Update on Treatment of Acute Ischemic Stroke

2013-04-03
Guidelines for the Early Management of Patients With Acute Ischemic Stroke
A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

The American Academy of Neurology affirms the value of this guideline as an educational tool for neurologists.

Endorsed by the American Association of Neurological Surgeons and Congress of Neurological Surgeons

(Stroke. 2013;44:870-947.)
### Table 1. Applying Classification of Recommendations and Level of Evidence

#### SIZE OF TREATMENT EFFECT

<table>
<thead>
<tr>
<th>CLASS I</th>
<th>Benefit &gt;&gt; Risk</th>
<th>Procedure/Treatment SHOULD be performed/administered</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS IIa</td>
<td>Benefit &gt;&gt; Risk</td>
<td>Additional studies with focused objectives needed</td>
</tr>
<tr>
<td>CLASS IIb</td>
<td>Benefit ≥ Risk</td>
<td>Additional studies with broad objectives needed; additional registry data would be helpful</td>
</tr>
<tr>
<td>CLASS III</td>
<td>No Benefit or CLASS III</td>
<td>Harm</td>
</tr>
</tbody>
</table>

#### LEVEL A

- Multiple populations evaluated*
- Data derived from multiple randomized clinical trials or meta-analyses

- Recommendation that procedure or treatment is useful/effective
- Sufficient evidence from multiple randomized trials or meta-analyses

#### LEVEL B

- Limited populations evaluated*
- Data derived from a single randomized trial or nonrandomized studies

- Recommendation that procedure or treatment is useful/effective
- Evidence from single randomized trial or nonrandomized studies

#### LEVEL C

- Very limited populations evaluated*
- Only consensus opinion of experts, case studies, or standard of care

- Recommendation that procedure or treatment is useful/effective
- Only expert opinion, case studies, or standard of care

#### ESTIMATE OF CERTAINTY (PRECISION) OF TREATMENT EFFECT

- Procedure/Test
- Treatment

- COR III: No benefit or benefit
- Excess Cost w/o Benefit or Harmful to Patients

- Recommendation that procedure or treatment is not useful/effective and may be harmful
- Sufficient evidence from multiple randomized trials or meta-analyses

- Recommendation that procedure or treatment is not useful/effective and may be harmful
- Evidence from single randomized trial or nonrandomized studies

- Recommendation that procedure or treatment is not useful/effective and may be harmful
- Only diverging expert opinion, case studies, or standard of care

- Recommendation that procedure or treatment is not useful/effective and may be harmful
- Only diverging expert opinion, case studies, or standard of care
<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection</td>
<td>Patient or bystander recognition of stroke signs and symptoms</td>
</tr>
<tr>
<td>Dispatch</td>
<td>Immediate activation of 9-1-1 and priority EMS dispatch</td>
</tr>
<tr>
<td>Delivery</td>
<td>Prompt triage and transport to most appropriate stroke hospital and prehospital notification</td>
</tr>
<tr>
<td>Door</td>
<td>Immediate ED triage to high-acuity area</td>
</tr>
<tr>
<td>Data</td>
<td>Prompt ED evaluation, stroke team activation, laboratory studies, and brain imaging</td>
</tr>
<tr>
<td>Decision</td>
<td>Diagnosis and determination of most appropriate therapy; discussion with patient and family</td>
</tr>
<tr>
<td>Drug</td>
<td>Administration of appropriate drugs or other interventions</td>
</tr>
<tr>
<td>Disposition</td>
<td>Timely admission to stroke unit, intensive care unit, or transfer</td>
</tr>
</tbody>
</table>

ED indicates emergency department; and EMS, emergency medical services.
Detection: Public stroke education
Dispatch: Qualified EMSS
Delivery: Prehospital management & stroke centers
Door: Code stroke
Data: Immediate diagnostic studies
Decision: Recanalization strategies
Drug: Anticoagulants and antiplatelets
Disposition: Medical and surgical treatments
Activation of the 9-1-1 system (Class I; Level of Evidence B)
- Detection: Public stroke education
- Dispatch: Qualified EMSS
- Delivery: Prehospital management & stroke centers
- Door: Code stroke
- Data: Immediate diagnostic studies
- Decision: Recanalization strategies
- Drug: Anticoagulants and antiplatelets
- Disposition: Medical and surgical treatments
Specific parameters that measure the quality of an EMSS (Emergency Medical Services System)

