Surgical decompression for stroke: Hemicraniectomy and posterior fossa decompression

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Disclosures

NIMHD R01MD017719 (consultant)

Aneuryst, Inc. (consultant)

Outline

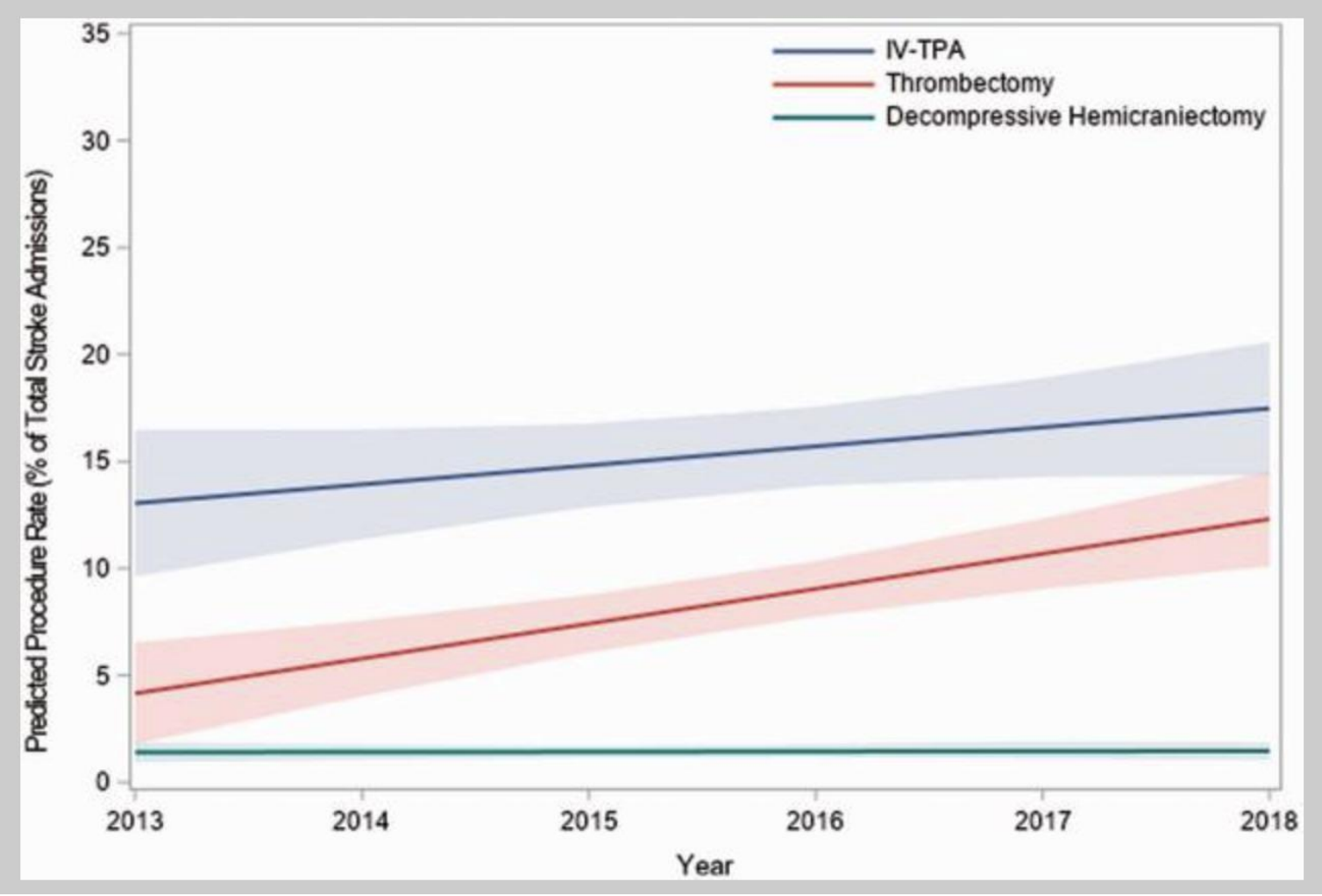
Epidemiology of space-occupying infarction

Patient selection

What to anticipate with DHC

Timing

Does thrombectomy reduce DHC?



Oravec CS, Tschoe C, Fargen KM, et al. Trends in mechanical thrombectomy and decompressive hemicraniectomy for stroke: A multicenter study. **Neuroradiol J.** 2022 Apr;35(2):170-176. doi: 10.1177/19714009211030526.

Early identification is critical

70% deteriorate <48 hours after stroke

6% deteriorate > day 6

Stroke
New online, 26 January 2026
https://doi.org/10.1161/STR.0000000000000513

AHA/ASA GUIDELINE

2026 Guideline for the Early Management of Patients With Acute Ischemic Stroke: A Guideline From the American Heart Association/American Stroke Association

Shyam Prabhakaran, MD, MS, FAHA, Chair, Nestor R. Gonzalez, MD, MSCR, FAHA, Co-Vice Chair, Kori S. Zachrison, MD, MSc, FAHA, Co-Vice Chair, Opeolu Adeoye, MD, MS, FAHA, Anne W. Alexandrov, PhD, AGACNP-BC, ANVP-BC, ASC-BC, Sameer A. Ansari, MD, PhD, FAHA, Sherita Chapman, MD, FAHA, Alexandra L. Czap, MD, Oana M. Dumitrascu, MD, MSc, FAHA, Koto Ishida, MD, FAHA, Ashutosh P. Jadhav, MD, PhD, FAHA, Brenda Johnson,

Stroke Subtypes: Hemicraniectomy and P-fossa decompression

- Space Occupying Ischemic Stroke
- Intracerebral hemorrhage (Dr. Taussky)
- Cerebellar Stroke
- Cerebellar Hemorrhage

Case

- 60 year old woman with LKW 12-hours prior, NIHSS 18 for aphasia, R facial weakness, R hemiparesis.

