

Hemicraniectomy: Is it time?

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Learning Objectives

At the conclusion of this course, participants should be able to

- Evaluate what constitutes Malignant Middle Cerebral Artery Infarction
- Describe randomized studies regarding Decompressive Craniectomy for middle cerebral artery stroke
- Identify reasonable candidates for Decompressive Craniectomy following middle cerebral artery stroke

Disclosures

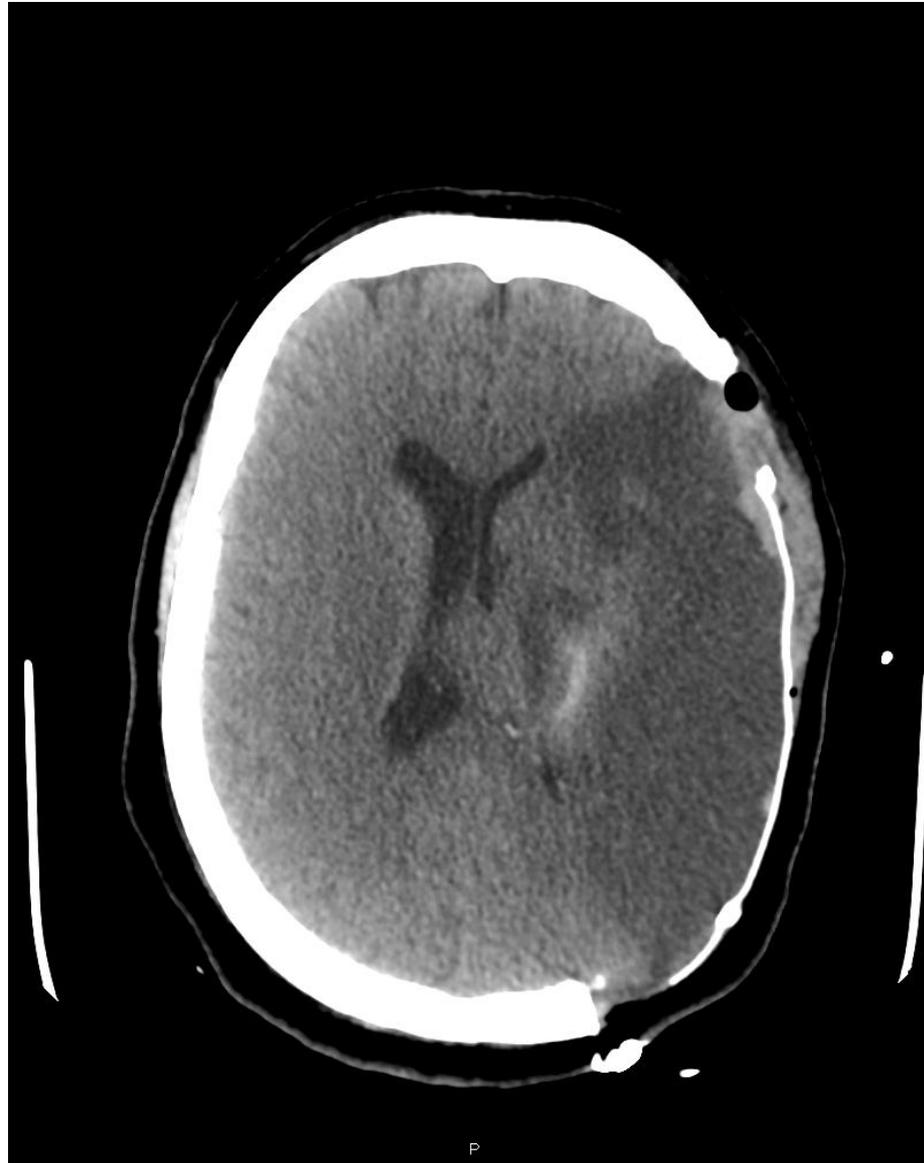
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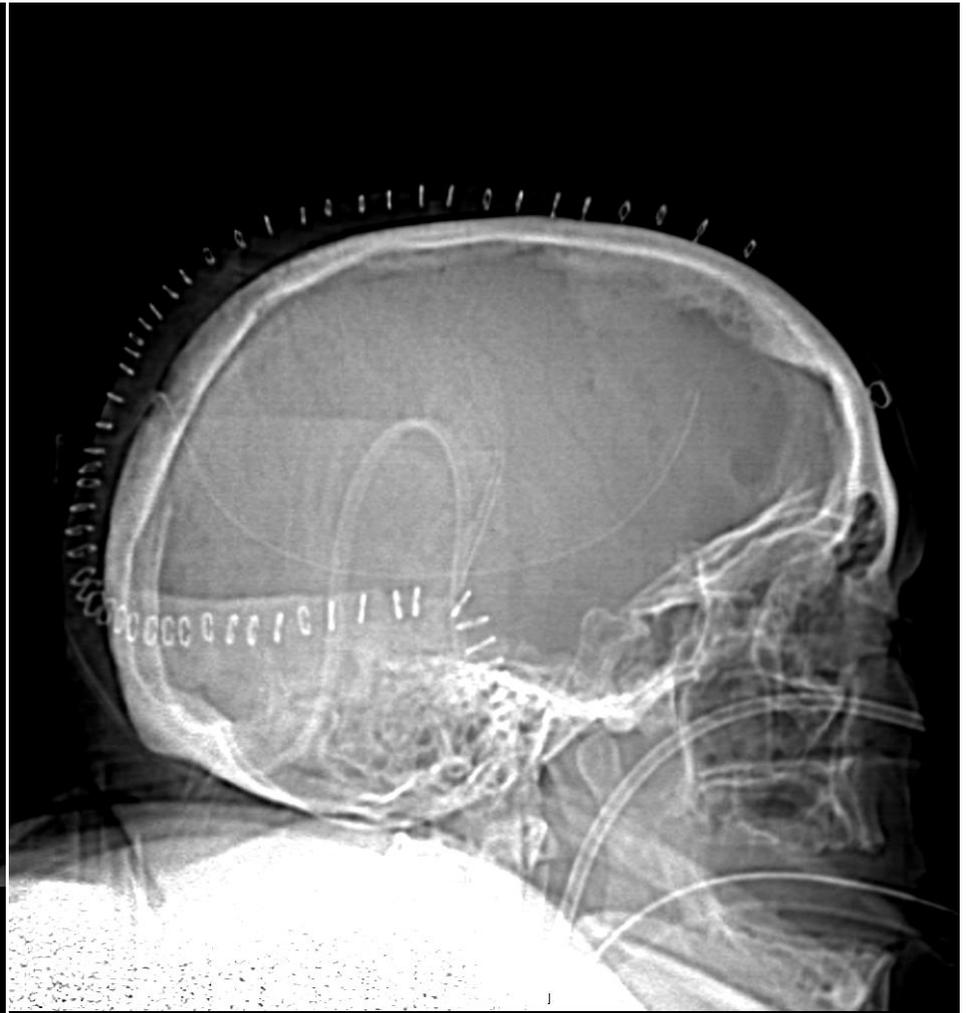
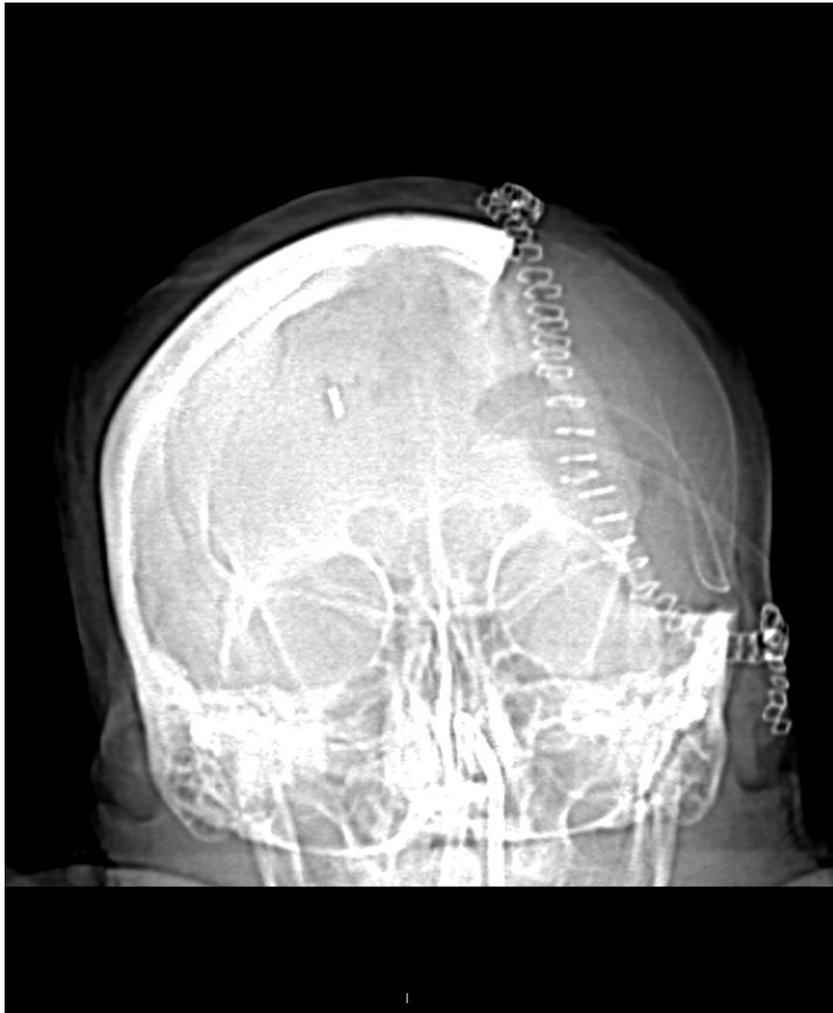
Representative Case

