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Original Research Article

Decompressive craniectomy for malignant middle cerebral artery territory infarct: an institutional experience

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ABSTRACT

Background: Decompressive craniectomy is the surgical procedure to reduce intracranial pressure, refractory to medical measures. We have described our experience associated with the clinical profile, radiological profile, postoperative status and long term outcome in patients with malignant middle cerebral artery (MCA) territory infarct.
Methods: Data were collected from patients who underwent hemispheric decompressive craniectomy for malignant MCA territory infarct in our hospital from May 2014 to June 2019. Clinical, radiological, surgical profile and long term outcome were studied.
Results: There were a total of 51 patients aged between 28 years to 76 years. Hypertension (70%) was the most common comorbidity associated. All the patients had at least one focal neurological deficit at the time of presentation. Mean time from the first symptoms to surgery was 2.4 days (about 58 hours). 7 patients died within one month of the surgery. Two third improved objectively within 1 month of surgery. Out of 44 patients, who survived beyond one month, none of the patients were functionally independent after one year of surgery (modified Rankin scale (mRS) of 0 or 1). The patients had a mean mRS of 3.8 at one year.
Conclusions: Over several decades decompressive craniectomy has been found to be the most effective measure to reduce mortality and morbidity associated with malignant MCA territory infarct. Early surgery (<48 hours) in patients with good Glasgow Coma scale score reduces the mortality. Larger multicentric trials are required to look at the long term effect on morbidity and mortality.

Keywords: MCA, Stroke, Infarction, Decompressive craniectomy, Morbidity, Radiology

INTRODUCTION

Out of all the causes of ischemic stroke, sudden occlusion of middle cerebral artery (MCA) or internal carotid artery (ICA) produces maximum damage to the brain.[1-3] Focal neurological deficits like sudden onset hemiparesis, aphasia and sensory deficits are one of the common presenting features.[4,5] Due to large area involved, medical treatment often does not prove beneficial and results in mortality as high as 70%.[6,7] Due to risk of irreversible damage of the ischemic zone, it is of extreme importance to provide space to expanding edematous brain by removing a larger part of the skull bone with resultant increase in blood perfusion.[8-10] Despite being the most prevalent mode of management, decompressive craniectomy has shown equivocal results in several randomized controlled trials.[11-14]

The study was done to discuss the study results after decompressive craniectomy done for malignant MCA territory infarct.

METHODS

This was a retrospective study of the patients who underwent decompressive craniectomy for malignant

MCA territory infarct at Himalayan hospital, Swami Rama Himalayan University, Jolly Grant, Dehradun from May 2014 to June 2019. All necessary clearances were obtained from Institutional research review committee and Ethics committee.

Patients

Patients were either admitted from Emergency Department directly for the surgery or taken transfer from the Department of Neuromedicine or Medicine. All patients who had radiological proof of malignant MCA territory infarct as seen on computed tomography (CT) or magnetic resonance imaging (MRI) brain images were evaluated. Patients who underwent hemispheric decompressive craniectomy for the above indications, irrespective of any comorbidity were included in the study. Patients with Glasgow Coma scale (GCS) score 4 or less, bilateral dilated and fixed pupil and absent brain stem reflexes were not taken for surgery and excluded from the study too. All the surgeries were performed at Himalayan hospital, Swami Rama Himalayan University, Jolly Grant, Dehradun using the same technique by 3 Neurosurgeons. Patients were evaluated in terms of time since the onset of first symptom, clinical features and GCS score at admission.

Radiological profile

CT/MRI brain with or without contrast were done. The images were evaluated for the presence of malignant MCA territory infarct (involving more than 50% area of MCA territory), associated arterial infarcts, midline shift in millimeters and presence of uncal herniation. All patients were subjected to postoperative plain CT brain on first postoperative day to look for the improvement in mass effect and suitability for extubation.

