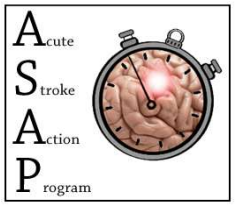


If found, please return to
Chrissy McIntosh
219 Biotech, 362-3998,
mcintoshc@neuro.wustl.edu

ASAP instructions

Stroke pager

- Activated when any patient arrives in ED within 6 hours of suspected stroke or at 6-24 hours with suspected large stroke
- You will see 3 pages for every patient
  - initial information from ED
    - patient's name & age, symptoms, onset (time last normal)
    - "EMS to CT scanner then tcc2, 31 yo F c/o numbness and tingling to left arm, slurred speech. Onset 12:45. Eta 4."
  - "104-xxxx"
    - where xxxx=last 4 digits of responding resident's pager, indicating resident got the page and will be in CT scanner within 5 minutes
  - summary page stating tPA decision or next step in evaluation
- You should go to the ED after any text page (1st in the series of 3) unless it starts with STROKE RN RESPOND—this indicates an inpatient tPA page
  - If you wait for the summary page, it will usually be too late
- Ignore numerical pages

Wear your white coat and ID badge; no shorts

What to do when you get to the ED

- Enter via basement of hospital near Southwest Tower elevators
- Press button to be buzzed in
- Go to CT scanner; if patient not there, go to TCC (Trauma Critical Care) bay at end of hall
- Introduce yourself to someone on the team
- Observe/focus on at least one item on the checklist on back of this card each time you go to the ED
- If tPA is administered, plan to stay for at least 30 minutes
  - While it is infusing, you can
    - perform the NIHSS/exam
    - look for improvement
    - ask questions
- Follow resident to review CTA/CTP if performed
  - Observe decision process for endovascular treatment
- Follow patient to angio suite if endovascular treatment is elected
  - Introduce yourself to neurointerventional fellow/attending
  - Observe procedure through the window

Observe/focus on at least one item on the following checklist each time you go to the ED:

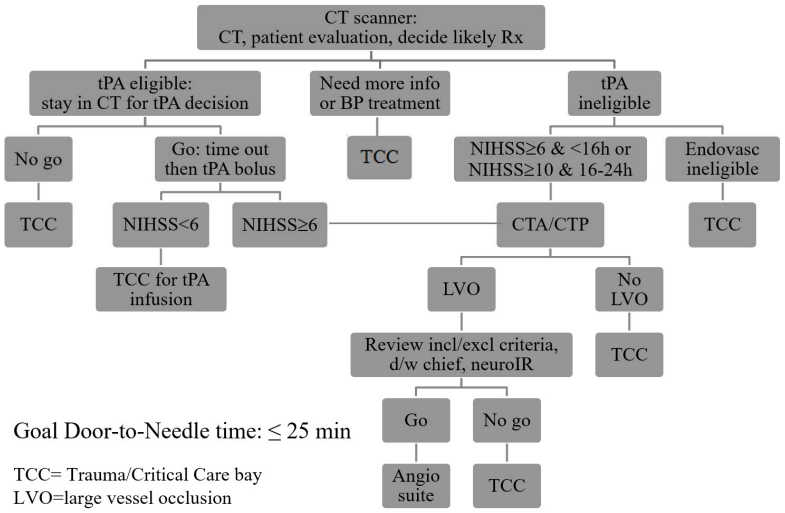
- ☐ The process as a whole—the various people involved, processes occurring, what created delays
- ☐ Obtaining history/time of onset
- ☐ Exam
  - ☐ Findings: dysarthria, aphasia, gaze deviation, visual field cut, hemiparesis, neglect
  - ☐ Tally the NIHSS as resident is doing it and compare your score to theirs
- ☐ Imaging
  - ☐ CT: Early stroke signs
  - ☐ CTA: Vessel occlusion
  - ☐ CTP: Mismatch between infarct core and penumbra
- ☐ Ensuring eligibility criteria
- ☐ Consent process with patient/family
- ☐ If tPA or thrombectomy weren't used, what was the reason?