- 50-something y.o. woman
- Presented with acute aphasia and right sided hemiplegia. Last known normal was 12 hours earlier
- Roughly 24 hours after presentation had decline in level of consciousness
- Occluded left MCA, and CCA bifurcation



DECRA





Background

- 1-10% of completed strokes are associated with substantial cerebral edema
- This can result in elevated ICP and subsequent cerebral herniation, known as a malignant infarction
- Usually due to occlusion of ICA or the proximal segment of MCA, known as Malignant Middle Cerebral Artery Infarction, or MMI
- Associated with 80% mortality

Posterior Fossa Decompression

- For cerebellar stroke
- No randomized trials have been conducted due to the apparent benefits of surgery
- One large series showed 74% of patients with massive cerebellar strokes had very good outcomes (mRS 0-1)

Radiologic predictors of MMI

- CT head — > 50% of MCA territory hypodensity
- MRI —
 - Volume >82 mL predicts the development of MMI with a high specificity (98%)
 - combined occlusion of the internal carotid and middle cerebral arteries (OR 5.38, 95% CI 1.55-18.68)
 - lesion size on DWI (per 1 mL odds ratio [OR] 1.04, 95% CI 1.02-1.06)

Randomized Controlled Studies

- DECIMAL trial
- DESTINY trial
- HAMLET trial
- HeaDDFIRST trial
- DESTINY II trial

Question:

Decompressive surgery vs. medical management
for MMI

Design - DDH

	DECIMAL	DESTINY	HAMLET
Class of evidence	I	I	I
Randomization	Surgery versus medical care	Surgery versus medical care	Surgery versus medical care
Number of patients	38	32	64
Follow-up	1 year	1 year	1 year
	Primary endpoint: Functional outcome at 6 months in survivors	Primary endpoint: Mortality at 1 month	Primary endpoint: Functional outcome (mRS score)
	Secondary endpoints: Survival at 6 and 12 months Functional outcome at 12 months	Secondary endpoints: Functional outcome at 6 and 12 months	Secondary endpoints: Case fatality Quality of life Symptoms of depression
Number of centres	13	6	6

Decision-making process

- Decision to perform DECRA based on MMI criteria
 - NIHSS including a score of 1 or greater (not alert but arousable)
 - CT or MRI evidence of unilateral MCA infarction
 - Mass effect or shift not necessary

Criteria

Similar inclusion criteria

- Age : DECIMAL 18–55 y; DESTINY 18–60 y; HAMLET 18-70 y pooled analysis of DESTINY/ DECIMAL/HAMLET 18–60 years.
- Time from onset of symptoms : DECIMAL <30 h; DESTINY <36 h; HAMLET <99 h.

Exclusion criteria

- significant pre-stroke disability; significant hemorrhagic infarction; coagulopathy

Neuroimaging criteria

- DECIMAL: V_{infarct} diffusion-weighted MRI >145 cm
- DESTINY: CT ischemic changes affecting > 2/3 of the MCA + including the basal ganglia
- HAMLET: CT ischemic changes affecting > 2/3 of the MCA + space-occupying edema

Outcomes (D+D)

Outcomes	DECIMAL			DESTINY		
	Surgery	Medical care	Statistical significance	Surgery	Medical care	Statistical significance
'Favourable' functional outcome (mRS \leq 3, 6 months)	25%	6%	None	47%	27%	None
mRS \leq 4 (6 months)	65%	23%	$p = 0.01$	78%	34%	$p = 0.01$
mRS 4 (6 months)	40%	17%	$p < 0.05$	29%	7%	$p = 0.01$
Survival at 30 days	N/A	N/A	N/A	88%	47%	$p = 0.02$
Survival at 6 months	75%	22%	$p < 0.0001$	82%	47%	$p = 0.03$

- DECIMAL was discontinued following recruitment problems with interim significant benefit on mortality
- DESTINY was discontinued for predetermined significant benefit on mortality

Outcomes (HAMLET)

Outcomes at 1 year	Surgery	Medical care	Statistical significance
Good functional outcome (mRS ≤ 3)	25%	25%	None
Poor functional outcome (mRS ≥ 4)	75%	75%	None
Mortality	22%	59%	0.002

- Absolute risk reduction on mortality of 37%
- No reduction in poor functional outcome
 - >99 hours timing
- DECRA was not cost-effective at 3 y

DDH

- All 3 showed reduced mortality when compared with medical management
- No individual study showed improvement in good outcome (mRS 0-3)

Pooled Analysis

Early decompressive surgery in malignant infarction of the middle cerebral artery: a pooled analysis of three randomised controlled trials



Katayoun Vahedi, Jeannette Hofmeijer, Eric Juettler, Eric Vicaut, Bernard George, Ale Algra, G Johan Amelink, Peter Schmiedeck, Stefan Schwab, Peter M Rothwell, Marie-Germaine Bousser, H Bart van der Worp, Werner Hacke, for the DECIMAL, DESTINY, and HAMLET investigators

Pooled Analysis

Primary outcome at 1 year

- Favorable (0–4) vs unfavorable (5 and death)

- Secondary outcome

- case fatality rate at 1 year
- Good mRS (0–3) vs 4-death

Panel: Eligibility criteria for the pooled analysis

Inclusion criteria

Age 18–60 years

Clinical deficits suggestive of infarction in the territory of the MCA with a score on the National Institutes of Health stroke scale (NIHSS) >15

Decrease in the level of consciousness to a score of 1 or greater on item 1a of the NIHSS

Signs on CT of an infarct of at least 50% of the MCA territory, with or without additional infarction in the territory of the anterior or posterior cerebral artery on the same side, or infarct volume >145 cm³ as shown on diffusion-weighted MRI

Inclusion within 45 h after onset of symptoms

Written informed consent by the patient or a legal representative

Exclusion criteria

Prestroke score on the mRS ≥ 2

Two fixed dilated pupils

Contralateral ischaemia or other brain lesion that could affect outcome

Space-occupying haemorrhagic transformation of the infarct (\geq parenchymal haemorrhage grade 2)

