CT ASPECTS SCORE IN ACUTE STROKE

Douglas J Mayson, MD

Assistant Professor of Neurology

Medstar Georgetown University Hospital

OUTLINE

- Early ischemic changes on CT
- Introduction to ASPECTS score (Alberta Stroke Program Early CT Score)
- ASPECTS scoring cases
- ASPECTS in tPA administration
- ASPECTS when considering thrombectomy

EARLY ISCHEMIC CHANGES IN ACUTE STROKE

- CT head is standard of care for acute stroke
  - Rule out hemorrhage when evaluating for tPA and thrombectomy candidacy
- CT is also useful to detect early ischemic changes (EICs)
  - Cerebral hypodensity
    - Loss of grey-white differentiation
  - Cortical swelling
    - Studies suggest may be consider oligemia and not infarction
- EICs are detectable within 1 hour and are visible in 75% of patients at 3 hours

S Prakkamakul, et al. Topics in Magnetic Resonance Imaging. 2017
K Butcher, et al. Stroke. 2007.

CT HEAD AT 1 AND 8 HOURS
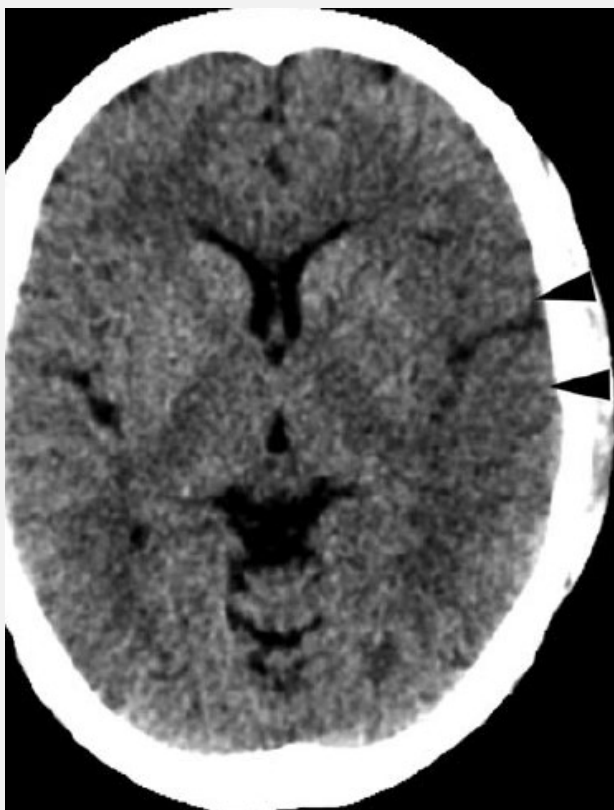
- Collaterals and penumbra determine rate of appearance and location of infarction and EICs

- Level of occlusion determines distribution of early ischemic changes

  - ICA/Proximal M1 – more basal ganglia involvement

  - Distal M1 – no basal ganglia involvement

  - M2 – no basal ganglia involvement, portion of MCA cortex

CT HEAD AT 1 AND 8 HOURS
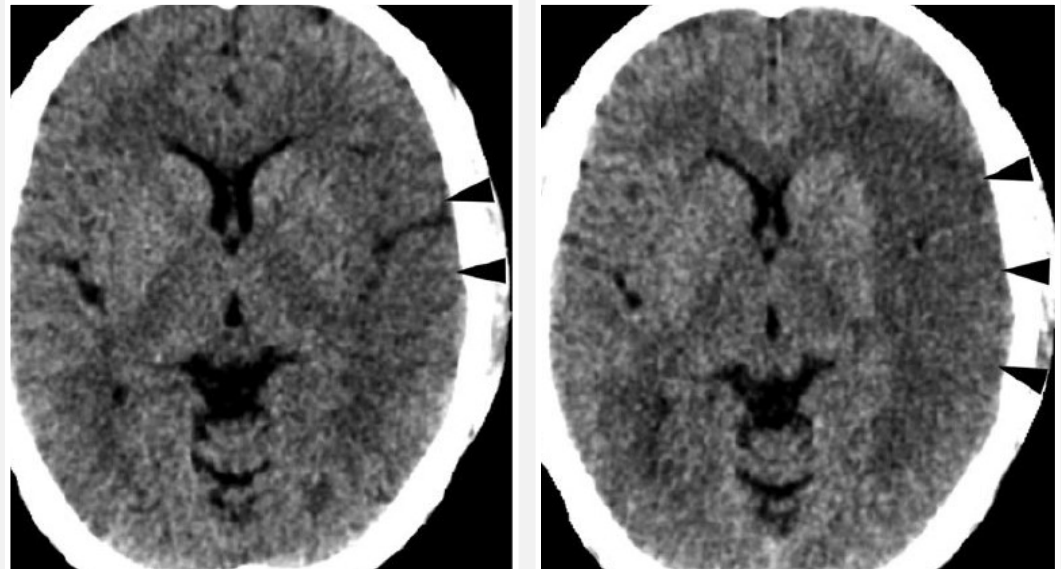
DEVELOPMENT OF ASPECTS SCORE

- Early ischemic change is subtle and may have patchy distribution

  - But predictive of infarct core

  - Method to rapid communication and patient selection needed in trials and clinical care

- Semi-quantitative assessment of early ischemic change in the middle cerebral artery territory

W Powers et al. Stroke 2019.
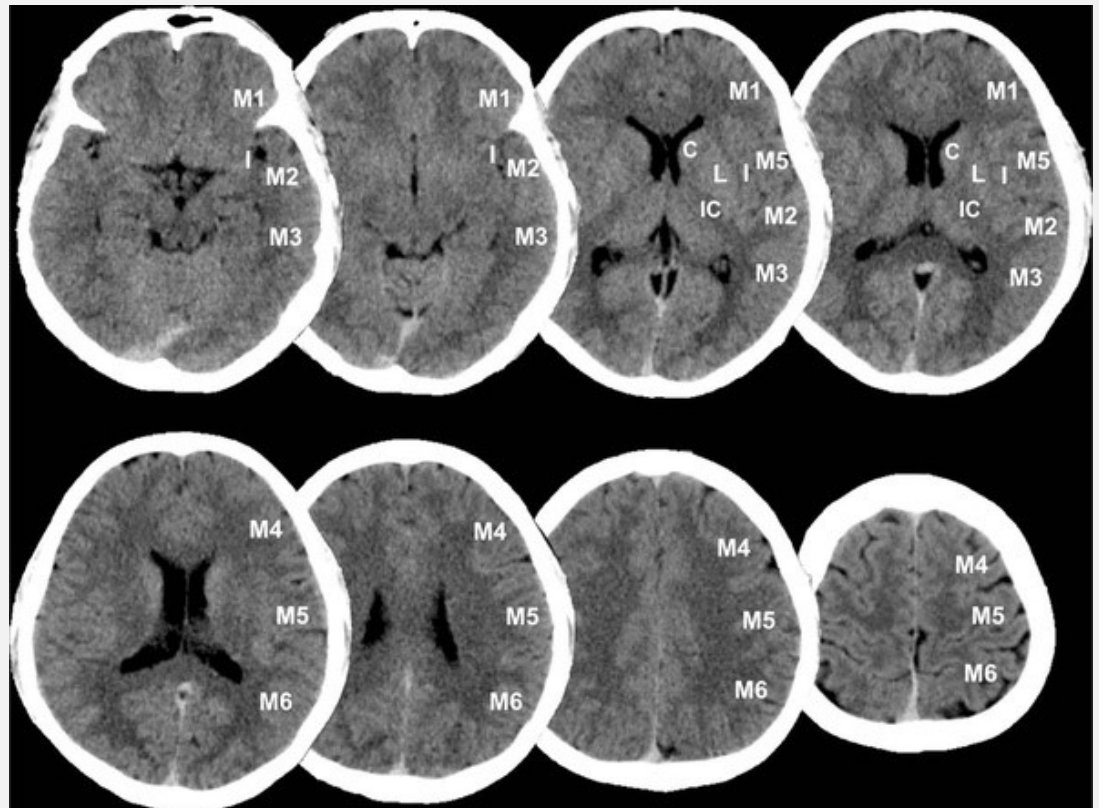
STEPS FOR ASSESSING ASPECTS

