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A study on the surgical outcomes of keyhole craniectomy for the evacuation of intracranial hematoma

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Abstract

SICH is caused by non-traumatic bleeding and the underlying causes such as arterial (large and small vessel disease), venous diseases, vascular malformations and hemostatic disorders must be further evaluated. In cases of TICH further evaluation of counter coup injuries, presence of extradural hematoma and subdural hematoma must be looked for. Hence differentiating between the two forms of ICH is important. Source of Data -patients presenting to VIMS Neurosurgery department with either spontaneous or traumatic ICH and posted for keyhole craniectomy were included as a part of the study over a period of 3 years Aug 2017 to Aug 2021. The location of ICH in spontaneous ICH was most commonly observed in basal ganglia region .The incidence of traumatic ICH was highest in temporal region followed by frontal region with a few in parietal and occipital region. Though the incidence of traumatic ICH was more common in our study it had a better outcome with death being reported in only 2 out of 25 patients as opposed to spontaneous ICH in which 5 out of 15 patients succumbed .This may be attributed to the elderly age of presentation and presence of comorbidities in spontaneous as opposed to traumatic ICH.

Keywords: Surgical outcomes, keyhole craniectomy, intracranial hematoma

Introduction

Intracerebral hemorrhage is one of the most devastating forms of cerebrovascular disease [1]. It refers to any bleeding within the brain parenchyma.

Intracerebral hemorrhage (ICH) can be broadly classified as being Traumatic Intra cerebral hematoma (TICH) and Spontaneous Intracerebral Hematoma (SICH). Though the incidence of intracerebral hemorrhage is half that of the incidence of that of ischemic stroke it causes significant mortality and morbidity [3].

SICH is caused by non-traumatic bleeding and the underlying causes such as arterial (large and small vessel disease), venous diseases, vascular malformations and hemostatic disorders must be further evaluated. In cases of TICH further evaluation of counter coup injuries, presence of extradural hematoma and subdural hematoma must be looked for. Hence differentiating between the two forms of ICH is important [4].

Increasing incidence of road traffic accidents and Traumatic brain injuries have resulted in an

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increased incidence of TICH. It is estimated that TICH occurs in 13-35% of patients after a traumatic brain injury, and an increase in ICH volume occurs within the first few hours after trauma , can lead to unfavorable outcomes (mass effect, refractory intracranial hypertension, and herniation) [2].

Various surgical strategies have been adopted over the years for evacuation of the intracerebral hematomas ranging from the large open craniectomy and decompression to the more minimally invasive therapies like stereotactic evacuation of hematomas, endoscopic evacuation, stereotactic endoscopic evacuation, stereotactic fibrinolytic therapy, etc. [5].

A novel approach to this was one adopted by Tsementzis using a small trephine craniotomy 3 cm in diameter and evacuation of the hematoma through this craniotomy, also referred to as keyhole craniectomy [6].

The authors present their experience with a keyhole craniectomy in the evacuation of both spontaneous and traumatic intracerebral hematomas [6].

Materials & Methods

Source of Data-patients presenting to VIMS Neurosurgery department with either spontaneous or traumatic ICH and posted for keyhole craniectomy were included as a part of the study over a period of 3 years Aug 2017 to Aug 2021.

Study design

- Prospective observational study.

Sample size

- 40 patients.

Inclusion criteria

- Patients with ICH due to trauma or spontaneous Intracranial bleed who underwent keyhole craniectomy.

Exclusion criteria

- ICH due to rupture of aneurysm, AV malformation, tumor or use of anticoagulants.
- Patients with polytrauma.
- Patients unfit for surgery.
- Patient with indications for craniotomy other than ICH like Extradural hematoma and subdural haematoma.
- ETHICAL committee clearance was taken prior to study. Written informed consent was taken prior to surgery.

Pre-operative workup

- Detail clinical examination and stabilization measures were taken as soon as the patient arrives.
- Preoperative GCS and presence of neurological deficits noted.
- Routine workup and NCCT brain done to all patients included in the study to know the site, volume of ICH, distance from cortical surface, it’s relation to eloquent areas and intraventricular extension.

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- Estimation of haematoma volume was done as follows [7]:-

The CT slice with the largest area of haemorrhage is selected.

a) Being the largest haemorrhage diameter on the selected slice (in centimetres [cm]).
b) Is the largest diameter which is perpendicular to A on the same slice.
c) Is the number of slices in which the haemorrhage is seen multiplied.

