AHA/ASA GUIDELINES

Guidelines for the Early Management of Patients with Acute Ischemic Stroke: 2019 Update to the 2018 Guidelines for the Early Management of Acute Ischemic Stroke

A guideline for healthcare professionals from the American Heart Association/American Stroke Association

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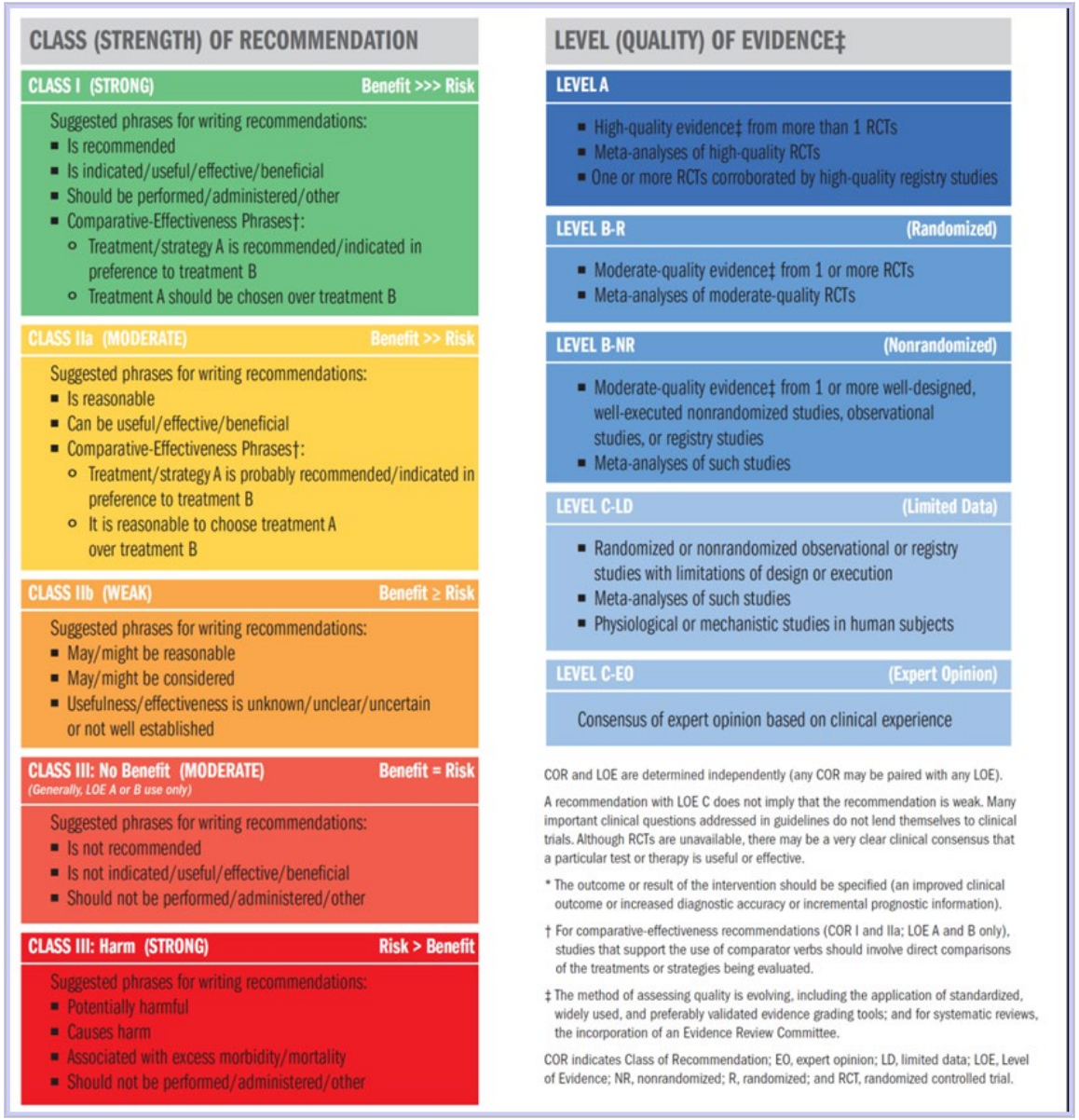
Applying Classification of Recommendations and Level of Evidence



CLASS (STRENGTH) OF RECOMMENDATION

CLASS I (STRONG) — Benefit >>> Risk

Suggested phrases for writing recommendations:
- Is recommended
- Is indicated/useful/effective/beneficial
- Should be performed/administered/other
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is recommended/indicated in preference to treatment B
  - Treatment A should be chosen over treatment B

CLASS IIa (MODERATE) — Benefit >> Risk

Suggested phrases for writing recommendations:
- Is reasonable
- Can be useful/effective/beneficial
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is probably recommended/indicated in preference to treatment B
  - It is reasonable to choose treatment A over treatment B

CLASS IIb (WEAK) — Benefit ≥ Risk

Suggested phrases for writing recommendations:
- May/might be reasonable
- May/might be considered
- Usefulness/effectiveness is unknown/unclear/uncertain or not well established

CLASS III: No Benefit (MODERATE) — Benefit = Risk
(Generally, LOE A or B use only)

Suggested phrases for writing recommendations:
- Is not recommended
- Is not indicated/useful/effective/beneficial
- Should not be performed/administered/other

CLASS III: Harm (STRONG) — Risk > Benefit

Suggested phrases for writing recommendations:
- Potentially harmful
- Causes harm
- Associated with excess morbidity/mortality
- Should not be performed/administered/other

LEVEL (QUALITY) OF EVIDENCE‡

LEVEL A
- High-quality evidence‡ from more than 1 RCTs
- Meta-analyses of high-quality RCTs
- One or more RCTs corroborated by high-quality registry studies

LEVEL B-R (Randomized)
- Moderate-quality evidence‡ from 1 or more RCTs
- Meta-analyses of moderate-quality RCTs

LEVEL B-NR (Nonrandomized)
- Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies
- Meta-analyses of such studies

LEVEL C-LD (Limited Data)
- Randomized or nonrandomized observational or registry studies with limitations of design or execution
- Meta-analyses of such studies
- Physiological or mechanistic studies in human subjects

LEVEL C-EO (Expert Opinion)

Consensus of expert opinion based on clinical experience

COR and LOE are determined independently (any COR may be paired with any LOE).

A recommendation with LOE C does not imply that the recommendation is weak. Many important clinical questions addressed in guidelines do not lend themselves to clinical trials. Although RCTs are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

* The outcome or result of the intervention should be specified (an improved clinical outcome or increased diagnostic accuracy or incremental prognostic information).

† For comparative-effectiveness recommendations (COR I and IIa; LOE A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

‡ The method of assessing quality is evolving, including the application of standardized, widely used, and preferably validated evidence grading tools; and for systematic reviews, the incorporation of an Evidence Review Committee.

COR indicates Class of Recommendation; EO, expert opinion; LD, limited data; LOE, Level of Evidence; NR, nonrandomized; R, randomized; and RCT, randomized controlled trial.

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Applying Classification of Recommendations and Level of Evidence

Guidelines are not a commandment or a legal decree. They are a resource and a roadmap

COR: *Estimate of the magnitude and certainty of benefit in proportion to risk*

LOE: *Rating the type, quantity, and consistency of data from clinical trials and other sources*

- ✓ Class I (Strong) Benefit >>>Risk
- ✓ "…for most patients, under most circumstances"

Introduction

Acute Ischemic Stroke (AIS)

- Time critical
- Early management key to optimizing outcomes
- New evidence has produced major changes in treatment

This guideline is a comprehensive guide to AIS management from symptom onset in the prehospital setting through 2 weeks post-stroke.

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Outline

1. Prehospital Stroke Management and Systems of Care
2. Emergency Evaluation and Treatment
3. General Supportive Care and Emergency Treatment
4. In-Hospital Management of AIS. General Supportive Care
5. In-Hospital Management of AIS: Treatment of Acute Complications
6. In-Hospital Institution of Secondary Stroke Prevention

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Prehospital Stroke Management and Systems of Care

1.1 Prehospital Systems

1.2 EMS Assessment and Management

1.3 EMS Systems

1.4 Hospital Stroke Capabilities

1.5 Hospital Stroke Teams

1.6 Telemedicine

1.7 Organization and Integration of Components

1.8 Establishment of Data Repositories

1.9 Stroke System Care Quality Improvement Process

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Prehospital Stroke Management and Systems of Care

Increase Utilization of Acute Stroke Therapies and Improve Outcomes Via:

- Increased awareness of stroke signs and symptoms
- Maximize utilization of EMS via 9-1-1
- Optimize prehospital management & triage
- Establish and continually improve quality of care at stroke centers
- Ensure rapid transport across hospitals when necessary

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Prehospital Stroke Management and Systems of Care

1.1 Prehospital Systems

Recommendations	COR	LOE
1. Public health leaders, along with medical professionals and others, should design and implement public education programs focused on stroke systems and the need to seek emergency care (by calling 9-1-1) in a rapid manner. These programs should be sustained over time and designed to reach racially/ethnically, age, and sex diverse populations.	I	B-NR
2. Such educational programs should be designed to specifically target the public, physicians, hospital personnel, and emergency medical services (EMS) personnel to increase use of the 9-1-1 EMS system, to decrease stroke onset to emergency department (ED) arrival times, and to increase timely use of thrombolysis and thrombectomy.	I	C-EO
3. Activation of the 9-1-1 system by patients or other members of the public is strongly recommended. 9-1-1 dispatchers should make stroke a priority dispatch, and transport times should be minimized.	I	B-NR

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Prehospital Stroke Management and Systems of Care

1.2 EMS Assessment and Management

Recommendations	COR	LOE
1. The use of a stroke assessment tool by first aid providers, including EMS dispatch personnel, is recommended.	I	B-NR
2. EMS personnel should provide prehospital notification to the receiving hospital that a suspected stroke patient is en route so that the appropriate hospital resources may be mobilized before patient arrival.	I	B-NR

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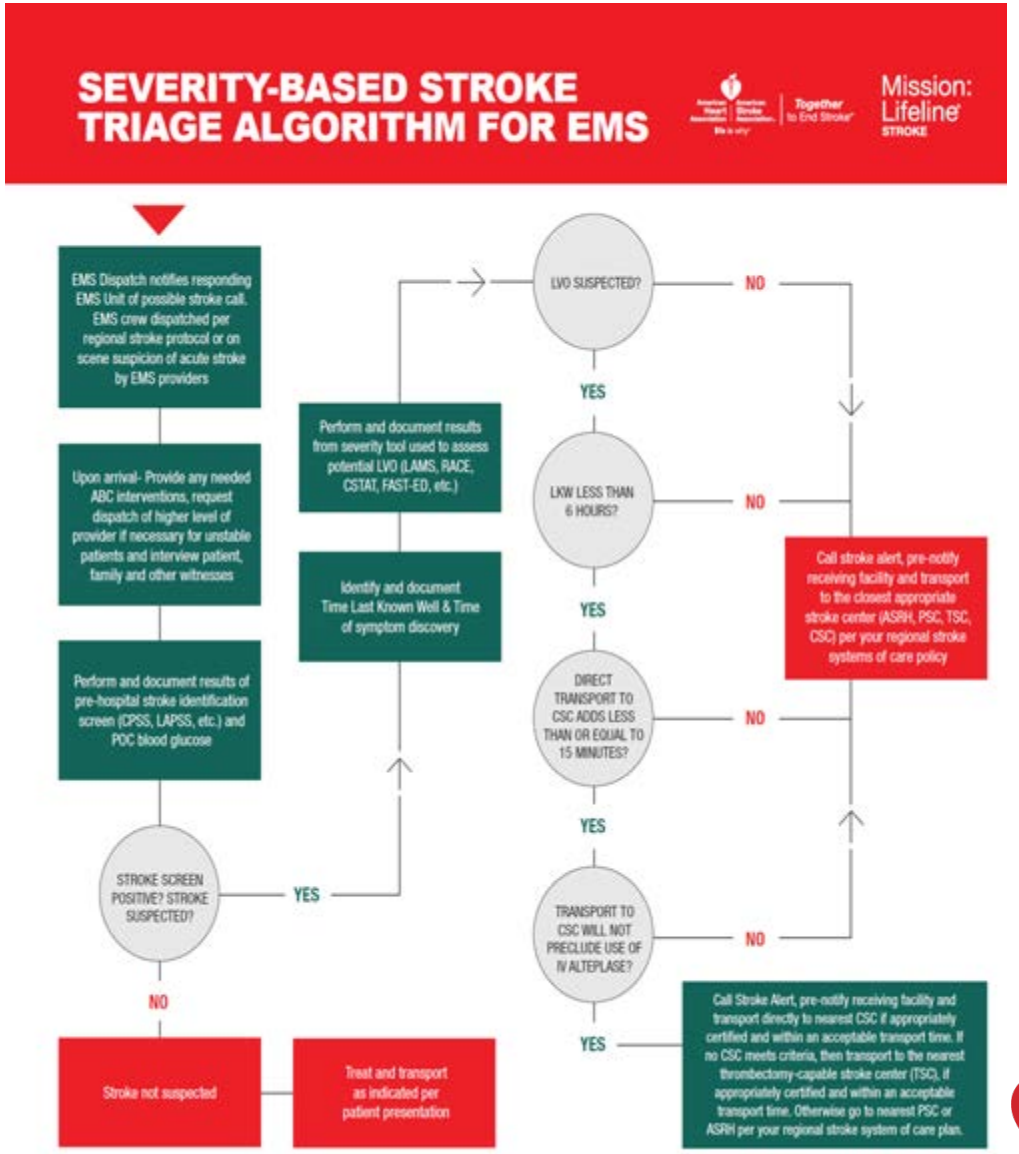
Prehospital Stroke Management and Systems of Care

EMS Systems

EMS should develop triage paradigms and protocols:

- Use validated screens for stroke
- Identify regional hospitals that can give IV alteplase and those that can perform thrombectomy
- AHA mission lifeline has proposed a severity based triage algorithm
  - Uncertainty exists over optimal algorithm and optimal prehospital LVO screen
  - Customization of proposed algorithm to account for local factors is needed



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Prehospital Stroke Management and Systems of Care

1.3 EMS Systems

Recommendations	COR	LOE
1. Regional systems of stroke care should be developed. These should consist of the following: (a) Healthcare facilities that provide initial emergency care, including administration of IV alteplase, and, (b) Centers capable of performing endovascular stroke treatment with comprehensive periprocedural care to which rapid transport can be arranged when appropriate.	I	A
2. EMS leaders, in coordination with local, regional, and state agencies and in consultation with medical authorities and local experts, should develop triage paradigms and protocols to ensure that patients with a known or suspected stroke are rapidly identified and assessed by use of a validated and standardized tool for stroke screening.	I	B-NR
3. Patients with a positive stroke screen or who are strongly suspected of having a stroke should be transported rapidly to the closest healthcare facilities that are able to administer IV alteplase.	I	B-NR
4. When several IV alteplase–capable hospital options exist within a defined geographic region, the benefit of bypassing the closest to bring the patient to one that offers a higher level of stroke care, including mechanical thrombectomy, is uncertain.	IIb	B-NR
5. Effective prehospital procedures to identify patients who are ineligible for IV thrombolysis and have a strong probability of large vessel occlusion (LVO) stroke should be developed to facilitate rapid transport of patients potentially eligible for thrombectomy to the closest healthcare facilities that are able to perform mechanical thrombectomy.	IIb	C-EO