Review the entire non-contrast CT head for early ischemic changes
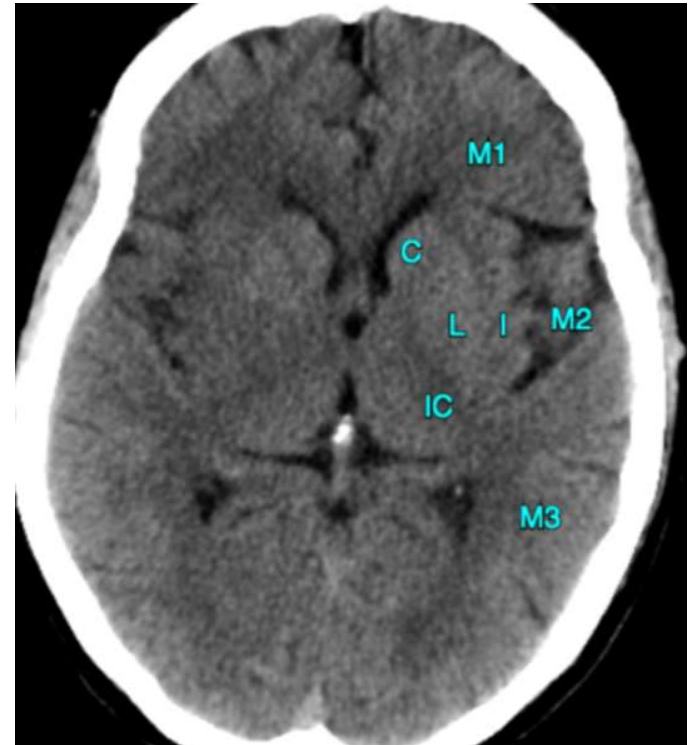
    Use 5mm reconstructed CT series

Compare the affected middle cerebral artery territory in one hemisphere with contralateral as control
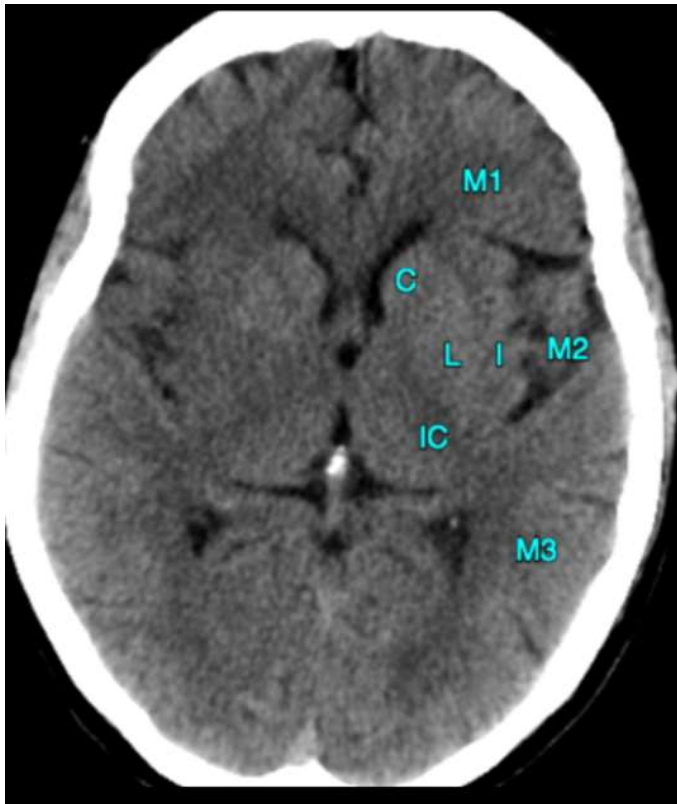
    Loss of grey-white matter differentiation counted if present on 2 slices

    Cortical swelling alone not counted

Total possible score 10

    Lose 1 point for each area that includes EICs

Calculating the ASPECTS Score:

Each area of grey white loss constitutes 1 deduction point

Subganglionic Nuclei:
    M1 - *Frontal operculum*   -1
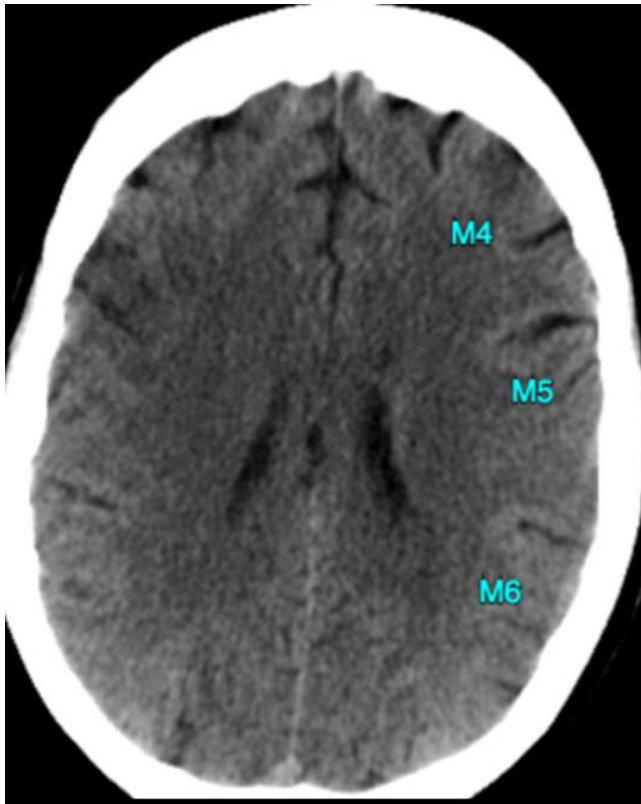   M2 - *Anterior temporal lobe*   -1
    M3 - *Posterior temporal lobe* -1
Supraganglionic Nuclei:
    M4 - *Anterior MCA*   -1
    M5 - *Lateral MCA*   -1
    M6 - *Posterior MCA*   -1
Basal Ganglia:
    Caudate (C)   -1
    Lentiform Nucleus (L)   -1
    Insula (I)   -1
    Internal Capsule (IC) *any part* -1

Total ASPECTS Score.   **/10**

www.aspectsinstroke.com

Calculating the ASPECTS Score:

