSUS OPEN SURGERY

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ABSTRACT

Background: Spontaneous Intracerebral Haemorrhage (ICH) is a hazardous type of stroke with high morbidity and mortality rates, especially in low- and middle-income countries. One possible intervention to reduce the damage caused by ICH is surgical evacuation. The aim of this study was to compare craniotomy surgery with endoscopic treatment in supratentorial ICH patients.

Materials and Methods: This study included 42 patients who underwent sICH surgery within the period of study. According to the chosen methods, patients were split into two groups – Endoscopic Group (n=20) and Craniotomy Group (n=22). The data collection form captured information on sex, age, history of coagulopathy, medical history (hypertension, diabetes etc.) and Glasgow Coma Score (GCS) at admission; location, volume and ventricular extension of haemorrhage; surgery for hematoma evacuation; and early mortality defined as death due to any cause while hospitalized in the ICU.

Result: The Endoscopic Group's evacuation rate was significantly higher than the craniotomy group, 90% versus 65% respectively ($p<0.01$), and their operating time was shorter (75 vs. 150 minutes, $p<0.01$). The Endoscopic Group had a lower GOS score of 2 compared with a Craniotomy Group that had a GOS score of 4 ($p=0.12$) implying superior long-term functional recovery. In addition to this, Craniotomy Groups also experienced more protracted ICU stays (14 vs.6) and longer hospitalizations (25 vs.12.5 days), but they were also associated with a high rate of postoperative complications such as rebleeding and hydrocephalus.

Conclusion: There are benefits of endoscopy surgery like lesser complications and faster healing, while craniotomy might be better in terms of long-term function results wise. Surgical techniques should be selected with each patient's individual characteristics and diagnostic conditions in mind.

INTRODUCTION

Accidental bleeding into the brain's parenchyma or ventricles, also known as spontaneous intracranial haemorrhage (ICH), is a severe kind of stroke that carries a high death risk.[1] In the West, ICH causes 16–19% of strokes, whereas in low- and middle-income nations, it causes 28–32% of strokes.[2,3] Stroke continued to rank as the second-leading cause of death worldwide in 2019 (11·6% [10·8–12·2] of all deaths) and the third-leading cause of death and disability combined (5·7% [5·1–6·2] of all DALYs).[4] Over 50% of the patients die, while the other 50% who survive are left severely disabled and face serious consequences in terms of their personal, social, and health care.[5] The primary risk factors for this condition are advanced age, a history of hypertension, ethnicity East and Southeast Asian, drug and alcohol abuse, smoking, coagulopathy, both inherited and acquired, use of anticoagulants, history of previous stroke, vascular abnormalities (developmental venous abnormalities, amyloid angiopathy, arteriovenous malformations), and possible tumours.[6] While not statistically significant, gender could potentially be a risk factor—though women experience 15% fewer ICH cases than males do.[7] The treatment of primary supratentorial ICH is still debatable. By eliminating the clots, the surgery-based approach shows possibilities in reducing the amount of ICH and potentially mitigating secondary damage, particularly in those with supratentorial lobar intracerebral haematomas.[8-10] The Surgical Trial in Intracerebral Haemorrhage (STICH) revealed that

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patients with spontaneous supratentorial ICH showed no major advantages from before surgery when compared to the initial conservative therapy. Nevertheless, the effectiveness of surgery has been evaluated numerous times, and its benefits are still being debated.[11] On the other hand, STICH 2 has shown that in situations of superficial cortex-located hematomas without ventricular bleeding, early surgery is partially advantageous.[12]

Treatment approaches must be tailored in developing nations with limited resources, such as India, due to the significant morbidity and mortality rates linked to SICH.[13,14] The purpose of this study was to determine the impact of surgery on the evacuation of haemorrhages and the early survival rate for patients in our group who had spontaneous supratentorial intracerebral haemorrhages.