- The time between the receipt of the call and the dispatch of the response team is <90 seconds.
- EMSS response time is <8 minutes (time elapsed from the receipt of the call by the dispatch entity to the arrival on the scene of a properly equipped and staffed ambulance).
- Dispatch time <1 minute
- Turnout time <1 minute (from when a call is received to the unit being en route)
- On-scene time <15 minutes (barring extenuating circumstances such as extrication difficulties)
Detection
- Public stroke education

Dispatch
- Qualified EMSS

Delivery
- Prehospital management & stroke centers

Door
- Code stroke

Data
- Immediate diagnostic studies

Decision
- Recanalization strategies

Drug
- Anticoagulants and antiplatelets

Disposition
- Medical and surgical treatments
PREHOSPITAL EVALUATION AND MANAGEMENT OF POTENTIAL STROKE PATIENTS
(CLASS I; LEVEL OF EVIDENCE B)

- Assess and manage ABCs
- Initiate cardiac monitoring
- Provide supplemental oxygen to maintain $O_2$ saturation >94%
- Establish IV access per local protocol
- Determine blood glucose and treat accordingly
- Determine time of symptom onset or last known normal, and obtain family contact information, preferably a cell phone
- Triage and rapidly transport patient to the closest available certified Primary Stroke Center or Comprehensive Stroke Center ... (Class I; Level of Evidence A)
- Notify hospital of pending stroke patient arrival (Class I; Level of Evidence B)
# Prehospital Stroke Assessment

*(Class I; Level of Evidence B)*

## LOS ANGELES PREHOSPITAL STROKE SCREEN (LAPSS)

<table>
<thead>
<tr>
<th>Screening Criteria</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Age over 45 years</td>
<td>___</td>
<td>___</td>
</tr>
<tr>
<td>5. No prior history of seizure disorder</td>
<td>___</td>
<td>___</td>
</tr>
<tr>
<td>6. New onset of neurologic symptoms in last 24 hours</td>
<td>___</td>
<td>___</td>
</tr>
<tr>
<td>7. Patient was ambulatory at baseline (prior to event)</td>
<td>___</td>
<td>___</td>
</tr>
<tr>
<td>8. Blood glucose between 60 and 400</td>
<td>___</td>
<td>___</td>
</tr>
</tbody>
</table>

Patient Name: ___________________

Rater Name: ___________________

Date: __________________________
9. **Exam: look for obvious asymmetry**

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Facial smile / grimace:</strong></td>
<td>□</td>
<td>□ Droop</td>
<td>□ Droop</td>
</tr>
<tr>
<td><strong>Grip:</strong></td>
<td>□</td>
<td>□ Weak Grip</td>
<td>□ Weak Grip</td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ No Grip</td>
<td>□ No Grip</td>
</tr>
<tr>
<td><strong>Arm weakness:</strong></td>
<td>□</td>
<td>□ Drifts Down</td>
<td>□ Drifts Down</td>
</tr>
<tr>
<td></td>
<td></td>
<td>□ Falls Rapidly</td>
<td>□ Falls Rapidly</td>
</tr>
</tbody>
</table>

Based on exam, patient has only unilateral (and not bilateral) weakness: Yes □ No □

10. If Yes (or unknown) to all items above LAPSS screening criteria met: Yes □ No □

11. If LAPSS criteria for stroke met, call receiving hospital with “CODE STROKE”, if not then return to the appropriate treatment protocol. (Note: the patient may still be experiencing a stroke if even if LAPSS criteria are not met.)
It evaluates three major physical findings.

- Facial droop
- Motor arm weakness
- Speech abnormalities

Patients with 1 of these 3 findings - as a new event - have a 72% probability of an ischemic stroke.