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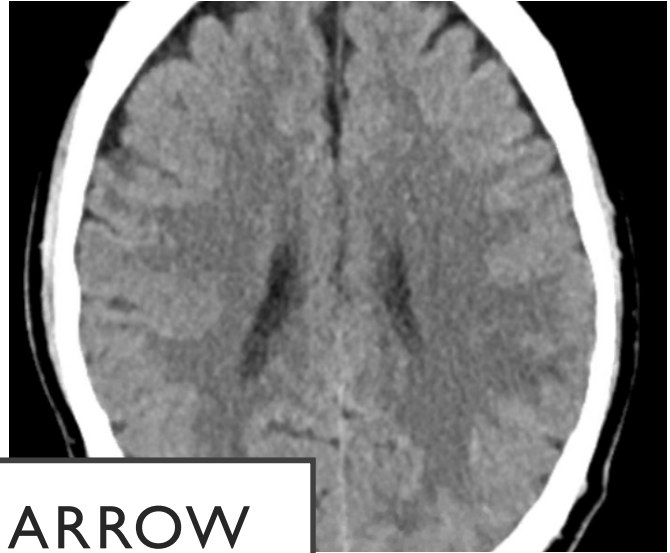   M2 - *Anterior temporal lobe*   -1
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Supraganglionic Nuclei:
    M4 - *Anterior MCA*   -1
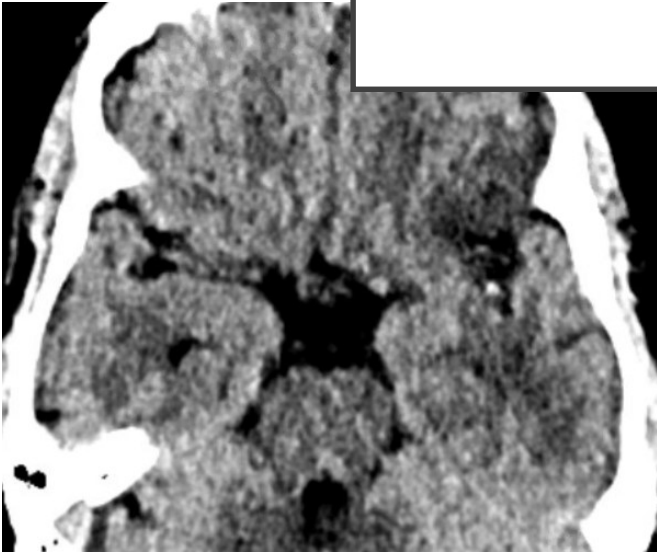   M5 - *Lateral MCA*   -1
    M6 - *Posterior MCA*   -1
Basal Ganglia:
    Caudate (C)   -1
    Lentiform Nucleus (L)   -1
    Insula (I)   -1
    Internal Capsule (IC) *any part* -1

Total ASPECTS Score.   **/10**
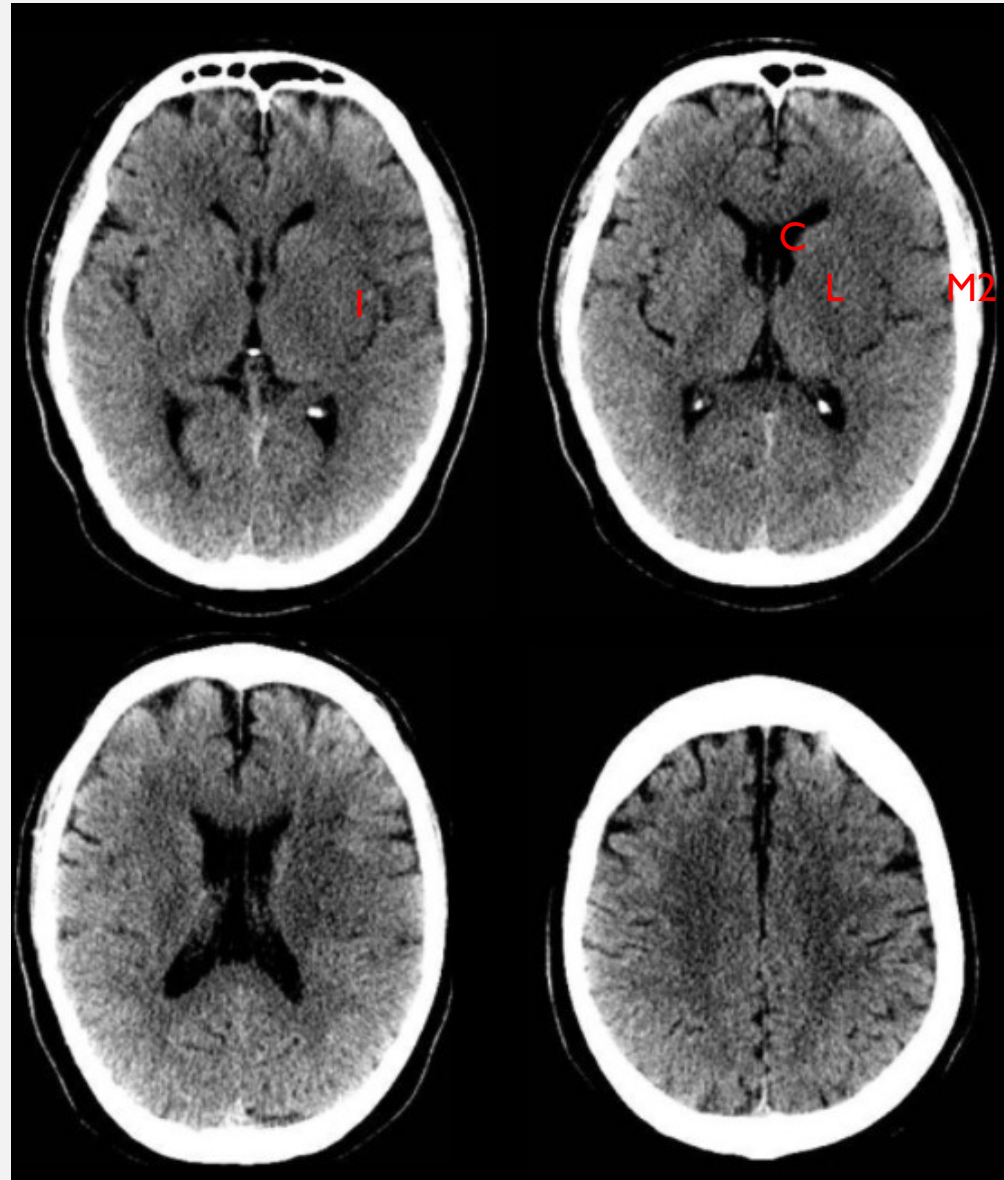
www.aspectsinstroke.com

WINDOWS: DEFAULT VS NARROW
(50:30, 40:40)

ASPECTS SCORING CASES

- 71 year old Female with acute onset aphasia and right sided weakness (L hemispheric symptoms)

- ASPECTS = 6

  - I – Insula

  - L – Lentiform nuclei

  - C – Caudate

 - M2 – Anterior temporal lobe

NEXT CASE

- 35 yo F w/ acute onset of left sided neglect and hemiplegia (R hemispheric symptoms)

- Scanned at 30 minutes from LKW.