Prehospital Stroke Management and Systems of Care
Hospital Stroke Capabilities

Certification of stroke centers by an external body is recommended

- CIHQ, DNV, HFAP, TJC, or state health department

Tiers of Stroke Hospitals have been proposed:

- Acute Stroke Ready Hospitals
- Primary Stroke Centers
- Comprehensive Stroke Centers

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Prehospital Stroke Management and Systems of Care

1.4 Hospital Stroke Capabilities

Recommendations	COR	LOE
1. Certification of stroke centers by an independent external body, such as Center for Improvement in Healthcare Quality, Det Norske Veritas, Healthcare Facilities Accreditation Program, and The Joint Commission (TJC),* or designation by a state health department, is recommended. *AHA has a cobranded, revenue-generating stroke certification with TJC.	I	B-NR

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Prehospital Stroke Management and Systems of Care

Hospital Stroke Teams

Timeline	*Action*
10 minutes from arrival or sooner	Evaluation by physician
≤ 15 minutes	Stroke or neurologic expertise contacted
≤ 20 minutes	NCCT or MRI
≤ 45 minutes or sooner	Interpretation of neuroimaging
≤ 60 minutes	Initiation of IV alteplase

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Prehospital Stroke Management and Systems of Care

1.5 Hospital Stroke Teams

Recommendations	COR	LOE
1. An organized protocol for the emergency evaluation of patients with suspected stroke is recommended.	I	B-NR
2. Designation of an acute stroke team that includes physicians, nurses, and laboratory/radiology personnel is recommended. Patients with stroke should have a careful clinical assessment, including neurological examination.	I	B-NR
3. Multicomponent quality improvement initiatives, which include ED education and multidisciplinary teams with access to neurological expertise, are recommended to safely increase IV fibrinolytic treatment.	I	A
4. It is recommended that stroke systems of care be developed so that fibrinolytic-eligible patients and mechanical thrombectomy-eligible patients receive treatment in the fastest achievable onset-to-treatment time.	I	A
5. Establishing and monitoring target time goals for Emergency Department door-to-treatment IV fibrinolysis time can be beneficial in order to monitor and enhance system performance.	I	B-NR

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Prehospital Stroke Management and Systems of Care

Telemedicine

Telemedicine solutions can help to improve care when on-site expertise is not available

- Teleradiology shown to be useful for rapid image interpretation
- Telestroke can be effective for IV alteplase decision making
  - Meta-analysis comparing telestroke to stroke centers showed no difference in mortality or functional outcomes at 3 months
- Telestroke may be reasonable for triaging patients for mechanical thrombectomy
  - A single observational study showed similar rates of reperfusion and functional outcomes between telestroke patients and those admitted directly to a tertiary care center

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Prehospital Stroke Management and Systems of Care

1.6 Telemedicine

Recommendations	COR	LOE
1. For sites without in-house imaging interpretation expertise, teleradiology systems approved by the US Food and Drug Administration are recommended for timely review of brain imaging in patients with suspected acute stroke.	I	A
2. When implemented within a telestroke network, teleradiology systems approved by the US Food and Drug Administration are effective in supporting rapid imaging interpretation in time for IV alteplase administration decision making.	I	A
3. The use of telemedicine/telestroke resources and systems should be supported by healthcare institutions, governments, payers, and vendors as one method to ensure adequate 24/7 coverage and care of acute stroke patients in a variety of settings.	I	C-EO
4. Telestroke/teleradiology evaluations of AIS patients can be effective for correct IV alteplase eligibility decision making.	IIa	B-R
5. Administration of IV alteplase guided by telestroke consultation for patients with AIS can be beneficial.	IIa	B-NR
6. Telestroke networks may be reasonable for triaging patients with AIS who may be eligible for interfacility transfer in order to be considered for mechanical thrombectomy.	IIb	B-NR
7. Providing alteplase decision-making support via telephone consultation to community physicians is feasible and safe and may be considered when a hospital has access to neither an in-person stroke team nor a telestroke system.	IIb	C-LD

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Prehospital Stroke Management and Systems of Care

Organization and Integration of Components

Stroke systems must integrate IV alteplase capable and mechanical thrombectomy capable centers

- Thrombectomy requires patients to be at an experienced center
- Noninvasive vascular imaging can select patients for transfer to a mechanical thrombectomy capable center
  - Decisions around developing this capability require realistic expectations that account for local resource availability
- Guidelines and protocols must ensure rapid transfer 24/7

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Prehospital Stroke Management and Systems of Care

1.7 Organization and Integration of Components

Recommendations	COR	LOE
1. All hospitals caring for stroke patients within a stroke system of care should develop, adopt, and adhere to care protocols that reflect current care guidelines as established by national and international professional organizations and state and federal agencies and laws.	I	C-EO
2. Different services within a hospital that may be transferring patients through a continuum of care, as well as different hospitals that may be transferring patients to other facilities, should establish hand-off and transfer protocols and procedures that ensure safe and efficient patient care within and between facilities. Protocols for interhospital transfer of patients should be established and approved beforehand so that efficient patient transfers can be accomplished at all hours of the day and night.	I	C-EO
3. Mechanical thrombectomy requires the patient to be at an experienced stroke center with rapid access to cerebral angiography, qualified neurointerventionalists, and a comprehensive periprocedural care team. Systems should be designed, executed, and monitored to emphasize expeditious assessment and treatment. Outcomes for all patients should be tracked. Facilities are encouraged to define criteria that can be used to credential individuals who can perform safe and timely intra-arterial revascularization procedures.	I	C-EO
4. It may be useful for primary stroke centers and other healthcare facilities that provide initial emergency care, including administration of IV alteplase, to develop the capability of performing emergency noninvasive intracranial vascular imaging to most appropriately select patients for transfer for mechanical thrombectomy and to reduce the time to mechanical thrombectomy.	IIb	C-LD
5. It may be useful for government agencies and third-party payers to develop and implement reimbursement schedules for patients with acute stroke that reflect the demanding care and expertise that such patients require to achieve an optimal outcome, regardless of whether they receive a specific medication or procedure.	IIb	C-EO

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Prehospital Stroke Management and Systems of Care
Data Repositories and Quality Improvement

Quality Improvement (QI) efforts improve outcomes

- QI efforts across the entire spectrum of care, from initial patient identification prehospital to post-stroke care can improve outcomes.
- Participation in GWTG-Stroke, a data repository, has been shown to improve outcomes after AIS.
- Within hospitals participating in GWTG-Stroke, a multi-disciplinary QI process has also been shown to improve outcomes.
- Stroke severity, as measured by the NIHSS, strongly influences outcomes. Outcome measures should include adjustments for baseline severity.

Prehospital Stroke Management and Systems of Care

1.8 Establishment of Data Repositories

Recommendations	COR	LOE
1. Participation in a stroke data repository is recommended to promote consistent adherence to current treatment guidelines, to allow continuous quality improvement, and to improve patient outcomes.	I	B-NR

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Prehospital Stroke Management and Systems of Care

1.9 Stroke System Care Quality Improvement Process

Recommendations	COR	LOE
1. Healthcare institutions should organize a multidisciplinary quality improvement committee to review and monitor stroke care quality benchmarks, indicators, evidence-based practices, and outcomes. The formation of a clinical process improvement team and the use of a stroke care registry 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.	I	B-NR
2. Stroke outcome measures should include adjustments for baseline severity.	I	B-NR
3. Continuous quality improvement processes, implemented by each major element of a stroke system of care and the system as a whole, can be useful in improving patient care or outcomes.	IIa	B-NR

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Emergency Evaluation and Treatment

2.1 Stroke Scales

2.2 Head and Neck Imaging

2.3 Other Diagnostic Tests

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Emergency Evaluation and Treatment

Stroke Scales

Standardized severity scales quantify neurologic deficit.

- Facilitate communication
- Identify patients for acute treatments
- Monitor for improvement or worsening

National Institute of Health Stroke Scale

- Preferred severity scale
  - Rapid
  - Accurate
  - Reliable
  - Can be performed by broad spectrum of providers

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Emergency Evaluation and Treatment
Stroke Scales

NIH Stroke Scale

Item	Title	Responses and Scores
1a.	Level of consciousness	0—alert 1—drowsy 2—obtunded 3—coma/unresponsive
1b.	Orientation questions (2)	0—answers both correctly 1—answers one correctly 2—answers neither correctly
1c.	Response to commands (2)	0—performs both tasks correctly 1—performs one task correctly 2—performs neither
2.	Gaze	0—normal horizontal movements 1—partial gaze palsy 2—complete gaze palsy
3.	Visual fields	0—no visual field defect 1—partial hemianopia 2—complete hemianopia 3—bilateral hemianopia
4.	Facial movement	0—normal 1—minor facial weakness 2—partial facial weakness 3—complete unilateral palsy
5.	Motor function (arm) a. Left b. Right	0—no drift 1—drift before 10 seconds 2—falls before 10 seconds 3—no effort against gravity 4—no movement
6.	Motor function (leg) a. Left b. Right	0—no drift 1—drift before 5 seconds 2—falls before 5 seconds 3—no effort against gravity 4—no movement
7.	Limb ataxia	0—no ataxia 1—ataxia in 1 limb 2—ataxia in 2 limbs
8.	Sensory	0—no sensory loss 1—mild sensory loss 2—severe sensory loss
9.	Language	0—normal 1—mild aphasia 2—severe aphasia 3—mute or global aphasia
10.	Articulation	0—normal 1—mild dysarthria 2—severe dysarthria
11.	Extinction or inattention	0—absent 1—mild loss (1 sensory modality lost) 2—severe loss (2 modalities lost)

Adapted from Lyden et al.74 Copyright © 1994, American Heart Association, Inc.

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Emergency Evaluation and Treatment
2.1 Stroke Scales

Recommendations	COR	LOE
1. The use of a stroke severity rating scale, preferably the NIHSS, is recommended.	I	B-NR

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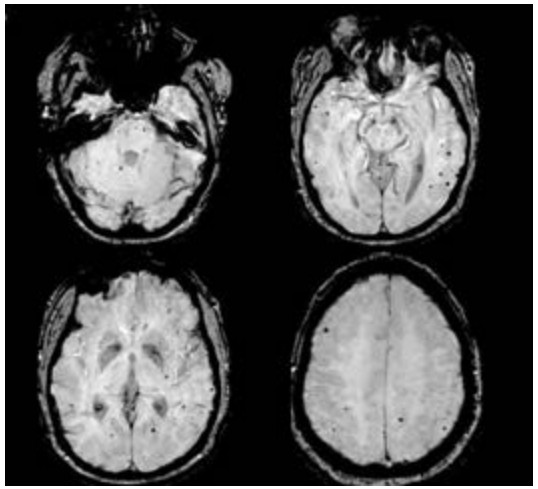
Emergency Evaluation and Treatment
2.2 Head and Neck Imaging
2.2.1 Initial Imaging

Recommendations	COR	LOE
1. All patients with suspected acute stroke should receive emergency brain imaging evaluation on first arrival to a hospital before initiating any specific therapy to treat AIS.	I	A
2. Systems should be established so that brain imaging studies can be performed as quickly as possible in patients who may be candidates for IV fibrinolysis or mechanical thrombectomy or both.	I	B-NR
3. Noncontrast computed tomography (NCCT) is effective to exclude ICH before IV alteplase administration.	I	A
4. Magnetic resonance imaging (MRI) is effective to exclude ICH before IV alteplase administration.	I	B-NR
5. CTA with CTP or MR angiography (MRA) with diffusion-weighted magnetic resonance imaging (DW-MRI) with or without MR perfusion is recommended for certain patients.	I	A

Emergency Evaluation and Treatment
2.2 Head and Neck Imaging
2.2.2 IV Alteplase Eligibility



Recommendations	COR	LOE
1. Administration of intravenous alteplase in eligible patients without first obtaining MRI to exclude cerebral microbleeds (CMBs) is recommended.	I	B-NR
2. In patients eligible for IV alteplase, since benefit of therapy is time dependent, treatment should be initiated as quickly as possible and not delayed for additional multimodal neuroimaging, such as CT and MRI perfusion imaging.	I	B-NR
3. In patients with AIS who awake with stroke symptoms or have unclear time of onset > 4.5 hours from last known well or at baseline state, MRI to identify diffusion-positive FLAIR-negative lesions can be useful for selecting those who can benefit from IV alteplase administration within 4.5 hours of stroke symptom recognition.	IIa	B-R

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Emergency Evaluation and Treatment
2.2 Head and Neck Imaging
2.2.3 Mechanical Thrombectomy Eligibility-Vessel Imaging

Recommendations	COR	LOE
1. For patients who otherwise meet criteria for mechanical thrombectomy, noninvasive vessel imaging of the intracranial arteries is recommended during the initial imaging evaluation.	I	A
2. For patients with suspected LVO who have not had noninvasive vessel imaging as part of their initial imaging assessment for stroke, non-invasive vessel imaging should then be obtained as quickly as possible (e.g. during alteplase infusion if feasible).	I	A
3. In patients with suspected intracranial LVO and no history of renal impairment, who otherwise meet criteria for mechanical thrombectomy, it is reasonable to proceed with CTA if indicated before obtaining a serum creatinine concentration.	IIa	B-NR
4. In patients who are potential candidates for mechanical thrombectomy, imaging of the extracranial carotid and vertebral arteries, in addition to the intracranial circulation, may be reasonable to provide useful information on patient eligibility and endovascular procedural planning.	IIb	C-EO
5. It may be reasonable to incorporate collateral flow status into clinical decision making in some candidates to determine eligibility for mechanical thrombectomy.	IIb	C-LD

Emergency Evaluation and Treatment
2.2 Head and Neck Imaging
2.2.4 Mechanical Thrombectomy Eligibility-Multimodal Imaging

Recommendations	COR	LOE
1. When selecting patients with AIS within 6 to 24 hours of last known normal who have LVO in the anterior circulation, obtaining CTP or DW-MRI, with or without MRI perfusion, is recommended to aid in patient selection for mechanical thrombectomy, but only when patients meet other eligibility criteria from one of the RCTs that showed benefit from mechanical thrombectomy in this extended time window.	I	A
2. When evaluating patients with AIS within 6 hours of last known normal with LVO and an Alberta Stroke Program Early Computed Tomography Score (ASPECTS) of ≥ 6, selection for mechanical thrombectomy based on CT and CTA or MRI and MRA is recommended in preference to performance of additional imaging such as perfusion studies.	I	B-NR

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Emergency Evaluation and Treatment
Other Diagnostic Tests

