



# Decompressive Craniectomy in Malignant MCA Infarct - Functional Outcome and Mortality In 50 Cases

Rajeev Goel<sup>1</sup>, Arvinpreet Kour<sup>2</sup>, Ajaydeep Singh<sup>3\*</sup>,  
G S Bindra<sup>4</sup>, Pratik mittal<sup>5</sup>

## Abstract

**Introduction:** Malignant MCA infarction is characterized by acute massive brain edema, elevated intracranial pressure, and uncal herniation. In spite of maximum medical therapy such as intracranial pressure lowering measures, hypothermia, and controlled hyperventilation, malignant MCA infarction could result in death in 70–80% of cases and most survivors are left with long-term disability. Several studies have suggested that decompressive surgery reduces mortality and improves functional outcome of these patients. Aim: To review our experience at tertiary care centre MMIMSR, Mullana with decompressive craniectomy in large hemispheric infarction with regard to the functional outcome and mortality.

**Material and Methods:** It was a prospective study included 50 patients (for 2 years) with large MCA territory infarction who were operated at MMIMSR, Mullana. Functional outcome was assessed in terms of mortality and modified Rankin Scale (mRS) for neurologic disability.

**Result:** Favourable functional outcome (mRS 0–3) noticed in 28% patients at 3 months which further improved to 42% at 6 months follow up, while poor outcome (mRS 4–6) noticed in 72% at 3 months which decreased to 42% at 6 months follow-up period. The overall mortality in this study was 16%.

**Conclusion:** Decompressive craniectomy for malignant MCA infarction has an effective role in increasing the number of patients with a favourable outcome.

**KeyWords:** Decompressive craniectomy, malignant MCA infarction, hemispheric infarction, hemiplegia, modified Rankin Scale

2140

**DOI Number:** 10.14704/nq.2022.20.11.NQ66209

**NeuroQuantology 2022; 20(11): 2140-2144**

## Introduction

Patients with large hemispheric infarction, have an increased incidence of significant disability and mortality<sup>1</sup> which represent 8–15% of all cerebrovascular strokes. Malignant MCA infarction is characterized by acute massive brain edema, elevated intracranial pressure, and uncal herniation. Can also show infarction of both the MCA and the ACA territories.<sup>2,3</sup> The neurological manifestations are more severe in malignant MCA infarctions, cranial nerve affections, including hemiplegia, hemianaesthesia, and global aphasia. These signs usually progress to decreased conscious level and

medical therapy malignant MCA infarction could result in 70–80% death and most survivors are left with long-term disability.<sup>4,5</sup> The optimal management protocol for malignant MCA infarction remains controversial, with many studies comparing the outcome of conservative medical treatment alone, or combined with surgical decompression in the form of decompressive craniectomy. Several studies reported 40–50% increased survival rates when decompressive craniectomy is performed in cases with malignant MCA infarctions.<sup>6,7</sup> Decompressive craniectomy was initially developed as a life-saving procedure for patients suffering from malignant

death within 1 – 3 days. In spite of maximum

**Corresponding author:** Ajaydeep Singh

**Address:** <sup>1</sup>Assistant Professor, Department of Neurosurgery MMIMSR, <sup>2</sup>Assistant Professor, Department of Anaesthesia MMIMSR, <sup>3</sup>Associate Professor, Department of Neurosurgery MMIMSR, <sup>4</sup> Professor, Department of Neurosurgery MMIMSR, <sup>5</sup>Assistant Professor, Department of Medicine MMIMSR

hemispheric infarction, but the survivors remained with severe disability which formed a serious



concern.<sup>8,9</sup> The decision for decompressive surgery in malignant MCA infarction is made on the basis of radiological data and progression of clinical course. Better results achieved with earlier surgery immediately after the start of neurological deterioration related to brain edema or even before.<sup>10,11</sup> The purpose of the present study was to review our experience with decompressive craniectomy in large hemispheric infarction with regard to the functional outcome and mortality.

## Material and Methods

This was a prospective clinical study including 50 patients (from Jan 2019 to Dec 2021) with large MCA territory infarction who were admitted at Neurosurgery Department of MMIMSR, Mullana and underwent decompressive craniectomy surgery. Cases followed-up for period ranging from 3 months to 6 months. All patients underwent a complete physical and neurological examination on admission. Radiological evaluation done using NCCT brain and in some cases by magnetic resonance imaging (MRI) of the brain.

