ICU Management of Acute Ischemic Stroke

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Objectives

- Discuss management of ischemic stroke in ICU
  - Post thrombolytic/endovascular therapy
  - Blood pressure
  - Blood glucose
  - Antithrombotic therapy
  - Hemorrhagic Conversion of Infarct
  - Decompressive hemicraniectomy
The Patient

- 67 year old woman with hypertension, CAD, current smoker, found “confused” by grandson

- EMS → Emergency Department

- Noted to have left-sided paralysis, left facial droop, and dysarthria

- CT head: No evidence of intracerebral hemorrhage or large infarct
Intravenous tPA for Acute Ischemic Stroke

• IV tPA is FDA approved for patients presenting within 3 hours of onset of stroke symptoms
  › Based on NINDS trial, showed 12% absolute increase in the number of patients with minimal or no disability
  › Symptomatic ICH in 0.6% of placebo patients, 6.4% of IV tPA patients
  › No difference in mortality at 90 days

• Used off-label up to 4.5 hours based on ECASS III results

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The Patient

- Any contraindications to IV tPA?
  - ICH on pretreatment CT
  - Symptoms minor or rapidly improving
  - No active internal bleeding
  - No current use of oral anticoagulants with INR > 1.6
  - No major surgery within 14 days
  - No stroke, intracranial surgery, or serious head trauma within 3 months
  - No GI or urinary tract hemorrhage within 21 days
  - No recent lumbar puncture
  - SBP <185/110
  - No history of intracranial hemorrhage
  - No seizure at onset of symptoms
  - No known AVM or aneurysm
• No contraindications to IV tPA, so IV tPA started at 1h 35min after last seen normal

• Patient subsequently taken to cath lab
TICI score

0: No perfusion

1: Perfusion past the initial obstruction, but limited distal branch filling with little or slow distal perfusion

2a: Perfusion of < 50% of the vascular distribution of the occluded artery

2b: Perfusion of > 50% of the vascular distribution of the occluded artery

3: Full perfusion with filling of all distal branches

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Post IV tPA Care

- Post IV tPA protocol:
  - Q1 hour neurochecks x 24 hours
  - No antiplatelet or anticoagulant medications x 24 hours
  - BP < 185/100
  - Avoid unnecessary lines, catheters, etc.
  - Stat CT head for any neuro worsening or headache
ICU Management of Acute Stroke

Blood Pressure management has to do with CORE vs PENUMBRA
• Our patient initially had little to no core, but large penumbra

• How do we preserve the penumbra?
  
  › Rapid revascularization: IV tPA, endovascular intervention
  
  › Maintenance of adequate blood flow until sufficient stable collateral flow develops
  
  › Blood pressure augmentation
Blood Pressure in AIS

- Elevated blood pressure common in acute ischemic stroke

- Extreme arterial hypertension detrimental
  - Encephalopathy, cardiac complications, renal insufficiency

- Hypotension runs the risk of hypoperfusing the penumbra

- Ideal blood pressure range not known
Blood Pressure in AIS

AHA guidelines: “…recommendation not to lower the blood pressure during the initial 24 hours of AIS unless the blood pressure is >220/120 mm Hg or there is a concomitant specific medical condition that would benefit from blood pressure lowering remains reasonable.”

• Concern for hemorrhagic transformation?
Blood Pressure Management in AIS

- Certain conditions (myocardial ischemia, aortic dissection, heart failure) may be exacerbated by HTN

- Unclear what optimal lowering is.

- Reasonable to lower by 15%, and monitor for neurologic deterioration

- Heart vs brain
Blood Pressure Management in AIS

• The perfusion-dependent patient: Worsening of symptoms at lower BP and improvement of symptoms at higher BP.