Other diagnostic testing should be individualized

- **Critical not to delay** initiation of IV alteplase
  - Only assessment of blood glucose must precede IV alteplase
  - Baseline ECG and troponins are recommended, but should not delay treatment
  - Utility of chest radiographs (CXR) is uncertain.
    - Cohort study comparing AIS patients with and without CXR showed longer door-to-needle (DTN) time in those with a CXR, no difference in cardiopulmonary events

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Emergency Evaluation and Treatment
2.3 Other Diagnostic Tests

Recommendations	COR	LOE
1. Only the assessment of blood glucose must precede the initiation of IV alteplase in all patients.	I	B-NR
2. Baseline electrocardiographic assessment is recommended in patients presenting with AIS but should not delay initiation of IV alteplase.	I	B-NR
3. Baseline troponin assessment is recommended in patients presenting with AIS but should not delay initiation of IV alteplase or mechanical thrombectomy.	I	C-LD
4. 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 IV alteplase.	IIb	B-NR

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General Supportive Care and Emergency Treatment

3.1 Airway, Breathing, and Oxygenation

3.2 Blood Pressure

3.3 Temperature

3.4 Blood Glucose

3.5 IV Alteplase

3.6 Other IV Fibrinolytics and Sonothrombolysis

3.7 Mechanical Thrombectomy

3.8 Other Endovascular Therapies

3.9 Antiplatelet Treatment

3.10 Anticoagulants

3.11 Volume Expansion/Hemodilution, Vasodilators, and Hemodynamic Augmentation

3.12 Neuroprotective Agents

3.13 Emergency Carotid Endarterectomy (CEA) Carotid Angioplasty and Stenting without Intracranial Clot

3.14 Other

General Supportive Care and Emergency Treatment
3.1 Airway, Breathing, and Oxygenation

Recommendations	COR	LOE
1. 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.	I	C-EO
2. Supplemental oxygen should be provided to maintain oxygen saturation >94%.	I	C-LD
3. Supplemental oxygen is not recommended in nonhypoxic patients with AIS.	III: No Benefit	B-R
4. Hyperbaric oxygen (HBO) is not recommended for patients with AIS except when caused by air embolization.	III: No Benefit	B-NR

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General Supportive Care and Emergency Treatment
Blood Pressure

- Ideal blood pressure targets in AIS remain unknown
  - Observational studies variable
- No clear data on fluid choice, volume, or duration
- BP with IV alteplase:
  - BP <185/110 mm Hg prior to administration
  - BP <180/105 mm Hg for 24 hours after administration
  - Target based on BPs in RCT of IV alteplase
    - Some data to suggest hemorrhage risk higher with higher BPs and BP variability, but exact BP that increases risk unknown
- BP with Intra-arterial Therapy
  - Optimal BP unknown
  - RCTs largely excluded BP >185/110 mm Hg
  - Reasonable to use <185/110 mm Hg as guideline

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General Supportive Care and Emergency Treatment
3.2 Blood Pressure

Recommendations	COR	LOE
1. Hypotension and hypovolemia should be corrected to maintain systemic perfusion levels necessary to support organ function.	I	C-EO
2. Patients who have elevated BP and are otherwise eligible for treatment with IV alteplase should have their BP carefully lowered so that their SBP is <185 mm Hg and their diastolic BP is <110 mm Hg before IV fibrinolytic therapy is initiated.	I	B-NR
3. In patients for whom mechanical thrombectomy is planned and who have not received IV fibrinolytic therapy, it is reasonable to maintain BP ≤185/110 mm Hg before the procedure.	IIa	B-NR
4. The usefulness of drug-induced hypertension in patients with AIS is not well established.	IIb	B-R

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General Supportive Care and Emergency Treatment
3.2 Blood Pressure

*Options to Treat Arterial Hypertension in Patients With AIS Who Are Candidates for Acute Reperfusion Therapy**	
Class IIb	**LOE C-EO**
Patient otherwise eligible for acute reperfusion therapy except that BP is >185/110 mm Hg:	
Labetalol 10–20 mg IV over 1–2 min, may repeat 1 time; or	
Nicardipine 5 mg/h IV, titrate up by 2.5 mg/h every 5–15 min, maximum 15 mg/h; when desired BP reached, adjust to maintain proper BP limits; or	
Clevidipine 1–2 mg/h IV, titrate by doubling the dose every 2–5 min until desired BP reached; maximum 21 mg/h	
Other agents (eg, hydralazine, enalaprilat) may also be considered	
If BP is not maintained ≤185/110 mm Hg, do not administer alteplase	
Management of BP during and after alteplase or other acute reperfusion therapy to maintain BP ≤180/105 mm Hg:	
Monitor BP every 15 min for 2 h from the start of alteplase therapy, then every 30 min for 6 h, and then every hour for 16 h	
If systolic BP >180–230 mm Hg or diastolic BP >105–120 mm Hg:	
Labetalol 10 mg IV followed by continuous IV infusion 2–8 mg/min; or	
Nicardipine 5 mg/h IV, titrate up to desired effect by 2.5 mg/h every 5–15 min, maximum 15 mg/h; or	
Clevidipine 1–2 mg/h IV, titrate by doubling the dose every 2–5 min until desired BP reached; maximum 21 mg/h	
If BP not controlled or diastolic BP >140 mm Hg, consider IV sodium nitroprusside	

*Different treatment options may be appropriate in patients who have comorbid conditions that may benefit from acute reductions in BP such as acute coronary event, acute heart failure, aortic dissection, or preeclampsia/eclampsia.
Data derived from Jauch et al. Stroke. 2013;44:870-947

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General Supportive Care and Emergency Treatment

Temperature

- Peak temperature in first 24 hours <37°C and >39°C associated with increased risk of in hospital death compared to normothermia
  - Retrospective cohort study of 9366 pts w/ AIS

- Hypothermia is a promising strategy but benefit not proven and studies suggest increased risk of infection

American Heart Association.

General Supportive Care and Emergency Treatment
3.3 Temperature

Recommendations	COR	LOE
1. 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.	I	C-LD
2. In patients with AIS, the benefit of treatment with induced hypothermia is uncertain.	IIb	B-R

American Heart Association.

General Supportive Care and Emergency Treatment
3.4 Blood Glucose

Recommendations	COR	LOE
1. Hypoglycemia (blood glucose <60 mg/dL) should be treated in patients with AIS.	I	C-LD
2. Evidence indicates that persistent in-hospital hyperglycemia during the first 24 hours after AIS 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 AIS.	IIa	C-LD

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General Supportive Care and Emergency Treatment
Intravenous Alteplase

- Benefit of IV alteplase well established in RCTs and confirmed by extensive experience
  - Alteplase is beneficial regardless of age and stroke severity
    - Although ECASS-III excluded patients age >80, patients on warfarin regardless of INR, patients with NIHSS >25, and patients with combined diabetes mellitus and prior stroke, analysis of available data indicates these exclusion criteria may not be justified in practice
    - Wake-Up: IV alteplase (0.9 mg/kg, maximum dose 90 mg over 60 min with initial 10% of dose given as bolus over 1 minute) administered within 4.5 hours of stroke symptom recognition can be beneficial in patients with AIS who awake with stroke symptoms or have unclear time of onset > 4.5 hours from last known well or at baseline state and who have a DW-MRI lesion smaller than one-third of the middle cerebral artery (MCA) territory and no visible signal change on FLAIR.
- Eligibility criteria have evolved over time as usefulness and risks better established
- If patient or representative not available for consent, justifiable to proceed without consent in an otherwise eligible patient

American Heart Association.

General Supportive Care and Emergency Treatment

3.5 IV Alteplase

3.5.1 General Principles

Recommendations	COR	LOE
1. In patients eligible for IV alteplase, benefit of therapy is time dependent, and treatment should be initiated as quickly as possible.	I	A
2. In patients undergoing fibrinolytic therapy, physicians should be prepared to treat potential emergent adverse effects, including bleeding complications and angioedema that may cause partial airway obstruction.	I	B-NR
3. The potential risks should be discussed during IV alteplase eligibility deliberation and weighed against the anticipated benefits during decision making.	I	C-EO
4. Treating clinicians should be aware that hypoglycemia and hyperglycemia may mimic acute stroke presentations and determine blood glucose levels before IV alteplase initiation. IV alteplase is not indicated for nonvascular conditions.	III: No Benefit	B-NR
5. Because time from onset of symptoms to treatment has such a powerful impact on outcomes, treatment with IV alteplase should not be delayed to monitor for further improvement.	III: Harm	C-EO

American Heart Association.

General Supportive Care and Emergency Treatment

3.5 IV Alteplase

3.5.2 Time Windows

Recommendations	COR	LOE
1. IV alteplase (0.9 mg/kg, maximum dose 90 mg over 60 minutes with initial 10% of dose given as bolus over 1 minute) is recommended for selected patients who can be treated within 3 hours of ischemic stroke symptom onset or patient last known well or at baseline state. Physicians should review the criteria outlined in Table 8 to determine patient eligibility.	I	A
2. IV alteplase (0.9 mg/kg, maximum dose 90 mg over 60 minutes with initial 10% of dose given as bolus over 1 minute) is also recommended for selected patients who can be treated within 3 and 4.5 hours of ischemic stroke symptom onset or patient last known well or at baseline state. Physicians should review the criteria outlined in Table 8 to determine patient eligibility.	I	B-R
3. IV alteplase (0.9 mg/kg, maximum dose 90 mg over 60 min with initial 10% of dose given as bolus over 1 minute) administered within 4.5 hours of stroke symptom recognition can be beneficial in patients with AIS who awake with stroke symptoms or have unclear time of onset > 4.5 hours from last known well or at baseline state and who have a DW-MRI lesion smaller than one-third of the middle cerebral artery (MCA) territory and no visible signal change on FLAIR.	IIa	B-R

General Supportive Care and Emergency Treatment

3.5 IV Alteplase

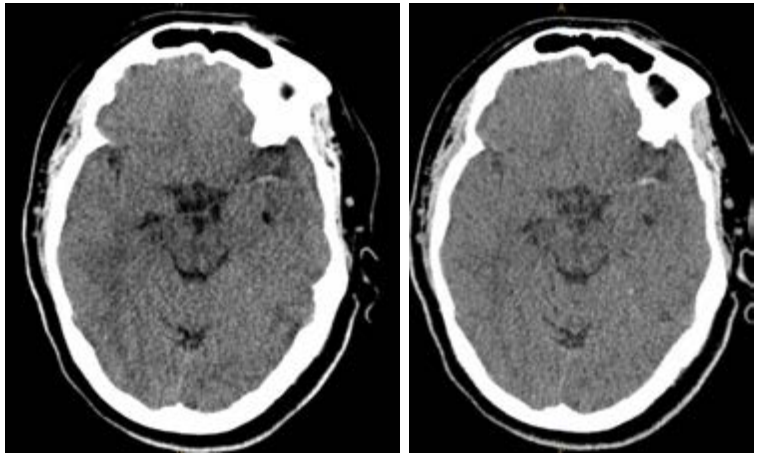
3.5.3 Mild Stroke

Recommendations	COR	LOE
1. For otherwise eligible patients with mild but disabling stroke symptoms, IV alteplase is recommended for patients who can be treated within 3 hours of ischemic stroke symptom onset or patient last known well or at baseline state.	I	B-R
2. For otherwise eligible patients with mild disabling stroke symptoms, IV alteplase may be reasonable for patients who can be treated within 3 and 4.5 hours of ischemic stroke symptom onset or patient last known well or at baseline state.	IIb	B-NR
3. For otherwise eligible patients with mild non-disabling stroke symptoms (NIHSS score 0-5), IV alteplase is not recommended for patients who could be treated within 3 hours of ischemic stroke symptom onset or patient last known well or at baseline state.	III: No Benefit	B-R
4. For otherwise eligible patients with mild non-disabling stroke symptoms (NIHSS score 0-5), IV alteplase is not recommended for patients who could be treated within 3 and 4.5 hours of ischemic stroke symptom onset or patient last known well or at baseline state.	III: No Benefit	C-LD

American Heart Association.

General Supportive Care and Emergency Treatment
3.5 IV Alteplase
3.5.4 Other Specific Circumstances

Recommendations	COR	LOE
1. IV alteplase for adults presenting with an AIS with known sickle cell disease can be beneficial.	IIa	B-NR
2. In patients with a hyperdense MCA sign, IV alteplase can be beneficial.	IIa	B-NR



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General Supportive Care and Emergency Treatment

3.5 IV Alteplase

3.5.5 Bleeding Risk

Recommendations	COR	LOE
1. Given the extremely low risk of unsuspected abnormal platelet counts or coagulation studies in a population, it is reasonable that urgent IV alteplase treatment not be delayed while waiting for hematologic or coagulation testing if there is no reason to suspect an abnormal test.	IIa	B-NR
2. In otherwise eligible patients who have previously had a small number (1–10) of CMBs demonstrated on MRI, administration of IV alteplase is reasonable.	IIa	B-NR
3. In otherwise eligible patients who have previously had a high burden of CMBs (>10) demonstrated on MRI, treatment with IV alteplase may be associated with an increased risk of sICH, and the benefits of treatment are uncertain. Treatment may be reasonable if there is the potential for substantial benefit.	IIb	B-NR
4. The efficacy of the IV glycoprotein IIb/IIIa inhibitors tirofiban and eptifibatide co-administered with IV alteplase is not well established.	IIb	B-R
5. Abciximab should not be administered concurrently with IV alteplase.	III: Harm	B-R
6. IV aspirin should not be administered within 90 minutes after start of IV alteplase.	III: Harm	B-R
7. IV alteplase should not be administered to patients who have received a full treatment dose of low-molecular-weight heparin (LMWH) within the previous 24 hours.	III: Harm	B-NR

General Supportive Care and Emergency Treatment

3.5 IV Alteplase

3.5.6 Post-Alteplase Treatment

Recommendations	COR	LOE
1. BP should be maintained at <180/105 mm Hg for at least the first 24 hours after IV alteplase treatment.	I	B-R
2. The risk of antithrombotic therapy (other than IV aspirin) within the first 24 hours after treatment with IV alteplase (with or without mechanical thrombectomy) is uncertain. Use might be considered in the presence of concomitant conditions for which such treatment given in the absence of IV alteplase is known to provide substantial benefit or withholding such treatment is known to cause substantial risk.	IIb	B-NR

Main elements of post-thrombolysis care are listed in separate table

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General Supportive Care and Emergency Treatment