Return all items Chrissy McIntosh (Biotech 219) at end of rotation or arrange to transfer to next student on schedule. If the latter, make sure you let Chrissy know you did this.

1. Pager
2. ASAP instructions
3. NIHSS scoring booklet

ED Acute Stroke Protocol

1. Patient arrives via ambulance/EMS or walks-in via ED triage.
2. Patient goes immediately to CT.
3. Team (Neuro and EM Residents, EM attending, RN, tech, Social Work, Pharmacist) converges at CT to obtain information from EMS regarding time of onset, witnesses, blood glucose, etc, obtain history and NIHSS, place IVs, draw blood
   a. RN immediately draws labs, estimates patient weight
   b. RN and/or ED resident order Stroke Order set
   c. Tech obtains EKG
   d. Social Work brings family to bedside to expedite getting time of onset (may help find phone numbers if family not present)
   e. Neuro + ED residents obtain history and NIHSS
      i. If NIHSS ≥ 6, CTA/CTP will be obtained
   f. EM resident orders BP meds as needed
   g. Neuro resident calls Neuro Chief→ tPA decision made; EM resident to ensure EM attending agrees with decision (if Attending not at bedside)→RN notified of tPA decision→ Neuro resident documents decision time
   h. TIME OUT: Neuro/EM Resident, EM attending, and ED RN at beside to agree on time of onset, weight, and dose of tPA
   i. EM resident orders tPA
   j. RN administers tPA & documents tPA bolus time in chart
   k. tPA may be administered either in CT or in TCC
4. Once tPA is administered, BP and neurological status (NIHSS) obtained every 15 minutes during tPA infusion; BP monitored q15 minutes for the first 2 hours, then q 30 minutes



Goal Door-to-Needle time: ≤ 25 min

TCC= Trauma/Critical Care bay
LVO=large vessel occlusion

Acute Ischemic Stroke IV tPA Eligibility Criteria

Inclusion Criteria:

1. Age ≥ 18 years *
2. Clinical diagnosis of ischemic stroke causing a measurable neurological deficit
3. Onset of stroke symptoms** well established to be within 4.5 hours of treatment

Exclusion Criteria:

1. Intracranial hemorrhage on head CT
2. Serious head trauma within past 3 months
3. Active bleeding or suspected underlying abnormality, including but not limited to:
   a. International Normalized Ratio (INR) >1.7 §
   b. Platelet count <100,000/ml §
   c. Patient has received heparin within 48 hours and has elevated PTT
   d. Patient has received treatment doses of injectable anticoagulants within 48 hours
   e. Patient takes apixaban and αFXa > 0.1U
   f. Patient takes dabigatran and thrombin time is ≥ 30
   g. Patient takes rivaroxaban and PT>13 / αFXa>0.1U. (If PT ≤13, consider tPA; if >13 check αFXa—if ≤0.1U, consider tPA; otherwise, no tPA.)
4. On repeated measurement, SBP > 185 or DBP > 110 (see Guidelines below)
5. Symptoms suggest subarachnoid hemorrhage despite no hemorrhage seen on CT
6. For 3-4.5 hour window only: severe deficits (NIHSS>25)

Relative Exclusion Criteria:

1. Major surgery or serious trauma (other than head) within last 14 days
2. Intracranial or intraspinal surgery in previous 3months
3. Serum glucose <50 or > 400 mg/dl (Treat to bring glucose >50 and <400 mg/dl; consider tPA if symptoms don't resolve after Rx and are consistent with stroke)
4. Stroke within past 3 months
5. History of intracranial hemorrhage *
6. GI or GU hemorrhage within 21 days or structural GI malignancy with bleeding risk
7. Primary or metastatic intracranial, intra-axial neoplasm $
8. Seizure at onset (with deficits thought due to ictal /post-ictal state, not new stroke)
9. Arterial puncture at non-compressible site
10. Unsecured intracranial aneurysm >10 mm or arteriovenous malformation

* May consider tPA (with chief/fellow/attending) in these situations: Age < 18, old traumatic intracranial hemorrhage, history of SAH with secured aneurysm (consider time since coil/clip & completeness of treatment). tPA is potentially harmful in patients w/ history of parenchymal hemorrhage. Incidental chronic micro-hemorrhages on MRI are not a contraindication

** Stroke Onset defined as last documented time patient observed to be without symptoms (time last known normal)—NOT time patient awakened with symptoms or was found down.