By the slice thickness (often 0.5cm slices).

- A, B, and C are then multiplied and the product is divided by 2.
- Patients with ICH volume >30 ml, with deteriorating GCS, with significant mass effect or midline shift were taken up for surgery.

Procedure

Surgery was performed under general anesthesia or local Anaesthesia with sedation. An incision was made over the area after localization of the hematoma. Periosteum was elevated and a burr hole was made. The burr hole is widened into a craniectomy about 4cm in diameter as near to the hematoma as possible. A cruciate dural opening is made and a cortical incision is made over this area. The hematoma is then evacuated by using mild suction and neurosurgical patties. Usage of high pressure suction and extensive irrigation is not advocated.

Hemostasis is achieved by continuous saline irrigation, using the bipolar cautery and standard micro-neurosurgical techniques

The clot cavity is usually lined by surgicel and the dura left open and covered with gel foam. Wound closed in layers.

Fig 1: Procedure

Post-operative follow-up

- Improvement/deterioration of GCS.
- Improvement/deterioration of pre-op neurological deficits or appearance of any new deficits.
- Post-operative CT scan carried out to look for the amount of residual hematoma/ rebleeding into the cavity after 48-72 hours.
- Duration of hospital stay.
- Patient followed up for upto 6 months post surgery and Glasgow outcome score documented.

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Results

Out of the 40 patients included in the study majority were Male (65%) compared to 35% females.

Table 1: Gender Distribution

Gender	Number of patients (%)
Male	26(65%)
Female	14(35%)

Table 2: Age Distribution

Age group	Frequency
<20	2
21-30	3
31-40	6
41-50	8
51-60	6
61-70	9
71-80	5
>80	1

The number of traumatic ICH in the study was 25% higher than that spontaneous ICH.

Table 3: Mode

Mode of insult	Number (%)
Spontaneous	15 (62.5%)
Traumatic	25 (37.5%)

The patients were categorized according to their Glasgow coma score into 4 categories. The maximum cases presented with a GCS ranging in between 9-12 (42.5%) and second common being GCS ranging between 6-8 (35%). Extremes of GCS i.e. <6 and 13-15 was 15% and 35%. All the Patients in whom volume of ICH was more than 30 ml underwent surgery regardless of spontaneous or traumatic.

Maximum number of patients had ICH volume between 40-50 ml.

The outcome of patients was calculated using Glasgow outcome scale with 4 and 5 of Glasgow outcome scale being grouped as good outcome and 1,2, 3 being poor outcome.

The location of ICH in spontaneous ICH was most commonly observed in basal ganglia region .The incidence of traumatic ICH was highest in temporal region followed by frontal region with a few in parietal and occipital region.

Though the incidence of traumatic ICH was more common in our study it had a better outcome with death being reported in only 2 out of 25 patients as opposed to spontaneous ICH in which 5 out of 15 patients succumbed .This may be attributed to the elderly age of presentation and presence of comorbidities in spontaneous as opposed to traumatic ICH.

Table 4: Pre Op GCS

Pre Op GCS	Number of patients
13-15	3(7.5%)
9-12	17(42.5%)
6-8	14(35%)
<6	6(15%)

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Table 5: Volume of ICH

Volume of ICH (ml)	No
30-40	10
40-50	11
50-60	3
60-70	8
>70	8

Table 6: Outcome

Outcome (Glasgow outcome scale)	Number
Good	26
Bad	14

Table 7: Death

Death	Number
Spontaneous	5
Traumatic	2

Table 8: Location of ICH

Location of ICH	No.	Spontaneous	Traumatic
Basal ganglia	10	10	0
Frontal	8	1	7
Temporal	13	2	11
Parietal	7	2	5
Occipital	2	0	2