If all 3 findings are present the probability of an acute stroke is more than 85%
Primary stroke center (PSC) (spoke hospital)
Comprehensive stroke center (CSC) (Hub hospital)
Acute stroke-ready hospital (ASRH)

Certification of stroke centers by an independent external body, such as TJC or state health department, is recommended (Class I; Level of Evidence B).
Primary Stroke Center
(CLASS I; LEVEL OF EVIDENCE B)

- A CT scan or MRI scanner must be available 24 hours each day, and should be reserved for stroke patients **within 25 minutes** of being ordered.
- Access to neurosurgical services (access to a brain surgeon).
- Laboratory tests of patients with acute stroke must be completed **within 45 minutes** of being ordered.
- A physician with expertise in interpreting CT or MRI studies must be available **within 20 minutes** of being asked to read a study.
- A written t-PA protocol must exist in the emergency department.
- Follow long-term stroke treatment outcomes, and design quality improvement activities.
- The hospital must have a "stroke unit".
- The stroke team must schedule stroke **medical education sessions** for stroke staff.
Comprehensive Stroke Center
Personnel with expertise

- Vascular Neurology
- Vascular Neurosurgery
- Advanced Practice Nursing
- Vascular Surgery
- Diagnostic radiology and neuroradiology
- Interventional/endovascular physicians
- Critical care medicine
- Psychiatrists
- Rehabilitation therapy (physical, occupational and speech therapy)
- Staff stroke nurses
- Respiratory Therapists
- Dysphagia (swallowing) evaluation
Comprehensive Stroke Center

Diagnostic techniques

- MRI with diffusion
- MRA and MRV
- Computed Tomography Angiogram (CTA)
- Digital cerebral angiography
- Transcranial Doppler
- Carotid duplex ultrasound
- Transthoracic and *transesophageal* echocardiograms
Comprehensive Stroke Center
Surgical and interventional therapies

- CEA
- Intracranial aneurysm clipping
- Placement of ventriculostomy
- Surgical removal or draining of blood from the brain
- Placement of intracranial pressure monitors
- Endovascular treatment of aneurysms and arteriovenous malformations
- Intra-arterial reperfusion therapy
- Endovascular treatment of vasospasm
Comprehensive Stroke Center

Infrastructure

- Stroke Unit
- Intensive Care Unit
- Operating room staffed 24/7
- Interventional radiology staff available 24/7
- Stroke registry
Comprehensive Stroke Center

Educational/research programs

- Community education
- Community prevention
- Professional education
- Patient education
ACUTE STROKE-READY HOSPITAL
PREVIOUSLY CALLED STROKE-CAPABLE HOSPITALS

- Able to administer intravenous rtPA
- Has well-developed relationships with regional PSCs and CSCs for additional support (hub-and-spoke model)
- Stroke expertise and neuroimaging interpretation in ASRHs are often in the forms of telemedicine and teleradiology (telestroke) (Class I; Level of Evidence B)
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<td>Disposition</td>
<td>Medical and surgical treatments</td>
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# EMERGENCY EVALUATION & DIAGNOSIS OF ACUTE ISCHEMIC STROKE

## Table 5. ED-Based Care

<table>
<thead>
<tr>
<th>Action</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door to physician</td>
<td>≤10 minutes</td>
</tr>
<tr>
<td>Door to stroke team</td>
<td>≤15 minutes</td>
</tr>
<tr>
<td>Door to CT initiation</td>
<td>≤25 minutes</td>
</tr>
<tr>
<td>Door to CT interpretation</td>
<td>≤45 minutes</td>
</tr>
<tr>
<td>Door to drug (≥80% compliance)</td>
<td>≤60 minutes</td>
</tr>
<tr>
<td>Door to stroke unit admission</td>
<td>≤3 hours</td>
</tr>
</tbody>
</table>

CT indicates computed tomography; and ED, emergency department. Source: Bock.⁹⁶
Detection
- Public stroke education

Dispatch
- Qualified EMSS

Delivery
- Prehospital management & stroke centers
- Code stroke

Data
- Immediate diagnostic studies

Decision
- Recanalization strategies

Drug
- Anticoagulants and antiplatelets

Disposition
- Medical and surgical treatments
IMMEDIATE DIAGNOSTIC STUDIES: ALL PATIENTS