## Inclusion criteria

1. Glasgow Coma Scale (GCS)  $\leq$  12)
2. CT/MRI brain evidence of large ischemic stroke with brain edema

## Exclusion criteria

1. Patients with GCS  $\leq$  4,
2. Loss of brain stem reflexes,
3. Severe hemodynamic instability
4. Intracerebralhaemorrhage

All cases were admitted in the neuro-intensive care unit, were investigated and medical treatment for cerebrovascular stroke were started immediately after admission and continued after surgery. All these patients were operated at earliest after initial stabilization and operative work up.

## Surgical technique

Standard decompressive surgery was performed on first day of admission for all cases according to the following steps: (1) Large fronto-temporo-parietal question mark skin incision (2) Large hemicraniectomy bone flap (minimum 12 cm to allow the external herniation of the swollen infarcted brain. Anteriorly, violation of the frontal sinus was avoided. The medial limit of the craniectomy was 2 cm from the midline while it

was extended posteriorly approximately 5–6 cm behind the external auditory canal. Basal decompression of the temporal pole was done by removing the temporal squamous bone to the level of the zygomatic arch. (3) A stellate-shaped opening of the dura, (4) augmentation of the dura with a pericranial flap or fascia lata graft, (5) Proper hemostasis is done. Finally, the temporalis muscle and skin flap are re-approximated and sutured in layers. Epidural wound drains were routinely used. The bone flap is stored in a tissue bank to be used later after 2–3 months in cranioplasty. Postoperatively patients managed in Neuro-ICU as per institute protocol. The modified Rankin Scale (mRS) used at discharge, 3 months & 6 months post-surgery as outcome parameters, and mRS 3 was referred to as moderate disability, mRS 4 defined as a moderate-severe disability, mRS 5 defined as a poor outcome or severe disability and mRS 6 defined as dead.

## Result

Enrolled 50 cases, 25 females (50%) and 25 males (50%); the age varied from 46 to 68 years, mean age 56 years and 34 (68%) patients were in age group between 50-60 years as shown in table no 1. Preoperative clinical symptoms included decreased consciousness, hemiparalysis and aphasia. On admission, the Glassgow Coma Scale of patients varied from 7 - 12 with a mean score of 10, 41 (82%) patients were having GCS between 9-12. All patients experienced large infarction of the MCA territory with involvement of left side in 22 (44%) patients. Six (12%) patients were having additional infarct of ACA territory. Midline shift was present in 47(94%) patients. Surgery was performed on 26 (52%) patients in the first 48 h post ictus while 24 patients (48%) were operated upon after 48 h post ictus.

## Complications

Pneumonia in nine (18%) patients, hemorrhagic transformation in three (6%) patients and wound infection in two (4%) patients. All complications did not require surgical interference and were managed conservatively. Six patients (12%) died in acute stage postoperatively.

Postoperative functional outcomes as shown in table no 2 using the modified Rankin Scale at discharge showed moderately severe disability (mRS 4) in 16 (32%) patients, severe disability (mRS 5) in 28 (56%) patients and 6 (12%) patients



died (mRS-6).  
 3 months follow-up 14 (28%) patients showed moderate disability (mRS 3), 17 (34%) patients showed moderate-severe disability (mRS 4), severe disability (mRS-5) was noticed in 11 (22%) patients while 2 (4%) patients died.

6 months follow-up 21 (42%), 13 (26%), 8 (16%) patients showed moderate disability (mRS 3), moderate-severe disability (mRS 4), severe disability (mRS-5) respectively.

**Table 1: Patient characteristics**

Data		n
Age (mean-56 yrs)	< 50 yrs	6 (12%)
	50 - 60 yrs	34 (68%)
	> 60 yrs	10 (20%)
Sex	Male	25 (50%)
	Female	25 (50%)
GCS	≤ 8	9 (18%)
	9-12	41 (82%)
Site	Left	22 (44%)
	Right	28 (56%)
Territory	MCA	44 (88%)
	MCA +ACA	6 (12%)
Midline Shift	> 5 mm	47 (94%)
	< 5 mm	3 (6%)
Time to surgery (Post-Ictus)	≤2 days	26 (52%)
	> 2 days	24 (48%)
Complications	Chest Infection	9 (18%)
	wound	2 (4%)
	Hemorrhagic Transformation	3 (6%)

2142

**Table 2: Patient outcomes on the modified Rankin Scale**

Modified Rankin Scale	n At Discharge	At 3-month follow-up	At 6-month follow-up
Moderate disability (mRS 3)	-	14 (28%)	21 (42%)
Moderate-severe disability (mRS 4)	16 (32%)	17 (34%)	13 (26%)
Poor outcome or severe disability (mRS 5)	28 (56%)	11 (22%)	8 (16%)
Dead (mRS 6)	6 (12%)	2 (4%)	-

