THE MOUNT SINAI HOSPITAL, NEW YORK **STANDARD:** Clinical Guideline	**SUBJECT NO.** CSC-2
DEPARTMENT: Emergency Department **SUBJECT:** Protocol for the Initial Evaluation and Management of Patients with Ischemic or Hemorrhagic Stroke	

CROSS-REFERENCE:
Rad-209-1 Standard Operating Procedure for Acute Stroke CT Study
CSC-5 Policy for IA/Catheter-Based Reperfusion Therapy and Procedure for Pre-, Intra, and Post- Intervention Nursing Care
CSC-3 SAH (Non-Traumatic) Management Protocol
CSC-4 Intracranial Hemorrhage Management Protocol

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6/11/15	8/25/15	2/16	03/2017				

Prehospital Notification

- EMS will give pre-arrival notification via dispatcher or directly via the ED phone service
- RN/MD will then activate stroke code via 33333
- ED charge nurse or attending will receive the notification and will relay patient information and ETA to the other as well as staff in the triage/resuscitation room nurses
- A patient bed will be designated

Initial Nursing Triage

If there was EMS notification of a possible acute stroke patient, follow the ED attending's pre-arrival instructions.
If the patient has a history or initial assessment suggestive of acute stroke without prehospital notification:

- The triage nurse will perform BE FAST assessment
- If stroke is suspected and if last known well less than 12 hours activate stroke code via 33333.
- The triage nurse notifies the appropriate zone attending about a possible acute stroke patient
- Triage to an ED bed or to the Resuscitation Room if vital signs are unstable or symptom onset is within 12 hours of arrival
- Obtain finger-stick blood sugar (FSBS)

Initial Emergency Department Physician Interventions

- Assess ABCs
- Review vitals and FSBS
- Focused History and PE including screening neurological examination. Document NIHSS.
- Verify time of symptom onset—Time of symptom onset is assumed to be the time that the patient was last known to be symptom-free (at his or her baseline)
- Verify time patient last seen normal
- If time of symptom onset is within 12 hours of arrival, activate the acute stroke team via the ED phone service at x4-3611 or 33333

Acute Stroke Team Notification	Call AMAC to activate acute stroke code or call stroke code operator via 33333	
Neurosurgery Consult	Beeper 2009	
Neuroradiology Physicians	Mon-Fri 8 am – 11 pm Sat & Sun 8 am – 5 pm Off hours	Extension x44261 page radiology resident at Beeper 1490
CT Scan Registrar	All hours	Call x47606 (alternate: x47412)
MRI Registrar	Mon-Fri 8 am – 11 pm Sat & Sun 8 am – 5 pm Off hours	Call x49182 Call CT tech at x47606
Laboratory Personnel	Extension 4-3895 (STAT Lab) Extension 8-8145 (Central Accessioning Main Number)	
Pharmacy	Extension 78789	

Initial Nursing Assessment

- Assess the patient's ability to maintain a patent airway
- Notify MD if not at bedside
- Place patient on a portable cardiac monitor and continuous pulse oximetry
- Obtain initial bedside finger-stick blood sugar if not performed in triage
- Place 20-gauge IV and obtain and send STAT blood work (details below**) AFTER** patient has been taken to CT scan
- Keep patient NPO until dysphagia screening performed by neurology/stroke service. If patient fails swallow assessment keep patient NPO until ST evaluation. This includes all PO medications

Initial Diagnostic and Laboratory Testing

Initial diagnostic testing for patients suspected of acute stroke should include:
Laboratory

- Finger-stick glucose
- GEM 3000 (if available)

- BMP (or ER venous panel)
- CBC
- PT/PTT/INR
- Troponin
- Type & Screen

Radiology

- CT/CTA Head Acute Stroke Protocol
- CTP (at the discretion of the Neurologist)
- CXR (if clinically indicated)

Cardiology

- EKG

In suspected intracranial hemorrhage patients, consider the following additional laboratory studies:

- D-dimer
- Fibrinogen
- Liver function tests
- Blood alcohol level
- Toxicology screen

In selected patients, also consider:

- Therapeutic drug levels
- Urinalysis
- Pregnancy test
- Lumbar puncture (if subarachnoid hemorrhage is suspected and head CT is negative for blood)
- EEG (if seizures are suspected)

Time Target Goals for Patients who Present within 12 Hours of Stroke Symptom Onset

In patients who present within 12 hours of suspected ischemic or hemorrhagic stroke symptom onset:

- Expedite completion and interpretation of relevant laboratory studies and non-contrast head CT
  to meet the following time target goals:

Door to ED MD Evaluation	≤10 minutes
Door to Stroke Team Assessment	≤15 minutes
Door to CT Performed	≤25 minutes
Door to CT Read	≤45 minutes
Door to Lab Results (if clinically indicated)	≤45 minutes
Door to IV tPA Administration (if eligible)	≤60 minutes

Interventions for Acute Ischemic Stroke

Intravenous tPA (alteplase)
Intra-arterial interventions (Refer to the Stroke Center's Policy for IA/Catheter-Based Reperfusion Therapy)

Indications and Contraindications for IV tPA (alteplase)

The acute ischemic stroke patient should be evaluated for his or her eligibility for treatment with IV tPA.

IV tPA is indicated when (all must be selected):

- ☐ Diagnosis of acute ischemic stroke
- ☐ Definite time of onset
- ☐ Diagnosis of ischemic stroke causing measurable neurologic deficit
- ☐ Non-contrast CT head showing no hemorrhage or well-established new infarct
- ☐ Onset of acute stroke symptoms within 3 hours. Between 3 and 4.5 hours from symptom onset, selected patients may be eligible for treatment with IV alteplase, at the discretion of the treating vascular neurologist.

IV tPA is contraindicated when (one or more are selected):

- ☐ IV or IA tPA given for these symptoms at an outside hospital
- ☐ Non-contrast CT head showing hemorrhage or well-established new infarct
- ☐ Systolic BP > 185 and Diastolic BP > 110 despite treatment
- ☐ History of intracranial hemorrhage, or known intra-axial brain tumor
- ☐ Intracranial or spinal surgery, or serious head trauma within the last 3 months
- ☐ Gastrointestinal Hemorrhage within the last 21 days
- ☐ Symptoms consistent with infective endocarditis
- ☐ Symptoms consistent with aortic arch dissection
- ☐ Suspicion of subarachnoid hemorrhage by imaging or clinical presentation
- ☐ Platelets < 100,000/mm^3, PTT not within normal range after IV heparin use, INR > or = 1.7, or other known bleeding diathesis
- ☐ In patient taking dabigatran whose last dose was at least 12 hours ago or who PTT is within normal limits, IV alteplase may be considered
- ☐ In Patients taking oral factor Xa inhibitors whose last does was at least 48 hours ago or whose direct factor Xa assay is within normal limits, IV alteplase may be considered
- ☐ It is reasonable to consider intravenous alteplase in suspected stroke patients with initial blood glucose levels <50 or > 400 mg/dL after appropriate glycemic management (ie, dextrose or insulin, respectively) and neurological reexamination within a short period of time. If significant neurological deficits persist with normalization of glucose levels, intravenous alteplase may be considered at the discretion of the treating vascular neurologist.