- ASPECTS = 10
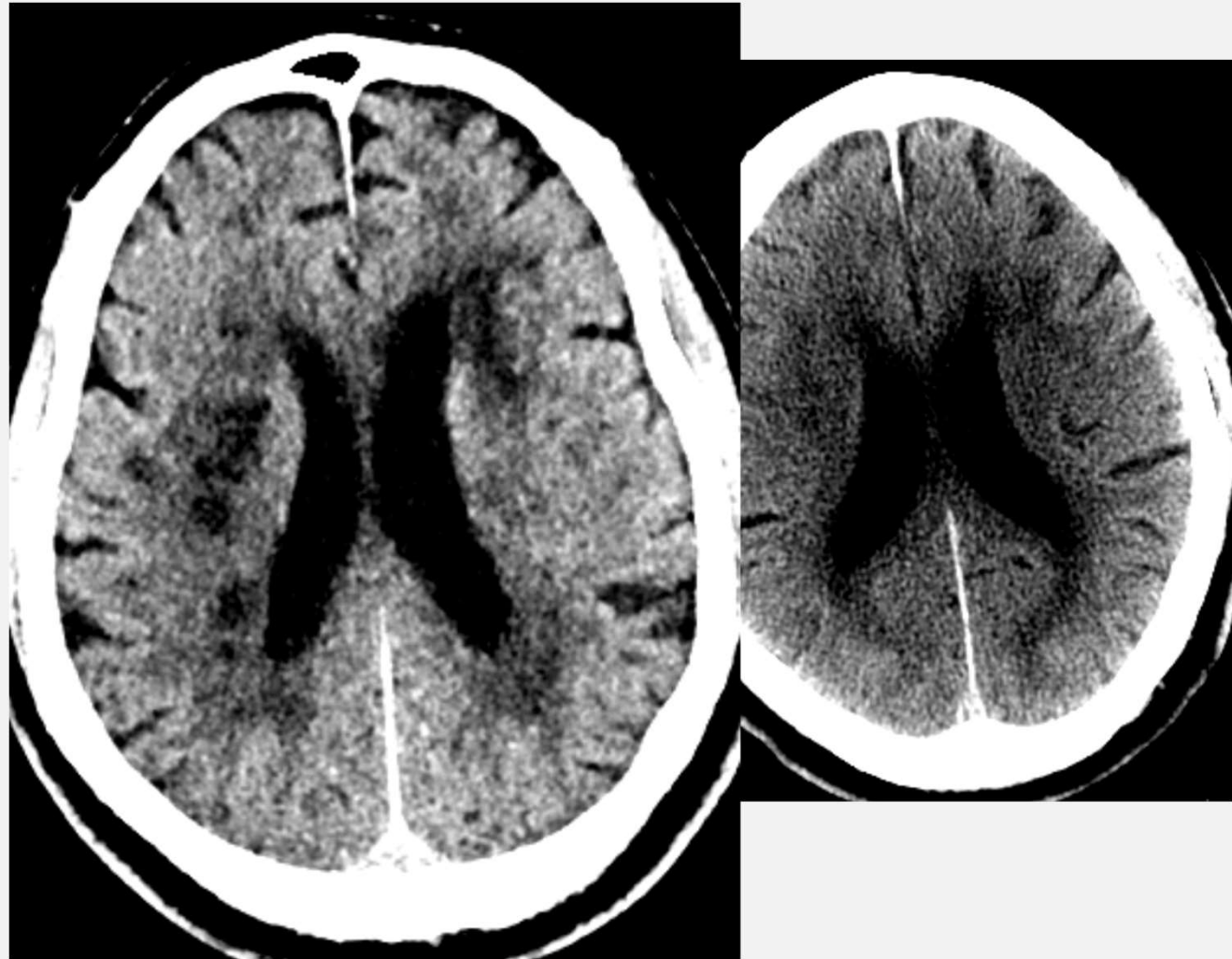
  - Too early to see EICs
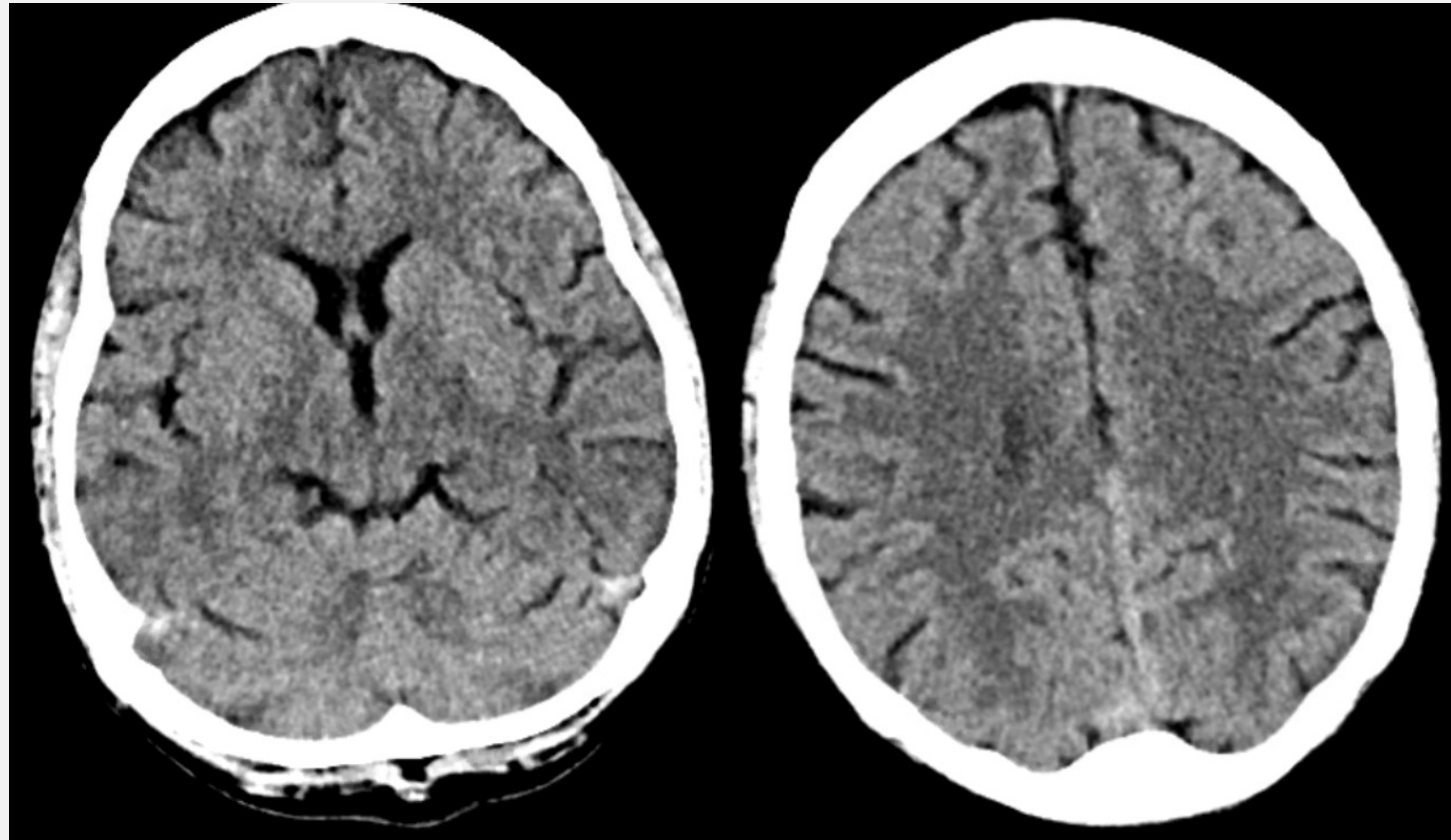
NEXT CASE