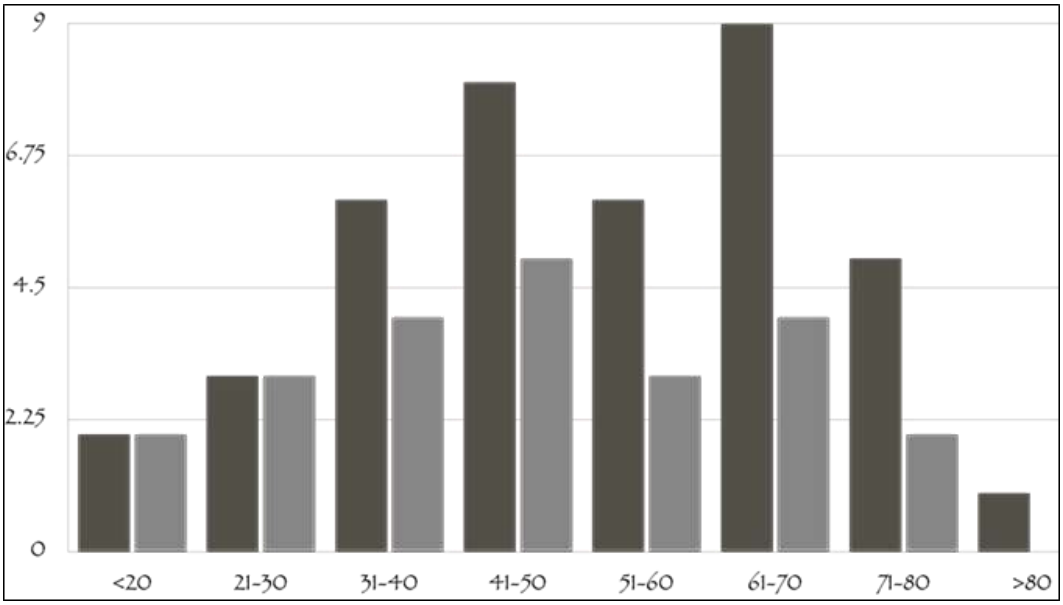

Fig 2: Correlation of age with outcome

With advancing age the outcome of the patients also gradually deteriorated with advanced age having poorer outcomes with mortality and morbidity.

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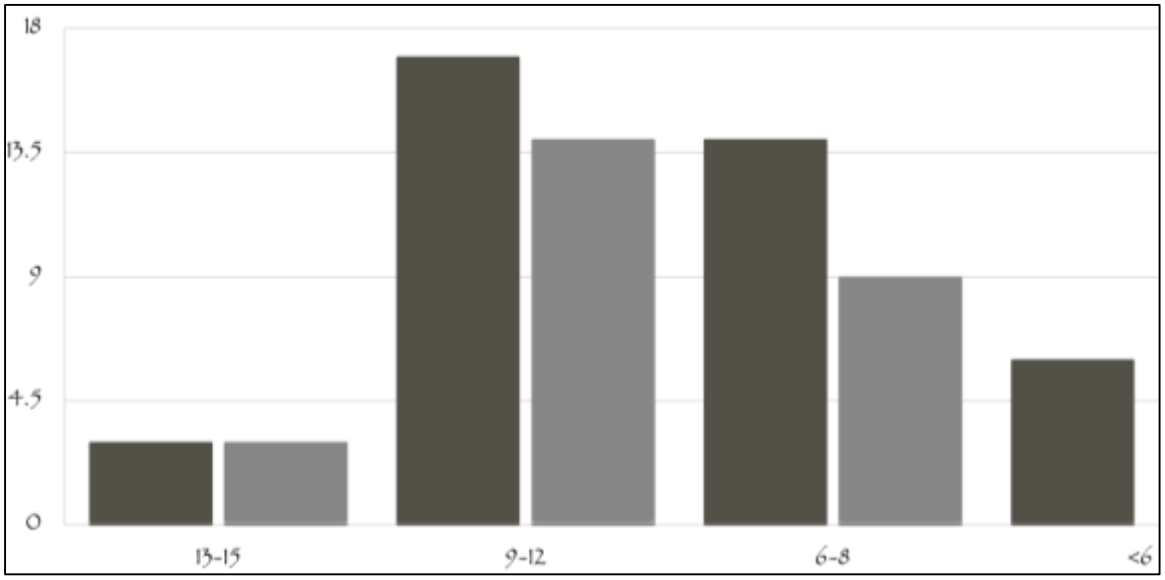

Fig 3: Correlation of pre-op GCS with outcome

The pre-op GCS of patient when compared to the post-operative outcome of the patients had direct correlation with all patients having GCS between 13-15 had a good outcome.14 out of 17 patients with pre Op GCS of 9-12 had good outcome. 9 out of 13 patients with GCS 6-8 had good outcome as measured by Glasgow outcome score. All patients with GCS <6 had poor outcome.