- Noncontrast brain CT or brain MRI
- Blood glucose
- Oxygen saturation
- Serum electrolytes/renal function tests*
- Complete blood count, including platelet count*
- Markers of cardiac ischemia*
- PT INR* & aPPT*
- ECG*

*Fibrinolytic therapy should not be delayed while awaiting the results unless
(1) there is clinical suspicion of a bleeding abnormality or thrombocytopenia,
(2) the patient has received heparin or warfarin, or
(3) the patient has received other anticoagulants (direct thrombin inhibitors or
direct factor Xa inhibitors).
IMMEDIATE DIAGNOSTIC STUDIES: SELECTED PATIENTS

- TT and/or ECT (ecarin clotting time) if it is suspected the patient is taking direct thrombin inhibitors or direct factor Xa inhibitors
- Hepatic function tests
- Toxicology screen
- Blood alcohol level
- Pregnancy test
- Arterial blood gas tests (if hypoxia is suspected)
- Chest radiography (if lung disease is suspected)
- Lumbar puncture (if SAH is suspected and CT scan is negative for blood)
- Electroencephalogram (if seizures are suspected)
1. Emergency imaging of the brain is recommended before initiating any specific therapy to treat acute ischemic stroke (Class I; Level of Evidence A). In most instances, NECT will provide the necessary information to make decisions about emergency management. (Unchanged from the previous guideline)
2. Either NECT or MRI is recommended before intravenous rtPA administration to exclude ICH (absolute contra-indication) and to determine whether CT hypodensity or MRI hyperintensity of ischemia is present (Class I; Level of Evidence A). (Revised)
3. Intravenous fibrinolytic therapy is recommended in the setting of early ischemic changes (other than frank hypodensity) on CT, regardless of their extent (Class I; Level of Evidence A). (Revised)
4. A noninvasive intracranial vascular study is strongly recommended during the initial imaging evaluation of the acute stroke patient if either *intra-arterial fibrinolysis* or *mechanical thrombectomy* is contemplated for management but should not delay intravenous rtPA if indicated (Class I; Level of Evidence A). (Revised)
5. In intravenous fibrinolysis candidates, the brain imaging study should be interpreted within 45 minutes of patient arrival in the ED by a physician with expertise in reading CT and MRI studies of the brain parenchyma (Class I; Level of Evidence C). (Revised)
6. CT perfusion and MRI perfusion and diffusion imaging, including measures of infarct core and penumbra, may be considered for the selection of patients for acute reperfusion therapy **beyond the time windows for intravenous fibrinolysis**. These techniques provide additional information that may improve diagnosis, mechanism, and severity of ischemic stroke and allow more informed clinical decision making (Class IIb; Level of Evidence B). (Revised)
7. Frank hypodensity on NECT may increase the risk of hemorrhage with fibrinolysis and should be considered in treatment decisions. If frank hypodensity involves more than one third of the MCA territory, intravenous rtPA treatment should be withheld (Class III; Level of Evidence A). (Revised)
1. Noninvasive imaging of the cervical vessels should be performed routinely as part of the evaluation of patients with suspected TIAs (Class I; Level of Evidence A). (Unchanged from the 2009 TIA scientific statement)
2. Noninvasive imaging by means of CTA or MRA of the intracranial vasculature is recommended to exclude the presence of proximal intracranial stenosis and/or occlusion (Class I; Level of Evidence A) and should be obtained when knowledge of intracranial stenoocclusive disease will alter management. Reliable diagnosis of the presence and degree of intracranial stenosis requires the performance of catheter angiography to confirm abnormalities detected with noninvasive testing. (Revised from the 2009 TIA scientific statement)
3. Patients with transient ischemic neurological symptoms should undergo neuroimaging evaluation within 24 hours of symptom onset or as soon as possible in patients with delayed presentations. MRI, including DWI, is the preferred brain diagnostic imaging modality. If MRI is not available, head CT should be performed (Class I; Level of Evidence B). (Unchanged from the 2009 TIA scientific statement)
CONTENT