**Discussion**

Malignant MCA infarction is a life-threatening condition caused by complete occlusion of the MCA alone or may be combined with ACA occlusion. It is diagnosed radiologically by the presence of signs of

ischemia in more than two thirds of the MCA territory associated with massive brain edema and uncal herniation. It does not have a certain age group at risk, and clinically worsening usually occurs in the first 24–48 h 12

Decompressive hemicraniectomy surgery is considered as a life-saving procedure for patients experiencing malignant hemispheric infarction



with refractory intracranial hypertension inspite of maximum medical therapy. It is the last resort to prevent fatal cerebral herniation and to achieve better functional outcomes.<sup>13</sup> Despite the effective role of decompressive craniectomy in malignant MCA infarction, the severe disability and poor quality of life suffered by many survivors is still a serious concern.<sup>14,15</sup> It is recommended to perform surgical decompression early before the development of major midline shift and conscious level deterioration. Some researches mentioned that patients for whom early decompressive craniectomy was done show better functional outcomes brought about by preventing fatal brain herniation and improving cerebral hemodynamics, thereby limiting secondary injury.<sup>16,17</sup> Thus, all patients with acute large hemispheric infarction should be monitored in an intensive care unit or stroke unit for the expedition of the timely surgical decompression. ICP monitoring prior to decompressive craniectomy in cases with severe neurological deterioration is one of the predicting factors of decompression surgery decision.<sup>18</sup>

Our study included 50 patients with radiologically proven malignant MCA infarcts; all were chosen to have GCS scores between 5 and 12. We studied the effect of decompressive surgery on the clinical outcome and overall mortality rates.

Many other researchers have published promising results of early decompressive hemicraniectomy for malignant MCA infarcts. Most of the studies stated that the incidence of permanent major disability or persistent vegetative state remains unchanged but there is a marked reduction in the overall mortality rates and also an increased percentage of cases with a good functional outcome. Three European randomized controlled trials published studying the effect of decompressive surgery for malignant MCA infarcts: the German DESTINY trial, the Dutch HAMLET trial, and the French DECIMAL trials.<sup>6,7,19</sup> Pooled analysis of these studies demonstrated 43% of cases had favourable functional outcome and 29% mortality rate.

In Kurten and colleague's trial 2022.8% of patients recovered to moderate disability (mRS 3) at 3-month follow-up, 44.6% remained with moderate-severe disability (mRS 4), and 32.6% suffered a poor outcome (mRS 5).

Our study enrolled 50 cases, 25 females (50%) and 25 males (50%); the age varied from 46 to 68 years with mean age 56 years. On admission, the Glasgow Coma Scale of patients varied from 7 to

12 with a mean score of 10, and 41 (82%) patients were having GCS between 9-12. Surgery was performed on 26 (52%) patients in the first 48 h post ictus while 24 patients (48%) were operated upon after 48 h post ictus.

We had eight (16) % mortalities among our cases, six in acute stage and two at 3 months follow up. Favourable functional outcome (mRS 0-3) noticed in 28% patients at 3 months which further improved to 42 % at 6 months follow up, while poor outcome (mRS 4-6) noticed in 72% at 3 months which decreased to 42 % at 6 months follow-up period. In all our cases, surgical decompression was done early<sup>21</sup>, on first day of admission. We had no surgery related complications.

Our study demonstrates that decompressive craniectomy improves functional outcomes at 6 months and lowers fatality rates in patients with malignant MCA infarction. Meticulous postoperative management after the decompressive surgery can increase the chance of favourable recovery.

## Conclusion

Malignant MCA infarcts, with massive brain edema and uncal herniation, remains a life-threatening condition that has to be instantly managed in order to reduce mortalities and morbidities. Early Decompressive craniectomy for malignant MCA infarction has an effective role in decreasing the mean intracranial pressure, reducing the mortality rate, and increasing the number of patients with a favourable outcome. A study with larger sample size and longer follow-up is recommended for better confirmation of these facts.

## References

- Wijdicks E, Sheth K, Carter B, Greer D, Kasner S, Kimberly W, et al. Recommendations for the management of cerebral and cerebellar infarction with swelling: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2014;45(4):1222-38
- Gwyn JC, Veenith T. Management of malignant middle cerebral artery infarction *EMJ Neurol*. 2015; 3(1):57-62.
- Jae Won YU, Choi J-H, Kim D-H, et al. Outcome following decompressive craniectomy for malignant middle cerebral artery infarction in patients older than 70 years old. *J CerebrovascEndovascNeurosurg*. 2012; 14(2):65-74.