Life expectancy <3 years

Other serious illness that could affect outcome

Known coagulopathy or systemic bleeding disorder

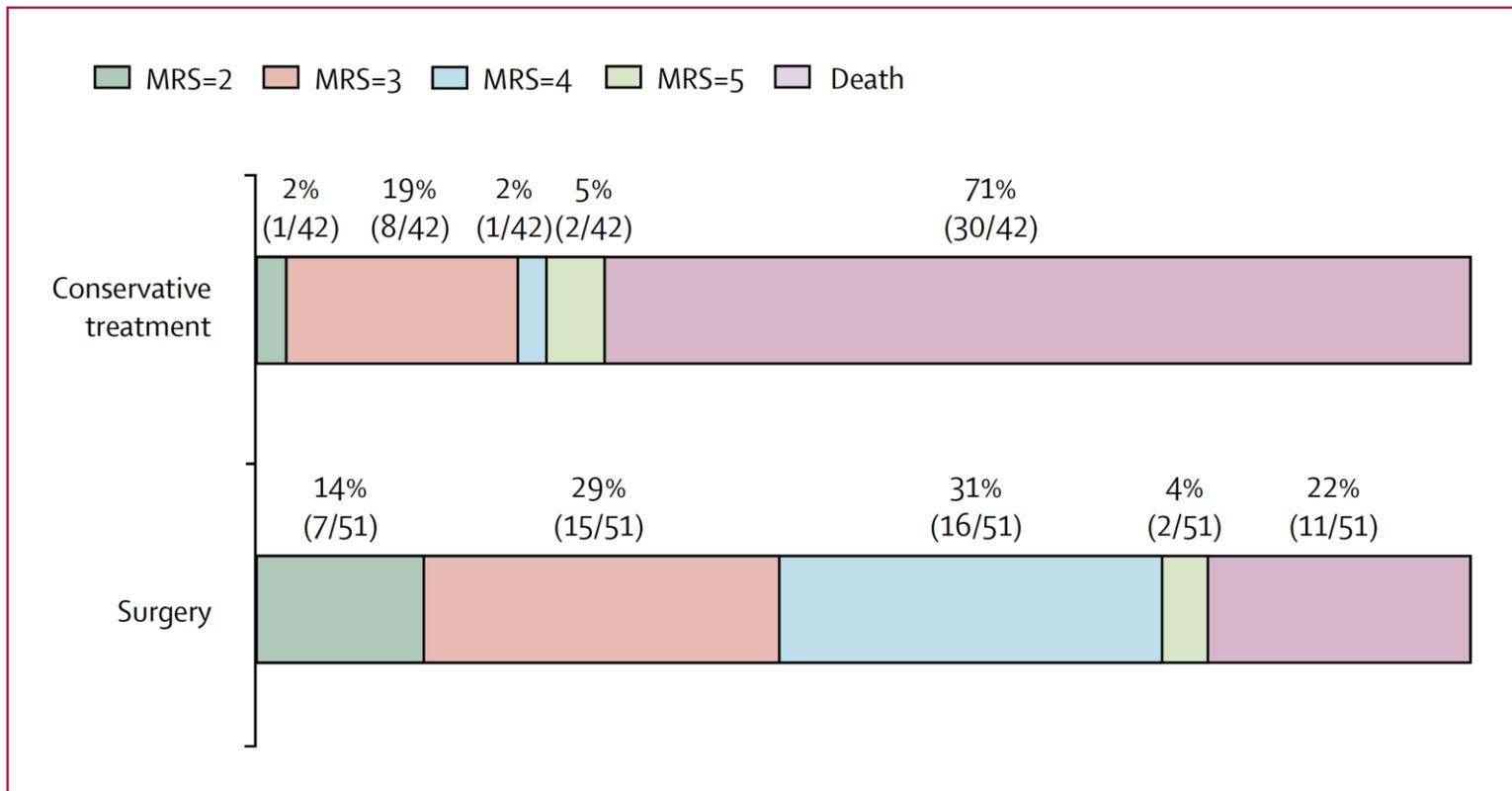
Contraindication for anaesthesia

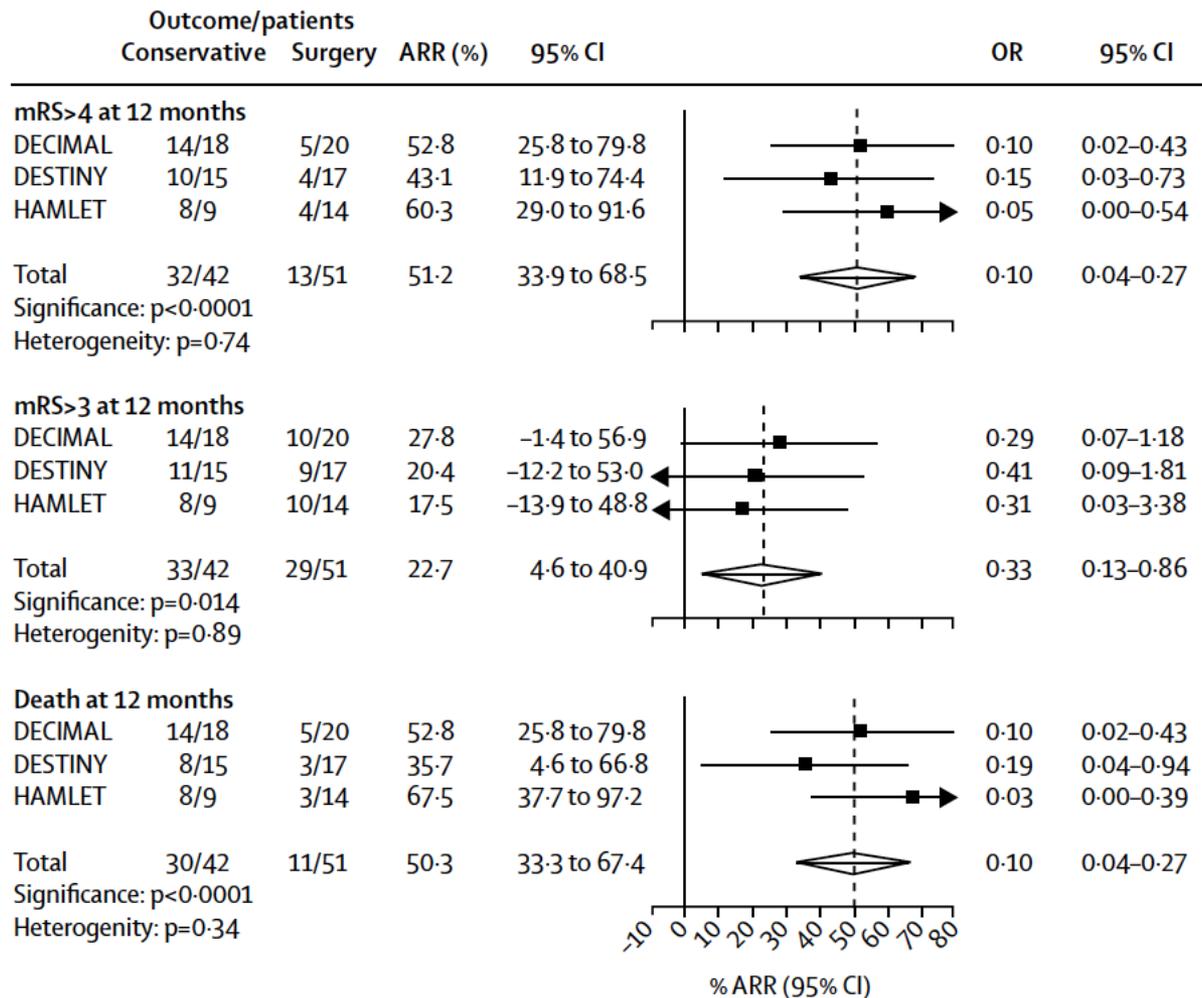
Pregnancy

DDH Inclusion into Pooled Analysis