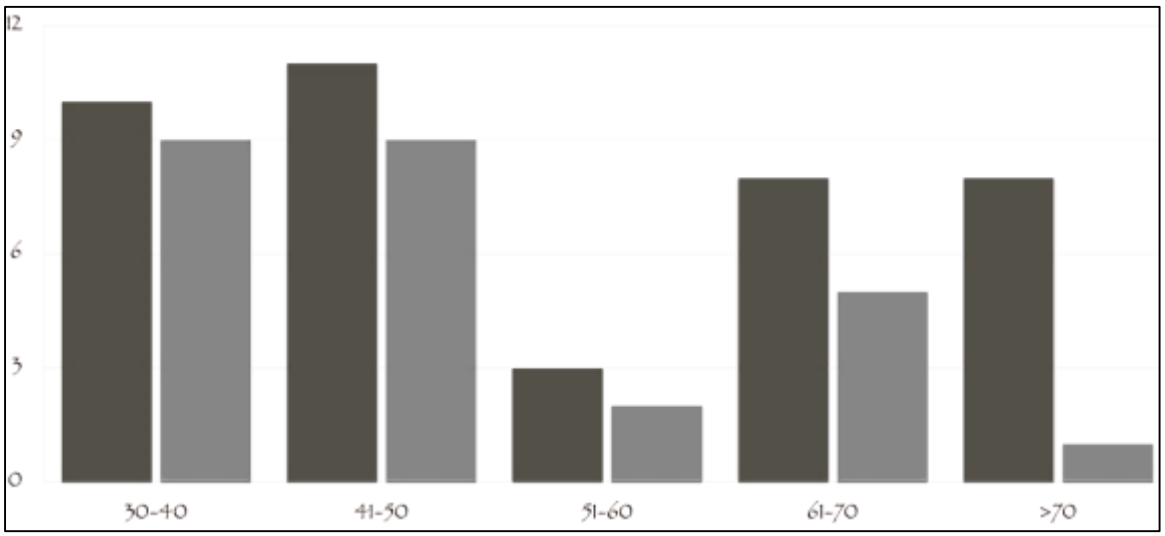

Fig 4: Correlation of volume of ICH with outcome

The volume of ICH greater than 70 ml correlated with poorer outcomes as of that lesser than 70 ml had better outcomes.

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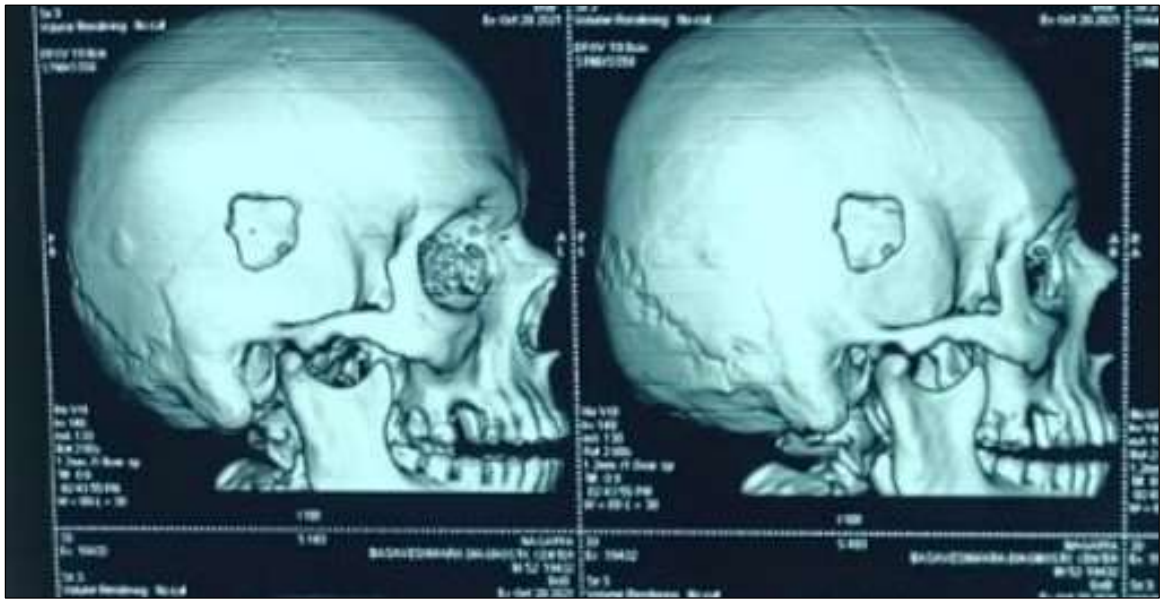

