Guidelines for the Early Management of Patients With Acute Ischemic Stroke: Executive Summary

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

Edward C. Jauch, MD, MS, FAHA, Chair; Jeffrey L. Saver, MD, FAHA, Vice Chair; Harold P. Adams, Jr, MD, FAHA; Askiel Bruno, MD, MS; J.J. (Buddy) Connors, MD; Bart M. Demaerschalk, MD, MSc; Pooja Khatri, MD, MSc, FAHA; Paul W. McMullan, Jr, MD, FAHA; Adnan I. Qureshi, MD, FAHA; Kenneth Rosenfield, MD, FAHA; Phillip A. Scott, MD, FAHA; Debbie R. Summers, RN, MSN, FAHA; David Z. Wang, DO, FAHA; Max Wintermark, MD; Howard Yonas, MD; on behalf of the American Heart Association Stroke Council, Council on Cardiovascular Nursing, Council on Peripheral Vascular Disease, and Council on Clinical Cardiology

This publication, "Guidelines for the Early Management of Patients With Acute Ischemic Stroke," from the American Heart Association/American Stroke Association (AHA/ASA) is an overview of the current evidence and management recommendations for evaluation and treatment of adults with acute ischemic stroke. The intended audiences are prehospital care providers, physicians, allied health professionals, and hospital administrators responsible for the care of acute ischemic stroke patients within the first 48 hours from stroke onset. These guidelines supersede the prior 2007 guidelines and the 2009 update on the extended time window for administration of fibrinolytic agents.

These guidelines take on increased relevance as the global burden of stroke continues to increase, and yet the impact of our focused attention on stroke is encouraging. In 2008, after years of being the third-leading cause of death in the United States, stroke dropped to fourth. In part, this may reflect the results of a commitment made by the AHA/ASA more than a decade ago to reduce stroke, coronary heart disease, and cardiovascular risk by 25% by the year 2010. The reasons for the success were multifactorial and included improved prevention and improved care within the first hours of acute stroke. To continue these encouraging trends, the public and healthcare professionals must remain vigilant and committed to improving overall stroke care. This document addresses opportunities for optimal stroke care in the acute phase of the acute ischemic stroke.

The goal of these guidelines is to further reduce the morbidity and mortality associated with stroke. The guidelines support the overarching concept of stroke systems of care and detail aspects of stroke care from patient recognition; emergency medical services (EMS) activation, transport, and triage; through the initial hours in the emergency department and stroke unit. These guidelines specifically deal with the acute diagnosis, stabilization, and medical and surgical treatments of acute ischemic stroke, as well as early inpatient management, secondary prevention, and complication management. Over the past several years, several new guidelines, policy statements, and recommendations on implementation strategies for EMS within stroke systems of care, imaging in acute ischemic stroke, management of stroke in infants and children, nursing and interdisciplinary care in acute stroke, primary prevention of ischemic stroke, stroke systems of care, and management of transient ischemic attack (TIA) related to acute ischemic stroke have been published by the AHA/ASA. To minimize redundancy, the reader will be referred to these publications where appropriate.

The Stroke Council of the AHA/ASA commissioned the assembled authors, representing the fields of cardiology,

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emergency medicine, neurosurgery, nursing, radiology, rehabilitation, neurocritical care, endovascular neurosurgical radiology, and vascular neurology, from several AHA/ASA councils to completely revise and update the guidelines for the management of acute ischemic stroke. Because of the wide scope of the guidelines, individual members of the panel were assigned as primary and secondary authors for individual sections, then the panel assessed the complete guidelines. If the panel concluded that data supported or did not support the use of a specific intervention, appropriate recommendations were made. In some instances, supporting evidence based on clinical trial research was not available for a specific intervention, but the panel has made a specific recommendation on the basis of pathophysiological reasoning and expert practice experience. In summary, in writing these guidelines, the panel applied the well-described rules of evidence and the formulation of strength of recommendations used by other panels of the AHA/ASA.

