Emergency Neurological Life Support

Ischemic Stroke

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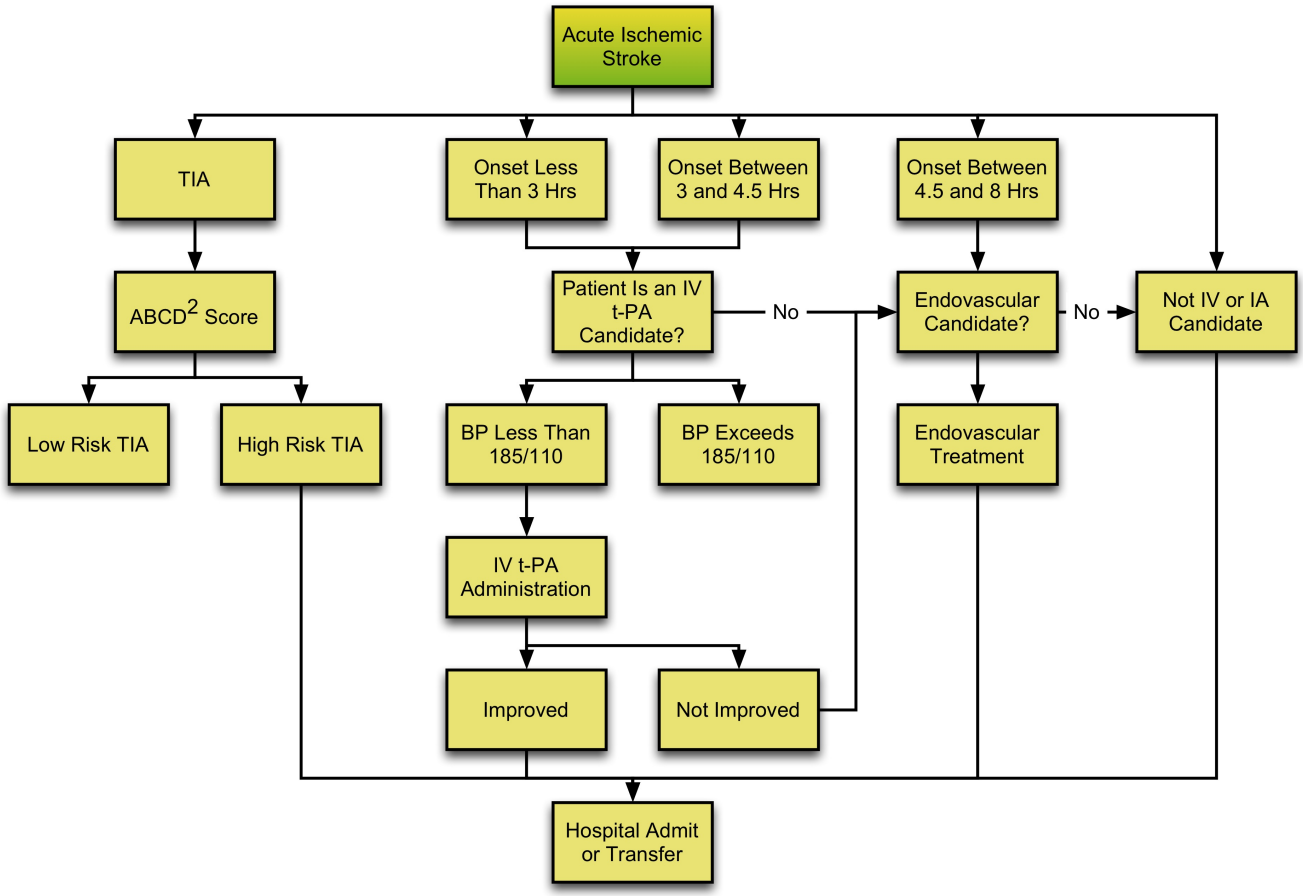

Checklist & Communication

Flowchart

Checklist

☐ Labs: capillary glucose, CBC with platelets, PT/PTT, EKG, and beta-HCG for women
☐ IV access
☐ Supplemental oxygen to maintain saturation > 94%
☐ Activate stroke code system (if available)
☐ Determine NIHSS score

Communication

☐ Age
☐ Airway status
☐ Time of symptom onset
☐ NIHSS
☐ CT or MRI results

Flowchart

Acute Ischemic Stroke

Based on imaging and symptoms

The diagnosis of acute ischemic stroke is based on new onset focal neurological findings with an imaging study (CT or MRI of the brain) that shows no hemorrhage, or shows evidence of ischemic infarction.