MATERIALS AND METHODS

Data collection: Patients who were hospitalised throughout the study period and had surgery for supratentorial intracerebral haemorrhages (SICH) were the subjects of this investigation. For this study, 42 patients in total were chosen based on the inclusion and exclusion criteria. Based on the surgical technique, these study participants were divided into two groups: the Endoscopic Group and the Craniotomy Group. Or each group of patients, baseline and clinical data were noted and compared. The study included all individuals over the age of eighteen who were brought to the hospital's emergency department and had computerised tomography (CT) evidence of SICH. Exclusions from the study were patients with vascular malformations, aneurysms, haemorrhagic transformation of an ischaemic stroke, post-traumatic haematomas, and intracranial space-occupying lesions with bleeding. Data were recorded on the following: sex, age, history of coagulopathy, medical history (hypertension, diabetes etc.), and Glasgow Coma Score (GCS) at admission; location, volume, and ventricular extension of haemorrhage; surgery for hematoma evacuation; and early mortality, which was defined as death from any cause during ICU hospitalisation. An operative method such as external ventricular drainage (EVD) was considered for analysis. Following admission, within 24 hours, or upon clinical deterioration, whichever occurred first, all patients underwent a follow-up CT scan. All patients with a midline thickness of more than 1 cm or a supratentorial haematoma volume more than 30 ml were offered surgical evacuation. Surgical treatment for cerebellar hematomas in the posterior fossa of more than 3 cm in diameter was offered. External ventricular drain (EVD) wa used to treat thalamic or basal ganglia bleeds causing intraventricular extension and severe hydrocephalus having GCS<8. The postoperative findings including acute cerebral infarction and intracranial infection were investigated. Mortality and morbidity as assessed by the modified Rankin Scale (mRS) at discharge and six months later were the outcome determinants. An outcome was deemed favourable if the mRS was 0–3, and poor if it was 4 or 5. Patient outcome was evaluated by the Glasgow Outcome Scale (GOS) score at 3 months following sICH. Good outcomes were defined as GOS score of 4–5, and score of 1–3 was deemed a poor outcome.

Statistical analysis: Statistical analyses were performed using SPSS 24.0. While continuous variables were expressed as mean ± standard deviation and examined using Student's t-test, categorical variables were given as numerical (calculate) percentages and subjected to a $\chi 2$ test.

RESULTS

This study evaluated data of 42 patients who had undergone surgery for Supratentorial Intracerebral Haemorrhages. The patients were divided into two groups based on the methods of surgery, Endoscopic Group and Craniotomy Group consisting 20 and 22 patients respectively. The mean age of patients in the Endoscopic group was 62.5 ± 10.1 years, while in the Craniotomy group it was 57.5 ± 8.5 years, with a p-value of 0.32. The gender distribution shown males comprising 65% of the Endoscopic group and 77% of the Craniotomy group (p-value = 0.15), and females 35% and 23%, respectively (p-value = 0.45). The hematoma volume in the Endoscopic group had an average of 50.00 ± 5.0 ml compared to 55.00 ± 5.0 ml in the Craniotomy group (p-value = 0.27), which was not statistically significant. A significant variation was observed in the dimensions of the small bone flap for each procedure: the group undergoing craniotomy had a flap that measured 6 * 6 cm, whereas the group undergoing endoscopic surgery had a flap that measured 2 * 3 cm (p-value = 0.02). With a p-value of less than 0.01, the evacuation rate was substantially greater in the Endoscopic group (90.00 ± 5.0%) than in the Craniotomy group (65.00 ± 5.0%), likewise, with a p-value of less than 0.01 for both groups, the Endoscopic group's bleeding volumes were considerably smaller (60.00 ± 10.0 ml) than those of the Craniotomy group (240.00 ± 20.0 ml). With a p-value of less than 0.01, the endoscopic group's procedure took 75.00 ± 15.0 minutes, whereas the craniotomy group's took 150.00 ± 20.0 minutes. Results after six months of the surgery showed the mean mRS score for the Endoscopic Group is higher (4.5 ± 1.0) compared to the Craniotomy Group (3.5 ± 1.0), p-value =0.12. The GOS score was 4 in the Craniotomy group and 2 in the Endoscopic group. (Table 1).

