

Resha Shrestha, MS
 Pranaya Shrestha, MS
 Pravesh Rajbhandari, MS
 Samir Acharya, MS
 Sudan Dhakal, MS
 Chandra Prakash Limbu, MS
 Avinash Chandra, MD
 Basant Pant, MD PhD

Department of Neurosurgery
 Annapurna Neurological Institute and Allied Sciences
 Maitighar, Kathmandu

Corresponding Author:

ReshaShrestha, MS
 Department of Neurosurgery
 Annapurna Neurological Institute and Allied Sciences
 Maitighar, Kathmandu
Email: reshkums@hotmail.com

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PPrimary intracerebral hematoma(ICH) constitutes about 10-15% of all stroke and is associated with high mortality and severe disability.¹⁵ The outcome of ICH is influenced by hemorrhage volume, progressive hemorrhagic expansion and necrosis of brain tissue.^{2,6} Secondary brain injury of the retained blood and blood breakdown products can damage the perihematoma tissue because of mass effect and progressive neurotoxicity.^{5,7}Theoretically, clot removal is beneficial as it reduces hematoma volume, reduce the chance of edemaformation, and improve perfusion in the affected hemisphere.¹⁴It is believed that minimal invasive stereotactic surgery may reduce secondary neurotoxicity but the outcome remains unclear.^{12,13}Routine craniotomy surgery to evacuate hematoma is another mode of treatment and it is controversial.¹⁰Many studies have suggested that endoscopic surgery can be safely performed after ICHbut the outcome remains to be proved.¹⁸

Technical Notes and Result of Stereotactic Evacuation of Hematoma in Spontaneous Supratentorial Intracerebral Hematoma

Primary intracerebral hematoma constitutes about 10-15% of all strokes and is associated with high mortality and severe disability. Surgical treatment of intracerebral hemorrhage is quite controversial. It is believed that minimal invasive stereotactic surgery may reduce hematoma volume and decrease secondary neurotoxicity. The technical note of stereotactic surgery has been illustrated. A retrospective study from March 2016 to March 2018 has been conducted and all patients who underwent stereotactic evacuation of hematoma were included in this study. Baseline characteristics of patients and outcome in terms of Glasgow Coma Scale(GCS) and Modified Rankin Scale(mRS) have been shown. We have found significant improvement in GCS postoperatively, however mRS did not improve immediately but was significantly better in three months follow up period.

Keywords: GCS, ICH, mRS, stereotactic, technical

Material and Methods

All the patients who underwent stereotactic evacuation of hematoma in Annapurna Neurological Institute and Allied Sciences from March 2016 to March 2018 were included in this study. The patients with craniotomy and evacuation of hematoma and non surgical management were excluded from this study. The patients'baseline characteristics were noted. Their preoperative GCS and volume of ICH was also calculated. The presence of hypertension or diabetes mellitus was also noted. Inclusion criteria for stereotactic evacuation of hematoma was blood volume more than 30 ml, GCS less than 15 and more than 9 and bleeding more than 3 days old.

Surgical technique:

Stereotactic frame (Komai, Mizuo) was kept under local anesthesia(1% xylocaine and adrenaline). The patient was taken to CT scan. For calculating the Z axis,



Figure 1a showing the Komai frame with coordinate scales in CT scan and Figure 1b showing assembly of frame in Operating theatre with trocar in situ

coordinates scale is kept just before CT scan as shown in figure 1a.

Then CT scan is done with 2 mm slice thickness and the film is printed with the highest blood volume image. Then the straight line is drawn between two markers as shown in Figure 2. The midpoint of this line is taken and another line perpendicular to this line is drawn. Then the area of interest for evacuation(target) is marked and then X, Y and Z are also calculated. For calculation of Z, the average between two Z(Z1 and Z2) is taken as shown in figure 2 and. $Z = \frac{Z1 + Z2}{2}$. X and Y is calculated manually from the CT scan. If the target is below the midline then Y comes to be negative.

The patient is taken to the operation theatre and the sterilized part of the frame is reassembled. The arc is also kept and the X,Y Z calculated is used. Linear incision is created 1 cm in front of coronal suture and 3 cm lateral to the midline and a burr hole is created. Dura is coagulated and cut. The size 4 trocar is used along with its stylet and is inserted so that it is on the target. 10 cc syringe is used and hematoma is evacuated as shown in figure 1b. Depending upon the target we can either go 5 to 10 mm deeper or shallower as per the need. We evacuate with minimal pressure and at the end push water to make sure that there is no pneumocephalus or fresh hemorrhage.

Descriptive study of the result is interpreted with various parameters. The outcome of patients in terms of GCS modified Rankin Score mRS was measured at the time of discharge and at 3 months follow up was noted. Statistical analysis was done for motor improvements.

Result

In two years duration, 531 patients were admitted with stroke, out of which 337(63%) were ischemic and 194 (37%) were hemorrhagic stroke. Out of 194 cases of hemorrhagic stroke, 95(49%) cases underwent conservative treatment and 51% underwent surgical treatment which included open craniotomies (87) and 12 patients underwent stereotactic evacuation of hematoma. The descriptive study of these 12 cases has been done. The male to female ratio was 5:1 and the age ranged from 28 years to 70 years with median age of 50 years. Eight cases had putaminal bleed and remaining 4 cases had thalamic bleed. Half of these cases were in right side and half in left side. The common presentation was hemiparesis and headache in all cases. There was upper motor neuron type facial palsy and aphasia in 6 cases. Two cases also had seizure at the time of presentation. The preoperative GCS was 10 in five cases, 11 in one case, 12 in four cases and 13 in two cases.