§ Because time is critical, tPA should not be delayed while waiting for results of PT, PTT, or platelet count unless bleeding abnormality or thrombocytopenia suspected or patient known or suspected to take an anticoagulant (e.g., in a patient with atrial fibrillation).

$ Extra-axial neoplasm (e.g. meningioma, schwannoma, arachnoid cyst) not contraindication

Populations with special considerations

Pregnancy & Postpartum: Consider in pregnancy when anticipated benefit > anticipated ↑ risk of uterine bleeding. Urgent consultation w/OB is recommended. Safety/efficacy in early postpartum period is unknown.

Rapidly Improving Deficits: Consider in pt w/early improvement who remains impaired/potentially disabled. Since time to Rx powerfully impacts outcome, delaying to monitor for further improvement not recommended

Acute MI or MI within 3 Months: For concurrent acute stroke + MI, tPA followed by coronary angioplasty ± stenting is reasonable. For recent MI, tPA is reasonable for non-STEMI or right/inferior STEMI; may be reasonable for left anterior STEMI.

Pericarditis: Urgent consultation with a cardiologist is recommended. tPA may be reasonable when stroke deficits are severe. When stroke deficits are mild, treatment with tPA is of uncertain net benefit.

Left-Sided Heart Thrombus: tPA may be reasonable when stroke deficits are severe. When deficits are mild, treatment with tPA is of uncertain net benefit.

Endocarditis: tPA is not recommended because of the increased risk of intracranial hemorrhage.

Hemodialysis is not a contraindication if PTT normal; ↑ PTT may ↑risk for hemorrhagic complications.

Dementia: Individual considerations such as life expectancy and premorbid level of function are important to determine whether tPA may offer a clinically meaningful benefit.

Guidelines for Blood Pressure Management *before* tPA administration

(Adapted from AHA Guidelines *Stroke.* 2007;38:1655-1711)

Note: *Suggested guidelines below are for 0-3 hour protocol only; for 3-4.5 hours, only one dose of IV Labetalol or Hydralazine may be attempted to lower BP*

Treat for Systolic BP > 185 mm Hg or Diastolic BP > 110 mm Hg

Labetalol 10-20 mg IV over 1 to 2 minutes, wait 10 minutes, may repeat x 1-2; For low heart rate < 70, may substitute Hydralazine 10-20 mg IV instead of Labetalol.

Or Nicardipine infusion, 5 mg/h, titrate up by 2.5 mg/h at 5- to 15-minute intervals, maximum dose 15 mg/h; when desired blood pressure attained, reduce to 3 mg/h;

If blood pressure remains >185/110 mm Hg, do not administer tPA.

Monitor blood pressure every 15 minutes during the antihypertensive therapy. Observe for hypotension (defined as BP lowering > 25% initial BP measurement on arrival). If neurologic worsening or hypotension occurs, consider IVF bolus, discontinuing nicardipine infusion, and/or reversing antihypertensive effects

Guidelines for Blood Pressure Management *during and after* tPA administration

(Adapted from AHA Guidelines *Stroke.* 2007;38:1655-1711)

Note: *Suggested guidelines below are for both 0-3 hour and for 3-4.5 hour protocols*

Monitor blood pressure every 15 minutes during treatment and for additional 2 hours after treatment, then every 30 minutes for 6 hours, and then every hour for 16 hours.

1. **For Systolic BP 175 to 179 mm Hg or Diastolic BP 100 to 104 mm Hg**

Recheck BP after 5 minutes. If still remains greater than or equal to above parameters, treat according to #2 below.

2. **For Systolic BP 180 to 230 mm Hg or Diastolic BP 105 to 120 mm Hg**

Labetalol 10 mg IV over 1 to 2 minutes, may repeat every 10 to 20 minutes, maximum dose of 300 mg; For low heart rate < 70, may substitute Hydralazine 10-20 mg IV instead of Labetalol.