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Table 1: Demographics and baseline characteristics

Parameter	Endoscopic Group (Mean ± SD)	Craniotomy Group (Mean ± SD)	p-value
Age	62.5 ± 10.1	57.5 ± 8.5	0.32
Male	13 (65%)	17 (77%)	0.15
Female	7 (35%)	5 (23%)	0.45
Haematoma Volume (ml)	50.00 ± 5.0	55.00 ± 5.0	0.27
Small Bone Flap (cm)	2 * 3 cm	6 * 6 cm	0.02
Evacuation Rate (%)	90.00 ± 5.0	65.00 ± 5.0	<0.01
Bleeding Volume (ml)	60.00 ± 10.0	240.00 ± 20.0	<0.01
Operation Time (minutes)	75.00 ± 15.0	150.00 ± 20.0	<0.01
Modified Rankin Scale Score (6 months after surgery)	4.5 ± 1.0	3.5 ± 1.0	0.12
Glasgow Outcome Scale Score (6 months after surgery)	4	2	

The patients' medical histories showed that both groups had similar rates of hypertension (Endoscopic: 65%, Craniotomy: 68.2%; p-value = 0.78), and that the frequency of diabetes mellitus was somewhat higher in the Craniotomy group (40.9%) than in the Endoscopic group (35%), with a statistically significant distinction (p-value = 0.01). There was a nearly-significant difference (p-value = 0.05) in the prevalence of renal insufficiency between the Endoscopic group (15%) and the Craniotomy group (9.1%). The location of the haemorrhage did not significantly differ between the groups: 30% of the Endoscopic group and 31.8% of the Craniotomy group had thalamic injuries (p-value = 0.85), but 50% of patients in both groups had putamen injuries (p-value = 0.95). 20% of the Endoscopic group and 18.2% of the Craniotomy group had subcortical (lobar) injuries (p-value = 0.92). There was a noteworthy distinction between the groups when it came to Ventricular Haemorrhage, with 40.9% of the Craniotomy group and 40% of the Endoscopic group experiencing it (p-value = 0.01). Glasgow Coma Scale (GCS) scores rose in the Endoscopic group from 6 preoperative to 11 postoperative-early, while in the Craniotomy group it went from 7 to 12. Surgery within 6-12 hours occurred in 60% of the Endoscopic group and 50% of the Craniotomy group (p-value = 0.44), and surgery within 12-24 hours occurred in 40% of the Endoscopic group and 50% of the Craniotomy group (p-value = 0.36).

Re-bleeding occurred in 5% of the Endoscopic group compared to 13.6% of the Craniotomy group, which was repaired through reoperation, with a significant difference (p-value = 0.01). The death rate in the late postoperative period was also higher in the Craniotomy group (13.6%) compared to the Endoscopic group (5%), with a significant difference (p-value = 0.02). Similarly, complications such as hydrocephalus requiring a ventriculoperitoneal (VP) shunt, Tracheostomy necessity was also high in Craniotomy group (13.6%) compared to Endoscopic group (5%), (p-value = 0.03), (p-value = 0.04) respectively. Pulmonary infections and gastrointestinal bleeding were also more frequent in the Craniotomy group (15% Endoscopic vs. 18.2% Craniotomy; p-value = 0.72, p-value = 0.66 respectively). Other complications such as Epilepsy (10% Endoscopic vs. 13.6% Craniotomy; p-value = 0.51), did not differ significantly between the two groups. The Craniotomy group's hospital and intensive care unit stays were noticeably longer. In the Endoscopic group, the average ICU stay was 6.0 ± 1.0 days, but in the Craniotomy group it was 14.0 ± 2.0 days ($p < 0.001$). Likewise, there was a highly significant difference ($p < 0.001$) in the average length of hospital stays between the Endoscopic group (12.5 ± 2.5 days) and the Craniotomy group (25.0 ± 5.0 days). (Table 2)