- All DECIMAL and DESTINY patients were included
- 23 of 57 HAMLET patients were included
 - 34 excluded for randomization >45 hours
- Total of 93 patients
 - Randomization
 - 51 to surgery
 - 42 to conservative management

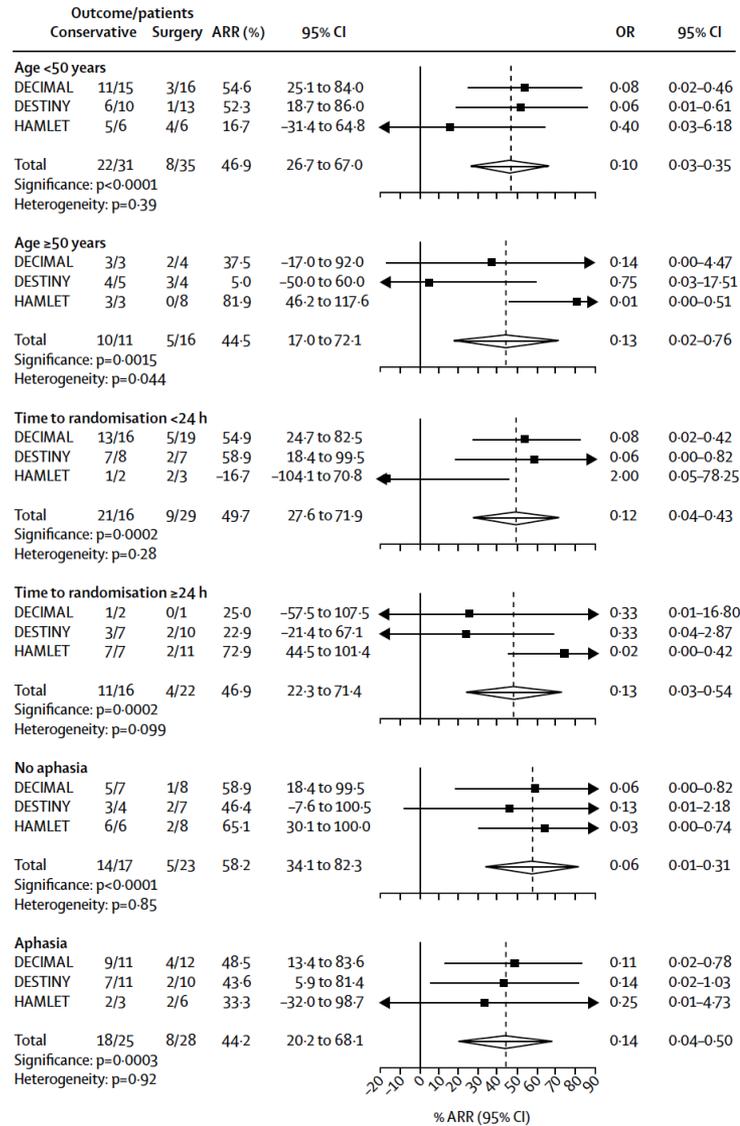
Distributions of the scores on the mRS and death after 12 months





