

## Decompressive surgery following malignant middle cerebral artery syndrome

S R Kummaraganti  
CT2 core medical training

Bernard Esi  
Consultant care of elderly medicine  
Bishop Auckland General Hospital  
Corresponding author: Dr Bernard Esi  
[Bernard.Esi@cddft.nhs.uk](mailto:Bernard.Esi@cddft.nhs.uk)

### Abstract:

Malignant middle cerebral artery infarction is a complication of stroke and is usually seen in younger patients. Treated conservatively it carries mortality of about 80%. NICE guidelines refer to possible benefits of decompressive surgery but there remains a reluctance to undertake this intervention<sup>1</sup>.

This case describes a 40 year old woman who was admitted with left hemiparesis. Investigation revealed right middle cerebral artery infarction on CT head. She became drowsy on day 4 and the repeat CT head showed extensive oedema in the surrounding brain, subfalcine and infratentorial herniation with right MCA infarction suggesting malignant right middle cerebral artery (MCA) infarction. She underwent decompressive surgery with hemicraniectomy 108 hours after symptom onset with successful outcome. The modified Rankin Score (mRS) at 6 months was 3. (See Appendix 1)

### Case history:

A 40 year old female with risk factors for vascular disease which included a smoking history and hypercholesterolemia was admitted following a sudden onset of left sided weakness. Initial assessment demonstrated a left hemiparesis involving her face, arm and leg. She also had a hemianopia and some left sided neglect. NIH stroke scale (NIHSS) score (see appendix 2) was 18. Glasgow coma score (GCS) was 15.

Clinical diagnosis on admission was a Right total anterior circulation stroke syndrome (TACS). Initial brain imaging (Fig-1) demonstrated a

large right middle cerebral artery infarct with some mild compression of the right lateral ventricle.

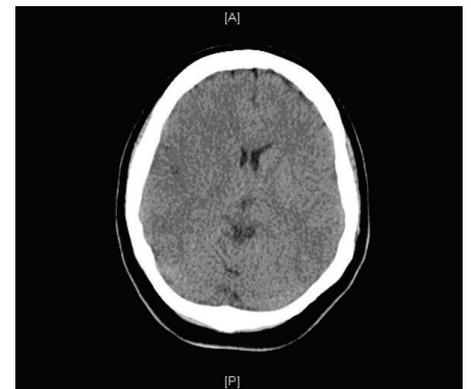


Figure- 1

Her initial course was uneventful though it was noted that she was at risk of developing malignant MCA infarction. 96 hours after her stroke, she had a drop in her conscious level, the Glasgow coma score dropping to 8 (E1 V2 M5). Urgent brain imaging on CT (Fig 2a, 2b) demonstrated a large right MCA territory infarct with extensive edema, midline shift and early subfalcine and infratentorial herniation consistent with malignant MCA territory infarction.

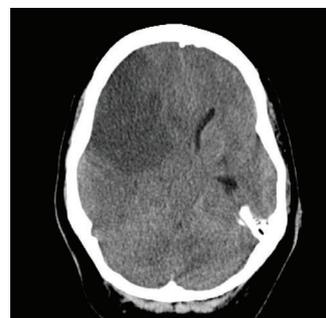


Figure 2 a

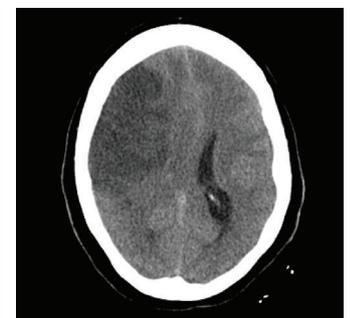


Figure 2 b

She was intubated and ventilated and her case was discussed with the regional neurosurgical referral centre where she was subsequently transferred for consideration for decompressive craniectomy.

She underwent a right fronto parietal decompressive craniectomy and lattice duroplasty and had a relatively uncomplicated post operative recovery. She was transferred back to our unit for further inpatient care and rehabilitation and made good progress. Further rehabilitation was then provided following discharge, at the day hospital where she continued to make improvement. At her last review 10 months after her stroke she had a modified Rankin score of 3.

## Discussion:

Life threatening space occupying brain edema occurs in 10-15% of patients with a supratentorial infarct and usually manifests between the second and fifth day after stroke<sup>2</sup>. There is no effective medical treatment of malignant middle cerebral artery (MCA) infarction. Randomised studies have shown a reduction in mortality without increasing the number of severely disabled survivors following the decompressive surgery<sup>4</sup>.

Herniation due to cerebral edema is a frequent cause of death in the first week following acute ischaemic stroke. It accounts for more deaths compared to symptomatic haemorrhage in relation to thrombolytic therapy. Malignant MCA infarction occurs more frequently among younger stroke victims (as a result of no pre-existing cerebral atrophy) and is usually fatal with case fatality rates up to 80%<sup>3</sup>. It can be easily diagnosed by its clinical and radiological features. The clinical course is characterised by progressive clinical deterioration as a result of increasing brain swelling, raised intracranial pressure and brain herniation. Decompressive hemicraniectomy for 'Malignant' MCA

infarction has been performed in several patients sporadically over the years and has been the subject of several non-randomised trials<sup>5</sup>.

Decompressive surgery can reduce ICP, secondary ischemia, edema and can also significantly decrease infarct size. More recently the results of pooled analysis of 3 randomised controlled trials were published<sup>4</sup>. The trials had examined the role of decompressive surgery for patients aged 18-60 years with space occupying MCA infarction and treated within 48 hours after stroke onset. Included in these results were DECIMAL, DESTINY and HAMLET trials. The primary outcome was the score on modified Rankin Scale at 1 year.