Surgical technique

All the patients were operated under general anesthesia. Patients were placed supine with head turned to the opposite side. Head was rested on a jelly ring. Standard fronto-temporo-parietal inverted question mark myocutaneous scalp flap was elevated, midline was identified in relation to the sagittal suture. With aid of multiple burr holes, a bone flap of minimum dimension 15×12 cms was curated. Squamous temporal bone was bitten off till the temporal base. Dura was opened first at perisylvian location and later the dura was cut till the craniectomy edges radially. Gel foam was used to cover the exposed part of the brain in between the dural leaflets. After achieving hemostasis, scalp flap was closed in layers over an uncharged subgaleal suction drain. Patients were put on sedation and ventilation for a minimum of 24 hours after surgery. A plain CT brain was obtained within 24 hours of the surgery to decide the suitability for weaning off or augmenting the sedation.

Postoperative evaluation and follow up

Postoperative evaluation was done in terms of GCS score at 7 days, 1 month, 3 months, 6 months and 1 year. Functional status of the patient was assessed in terms of modified Rankin scale (mRS) at 1 month, 3 months, 6 months and 1 year time. Scores of 0-3 were rated as good outcome and 4-6 were rated as poor outcome.[15-17]

Statistical analysis

Data were entered in Excel software (Microsoft, Seattle, WA) and were analyzed using SPSS software, version 11.5 (SPSS, Inc. Chicago, IL).

Ethical approval

All necessary approvals were obtained from institutional review board for research and ethical committee.

RESULTS

In the present study, a total of 51 cases with malignant MCA infarct from May 2014 to June 2019. About double the patients were consulted with the same diagnosis in this duration, who were either managed conservatively or the relatives did not agree for the surgery.

Patients

Age and sex profile of the patients is mentioned in Table 1. There was a total of 51 patients aged between 28 years to 76 years (mean age 52.4 with standard deviation of 14.2 years). More than half of the patients were between 40 to 60 years. Ratio of male to female patients was 2.4:1. Hypertension (70%) was the most common comorbidity associated followed by diabetes mellitus (35%) and cardiac problems (25%). About 10% patients had renal dysfunction or morbid obesity.

Clinical profile

Clinical profile of the patients is mentioned in Table 2. All the patients had at least one focal neurological deficit at the time of presentation. About 3/4th patients either had history of facial deviation before coming to hospital or found to have contralateral upper motor neuron (UMN) facial paresis on assessment. 92.2% of the patients were in altered sensorium, with a mean GCS score of 9.5 ± 3.2 at presentation. All the patients with left sided infarct had motor, sensory or mixed aphasia at presentation. Time between the first symptom and surgery was variable due to previous consultations in multiple other hospitals or delay in surgical decisions from relatives. Mean time from the first symptoms to surgery was 2.4 days (about 58 hours). Most of the patients (47%) underwent decompression between 48 to 72 hours.

Table 1: Age and diagnosis (n=51).

Variable	No. of patients (%)
Age (in years)	
20 to 30	2 (3.9)
31 to 40	6 (11.8)
41 to 50	13 (25.5)
51 to 60	20 (39.2)
61 to 70	9 (17.7)
71 to 80	1 (1.9)
Sex	
Males	36 (70.6)
Females	15 (29.4)
Co-morbidities associated	
Hypertension	36 (70.6)
Diabetes mellitus type II	18 (35.3)
Cardiac problems	13 (25.5)
Other illnesses	5 (9.8)

Table 2: Clinical features (n=51).

Feature	No of patients (%)
Time from onset of first symptom and surgery	
Less than 24 hours	4 (7.8)
24-48 hours	12 (23.5)
48-72 ours	24 (47.1)
>72 hours	11 (21.6)
Symptoms	
Facial deviation (UMN facial paresis)	39 (76.5)
Contralateral hemiparesis	51 (100)
Altered sensorium	47 (92.2)
Aphasia	29 (56.9)
Seizures	4 (7.8)
Preoperative GCS score	
3-8	14 (27.5)
9-12	29 (56.9)
13-15	8 (15.7)

Radiological profile

CT brain with or without contrast was available for all the patients with 37 patients having additional MRI brain done at our institution. Left sided infarct (57%) was slightly more common in the patients operated at our centre. About 24% patients had additional involvement of other arterial territories, most commonly posterior cerebral artery. 8 patients were operated without any clinical or radiological evidence of worsening for prophylactic reasons and 55% patients had midline shift to opposite side between 5 to 10 mm. 12 patients (23%) had ipsilateral uncal herniation.