Eligibility Recommendations for IV Alteplase in Patients with AIS

Indications (COR I)	
Within 3 h*	IV alteplase (0.9 mg/kg, maximum dose 90 mg over 60 min with initial 10% of dose given as bolus over 1 min) is recommended for selected patients who may be treated within 3 h of ischemic stroke symptom onset or patient last known well or at baseline state. Physicians should review the criteria outlined in this table to determine patient eligibility.† (*COR I; LOE A*)
Within 3 h–Age	For otherwise medically eligible patients ≥18 y of age, IV alteplase administration within 3 h is equally recommended for patients ≤80 and >80 y of age.† (*COR I; LOE A*)
Within 3 h–Severe stroke	For severe stroke, IV alteplase is indicated within 3 h from symptom onset of ischemic stroke. Despite increased risk of hemorrhagic transformation, there is still proven clinical benefit for patients with severe stroke symptoms.† (*COR I; LOE A*)
Within 3 h–Mild disabling stroke	For otherwise eligible patients with mild but disabling stroke, IV alteplase is recommended for patients who can be treated within 3 h of ischemic stroke symptom onset or patient last known well or at baseline state (*COR I; LOE B-R*)‡
3–4.5 h*	IV alteplase (0.9 mg/kg, maximum dose 90 mg over 60 min with initial 10% of dose given as bolus over 1 min) is also recommended for selected patients who can be treated within 3 and 4.5 h of ischemic stroke symptom onset or patient last known well. Physicians should review the criteria outlined in this table to determine patient eligibility.† (*COR I; LOE B-R*)§
3–4.5 h–Age	IV alteplase treatment in the 3- to 4.5-h time window is recommended for those patients ≤80 y of age, without a history of both diabetes mellitus and prior stroke, NIHSS score ≤25, not taking any OACs, and without imaging evidence of ischemic injury involving more than one-third of the MCA territory.† *(COR I; LOE B-R)*§
Urgency	Treatment should be initiated as quickly as possible within the above-listed time frames because time to treatment is strongly associated with outcomes.† (*COR I; LOE A*)
BP	IV alteplase is recommended in patients with BP <185/110 and in those patients whose BP can be lowered safely to this level with antihypertensive agents, with the physician assessing the stability of the BP before starting IV alteplase.† (*COR I; LOE B-NR*)§
Blood glucose	IV alteplase is recommended in otherwise eligible patients with initial glucose levels >50 mg/dL.† (*COR I; LOE A*)
CT	IV alteplase administration is recommended in the setting of early ischemic changes on NCCT of mild to moderate extent (other than frank hypodensity).† (*COR I; LOE A*)
Prior antiplatelet therapy	IV alteplase is recommended for patients taking antiplatelet drug monotherapy before stroke on the basis of evidence that the benefit of alteplase outweighs a possible small increased risk of sICH.† (*COR I; LOE A*)
	IV alteplase is recommended for patients taking antiplatelet drug combination therapy (eg, aspirin and clopidogrel) before stroke on the basis of evidence that the benefit of alteplase outweighs a probable increased risk of sICH.† (*COR I; LOE B-NR*)§
End-stage renal disease	In patients with end-stage renal disease on hemodialysis and normal aPTT, IV alteplase is recommended.† (*COR I; LOE C-LD*)§ However, those with elevated aPTT may have elevated risk for hemorrhagic complications.

General Supportive Care and Emergency Treatment Eligibility Recommendations for IV Alteplase in Patients with AIS

Additional recommendations for treatment with IV alteplase for patients with AIS (COR IIa)	And (COR IIb)
3 to 4.5 h–Age	For patients >80 y of age presenting in the 3- to 4.5-h window, IV alteplase is safe and can be as effective as in younger patients.† (*COR IIa; LOE B-NR*)§
3 to 4.5 h–Diabetes mellitus and prior stroke	In AIS patients with prior stroke and diabetes mellitus presenting in the 3- to 4.5- h window, IV alteplase may be as effective as treatment in the 0- to 3-h window and may be a reasonable option.† (*COR IIb; LOE B-NR*)§
3 to 4.5 h–Severe stroke	The benefit of IV alteplase between 3 and 4.5 h from symptom onset for patients with very severe stroke symptoms (NIHSS score >25) is uncertain.† (*COR IIb; LOE C-LD*)§
3 to 4.5 h–Mild disabling stroke	For otherwise eligible patients with mild disabling stroke, IV alteplase may be reasonable for patients who can be treated within 3 and 4.5 h of ischemic stroke symptom onset or patient last known well or at baseline state. (*COR IIb; LOE B-NR*)‡
Wake-up and unknown time of onset	IV alteplase (0.9 mg/kg, maximum dose 90 mg over 60 min with initial 10% of dose given as bolus over 1 min) administered within 4.5 h of stroke symptom recognition can be beneficial in patients with AIS who awaken with stroke symptoms or have unclear time of onset >4.5 h from last known well or at baseline state and who have a DWI lesion smaller than one-third of the MCA territory and no visible signal change on FLAIR. (*COR IIa; LOE B-R*)‡
Preexisting disability	Preexisting disability does not seem to independently increase the risk of sICH after IV alteplase, but it may be associated with less neurological improvement and higher mortality. Therapy with IV alteplase for acute stroke patients with preexisting disability (mRS score ≥2) may be reasonable, but decisions should take into account relevant factors, including quality of life, social support, place of residence, need for a caregiver, patients' and families' preferences, and goals of care.† (*COR IIb; LOE B-NR*)§
	Patients with preexisting dementia may benefit from IV alteplase. Individual considerations such as life expectancy and premorbid level of function are important to determine whether alteplase may offer a clinically meaningful benefit.† (*COR IIb; LOE B-NR*)§
Early improvement	IV alteplase treatment is reasonable for patients who present with moderate to severe ischemic stroke and demonstrate early improvement but remain moderately impaired and potentially disabled in the judgment of the examiner.† (*COR IIa; LOE A*)
Seizure at onset	IV alteplase is reasonable in patients with a seizure at the time of onset of acute stroke if evidence suggests that residual impairments are secondary to stroke and not a postictal phenomenon.† (*COR IIa; LOE C-LD*)§

Continued

General Supportive Care and Emergency Treatment Eligibility Recommendations for IV Alteplase in Patients with AIS

Additional recommendations for treatment with IV alteplase for patients with AIS (COR IIa)	And (COR IIb)
Blood glucose	Treatment with IV alteplase in patients with AIS who present with initial glucose levels <50 or >400 mg/dL that are subsequently normalized and who are otherwise eligible may be reasonable. (Recommendation modified from 2015 IV Alteplase to conform to text of 2015 IV Alteplase. [*COR IIb; LOE C-LD*])§
Coagulopathy	IV alteplase may be reasonable in patients who have a history of warfarin use and an INR ≤1.7 and/or a PT <15 s.† (*COR IIb; LOE B-NR*)§
	The safety and efficacy of IV alteplase for acute stroke patients with a clinical history of potential bleeding diathesis or coagulopathy are unknown. IV alteplase may be considered on a case-by-case basis.† (*COR IIb; LOE C-EO*)§
Dural puncture	IV alteplase may be considered for patients who present with AIS, even in instances when they may have undergone a lumbar dural puncture in the preceding 7 d.† (*COR IIb; LOE C-EO*)§
Arterial puncture	The safety and efficacy of administering IV alteplase to acute stroke patients who have had an arterial puncture of a noncompressible blood vessel in the 7 d preceding stroke symptoms are uncertain.† (*COR IIb; LOE C-LD*)§
Recent major trauma	In AIS patients with recent major trauma (within 14 d) not involving the head, IV alteplase may be carefully considered, with the risks of bleeding from injuries related to the trauma weighed against the severity and potential disability from the ischemic stroke. (Recommendation modified from 2015 IV Alteplase to specify that it does not apply to head trauma. [*COR IIb; LOE C-LD*])§
Recent major surgery	Use of IV alteplase in carefully selected patients presenting with AIS who have undergone a major surgery in the preceding 14 d may be considered, but the potential increased risk of surgical-site hemorrhage should be weighed against the anticipated benefits of reduced stroke related neurological deficits.† (*COR IIb; LOE C-LD*)§
GI and genitourinary bleeding	Reported literature details a low bleeding risk with IV alteplase administration in the setting of past GI/genitourinary bleeding. Administration of IV alteplase in this patient population may be reasonable.† (*COR IIb; LOE C-LD*§ (Note: Alteplase administration within 21 d of a GI bleeding event is not recommended; see Contraindications.)

Continued

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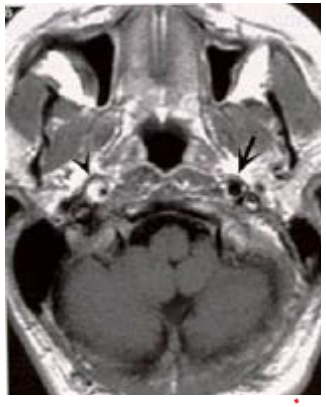
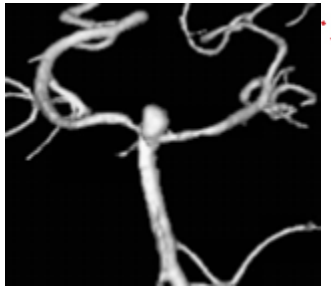
General Supportive Care and Emergency Treatment Eligibility Recommendations for IV Alteplase in Patients with AIS

Additional recommendations for treatment with IV alteplase for patients with AIS (COR IIa)	And (COR IIb)
Menstruation	IV alteplase is probably indicated in women who are menstruating who present with AIS and do not have a history of menorrhagia. However, women should be warned that alteplase treatment could increase the degree of menstrual flow.† (*COR IIa; LOE C-EO*)§
	When there is a history of recent or active vaginal bleeding causing clinically significant anemia, then emergency consultation with a gynecologist is probably indicated before a decision about IV alteplase is made.† (*COR IIa; LOE C-EO*)§
	Because the potential benefits of IV alteplase probably outweigh the risks of serious bleeding in patients with recent or active history of menorrhagia without clinically significant anemia or hypotension, IV alteplase administration may be considered.† (*COR IIb; LOE C-LD*)§
Extracranial cervical dissections	IV alteplase in AIS known or suspected to be associated with extracranial cervical arterial dissection is reasonably safe within 4.5 h and probably recommended.† (*COR IIa; LOE C-LD*)§
Intracranial arterial dissection	IV alteplase usefulness and hemorrhagic risk in AIS known or suspected to be associated with intracranial arterial dissection remain unknown, uncertain and not well established.† (*COR IIb; LOE C-LD*)§
Unruptured intracranial aneurysm	For patients presenting with AIS who are known to harbor a small or moderate-sized (<10 mm) unruptured and unsecured intracranial aneurysm, administration of IV alteplase is reasonable and probably recommended.† (*COR IIa; LOE C-LD*)§
	Usefulness and risk of IV alteplase in patients with AIS who harbor a giant unruptured and unsecured intracranial aneurysm are not well established.† (*COR IIb; LOE C-LD*)§
Intracranial vascular malformations	For patients presenting with AIS who are known to harbor an unruptured and untreated intracranial vascular malformation the usefulness and risks of administration of IV alteplase are not well established.† (*COR IIb; LOE C-LD*)§
	Because of the increased risk of ICH in this population of patients, IV alteplase may be considered in patients with stroke with severe neurological deficits and a high likelihood of morbidity and mortality to outweigh the anticipated risk of ICH.† (*COR IIb; LOE C-LD*)§
CMBs	In otherwise eligible patients who have previously had a small number (1–10) of CMBs demonstrated on MRI, administration of IV alteplase is reasonable. (*COR IIa; Level B-NR*)‡
	In otherwise eligible patients who have previously had a high burden of CMBs (>10) demonstrated on MRI, treatment with IV alteplase may be associated with an increased risk of sICH, and the benefits of treatment are uncertain. Treatment may be reasonable if there is the potential for substantial benefit. (*COR IIb; Level B-NR*)‡





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General Supportive Care and Emergency Treatment
Eligibility Recommendations for IV Alteplase in Patients with AIS

Additional recommendations for treatment with IV alteplase for patients with AIS (COR IIa)	And (COR IIb)
Concomitant tirofiban, epifibatide	The efficacy of the IV glycoprotein IIb/IIIa inhibitors tirofiban and eptifibatide coadministered with IV alteplase is not well established. (*COR IIb; Level B-NR*)‡
Extra-axial intracranial neoplasms	IV alteplase treatment is probably recommended for patients with AIS who harbor an extra-axial intracranial neoplasm.† (*COR IIa; LOE C-EO*)§
Acute MI	For patients presenting with concurrent AIS and acute MI, treatment with IV alteplase at the dose appropriate for cerebral ischemia, followed by percutaneous coronary angioplasty and stenting if indicated, is reasonable.† (*COR IIa; LOE C-EO*)§
Recent MI	For patients presenting with AIS and a history of recent MI in the past 3 mo, treating the ischemic stroke with IV alteplase is reasonable if the recent MI was non-STEMI.† (*COR IIa; LOE C-LD*)§
	For patients presenting with AIS and a history of recent MI in the past 3 mo, treating the ischemic stroke with IV alteplase is reasonable if the recent MI was a STEMI involving the right or inferior myocardium.† (*COR IIa; LOE C-LD*)§
	For patients presenting with AIS and a history of recent MI in the past 3 mo, treating the ischemic stroke with IV alteplase may reasonable if the recent MI was a STEMI involving the left anterior myocardium.† (*COR IIb; LOE C-LD*)§
Acute pericarditis	For patients with major AIS likely to produce severe disability and acute pericarditis, treatment with IV alteplase may be reasonable† (*COR IIb; LOE C-EO*)§; urgent consultation with a cardiologist is recommended in this situation.
	For patients presenting with moderate AIS likely to produce mild disability and acute pericarditis, treatment with IV alteplase is of uncertain net benefit.† (*COR IIb; LOE C-EO*)§
Left atrial or ventricular thrombus	For patients with major AIS likely to produce severe disability and known left atrial or ventricular thrombus, treatment with IV alteplase may be reasonable.† (*COR IIb; LOE C-LD*)§
	For patients presenting with moderate AIS likely to produce mild disability and known left atrial or ventricular thrombus, treatment with IV alteplase is of uncertain net benefit.† (*COR IIb; LOE C-LD*)§
Other cardiac diseases	For patients with major AIS likely to produce severe disability and cardiac myxoma, treatment with IV alteplase may be reasonable.† (*COR IIb; LOE C-LD*)§
	For patients presenting with major AIS likely to produce severe disability and papillary fibroelastoma, treatment with IV alteplase may be reasonable.† (*COR IIb; LOE C-LD*)§

Continued

General Supportive Care and Emergency Treatment Eligibility Recommendations for IV Alteplase in Patients with AIS