- 55 yo F with left hemispheric symptoms 70 min from LKW.
- ASPECTS = 4
  - I – Insula
  - L – Lentiform nuclei
  - C – Caudate
  - M2 – Anterior temporal lobe
  - M4 – Supraganglionic anterior
  - M5 – Supragangionic lateral
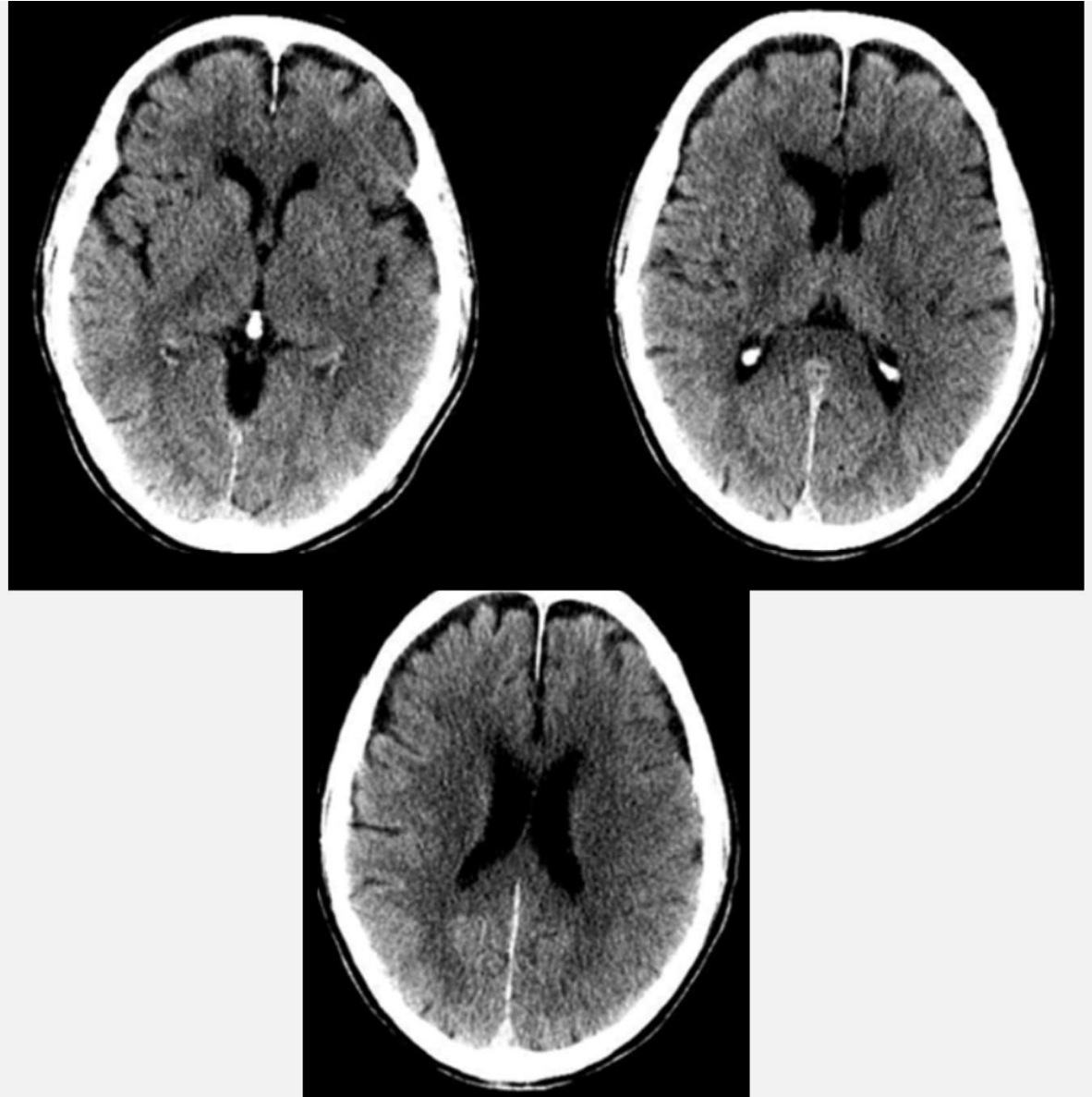
NEXT CASE

- 60 yo M with right hemispheric symptoms 6 hours LKW.

- ASPECTS = 10
  - Despite significant small vessel disease burden

ASPECTS – Very low sensitivity for deep watershed strokes

UTILITY OF ASPECTS

- Predictive of functional outcome in initial ASPECTS study

  - Sensitivity 0.78, Specificity 0.96 p<0.001

- Larger Canadian CASES study observation cohort of 1135 tPA patients

  - Each point lower ASPECTS associated with lower functional outcome (OR 0.81, 95% CI 0.75-0.87)

- Predictive of symptomatic intracerebral hemorrhage (P = 0.012)

- Used as selection criteria in several randomized endovascular trials

  - Component of thrombectomy selection criteria in American Stroke Association Early Stroke Management Guidelines. (Class 1)

PA Barber, et al. Lancet 2000.
MD Hill, et al. CMAJ 2005.
W Powers et al. Stroke 2019.

INTEROBSERVER REPRODUCIBILITY

- Some studies have shown excellent agreement (B Coutts, et al)

  - Comparing treating physician to expert reader showed excellent agreement: Kw = 0.69

- Others have shown excellent agreement on overall scale, but only moderate agreement when dichotomized at 7 (k = 0.53) (AC Gupta, et al.)

- Still others have shown only moderate levels of agreement when performed by non-expert readers.

- Factors effecting interobserver reproducibility

  - Time from stroke onset to scan

    - Scans performed <90 minutes from LKW have especially low reproducibility

  - Technique (such as low radiation scans) may reduce sensitivity for early ischemic change