Management of the IV tPA-eligible Patient (Refer to Nursing Procedure No. 229)

Prior to IV tPA administration:

- Make sure that the patient has 2 IVs (at least 1 of which is 20-gauge)
- Ensure that all invasive procedures, including placement of central venous access and arterial punctures, are completed and that all indwelling lines and tubes, including NG tubes and foley catheters, are inserted. Do not delay IV tPA administration to place an NG tube, foley catheter, or additional IV line
- Call the ED pharmacist or the pharmacy tPA hotline at x7-8789 for all cases requiring tPA preparation, regardless of patient location or time of day

- Obtain the patient's weight. If unavailable, estimate the patient's weight
- Give 0.9 mg/kg (maximum of 90 mg) tPA (alteplase, Activase) infused over 60 minutes with 10% of the total dose administered as an initial intravenous bolus over 1 minute (1 lb = 0.45 kg)
- Beginning with administration of the tPA bolus, vital signs and neurologic assessments must be performed and documented by the nurse on the EPIC tPA Flowsheet:
  - Every 15 minutes x 2 hours (includes the hour of IV tPA administration)
  - Then every 30 minutes x 6 hours
  - Then every 60 minutes x 16 hours
- The treating neurologist will designate and communicate to the nurse a cardinal sign (one aspect of the NIH stroke scale) to be monitored on the tPA Flowsheet for worsening or improvement
- During and after the tPA infusion, increase the frequency of blood pressure measurements if systolic blood pressure is >180 mm Hg or if diastolic blood pressure is >105 mm Hg; administer antihypertensive medications per the Guidelines in Table 1 to maintain blood pressure at or below these levels
- If the patient develops severe headache, acute hypertension, nausea, or vomiting, or new focal neurologic deficits, discontinue the infusion (if IV tPA is being administered) and obtain emergent CT scan
- Acute ischemic stroke patients who receive intravenous tPA and are eligible for intra-arterial intervention may go on to receive acute procedural and post-procedural anti-coagulants or anti-platelet medications based on the procedure performed and judgment of the treating physicians. (Further addressed in the Stroke Center's Policy for IA/Catheter-Based Reperfusion Therapy)

Assessment for and Management of Angioedema in IV tPA-treated Patients

- If angioedema is suspected:
  - Alert the physician for early discontinuation of the tPA infusion
  - Administer Benadryl 50 mg IV and Famotidine 20 mg IV
- If tongue continues to enlarge, give Solumedrol 80-100 mg IV
- If any further tongue enlargement:
  - Give epinephrine 0.1% 0.3 mL SC or 0.5 mL via nebulizer
  - Call ENT, anesthesiology or other appropriate in-house service STAT for possible emergent cricotomy, tracheostomy or fiberoptic nasotracheal intubation if oral intubation unsuccessful (secondary to impending airway obstruction)

Management of Arterial Hypertension

- Follow guidelines in TABLE 1 (Approach to Elevated Blood Pressure in Acute Ischemic Stroke) unless otherwise clinically indicated.

Management of Arterial Hypotension

- Correct potential causes including volume replacement with normal saline for hypovolemia
- Consider vasopressors as clinically indicated

Management of Patients NOT Eligible for IV tPA or Intra-Arterial Interventions

- Antihypertensive agents should be avoided unless the Systolic BP is > 220 mm Hg or the MAP is > 100 mm Hg or treatment of co-morbid end-organ involvement, such as aortic dissection, AMI, pulmonary edema, or hypertensive encephalopathy, is needed
- Administer an antithrombotic agent (consider aspirin per rectum if NPO or by mouth if dysphagia screening performed by neurology/stroke service and patient safe to swallow medications)
- Repeat vital signs every 2 hours or as determined by the stroke team while patient remains in emergency department with presumptive diagnosis of acute stroke.

Disposition

- The patient should be admitted to an appropriately monitored setting (i.e. NSICU or stroke unit) as determined by the stroke team and ED Attending Physician.