Significantly fewer patients had an unfavourable outcome (mRS>4) after surgery **but also** significantly fewer patients had an mRS >3 after surgery

Survival rate at 12 months was higher after surgical treatment than after conservative treatment.



Surgery was beneficial ($p<0.01$) in all subgroups, as measured by mRS of 4 or less at 12 months, with no significant subgroup-treatment effect interactions

Pooled Analysis Summary

Outcomes at 12 months	Surgery	Medical care	Statistical significance
Mortality	22%	71%	$p < 0.0001$
mRS 4	31%	2%	$p < 0.0001$
mRS <4	74%	23%	$p < 0.0001$

- Patients randomized within 48 hours showed risk reduction in case fatality and poor outcome
- No patients had mRS 0-1, 14% had mRS = 2
- mRS 2-3 (good outcome) was 43% in surgery vs 21%
- NNT
 - 6 to prevent poor outcome (mRS >3)
 - 2 to prevent mRS >4
 - 2 to prevent death

HeaDDFIRST trial

Outcomes	Surgery	Medical Care	Statistical significance
Mortality at 21 days	23%	40%	$p < 0.05$
Mortality at 180 days	37.5%	40%	None

- Inclusion criteria: Ages 18–75; NIHSS > 18; premorbid mRS <2 with complete MCA + /– ACA or PCA infarction; infarct volume > 50 % MCA territory or > 90 cm³ on early CT, or > 180 cm³ on late CT.
- Randomization triggered by development of midline shift (≥ 7 mm septal or > 4 mm pineal gland displacement).
- Follow up: 180 d, primary endpoint - mortality / secondary endpoint – functional outcome
- Statistically non-significant reduction in mortality
- Improved outcomes felt to be due to standardized medical management protocol

DESTINY 2

- Looked at patients older than 60 (61-82)
- 112 patients randomized to Conservative vs Surgical tx
- Primary endpoint = survival without severe disability (mRS 0-4)
- DECRA improved primary outcome (38% vs 18%)
- mRS 3 in 7% vs 3%
- No patients had mRS 0-2
- 33% mortality vs 70% in medical group

Summary

- **DECIMAL:**
 - Surgery improves survival in young MMI patients
 - Increased number of patients with moderately severe disability
- **DESTINY:**
 - Early decompressive surgery for MMI reduces mortality
 - Increased favorable functional outcome
- **HAMLET:**
 - Reduction in fatality
 - No improvement in functional outcomes
- **HeaDDFIRST:**
 - No difference in mortality at 180 days
- **DESTINY II:**
 - Increased survival without severe disability in patients >60

AHA/ASA Scientific Statement- 2014

- Endorsed by AANS, CNS and Neurocritical Care Society
- American Academy of Neurology “affirms the value of this statement”

Neurosurgical Options: Recommendations

1. In patients <60 years of age with unilateral MCA infarctions that deteriorate neurologically within 48 hours despite medical therapy, decompressive craniectomy with dural expansion is effective. The effect of later decompression is not known, but it should be strongly considered (*Class I; Level of Evidence B*).
2. Although the optimal trigger for decompressive craniectomy is unknown, it is reasonable to use a decrease in level of consciousness and its attribution to brain swelling as selection criteria (*Class IIa; Level of Evidence A*).
3. The efficacy of decompressive craniectomy in patients >60 years of age and the optimal timing of surgery are uncertain (*Class IIb; Level of Evidence C*).
4. Suboccipital craniectomy with dural expansion should be performed in patients with cerebellar infarctions who deteriorate neurologically despite maximal medical therapy (*Class I; Level of Evidence B*).

Decompressive hemicraniectomy for malignant middle cerebral artery territory infarction: is life worth living?