- CT/CTA with L M1 occlusion.

- TICI 0.

What is the next best step in management?

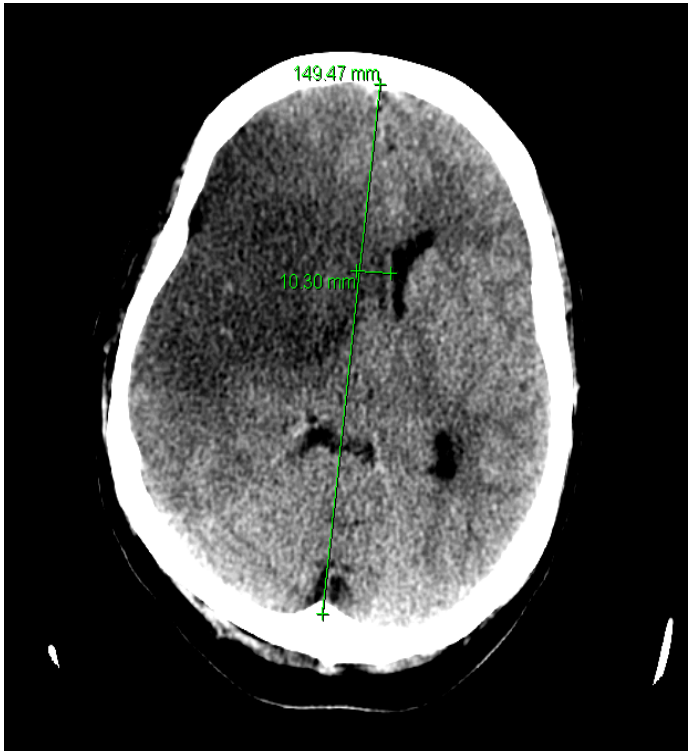
A) Consult neurosurgery

B) Early repeat CT or MRI with DWI

C) Discuss goals of care

D) Admit to the medical ICU

Space Occupying Infarction



~10% of ischemic strokes
~80% mortality (medical therapy)

Torbey MT et al. Evidence-based guidelines for the management of large hemispheric
Neurocrit Care. 2015 Feb;22(1):146-64.

Multiple RCTs support early DHC

- *DE*compressive *C*raniectomy *I*n *MAL*ignant MCA Infarction [DECIMAL]
- Decompressive Surgery for the Treatment of Malignant Infarction of the Middle Cerebral Artery [DESTINY]*
- Hemicraniectomy after Middle Cerebral Artery Infarction with Life-threatening Edema Trial [HAMLET]
- Hemicraniectomy and Durotomy Upon Deterioration From Infarction-Related Swelling Trial [HeADDFIRST],
- Hemicraniectomy for Malignant Middle cerebral Artery Infarction [HeMMI]

Which patients are most likely to benefit?

Decompressive Surgery for the Treatment of Malignant Infarction of the Middle Cerebral Artery (DESTINY)

A Randomized, Controlled Trial

Eric Jüttler, MD; Stefan Schwab, MD, PhD; Peter Schmiedek, MD, PhD;
Andreas Unterberg, MD, PhD; Michael Hennerici, MD, PhD; Johannes Woitzik, MD;
Steffen Witte, PhD; Ekkehart Jenetzky, MD; Werner Hacke, MD, PhD;
for the DESTINY Study Group*

Background and Purpose—Decompressive surgery (hemicraniectomy) for life-threatening massive cerebral infarction represents a controversial issue in neurocritical care medicine. We report here the 30-day mortality and 6- and 12-month functional outcomes from the DESTINY trial.

Methods—DESTINY (ISRCTN01258591) is a prospective, multicenter, randomized, controlled, clinical trial based on a sequential design that used mortality after 30 days as the first end point. When this end point was reached, patient enrollment was interrupted as per protocol until recalculation of the projected sample size was performed on the basis of the 6-month outcome (primary end point=modified Rankin Scale score, dichotomized to 0 to 3 versus 4 to 6). All analyses were based on intention to treat.

Stroke. 2007;38:2518-2525.

DESTINY inclusion criteria

- Age 18-60
- NIHSS >18 (non-dom.) or > 20 (dom.)
- Decrease level of consciousness ≥1 (item 1a NIHSS)
- CT unilateral MCA infarct, ≥ 2/3 territory, +BG, ± ipsi. ACA or PCA
- Onset >12hrs and <36hrs before possible surgical intervention
- Treatment/surgery within 6hrs after randomization

DESTINY: *What* was decompressive hemicraniectomy?

- Bone flap diameter > 12cm
- Remove temporal bone to floor of middle cerebral fossa
- Durotomy- meta-analysis of 4 studies showed reduced likelihood of complications and procedural duration in the open-dura group. no higher incidence of CSF leak or infections.
- No resection of infarcted brain

Lepine HL, Semione G, Povoa RG, de Oliveira Almeida G, Abraham D, Figueiredo EG. Decompressive craniectomy with or without dural closure: systematic review and meta-analysis. *Neurocrit Care*. 2024;42:635–643.