Additional recommendations for treatment with IV alteplase for patients with AIS (COR IIa)	And (COR IIb)
Procedural stroke	IV alteplase is reasonable for the treatment of AIS complications of cardiac or cerebral angiographic procedures, depending on the usual eligibility criteria.† (*COR IIa; LOE A*)§
Systemic malignancy	The safety and efficacy of IV alteplase in patients with current malignancy are not well established.† (*COR IIb; LOE C-LD*)§ Patients with systemic malignancy and reasonable (>6 mo) life expectancy may benefit from IV alteplase if other contraindications such as coagulation abnormalities, recent surgery, or systemic bleeding do not coexist.
Pregnancy	IV alteplase administration may be considered in pregnancy when the anticipated benefits of treating moderate or severe stroke outweigh the anticipated increased risks of uterine bleeding.† (*COR IIb; LOE C-LD*)§
	The safety and efficacy of IV alteplase in the early postpartum period (<14 d after delivery) have not been well established.† (*COR IIb; LOE C-LD*)§
Ophthalmological conditions	Use of IV alteplase in patients presenting with AIS who have a history of diabetic hemorrhagic retinopathy or other hemorrhagic ophthalmic conditions is reasonable to recommend, but the potential increased risk of visual loss should be weighed against the anticipated benefits of reduced stroke-related neurological deficits.† (*COR IIa; LOE B-NR*)§
Sickle cell disease	IV alteplase for adults presenting with an AIS with known sickle cell disease can be beneficial. (*COR IIa; LOE B-NR*)‡
Hyperdense MCA sign	In patients with a hyperdense MCA sign, IV alteplase can be beneficial. (*COR IIa; LOE B-NR*)‡
Illicit drug use	Treating clinicians should be aware that illicit drug use may be a contributing factor to incident stroke. IV alteplase is reasonable in instances of illicit drug use–associated AIS in patients with no other exclusions.† (*COR IIa; LOE C-LD*)§
Stroke mimics	The risk of symptomatic intracranial hemorrhage in the stroke mimic population is quite low; thus, starting IV alteplase is probably recommended in preference over delaying treatment to pursue additional diagnostic studies.† (*COR IIa; LOE B-NR*)

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General Supportive Care and Emergency Treatment Eligibility Recommendations for IV Alteplase in Patients with AIS

Contraindications (COR III: No Benefit)	And (COR III: Harm)
0- to 3-h window–Mild nondisabling stroke	For otherwise eligible patients with mild nondisabling stroke (NIHSS score 0–5), IV alteplase is not recommended for patients who could be treated within 3 h of ischemic stroke symptom onset or patient last known well or at baseline state. (*COR III: No Benefit, LOE B-R*)‡
3- to 4.5-h window–Mild nondisabling stroke	For otherwise eligible patients with mild nondisabling stroke (NIHSS score 0–5), IV alteplase is not recommended for patients who could be treated within 3 and 4.5 h of ischemic stroke symptom onset or patient last known well or at baseline state. (*COR III: No Benefit, LOE C-LD*)‡
CT	There remains insufficient evidence to identify a threshold of hypoattenuation severity or extent that affects treatment response to alteplase. However, administering IV alteplase to patients whose CT brain imaging exhibits extensive regions of clear hypoattenuation is not recommended. These patients have a poor prognosis despite IV alteplase, and severe hypoattenuation defined as obvious hypodensity represents irreversible injury.† (*COR III: No Benefit; LOE A*)‖
ICH	IV alteplase should not be administered to a patient whose CT reveals an acute intracranial hemorrhage.† (*COR III: Harm; LOE C-EO*)§‖
Ischemic stroke within 3 mo	Use of IV alteplase in patients presenting with AIS who have had a prior ischemic stroke within 3 mo may be harmful.† (*COR III: Harm; LOE B-NR*)§‖
Severe head trauma within 3 mo	In AIS patients with recent severe head trauma (within 3 mo), IV alteplase is contraindicated.† (*COR III: Harm; LOE C-EO*)§‖
Acute head trauma	Given the possibility of bleeding complications from the underlying severe head trauma, IV alteplase should not be administered in posttraumatic infarction that occurs during the acute in-hospital phase.† (*COR III: Harm; LOE C-EO*)§‖ (Recommendation wording modified to match COR III stratifications.)
Intracranial/intraspinal surgery within 3 mo	For patients with AIS and a history of intracranial/spinal surgery within the prior 3 mo, IV alteplase is potentially harmful.† (*COR III: Harm; LOE C-EO*)§‖

Continued

General Supportive Care and Emergency Treatment Eligibility Recommendations for IV Alteplase in Patients with AIS

Contraindications (COR III: No Benefit)	And (COR III: Harm)
Intracranial/intraspinal surgery within 3 mo	For patients with AIS and a history of intracranial/spinal surgery within the prior 3 mo, IV alteplase is potentially harmful.† (*COR III: Harm; LOE C-EO*)§‖
History of intracranial hemorrhage	IV alteplase administration in patients who have a history of intracranial hemorrhage is potentially harmful.† (*COR III: Harm; LOE C-EO*)§‖
Subarachnoid hemorrhage	IV alteplase is contraindicated in patients presenting with symptoms and signs most consistent with an SAH.† (*COR III: Harm; LOE C-EO*)§‖
GI malignancy or GI bleed within 21 d	Patients with a structural GI malignancy or recent bleeding event within 21 d of their stroke event should be considered high risk, and IV alteplase administration is potentially harmful.† (*COR III: Harm; LOE C-EO*)§‖
Coagulopathy	The safety and efficacy of IV alteplase for acute stroke patients with platelets <100 000/mm^3, INR >1.7, aPTT >40 s, or PT >15 s are unknown, and IV alteplase should not be administered.† (*COR III: Harm; LOE C-EO*)§‖ (In patients without history of thrombocytopenia, treatment with IV alteplase can be initiated before availability of platelet count but should be discontinued if platelet count is <100 000/mm^3. In patients without recent use of OACs or heparin, treatment with IV alteplase can be initiated before availability of coagulation test results but should be discontinued if INR is >1.7 or PT is abnormally elevated by local laboratory standards.) (Recommendation wording modified to match COR III stratifications.)
LMWH	IV alteplase should not be administered to patients who have received a full treatment dose of LMWH within the previous 24 h.† (*COR III: Harm; LOE B-NR*)‡ (Recommendation wording modified to match COR III stratifications.)

Continued

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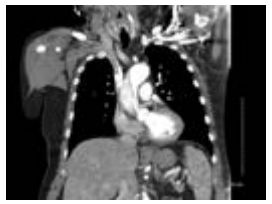
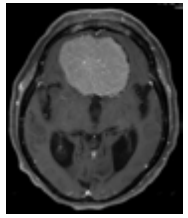
General Supportive Care and Emergency Treatment Eligibility Recommendations for IV Alteplase in Patients with AIS

Contraindications (COR III: No Benefit)	And (COR III: Harm)
Thrombin inhibitors or factor Xa inhibitors	The use of IV alteplase in patients taking direct thrombin inhibitors or direct factor Xa inhibitors has not been firmly established but may be harmful.† (*COR III: Harm; LOE C-EO*)§‖ IV alteplase should not be administered to patients taking direct thrombin inhibitors or direct factor Xa inhibitors unless laboratory tests such as aPTT, INR, platelet count, 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 >48 h (assuming normal renal metabolizing function). (Alteplase could be considered when appropriate laboratory tests such as aPTT, INR, ecarin clotting time, thrombin time, or direct factor Xa activity assays are normal or when the patient has not taken a dose of these ACs for >48 h and renal function is normal.) (Recommendation wording modified to match COR III stratifications.)
Concomitant Abciximab	Abciximab should not be administered concurrently with IV alteplase. (*COR III: Harm; LOE B-R*)‡
Concomitant IV aspirin	IV aspirin should not be administered within 90 min after start of IV alteplase. (*COR III: Harm; LOE B-R*)‡
Infective endocarditis	For patients with AIS and symptoms consistent with infective endocarditis, treatment with IV alteplase should not be administered because of the increased risk of intracranial hemorrhage.† (*COR III: Harm; LOE C-LD*)§‖ (Recommendation wording modified to match COR III stratifications.)
Aortic arch dissection	IV alteplase in AIS known or suspected to be associated with aortic arch dissection is potentially harmful and should not be administered.† (*COR III: Harm; LOE C-EO*)§‖ (Recommendation wording modified to match COR III stratifications.)
Intra-axial intracranial neoplasm	IV alteplase treatment for patients with AIS who harbor an intra-axial intracranial neoplasm is potentially harmful.† (*COR III: Harm; LOE C-EO*)§‖

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General Supportive Care and Emergency Treatment
Eligibility Recommendations for IV Alteplase in Patients with AIS

†Recommendation unchanged or reworded for clarity from 2015 IV Alteplase. See Table XCV in online Data Supplement 1 for original wording.
‡See also the text of these guidelines for additional information on these recommendations.
§LOE amended to conform with American College of Cardiology/AHA 2015 Recommendation Classification System.
‖COR amended to conform with American College of Cardiology/AHA 2015 Recommendation Classification System.

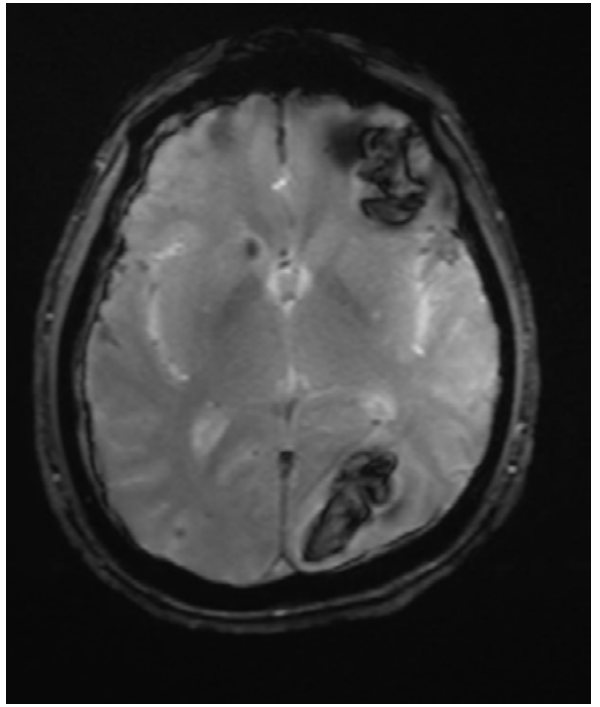
American Heart Association.

General Supportive Care and Emergency Treatment Treatment of AIS: IV Administration of Alteplase

Infuse 0.9 mg/kg (maximum dose 90 mg) over 60 min, with 10% of the dose given as a bolus over 1 min.
Admit the patient to an intensive care or stroke unit for monitoring.
If the patient develops severe headache, acute hypertension, nausea, or vomiting or has a worsening neurological examination, discontinue the infusion (if IV alteplase is being administered) and obtain emergency head CT scan.
Measure BP and perform neurological assessments every 15 min during and after IV alteplase infusion for 2 h, then every 30 min for 6 h, then hourly until 24 h after IV alteplase treatment.
Increase the frequency of BP measurements if SBP is >180 mm Hg or if DBP is >105 mm Hg; administer antihypertensive medications to maintain BP at or below these levels (Table 5).
Delay placement of nasogastric tubes, indwelling bladder catheters, or intra-arterial pressure catheters if the patient can be safely managed without them.
Obtain a follow-up CT or MRI scan at 24 h after IV alteplase before starting anticoagulants or antiplatelet agents.

General Supportive Care and Emergency Treatment Management of Symptomatic Intracranial Bleeding Occurring Within 24 Hours After Administration of IV Alteplase for Treatment of AIS

COR IIb	LOE C-EO
Stop alteplase infusion	
CBC, PT (INR), aPTT, fibrinogen level, and type and cross-match	
Emergent nonenhanced head CT	
Cryoprecipitate (includes factor VIII): 10 U infused over 10–30 min (onset in 1 h, peaks in 12 h); administer additional dose for fibrinogen level of <150 mg/dL	
Tranexamic acid 1000 mg IV infused over 10 min OR ε-aminocaproic acid 4–5 g over 1 h, followed by 1 g IV until bleeding is controlled (peak onset in 3 h) (Potential for benefit in all patients, but particularly when blood products are contraindicated or declined by patient/family or if cryoprecipitate is not available in a timely manner.)	
Hematology and neurosurgery consultations	
Supportive therapy, including BP management, ICP, CPP, MAP, temperature, and glucose control	



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General Supportive Care and Emergency Treatment Management of Orolingual Angioedema Associated with IV Alteplase Administration for AIS

COR IIb	LOE C-EO
Maintain airway	
Endotracheal intubation may not be necessary if edema is limited to anterior tongue and lips.	
Edema involving larynx, palate, floor of mouth, or oropharynx with rapid progression (within 30 min) poses higher risk of requiring intubation.	
Awake fiberoptic intubation is optimal. Nasal-tracheal intubation may be required but poses risk of epistaxis after IV alteplase. Cricothyroidotomy is rarely needed and also problematic after IV alteplase.	
Discontinue IV alteplase infusion and hold ACE inhibitors	
Administer IV methylprednisolone 125 mg	
Administer IV diphenhydramine 50 mg	
Administer ranitidine 50 mg IV or famotidine 20 mg IV	
If there is further increase in angioedema, administer epinephrine (0.1%) 0.3 mL subcutaneously or by nebulizer 0.5 mL	
Icatibant, a selective bradykinin B_2 receptor antagonist, 3 mL (30 mg) subcutaneously in abdominal area; additional injection of 30 mg may be administered at intervals of 6 h not to exceed a total of 3 injections in 24 h; and plasma-derived C1 esterase inhibitor (20 IU/kg) has been successfully used in hereditary angioedema and ACE inhibitor–related angioedema	
Supportive care	

General Supportive Care and Emergency Treatment

3.6 Other IV Fibrinolytics and Sonothrombolysis

Recommendations	COR	LOE
1. It may be reasonable to choose tenecteplase (single IV bolus of 0.25 mg/kg, maximum 25 mg) over IV alteplase in patients without contraindications for IV fibrinolysis who are also eligible to undergo mechanical thrombectomy.	IIb	B-R
2. Tenecteplase administered as a 0.4 mg/kg single IV bolus has not been proven to be superior or noninferior to alteplase but might be considered as an alternative to alteplase in patients with minor neurological impairment and no major intracranial occlusion.	IIb	B-R
3. The administration of IV defibrinogenating agents or IV fibrinolytic agents other than alteplase and tenecteplase is not recommended.	III: No Benefit	B-R
4. The use of sonothrombolysis as adjuvant therapy with IV fibrinolysis is not recommended.	III: No Benefit	A

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General Supportive Care and Emergency Treatment

3.7 Mechanical Thrombectomy

3.7.1 Concomitant IV Alteplase

Recommendations	COR	LOE
1. Patients eligible for IV alteplase should receive IV alteplase even if mechanical thrombectomy is being considered.	I	A
2. In patients under consideration for mechanical thrombectomy, observation after IV alteplase to assess for clinical response should not be performed.	III: Harm	B-R

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General Supportive Care and Emergency Treatment

3.7 Mechanical Thrombectomy

3.7.2 0 to 6 Hours from Onset

Recommendations	COR	LOE
1. Patients should receive mechanical thrombectomy with a stent retriever if they meet all the following criteria: (1) prestroke mRS score of 0 to 1; (2) causative occlusion of the internal carotid artery or MCA segment 1 (M1); (3) age ≥18 years; (4) NIHSS score of ≥6; (5) ASPECTS of ≥6; and (6) treatment can be initiated (groin puncture) within 6 hours of symptom onset.	I	A
2. Although the benefits are uncertain, the use of mechanical thrombectomy with stent retrievers may be reasonable for carefully selected patients with AIS in whom treatment can be initiated (groin puncture) within 6 hours of symptom onset and who have causative occlusion of the MCA segment 2 (M2) or MCA segment 3 (M3) portion of the MCAs.	IIb	B-R
3. Although its benefits are uncertain, the use of mechanical thrombectomy with stent retrievers may be reasonable for patients with AIS in whom treatment can be initiated (groin puncture) within 6 hours of symptom onset and who have prestroke mRS score >1, ASPECTS <6, or NIHSS score <6, and causative occlusion of the internal carotid artery (ICA) or proximal MCA (M1).	IIb	B-R
4. Although the benefits are uncertain, the use of mechanical thrombectomy with stent retrievers may be reasonable for carefully selected patients with AIS in whom treatment can be initiated (groin puncture) within 6 hours of symptom onset and who have causative occlusion of the anterior cerebral arteries, vertebral arteries, basilar artery, or posterior cerebral arteries.	IIb	C-LD

General Supportive Care and Emergency Treatment

3.7 Mechanical Thrombectomy

3.7.3 6 to 24 Hours from Onset

Recommendations	COR	LOE
1. In selected patients with AIS within 6 to 16 hours of last known normal who have LVO in the anterior circulation and meet other DAWN or DEFUSE 3 eligibility criteria, mechanical thrombectomy is recommended.	I	A
2. In selected patients with AIS within 16 to 24 hours of last known normal who have LVO in the anterior circulation and meet other DAWN eligibility criteria, mechanical thrombectomy is reasonable.	IIa	B-R

American Heart Association.