Out of 12 patients, 7 patients were undiagnosed case of hypertension and they were not undergoing any treatment. Two cases were diagnosed case of hypertension but they were not taking any medications. Two cases were diagnosed case of hypertension but they left medication on their own and only one case was taking regular medicine of hypertension. None of the patients had diabetes Mellitus. 50 percent of the patients were smoker and consumed alcohol as shown in Table 1.

Stereotactic evacuation of hematoma

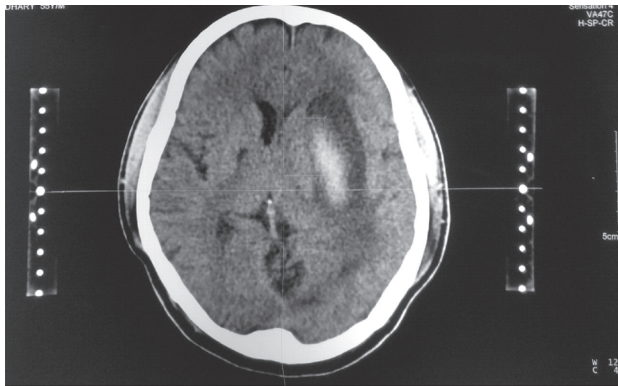


Figure 2: Ct scan showing hematoma with midline shift. Straight transverse line connecting the two adjacent dots (midpoint of Z) and another line perpendicular to this line is drawn at midpoint and X and Y coordinates calculated after giving the targets. Z is calculated by taking mean of the two adjacent outer dots.

The volume of hematoma ranged between 30 ml to 80 ml with the median volume of 40 ml. The duration of surgery ranged from 40 minutes to 60 minutes. The duration of illness ranged from 3 days to 17 days. The duration of hospital stay ranged from 6 days to 61 days. There was one case of postoperative infection which had to be reevacuated by open craniotomy and this patient stayed for 61 days. There were no other complications. Post operative GCS was 15 in 6 cases and 13 in remaining 6 cases with aphasia. The motor weakness or hemiparesis did not improve immediately postoperatively but in 3 months follow up, 60 percent of cases had improved motor power to 5/5 in lower limbs and 3/5 in upper limb and some improvement in verbal response as well which was statistically significant (p value < 0.05). The Modified Rankin's scale at the time of discharge was 4 in all cases at the time of discharge and it was 2 in 7 cases (60%) and 3 (40%) in remaining cases at three months follow up. (p value < 0.05) as shown in Table 2.

Total number of cases(N)	12
Male:Female	5:1
Median age(range)	50(28-70) years
Site(N)	
Putamen	8
Thalamus	4
Left	6
Right	6

Hypertension(N)	
Undiagnosed	7
Untreated	2
Treated	1
Left Medicine	2
Dibetes Mellitus	None
Smoker(N)	6
Alcohol Consumption(N)	6
Median Volume of Hematoma(range)	40(30-80)ml

Table 1 showing baseline characteristics

Preoperative GCS(N)	Postoperative GCS(N)		
10(5)	15(6)	$p < 0.05$	
11(1)	13(6)		
12(4)			
13(2)			
Preoperative mRS(N)	Postoperative mRS(N)	mRS at 3 months follow up	
4(12)	4(12)	2(7)	$p < 0.05$
		3(5)	

P value significant in Wilcoxon sign Rank test

Table 2 showing Outcome of the cases

Discussion:

Surgical treatment of intracerebral hemorrhage is quite controversial. Though it is well recommended for large and symptomatic hypertensive cerebellar hemorrhage, STICH trial has failed to show benefit from surgical evacuation of supratentorial intracerebral hemorrhage. However post hoc data analysis has suggested that some patients with ICH will benefit from surgery.^{4,10,11}

In this study only selected patients underwent stereotactic evacuation of hematoma (2%) and remaining 16% underwent open craniotomies. This is quite similar to surgical treatment of stroke patients from data from

another series.¹⁷ Our main selection criteria was deep seated hemorrhage with volume more than 30 ml which ruled out unnecessary surgery for smaller ICH. One of the studies have stated that volume of hematoma and the preoperative GCS was the strongest predictor of the 30 day mortality of the patients with the highest among ICH volume more than 60 cm³ and GCS 8 and lowest among hematoma less than 30 cm³ and GCS more than 9.⁸

One of the alarming findings was the association of hypertension in intracerebral hematoma. Seven out of 12 patients were undiagnosed case of hypertension and their primary presentation of hypertension was ICH. Rest of the two patients had left medicine on their own thinking that their blood pressure was already normal. As we all know that hypertension is an independent risk factor of ICH and controlling it can decrease the odds ratio of disease^{19,20} we suggest that we have to increase the awareness in the general public about it. It was found that the level of awareness, treatment and control of hypertension in adults in Nepal was low.⁹ Though none of our patients had diabetes mellitus, it is because of the small sample size and diabetes is a well established independent risk of both types of stroke.³ Fifty percent of our patient were smoker and consumed alcohol and this is similar to other hospital based studies in Nepal²⁰ and both are the modifiable risk factors of stroke.

Though the outcome of patients improved in terms of GCS it remained unchanged in mRS. However, mRS improved in three months follow up period. This may be due to natural courses of the disease itself or because of evacuation of hematoma as we have not compared with other patients with conservative treatment. However, SICHPA (Stereotactic treatment of intracerebral hemorrhage by means of plasminogen activator) trial though small, demonstrated that ICH volume reduction, which is assumed to be associated with lower mortality, is practically achievable by this method leading to more favorable outcome.¹⁶

Conclusion

Stereotactic evacuation of hematoma is technically simple, less invasive surgical treatment of intracerebral hematoma in selected cases. It can improve the outcome of patients in terms of GCS. There is improvement in mRS in follow up period. However larger sample size is required to prove it.

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