This guideline document is a testament to the incredible commitment of AHA/ASA expert volunteers and reviewers to produce a contemporary document that summarizes the current state of science regarding acute stroke care. Adherence to these guidelines will certainly contribute to the decreased morbidity and mortality of patients with acute stroke.

Recommendations

Prehospital Stroke Management

1. To increase both the number of patients who are treated and the quality of care, educational stroke programs for physicians, hospital personnel, and EMS personnel are recommended (*Class I; Level of Evidence B*). (Unchanged from the previous guideline)
2. Activation of the 911 system by patients or other members of the public is strongly recommended (*Class I; Level of Evidence B*). 911 Dispatchers should make stroke a priority dispatch, and transport times should be minimized. (Unchanged from the previous guideline)
3. Prehospital care providers should use prehospital stroke assessment tools, such as the Los Angeles Prehospital Stroke Screen or Cincinnati Prehospital Stroke Scale *(Class I; Level of Evidence B)*. (Unchanged from the previous guideline)
4. EMS personnel should begin the initial management of stroke in the field, as outlined in Table 4 in the full text of the guideline *(Class I; Level of Evidence B)*. Development of a stroke protocol to be used by EMS personnel is strongly encouraged. (Unchanged from the previous guideline)
5. Patients should be transported rapidly to the closest available certified primary stroke center or comprehensive stroke center or, if no such centers exist, the most appropriate institution that provides emergency stroke care as described in the statement *(Class I; Level of Evidence A)*. In some instances, this may involve air medical transport and hospital bypass. (Revised from the previous guideline)
6. EMS personnel should provide prehospital notification to the receiving hospital that a potential stroke patient is en route so that the appropriate hospital resources may be mobilized before patient arrival *(Class I; Level of Evidence B)*. (Revised from the previous guideline)

Designation of Stroke Centers and Stroke Care Quality Improvement Process

1. The creation of primary stroke centers is recommended *(Class I; Level of Evidence B)*. The organization of such resources will depend on local resources. The stroke system design of regional acute stroke-ready hospitals and primary stroke centers that provide emergency care and that are closely associated with a comprehensive stroke center, which provides more extensive care, has considerable appeal. (Unchanged from the previous guideline)
2. Certification of stroke centers by an independent external body, such as The Joint Commission or state health department, is recommended *(Class I; Level of Evidence B)*. Additional medical centers should seek such certification. (Revised from the previous guideline)
3. Healthcare institutions should organize a multidisciplinary quality improvement committee to review and monitor stroke care quality benchmarks, indicators, evidence-based practices, and outcomes (*Class I; Level of Evidence B*). The formation of a clinical process improvement team and the establishment of a stroke care data bank are helpful for such quality of care assurances. The data repository can be used to identify the gaps or disparities in quality stroke care. Once the gaps have been identified, specific interventions can be initiated to address these gaps or disparities. (New recommendation)
4. For patients with suspected stroke, EMS should bypass hospitals that do not have resources to treat stroke and go to the closest facility most capable of treating acute stroke (*Class I; Level of Evidence B*). (Unchanged from the previous guideline)
5. For sites without in-house imaging interpretation expertise, teleradiology systems approved by the Food and Drug Administration (or equivalent organization) are recommended for timely review of brain computed tomography (CT) and magnetic resonance imaging (MRI) scans in patients with suspected acute stroke (*Class I; Level of Evidence B*). (New recommendation)
6. When implemented within a telestroke network, teleradiology systems approved by the Food and Drug Administration (or equivalent organization) are useful in supporting rapid imaging interpretation in time for fibrinolysis decision making *(Class I; Level of Evidence B)*. (New recommendation)
7. The development of comprehensive stroke centers is recommended *(Class I; Level of Evidence C)*. (Unchanged from the previous guideline)
8. Implementation of telestroke consultation in conjunction with stroke education and training for healthcare providers can be useful in increasing the use of intravenous recombinant tissue-type plasminogen activator (rtPA) at community hospitals without access to adequate onsite stroke expertise (*Class IIa; Level of Evidence B*). (New recommendation)
9. The creation of acute stroke-ready hospitals can be useful (*Class IIa; Level of Evidence C*). As with primary stroke centers, the organization of such resources will

depend on local resources. The stroke system design of regional acute stroke-ready hospitals and primary stroke centers that provide emergency care and that are closely associated with a comprehensive stroke center, which provides more extensive care, has considerable appeal. (New recommendation)