Surgical profile

Findings are summarized in Table 3. All the patients were operated using the same operative technique by 3 neurosurgeons over a period of 5 years. Size of the bone flap removed was minimum 15×12 cms in size. Average time taken for surgery was 2 hours with a mean blood loss of 350 ml. All the patients were put on elective sedation and ventilation for a minimum of 24 hours as per the institutional protocol. Till the date of suture removal or discharge, 6 patients had partial wound dehiscence, which was managed with secondary suturing or conservatively by repeated dressing. 7 patients developed ventilator associated pneumonia, 11 patients had culture proven symptomatic or asymptomatic bacteriuria during their inpatient stay.

Table 3: Radiological features.

Feature	No of patients (%)
Side of infarct	
Right	22 (43.1)
Left	29 (56.9)
Other arterial territory infarct	
Present	12 (23.5)
Absent	39 (76.5)
Midline shift in mm	
Less than 5	8 (15.7)
5-10	28 (54.9)
11 or more	15 (29.4)
Uncal herniation	
Present	12 (23.5)
Absent	39 (76.5)

Table 4: Follow up and outcome (n=51).

Feature	No of patients (%)
Improvement in GCS score within 1 month	
Perceived	34 (66.7)
Not Perceived	17 (33.3)
Functional status (mRS) after one month	
0	0 (0)
1	0 (0)
2	4 (7.8)
3	9 (17.7)
4	15 (29.4)
5	16 (31.4)
Mortality	7 (13.7)

Postoperative outcome

The findings are summarized in Table 4. End point of the follow up was either mortality or functional status at one year time after surgery. All patients could be followed up telephonically for at least a period of one year. 7 patients died within one month of the surgery, out of whom 3 patients expired within one week. Out of 7, 3 patients expired over second and third week due to myocardial infarction or ventilator associated pneumonia. Out of all patients, two third improved objectively within 1 month of surgery. Out of 44 patients, who survived beyond one month, none of the patient was functionally independent after one year of surgery (mRS of 0 or 1). The patients had a mean of 3.8 at one year. None of the patients could go to work independently at last follow up.