In some centers, patients may be screened at the door when EMS arrives and then is taken directly to CT (or MRI) based on symptoms of facial droop, dysarthria, gaze preference, motor weakness or other focal findings.

If not completed already:

- STAT vital signs, capillary glucose, CBC with platelets, PT/PTT, EKG, and beta-HCG for women
- IV access
- Supplemental oxygen to maintain saturation >94% (hyperoxia may be detrimental in stroke, so no need for high flow oxygen)
- Activate stroke code system (if available)
- Stroke MD/team to evaluate patient with 5 minutes
- Determine NIHSS score

Topic Co-Chairs: Hartmut Gross, MD Gene Sung, MD

Flowchart

Administer IV t-PA

Start IV t-PA infusion

After placing 2 peripheral IV lines:

- Weight the patient; do not estimate body weight.
- Mix (do not shake) 0.9 mg/kg t-PA, total dose not to exceed 90 mg.
- Give 10% of the total dose of t-PA by bolus, then infuse the remaining dose over 1 hour.

Footnote:
As t-PA is dispensed in 50 and 100 mg bottles, it is suggested to draw off and discard any excess tPA to avoid accidental infusion of excess t-PA.

Flowchart

Endovascular treatment

Consider IA thrombolysis or thrombectomy

If the patient has a large vessel occlusion (MCA, intracranial ICA, basilar or vertebral artery) and is within an 8-hour time window, IA treatment may be helpful. Large vessel occlusion can be suspected by seeing a hyperdense sign (clot within the vessel) on non-contrast CT imaging but this sign is insensitive. CTA or MRA is diagnostic, as is conventional angiography.

- Contact the neurointerventional physician on call; if the treating hospital does not have this capability, consider transfer to a comprehensive stroke center
- Some hospitals use CT perfusion or MR perfusion techniques to select appropriate patients for intervention (ischemic penumbra)

Flowchart

Hospital Admission & Transfer

While waiting for ICU bed

After IV, IA or no specific treatment consider the following initial admission orders:

- Neuro check q30 min x 6 hrs., then q1 hr.
- Oxygenation to keep O2 sat > 94%
- BP check q 15 min x 2 hrs., then q 30 min x 6 h, then q 1h x 16 h
- BP-after reperfusion treatment keep <180/105 (Note: this is lower than pretreatment values); if no t-PA given, keep BP <220/120
- Bedside swallow test (30 mL water PO) before anything else PO
- Keep glucose <140, consider insulin drip
- IVF (NS) to keep euvolemia
- Monitor for A-fib
- Treat fever sources with antipyretics

If t-PA was administered:

- avoid indwelling urinary catheter, nasogastric tubes, intra-arterial catheters for 4 hours; do not give anticoagulant/antiplatelet therapy for 24 hours; repeat head CT or MRI at 24 hrs. before starting anticoagulant/antiplatelet meds

Watch for complications of t-PA, including

- Airway obstruction due to angioedema- consider rapid intubation
- Hemorrhage- stop t-PA
- Sudden deterioration in mental status- see below
- Severe hypertension or hypotension- may be signs of ICH or systemic hemorrhage

A sudden decline in neurological exam during or following t-PA administration may be due to an intracranial hemorrhage. This is often accompanied by a marked rise in blood pressure; however, a marked rise or fall in blood pressure alone may signal an ICH. Do the following immediately:

- STOP t-PA infusion
- Obtain STAT head CT scan
- Notify your neurosurgeon on call; if not available begin the process to transfer the patient to a facility with neurosurgical capability once the CT scan results are available
- Stat labs: PT, PTT, Platelets, fibrinogen, type and cross 2-4 unit PRBCs
- Give the following:
  - 6-8 units of cryoprecipitate
  - 6-8 units of platelets
  - Consider 40-80 mcg/kg of recombinant Factor VIIa while waiting for platelets and cryoprecipitate

Flowchart

Consider patient transfer

- if the treating hospital cannot provide the level of care for the patient (no ICU for example). Patient outcomes have been shown to improve if the patient is treated in a stroke center.
- if there is evidence of large vessel occlusion (CTA/MRA, hyperdense vessel sign on imaging; or clinical findings consistent with an MCA stroke) and the patient can arrive and be treated at the receiving hospital within 8 hours of symptom onset.