TABLE 1. Approach to Elevated Blood Pressure in Acute Ischemic Stroke

Blood Pressure (mmHg)	Treatment
Not eligible for thrombolytic therapy	
Systolic < 220 OR Diastolic < 120	Observe unless co-morbid end-organ involvement such as aortic dissection, AMI, pulmonary edema, hypertensive encephalopathy
Systolic > 220 OR Diastolic > 120	Labetalol 10-20 mg IV over 1-2 minutes May repeat or double every 10 minutes (maximum dose 300 mg) OR Nicardipine 5 mg/hr IV infusion as initial dose; titrate to desired effect by increasing 2.5 mg/hr every 5 minutes to maximum of 15 mg/hr Aim for a 10% to 15% reduction in blood pressure
Eligible for thrombolytic therapy	
Systolic > 185 OR Diastolic > 110	Labetalol 10-20 mg IV over 1-2 minutes May repeat x 1 OR Nicardipine 5 mg/hr IV infusion as initial dose; titrate to desired effect by increasing 2.5 mg/hr every 5 minutes to maximum of 15 mg/hr When desired blood pressure attained, reduce to 3 mg/hr **If blood pressure is not reduced and maintained at desired levels, (systolic ≤ 185 and diastolic ≤ 110), do not administer IV tPA**
During and after thrombolytic therapy	
Monitor BP	Check BP every 15 minutes for 2 hours, then every 30 minutes for 6 hours, and then every hour for at least 16 hours
Systolic 180-230 OR Diastolic 105-120	Labetalol 10-20 mg IV over 1-2 minutes May repeat or double every 10 to 20 minutes to a maximum dose 300 mg or give the initial labetalol bolus and then start a labetalol drip at 2 to 8 mg/min OR Nicardipine 5 mg/hr IV infusion as initial dose; titrate to desired effect by increasing 2.5 mg/hr every 5 minutes to maximum of 15 mg/hr When desired blood pressure attained, reduce to 3 mg/hr
Systolic > 230 OR Diastolic 121-140	Labetalol 10-20 mg IV over 1-2 minutes May repeat or double every 10 minutes to a maximum dose 300 mg or give the initial labetalol bolus and then start a labetalol drip at 2 to 8 mg/min OR Nicardipine 5 mg/hr IV infusion as initial dose; titrate to desired effect by increasing 2.5 mg/hr every 5 minutes to maximum of 15 mg/hr OR If BP is not controlled, consider sodium nitroprusside

Interventions for Acute Hemorrhagic Stroke

Blood pressure management, reversal of anticoagulants and seizure prophylaxis are the hallmarks of initial management of hemorrhagic stroke. The following interventions should be performed expeditiously.

Approach to Elevated Blood Pressure in Acute Hemorrhagic Stroke

Maintain SBP 140 mm Hg within 30 minutes of diagnostic CT and MAP < 130 mmHg with one of the following:

- First line: Nicardipine drip 5-15mg/h
  - Alternative: Clevidipine (Cleviprex) 0.5 mg/mL
    - Initiation: Initiate at 1-2 mg/hour
    - Titration: Double the dose at 90 second intervals initially. As the BP approaches goal, increase the dose by less than doubling and lengthen the time between dose adjustments to every 5-10 minutes. A 1-2 mg/hour increase will produce an additional 2-4 mm Hg decrease in SBP
    - Maintenance: Most patients will achieve the desired therapeutic response at 4-6 mg/hour. Severe HTN may require higher doses
      Maximum: No more than an average of 21 mg/hour is recommended per 24 hour period
- Second line: Labetalol 5-20 mg bolus and infusion at 2 mg/min (maximum 300 mg/d)
- Avoid nitroprusside (can increase ICP)

1. If SBP is >200 mm Hg or MAP is >150 mm Hg
   Aggressive BP reduction with continuous IV infusion, Check BP Q 5 min
2. If SBP is >180 mm Hg or MAP is >130 mm Hg and evidence or suspicion of elevated ICP
   Consider monitoring ICP and reducing BP to keep CPP > 60 to 80 mm Hg
3. If SBP is >180 mm Hg or MAP is >130 mm Hg without evidence or suspicion of elevated ICP
   Consider a modest BP reduction (target MAP of 105 mm Hg or target blood pressure of 140/85
   mm Hg). Check BP Q 15 min

Approach to Hypotension in Acute Hemorrhagic Stroke

- Maintain minimum SBP at >90 mm Hg; begin with isotonic fluid before starting vasopressors
- Consider norepinephrine 2–30 mcg/min infusion or Phenylephrine 100-180 mcg/min infusion