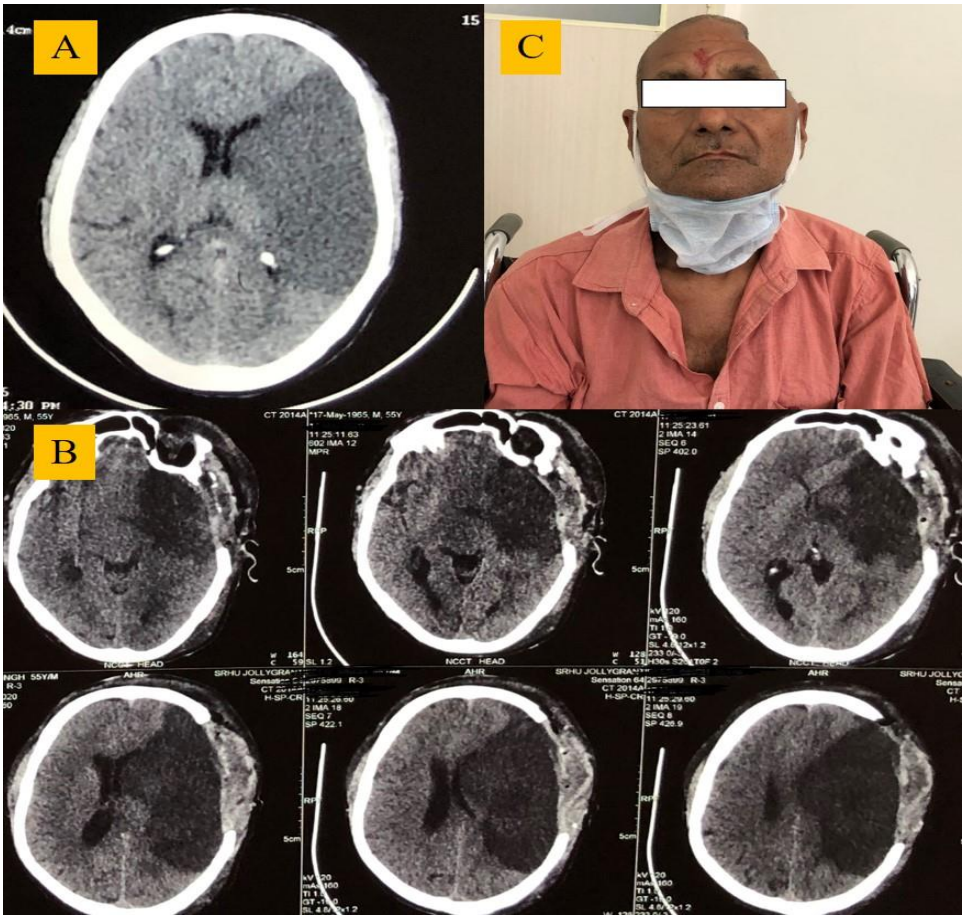

Figure 1: Preoperative plain CT brain showed left MCA territory infarct without any associated midline shift, there was minimal effacement of the left frontal horn, (A) patient had deterioration in GCS score 48 hours after the first symptom and underwent decompressive craniectomy. Postoperative CT scan on first postoperative day showed timely adequate decompression; (B) on follow up visit after one month; (C) the flap was sunken and his GCS score was E4VaM6.

Figure 2: Plain MRI brain showing no significant findings in T2W images at the top, diffusion images showed restriction in left MCA and PCA territory, the image emphasizes the importance of getting early MRI brain with diffusion-weighted imaging if CT brain is normal and there is high suspicion of ischemic stroke.

DISCUSSION

Ischemic infarct of the brain causes significant morbidity and mortality throughout the world. Although it varies in extent but complete occlusion of the middle cerebral artery or internal carotid artery affects the large and eloquent areas in the brain. Based on the extent of ischemic damage, malignant infarct is the term used to denote, those cases where either >50% of the MCA territory is affected or the volume of the brain affected is more than 150 cm.[3,18] The malignant word is used due to sudden and severe nature of the infarct progression and brain damage. Due to this large area of ischemia and resultant edema, medical measures alone are not of much use and may result in mortality up to 80%.[6,7] By converting the closed skull compartment into an open one, intracranial pressure (ICP) can be reduced effectively in a short time. Not only it protects the normal side of the brain to get compressed by the oedematous side, but also helps in proper blood perfusion of the tissue at risk.[19] Despite being an effective procedure to reduce mortality, decompressive craniectomy puts added morbidity to the patient. Multiple multicentric trials like decimal, hamlet and destiny demonstrated reduction in mortality to about 50% at the cost of increased morbidity and complications.[11,12,14] Data regarding the functional outcome is variable. About 25% of our patients had good functional outcome at discharge (mRS of 0-3). This was significantly low when compared with 66% good outcome in a study conducted by Bansal et al taking 53 patients.[18] Higher morbidity in patients operated by us could be due to the fact that 68.6% of our patients were operated after 48 hours of stroke. Out of 13 patients, who had mRS score of 3 or less at one month time, 9 (69.2%) were less than 60 years of age. The findings were close to 78% patients as found in study by Bansal et al.[18] Before this, almost all the studies have shown higher age as a poor prognostic factor for the postoperative recovery.

About 57% patients had left sided infarct in our study. Some form of aphasia (sensory, motor or both) was present in all the patients with left sided pathology. 46% of patients with mRS score of 3 or less at one month, had left sided pathology. Though the patients with left sided pathology showed a poorer prognosis, difference was not found to be statistically significant. The finding was similar to study by Olivecrona et al and Gupta et al who reported no significant change in patient survival and morbidity associated with hemispheric dominance.[19,20]

CONCLUSION

We concluded that decompressive craniectomy is the most effective measure to reduce mortality and morbidity associated with malignant MCA territory infarct. Early surgery (<48 hours), good preoperative GCS score (10 or more) and young age were the factors associated with good functional outcome (mRS score 3 or less). Proper preoperative counselling regarding poor recovery of aphasia in left sided strokes and contralateral hemiparesis in all cases is extremely important factor for subjective satisfaction. Larger multicentric trials are required to look at the long term effect on morbidity and mortality.

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