NMH ACUTE ISCHEMIC STROKE PROTOCOL

(Includes all acute ischemic strokes involving intra and extra cranial arteries)

Immediate Response

When a stroke patient is first identified, the following steps and procedures should be initiated as soon as possible.

- Stabilize the patient's vital functions
- Call the Acute Stroke Team (5-5555)
- Connect the patient to cardiac and respiratory monitors with alarms **on**
- Begin 2 IV lines (one in each arm, if possible)
- Send the following blood tests: complete blood counts, routine blood chemistries, PT, PTT and a drug screen on a **SUPER-STAT** basis
- If the patient may receive IV Alteplase (IV t-PA), send blood for a type and screen
- Check a blood glucose dextrostick
- Order a STAT head CT scan, without contrast
- Obtain an ECG, urinalysis and CXR (if time permits)
- Complete a screening history and physical, focusing on neurologic deficits and cardiac function, including carotid bruits
- Obtain additional history from family/friends, such as the exact time of onset, medical history and concomitant medications
- Communicate clinical situation and treatment options with the medical care team
- Alert Anesthesia service if appropriate

Imaging: Case Escalation and other considerations

Case Escalation

Definition: Escalation of case interpretation from the Senior Radiology resident in the ED to simultaneous interpretation by the Senior Radiology resident in the ED and the on-call Neuroradiology Fellow. The Neuroradiology attending serves as the back-up in all circumstances.

The following Stroke Neurology cases will be "escalated":

Stroke Code Head CT: for patients in whom IV/IA tPA or endovascular treatment is being considered

Stroke Code MR/MRA/MRP: for patients in whom IV/IA tPA or endovascular treatment is being considered

Arterial Dissection MRI/MRA and/or CTA: patients with acute neurological deficits for whom acute and significant therapeutic decisions must be made at the time of presentation

Venous Thrombosis MRI/MRA/MRV and/or CTA/CTV: patients with acute neurological deficits for whom acute and significant therapeutic decisions must be made at the time of presentation

Imaging: Case Escalation and other considerations con't

Other considerations: General agreements/definitions/tenets

Normal hours are defined as 7:30 am to 5:00pm Monday through Friday

After hours are defined as after 5:00 pm on weekdays and all day Saturday, Sunday and holidays.

A "Stroke Code Pager" will be worn at all times by the Senior Radiology Resident in the ED.

Direct consultation between the examining Neurology resident/stroke fellow and Senior Radiology resident/fellow in the ED is mandatory for all cases in which Neurology is involved. This contact, in person or on telephone (6-7038), will be initiated by the examining Neurology resident/stroke fellow.

Direct consultation between Stroke/ESN Team and Radiology Team is mandatory for all cases beyond 3 hours in which IA therapy is considered. This contact, in person or on the telephone, will be initiated by the Stroke/ESN Team.

For ED patients in whom MRI is ordered, MR compatible leads will be placed in the ED prior to transporting to MRI.

Post-IA /endovascular: therapy: Immediate, defined as within 2 hours after completion of IA therapy.

All immediate/delayed post-IA examinations are optional and under the discretion of the interventionalist/stroke neurologist.

Basic tenets guiding which scanner to use include first available followed by best available technology (slice profile, perfusion package) and will be made on a case by case basis.

Access to the full PACS application, NMH applications and voice recognition is integral to the program and will be achieved and deployed to the appropriate personnel including but not limited to all Neuroradiology attendings and Neuroradiology Fellows.

Stroke Code Imaging Protocols:

Acute Ischemic Stroke Imaging Protocol: < 3 hours

Examination: Non-contrast CT Head

Interpretation: Normal hours
CT Team

After hours
Senior Radiology resident in ED simultaneous with on-call Neuroradiology Fellow
Back-up: Neuroradiology Attending

Option(s): CTA Head/Neck, CT Perfusion

Interpretation: Normal hours
CT Team
Fxn Team

After hours
Senior Radiology resident in ED simultaneous with on-call Neuroradiology Fellow
Back-up: Neuroradiology Attending

Acute Ischemic Stroke Imaging Protocol: >3 hours

Examination(s): Non-contrast CT Head
Stroke Code MRI/MRA/MRP

Interpretation: Normal hours
CT Team
MR/FxnTeams

After hours
Senior Radiology resident in ED simultaneous with on-call Neuroradiology Fellow
Back-up: Neuroradiology Attending