• Often suggested by perfusion imaging, but nothing beats the clinical exam

• If patient’s exam worsens when blood pressure drops, you’ve found the pressure their brain requires to maintain perfusion
Blood Pressure Management in AIS

• Induced HTN:
  › Make sure patient is volume replete
  › Discontinuation of outpatient antihypertensives
  › If no significant pre-existing cardiac disease, usually use neosynephrine drip
  › MAP or systolic goals are usually somewhat arbitrary (suggest 20 mm Hg higher than BP at which patient is symptomatic)
  › Escalate if no effect but suspicion of perfusion dependence is high
  › Time limited trial
Blood Pressure Management in AIS

• In the post IV tPA patient:
  › Protocol mandates BP < 185/110 prior to giving IV tPA
  › BP < 185/105 x 24 hours after IV tPA
  › Can allow permissive hypertension until this number is reached.
  › Nicardipine/enalaprilat infusion over labetalol/hydralazine pushes
Blood Glucose

- Hyperglycemia common in the immediate post-stroke period
  - Likely due to non-fasting state and impaired glucose metabolism from stress state

- In hospital hyperglycemia associated with:
  - Worse clinical outcomes
  - Increased risk of sICH after tPA
  - Larger MRI infarct volumes

- Current guidelines suggest targeting blood glucose 140-180 mg/dL

- Stroke Hyperglycemia Insulin Network Effort (SHINE) Trial is currently enrolling
  - Intensive glucose control (80-130) vs standard care (< 180)

Antithrombotic Therapy in AIS

• Antithrombotic therapy usually started in the ICU for secondary stroke prevention

• No antiplatelets or anticoagulants x 24 hours post IV tPA

• Choice of antiplatelets (aspirin or Plavix) vs anticoagulants (heparin, enoxaparin, warfarin, NOAC) depends on stroke etiology

• Do not routinely use heparin drips for acute ischemic stroke
  • Recent Cochrane Review: Anticoagulation within 48 hours of stroke
    • Decreased risk of recurrent ischemic stroke, PE
    • Significant increase in intracranial and extracranial hemorrhage
    • No mortality benefit

Sandercock et al, The Cochrane Library 2015
Antithrombotic Therapy in AIS

- Usually start ASA 325mg once 24 hours post IV tPA, then 81mg daily (or immediately if no tPA given)

- If severe atherosclerosis, or post stenting, will start dual antiplatelet therapy (ASA + Plavix)

- Rare occasions in which full-dose anticoagulation will be started soon after ischemic stroke
Antithrombotic Therapy in AIS

When to consider early anticoagulation?

- Intracardiac thrombus
- Question: Critical stenosis in arterial dissection
- Atrial fibrillation carries risk of repeat embolism, but risk is anywhere from 0.5% per day to ~8% in the first week
- If small, punctate infarct, can usually start oral anticoagulation immediately in the setting of a-fib
- If stroke is moderate to large, usually wait 1-2 weeks prior to starting oral anticoagulation (bridge with ASA)

Feng D. Circulation 2007.
Hemorrhagic Conversion of Ischemic Stroke

- Can occur with or without IV tPA administration

- Suggested risk factors:
  - Size of infarction
  - Cardioembolic stroke
  - High NIHSS
  - Hyperglycemia
  - Low total cholesterol and LDL levels
  - Thrombocytopenia
  - Thrombolytic administration

Hemorrhagic Conversion of Ischemic Stroke
Management of ICH after IV tPA

• Symptomatic ICH occurs in ~6% of post IV tPA patients

• Strict adherence to post IV tPA protocols minimizes risk

• Hemorrhagic transformation can occur in patients who did not receive IV tPA

• Risk factors for symptomatic ICH:
  › Large strokes
  › Older age
  › Cardioembolic pathogenesis

• Usually occur within 24 hours of IV tPA administration
Management of ICH after IV tPA

- No universal protocol exists
- If infusion still running, stop immediately
- Stat head CT
- Stat fibrinogen, PT/INR, PTT, CBC
- Stat type and cross
- Order 6-8 units of cryoprecipitate or FFP
- ENLS recommends giving 6-8 units platelets in addition to cryo
- Consider protamine as well if endovascular case, especially if PTT is high
- Consider aFVII while awaiting cryo and platelets
- Neurosurgical consultation

AHA/ASA Acute Ischemic Stroke Guidelines 2013
Malignant MCA Infarcts
Malignant MCA infarction

- Massive, space occupying lesion from post-stroke edema
- Occurs in 10% of all strokes
- ~13% of all proximal MCA occlusions develop severe brain swelling and herniation
- ~7% die in the first week secondary to brain edema


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Malignant MCA Infarcts

- Post stroke, infarcted tissue will develop edema

- “Malignant” MCA infarcts occur when enough tissue has been infarcted that the subsequent edema will be life-threatening

- General rule is peak edema from day 2-5 (but can have early or late edema!)