TABLE 3. Baseline Patient Characteristics by Group

	Surgery Group	Conservative Treatment Group	Total	*P* Value
	n=17	n=15	n=32	
Sex				
Male	47%	47%	47%	*P*=0.98*
Female	53%	53%	53%	
Age, y				
Mean±SD	43.2±9.7	46.1±8.4	44.6±9.1	*P*=0.44†
Median	43.0	46.0	44.5	
Range	30.0–60.0	29.0–59.0	29.0–60.0	
Hemisphere				
Dominant	53%	73%	63%	*P*=0.23*
Nondominant	47%	27%	38%	
NIHSS score on admission				
Median	21	24	22	*P*<0.01
Range	19–26	19–31	19–31	
Time from symptom onset to treatment start, h				
Mean±SD	24.4±6.9	23.8±7.8	24.1±7.2	*P*=0.66
Median	24.0	22.5	24.0	
Range	13.5–36.0	12.0–35.0	12.0–36.0	

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

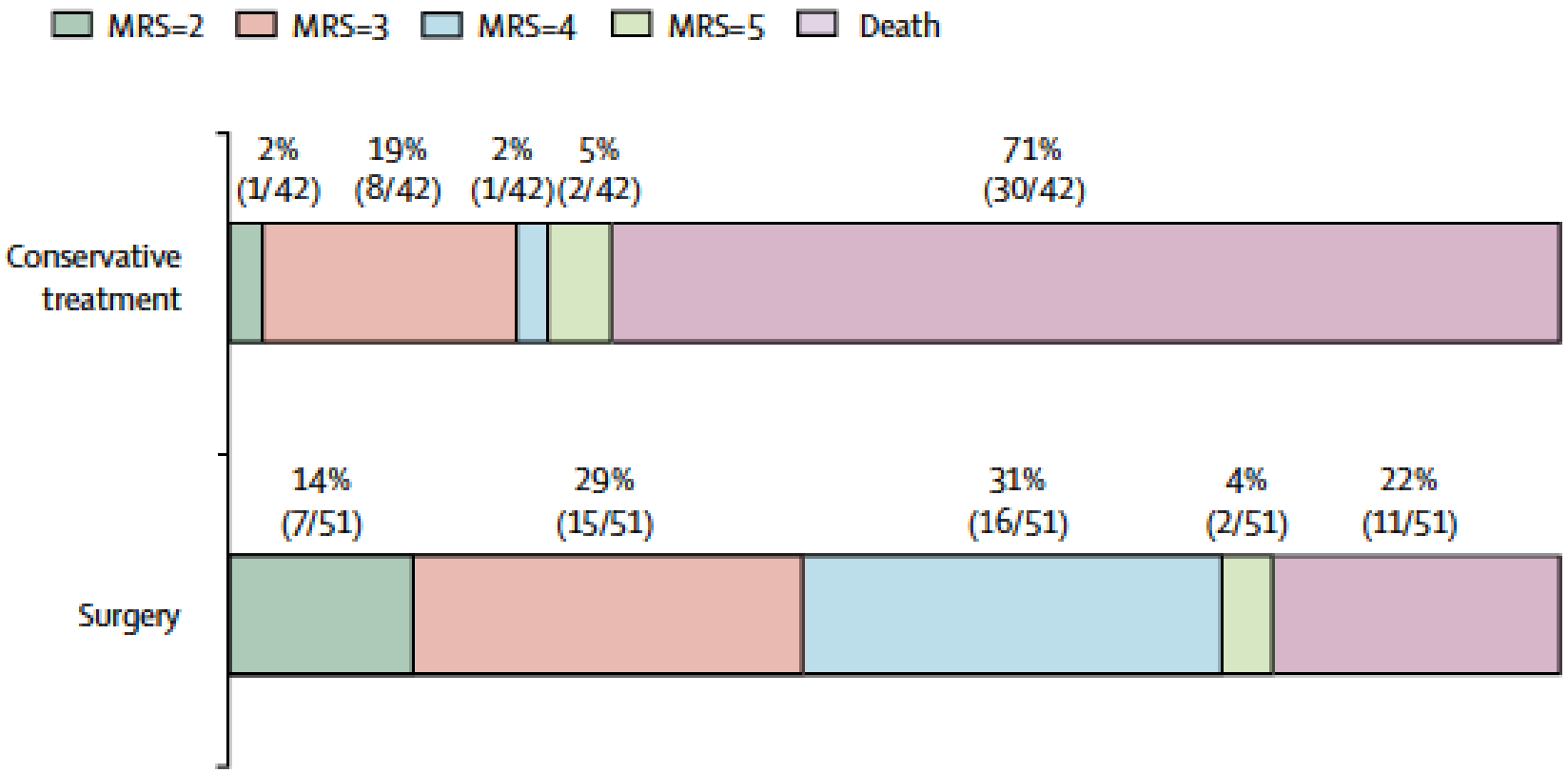
Katayoun Vahedi, Jeannette Hofmeijer, Eric Juettler, Eric Vicaut, Bernard George, Ale Algra, G Johan Amelink, Peter Schmiedeck, Stefan Schwab, Peter M Rothwell, Marie-Germaine Bousser, H Bart van der Worp, Werner Hacke, for the DECIMAL, DESTINY, and HAMLET investigators

Summary

Background Malignant infarction of the middle cerebral artery (MCA) is associated with an 80% mortality rate. Non-randomised studies have suggested that decompressive surgery reduces this mortality without increasing the number of severely disabled survivors. To obtain sufficient data as soon as possible to reliably estimate the effects of decompressive surgery, results from three European randomised controlled trials (DECIMAL, DESTINY, HAMLET) were pooled. The trials were ongoing when the pooled analysis was planned.