General Supportive Care and Emergency Treatment

3.7 Mechanical Thrombectomy

3.7.4 Technique

Recommendations	COR	LOE
1. Use of stent retrievers is indicated in preference to the Mechanical Embolus Removal in Cerebral Ischemia (MERCI) device.	I	A
2. The technical goal of the thrombectomy procedure should be reperfusion to a modified Thrombolysis in Cerebral Infarction (mTICI) 2b/3 angiographic result to maximize the probability of a good functional clinical outcome.	I	A
3. To ensure benefit, reperfusion to mTICI grade 2b/3 should be achieved as early as possible within the therapeutic window.	I	A
4. In the 6-24 hour thombectomy window evaluation and treatment should proceed as rapidly as possible to ensure access to treatment for the greatest proportion of patients.	I	B-R
5. Direct aspiration thrombectomy as first pass mechanical thrombectomy is recommended as non-inferior to stent retriever for patients who meet all the following criteria: (1) prestroke mRS score of 0 to 1; (2) causative occlusion of the internal carotid artery or M1; (3) age ≥18 years; (4) NIHSS score of ≥6; (5) ASPECTS of ≥6; and (6) treatment initiation (groin puncture) within 6 hours of symptom onset.	I	B-R
6. It is reasonable to select an anesthetic technique during EVT for AIS on the basis of individualized assessment of patient risk factors, technical performance of the procedure, and other clinical characteristics.	IIa	B-R
7. The use of a proximal balloon guide catheter or a large-bore distal-access catheter, rather than a cervical guide catheter alone, in conjunction with stent retrievers may be beneficial.	IIa	C-LD
8. Treatment of tandem occlusions (both extracranial and intracranial occlusions) when performing mechanical thrombectomy may be reasonable.	IIb	B-R
9. The safety and efficacy of IV glycoprotein IIb/IIIa inhibitors administered during endovascular stroke treatment are uncertain.	IIb	C-LD
10. Use of salvage technical adjuncts including intra-arterial fibrinolysis may be reasonable to achieve mTICI grade 2b/3 angiographic results.	IIb	C-LD

General Supportive Care and Emergency Treatment
3.7 Mechanical Thrombectomy
3.7.5 Blood Pressure Management

Recommendations	COR	LOE
1. In patients who undergo mechanical thrombectomy, it is reasonable to maintain the BP at ≤180/105 mm Hg during and for 24 hours after the procedure.	IIa	B-NR
2. In patients who undergo mechanical thrombectomy with successful reperfusion, it might be reasonable to maintain BP at a level <180/105 mm Hg.	IIb	B-NR

American Heart Association.

General Supportive Care and Emergency Treatment
3.8 Other Endovascular Therapies

Recommendations	COR	LOE
1. Mechanical thrombectomy with stent retrievers is recommended over intra-arterial fibrinolysis as first-line therapy.	I	C-EO
2. Intra-arterial fibrinolysis initiated within 6 hours of stroke onset in carefully selected patients who have contraindications to the use of IV alteplase might be considered, but the consequences are unknown.	IIb	C-EO

American Heart Association.

General Supportive Care and Emergency Treatment

3.9 Antiplatelet Treatment

Recommendations	COR	LOE
1. Administration of aspirin is recommended in patients with AIS within 24 to 48 hours after onset. For those treated with IV alteplase, aspirin administration is generally delayed until 24 hours later but might be considered in the presence of concomitant conditions for which such treatment given in the absence of IV alteplase is known to provide substantial benefit or withholding such treatment is known to cause substantial risk.	I	A
2. In patients presenting with minor non-cardioembolic ischemic stroke (NIHSS ≤3) who did not receive IV alteplase, treatment with dual antiplatelet therapy (aspirin and clopidogrel) started within 24 hours after symptom onset and continued for 21 days is effective in reducing recurrent ischemic stroke for a period of up to 90 days from symptom onset.	I	A
3. The efficacy of the IV glycoprotein IIb/IIIa inhibitors tirofiban and eptifibatide in the treatment of AIS is not well established.	IIb	B-R
4. Ticagrelor is not recommended over aspirin for treatment of patients with minor acute stroke.	III: No Benefit	B-R
5. The administration of the IV glycoprotein IIb/IIIa inhibitor abciximab as medical treatment for AIS is potentially harmful and should not be performed.	III: Harm	B-R
6. Aspirin is not recommended as a substitute for acute stroke treatment in patients who are otherwise eligible for IV alteplase or mechanical thrombectomy.	III: Harm	B-R

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General Supportive Care and Emergency Treatment

3.10 Anticoagulants

Recommendations	COR	LOE
1. The usefulness of urgent anticoagulation in patients with severe stenosis of an internal carotid artery ipsilateral to an ischemic stroke is not well established.	IIb	B-NR
2. The safety and usefulness of short-term anticoagulation for nonocclusive, extracranial intraluminal thrombus in the setting of AIS are not well established.	IIb	C-LD
3. At present, the usefulness of argatroban, dabigatran, or other thrombin inhibitors for the treatment of patients with AIS is not well established.	IIb	B-R
4. The safety and usefulness of oral factor Xa inhibitors in the treatment of AIS are not well established.	IIb	C-LD
5. Urgent anticoagulation, with the goal of preventing early recurrent stroke, halting neurological worsening, or improving outcomes after AIS, is not recommended for treatment of patients with AIS.	III: No Benefit	A

American Heart Association.

General Supportive Care and Emergency Treatment

3.11 Volume Expansion/Hemodilution, Vasodilators, and Hemodynamic Augmentation

Recommendations	COR	LOE
1. Hemodilution by volume expansion is not recommended for treatment of patients with AIS.	III: No Benefit	A
2. The administration of high-dose albumin is not recommended for the treatment of patients with AIS.	III: No Benefit	A
3. The administration of vasodilatory agents, such as pentoxifylline, is not recommended for treatment of patients with AIS.	III: No Benefit	A
4. Devices to mechanically augment cerebral blood flow for the treatment of patients with AIS are not useful.	III: No Benefit	B-R

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General Supportive Care and Emergency Treatment

3.12 Neuroprotective Agents

Recommendations	COR	LOE
1. At present, pharmacological or non-pharmacological treatments with putative neuroprotective actions are not recommended.	III: No Benefit	A

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General Supportive Care and Emergency Treatment

3.13 Emergency Carotid Endarterectomy, Carotid Angioplasty and Stenting without Intracranial Clot

Recommendations	COR	LOE
1. The usefulness of emergent or urgent CEA/Carotid angioplasty and stenting 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 CEA, in which acute thrombosis of the surgical site is suspected, is not well established.	IIb	B-NR
2. In patients with unstable neurological status (eg, stroke-in-evolution), the efficacy of emergency or urgent CEA /Carotid angioplasty and stenting is not well established.	IIb	B-NR

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General Supportive Care and Emergency Treatment
3.14 Other

Recommendations	COR	LOE
1. Transcranial near-infrared laser therapy is not recommended for the treatment of AIS.	III: No Benefit	B-R

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In-hospital Management of AIS: General Supportive Care

4.1 Stroke Units

4.2 Head Positioning

4.3 Supplemental Oxygen

4.4 Blood Pressure

4.5 Temperature

4.6 Glucose

4.7 Dysphagia

4.8 Nutrition

4.9 Deep Vein Thrombosis Prophylaxis

4.10 Depression Screening

4.11 Other

4.12 Rehabilitation

American Heart Association.

In-hospital Management of AIS: General Supportive Care

Stroke Units

- Numerous studies have demonstrated that Stroke Units reduce morbidity and mortality after stroke
- Standardized stroke order sets help to ensure best practices are followed
- Multidisciplinary teams and coordinated care
- Continuous quality improvement

American Heart Association.

In-hospital Management of AIS: General Supportive Care

4.1 Stroke Units

Recommendations	COR	LOE
1. The use of comprehensive specialized stroke care (stroke units) that incorporates rehabilitation is recommended.	I	A
2. The use of standardized stroke care order sets is recommended to improve general management.	I	B-NR

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In-hospital Management of AIS: General Supportive Care

4.2 Head Positioning

Recommendations	COR	LOE
1. The benefit of flat-head positioning early after hospitalization for stroke is uncertain.	IIb	B-R

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In-hospital Management of AIS: General Supportive Care

Supplemental Oxygen

- Supplemental Oxygen
  - Guidelines unchanged from 2013 recommendations
  - Maintain O_2 saturations >94%; supplemental O_2 is not recommended in non-hypoxic patients
  - New RCT with 8003 pts randomized within 24 hours
    - O_2 at 2L/min (saturations >93%) or 3L/min (saturations ≤93%)
    - Duration: continuously for 72 hours or nocturnally for 3 nights
    - No benefit in functional outcomes at 90 days

American Heart Association.

In-hospital Management of AIS: General Supportive Care
4.3 Supplemental Oxygen

Recommendations	COR	LOE
1. 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.	I	C-EO
2. Supplemental oxygen should be provided to maintain oxygen saturation >94%.	I	C-LD
3. Supplemental oxygen is not recommended in nonhypoxic patients hospitalized with AIS.	III: No Benefit	B-R

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In-hospital Management of AIS: General Supportive Care
Blood Pressure

- Blood Pressure
  - Optimal BP strategy for stroke pts remains unclear and depends on the clinical situation
    - Some may have concomitant comorbidities that require acute BP lowering (eg, aortic dissection, acute heart failure, etc.)
    - Excessive BP lowering can worsen cerebral ischemia, though
    - Lowering BP acutely by 15% is probably safe
    - Initial BP <220/120 mm Hg: reinitiating antihypertensive is safe but is not associated with improved outcomes
    - Initial BP >220/120 mm Hg: possibly reasonable to lower by 15% in the first 24 hours
    - Neurologically stable patients: probably safe to restart antihypertensive if BP >140/90 mm Hg
    - Hypotension and hypovolemia should be corrected

In-hospital Management of AIS: General Supportive Care

4.4 Blood Pressure

Recommendations	COR	LOE
1. Hypotension and hypovolemia should be corrected to maintain systemic perfusion levels necessary to support organ function.	I	C-EO
2. In patients with AIS, early treatment of hypertension is indicated when required by comorbid conditions (eg, concomitant acute coronary event, acute heart failure, aortic dissection, post-fibrinolysis sICH, or preeclampsia/eclampsia).	I	C-EO
3. In patients with BP ≥220/120 mm Hg who did not receive IV alteplase or mechanical thrombectomy and have no comorbid conditions requiring urgent antihypertensive treatment, the benefit of initiating or reinitiating treatment of hypertension within the first 48 to 72 hours is uncertain. It might be reasonable to lower BP by 15% during the first 24 hours after onset of stroke.	IIb	C-EO
4. In patients with BP <220/120 mm Hg who did not receive IV alteplase or mechanical thrombectomy and do not have a comorbid condition requiring urgent antihypertensive treatment, initiating or reinitiating treatment of hypertension within the first 48 to 72 hours after an AIS is not effective to prevent death or dependency.	III: No Benefit	A

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In-hospital Management of AIS: General Supportive Care
Temperature

- Temperature
  - Identify sources of temperature >38ºC and treat
  - New data from retrospective cohort study (9366 pts)
    - Temperatures in the first 24 hours below 37C and above 39C associated with increased in-hospital death
  - Benefit of hypothermia in acute ischemic stroke patient is not proven
  - Therapeutic hypothermia should only be undertaken in clinical trials

American Heart Association.

In-hospital Management of AIS: General Supportive Care

4.5 Temperature

Recommendations	COR	LOE
1. Sources of hyperthermia (temperature >38°C) should be identified and treated. Antipyretic medications should be administered to lower temperature in hyperthermic patients with stroke.	I	C-LD
2. In patients with acute ischemic stroke, the benefit of treatment with induced hypothermia is uncertain.	IIb	B-R

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In-hospital Management of AIS: General Supportive Care

Glucose

- Hyperglycemia
  - Common in stroke patients (elevated admission blood glucose in >40%, most frequently in diabetic patients)
  - Persistent hyperglycemia associated with worse outcomes
  - Main risk of correction: hypoglycemia

- Hypoglycemia (<60mg/dL)
  - Symptoms: autonomic and brain dysfunction
  - Correct with IV push of dextrose

American Heart Association.