Flowchart

Low Risk TIA

ABCD^2 Score 0-3

Outpatient workup:

- Start on antithrombotic agent (ASA, clopidogrel 75 mg/day, or ASA/ extended release dipyridamole)
- Carotid imaging: ultrasound, CTA or MRA
- Consider echocardiography
- Consider long-term cardiac monitor*
- Smoking cessation
- Initiate statin

*- if ECG or rhythm strip shows atrial fibrillation consider starting anticoagulation (oral anticoagulant or low molecular weight heparin) or ASA depending on $CHADS_2$ score.

Flowchart

No

Blood pressure exceeds 185 over 110 mm Hg

- This is too high for IV t-PA administration and *requires* gentle reduction prior to initiating t-PA.
- Labetalol 10 mg IV every 10 minutes (consider doubling dose (i.e. 20, 40, 80) to max total dose of 150 mg. Start maintenance infusion.
- Nicardipine IV- start 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 BP falls below 185/110 mmHg, proceed to IV t-PA administration.

If BP proves refractory to the above, the patient is considered too high risk for intracerebral hemorrhage and should not be treated with t-PA. Continue to treat BP to keep less than 220/120 mmHg however.

Footnote:
While nitroglycerin paste (for patients with no IV access), labetalol, and nicardipine are recommended by the American Stroke association, other new drugs are available, but not yet studied in acute stroke management, including clevidipine. Be sure to initiate a drip as boluses will wear off and BP will likely return to its previous high levels.

Permissive hypertension is allowed for TIA, as it is for non-t-PA treated patients, up to 220/120 mmHg.

Flowchart

No improvement following t-PA

Within 1 hour no change in exam?

Often this is defined as no change in the NIHSS score.

Flowchart

Not low risk

TIA risk moderate or high, or unable to arrange timely outpatient work-up and follow-up

Admit for observation:

- Permissive hypertension (not to exceed 220/120 mm Hg)
- Start ASA, clopidogrel or ASA/extended release dipyridamole
- Carotid imaging: ultrasound, CTA or MRA
- Consider echocardiography
- Telemetry*
- Smoking cessation
- Initiate statin
- Consider keeping patient flat to improve brain perfusion (controversial)

*if ECG or rhythm strip shows atrial fibrillation consider starting anticoagulation (oral anticoagulant or low molecular weight heparin) or ASA depending on CHADS2 score.

Flowchart

Onset less than 3 hours

Time from stroke symptom onset is less than 3 hours

Time of onset is when the patient was last seen normal.

- If they can say when the first symptoms began, use that time
- If an observer can say when they saw the symptoms begin (excluding wake up), use that time
- If a patient awakens with a stroke, the time of onset is when they last went to bed

The time of onset is critical for using t-PA as the risk of intracerebral bleeding increases with increased time from stroke onset. If you cannot establish the time with certainty, most physicians will not treat with t-PA.

Check eligibility for on-label (US and elsewhere) use of IV t-PA:

- Diagnosis of ischemic stroke causing measurable neurological deficit.
- The neurological signs should not be clearing spontaneously.
- The neurological signs should not be minor and isolated.
- Caution should be exercised in treating a patient with major deficits.
- The symptoms of stroke should not be suggestive of subarachnoid hemorrhage.
- No head trauma or prior stroke in previous 3 months.
- No myocardial infarction in the previous 3 months.
- No gastrointestinal or urinary tract hemorrhage in previous 21 days.
- No major surgery in the previous 14 days.
- No arterial puncture at a noncompressible site in the previous 7 days.
- No history of previous intracranial hemorrhage.
- Blood pressure not elevated (systolic < 185 mm Hg and diastolic < 110 mm Hg).
- No evidence of active bleeding or acute trauma (fracture) on examination.
- Not taking an oral anticoagulant or, if anticoagulant being taken, INR < 1.7.
- If receiving heparin in previous 48 hours, aPTT must be in normal range.
- Platelet count <100 000 mm3.
- Blood glucose concentration < 50 mg/dL (2.7 mmol/L).
- No seizure with postictal residual neurological impairments.
- CT does not show a multilobar infarction (hypodensity >1/3 cerebral hemisphere).
- The patient or family members understand the potential risks and benefits from treatment.