Emergency Evaluation and Diagnosis of Acute Ischemic Stroke

1. An organized protocol for the emergency evaluation of patients with suspected stroke is recommended *(Class I; Level of Evidence B)*. The goal is to complete an evaluation and to begin fibrinolytic treatment within 60 minutes of the patient's arrival in an emergency department. Designation of an acute stroke team that includes physicians, nurses, and laboratory/radiology personnel is encouraged. Patients with stroke should have a careful clinical assessment, including neurological examination. (Unchanged from the previous guideline)
2. The use of a stroke rating scale, preferably the National Institutes of Health Stroke Scale (NIHSS), is recommended *(Class I; Level of Evidence B)*. (Unchanged from the previous guideline)
3. A limited number of hematologic, coagulation, and biochemistry tests are recommended during the initial emergency evaluation, and only the assessment of blood glucose must precede the initiation of intravenous rtPA (Table 8 in the full text of the guideline) *(Class I; Level of Evidence B)*. (Revised from the previous guideline)
4. Baseline electrocardiogram assessment is recommended in patients presenting with acute ischemic stroke but should not delay initiation of intravenous rtPA *(Class I; Level of Evidence B)*. (Revised from the previous guideline)
5. Baseline troponin assessment is recommended in patients presenting with acute ischemic stroke but should not delay initiation of intravenous rtPA *(Class I; Level of Evidence C)*. (Revised from the previous guideline)
6. The usefulness of chest radiographs in the hyperacute stroke setting in the absence of evidence of acute pulmonary, cardiac, or pulmonary vascular disease is unclear. If obtained, they should not unnecessarily delay administration of fibrinolysis *(Class IIb; Level of Evidence B)*. (Revised from the previous guideline)

Early Diagnosis: Brain and Vascular Imaging

For patients with acute cerebral ischemic symptoms that have not yet resolved:

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, non–contrast-enhanced CT will provide the necessary information to make decisions about emergency management. (Unchanged from the previous guideline)
2. Either non–contrast-enhanced CT or MRI is recommended before intravenous rtPA administration to exclude intracerebral hemorrhage (absolute contraindication) and to determine whether CT hypodensity or MRI hyperintensity of ischemia is present *(Class I; Level of Evidence A)*. (Revised from the 2009 imaging scientific statement)
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 from the 2009 imaging scientific statement)
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 from the 2009 imaging scientific statement)
5. In intravenous fibrinolysis candidates, the brain imaging study should be interpreted within 45 minutes of patient arrival in the emergency department by a physician with expertise in reading CT and MRI studies of the brain parenchyma *(Class I; Level of Evidence C)*. (Revised from the previous guideline)
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 from the 2009 imaging scientific statement)
7. Frank hypodensity on non–contrast-enhanced CT 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 middle cerebral artery territory, intravenous rtPA treatment should be withheld *(Class III; Level of Evidence A)*. (Revised from the 2009 imaging scientific statement)

For patients with cerebral ischemic symptoms that have resolved:

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 CT angiography or magnetic resonance angiography 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 steno-occlusive 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 diffusion-weighted imaging, 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)