Lancet Neurol 2007; 6: 215–22
Published Online February 9, 2007
DOI:10.1016/S1474-4422(07)70036-4

See Reflection and Reaction



Vahedi K, et al. Lancet Neurol. 2007

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ESTABLISHED IN 1812 MARCH 20, 2014 VOL. 370 NO. 12

Hemicraniectomy in Older Patients with Extensive Middle-Cerebral-Artery Stroke

Eric Jüttler, M.D., Ph.D., Andreas Unterberg, M.D., Ph.D., Johannes Woitzik, M.D., Ph.D., Julian Bösel, M.D., Hemasse Amiri, M.D., Oliver W. Sakowitz, M.D., Ph.D., Matthias Gondan, Ph.D., Petra Schiller, Ph.D., Ronald Limprecht, Steffen Luntz, M.D., Hauke Schneider, M.D., Ph.D., Thomas Pinzer, M.D., Ph.D., Carsten Hobohm, M.D., Jürgen Meixensberger, M.D., Ph.D., and Werner Hacke, M.D., Ph.D., for the DESTINY II Investigators*

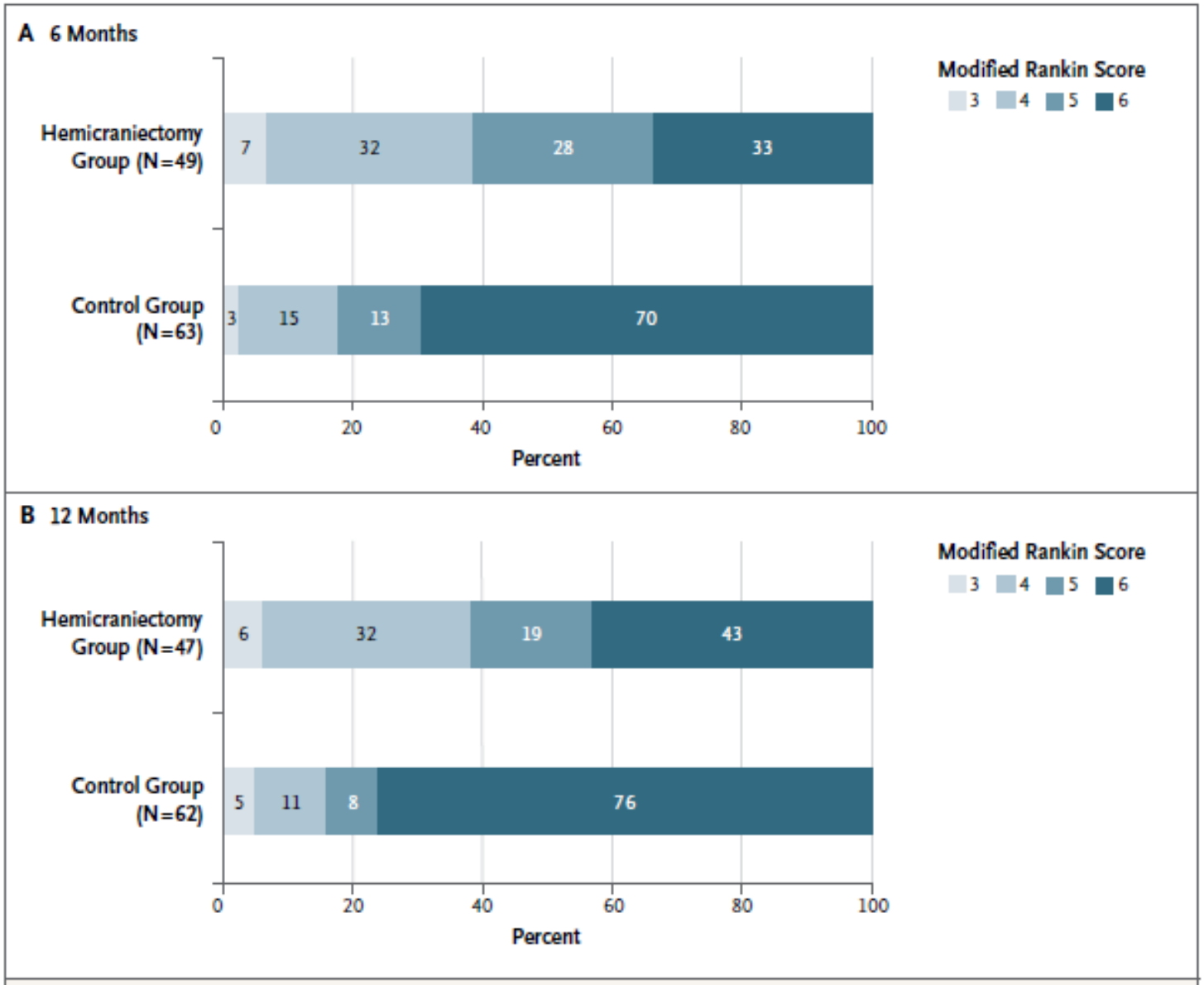


Figure 1. **Functional Outcome after Hemicraniectomy and after Conservative Treatment Alone According to the Modified Rankin Score.**

Practical steps for evaluating potential need for DHC

1) Identify at Risk Population:

NIHSS > 12

Hemispheric infarct > 50% territory

Failed thrombectomy and ASPECTS <6 or poor CTA collaterals

2) Diagnose:

Early repeat CT or MRI (preferred) within 6-hours

3) Inclusion criteria:

Large stroke (>50% territory on CT or > 145ml DWI)

and

Altered LOC (Score >1 on item 1a of NIHSS or GCS < 9 (dom.), GCS < 13 (non-dom.)