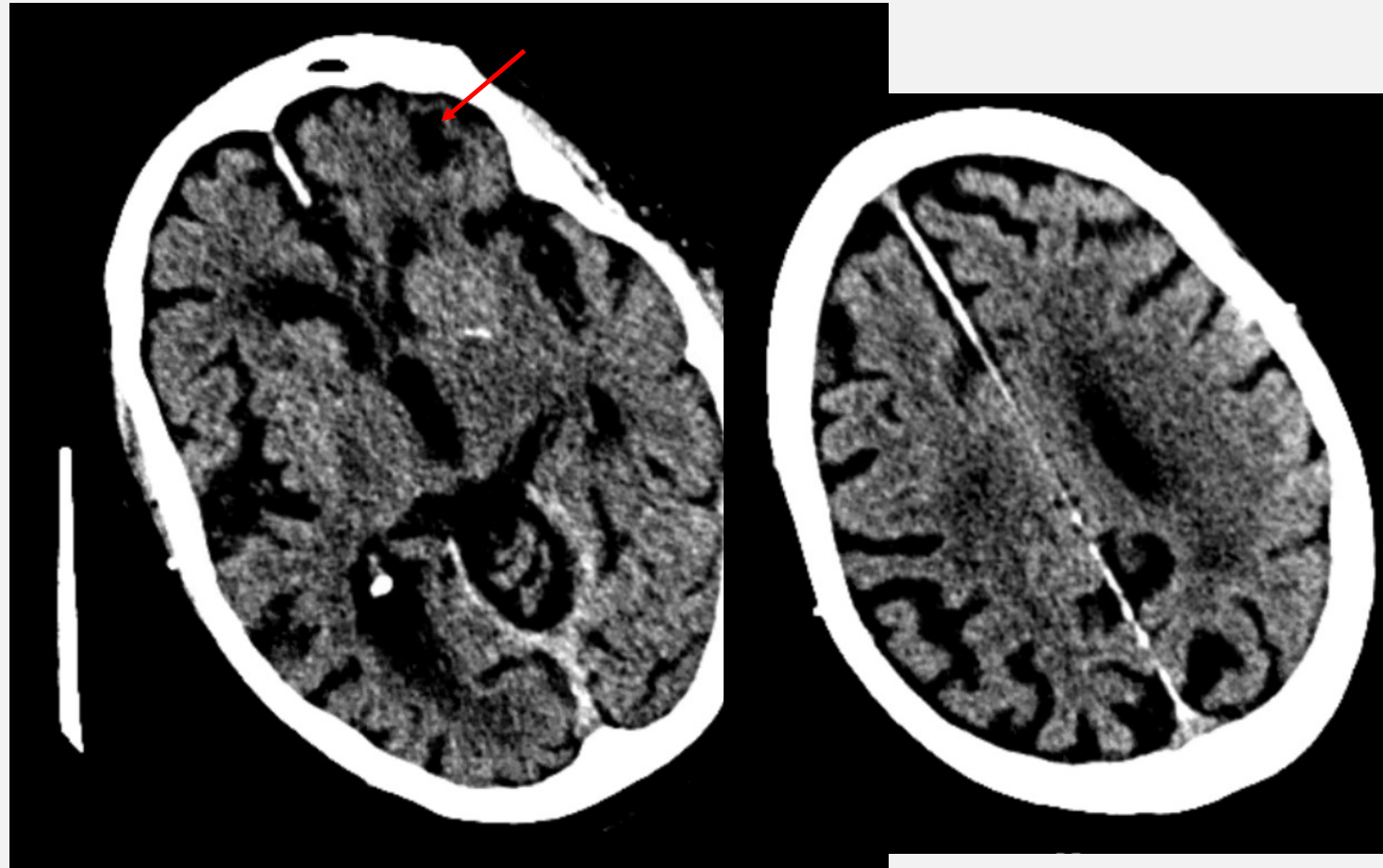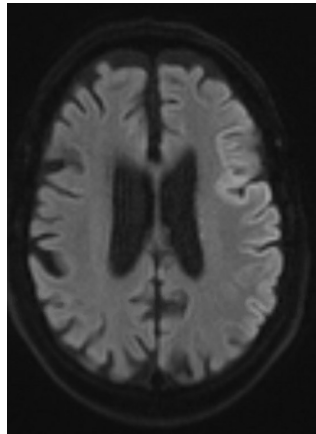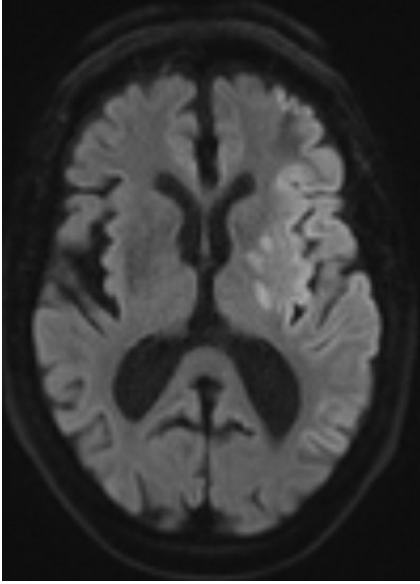 - Limited experience and lack of specific training program in ASPECTS
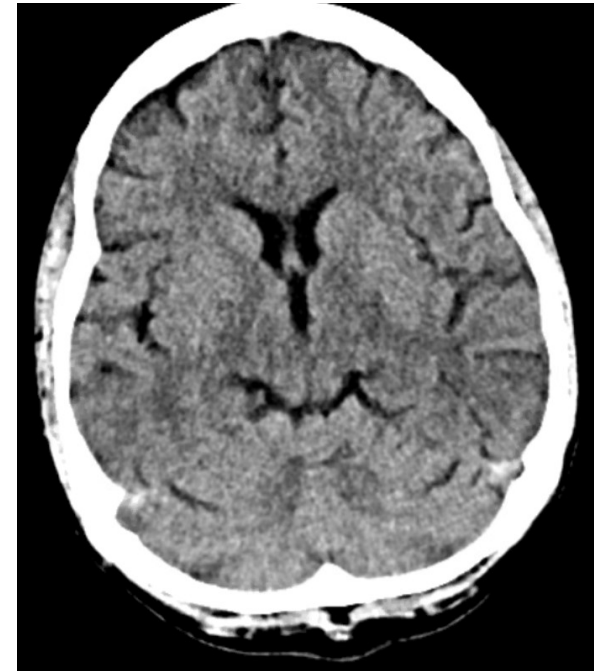
B Coutts, et al. Stroke 2004

AC Gupta, et al. AJNR 2012

NEXT CASE

- 82 yo F w/ acute onset of aphasia and right sided weakness
- Scanned at 90 minutes from LKW.
- ASPECTS = 6
  - I - Insula
  - L – Lentiform Nuclei
  - M4
  - M6
- **Would you give tPA?**
  - Assuming no contraindication

CASE CONTINUED

- tPA was administered to patient
- Recanalization obtained
- Extent of stroke limited to cortex
- Patient functionally independent after lengthy rehab course

TPA AND ASPECTS

- Lower ASPECTS associated with increased hemorrhage and worse outcome
- Post-hoc analysis of NINDS rtPA trial and ECASS II trial
  - Failed to demonstrate treatment modifying effect dichotomized by ASPECTS 7
- Per ASA 2019 guidelines
  - IV Alteplase recommended in patients with mild and moderate EICs (Class 1, LOE A)
    - Per guidelines: Insufficient evidence to identify a threshold for extent of EICs.
    - However extensive hypodensity is potentially a contraindication
   - Given poor prognosis regardless of tPA administration.

AM Demuchuk, et al. Stroke 2005
BM Demaerschalk, et al. Stroke 2016

OUR PRACTICE?