3. **For Systolic BP > 231 mm Hg or Diastolic BP > 121 mm Hg**

Labetalol 10 mg IV over 1 to 2 minutes, may repeat every 10 to 20 minutes, maximum dose of 300 mg; For low heart rate < 70, may substitute Hydralazine 10-20 mg IV instead of Labetalol.

Or Nicardipine infusion, 5 mg/h, titrate up to desired effect by increasing 2.5 mg/h every 5 minutes to maximum of 15 mg/h
If blood pressure not controlled, discuss use of further agents with attending.

Monitor blood pressure every 15 minutes during the antihypertensive therapy. Observe for hypotension (defined as BP lowering > 25% initial BP measurement on arrival). If neurologic worsening or hypotension occurs, consider IVF bolus, discontinuing nicardipine infusion, and/or reversing antihypertensive effects

tPA Dosing

Patient weight		Total Dose	Bolus Dose	Infusion Dose	Patient weight		Total Dose	Bolus Dose	Infusion Dose
lbs	kg	(mg)	(mg)	(mg)	lbs	kg	(mg)	(mg)	(mg)
90	40.9	36.8	3.7	33.1	158	71.8	64.6	6.5	58.1
92	41.8	37.6	3.8	33.8	160	72.7	65.4	6.5	58.6
94	42.7	38.4	3.8	34.6	162	73.6	66.2	6.6	59.9
96	43.6	39.2	3.9	35.3	164	74.6	67.1	6.7	60.4
98	44.6	40.1	4	36.1	166	75.5	68	6.8	61.2
100	45.5	41	4.1	36.9	168	76.4	68.8	6.9	61.9
102	46.4	41.8	4.2	37.6	170	77.3	69.6	7	62.6
104	47.3	42.6	4.3	38.3	172	78.2	70.4	7	63.4
106	48.2	43.4	4.3	39.1	174	79.1	71.2	7.1	64.1
108	49.1	44.2	4.4	39.8	176	80	72	7.2	64.8
110	50	45	4.5	40.5	178	80.9	72.8	7.3	65.5
112	50.9	45.8	4.6	41.2	180	81.8	73.6	7.4	67
114	51.8	46.6	4.7	41.9	182	82.7	74.4	7.4	67
116	52.7	47.4	4.7	42.7	184	83.6	75.2	7.5	67.7
118	53.6	48.2	4.8	43.4	186	84.6	76.1	7.6	68.5
120	54.6	49.1	4.9	44.2	188	85.5	77	7.7	69.3
122	55.5	50	5	45	190	86.4	77.8	7.8	70
124	56.4	50.8	5.1	45.7	192	87.3	78.6	7.9	70.7
126	57.3	51.6	5.2	46.4	194	88.2	79.4	7.9	71.5
128	58.2	52.4	5.2	47.2	196	89.1	80.2	8	72.2
130	59.1	53.2	5.3	47.9	198	90	81	8.1	72.9
132	60	54	5.4	48.6	200	90.9	81.8	8.2	73.6
134	60.9	54.8	5.5	49.3	202	91.8	82.6	8.3	74.3
136	61.8	55.6	5.6	50	204	92.7	83.4	8.3	75.1
138	62.7	56.4	5.6	50.8	206	93.6	84.2	8.4	75.8
140	63.6	57.2	5.7	51.5	208	94.6	85.1	8.5	76.6
142	64.6	58.1	5.8	52.3	210	95.5	86	8.6	77.4
144	65.5	59	5.9	53.1	212	96.4	86.8	8.7	78.1
146	66.4	59.8	6	53.8	214	97.3	87.6	8.8	78.8
148	67.3	60.6	6.1	54.5	216	98.2	88.4	8.8	79.6
150	68.2	61.4	6.1	55.3	218	99.1	89.2	8.9	80.3
152	69.1	62.2	6.2	56	220	99.8	90	9	81
154	70	63	6.3	56.7	> 220	> 100	90	9	81
156	70.9	63.8	6.4	57.4					

Guidelines for Management of Intracranial Hemorrhage Post-tPA Administration

Adapted from Brain Attack Coalition Guidelines

Suspect intracranial hemorrhage following start of tPA infusion if there is acute neurological deterioration, new headache, acute hypertension, or nausea and vomiting.