Fig 5: Post-operative scan showing mini craniectomy

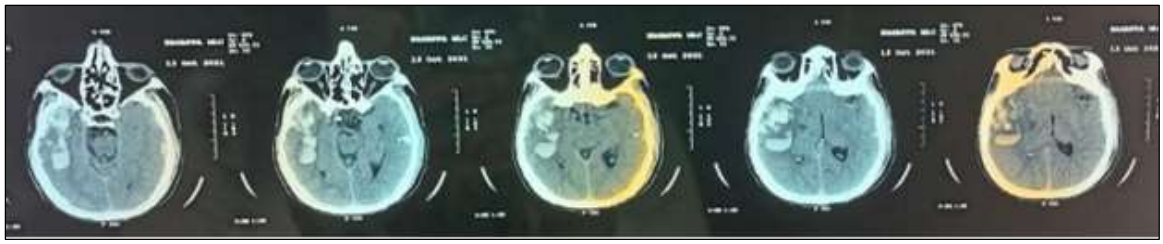

Fig 6: Pre-operative CT scan showing temporal ICH

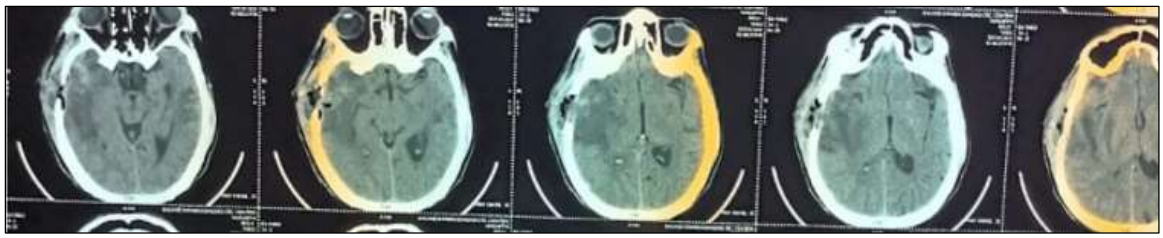

Fig 7: Post operative scan after evacuation of temporal ICH

Discussion

Over the years many surgical techniques have been advocated for surgical evacuation of intracerebral hematoma. These range from Decompressive craniectomy to a more minimally invasive techniques like stereotactic aspiration to endoscopic evacuation of hematoma [9].
Though most studies have only studied spontaneous ICH and its management, the majority of the cases in our study were that of traumatic ICH. The incidence of these cases in our study is higher as the cases of traumatic head injury like road traffic accident are higher attributable to poor road and safety conditions and only cases of SICH which underwent surgery were included as a part of this study. The purpose of this study was to study the efficacy of the surgical technique of keyhole craniectomy, a relatively simple surgical approach in management of ICH and its outcomes.
The formal craniotomy approach and decompressive craniectomy approach have been used as measures to relieve Intracranial pressure, but the disadvantages of this approach is the morbidity caused by extensive craniotomy, the time taken for surgery, increased blood loss

and difficulty in achieving haemostasis [8]. The 'edge effect 'caused by compression of the cortical veins and brain along the edges of craniotomy is also one of the disadvantages.
On the other hand, methods like stereotactic aspiration or endoscopic aspiration require expensive instruments and infrastructure [10].
Keyhole craniectomy strikes the balance between the craniotomy approaches and stereotactic approaches. It is a procedure that can be performed in all neurosurgical centres without any expensive instruments such as stereotactic apparatus or endoscope.
As with the previous studies and literature which focused mainly on the surgical management of SICH, the factors affecting the outcome of the procedure were no different [11, 12]. The number of cases of traumatic ICH included as a part of our study was higher than most studies. Most of the cases of traumatic ICH have a better prognosis as compared to spontaneous ICH. This is mainly due to the associated comorbidities and advanced age of the patients in SICH group. The preoperative GCS also correlated well with the surgical outcome, with GCS <6 carrying poor prognosis and GCS 13-15 carrying best prognosis .More the volume of haematoma >70 ml poorer the outcome.

Conclusion

In conclusion, Keyhole craniectomy for the surgical evacuation of a ICH is a less invasive and effective surgical modality. The ICH can be evacuated and good haemostasis can be achieved with this method. TICH carries a better prognosis than SICH with surgical Intervention. Poor surgical outcome can be expected with patients of poor pre-operative GCS, Increased haematoma volume >60 ml and older age.

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