- Mild EICs (ASPECTS 7-10)?
  - Consider tPA
- Moderate changes (ASPECTS 4-6)
  - Consider in context of :
    - Clinical presentation
    - Baseline functional status
    - Risk of hemorrhage
- Patients with extensive EICs (ASPECTS 0-3) or frank hypodensity involving >1/3 of MCA territory I would exclude from tPA administration
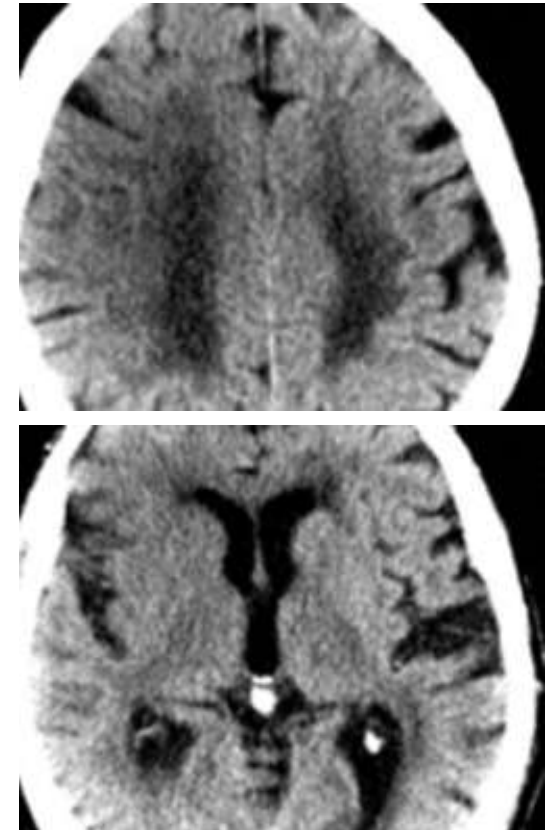
NEXT CASE
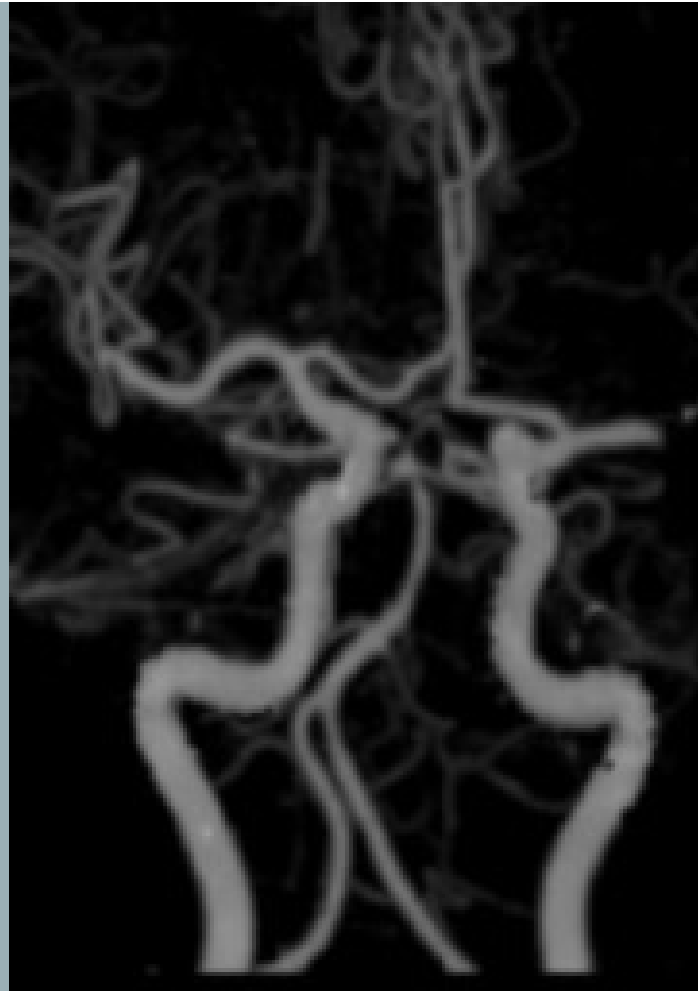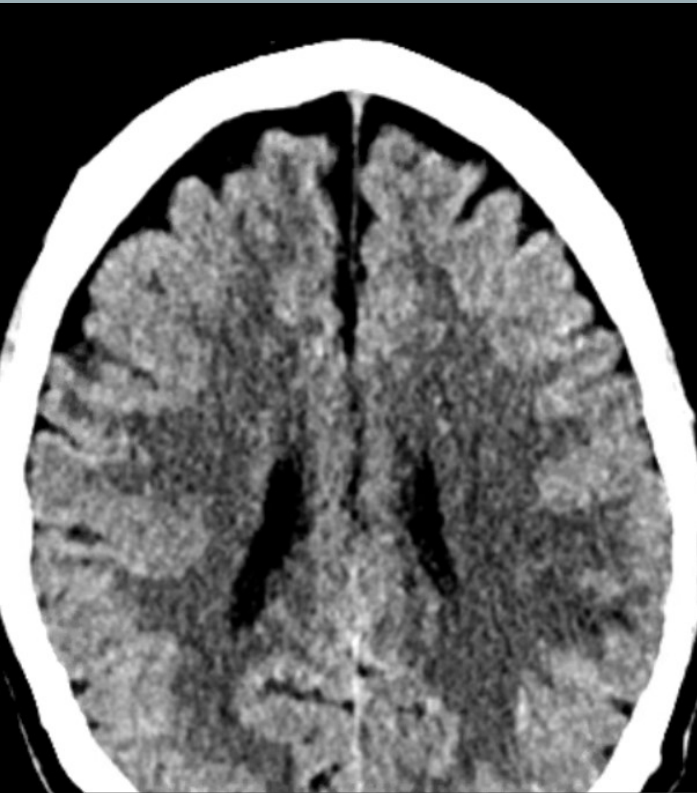
HOW DOES ASPECTS INFORM THROMBECTOMY DECISION?

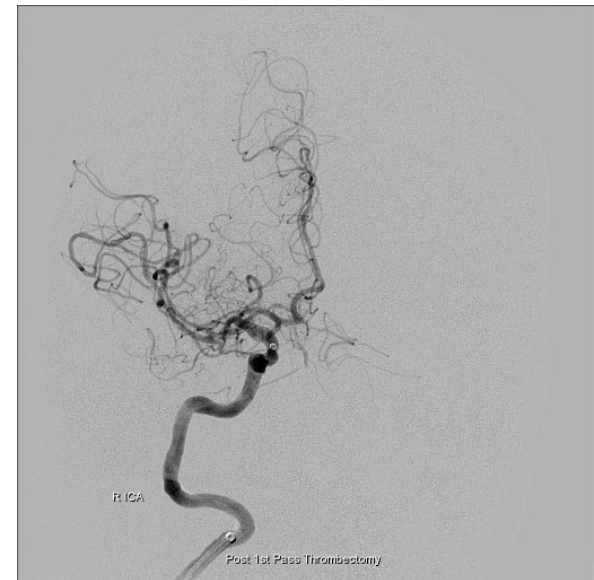## ASPECTS AND ENDOVASCULAR THERAPY (EVT)

- Retrospective analysis of PROACT-II RCT of IA pro-urokinase for proximal MCA occlusion

    - Clinical benefit in patients with ASPECTS >7, no benefit ASPECTS ≤ 7

- Conversely, IMS-3 an early thrombectomy RCT that failed to demonstrate benefit over tPA alone

    - Failed to show specific benefit when ASPECTS dichotomized at 7 in retrospective analysis

- In 2013 IMS-3 and other early window trials failed to show benefit from EVT

    - Some next generation of trials incorporated ASPECTS score into inclusion/exclusion criteria
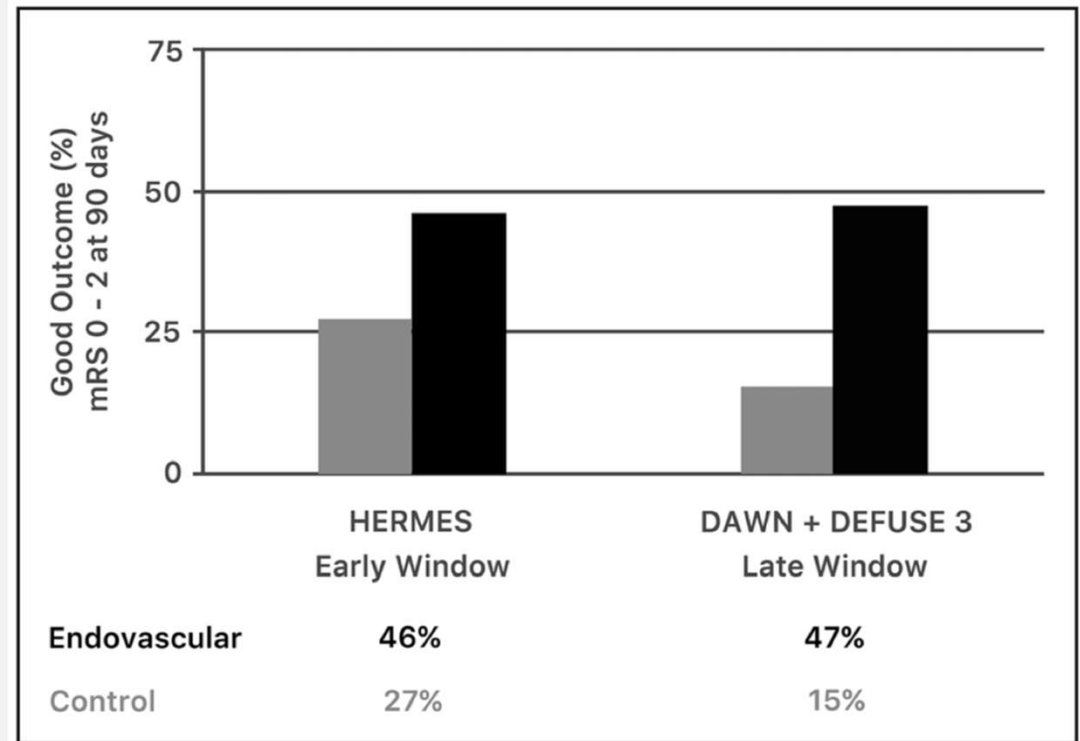
        - SWIFT PRIME, ESCAPE, REVASCAT

Hill MD et al. Stroke 2003.
Hill MD et al. Stroke 2014.