Clinical article

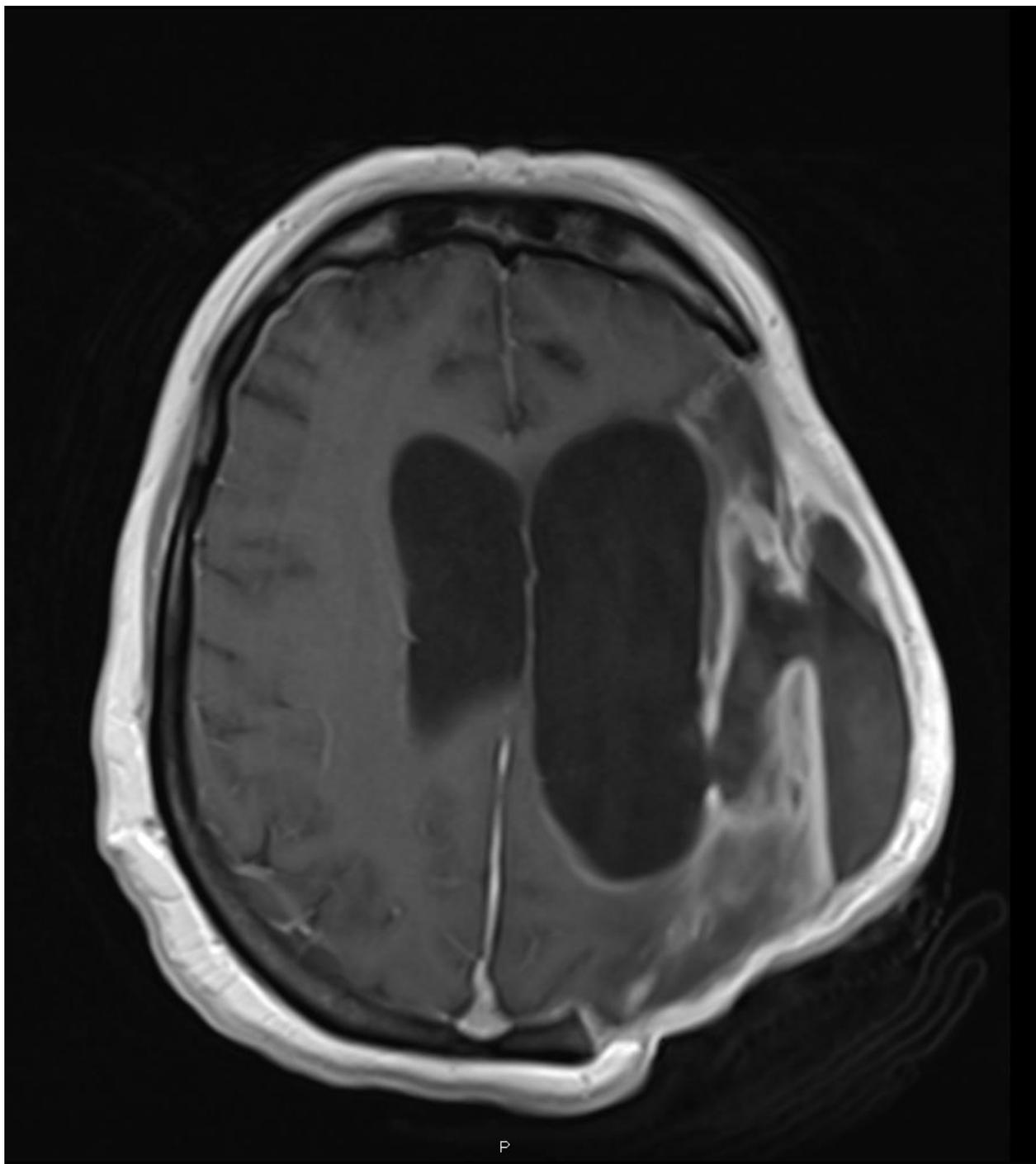
RALPH RAHME, M.D.,¹ MARIO ZUCCARELLO, M.D.,¹ DAWN KLEINDORFER, M.D.,²
OPEOLU M. ADEOYE, M.D.,¹ AND ANDREW J. RINGER, M.D.¹

- Literature analysis
- 157 survivors had quality of life assessment
- Mean overall reduction in QOL was 45% (67% for physical, and 37% for psychosocial)
- Depression in 56% of patients, moderate/severe in 25%
- 77% of patients and caregivers interviewed were satisfied and would give consent again

Why not DECRA on everyone?

- Complication rates of 30-40% are seen with DECRA
 - Infection
 - Wound issues
 - Hematomas
 - Hydrocephalus





- Wound vac
- IV Abx
- Intraventricular Abx





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Akins et al

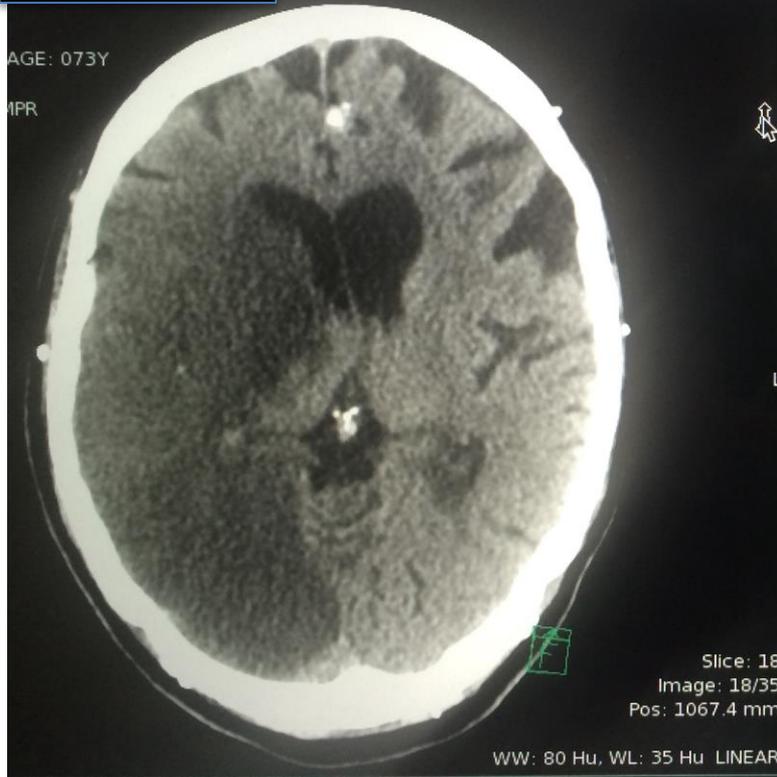
- Patients were managed in neurocritical care unit with serial CTs
 - Neurosurgical consultation, Hourly neurochecks, CT on admission, and HD#1 and #2, and otherwise as clinically indicated
 - Patients with mass effect were monitored through post-stroke day #4
- DECRA was reserved for CVA with concerning mass effect
 - Hypothesized that “only risks and no benefit of DC for hemispheric stroke patients, if the stroke did not cause mass effect”
- DECRA rates were decreased by 60% when compared to early prophylactic surgery
- No increase in death or survival with severe disability