If hemorrhage is suspected do the following:

- Discontinue tPA infusion unless other causes of neurological deterioration are apparent.
- Obtain immediate CT scan.
- Draw blood for PT, aPTT, platelet count, fibrinogen, and type and cross
-

If intracranial hemorrhage present:

- Administer 10 units of cryoprecipitate
- If patient is on an antiplatelet agent or platelet dysfunction is suspected, administer one 6-pack of platelets
- After cryoprecipitate administered, check fibrinogen. If low, give 10 units more cryoprecipitate
- Consider second CT to assess progression of intracranial hemorrhage.
- If continued bleeding, consider additional cryoprecipitate, platelets, and/or fresh frozen plasma (FFP) and/or prothrombin complex concentrate (PCC)
- Consider neurosurgical consultation

Inpatient tPA pages

(Alteplase supply for patients located *in 10400 ICU*)

1) Neurology resident learns about potential tPA patient and initiates tPA page, texting "STROKE RN RESPOND" with patient name, birth date, and hospital room
2) Neurology resident proceeds to patient room to evaluate patient
3) RN from Neuro Step-down or NeuroICU meets resident at bedside with tPA and assumes all tPA-related nursing care
4) Neurology resident and RN transport patient to head CT on 2nd floor of Mallinckrodt.
5) tPA may be administered in CT if decision ready; otherwise return to patient room for decision.

NOTE for stroke team: Alteplase can only be dispensed directly to a physician.

Abbreviated Alteplase (tPA) mixing instructions:

1) Insert spike included in kit into diluent (liquid) vial. Leave vial upright.
2) Place vial containing powder over diluent vial and insert into spike.
3) Invert vials to allow diluent to drip into powder vial
4) Remove diluent vial after empty.
5) *Gently swirl* vial to dissolve powder. **DO NOT SHAKE.** (Vial will become foam if shaken.)
6) **DO NOT DISCARD unused** vials. Return to pharmacy and hospital will be reimbursed.

Acute Ischemic Stroke Endovascular Treatment Algorithm

Inclusion Criteria

1. Age >18
2. NIHSS ≥ 6 if <16 hours from time last seen well (TLSW) or NIHSS ≥ 10 if 16-24 hours from TLSW
3. For posterior circulation stroke: treatment time window is at the discretion of attending physician

Exclusion Criteria*

1. Pre-morbid disability (mRS >2) or comorbidities that will affect recovery potential
2. Intracranial hemorrhage, mass, or mass effect as cause of symptoms
3. Current severe uncontrolled hypertension (e.g. SBP > 185 mmHg or DBP > 110 mmHg) despite reasonable efforts to treat
4. Bleeding diathesis**
   a. Use of warfarin: INR > 3.0
   b. Use of dabigatran: TT > 30 sec and PTT> 70 sec (wait for manual TT correction to rule out heparin contamination)
   c. Use of rivaroxaban: PT > 20 sec or αFXa > 0.5 U of heparin activity (check only if PT 15-20 sec; takes 30 minutes to run)
   d. Use of apixiban: αFXa > 0.15 U of heparin activity
   e. Use of edoxaban: αFXa > 0.15 U of heparin activity
   f. Thrombocytopenia: platelet count < 30,000/mL

Imaging selection criteria

1. Arterial occlusion at M1, ICA, vertebral, or basilar***
2. Absence of vascular anatomy or concomitant vascular lesion that would substantially impede safe endovascular treatment
3. No evidence of large completed infarct (e.g., ASPECTS score ≥ 6)
4. If treatment expected within 6-16 hours of TLSW, core infarct volume ≤ 70 mL, mismatch volume ≥ 15 mL, mismatch ratio ≥ 1.8
5. If treatment expected within 16-24 hours of TLSW, core infarct volume ≤ 30 mL (for age < 80 years) or ≤ 20 mL (for age ≥ 80)