General Supportive Care and Treatment of Acute Complications

1. Cardiac monitoring is recommended to screen for atrial fibrillation and other potentially serious cardiac arrhythmias that would necessitate emergency cardiac interventions. Cardiac monitoring should be performed for at least the first 24 hours *(Class I; Level of Evidence B)*. (Revised from the previous guideline)
2. Patients who have elevated blood pressure and are otherwise eligible for treatment with intravenous rtPA should have their blood pressure carefully lowered (Table 9 in the full text of the guideline) so that their systolic blood pressure is <185 mm Hg and their diastolic blood pressure is <110 mm Hg *(Class I; Level of Evidence B)* before fibrinolytic therapy is initiated. If medications are given to lower blood pressure, the clinician should be sure that the blood pressure is stabilized at the lower level before beginning treatment with intravenous rtPA and maintained below 180/105 mm Hg for at least the first 24 hours after intravenous rtPA treatment. (Unchanged from the previous guideline)
3. Airway support and ventilatory assistance are recommended for the treatment of patients with acute stroke who have decreased consciousness or who have bulbar dysfunction that causes compromise of the airway (*Class I; Level of Evidence C*). (Unchanged from the previous guideline)
4. Supplemental oxygen should be provided to maintain oxygen saturation >94% *(Class I; Level of Evidence C)*. (Revised from the previous guideline)
5. Sources of hyperthermia (temperature >38°C) should be identified and treated, and antipyretic medications should be administered to lower temperature in hyperthermic patients with stroke *(Class I; Level of Evidence C)*. (Unchanged from the previous guideline)
6. Until other data become available, consensus exists that the previously described blood pressure recommendations should be followed in patients undergoing other acute interventions to recanalize occluded vessels, including intra-arterial fibrinolysis *(Class I; Level of Evidence C)*. (Unchanged from the previous guideline)
7. In patients with markedly elevated blood pressure who do not receive fibrinolysis, a reasonable goal is to lower blood pressure by 15% during the first 24 hours after onset of stroke. The level of blood pressure that would mandate such treatment is not known, but consensus exists that medications should be withheld unless the systolic blood pressure is >220 mm Hg or the diastolic blood pressure is >120 mm Hg *(Class I; Level of Evidence C)*. (Revised from the previous guideline)
8. Hypovolemia should be corrected with intravenous normal saline, and cardiac arrhythmias that might be reducing cardiac output should be corrected *(Class I; Level of Evidence C)*. (Revised from the previous guideline)
9. Hypoglycemia (blood glucose <60 mg/dL) should be treated in patients with acute ischemic stroke *(Class I; Level of Evidence C)*. The goal is to achieve normoglycemia. (Revised from the previous guideline)
10. Evidence from one clinical trial indicates that initiation of antihypertensive therapy within 24 hours of stroke is relatively safe. 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)*. (Revised from the previous guideline)
11. No data are available to guide selection of medications for the lowering of blood pressure in the setting of acute ischemic stroke. The antihypertensive medications and doses included in Table 9 in the full text of the guideline are reasonable choices based on general consensus *(Class IIa; Level of Evidence C)*. (Revised from the previous guideline)
12. Evidence indicates that persistent in-hospital hyperglycemia during the first 24 hours after stroke is associated with worse outcomes than normoglycemia, and thus, it is reasonable to treat hyperglycemia to achieve blood glucose levels in a range of 140 to 180 mg/dL and to closely monitor to prevent hypoglycemia in patients with acute ischemic stroke *(Class IIa; Level of Evidence C)*. (Revised from the previous guideline)
13. The management of arterial hypertension in patients not undergoing reperfusion strategies remains challenging. Data to guide recommendations for treatment are inconclusive or conflicting. Many patients have spontaneous declines in blood pressure during the first 24 hours after onset of stroke. Until more definitive data are available, the benefit of treating arterial hypertension in the setting of acute ischemic stroke is not well established *(Class IIb; Level of Evidence C)*. Patients who have malignant hypertension or other medical indications for aggressive treatment of blood pressure should be treated accordingly. (Revised from the previous guideline)
14. Supplemental oxygen is not recommended in nonhypoxic patients with acute ischemic stroke *(Class III; Level of Evidence B)*. (Unchanged from the previous guideline)