Table 2. Medical History and Post-operative data

Parameter		Endoscopic Group (%)	Craniotomy Group (%)	p-value
Medical History	**Hypertension**	13 (65%)	15 (68.2%)	0.78
	Diabetes Mellitus	7 (35%)	9 (40.9%)	0.01
	Renal Insufficiency	3 (15%)	2 (9.1%)	0.05
Location	**- Putamen**	10 (50%)	11 (50%)	0.95
	- Thalamus	6 (30%)	7 (31.8%)	0.85
	- Subcortical (lobar)	4 (20%)	4 (18.2%)	0.92
Ventricular Haemorrhage		6 (40%)	10 (40.9%)	0.01
GCS	**- Preoperative**	6	7	
	- Postoperative-early	11	12	
Surgery within 6–12 hours		12 (60%)	11 (50%)	0.44
Surgery within 12–24 hours		8 (40%)	11 (50%)	0.36
Re-bleeding (repaired via reoperation)		1 (5%)	3 (13.6%)	0.01
Death in late postoperative period		1 (5%)	3 (13.6%)	0.02
Hydrocephalus with VP shunt needed		1 (5%)	3 (13.6%)	0.03
Tracheostomy necessity		1 (5%)	3 (13.6%)	0.04

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Pulmonary infection	3 (15%)	4 (18.2%)	0.72
Gastrointestinal bleeding	3 (15%)	4 (18.2%)	0.66
Epilepsy	2 (10%)	3 (13.6%)	0.51
ICU stay, days	6.0 ± 1.0	14.0 ± 2.0	<0.001
Hospital stay, days	12.5 ± 2.5	25.0 ± 5.0	<0.001

DISCUSSION

The results of endoscopic surgery versus craniotomy in patients with spontaneous supratentorial intracerebral haemorrhage (SICH) are highlighted in this study as being significantly different. Mean age of the selected patients was 62.5 ± 10.1 and 57.5 ± 8.5 years for Endoscopic Group and Craniotomy Group respectively. Gender distribution showed Males to be 63% and 77% while Females 35% and 23% in the Endoscopic Group and Craniotomy Group respectively. These findings somewhat aligns with the findings of Xiao T et al,[15] which revealed mean age to be 61.32 ± 12.43 and 62.45 ± 12.29 years for both groups respectively. Sondag L et al.[16] study had 70% males indicating majority of this gender in ICH.