- Detection
  - Public stroke education
- Dispatch
  - Qualified EMSS
- Delivery
  - Prehospital management & stroke centers
- Door
  - Code stroke
- Data
  - Immediate diagnostic studies
- Decision
  - Recanalization strategies
- Drug
  - Anticoagulants and antiplatelets
- Disposition
  - Medical and surgical treatments
- Basilar artery: 30% [7]
- Terminal part of the ICA: 6%[9]
- M1 part of the MCA: 30% [4]
- M2 part of the MCA: 44% [3]
- Tandem ICA and MCA occlusion: 27%[5+6]

Diagnosis of ischemic stroke causing measurable neurological deficit

Onset of symptoms <3 hours before beginning treatment

Aged ≥18 years
EXCLUSION CRITERIA FOR PATIENTS WITH ISCHEMIC STROKE WHO COULD BE TREATED WITH IV RTPA WITHIN 3 HOURS FROM SYMPTOM ONSET

- Significant head trauma or prior stroke in previous 3 months
- Symptoms suggest subarachnoid hemorrhage
- Arterial puncture at noncompressible site in previous 7 days
- History of previous intracranial hemorrhage
- Intracranial neoplasm, arteriovenous malformation, or aneurysm
- Recent intracranial or intraspinal surgery
- Elevated blood pressure (systolic >185 mm Hg or diastolic >110 mm Hg)
- Active internal bleeding
- Acute bleeding diathesis, including but not limited to platelet <100000/mm³
- Heparin received within 48 hours, resulting in abnormally elevated aPTT
- Current use of anticoagulant with INR >1.7 or PT >15 seconds
- Current use of direct thrombin inhibitors or direct factor Xa inhibitors with elevated sensitive laboratory tests (such as aPTT, INR, platelet count, and ECT; TT; or appropriate factor Xa activity assays)
- Blood glucose concentration <50 mg/dL (2.7 mmol/L)
- CT demonstrates multilobar infarction (hypodensity >1/3 cerebral hemisphere)
RELATIVE EXCLUSION CRITERIA
PATIENTS MAY RECEIVE FIBRINOLYTIC THERAPY DESPITE 1 OR MORE RELATIVE CONTRAINDICATIONS (CLASS IIB)

- Only minor or rapidly improving stroke symptoms (clearing spontaneously)
- Pregnancy
- Seizure at onset with postictal residual neurological impairments
- Major surgery or serious trauma within previous 14 days
- Recent gastrointestinal or urinary tract hemorrhage (within previous 21 days)
- Recent myocardial infarction (within previous 3 months)

“Caution” instead of “contraindication”
Inclusion criteria
- Diagnosis of ischemic stroke causing measurable neurological deficit
- Onset of symptoms within 3 to 4.5 hours before beginning treatment

Relative exclusion criteria
- Aged >80 years
- Severe stroke (NIHSS>25)
- Taking an oral anticoagulant regardless of INR
- History of both diabetes and prior ischemic stroke

ACUTE ISCHEMIC STROKE WHO COULD BE TREATED WITH IV RTPA WITHIN 3 TO 4.5 HOURS FROM SYMPTOM ONSET

(-) → Class I; Level of Evidence B
(+) → Class IIb; Level of Evidence C
IV or IA rtPA may be harmful and is not recommended unless sensitive laboratory tests such as aPTT, INR, platelet count, and ECT, TT, or appropriate direct factor Xa activity assays are normal, or the patient has NOT received a dose of these agents for >2 days (assuming normal renal metabolizing function) (Class III; Level of Evidence C).
STROKE MIMICS

- Most frequent: Psychogenic, seizures
- Others: Hypoglycemia, migraine with aura, hypertensive encephalopathy, Wernicke’s encephalopathy, CNS abscess, CNS tumor, Drug toxicity
- Lack of apparent harm of intravenous rtPA in stroke mimics
- Stroke mimic treatment rates at experienced centers should be <3% using noncontrast CT alone
Interventional Management of Stroke III (IMS III) trial
- Phase III randomized multicenter open-label clinical trial
- IV rt-PA initiated within 3 h of stroke onset
- Stopped after 656 of the intended 900 patients were enrolled for there was a very low likelihood of finding a 10% difference in favorable clinical outcome at 90 days (modified Rankin Scale score of 0~2) in combined treatment arm