- Park J, Goh DH, Sung JK, Yang-Ha Hwang YH, Kang DH, Kim Y. Timely assessment of infarct volume and brain atrophy in acute hemispheric infarction for early surgical decompression: strict cut off criteria with high specificity. *Acta Neurochir.* 2012; 154:79–85.
- Rai V, Bhatia R, Prasad K, Srivastava M, Singh S, Rai N, et al. Long-term outcome of decompressive hemicraniectomy in patients with malignant middle cerebral artery infarction: a prospective observational study. *Neurol India.* 2014; 62:26–31.
- Jüttler E, DESTINY study group. Decompressive surgery for the treatment of malignant infarction of the middle cerebral artery: a randomized, controlled trial. *Stroke.* 2007; 38:2518–25.
- Hofmeijer J, Hamlet investigators. Surgical decompression for space-occupying cerebral infarction (Hemicraniectomy after Middle Cerebral Artery infarction with Life-Threatening Edema Trial [HAMLET]): a multicentre, open, randomized trial. *Lancet Neurol.* 2009; 8:326–33.
- Hofmeijer J, Algra A, Kappelle LJ, van der Worp HB. Predictors of life-threatening brain edema in middle cerebral artery infarction. *Cerebrovasc Dis.* 2008; 25:176–84.
- Slezins J, Keris V, Bricis R, Millers A, Valeinis E, Stukens J, et al. Preliminary results of randomized controlled study on decompressive craniectomy in treatment of malignant middle cerebral artery stroke. *Medicina.* 2012; 48:521–4.
- Guresir E, Schuss P, Oszvald A, Raabe A, Seifert V, Beck J. Rapid closure technique in decompressive craniectomy. *J Neurosurg.* 2011; 114:954–60.
- Yoo BR, Yoo CJ, Kim MJ, Kim WK, Choi DH. Analysis of the outcome and prognostic factors of decompressive craniectomy between young and elderly patients for acute middle cerebral artery infarction. *J CerebrovascEndovascNeurosurg.* 2016; 18(3):175–84.
- Fandino J, Keller E, Barth A, et al. Decompressive craniotomy after middle cerebral artery infarction. Retrospective analysis of patients treated in three centers in Switzerland. *Swiss Med Wkly.* 2004;134:423–9.
- Neugebauer H, Creutzfeldt CJ, Hemphill JC 3rd, Heuschmann PU, Jüttler E. DESTINY-S: attitudes of physicians toward disability and treatment in malignant MCA infarction. *Neurocrit Care.* 2014;21:27–34.
- Mori K, Aoki A, Yamamoto T, Horinaka N, Maeda M. Aggressive decompressive surgery in patients with massive hemispheric embolic cerebral infarction associated with severe brain swelling. *Acta Neurochir.* 2001; 143:483–91.
- Zanaty M, Chalouhi N, Starke RM, Clark SW, Bovenzi CD, Saigh M, et al. Complications following cranioplasty: incidence and predictors in 348 cases. *J Neurosurg.* 2015;123(1):182–8.
- Geurts M, van der Worp HB, Kappelle LJ, Amelink GJ, Algra A, Hofmeijer J. Surgical decompression for space-occupying cerebral infarction: outcomes at 3 years in the randomized HAMLET trial. *Stroke.* 2013; 44:2506–8.
- ArvinpreetKour, Ajaydeep Singh. Surgical outcome of poor GCS patients of a acute subdural hematoma with decompressive craniotomy alone v/s decompressive craniotomy with cisternostomy *European Journal of Molecular & Clinical Medicine,* 2020, volume 7, issue 10, pages 4435-4442. [https://ejmcm.com/article\\_11417.html](https://ejmcm.com/article_11417.html)
- Vibbert M, Mayer SA. Early decompressive hemicraniectomy following malignant ischemic stroke: the crucial role of timing. *CurrNeurolNeurosci Rep.* 2010;10:1–3.
- Vahedi K, Vicaut MJ, et al. Sequential-design, multicenter, randomized, controlled trial of early decompressive craniectomy in malignant middle cerebral artery infarction (DECEMIAL Trial). *Stroke.* 2007;38(9):2506–17.
- Kürten S, Munoz C, Beseoglu K, Fischer I, Perrin J, Steiger H-J. Decompressive hemicraniectomy for malignant middle cerebral artery infarction including patients with additional involvement of the anterior and/or posterior cerebral artery territory- outcome analysis and definition of prognostic factors. *Acta Neurochir.* 2018;160:83–9.
- Kour, A., Singh, A., Sharma, S., Bindra, G. S., & Sharma, S. (2022). Prefer early tracheostomy: Comparative study of early and late tracheostomy with poor GCS patients in intensive care units in two hospitals. *International Journal of Health Sciences,* 6(S3), 2903–2909. <https://doi.org/10.53730/ijhs.v6nS3.6204>