* IV tPA exclusions related to risks of systemic complications of fibrinolysis are generally not risks for endovascular treatment (e.g., post-operative systemic bleeding risk, therapeutic oral anticoagulation)

**Correction of bleeding diathesis may be considered on a case-by-case basis following discussion between stroke neurology and INR

*** Exceptions may be made for other vessel occlusions (e.g., M2) in the presence of an approved research protocol or at the discretion of the treating physician if there is compelling clinical and radiological evidence suggesting benefit

NIH Stroke Scale

NIHSS	FIRST EXAM NIH
Date	/ /
0=alert 1=drowsy 2=stuporous 3=coma	LOC 0 1 2 3
What is the MONTH? What is your AGE? 0=both correct 1=one correct 2=neither correct 9=untestable	LOC QUESTIONS 0 1 2
"CLOSE EYES, MAKE FIST" 0=both correct 1=one correct 2=neither correct	LOC COMMANDS 0 1 2
0=normal 1=partial hor. gaze paresis 2=forced horizontal gaze deviation	GAZE 0 1 2
0=normal 1=partial 2=complete HH 3=bilateral Blind from stroke=3	FIELDS 0 1 2 3
0=normal 1=minor 2=partial (UMN) 3=LMN or bilateral	FACE 0 1 2 3
0=normal 1=drift (10 sec) 2=effort against gravity 3=no effort against gravity 4=0/5	RUE 0 1 2 3 4 LUE 0 1 2 3 4
0=no drift (5 sec) 1=drift 2=effort against gravity 3=no effort against gravity 4=no movement	RLE 0 1 2 3 4 LLE 0 1 2 3 4
0=absent 1=unilat in 1 limb 2=unilat in 2 limbs or bilateral	ATAXIA 0 1 2
0=normal 1=partial 2=dense	SENSORY 0 1 2
0=normal 1=mild/mod dysphasia 2=severe 3=mute	APHASIA 0 1 2 3
0=normal 1=mild/mod 2=near unintelligible	DYSARTHRIA 0 1 2
0=none 1=one modality 2=sensory + visual	NEGLECT 0 1 2
TOTAL SCORE	Total

Acute Stroke Team

Stroke attendings

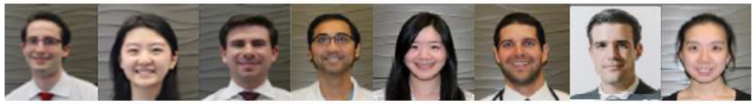
David Carpenter, Andria Ford, Derek Holder, Salah Keyrouz, Jin-Moo Lee, Renee Van Stavern, Allyson Zazulia

Stroke fellow

James Giles

Neurology residents

Brandi Baker, Maggie Blattner, John Ciotti, Kalen Dionne, Elyse Everett, Lindsay Frerichs, Ethan Hoang



Alan Plotzker, Yan Wang, Anson Wilks, Omar Butts, Chris Chou, Nick Coman, Mark Garret, Helen Hwang

Lindsay Laws, Victoria Levasseur, Liz Perelstein, Ada Uzo-Okerke, Nirupama Yechoor, Matt Brier, Mysti Harrison, Nigel Harrison

BJ Heuermann, Jamie Holloman, Jeet Kapadia, Angela Liu, Shahvaiz Magsi, Caroline Tang, Jonathan Williams, Mary Wren

Emergency Medicine PGY-4 (senior) residents

Cameron Crockett, Sarah Dixon, Mili Galardi, Cristina Guadioso

Kevin Baumgartner, Christina Creel-Bulos, Heather de Anda, Jarrod Dornfeld

Luke Hofkamp, Erin Kane, Nicole Messenger, Sahar Morkos, Sonya Naganathan, Adam Rieves, Andrea Spangler, Chelsea Williams

ED attendings

Laura Heitsch, Peter Panagos

ED nurse

Charlie Peterson

ED pharmacist

Craig McCammom

Research coordinators

Jill Newgent, Jenny Babka