Major categories and timing for considering DHC

1) “Younger and early” - Urgent neurosurgical consult with DHC ASAP (goal < 48-hours)

- age < 61
- less than 48-hours from stroke onset

2) “older or late”

- Age 61-80 or any age patient presenting > 48-hours from symptom onset
- Patient/Family discussion: functional outcome acceptable→ neurosurgical consult.
- Timing of DHC variable.
- Medical therapy often first line.

Generally not eligible for DHC

- Age > 80
- Pre-existing mRS > 2 or life expectancy < 3-years
- Clinically significant contralateral stroke or hemorrhage
- Contraindication to general anesthesia
- Uncontrollable coagulopathy or bleeding disorder

Hemicraniectomy after IV Thrombolysis?

ENCHANTED – post hoc analysis (n=73) of DHC < 48hrs.

- IV tPA did not affect patient outcome or mortality
- no associated increased risk with surgery

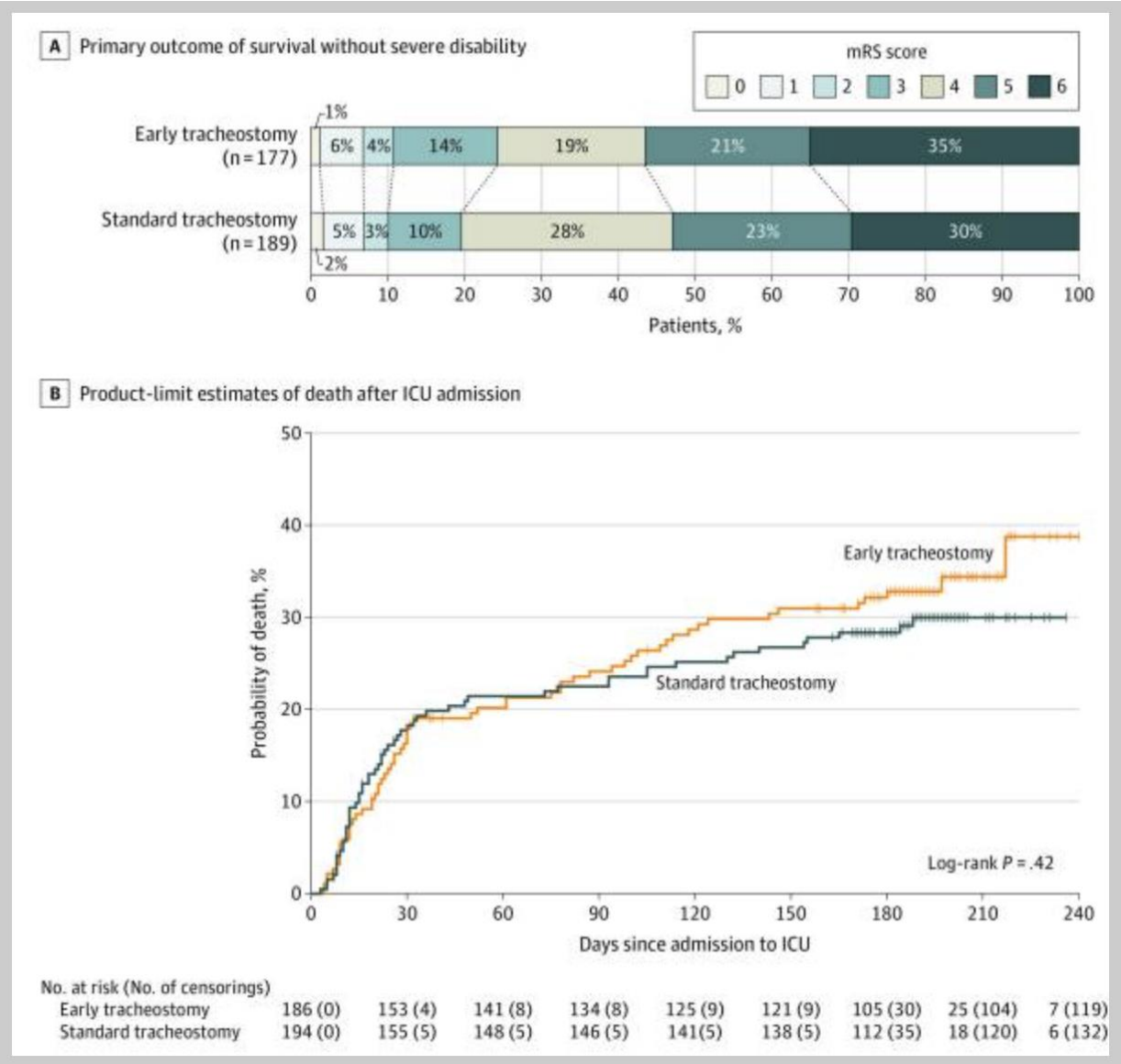
Systematic review of 4 studies (n=98)

- IV tPA did not affect mortality, functional outcome, or hemorrhagic complications

Xia C, Wang X, Lindley RI, Delcourt C, Chen X, Zhou Z, Guo R, Carcel C, Malavera A, Calic Z, et al. Early decompressive hemicraniectomy in thrombolyzed acute ischemic stroke patients from the international ENCHANTED trial. *Sci Rep*. 2021;11:16495.

Pedro KM, Roberto KT, Chua AE. Safety and outcome of decompressive hemicraniectomy after recombinant tissue plasminogen activator thrombolysis for acute ischemic stroke: a systematic review. *World Neurosurg*. 2020;144:50–58.

