Objectives

- Understand history and importance of imaging triage for stroke
- Identify different imaging tools and their uses
- Have basic understanding of imaging related to acute ischemic stroke (case examples)
  - See some of my pictures of Ethiopia IR experience...
Disclosures

- Proctor for Pipeline Embolization Device, Medtronic
Historically, non-contrast head CT (HCT) used to rule out stroke mimics

Patients triaged to t-PA and/or endovascular therapy (EVT) based on HCT and symptoms

EVT devices in infancy, and not very good

Several large studies evaluated efficacy of EVT vs t-PA
  - IMS III, MR Rescue, Synthesis Expansion
Endovascular Therapy after Intravenous t-PA versus t-PA Alone for Stroke

for the Interventional Management of Stroke (IMS) III Investigators

ABSTRACT

BACKGROUND
Endovascular therapy is increasingly used after the administration of intravenous tissue plasminogen activator (t-PA) for patients with moderate-to-severe acute ischemic stroke, but whether a combined approach is more effective than intravenous t-PA alone is uncertain.

METHODS
We randomly assigned eligible patients who had received intravenous t-PA within 3 hours after symptom onset to receive additional endovascular therapy or intravenous t-PA alone, in a 2:1 ratio. The primary outcome measure was a modified Rankin scale score of 2 or less (indicating functional independence) at 90 days (scores range from 0 to 6, with higher scores indicating greater disability).

RESULTS
The study was stopped early because of futility after 656 participants had undergone randomization (434 patients to endovascular therapy and 222 to intravenous t-PA alone). The proportion of participants with a modified Rankin score of 2 or less at 90 days did not differ significantly according to treatment (40.8% with endovascular therapy and 38.7% with intravenous t-PA; absolute adjusted difference, 1.5 percentage points; 95% confidence interval [CI], −6.1 to 9.1, with adjustment for the National Institutes of Health Stroke Scale [NIHSS] score [8–19] indicating moderately severe stroke, or ≥20, indicating severe stroke), nor were there significant differences for the predefined subgroups of patients with an NIHSS score of 20 (6.8 percentage points; 95% CI, −4.4 to 18.1) and those with a score of 19 or lower (1.0 percentage point; 95% CI, −10.8 to 8.8). Findings in the endovascular-therapy and intravenous t-PA groups were similar for mortality at 90 days (19.1% and 21.6%, respectively; P = 0.52) and the proportion of patients with symptomatic intracerebral hemorrhage within 30 hours after initiation of t-PA (6.2% and 5.9%, respectively; P = 0.93).

CONCLUSIONS
The trial showed similar safety outcomes and no significant difference in functional independence with endovascular therapy after intravenous t-PA, as compared with intravenous t-PA alone. (Funded by the National Institutes of Health and others; ClinicalTrials.gov number, NCT00559424.)
“EVT is not superior to standard treatment with IV tPA”
The majority of patients included in the study:
  - Were not imaged using modern
  - Were not triaged using modern approaches
  - Were not treated using modern devices

These studies were widely disputed by NIR and Stroke community
Recanalization is strongly associated with improved function outcomes and reduced mortality.
Thrombus Length and Recanalization

No patients with > 8mm clot were recanalized with only IV tpa (n=138)

Probability of Recanalization

100%

0%
Newer Technologies = Better Recanalization

- **Solitaire FR**
  - 4mm Soft Radiopaque Tip
  - 10mm Tapered Area
  - 20mm Active Area
  - 10mm Tapered Area
  - 44mm Total Length (Tip to Tail)

- **Trevo**
  - Proximal Radiopaque Marker

- **Separator 3-D**

- **Penumbra Max System**
Lessons Learned from Ischemic Stroke Trials

- It is not tPA vs EVT
  - IV t-PA is proven Class 1 – it should not be denied from patients

- Select patients with LVO (large vessel occlusion)

- Excellent recanalization is needed
  - TICI 2B or 3

- Better determination of salvageable brain tissue *WITH IMAGING!*
  - ASPECTS
  - CTA
  - CTP
  - MRI Diffusion/Perfusion
Ethiopia IR Experience

September, 2018
Current Stroke Imaging Tools

- HCT – stroke mimics
- ASPECTS grading
- CTA
- CTP/Rapid
- MRI
Baseline head CT
*stroke “mimics”*

HEMORRHAGE

MASS
ASPECTS

- Alberta Stroke Program Early CT Score
- Amount of brain showing early changes of stroke
- 10 points: 1 point subtracted for each area with changes
- Higher score (>6): better outcome for EVT
ASPECTS Score: 4

- 6 areas showing changes of completed stroke (10 - 6 = 4)
CTA: Carotid arteries

- A: High-grade stenosis which could require stent
- B: Complete occlusion
A, B: Left M1 occlusion

C, D: Basilar, left P1 occlusion
Complete carotid occlusion at bifurcation

No intracranial flow
Large penumbra, no infarct

Mean Transit Time

Blood Volume
Stent placement, balloon expansion

Waist at stenosis

Balloon inflation
Large bore aspiration catheter advanced to intracranial occlusion
Successful Recanalization

FIRST PASS
(6 CM CLOT REMOVED)

SECOND PASS
(1 CM CLOT REMOVED)
6 cm clot aspirated

This is a record-breaking clot! Most clots 1-2 mm in size
Penumbra

- Area of markedly reduced perfusion
- Loss of function; neurons still viable
- Reperfusion may prevent cell death and restore normal function
CTP
Determination of Penumbra

- CTP: compares contrast density (computer algorithm)
- Color maps generated
- CBV identifies core infarct
- CBV compared with other parameters (CBF, MTT) to determine penumbra

- RAPID software analysis
- Instant comparison of perfusion data using threshold values
- Data/images sent to cell phones
CTP Case Example

- 46 y/o female with right hemiplegia
- What is arrow showing?
Area of marked underperfusion in right MCA territory

Patient had successful thrombectomy!
Highly sensitive for detection of acute ischemia.

Mostly impractical:
- MR tech availability
- Magnet not close to ED
- Significant constraints on things allowed in MRI suite
- Long scan times

Some "fast" protocols exist, but limitations:
- Need MRA at same time
- Doesn't show penumbra unless perfusion scan performed
My skills in Ethiopia...
Questions?