Tools Help



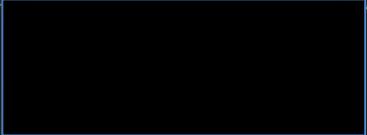
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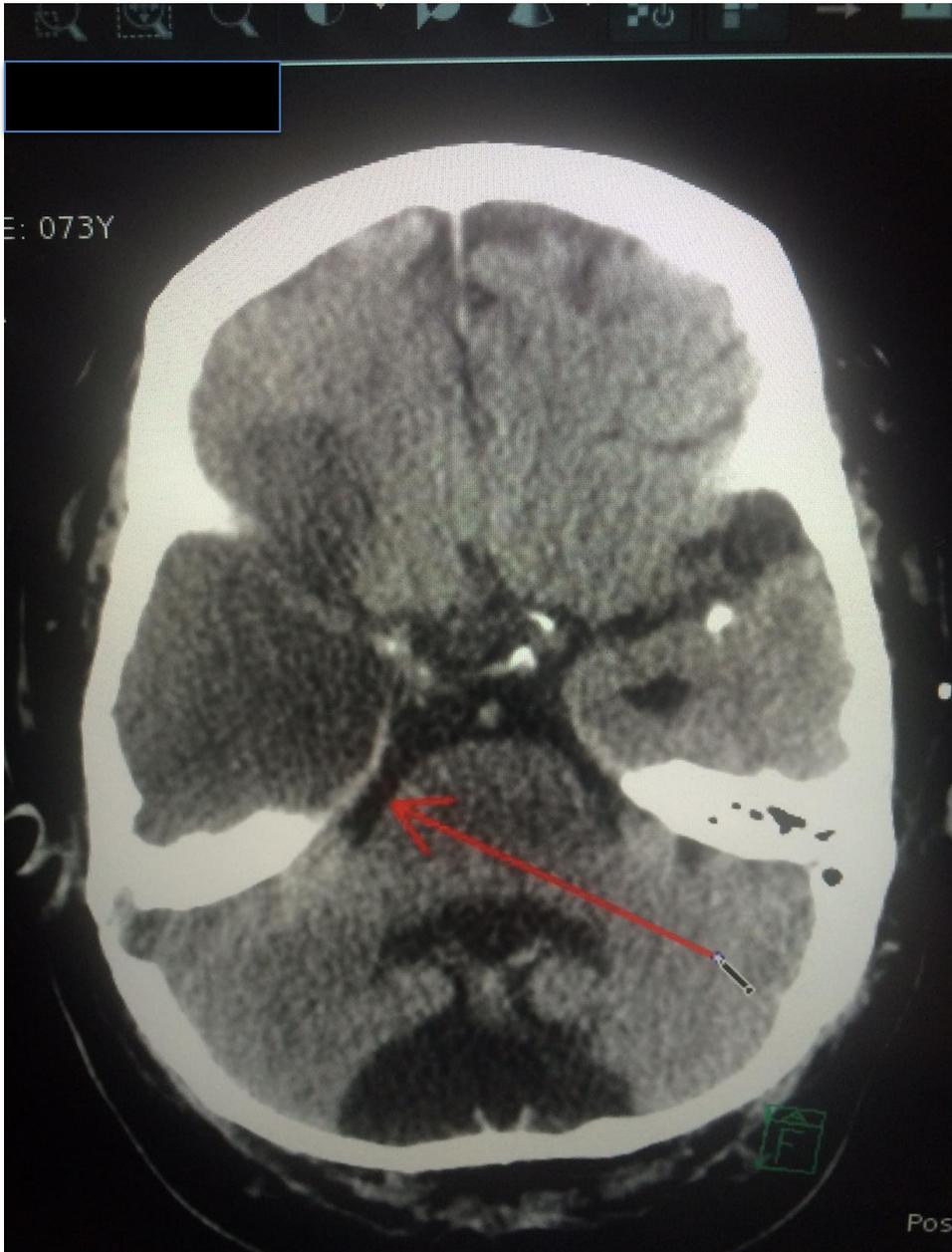
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Conclusions

- Decompressive craniectomy reduces mortality when compared to medical management
- DECRA is likely associated with improved functional outcomes for survivors
- What constitutes an acceptable functional outcome remains controversial
- Complications can be catastrophic, and therefore the decision to offer DECRA should consider a combination of neurological exam, radiological findings, and patient/family wishes

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