Related supports: (Tracheostomy)



Bösel J, et al. SETPOINT2 and the IGNITE Study Groups. Effect of Early vs Standard Approach to Tracheostomy on Functional Outcome at 6 Months Among Patients With Severe Stroke Receiving Mechanical Ventilation: The SETPOINT2 Randomized Clinical Trial. JAMA. 2022 May 17;327(19):1899-1909. doi: 10.1001/jama.2022.4798. PMID: 35506515

Back to the case- next best step in management?

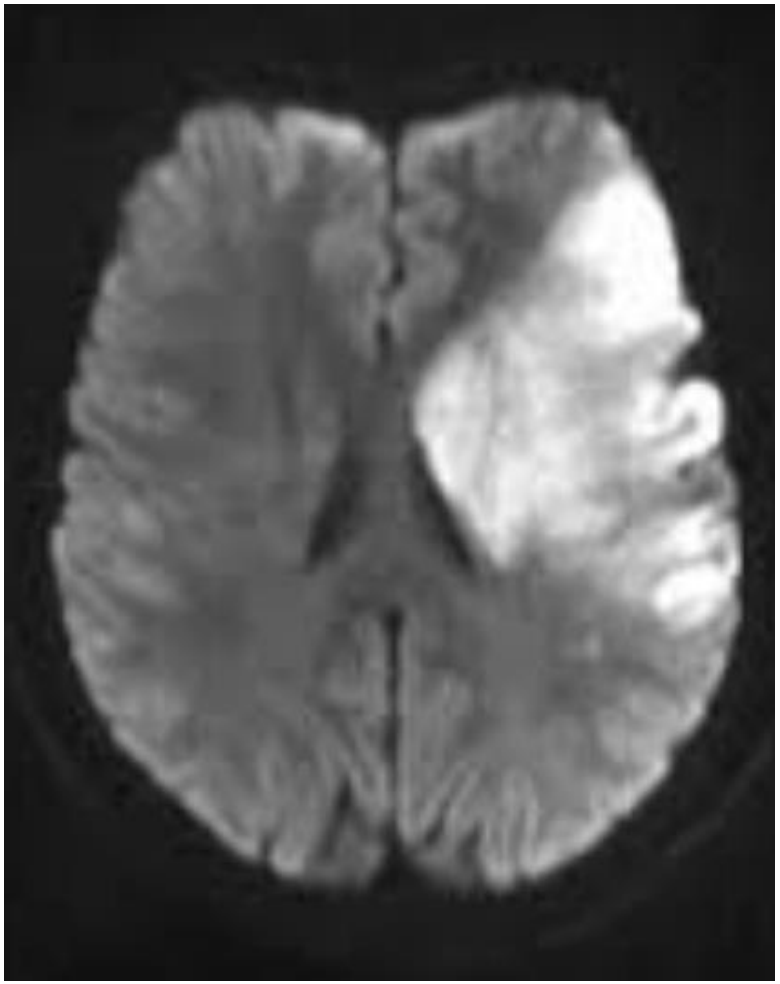
A) Consult neurosurgery

B) Early repeat CT or MRI with DWI

C) Discuss patient values and preferences

D) Admit to the medical ICU

Case: MRI result



What is the next best step in management?

A) Consult neurosurgery

B) Early repeat CT or MRI with DWI

C) Discuss patient values and preferences

D) Admit to the neuro ICU

Intracerebral hemorrhage (briefly)