<table>
<thead>
<tr>
<th>IV-rtPA</th>
<th>IV-rtPA + IA-rtPA via standard microcatheter</th>
</tr>
</thead>
<tbody>
<tr>
<td>vs</td>
<td>IV-rtPA + IA-rtPA via EKOS micro-infusion catheter</td>
</tr>
<tr>
<td></td>
<td>IV-rtPA + Merci Retriever ± IA-rtPA</td>
</tr>
<tr>
<td></td>
<td>IV-rtPA + Penumbra Aspiration System ± IA-rtPA</td>
</tr>
<tr>
<td></td>
<td>IV-rtPA + Solitaire FR Revascularization Device ± IA-rtPA</td>
</tr>
</tbody>
</table>
Endovascular Therapy after Intravenous t-PA versus t-PA Alone for Stroke

- Similar for independence (mRS ≤ 2) at 90 days (40.8% with endovascular therapy and 38.7% with intravenous t-PA; with adjustment for the National Institutes of Health Stroke Scale [NIHSS] score
- Similar for mortality at 90 days (19.1% and 21.6%, respectively; P = 0.52)
- Similar for the proportion of patients with symptomatic intracerebral hemorrhage within 30 hours after initiation of t-PA (6.2% and 5.9%, respectively; P = 0.83)
Patients eligible for intravenous rtPA should receive intravenous rtPA even if intra-arterial treatments are being considered (Class I; Level of Evidence A). (Unchanged from the previous guideline)
IA fibrinolysis is beneficial for treatment of carefully selected patients with major ischemic strokes of <6 hours’ duration caused by occlusions of the MCA who are not otherwise candidates for IV rtPA (Class I; Level of Evidence B).

The optimal dose of IA rtPA is not well established, and rtPA does not have FDA approval for IA use.
ENDOVASCULAR INTERVENTIONS
RECOMMENDATION

- When mechanical thrombectomy is pursued, stent retrievers such as Solitaire FR and Trevo are generally preferred to coil retrievers such as Merci (Class I; Level of Evidence A).
- The relative effectiveness of the Penumbra System versus stent retrievers is not yet characterized.
PENUMBRA ASPIRATION SYSTEM
SOLITAIRE FR
REVASCULARIZATION DEVICE
The Merci, Penumbra System, Solitaire FR, and Trevo thrombectomy devices can be useful in achieving recanalization alone or in combination with pharmacological fibrinolysis in carefully selected patients (Class IIa; Level of Evidence B).

These devices should continue to be studied in randomized controlled trials to determine the efficacy of such treatments in improving patient outcomes.
Intra-arterial fibrinolysis or mechanical thrombectomy is reasonable in patients who have contraindications to the use of intravenous fibrinolysis (Class IIa; Level of Evidence C).
Rescue intra-arterial fibrinolysis or mechanical thrombectomy may be reasonable approaches to recanalization in patients with large-artery occlusion who have not responded to intravenous fibrinolysis. Additional randomized trial data are needed (Class IIb; Level of Evidence B).
The usefulness of emergent intracranial angioplasty and/or stenting is not well established. These procedures should be used in the setting of clinical trials (Class IIb; Level of Evidence C).

The usefulness of emergent angioplasty and/or stenting of the extracranial carotid or vertebral arteries in unselected patients is not well established (Class IIb; Level of Evidence C). Use of these techniques may be considered in certain circumstances, such as in the treatment of acute ischemic stroke resulting from cervical atherosclerosis or dissection (Class IIb; Level of Evidence C).
- Detection: Public stroke education
- Dispatch: Qualified EMSS
- Delivery: Prehospital management & stroke centers
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- Data: Immediate diagnostic studies
- Decision: Recanalization strategies
- Drug: Anticoagulants and antiplatelets
- Disposition: Medical and surgical treatments
The usefulness of argatroban or other thrombin inhibitors for treatment of patients with acute ischemic stroke is not well established (Class IIb; Level of Evidence B). These agents should be used in the setting of clinical trials.

The usefulness of urgent anticoagulation in patients with severe stenosis of an internal carotid artery ipsilateral to an ischemic stroke is not well established (Class IIb; Level of Evidence B).
Urgent anticoagulation, with the goal of preventing early recurrent stroke, halting neurological worsening, or improving outcomes after acute ischemic stroke, is not recommended for treatment of patients with acute ischemic stroke.