Seizure Management & Prophylaxis

- For patients actively seizing, follow status epilepticus protocol
- For patients with seizure prior to presentation, load with fosphenytoin 20 mg/kg IV (or phenytoin equivalent) or Keppra 1 g PO/IV
- For seizure prophylaxis (in patients unable to follow commands, with cortical involvement, evidence of midline shift on head CT, or going to the OR for neurosurgery), consider loading with fosphenytoin 20 mg/kg IV or Keppra 1g PO/IV

Coagulopathy, Anticoagulant and Antiplatelet Reversal

Warfarin

Any patient with a history of recent warfarin use, regardless of INR or PT, should receive:

- Vitamin K 10 mg IV over one hour (monitor for hypotension / anaphylaxis) &
- 50 units/kg of Prothrombin Complex Concentrate (Bebulin or Profilnine or 4-Factor PCC (Kcentra))
- Four-Factor PCC (Kcentra) doses:
- INR 2 to < 4 (25 Units/Kg), max dose 2500 Units
- INR 4 to 6 (35 Units/Kg), max dose 3500 Units
- INR >5 (50 Units/Kg), max dose 5000 Units
  - Call blood bank and order STAT
  - If PCC is unavailable, give 15 cc/kg of FFP
  - CAUTION when considering PCC in patients with recent thrombotic event (e.g., MI, STROKE, PE, DVT) or patients in DIC

Liver failure with known coagulopathy or elevated PT or INR ≥ 1.2

- Vitamin K 10 mg IV over one hour (monitor for hypotension / anaphylaxis) &
- 50 units/kg of Prothrombin Complex Concentrate (Bebulin or Profilnine) &
- 2 units of FFP
  - If PCC is unavailable, give 15 cc/kg of FFP total

Reversal of Platelet Dysfunction: For any patient with antiplatelet (Aspirin, Aggrenox, GPIIbIIIa or Clopidogrel) use in last 24 hours and ICH onset within 3 days

- DDAVP 0.3 mcg/kg x 1 (20 mcg in 50 cc NS over 15-30 minutes) &
- One apheresis platelet unit
- For patients with von Willebrand disease: DDAVP 0.3 mcg/kg x 1 (20 mcg in 50 cc NS over 15-30 minutes)

Renal disease - Patients with increased creatinine (significant elevation from baseline, or Cr > 1.5)

- DDAVP 20 mcg in 50 cc NS over 15-30 minutes
- One apheresis platelet unit

For clinical deterioration, administer 6 units of cryoprecipitate or FFP

Thrombocytopenia

- Transfuse for platelets <50,000

Unfractionated Heparin – Protamine Administration

- 0-30 minutes from heparin administration, give 1.0 mg Protamine IV per 100 units heparin
- 31-60 minutes from heparin administration, give 0.75 mg Protamine IV per 100 units heparin
- 61-120 minutes, give 0.5 mg per 100 units heparin
- >2 hours from heparin administration, give 0.3 mg Protamine IV per 100 units heparin

- Protamine: Maximum dose 50 mg, max infusion rate 5 mg/min. (monitor for anaphylaxis / hypotension)

Low molecular weight Heparin/ Lovenox- Protamine Administration

- **Enoxaparin** (Lovenox): 1 mg Protamine IV per 1 mg of enoxaparin given in last 8 hours;
  - If >8 hours since Lovenox, no Protamine
  - If bleeding continues: 0.5 mg Protamine IV per 1 mg of enoxaparin in last 8 hours
- Protamine has negligible reversal effects on danaparoid and fondaparinux
- **Dalteparin** or **tinzaparin**: 1 mg protamine for each 100 anti-Xa IU of dalteparin or tinzaparin;
- If bleeding, consider additional dose of 0.5 mg for each 100 anti-Xa IU of dalteparin/tinzaparin

Direct thrombin inhibitors:

- **Argatroban, Hirudin (Bivalirudin, Lepirudin)**
- There is no established reversal agent for these drugs.
- For reversal consider:
- Oral activated charcoal (25 to 50 grams in adults) if given within 2 hours post ingestion.
- Four-Factor PCC 50 units/kg
- Alternative: Activated PCC (FEIBA) 50 to 100 units/kg
- Consider hemodialysis
- **Dabigatran (Pradaxa)**
- Praxbind (idarucizumab) 5g IV given as bolus or IV infusion. Additional 5 g may be considered if coagulation parameters re-elevate and clinically relevant bleeding occurs or if a second emergency surgery/urgent procedure is required and patient has elevated coagulation parameters.

Factor Xa Inhibitors

- **For Rivarxaban (Xareto)** or **Apixaban (Eliquis)** reversal, consider
- Oral activated charcoal (25 to 50 grams in adults) if given within 2 hours post ingestion.
- Four-Factor PCC 50 units/kg
- Activated PCC (FEIBA) 50 to 100 units/kg
- Hemodialysis may be considered in patients with impaired renal function

Hemophilia without Inhibitors / Antibodies

- **Factor 8**-Adults 40 units / Kg then 20 units / Kg Q12 hours
- Peds 50 units / Kg then 25 units / Kg Q12 hours
- **Factor 9**-Adults 80 units / Kg then 40 units / Kg Q24 hours
- Peds 100 units / Kg then 50 units / Kg Q24 hours

Hemophilia with Inhibitors / Antibodies

- FEIBA-Factor 8 Inhibitor Bypassing Activity, Administer 75 units / Kg IV Q12 hours
- If ICH worsens, give Recombinant Factor VIIa 90 units / Kg IV Q2 hours

For treatment of Intracranial Hemorrhage associated with new oral anticoagulants, consult Hematology

Treatment of Intracranial Hemorrhage after IV tPA

- Stop IV tPA infusion
- Administer 12 units of cryoprecipitate and 6 units of platelets

If the patient has clinical deterioration or enlargement of ICH on repeat Head CT (after anticoagulant or antiplatelet reversal), additional correction / reversal agent should be given.

Treatment of Intracranial Hypertension

In most instances, patients with signs of intracranial hypertension will be transferred to the NSICU. In event of suspicion for intracranial hypertension in a patient still in the ED, consider the following agents in consultation with Neurology and/or Neurosurgery:

- Analgesia and sedation to minimize agitation; if it continues, intubate and sedate
- Mannitol 20% 1 g / kg bolus (100g if weight unknown); redose q 1 hour as needed
- Place central line
- Assess for need for urgent external ventricular drain placement (Unable to follow commands or symptomatic hydrocephalus)
    - If external ventricular drain placed, give Ancef 1 g IV prior to drain insertion and one dose 8 hours later
    - If ICP monitoring in place: titrate BP control to keep CPP 60-80 mmHg
- Q15 minute neurological exams to assess for signs of herniation

Management of Blood Glucose

- Maintain euglycemia (serum glucose >70 and <185 mg/dL; use IV insulin for hyperglycemia)

Management of Subarachnoid Hemorrhage

- Fosphenytoin 20 mg/kg (or phenytoin equivalent) IV load or Levetiracetam (Keppra) 1 g PO/IV
- Nimodipine 60 mg PO q 4 h for SBP ≥140, 30 mg for SBP 120-140, hold for SBP ≤120 (place NGT if necessary)
- Maintain Systolic BP ≤ 140 (Goal SBP: 90-140) with a nicardipine or labetalol drip (Avoid nitroprusside as this can raise ICP)

Increase Systolic BP ≤ 90 (Goal SBP: 90-140) with Norepinephrine 2–30 mcg/min infusion or Phenylephrine 100 -180 mcg/min infusion

Disposition

Monitoring and management of patients with an acute hemorrhagic stroke should take place in the NSICU or stroke unit at the discretion of the stroke team and the ED Attending physician.

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