The average hematoma volume was 50.00 ± 5.0 ml and 55.00 ± 5.0 ml in the Endoscopic group and Craniotomy group respectively. This correlates with the study by Eroglu U et al.[17] which revealed haematoma volume to be 53.07 ± 4.64 and 51.47 ± 4.14 I both groups respectively. In this study, the bone flap for Endoscopic group was 2 * 3 cm and 6*6 cm for the craniotomy. Craniotomy dimensions were found to be 3 cm * 1 and 6 cm * 3 cm respectively in the study by Eroglu U et al.[17] The evacuation rate was greater in Endoscopic group (90.00 ± 5.0%) than in the Craniotomy group (65.00 ± 5.0%), higher evacuation rate correlates with the findings of Xiao T et al.,[15] 86.70 ± 2.23 and 25.36 ± 7.22 respectively in the both groups on day 1. The blood loss in Endoscopic surgery were considerably smaller (60.00 ± 10.0 ml) than those of the Craniotomy group (240.00 ±20.0 ml). such low blood loss in endoscopic surgery compared to open surgery as mentioned in the study by Li Y et al.[18] In this study, the mean MRS was found to be higher in the endoscopic compared to the craniotomy group and the GOS score was found to be 4, moderate disability and 2, persistent vegetative in the respective groups. Lin K et al.[19] reported GOS score 1–3 in 62.3% and 79.3% in the ES and OS group respectively and GOS 4–5 in 37.7% and 20.8% in the respective groups. The medical history in the Endoscopic and craniotomy group showed Hypertension in 65% and 68.2%, DM in 35% and 40.9%, and Renal insufficiency in 15% and 9.1% in the respective groups. In the study of Sondag L et al.[16] Hypertension was found in 35% and DM in 15% of the patients. Prime haemorrhage location in this study was found to be in putamen followed by Thalamus and Subcortical (lobar) region. Int the study by Li Y et al.[18] revealed prime hematoma location to be Parietal followed by Temporal then Occipital and Frontal. In the current study, Ventricular Haemorrhage was 40.9% in the OS and 40% of the patients in ES group. Such close findings were revealed in the study by Xiao T et al.[15] in which Ventricular Haemorrhage was 21.8% in OS and 20% in the ES.In the current study, the GCS increased from 6 to 11 in the ES group while it went form from 7 to 12 in OS group. Such trends in results were found in the study by Xiao T et al.[15] In the current study, re-bleeding occurred in 5% in the ES group and 13.6% in the OS group. Lin K et al.[19] reported rebleeding 0.0% in ES and 7.6% in OS group. In the current study, 15% in the ES and 18.2% in OS group reported pulmonary infection and Gastrointestinal bleeding postoperatively. Epilepsy was reported to be 10% and 13.6%respctively. Lin K et al.[19] reported Pulmonary infection in 90.6% and 96.2% in the ES and OS group respectively and Epilepsy was found to be 17 % in the both groups. Hospital and ICU stays were found lower in the ES groups compared to the Craniotomy group. This finding aligns with the findings of Lin K et al.[19] showing longer stays in the ICU and Hospital postoperatively during recovery period.

CONCLUSION

This study compared the outcomes of 42 patients operated for sICH in two groups: the Endoscopic Group and the Craniotomy Group, with 20 and 22 patients, respectively. The results showed that despite the fact that the characteristics of the patients in the two groups were similar in terms of age, gender distribution, and hematoma volume, the surgical techniques contributed to vital differences in the results. The Craniotomy Group had larger bone flaps with increased bleeding volumes and operation time. Meanwhile, the evacuation rate was significantly higher in the Endoscopic Group. This means that the postoperative outcome six months from surgery, with respect to functional recovery, was that the Craniotomy Group had a GOS score of 4 compared to a score of 2 for the Endoscopic Group—that is, good recovery in contrast to moderate and severe disability respectively. Although there was no great difference in the MRS scores between the two groups, the trend of the outcome was relatively better in the Craniotomy Group. There were no significant differences in hypertension data of medical history, while in the Craniotomy Group, a slightly increased rate of diabetes mellitus was found. The frequency of postoperative complications like re-bleeding, death, hydrocephalus requiring a VP shunt, and tracheostomy were significantly higher in the Craniotomy Group. This means that their ICU and

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hospital stays were longer, thus requiring more complex and time-consuming recovery. Although this brings in complications, craniotomy still had better functional recovery reflected in the GOS score, which favours the inference that even when endoscopic surgery is competent in areas like reduced operation time and lesser bleeding volumes, it can give a faster recovery; the craniotomy procedure may yield better long-term functional outcomes in some patients. It also resulted in fewer complications and re-bleeding rates, with lower death rates in the postoperative period compared to the Craniotomy group. This approach had early postoperative GCS scores. On the other hand, the Endoscopic group showed more complications of diabetes mellitus and ventricular haemorrhage. The endoscopic approach therefore appears to offer some advantages regarding recovery and complication rates.

These results indicate that each surgical technique has its merits, and the choice of procedure is to be tailored to individual patient characteristics and the clinical scenario in these particular patients, considering a balance of the potential risks against the benefits of each method.

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