ICH surgical trials

STICH

- Equipoise required for enrollment
- 26% cross-over to surgical arm

STICH II

- Superficial (<1cm from cortex) ICH
- No difference from medical tx arm

ENRICH

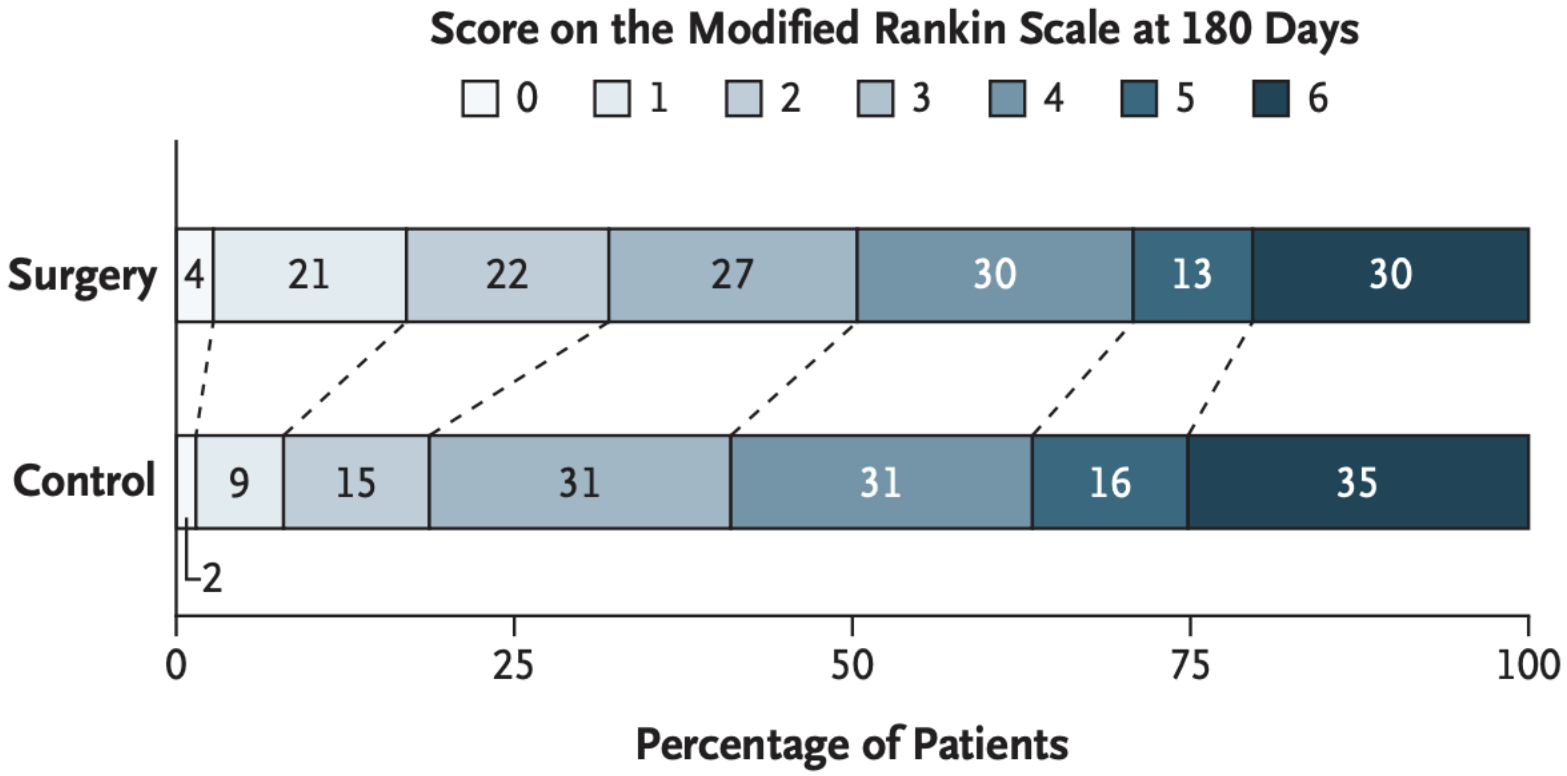
- Lobar or BG hemorrhage (30 – 80 ml)
- Utility-weighted mRankin at 180 days.

SWITCH

- Large ICH (~55cc) in basal ganglia and thalamus.