Intravenous Fibrinolysis

1. Intravenous rtPA (0.9 mg/kg, maximum dose 90 mg) is recommended for selected patients who may be treated within 3 hours of onset of ischemic stroke *(Class I; Level of Evidence A)*. Physicians should review the criteria outlined in Tables 10 and 11 in the full text of the guideline (which are modeled on those used in the National Institute of Neurologic Disorders and Stroke rt-PA Stroke Study) to determine the eligibility of the patient. A recommended regimen for observation and treatment of patients who receive intravenous rtPA is described in Table 12 in the full text of the guideline. (Unchanged from the previous guideline)
2. In patients eligible for intravenous rtPA, benefit of therapy is time dependent, and treatment should be initiated as quickly as possible. The door-to-needle time (time of bolus administration) should be within 60 minutes from hospital arrival *(Class I; Level of Evidence A)*. (New recommendation)
3. Intravenous rtPA (0.9 mg/kg, maximum dose 90 mg) is recommended for administration to eligible patients who can be treated in the time period of 3 to 4.5 hours after stroke onset *(Class I; Level of Evidence B)*. The eligibility criteria for treatment in this time period are similar to

those for people treated at earlier time periods within 3 hours, with the following additional exclusion criteria: patients >80 years old, those taking oral anticoagulants regardless of international normalized ratio, those with a baseline NIHSS score >25, those with imaging evidence of ischemic injury involving more than one third of the middle cerebral artery territory, or those with a history of both stroke and diabetes mellitus. (Revised from the 2009 IV rtPA Science Advisory)

4. Intravenous rtPA is reasonable in patients whose blood pressure can be lowered safely (to below 185/110 mm Hg) with antihypertensive agents, with the physician assessing the stability of the blood pressure before starting intravenous rtPA *(Class I; Level of Evidence B)*. (Unchanged from the previous guideline)
5. In patients undergoing fibrinolytic therapy, physicians should be aware of and prepared to emergently treat potential side effects, including bleeding complications and angioedema that may cause partial airway obstruction *(Class I; Level of Evidence B)*. (Revised from the previous guideline)
6. Intravenous rtPA is reasonable in patients with a seizure at the time of onset of stroke if evidence suggests that residual impairments are secondary to stroke and not a postictal phenomenon *(Class IIa; Level of Evidence C)*. (Unchanged from the previous guideline)
7. The effectiveness of sonothrombolysis for treatment of patients with acute stroke is not well established *(Class IIb; Level of Evidence B)*. (New recommendation)
8. The usefulness of intravenous administration of tenecteplase, reteplase, desmoteplase, urokinase, or other fibrinolytic agents and the intravenous administration of ancrod or other defibrinogenating agents is not well established, and they should only be used in the setting of a clinical trial *(Class IIb; Level of Evidence B)*. (Revised from the previous guideline)
9. For patients who can be treated in the time period of 3 to 4.5 hours after stroke but have 1 or more of the following exclusion criteria: (1) patients >80 years old, (2) those taking oral anticoagulants, even with international normalized ratio ≤1.7, (3) those with a baseline NIHSS score >25, or (4) those with a history of both stroke and diabetes mellitus, the effectiveness of intravenous treatment with rtPA is not well-established, *(Class IIb, Level of Evidence C)*, and requires further study.
10. Use of intravenous fibrinolysis in patients with conditions of mild stroke deficits, rapidly improving stroke symptoms, major surgery in the preceding 3 months, and recent myocardial infarction may be considered, and potential increased risk should be weighed against the anticipated benefits *(Class IIb; Level of Evidence C)*. These circumstances require further study. (New recommendation)
11. The intravenous administration of streptokinase for treatment of stroke is not recommended *(Class III; Level of Evidence A)*. (Revised from the previous guideline)
12. The use of intravenous rtPA in patients taking direct thrombin inhibitors or direct factor Xa inhibitors may be harmful and is not recommended unless sensitive laboratory tests such as activated partial thromboplastin time, international normalized ratio, platelet count, and ecarin clotting time, thrombin time, 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). Similar consideration should be given to patients being considered for intra-arterial rtPA *(Class III; Level of Evidence C)*. (New recommendation) Further study is required.