Urgent anticoagulation for the management of noncerebrovascular conditions is not recommended for patients with moderate-to-severe strokes because of an increased risk of serious intracranial hemorrhagic complications.
Aspirin (initial dose is 325 mg) within 24 to 48 hours after stroke (Class I; Level of Evidence A).

The usefulness of clopidogrel is not well established (Class IIb; Level of Evidence C). Further research testing is required.

The efficacy of intravenous tirofiban and eptifibatide is not well established (Class IIb; Level of Evidence C).

The administration of other intravenous antiplatelet agents that inhibit the glycoprotein IIb/IIIa receptor (Abciximab) is not recommended (Class III; Level of Evidence B).
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Disposition
- Medical and surgical treatments
Cardiac monitoring should be performed for at least the first 24 hours (Class I; Level of Evidence B).

Supplemental oxygen should be provided to maintain oxygen saturation >94% (Class I; Level of Evidence C).

In patients with BP > 220/120, a reasonable goal is to lower blood pressure by 15% during the first 24 hours after onset of stroke. (Class I; Level of Evidence C).

Restarting antihypertensive medications is reasonable after the first 24 hours for patients who have preexisting hypertension and are neurologically stable unless a specific contraindication to restarting treatment is known (Class IIa; Level of Evidence B).
EMERGENT OR URGENT
CAROTID ENDARTERECTOMY

- A small infarct core with large territory at risk (eg, *penumbra*), compromised by inadequate flow from a critical carotid stenosis or occlusion, or in the case of acute neurological deficit after CEA (*Class IIb*; *Level of Evidence B*)

- **Unstable** neurological status (either stroke-in-evolution or crescendo TIA) (*Class IIb*; *Level of Evidence B*)
1. Decompressive surgical evacuation of a space-occupying cerebellar infarction (Level of Evidence B)

2. Placement of a ventricular drain is useful in patients with acute hydrocephalus secondary to ischemic stroke (Level of Evidence C)

3. Decompressive surgery for malignant edema of the cerebral hemisphere is effective and potentially lifesaving (Level of Evidence B). Advanced patient age and patient/family valuations of achievable outcome states may affect decisions regarding surgery.
HEMICRANIECTOMY & DURAPLASTY FOR LARGE HEMISPHERIC INFARCTION OR MALIGNANT MCA INFARCTION

Should be held within 48 hours after onset of stroke
5 RANDOMIZED TRIALS OF HEMICRANIECTOMY & DURAPLASTY FOR MALIGNANT MCA INFARCTION

- HeADDFIRST (US)
- HeMMI (Philippines)
- HAMLET (Netherlands)
- DECIMAL (France)
- DESTINY (Germany)
HEMICRANIECTOMY & DURAPLASTY FOR MALIGNANT MCA INFARCTION

INCLUSION CRITERIA

- Age 18–60 years
- MCA infarction, including at least 2/3 of the territory and including at least part of the basal ganglia, with or without additional ipsilateral infarction of the ACA or PCA
- NIHSS score > 18 for lesions of the nondominant and > 20 for lesions of the dominant hemisphere
- Consciousness: drowsy or obtunded
- Onset of symptoms < 36 hours
- Start treatment/surgery within 6 hours
HEMICRANIECTOMY & DURAPLASTY FOR MALIGNANT MCA INFARCTION

EXCLUSION CRITERIA

- Prestroke mRS score $\geq 2$
- Prestroke score on the Barthel Index < 95
- Score on the Glasgow Coma Scale < 6
- Both pupils fixed and dilated
- Any other coincidental brain lesion that might affect outcome
- Space-occupying hemorrhagic transformation of the infarct
- Life expectancy < 3 years
- Other serious illness that might affect outcome
FOR EVERY 10 HEMICRANIECTOMIES FOR MCA INFARCTION

- 5 patients will escape death and at 1 year
  - Mild disability = 1
  - Moderate disability = 1
  - Moderate-to-severe disability = 3 (unable to walk independently)
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