In-hospital Management of AIS: General Supportive Care

4.6 Glucose

Recommendations	COR	LOE
1. Hypoglycemia (blood glucose <60 mg/dL) should be treated in patients with AIS.	I	C-LD
2. Evidence indicates that persistent in-hospital hyperglycemia during the first 24 hours after AIS 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.	IIa	C-LD

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In-hospital Management of AIS: General Supportive Care
Dysphagia

- Dysphagia Screening
  - Post-stroke dysphagia
    - Very common
    - Risk factor for aspiration pneumonia
    - Associated with worse patient outcomes
  - Screening
    - Insufficient data whether screening protocol decreases death or dependency, but that does not mean screening is ineffective
    - Overall, early screening is reasonable
    - Those who fail screening
      -usually older
      -more comorbidities
      -coming from a facility
      -presenting with weakness and speech difficulties
      -lower level of consciousness
      -higher stroke severity

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In-hospital Management of AIS: General Supportive Care

4.7 Dysphagia

Recommendations	COR	LOE
1.Dysphagia screening before the patient begins eating, drinking, or receiving oral medications is effective to identify patients at increased risk for aspiration.	I	C-LD
2. An endoscopic evaluation is reasonable for those patients suspected of aspiration to verify the presence/absence of aspiration and to determine the physiological reasons for the dysphagia to guide the treatment plan.	IIa	B-NR
3. It is reasonable for dysphagia screening to be performed by a speech-language pathologist or other trained healthcare provider.	IIa	C-LD
4. It is not well-established which instrument to choose for evaluation of swallowing with sensory testing, but the choice may be based on instrument availability or other considerations (ie, fiberoptic endoscopic evaluation of swallowing, videofluoroscopy, fiberoptic endoscopic evaluation).	IIb	C-LD
5. Implementing oral hygiene protocols to reduce the risk of pneumonia after stroke may be reasonable.	IIb	B-NR

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In-hospital Management of AIS: General Supportive Care
Nutrition

- Nutrition
  - Stroke patients should be started on an enteral diet within 7 days
    - FOOD RCTs
      -Supplemented diet: absolute reduction in risk of death: 0.7%
    - Cochrane review (33 RCTs)
      -Available data suggest that PEG and NG are similar with regard to case-fatality, death, and dependency but PEG is associated with fewer treatment failures, less GI bleeding, and higher food delivery
  - Oral hygiene may reduce pneumonia risk
    - Standardized screening and diet along with standardized oral hygiene may reduce pneumonia

American Heart Association.

In-hospital Management of AIS: General Supportive Care

4.8 Nutrition

Recommendations	COR	LOE
1. Enteral diet should be started within 7 days of admission after an acute stroke.	I	B-R
2. For patients with dysphagia, it is reasonable to initially use nasogastric tubes for feeding in the early phase of stroke (starting within the first 7 days) and to place percutaneous gastrostomy tubes in patients with longer anticipated persistent inability to swallow safely (>2–3 weeks).	IIa	C-EO
3. Nutritional supplements are reasonable to consider for patients who are malnourished or at risk of malnourishment.	IIa	B-R

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In-hospital Management of AIS: General Supportive Care
Deep Vein Thrombosis Prophylaxis

- DVT Prophylaxis
  - Pneumatic compression is more effective than routine care
    - Primary outcome of DVT: 9.6% vs 14%
  - Benefit of prophylactic heparin (UFH or LMWH) is not well established
    - Reductions in PE and DVT but increases in ICH and extracranial bleeds
  - LMWH vs UFH
    - LMWH is once daily but is more expensive and associated with increased bleeding in elderly patients with kidney disease
  - Elastic compression stockings should not be used

American Heart Association.

In-hospital Management of AIS: General Supportive Care
4.9 Deep Vein Thrombosis Prophylaxis

Recommendations	COR	LOE
1. In immobile stroke patients without contraindications, intermittent pneumatic compression (IPC) in addition to routine care (aspirin and hydration) is recommended over routine care to reduce the risk of deep vein thrombosis (DVT).	I	B-R
2. The benefit of prophylactic-dose subcutaneous heparin (unfractionated heparin [UFH] or LMWH) in patients with AIS is not well established.	IIb	A
3. When prophylactic anticoagulation is used, the benefit of prophylactic-dose LMWH over prophylactic-dose UFH is uncertain.	IIb	B-R
4. In ischemic stroke, elastic compression stockings should not be used.	III: Harm	B-R

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In-hospital Management of AIS: General Supportive Care
Depression Screening

- Depression Screening
  - Post-stroke depression (PSD) is common
  - Structured screening is recommended
  - Optimal screen and timing remains unclear
  - Patients with PSD should be treated with antidepressants, if no contraindications, and the response monitored

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In-hospital Management of AIS: General Supportive Care

4.10 Depression Screening

Recommendations	COR	LOE
1. Administration of a structured depression inventory is recommended to routinely screen for poststroke depression.	I	B-NR
2. Patients diagnosed with poststroke depression should be treated with antidepressants in the absence of contraindications and closely monitored to verify effectiveness.	I	B-R

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In-hospital Management of AIS: General Supportive Care

Other

- Reasonable to direct appropriate patients and families to palliative care resources, as appropriate
- Avoid prophylactic antibiotics
- Avoid routine placement of indwelling bladder catheters
- Perform regular skin assessments
- Perform good skin hygiene until mobility returns

American Heart Association.

In-hospital Management of AIS: General Supportive Care
4.11 Other

Recommendations	COR	LOE
1. During hospitalization and inpatient rehabilitation, regular skin assessments are recommended with objective scales of risk such as the Braden scale.	I	C-LD
2. It is recommended to minimize or eliminate skin friction, to minimize skin pressure, to provide appropriate support surfaces, to avoid excessive moisture, and to maintain adequate nutrition and hydration to prevent skin breakdown. Regular turning, good skin hygiene, and use of specialized mattresses, wheelchair cushions, and seating are recommended until mobility returns.	I	C-LD
3. It is reasonable for patients and families with stroke to be directed to palliative care resources as appropriate.	IIa	C-EO
4. Routine use of prophylactic antibiotics has not been shown to be beneficial.	III: No Benefit	A
5. Routine placement of indwelling bladder catheters should not be performed because of the associated risk of catheter-associated urinary tract infections.	III: Harm	C-LD

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In-hospital Management of AIS: General Supportive Care
Rehabilitation

- Rehabilitation
  - Assessment
    - Patients with stroke need formal multi-domain assessments before hospital discharge
    - Patients with residual deficits should have an assessment by a clinician with expertise in rehabilitation
  - Timing and intensity
    - High-dose and very early (within 24 hours) should not be performed
      --AVERT RCT (46% vs 50%) compared with usual care
      Reduced likelihood of favorable outcome
    - Intensity commensurate with benefit and tolerance
    - Effectiveness of fluoxetine/other SSRIs is unclear

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In-hospital Management of AIS: General Supportive Care

4.12 Rehabilitation

Recommendations	COR	LOE
1. It is recommended that early rehabilitation for hospitalized stroke patients be provided in environments with organized, interprofessional stroke care.	I	A
2. It is recommended that stroke survivors receive rehabilitation at an intensity commensurate with anticipated benefit and tolerance.	I	B-NR
3. It is recommended that all individuals with stroke be provided a formal assessment of their activities of daily living and instrumental activities of daily living, communication abilities, and functional mobility before discharge from acute care hospitalization and the findings be incorporated into the care transition and the discharge planning process.	I	B-NR
4. A functional assessment by a clinician with expertise in rehabilitation is recommended for patients with an acute stroke with residual functional deficits.	I	C-LD
5. The effectiveness of fluoxetine or other selective serotonin reuptake inhibitors to enhance motor recovery is not well established.	IIb	C-LD
6. High-dose, very early mobilization within 24 hours of stroke onset should not be performed because it can reduce the odds of a favorable outcome at 3 months.	III: Harm	B-R

In-hospital Management of AIS: Treatment and Acute Complications

5.1 Brain Swelling

5.2 Seizures

American Heart Association.

In-hospital Management of AIS: Treatment and Acute Complications

5.1 Brain Swelling

5.1.1 General Recommendations

Recommendations	COR	LOE
1. Patients with large territorial cerebral and cerebellar infarctions are at high risk for developing brain swelling and herniation. Discussion of care options and possible outcomes should take place quickly with patients (if possible) and family or next of kin. Medical professionals and caregivers should ascertain and include patient-centered preferences in shared decision making, especially during prognosis formation and when considering interventions or limitations in care.	I	C-EO
2. Measures to lessen the risk of swelling and close monitoring of the patient for signs of neurological worsening during the first days after stroke are recommended. Early transfer of patients at risk for malignant brain swelling to an institution with appropriate neurosurgical expertise should be considered.	I	C-LD

In-hospital Management of AIS: Treatment and Acute Complications

5.1 Brain Swelling

5.1.2 Medical Management

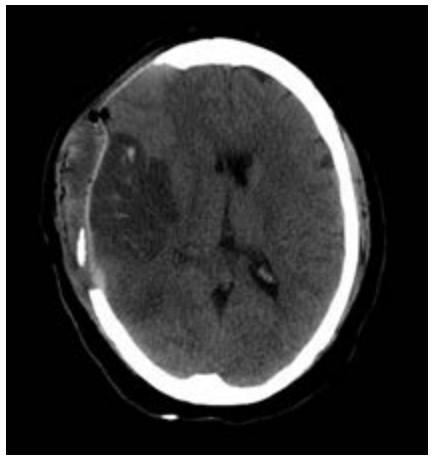
Recommendations	COR	LOE
1. Use of osmotic therapy for patients with clinical deterioration from brain swelling associated with cerebral infarction is reasonable.	IIa	C-LD
2. Use of brief moderate hyperventilation (PCO_2 target, 30–34 mm Hg) is a reasonable treatment for patients with acute severe neurological decline from brain swelling as a bridge to more definitive therapy.	IIa	C-LD
3. Hypothermia or barbiturates in the setting of ischemic cerebral or cerebellar swelling are not recommended.	III: No Benefit	B-R
4. Because of a lack of evidence of efficacy and the potential to increase the risk of infectious complications, corticosteroids (in conventional or large doses) should not be administered for the treatment of brain swelling complicating ischemic stroke.	III: Harm	A

American Heart Association.

In-hospital Management of AIS: Treatment and Acute Complications

5.1 Brain Swelling

5.1.3 Surgical Management – Supratentorial Infarction



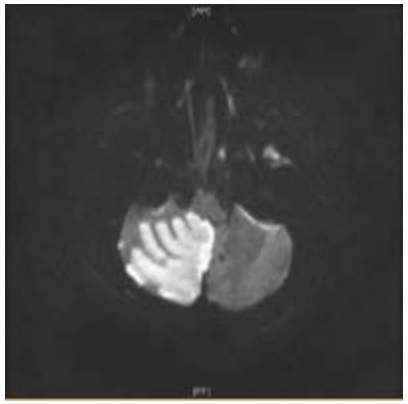
Recommendations	COR	LOE
1. Although the optimal trigger for decompressive craniectomy is unknown, it is reasonable to use a decrease in level of consciousness attributed to brain swelling as selection criteria.	IIa	A
2. In patients ≤60 years of age who deteriorate neurologically within 48 hours from brain swelling associated with unilateral MCA infarctions despite medical therapy, decompressive craniectomy with dural expansion is reasonable.	IIa	A
3. In patients >60 years of age who deteriorate neurologically within 48 hours from brain swelling associated with unilateral MCA infarctions despite medical therapy, decompressive craniectomy with dural expansion may be considered.	IIb	B-R

American Heart Association.

In-hospital Management of AIS: Treatment and Acute Complications

5.1 Brain Swelling

5.1.4 Surgical Management – Cerebellar Infarction



Recommendations	COR	LOE
1. Ventriculostomy is recommended in the treatment of obstructive hydrocephalus after cerebellar infarction. Concomitant or subsequent decompressive craniectomy may or may not be necessary on the basis of factors such as the size of the infarction, neurological condition, degree of brainstem compression, and effectiveness of medical management.	I	C-LD
2. Decompressive suboccipital craniectomy with dural expansion should be performed in patients with cerebellar infarction causing neurological deterioration from brainstem compression despite maximal medical therapy. When deemed safe and indicated, obstructive hydrocephalus should be treated concurrently with ventriculostomy.	I	B-NR
3. When considering decompressive suboccipital craniectomy for cerebellar infarction, it may be reasonable to inform family members that the outcome after cerebellar infarct can be good after the surgery.	IIb	C-LD

American Heart Association.

In-hospital Management of AIS: Treatment and Acute Complications

5.2 Seizures

Recommendations	COR	LOE
1. Recurrent seizures after stroke should be treated in a manner similar to when they occur with other acute neurological conditions, and anti-seizure drugs should be selected on the basis of specific patient characteristics.	I	C-LD
2. Prophylactic use of anti-seizure drugs is not recommended.	III: No Benefit	C-LD

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention

6.1 Brain Imaging

6.2 Vascular Imaging

6.3 Cardiac Evaluation

6.4 Glucose

6.5 Other Tests for Secondary Prevention

6.6 Antithrombotic Treatment

6.7 Carotid Revascularization

6.8 Treatment of Hyperlipidemia

6.9 Institution of Antihypertensive Medications

6.10 Smoking Cessation Intervention

6.11 Stroke Education

In-hospital Institution of Secondary Stroke Prevention

The recommendations in this section reference other current AHA guidelines for secondary stroke prevention where applicable. These other guidelines should be referred to for further information regarding secondary stroke prevention not covered in this document. These other guidelines are updated regularly and the most recent versions should be used.

Guidelines Relevant to Secondary Stroke Prevention		
Document Title	**Year Published**	**Abbreviation Used in This Document**
"Guidelines for the Prevention of Stroke in Patients With Stroke and Transient Ischemic Attack: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association" [10]	2014	2014 Secondary Prevention
"2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines"[18]	2017	N/A
"2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines" [19]	2018	2018 Cholesterol Guidelines

In-hospital Institution of Secondary Stroke Prevention
6.1 Brain Imaging

Recommendations	COR	LOE
1. For prevention of recurrent stroke, the use of MRI is reasonable in some patients with AIS to provide additional information to guide selection of appropriate secondary stroke prevention treatments.	IIa	C-EO
2. Brain MRI is reasonable in selected patients as part of a comprehensive evaluation to determine if they meet the eligibility criteria of the RCTs that investigated mechanical closure of patent foramen ovale for prevention of recurrent stroke.	IIa	B-R
3. The effectiveness of routine brain MRI to guide treatment selection for prevention of recurrent stroke is uncertain.	IIb	B-NR

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention

6.2 Vascular Imaging

Recommendations	COR	LOE
1. For patients with nondisabling (mRS score 0–2) AIS in the carotid territory who are candidates for CEA or stenting, noninvasive imaging of the cervical carotid arteries should be performed routinely within 24 hours of admission.	I	B-NR
2. For prevention of recurrent stroke, the use of intracranial vessel imaging is reasonable in some patients with AIS to provide additional information to guide selection of appropriate secondary stroke prevention treatments.	IIa	C-EO
3. Imaging of the intracranial vasculature to detect atherosclerotic stenosis of a major intracranial artery is reasonable in selected patients as part of a comprehensive evaluation to determine if they meet the eligibility criteria of the RCTs that investigated mechanical closure of patent foramen ovale for prevention of recurrent stroke.	IIa	B-R
4. Routine imaging of the intracranial vasculature to detect atherosclerotic stenosis of a major intracranial artery to guide selection of antithrombotic or intracranial endovascular treatment for prevention of recurrent stroke is not well-established.	IIb	B-NR

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention
6.3 Cardiac Evaluation
6.3.1 Electrocardiographic Monitoring

Recommendations	COR	LOE
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.	I	B-NR
2. The effectiveness of prolonged cardiac monitoring during hospitalization after AIS to guide treatment selection for prevention of recurrent stroke is uncertain.	IIb	C-LD

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention

6.3 Cardiac Evaluation

6.3.2 Echocardiography

Recommendations	COR	LOE
1. For prevention of recurrent stroke, the use of echocardiography is reasonable in some patients with AIS to provide additional information to guide selection of appropriate secondary stroke prevention.	IIa	C-EO
2. Echocardiography is reasonable in selected patients as part of a comprehensive evaluation to determine if they meet the eligibility criteria of the RCTs that investigated mechanical closure of patent foramen ovale for prevention of recurrent stroke.	IIa	B-R
3. The effectiveness of routine echocardiography to guide treatment selection for prevention of recurrent stroke is uncertain.	IIb	B-NR

American Heart Association.