Flowchart

Onset between 3 and 4.5 hours

Time from stroke onset is between 3 and 4.5 hours

Time of onset is when the patient was last seen normal.

- If they can say when the first symptoms began, use that time
- If an observer can say when they saw the symptoms begin (excluding wake up), use that time
- If a patient awakens with a stroke, the time of onset is when they last went to bed

The time of onset is critical for using t-PA as the risk of intracerebral bleeding increases with increased time from stroke onset. If you cannot establish the time with certainty, most physicians will not treat with t-PA.

In the US, t-PA is not yet approved for 3-4.5 use, although it is approved in Europe and Canada. The inclusion criteria are similar to those of < 3 hours, but are modified as follows:

- Age < 80 years
- No anticoagulant use, regardless of INR
- NIHSS < = 25
- No combined history of prior stroke and diabetes

Flowchart

Patient improves following t-PA

Measurable improvement within 1 hour?

Often this is defined as a lowering of the NIHSS score, and there is no clear consensus as to how much.

Flowchart

Patient is an IV t-PA Candidate

Is BP less than 185/110 mm Hg?

After reviewing the inclusion/exclusion criteria for IV t-PA use, the patient is eligible to receive the drug. Current blood pressure is the last inclusion criteria. If it is too high, the risk of ICH from t-PA is increased. Steps can be taken to lower blood pressure so as to make the patient eligible for t-PA.

Flowchart

Patient is not an IV t-PA or IA treatment candidate

Neither IV t-PA or IA intervention is appropriate

Common exclusions for IV t-PA are time (duration > 4.5 hours), and contraindications to t-PA (recent surgery, current bleeding at a non-compressible site, etc.), and large area of infarction already present on the brain imaging study (> 1/3 of the MCA territory).

IA exclusions include lack of large vessel occlusion on CTA or MRA, lack of consent from the patient or surrogate, or large area of infarction already present on the brain imaging study. If IA intervention is not available at the treating hospital, but there is clinical or radiographic evidence of a large vessel occlusion, consider rapid transfer to a facility with this capability.

Flowchart

Symptom onset between 4.5 and 8 hours

Outside IV t-PA window

Beyond 4.5 hours, IV t-PA is associated with intracerebral hemorrhage. IA therapies may be helpful in this time window (and earlier as well).

Flowchart

The ABCD^2 Score

What is the predicted risk for stroke?

The ABCD^2 score is an ordinal scale that provides risk prediction of stroke following the TIA. It is scored as follows:

ABCD^2 Element	Points
Age > 60 years	1
Blood Pressure ≥ 140/90 on initial evaluation	1
Clinical Features	
Speech disturbance without weakness	1
Unilateral weakness	2
Duration of symptoms	
10-59 minutes	1
60 minutes or greater	2
Diabetes mellitus in patient's history	1
Total Score	0 - 7

The following is the estimated risk (%) of a stroke occurring within various time ranges:

Total Risk	ABCD^2 Score	2 day	7 day	90 day
Low	0-3	1.0	1.2	3.1
Moderate	4-5	4.1	5.9	9.8
High	6-7	8.1	12	18

Ref:Cucchlara B et al, Ann Emerg Med 2008, 52:S27-39

Based on this risk stratification some physicians choose to admit high-risk patients and discharge low risk, and controversy exists about moderate risk patients.

Flowchart

TIA

Symptoms have completely resolved

Diagnosis of TIA (transient ischemic attack) is based on new onset of focal neurological symptoms that are explainable by a vascular cause (i.e. arterial occlusion of a single or group of arteries adequately explain the patient's signs and symptoms) and these signs and symptoms resolve within 24 hours.