Endovascular Interventions

1. 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)
2. Intra-arterial fibrinolysis is beneficial for treatment of carefully selected patients with major ischemic strokes of <6 hours' duration caused by occlusions of the middle cerebral artery who are not otherwise candidates for intravenous rtPA (*Class I; Level of Evidence B*). The optimal dose of intra-arterial rtPA is not well established, and rtPA does not have Food and Drug Administration approval for intra-arterial use. (Revised from the previous guideline)
3. As with intravenous fibrinolytic therapy, reduced time from symptom onset to reperfusion with intra-arterial therapies is highly correlated with better clinical outcomes, and all efforts must be undertaken to minimize delays to definitive therapy *(Class I; Level of Evidence B)*. (New recommendation)
4. Intra-arterial treatment requires the patient to be at an experienced stroke center with rapid access to cerebral angiography and qualified interventionalists. An emphasis on expeditious assessment and treatment should be made. Facilities are encouraged to define criteria that can be used to credential individuals who can perform intra-arterial revascularization procedures. Outcomes on all patients should be tracked *(Class I; Level of Evidence C)*. (Revised from the previous guideline)
5. 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. (New recommendation)
6. 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)*. Their ability to improve patient outcomes has not yet been established. These devices should continue to be studied in randomized controlled trials to determine the efficacy of such treatments in improving patient outcomes. (Revised from the previous guideline)
7. 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)*. (Revised from the previous guideline)
8. 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)*. (New recommendation)
9. The usefulness of mechanical thrombectomy devices other than the Merci retriever, the Penumbra System, Solitaire FR, and Trevo is not well established *(Class IIb; Level of Evidence C)*. These devices should be used in the setting of clinical trials. (Revised from the previous guideline)
10. 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)*. (New recommendation)
11. 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)*. Additional randomized trial data are needed. (New recommendation)

Anticoagulants

1. At present, 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. (New recommendation)
2. 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*). (New recommendation)
3. 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 *(Class III; Level of Evidence A)*. (Unchanged from the previous guideline)
4. 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 *(Class III; Level of Evidence A)*. (Unchanged from the previous guideline)
5. Initiation of anticoagulant therapy within 24 hours of treatment with intravenous rtPA is not recommended *(Class III; Level of Evidence B)*. (Unchanged from the previous guideline)

Antiplatelet Agents

1. Oral administration of aspirin (initial dose is 325 mg) within 24 to 48 hours after stroke onset is recommended for treatment of most patients *(Class I; Level of Evidence A)*. (Unchanged from the previous guideline)
2. The usefulness of clopidogrel for the treatment of acute ischemic stroke is not well established *(Class IIb; Level of Evidence C)*. Further research testing the usefulness of the emergency administration of clopidogrel in the treatment of patients with acute stroke is required. (Revised from the previous guideline)
3. The efficacy of intravenous tirofiban and eptifibatide is not well established, and these agents should be used only in the setting of clinical trials (*Class IIb; Level of Evidence C*). (New recommendation)
4. Aspirin is not recommended as a substitute for other acute interventions for treatment of stroke, including intravenous rtPA *(Class III; Level of Evidence B)*. (Unchanged from the previous guideline)
5. The administration of other intravenous antiplatelet agents that inhibit the glycoprotein IIb/IIIa receptor is not recommended *(Class III; Level of Evidence B)*. (Revised from the previous guideline) Further research testing the usefulness of emergency administration of these medications as a treatment option in patients with acute ischemic stroke is required.
6. The administration of aspirin (or other antiplatelet agents) as an adjunctive therapy within 24 hours of intravenous fibrinolysis is not recommended *(Class III; Level of Evidence C)*. (Revised from the previous guideline)