The summary of findings when compared with the control group was that more patients in the group that had decompressive surgery had a modified Rankin Scale (mRS) score of 4 or less (75% vs. 24 %; pooled absolute risk reduction 51 % (95% CI [34-69]), a mRS of 3 or less 43 % vs. 21 %; 23% [5-41], and survival (78%vs29%; 50% [33-67]).<sup>4</sup>

The HAMLET<sup>6</sup> has also recently been independently published and has shown that surgical decompression reduces case fatality and poor outcome in patients with space-occupying infarctions who are treated within 48 hours of stroke onset with favorable functional outcome. This trial showed no evidence in improving functional outcome (absolute risk reduction [ARR] 0%, 95% CI -21 to 21) when the hemicraniectomy delayed for up to 96 h after stroke onset, but did reduce case fatality (ARR 38%, 15 to 60).

Our patient - in contrast to what current evidence suggests - had decompressive surgery at 108 hours post stroke and at her last review 10 months from her surgery is doing well with a modified Rankin Score of 3.

## Conclusion:

1. Malignant middle cerebral artery (MCA) infarction is a large hemispheric infarction with poor outcome attributable to the ischemic edema that causes an early rise in intracranial pressure and subsequent brain herniation and death. There is no reliable medical treatment.
2. Surgical decompression reduces case fatality and poor outcome in patients with space-occupying infarctions who are treated within 48 hours of stroke onset.
3. The decision to perform the operation should be made on an individual basis as emphasised by our patient who had surgery 108 hours post stroke onset.

## Appendix-1: Modified Rankin Scale (mRS)

The modified Rankin Scale (mRS) is a commonly used scale for measuring the degree of disability or dependence in the daily activities of people who have suffered a stroke, and it has become the most widely used clinical outcome measure for stroke clinical trials.

SCORE	DESCRIPTION
0	No symptoms at all
1	No significant disability despite symptoms; able to carry out all usual duties and activities
2	Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance
3	Moderate disability; requiring some help, but able to walk without assistance
4	Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
5	Severe disability; bedridden, incontinent and requiring constant nursing care and attention
6	Dead

## Appendix-2: National institute of health stroke scale (NIHSS)

The NIHSS is widely used to assess the severity of acute ischemic stroke. It is a well validated tool and has been used in many trials and also helps predict stroke outcome. The NIHSS score strongly predicts the likelihood of a patient's recovery after stroke, and it is now used routinely in most stroke units. A score of 14 or higher forecasts a poor prognosis. It has also been used in thrombolysis trials to exclude patients from treatment. There are 11 parts to the NIHSS with 13 specific tests being performed. The maximum score on the NIHSS is 42.

## References:

1. NICE guidelines.
2. Hacke W, Schwab S, Horn M, Springer M, de George M, Von Kummer R. Malignant middle cerebral artery territory infarction: Clinical course and prognostic signs. *Arch Neurol.* 1996; 53: 309-315
3. Berronschot J, Sterker M, Bettin S, Koser J, Schneider D. Mortality of space occupying (malignant) middle cerebral artery territory infarction under conservative intensive care. *Intensive care med.* 1998; 24: 620-623
4. Katayoun Vahedi, Jeannette Hofmeijer, Eric Juettler, Eric Vicaut, Bernard George, Ale Algra, G Johan Amelink f, Peter Schmiedeck, Stefan Schwab, Peter M Rothwell, Marie-Germaine Bousser, H Bart van der Worp, Prof Werner Hacke, for the DECIMAL, DESTINY, and HAMLET investigators Early decompressive surgery in malignant infarction of the middle cerebral artery: a pooled analysis of three randomised controlled trials *The Lancet Neurology*, Volume 6, Issue 3, Pages 215 - 222, March 2007
5. Pranesh, Dinesh Nayak S, Mathew V, Prakash B, Natarajan M, Rajmohan V, Murali R, Pehlaj A. Hemicraniectomy for large middle cerebral artery infarction: outcome in 19 patients. *J Neurol Neurosurgery Psychiatry* 2003; 74: 8800-802
6. Jeannette Hofmeijer L Jaap Kappelle, Ale Algra c, G Johan Amelink, Jan van Gijn, H Bart van der Worp, for the HAMLET investigators Surgical decompression for space-occupying cerebral infarction (the Hemicraniectomy After Middle Cerebral Artery infarction with Life-threatening Edema Trial [HAMLET]): a multicentre, open, randomised trial *The Lancet Neurology*, Volume 8, Issue 4, Pages 326 - 333, April 2009
7. Katayoun Vahedi,; Eric Vicaut, Joaquim Mateo, Annie Kurtz, Mikael Orabi, Jean-Pierre Guichard, Carole Boutron, Gregory Couvreur, Francois Rouanet, Emmanuel Touze', Benoît Guillon, Alexandre Carpentier, Alain Yelnik, Bernard George, Didier Payen, Marie-Germaine Bousser, on behalf of the DECIMAL Investigators Sequential-Design, Multicenter, Randomized, Controlled Trial of Early Decompressive Craniectomy in Malignant Middle Cerebral Artery Infarction (DECIMAL Trial) *Stroke* 2007; 38; 2506-2517; originally published online Aug 9, 2007
8. Eric Juettler, Stefan Schwab, Peter Schmiedek, Andreas Unterberg, Michael Hennerici, Johannes Woitzik, Steffen Witte, Ekkehart Jennets, Werner Hacke, for the DESTINY Study Group Decompressive Surgery for the Treatment of Malignant Infarction of the Middle Cerebral Artery (DESTINY) A Randomized, Controlled Trial *Stroke* 2007; 38; 2518-2525; originally published online Aug 9, 2007