Option(s): Non-contrast CT Head
CTA Head/Neck
CTP Head

Interpretation: Normal hours
CT Team
Fxn Team

After hours
Senior Radiology resident in ED simultaneous with on-call Neuroradiology Fellow

Back-up: Neuroradiology Attending

Acute Ischemic Stroke Imaging Protocols: Post-IA therapy

Post-IA therapy: Immediate

Examination(s): Non-contrast CT Head

Interpretation: All hours
Neuroradiology/ESN fellow involved in case
Back-up: Neuroradiology Attending

Option: Stroke Code MRI/MRA/MRP

Interpretation: All hours
Neuroradiology/ESN fellow involved in case
Back-up: Neuroradiology Attending

Post-IA/Endovascular therapy: Delayed

Examination(s): Stroke Code MRI/MRA/MRP

Interpretation: Normal hours
Fxn Team

After hours
Neuroradiology/ESN fellow involved in case
Back-up: Neuroradiology Attending

Acute Ischemic Stroke Imaging Protocols: Delayed imaging

Follow-up brain imaging

Examination(s): Non-contrast CT Brain or MRI Brain

Interpretation: CT or MRI Team

Report contents: Final infarct size compared to initial estimates

Notes: Performed at 1 week or upon discharge, whichever comes first.

IV Alteplase (IV t-PA) Protocol:

Inclusion/Exclusion criteria

Inclusion Criteria

1. Diagnosis of any ischemic stroke in any circulation causing measurable, significant neurological deficit?
2. The neurological signs should not be clearing spontaneously.
3. The neurological signs should not be minor and isolated
4. Unambiguous determination of symptoms onset, or time patient last confirmed normal
5. Ability to begin IV Altaplase (IV t-PA) therapy within 3 hours of symptom onset.
6. Head CT scan without any evidence of hemorrhage, meningioma causing edema or other complicating diseases.
7. Age 18 or older*.
8. A patient with seizure at the time of onset of stroke may be eligible for treatment as long as the physician is convinced that the residual impairments are due to stroke and not a postictal phenomenon.

Absolute Contraindications

7. Any past history of intracerebral or subarachnoid hemorrhage
8. Symptoms suggestive of subarachnoid hemorrhage
9. CT (or MRI) scan showing evidence of hemorrhage, AVM, tumor (except meningioma not causing brain edema)
10. BP is greater than 185/110, or patient requires continuous IV antihypertensive medication to maintain BP less than 185/110.
11. Seizure in which the major clinical deficit is due to a postictal phenomenon. A patient with seizure at the time of onset of stroke may be eligible for treatment as long as the physician is convinced that the residual impairments are due to stroke and not a postictal phenomenon).
12. Any known intracranial or intraspinal surgery within the past 3 months
13. Any known major surgery that presents unacceptable bleeding risk in the past 14 days
14. Known major head trauma or prior stroke (New deficit lasting greater than 24 hours) in previous 3 months
15. Known myocardial infarction in previous 3 months
16. PTT > 5 seconds over ULN or INR greater than 1.7

(If not on warfarin and no suspicion of coagulopathy, may administer tPA before stat coags results available)

17. range Use of heparin within last 48 hours with PTT out of normal

(If no use of heparin and no suspicion of coagulopathy, may administer tPA before stat coags results available)

18. Use of anticoagulant dose of heparinoid, other non-heparin anticoagulant or IIB/IIIa inhibitor in last 24 hours (Enoxoparin. or other Synthetic Heparinoid; Abciximab; Eptifibatide; or other IIB/IIIA Argatroban; Rifludin; or other direct thrombin inhibitor)

19. Platelet count less than 100,000/mm3

(If no suspected thrombocytopenia, tPA may be administered before STAT platelet count available)

20. Major active internal bleeding

21. Subdural hematoma within the past six months

Relative Contraindications

If tPA is ordered despite relative contraindication, state reason that the benefits of intravenous tPA administration likely outweigh the risks:

22. Dramatic improvement or minor symptoms

23. Clear evidence or strong suspicion of active pericarditis, endocarditis, aortic dissection, septic embolus, recent or current pregnancy, inflammatory bowel disease; or other condition posing risk of uncontrollable internal bleeding

24. CT scan shows unequivocal hypodensity in greater than 1/3 cerebral hemisphere (Early infarct signs are not a contraindication)

25. Known history of internal, GI, or abnormal GU bleeding in the past 21 days

26. Non-compressible arterial puncture or known internal biopsy, in last 7 days

27. Known invasive surgical procedure within last 14 days

28. Blood glucose less than 50 or greater than 400mg/dL

29. Known active alcohol abuse or illicit drug use

33. Coma or stupor

Patients with an NIH stroke score >22, may be at increased risk for bleeding complications. However, this group of patients still benefit from TPA therapy.