- Volume criteria on initial imaging:
  - Early hypodensity of >50% of MCA territory on CT
  - DWI lesion of 82cc on < 6 hour MRI
  - DWI lesion of 145cc on > 14 hour MRI
Treatment of Malignant MCA Infarct

Aggressive medical therapy is the same as for any other space occupying lesion causing raised ICP:

- HOB 30 degrees, head midline
- Sedation, intubation if necessary
- Osmotherapy: Hypertonic saline/mannitol
- Avoidance of fever/therapeutic hypothermia
- Hyperventilation – only briefly, in emergency
Malignant MCA Infarct

- Despite medical therapy, mortality reported at up to 80%

- Most effective treatment is *decompressive hemicranieotomy*

- 3 trials performed concurrently
  - DESTINY
  - DECIMAL
  - HAMLET
Malignant MCA Infarct

Pooled analysis of these 3 trials:
- 93 patients included
- Decompressive hemicraniectomy within 48 hours vs medical management
- DHC group had increased survival (78% vs 29%)
  - DH increased likelihood of mRS ≤ 3 (43% vs 21%)
  - Increased likelihood of mRS ≤ 4 (75% vs 24%)
- Conclusion: Decompressive surgery in malignant MCA infarction within 48h reduces mortality and increases likelihood of favorable functional outcome

Vahedi et al. Lancet Neurol 2007; 6:21
The Modified Rankin Scale

0  No symptoms
1  No significant disability, despite symptoms; able to perform all usual duties and activities
2  Slight disability; unable to perform all previous activities but able to look after own affairs without assistance
3  Moderate disability; requires 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 requires constant nursing care and attention
6  Death
Malignant MCA Infarction

- These three trials excluded patients > 60

  - Subsequent study analyzed patients age 60-80
    - Again found significant decrease in mortality and mRS > 4 in DHC group

PROPHYLACTIC measure: DHC should be undertaken within 48 hours

Zhao et al. *Neurocrit Care* 2012; 17(2):161-71
Another Case…

- 54 year old male with uncontrolled HTN who was found to have a Type A aortic dissection
- Transferred emergently to Stanford, underwent complicated repair
- Postoperative hypoxia, so sedated for 2 days
- On POD #3, patient was noted to be weak on the left side, with right gaze deviation, able to briskly follow commands
Hospital Course

- Patient started hypertonic saline, Na goal > 150
- Neurosurgical consult: Given unclear time of infarct (presumably intraop), patient felt to be near peak swelling. Watchful waiting.
- Exam on POD #3-8 stable except for slightly worsening anisocoria
POD #9: Call from night float neurology resident at 6 AM

- “Patient has blown his right pupil and is unresponsive”
- STAT head CT:
• Markedly worsened cerebral edema with increased midline shift, uncal herniation and compression of midbrain

• Patient given 23% saline and mannitol

• Neurosurgery rushed him to the OR for decompression

• Despite surgery, patient subsequently met criteria for brain death

• Organ donor
2nd Patient

- 61 year old woman admitted to the CVICU after emergent repair of an acute type A aortic dissection

- Sedation lightened ~4 hours post-op
  - Patient now with left hemiplegia, could move right side and follow commands

- CT head:
• Patient taken that evening for prophylactic decompressive hemicraniectomy
Day 9 MRI
The Lesson

• Decompressive hemicraniectomy in malignant MCA infarct is PROPHYLACTIC – No role in waiting until patient is in trouble

• Discussion with family about whether patient would be accepting of a quality of life in which they were dependent
Thank You