ENDOVASCULAR THERAPY (EVT) AND LARGE VESSEL OCCLUSION

- In 2014/15 five multicenter, open-label randomized controlled trials (MR CLEAN, ESCAPE, SWIFT PRIME, EXTEND-IA, and REVASCAT) proven highly effective and safe in first 0-6 hours from LKW

- In 2018 extended window (DAWN/DEFUSE 3) also proven safe and highly effective to 24 hours from LKW

  - Selected using CT/MR perfusion

  - ASPECTS score used in DEFUSE 3 trial only

Albers GW. Stroke 2018.

ASPECTS AND EVT

3.7.2. 0 to 6 Hours From Onset	COR	LOE
1. Patients should receive mechanical thrombectomy with a stent retriever if they meet all the following criteria: (1) prestroke mRS score of 0 to 1; (2) causative occlusion of the internal carotid artery or MCA segment 1 (M1); (3) age ≥18 years; (4) NIHSS score of ≥6; (5) ASPECTS of ≥6; and (6) treatment can be initiated (groin puncture) within 6 hours of symptom onset.	I	A

2019 ASA/AHA guidelines for thrombectomy within 6 hours

Class 1, LOE A for ASPECTS ≥ 6 in favor of EVT

W Powers et al. Stroke 2019

ASPECTS <6 IN EARLY TIME WINDOW

|		
4. Although its benefits are uncertain, the use of mechanical thrombectomy with stent retrievers may be reasonable for patients with AIS in whom treatment can be initiated (groin puncture) within 6 hours of symptom onset and who have prestroke mRS score >1, ASPECTS <6, or NIHSS score <6, and causative occlusion of the internal carotid artery (ICA) or proximal MCA (M1).	IIb	B-R

1. In selected patients with AIS within 6 to 16 hours of last known normal who have LVO in the anterior circulation and meet other DAWN or DEFUSE 3 eligibility criteria, mechanical thrombectomy is recommended.	I	A	New recommendation.
2. In selected patients with AIS within 16 to 24 hours of last known normal who have LVO in the anterior circulation and meet other DAWN eligibility criteria, mechanical thrombectomy is reasonable.	IIa	B-R	New recommendation.

- MR CLEAN did not exclude such patients
  - Retrospective analysis did not show difference in outcome when trichotomized ASPECTS (0-4, 5-7, 8-10)
  - Limitation – trial included very few patients with ASPECTS 0-4 (6% of total trial population)
- Furthermore, 2019 retrospective European registry study of thrombectomy in 237 patients with ASPECTS 0-5
  - Patients revascularized had greater odds of functional independence. (aOR, 5.583; 95% CI, 1.964–15.873),
- 2019 AHA/ASA Guidelines - Patients with ASPECTS < 6 benefits uncertain, thrombectomy may be reasonable (Class IIb LOE B-R)
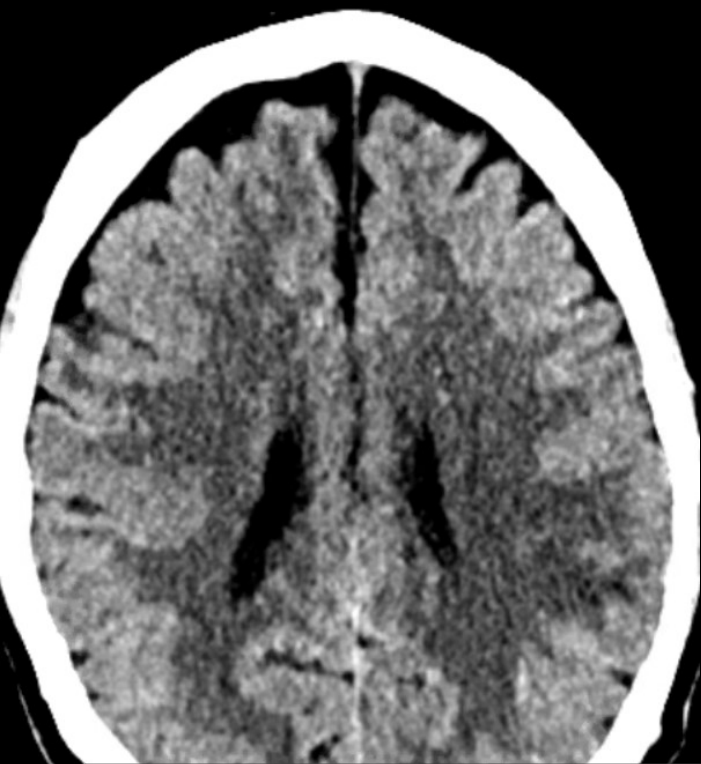
Kaesmacher J et al. Stroke 2019.

OUR PRACTICE?

- ASPECTS 6 or greater?
  - Thrombectomy!
- ASPECTS 3-5
  - Consider in context of baseline functional status and risk of hemorrhage
- ASPECTS 0-3
  - We would be unlikely to take patient for thrombectomy
    - However, may consider in context of perfusion imaging with large penumbra, excellent baseline functional status
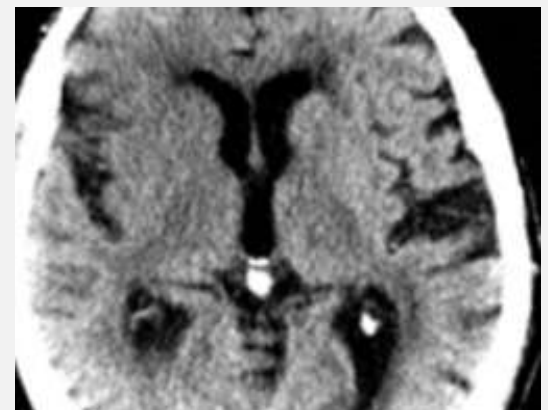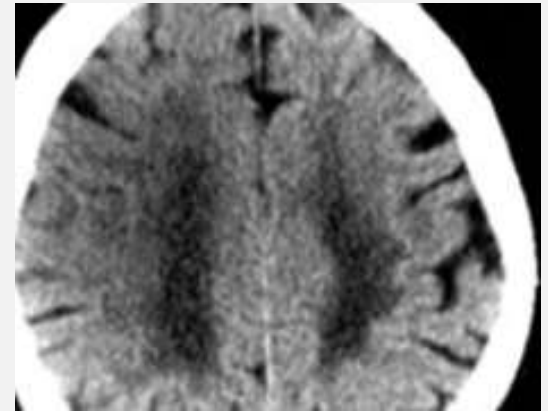
BACK TO PRIOR CASE

WOULD YOU OFFER THROMBECTOMY?

THROMBECTOMY?

49 yo healthy fighter pilot

NIHSS 7

CT with ASPECTS 6

CTA showing large vessel occlusion

Class 1 Level A evidence for EVT

CONCLUSION

ASPECTS is a useful tool to assess early ischemic changes

It is predictive of functional outcome and hemorrhage

Variable inter-observer reliability

Helpful addition in assessment for EVT despite no hard ASPECTS cutoff