Patients with hypodensity in > 1/3 of the MCA territory on the head CT scan may be at a significantly increased risk of ICH; in such cases, it may be reasonable to withhold TPA therapy.

* In elderly patients > 80 years old, IV Alteplase (IV t-PA) appears to have efficacy similar to younger patients, although there may be a slightly higher risk of ICH.

* The safety and efficacy of IV Alteplase in patients >80 years old is unclear at this time. Recent studies have shown that the risk of ICH is not substantially increased in the elderly, although this observation is based on very limited data. The use of IV Altaplase in children is unclear. There may be an increased risk of hemorrhage. Dosages of 0.5 mg/kg have been suggested. The etiologies of stroke in children include many different mechanisms, some of which may not respond to lytic therapy.

** In patients without a recent history of use of anticoagulants and no history of bleeding problems, IV Alteplase (IV t-PA) may be initiated pending PT/PTT results, but must be STOPPED should these coagulation studies be elevated.

IV t-PA Treatement Decision

• Once a decision to administer the medication has been made, Inform patient and family about risks and benefits of IV Alteplase (IV t-PA) therapy

• A formal signed informed consent is not required since this is an FDA approved therapy and it is recommended as standard of care in most stroke treatment guidelines.

• Communicate clinical situation and treatment options with the medical care team

• IV Alteplase (IV t-PA) for ischemic stroke should only be administered by Neurology house staff under orders from a Neurology Attending.

TPA Administration

Administer IV Alteplase (IV t-PA) as soon as possible. Do not delay administration for patient transfer to another unit or ward. Do not transfer patient during the infusion.

1. Dose = 0.9 mg/kg with a maximum dose of 90 mg
2. 10% as an IV bolus over 1-2 minutes; remainder IV infusion over 1 hour
3. Measure blood pressure every 15 minutes for the first 2 hours and subsequently every 30 minutes for the next 6 hours, then hourly until 24 hours after treatment
4. Perform neurological assessments every 15 minutes during infusion and every 30 minutes thereafter for the next 6 hours, then hourly until 24 hours after treatment
5. If the patient develops severe headache, acute hypertension, nausea or vomiting, discontinue infusion (if rt-PA is being administered) and obtain emergency CT scan
6. Treat BP to keep BP < 180 systolic / < 105 diastolic during and 24 hours after infusion
7. Discontinue the infusion if vital signs become unstable, neurologic status worsens or severe headache develops
8. Obtain a STAT head CT scan if the above occur
9. Rare cases of angioedema have been reported during or after IV Alteplase (IV t-PA) therapy.
10. Avoid ACE inhibitors as these may precipitate angioedema

Post-TPA Infusion Care

1. Admit the patient to the Stroke Unit or an ICU
2. Measure blood pressure every 15 minutes for the first 2 hours and subsequently every 30 minutes for the next 6 hours, then hourly until 24 hours after treatment
3. Perform neurological assessments every 15 minutes during infusion and every 30 minutes thereafter for the next 6 hours, then hourly until 24 hours after treatment
4. DO NOT ADMINISTER ANY ANTICOAGULANTS OR ANTIPLATELET AGENTS FOR 24 HOURS POST-INFUSION
5. NO ARTERIAL PUNCTURES, INVASIVE PROCEDURES, OR CATHETER PLACEMNTS FOR 12 HOURS POST-INFUSION
6. If signs of neurologic deterioration occur, obtain a STAT head CT
7. If there is evidence of severe peripheral bleeding or symptomatic ICH, infuse cryoprecipitate, 5-10 units, immediately

8. If bleeding persists, infuse Prothrombin complex concentrate (PCC, ordered as "Feiba"), PRBC and/or platelets as needed
9. Repeat head CT scan 24 hours post-infusion to evaluate for ICH

Patients who are eligible for IV tPA may be considered for endovascular therapy if the following criteria are met:

1. They have clinical signs of major stroke from large vessel occlusion
2. Imaging documents large vessel (M1, Basilar, Carotid T) occlusion.
3. Imaging may be CT, CTA, MRI, MRA or angiography.
4. Endovascular therapy can begin (defined as infusion of drug or insertion of device) within 1 hour of the decision to initiate same
5. Patient or family can consent to the treatment (telephone consent acceptable under usual NMH guidelines)
6. Patient or family understands that IV tPA is the FDA approved standard therapy; but that in the judgment of the stroke and endovascular attendings, endovascular therapy may be superior in this patient.