Glucose

- Screening for diabetes mellitus is reasonable in AIS patient
  - Fasting plasma glucose
  - **HgbA1c (may be more accurate in the acute setting)**
  - Oral glucose tolerance test

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention
6.4 Glucose

Recommendations	COR	LOE
1. After AIS, it is reasonable to screen all patients for diabetes mellitus with testing of fasting plasma glucose, hemoglobin A1c, or an oral glucose tolerance test. Choice of test and timing should be guided by clinical judgment and recognition that acute illness may temporarily perturb measures of plasma glucose. In general, hemoglobin A1c may be more accurate than other screening tests in the immediate post-event period.	IIa	C-EO

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention

6.5 Other Tests for Secondary Prevention

Recommendations	COR	LOE
1. The usefulness of screening for thrombophilic states in patients with ischemic stroke is unknown.	IIb	C-LD
2. Routine screening of patients with recent ischemic stroke for obstructive sleep apnea (OSA) is not recommended.	III: No Benefit	B-R
3. Routine testing for antiphospholipid antibodies is not recommended for patients with ischemic stroke who have no other manifestations of the antiphospholipid syndrome and who have an alternative explanation for their ischemic event, such as atherosclerosis, carotid stenosis, or atrial fibrillation.	III: No Benefit	C-LD
4. Routine screening for hyperhomocysteinemia among patients with a recent ischemic stroke is not indicated.	III: No Benefit	C-EO

American Heart Association.

Antithrombotic Therapy

- Antiplatelet therapy
  - Recommended for non-cardioembolic AIS
  - Increasing aspirin dose or switching antiplatelet agents is not well established
    - -SPS-3: no benefit to adding clopidogrel to aspirin
    - -WARSS: no difference in stroke recurrence after switching to warfarin
    - -WASID: no difference after switching to warfarin
- Anticoagulation for AIS due to atrial fibrillation
  - Reasonable to initiate oral anticoagulation 4-14 days after AIS for most patients
- Hemorrhagic transformation: reinitiation depends on clinical scenario
- Dissection: antiplatelet or anticoagulation is reasonable (CADISS). If recurrence, the value of intracranial stenting is not well established

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention
6.6 Antithrombotic Treatment
6.6.1 Noncardioembolic Stroke

Recommendations	COR	LOE
1. For patients with non-cardioembolic AIS, the use of antiplatelet agents rather than oral anticoagulation is recommended to reduce the risk of recurrent stroke and other cardiovascular events.	I	A
2. For early secondary prevention in patients with noncardioembolic AIS, the selection of an antiplatelet agent should be individualized on the basis of patient risk factor profiles, cost, tolerance, relative known efficacy of the agents, and other clinical characteristics.	I	C-EO
3. For patients who have a noncardioembolic AIS while taking aspirin, increasing the dose of aspirin or switching to an alternative antiplatelet agent for additional benefit in secondary stroke prevention is not well established.	IIb	B-R
4. Anticoagulation might be considered in patients who are found to have abnormal findings on coagulation testing after an initial ischemic stroke, depending on the abnormality and the clinical circumstances.	IIb	C-LD
5. For patients who have a noncardioembolic AIS while taking antiplatelet therapy, switching to warfarin is not indicated for secondary stroke prevention.	III: No Benefit	B-NR
6. In patients with non-cardioembolic ischemic stroke, treatment with triple antiplatelet therapy (aspirin + clopidogrel + dipyridamole) for secondary stroke prevention is harmful and should not be administered.	III: Harm	B-R

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention
6.6 Antithrombotic Treatment
6.6.2 Atrial Fibrillation

Recommendations	COR	LOE
1. For most patients with an AIS in the setting of atrial fibrillation, it is reasonable to initiate oral anticoagulation between 4 to 14 days after the onset of neurological symptoms.	IIa	B-NR
2. For patients with a history of ischemic stroke, atrial fibrillation, and coronary artery disease, the usefulness of adding antiplatelet therapy to oral anticoagulants is uncertain for purposes of reducing the risk of ischemic cardiovascular and cerebrovascular events. Unstable angina and coronary artery stenting represent special circumstances in which management may warrant dual antiplatelet/oral anticoagulation.	IIb	C-LD

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention

6.6 Antithrombotic Treatment

6.6.3 Arterial Dissection

Recommendations	COR	LOE
1. For patients with AIS and extracranial carotid or vertebral arterial dissection, treatment with either antiplatelet or anticoagulant therapy for 3 to 6 months is reasonable.	IIa	B-NR
2. For patients with AIS and extracranial carotid or extracranial vertebral arterial dissection who have definite recurrent cerebral ischemic events despite medical therapy, the value of extracranial EVT (stenting) is not well established.	IIb	C-LD

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention
6.6 Antithrombotic Treatment
6.6.4 Hemorrhagic Transformation

Recommendations	COR	LOE
1. For patients with AIS and HT, initiation or continuation of antiplatelet or anticoagulation therapy may be considered, depending on the specific clinical scenario and underlying indication.	IIb	C-LD

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention
6.7 Carotid Revascularization

Recommendations	COR	LOE
1. When revascularization is indicated for secondary prevention in patients with minor, nondisabling stroke (mRS score 0–2), it is reasonable to perform the procedure between 48 hours and 7 days of the index event rather than delay treatment if there are no contraindications to early revascularization.	IIa	B-NR

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention
6.8 Treatment of Hyperlipidemia
6.8.1 General Principles

Recommendations	COR	LOE
1. Patients with AIS should be managed according to the 2018 ACC/AHA Cholesterol Guidelines, which include lifestyle modification, dietary recommendations, and medication recommendations.	I	A
2. In adults who are 20 years of age or older and not on lipid-lowering therapy, measurement of either a fasting or a nonfasting plasma lipid profile is effective in estimating atherosclerotic cardiovascular disease (ASCVD) risk and documenting baseline low density lipoprotein cholesterol (LDL-C).	I	B-NR
3. Adherence to changes in lifestyle and effects of LDL-C–lowering medication should be assessed by measurement of fasting lipids and appropriate safety indicators 4 to 12 weeks after statin initiation or dose adjustment and every 3 to 12 months thereafter based on need to assess adherence or safety.	I	A

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention

6.8 Treatment of Hyperlipidemia

6.8.2 Choice of Lipid-lowering Drugs for Patients with Clinical Atherosclerotic Cardiovascular Disease* (ASCVD)

Recommendations	COR	LOE
1. In patients who are 75 years of age or younger with clinical ASCVD, high-intensity statin therapy should be initiated or continued with the aim of achieving a 50% or greater reduction in LDL-C levels.	I	A
2. In patients with clinical ASCVD in whom high-intensity statin therapy is contraindicated or who experience statin-associated side effects, moderate-intensity statin therapy should be initiated or continued with the aim of achieving a 30% to 49% reduction in LDL-C levels.	I	A
3. In patients at increased ASCVD risk with chronic, stable liver disease (including non-alcoholic fatty liver disease) when appropriately indicated, it is reasonable to use statins after obtaining baseline measurements and determining a schedule of monitoring and safety checks.	I	B-R
4. In patients with clinical ASCVD, who are judged to be very high-risk and considered for proprotein convertase subtilison/kexin type 9 (PCSK9) therapy, maximally tolerated LDL-C lowering therapy should include maximally tolerated statin therapy and ezetimibe.	I	B-R

Continued

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention

6.8 Treatment of Hyperlipidemia

6.8.2 Choice of Lipid-lowering Drugs for Patients with ASCVD*

Recommendations	COR	LOE
5. In patients with clinical ASCVD who are judged to be very high risk and who are on maximally tolerated LDL-C lowering therapy with LDL-C 70 mg/dL or higher (≥1.8 mmol/L) or a non–HDL-C level of 100 mg/dL or higher (≥2.6 mmol/L), it is reasonable to add a PCSK9 inhibitor following a clinician–patient discussion about the net benefit, safety, and cost.	IIa	A
6. At mid-2018 list prices, PCSK9 inhibitors have a low cost value (>$150,000 per quality-adjusted life year) compared to good cost value (<$50,000 per quality-adjusted life year).	Value Statement: Low Value (LOE: B-NR)	
7. In patients with clinical ASCVD who are on maximally tolerated statin therapy and are judged to be at very high risk and have an LDL-C level of 70 mg/dL or higher (≥1.8 mmol/L), it is reasonable to add ezetimibe therapy.	IIa	B-R
8. In patients older than 75 years of age with clinical ASCVD, it is reasonable to initiate moderate- or high-intensity statin therapy after evaluation of the potential for ASCVD risk reduction, adverse effects, and drug–drug interactions, as well as patient frailty and patient preferences.	IIa	B-R

Continued

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention

6.8 Treatment of Hyperlipidemia

6.8.2 Choice of Lipid-lowering Drugs for Patients with Clinical ASCVD*

Recommendations	COR	LOE
9. In patients older than 75 years of age who are tolerating high-intensity statin therapy, it is reasonable to continue high-intensity statin therapy after evaluation of the potential for ASCVD risk reduction, adverse effects, and drug-drug interactions, as well as patient frailty and patient preferences.	IIa	C-LD
10. In patients with clinical ASCVD who are receiving maximally tolerated statin therapy and whose LDL-C level remains 70 mg/dL or higher (≥1.8 mmol/L), it may be reasonable to add ezetimibe.	IIb	B-R

***Clinical ASCVD includes acute coronary syndrome, those with history of MI, stable or unstable angina or coronary or other arterial revascularization, stroke, TIA, or peripheral artery disease including aortic aneurysm, all of atherosclerotic origin.**

For high-intensity statin therapy, the 2018 ACC/AHA Cholesterol Guidelines recommend atorvastatin 80 mg daily or rosuvastatin 20 mg daily.

Continued

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention

6.8 Treatment of Hyperlipidemia

6.8.2 Choice of Lipid-lowering Drugs for Patients with Clinical ASCVD*

Very high risk includes a history of multiple major ASCVD events or 1 major ASCVD event and multiple high-risk conditions:

Major ASCVD events

- Recent acute coronary syndrome (within the past 12 mo)
- History of MI (other than recent acute coronary syndrome event listed above)
- History of ischemic stroke
- Symptomatic peripheral arterial disease (history of claudication with ankle-brachial index <0.85, or previous revascularization or amputation.

High-risk conditions

- Age ≥65 years
- Heterozygous familial hypercholesterolemia
- History of prior coronary artery bypass surgery or percutaneous coronary intervention outside of the major ASCVD events
- Diabetes mellitus
- Hypertension
- Chronic kidney disease (estimated glomerular filtration rate 15-59 ml/min/1.73 m^2)
- Current smoking

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention
6.8 Treatment of Hyperlipidemia
6.8.3 Implementation

Recommendations	COR	LOE
1. A clinician–patient risk discussion is recommended before initiation of statin therapy to review net clinical benefit, weighing the potential for ASCVD risk reduction against the potential for statin-associated side effects, statin–drug interactions, and safety, while emphasizing that side effects can be addressed successfully.	I	A
2. In patients with indication for statin therapy, identification of potential predisposing factors for statin-associated side effects, including new-onset diabetes mellitus and statin-associated muscle symptoms, is recommended before initiation of treatment.	I	B-R
3. In patients with statin-associated side effects that are not severe, it is recommended to reassess and to rechallenge to achieve a maximal LDL-C lowering by modified dosing regimen, an alternate statin or in combination with nonstatin therapy.	I	B-R
4. In patients at increased ASCVD risk with severe statin-associated muscle symptoms or recurrent statin-associated muscle symptoms despite appropriate statin rechallenge, it is reasonable to use RCT proven non-statin therapy that is likely to provide net clinical benefit.	IIa	B-R

In-hospital Institution of Secondary Stroke Prevention
6.8 Treatment of Hyperlipidemia
6.8.4 Timing

Recommendations	COR	LOE
1. Among patients already taking statins at the time of onset of ischemic stroke, continuation of statin therapy during the acute period is reasonable.	IIa	B-R
2. For patients with AIS who qualify for statin treatment, in-hospital initiation of statin therapy is reasonable.	IIa	C-LD

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention
6.8 Treatment of Hyperlipidemia
6.8.5 Special Patient Groups

Recommendations	COR	LOE
1. Women of childbearing age who are treated with statin therapy and are sexually active should be counseled to use a reliable form of contraception.	I	C-LD
2. Women of childbearing age with hypercholesterolemia who plan to become pregnant should stop the statin 1 to 2 months before pregnancy is attempted, or if they become pregnant while on a statin, should have the statin stopped as soon as the pregnancy is discovered.	I	C-LD
3. In adults with advanced kidney disease that requires dialysis treatment who are currently on LDL-lowering therapy with a statin, it may be reasonable to continue the statin.	IIb	C-LD
4. In adults with advanced kidney disease who require dialysis treatment, initiation of a statin is not recommended.	III: No Benefit	B-R

In-hospital Institution of Secondary Stroke Prevention

6.9 Institution of Antihypertensive Medications

Recommendations	COR	LOE
1. Starting or restarting antihypertensive therapy during hospitalization in patients with BP >140/90 mm Hg who are neurologically stable is safe and is reasonable to improve long-term BP control unless contraindicated.	IIa	B-R

American Heart Association.

Smoking Cessation Intervention

Therapeutic options include:

- Counseling
- Nicotine products
- Varenicline

In-hospital initiation of any of the above is reasonable

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention

6.10 Smoking Cessation Intervention

Recommendations	COR	LOE
1. Smokers with AIS should receive in-hospital initiation of high-intensity behavioral interventions to promote smoking cessation.	I	A
2. For smokers with an AIS, who receive in-hospital initiation of high-intensity behavioral interventions to promote smoking cessation, nicotine replacement therapy is recommended.	I	A
3. Healthcare providers should strongly advise every patient with AIS who has smoked in the past year to quit.	I	C-EO
4. It is reasonable to advise patients after ischemic stroke to avoid second-hand (passive) tobacco smoke.	IIa	B-NR
5. For smokers with an AIS, in-hospital initiation of varenicline to promote smoking cessation might be considered.	IIb	B-R

American Heart Association.

Stroke Education

- Discussion before discharge regarding:
  - What is a stroke
  - Stroke risk factors
  - Medications
  - When to call 911
  - Any other stroke-related questions

American Heart Association.

In-hospital Institution of Secondary Stroke Prevention

6.11 Stroke Education

Recommendations	COR	LOE
1. Patient education about stroke is recommended. Patients should be provided with information, advice, and the opportunity to talk about the impact of the illness on their lives.	I	C-EO

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