Volume Expansion, Vasodilators, and Induced Hypertension

1. In exceptional cases with systemic hypotension producing neurological sequelae, a physician may prescribe vasopressors to improve cerebral blood flow. If drug-induced hypertension is used, close neurological and cardiac monitoring is recommended *(Class I; Level of Evidence C)*. (Revised from the previous guideline)
2. The administration of high-dose albumin is not well established as a treatment for most patients with acute ischemic stroke until further definitive evidence regarding efficacy becomes available *(Class IIb; Level of Evidence B)*. (New recommendation)
3. At present, use of devices to augment cerebral blood flow for the treatment of patients with acute ischemic stroke is not well established *(Class IIb; Level of Evidence B)*. These devices should be used in the setting of clinical trials. (New recommendation)
4. The usefulness of drug-induced hypertension in patients with acute ischemic stroke is not well established *(Class IIb; Level of Evidence B)*. (Revised from the previous guideline) Induced hypertension should be performed in the setting of clinical trials.
5. Hemodilution by volume expansion is not recommended for treatment of patients with acute ischemic stroke *(Class III; Level of Evidence A)*. (Revised from the previous guideline)
6. The administration of vasodilatory agents, such as pentoxifylline, is not recommended for treatment of patients with acute ischemic stroke *(Class III; Level of Evidence A)*. (Unchanged from the previous guideline)

Neuroprotective Agents

1. Among patients already taking statins at the time of onset of ischemic stroke, continuation of statin therapy during the acute period is reasonable *(Class IIa; Level of Evidence B)*. (New recommendation)
2. The utility of induced hypothermia for the treatment of patients with ischemic stroke is not well established,

and further trials are recommended *(Class IIb; Level of Evidence B)*. (Revised from the previous guideline)
3. At present, transcranial near-infrared laser therapy is not well established for the treatment of acute ischemic stroke *(Class IIb; Level of Evidence B)*, and further trials are recommended. (New recommendation)
4. At present, no pharmacological agents with putative neuroprotective actions have demonstrated efficacy in improving outcomes after ischemic stroke, and therefore, other neuroprotective agents are not recommended *(Class III; Level of Evidence A)*. (Revised from the previous guideline)
5. Data on the utility of hyperbaric oxygen are inconclusive, and some data imply that the intervention may be harmful. Thus, with the exception of stroke secondary to air embolization, this intervention is not recommended for treatment of patients with acute ischemic stroke *(Class III; Level of Evidence B)*. (Unchanged from the previous guideline)

Surgical Interventions

1. The usefulness of emergent or urgent carotid endarterectomy when clinical indicators or brain imaging suggests 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 carotid endarterectomy, in which acute thrombosis of the surgical site is suspected, is not well established *(Class IIb; Level of Evidence B)*. (New recommendation)
2. In patients with unstable neurological status (either stroke-in-evolution or crescendo TIA), the efficacy of emergent or urgent carotid endarterectomy is not well established *(Class IIb; Level of Evidence B)*. (New recommendation)

Admission to the Hospital and General Acute Treatment (After Hospitalization)