Endovascular protocol (mechanical and/or chemical)

Review <3 hours IA tPA criteria above
3-6 hours for full dose IA tPA
3-8 hours for mechanical treatment

Notify Anesthesia service as early as possible

Inclusion criteria:

Answer to all should be yes:

1. Acute ischemic stroke diagnosed clinically with NIHSS ≥ 8 unless aphasia, visual field deficit, or major neglect syndrome.
2. CT. CTA, MRI, MRA, or Angiogram shows large vessel occlusion
3. For anterior circulation strokes, clearly documented time of onset or time last seen normal < 8 hours
4. For "locked-in" syndrome, may consider interventions. Clearly documented time of onset or time last seen normal < 24 hours see above
5. Endovascular therapy (defined as infusion of drug or insertion of device) can begin before 8 hours for anterior circulation and distal posterior circulation stroke and within 24 hours for basilar artery occlusion
6. CT hypodensity (lucency) < 1/3 MCA territory
    a. Include ASPECT score
7. Absent hemorrhage and midline shift on CT 0-3 hours

All the above should be yes and the patient should meet exclusion criteria for IV TPA

Relative contraindications to IA pharmacological lysis: (mechanical may still be used without lytics):

Patients with conditions listed with asterisks (**) should be considered for a "low dose" protocol (described below)

1. **Use of heparin within 48 hours with PTT > 1.5x ULN
2. **Glucose < 50 mg/dl or > 400 at time of treatment**.** (must be corrected before therapy)
3. **History of clinical stroke in the previous 6 weeks
    - Non-Lacunar
    - Consider size and location of stroke
    - Ipsilateral large stroke (enhancing brain infarct)= OK for mechanical use- no lytics
4. **Known prior history of non-trivial intracranial bleeding.
    a. Prior bleeding which is deemed by the treating physician as having an increased risk for further bleeding (i.e. suspected intracranial hemorrhage)
5. **CT evidence or clinical history of intracranial neoplasm except meningioma not causing brain edema
6. **Any vascular puncture
7. **Removal of central line IV in non-compressible site within 24 hours
8. Anterior circulation stroke with time of onset or time last seen normal > 8 hours "Locked-in" syndrome with time of onset > 72 hours unless D/P imaging suggests otherwise
9. CT scan shows any acute intracranial hemorrhage.
10. Acute hypodensity on CT > 1/3 MCA territory, or revealing significant mass effect or midline shift.
11. PTT > 5 seconds over ULN or INR greater than 1.7
12. Known hemorrhagic diathesis.
13. Platelet count < 30,000
14. Severe hypertension with SBP > 185 or DBP > 110 even with continuous infusion of antihypertensive medication.
15. Dramatic improvement prior to therapy.
16. Clinical presentation suggestive of subarachnoid hemorrhage.
17. Major head trauma in the prior 90 days.
18. Active or recent major hemorrhage in the last 30 days
19. PT > 2 seconds above ULN, or PTT > 3 seconds above ULN
20. Use of **anticoagulant** dose of synthetic heparinoid, non-heparin anticoagulant, or any IIb/IIIa inhibitor, in last 24 hours.
21. High clinical suspicion of septic embolism.
22. Any intracranial or intraspinal surgery in the prior 6 weeks.
23. Arterial puncture at a noncompressible site in the previous 7 days

Relative contraindications for mechanical and chemical thrombolysis

All of the following must be answered **"no"** to administer intraarterial lytic drugs (including IIb/IIIa inhibitors):

1. Inability to deliver device by 8 hours from time of onset or time last seen normal in anterior circulation strokes or within 72 hours of posterior circulation unless perfusion/ diffusion imaging suggests potential benefit.
2. Uncontrolled hypertension > 185/110 despite maximal continuous IV therapy.
3. Infarct >1/3 MCA distribution, and or midline shift on CT or MRI
4. Platelet count<30,000
5. Large subacute stroke

IA chemical thrombolysis Protocol:

TPA up to 20 mg
Reopro up to 5 mg
ACT 150-200

IA Chemical thrombolysis: Low dose protocol:

TPA up to 5mg
Reopro up to 2 mg
ACT 150-200

Source: Northwestern Memorial Hospital, Chicago.