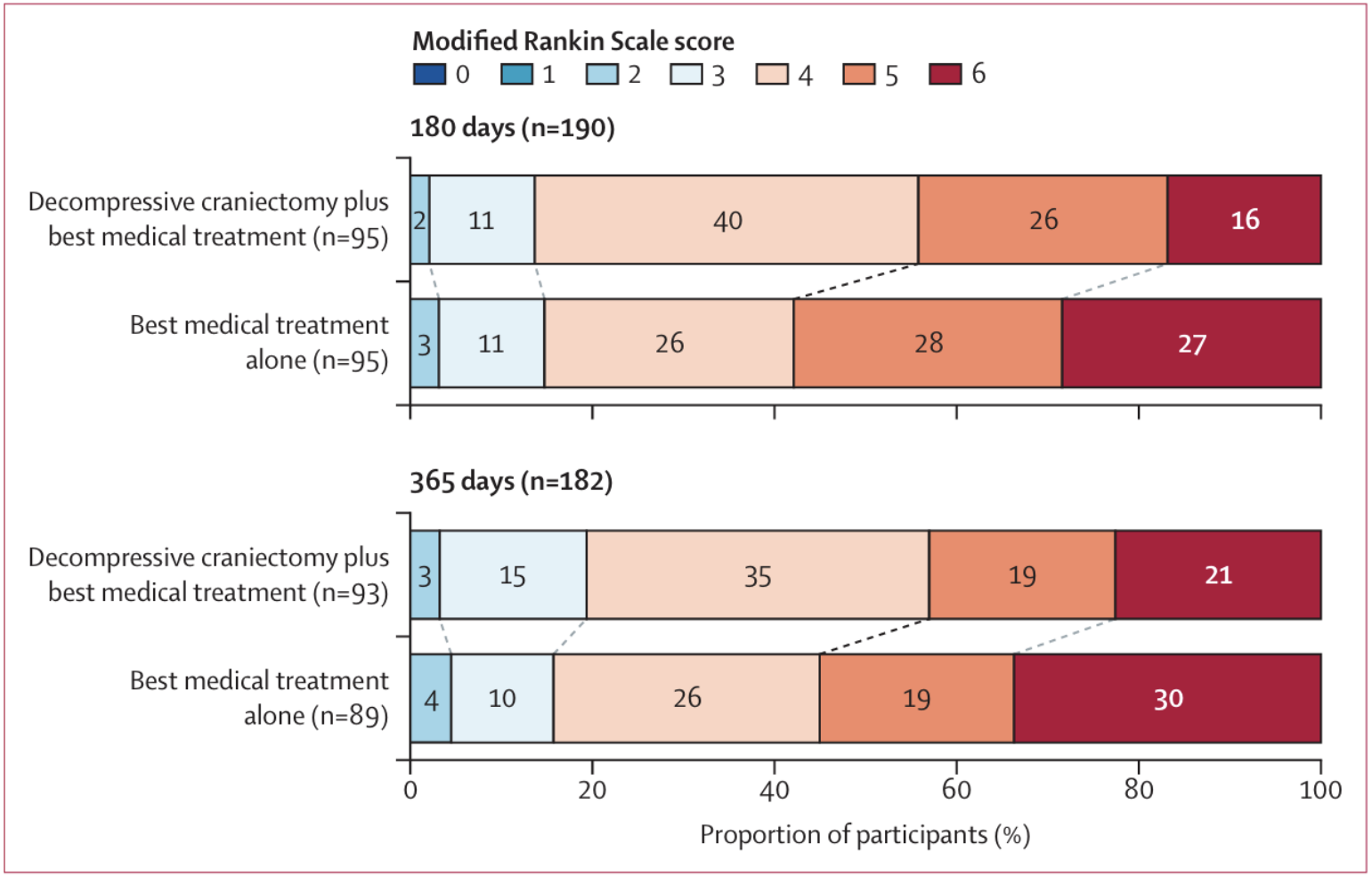
MINUTE

ENRICH trial results



Pradilla G, et al. ENRICH Trial Investigators. Trial of Early Minimally Invasive Removal of Intracerebral Hemorrhage. N Engl J Med. 2024 Apr 11;390(14):1277-1289.

SWITCH trial results



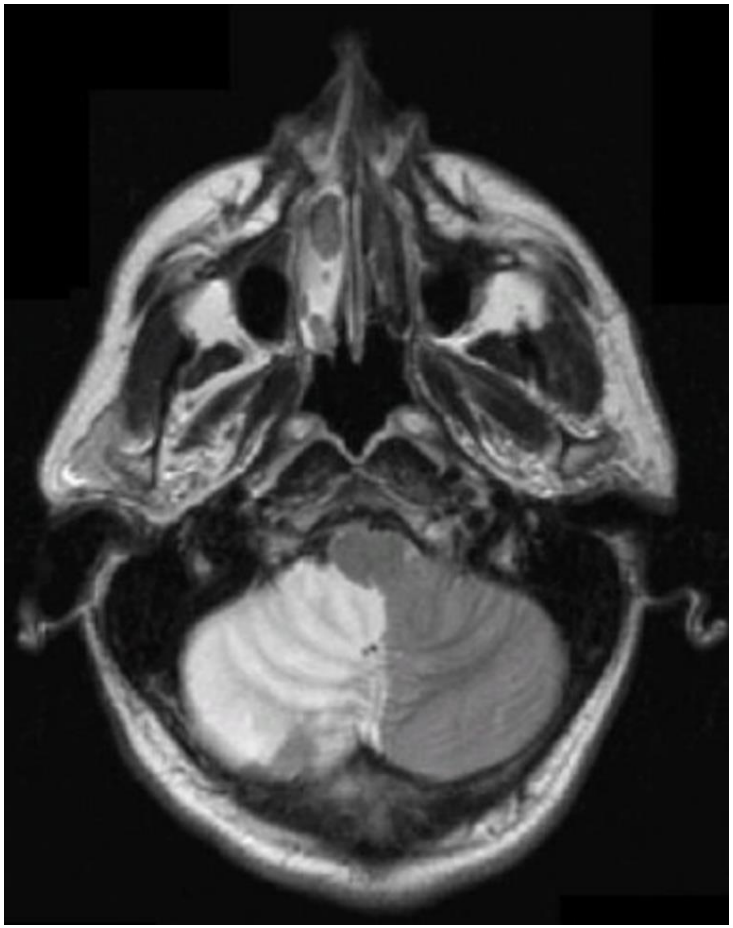
Beck et al, Lancet 2024

Minimally Invasive Neuroendoscopic Ultra-Early Targeted ICH Evacuation Trial

- Age ≥ 18 and ≤ 80 years
- Non-traumatic, spontaneous, supratentorial, non-thalamic, BGH ≥ 20 mL
- No underlying vascular lesion
- Pre-ICH mRS 0-2
- Surgery initiated <120 min from randomization
- Randomization ≤16 hours from LKW

NIH StrokeNet
PREVENTION | TREATMENT | RECOVERY

P-fossa decompression



Cerebellar Hemorrhage	Cerebellar Ischemic Stroke
Neurosurgical emergency	Variable approach
>3cm (15ml) generally operable	>1/3 or causing deterioration
EVD generally after decompression	EVD less common

AHA guideline: Urgent surgical hematoma evacuation with or without EVD if: 1) deteriorating neurologically, or 2) brainstem compression and/or hydrocephalus, 3) or have cerebellar ICH volume ≥15 mL

AHA guideline: SOC with dural expansion in patients with deterioration with brainstem compression despite maximal medical therapy.

Summing it up

Stroke type	Location	Timing
Ischemic	Hemispheric	<48hrs
Ischemic	Cerebellar	Clinical syndrome
ICH	Hemispheric	DHC- Variable (2-96hrs) MIS- < 24-hrs
ICH	Cerebellar	Emergent depending on size

Minimally invasive surgery for ICH is growing

EMINENT-ICH (NCT05681988)- feasibility and safety, 69.5% median hematoma reduction rate. 60% of patients with mRS ≤3 at 6 months.

INVEST-REGISTRY (NCT02661672) – Registry of clot evacuation devices for safety and feasibility.

EVACUATE (NCT04434807)- pilot safety and feasibility

MIND (NCT03342664)- stopped early following ENRICH.

Coming soon…

DIST (NCT05460793) – Dutch stud of MIS < 8-hours, actively enrolling.

MINUTE (NCT07260916)- rolling site activations

Summary

- Strokes requiring decompression or evacuation remain a clinical challenge
- Algorithmic approach to DHC in ischemic stroke can be helpful
- Suboccipital decompression often guided by both imaging and clinical presentation
- Evidence for minimally invasive surgery (MIS) rapidly growing
- Optimal approach remains highly individualized with alignment of patient and family expectations with data on outcomes

Thank you.

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