1. The use of comprehensive specialized stroke care (stroke units) that incorporates rehabilitation is recommended *(Class I; Level of Evidence A)*. (Unchanged from the previous guideline)
2. Patients with suspected pneumonia or urinary tract infections should be treated with appropriate antibiotics *(Class I; Level of Evidence A)*. (Revised from the previous guideline)
3. Subcutaneous administration of anticoagulants is recommended for treatment of immobilized patients to prevent deep vein thrombosis *(Class I; Level of Evidence A)*. (Unchanged from the previous guideline)
4. The use of standardized stroke care order sets is recommended to improve general management *(Class I; Level of Evidence B)*. (Unchanged from the previous guideline)
5. Assessment of swallowing before the patient begins eating, drinking, or receiving oral medications is recommended (*Class I; Level of Evidence B*). (Unchanged from the previous guideline)
6. Patients who cannot take solid food and liquids orally should receive nasogastric, nasoduodenal, or percutaneous endoscopic gastrostomy tube feedings to maintain hydration and nutrition while undergoing efforts to restore swallowing *(Class I; Level of Evidence B)*. (Revised from the previous guideline)
7. Early mobilization of less severely affected patients and measures to prevent subacute complications of stroke are recommended *(Class I; Level of Evidence C)*. (Unchanged from the previous guideline)
8. Treatment of concomitant medical diseases is recommended *(Class I; Level of Evidence C*). (Unchanged from the previous guideline)
9. Early institution of interventions to prevent recurrent stroke is recommended *(Class I; Level of Evidence C)*. (Unchanged from the previous guideline)
10. The use of aspirin is reasonable for treatment of patients who cannot receive anticoagulants for prophylaxis of deep vein thrombosis *(Class IIa; Level of Evidence A)*. (Revised from the previous guideline)
11. In selecting between nasogastric and percutaneous endoscopic gastrostomy tube routes of feeding in patients who cannot take solid food or liquids orally, it is reasonable to prefer nasogastric tube feeding until 2 to 3 weeks after stroke onset *(Class IIa; Level of Evidence B)*. (Revised from the previous guideline)
12. The use of intermittent external compression devices is reasonable for treatment of patients who cannot receive anticoagulants *(Class IIa; Level of Evidence B)*. (Revised from the previous guideline)
13. Routine use of nutritional supplements has not been shown to be beneficial *(Class III; Level of Evidence B)*. (Revised from the previous guideline)
14. Routine use of prophylactic antibiotics has not been shown to be beneficial *(Class III; Level of Evidence B)*. (Revised from the previous guideline)
15. Routine placement of indwelling bladder catheters is not recommended because of the associated risk of catheter-associated urinary tract infections *(Class III; Level of Evidence C)*. (Unchanged from the previous guideline)

Treatment of Acute Neurological Complications

1. Patients with major infarctions are at high risk for complicating brain edema and increased intracranial pressure. Measures to lessen the risk of edema and close monitoring of the patient for signs of neurological worsening during the first days after stroke are recommended *(Class I; Level of Evidence A)*. Early transfer of patients at risk for malignant brain edema to an institution with neurosurgical expertise should be considered. (Revised from the previous guideline)
2. Decompressive surgical evacuation of a space-occupying cerebellar infarction is effective in preventing and treating herniation and brain stem compression *(Class I; Level of Evidence B)*. (Revised from the previous guideline)
3. Decompressive surgery for malignant edema of the cerebral hemisphere is effective and potentially lifesaving (*Class I; Level of Evidence B*). Advanced patient age and patient/family valuations of achievable outcome states may affect decisions regarding surgery. (Revised from the previous guideline)

4. Recurrent seizures after stroke should be treated in a manner similar to other acute neurological conditions, and antiepileptic agents should be selected by specific patient characteristics (*Class I; Level of Evidence B*). (Unchanged from the previous guideline)
5. Placement of a ventricular drain is useful in patients with acute hydrocephalus secondary to ischemic stroke (*Class I; Level of Evidence C*). (Revised from the previous guideline)
6. Although aggressive medical measures have been recommended for treatment of deteriorating patients with malignant brain edema after large cerebral infarction, the usefulness of these measures is not well established (*Class IIb; Level of Evidence C*). (Revised from the previous guideline)
7. Because of lack of evidence of efficacy and the potential to increase the risk of infectious complications, corticosteroids (in conventional or large doses) are not recommended for treatment of cerebral edema and increased intracranial pressure complicating ischemic stroke (*Class III; Level of Evidence A*). (Unchanged from the previous guideline)
8. Prophylactic use of anticonvulsants is not recommended (*Class III; Level of Evidence C*). (Unchanged from the previous guideline)

References

References are available in the full text of this guideline: http://stroke.ahajournals.org/lookup/doi/10.1161/STR.0b013e318284056a.