

AHA/ASA Expert Consensus Document

An Updated Definition of Stroke for the 21st Century

**A Statement for Healthcare Professionals from the American Heart
Association/American Stroke Association**
**The American Academy of Neurology affirms the value of this statement
as an educational tool for neurologists**



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On behalf of the American Heart Association Stroke Council, Council on Cardiovascular Surgery and Anesthesia, Cardiovascular Radiology and Intervention, Cardiovascular Nursing, Epidemiology and Prevention, Peripheral Vascular Disease, and Nutrition, Physical Activity and Metabolism



Stroke Council Professional Education Committee

This slide presentation was developed by a member of the Stroke Council Professional Education Committee.

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Proposed New Definitions

- CNS Infarction

- *brain, spinal cord, or retinal cell death due to ischemia, based on:*

- pathological, imaging, or other objective evidence of cerebral, spinal cord, or retinal focal ischemic injury in a defined vascular distribution

OR

- clinical evidence of cerebral, spinal cord, or retinal focal ischemic injury based on symptoms persisting ≥ 24 hours or until death, and other etiologies excluded

Definitions

- **Ischemic Stroke**
 - An episode of neurological dysfunction caused by focal cerebral, spinal, or retinal infarction.
- **Silent CNS Infarction**
 - Imaging or neuropathologic evidence of CNS infarction, without a history of acute neurological dysfunction attributable to the lesion.

Definitions

- **Intracerebral hemorrhage**
 - A focal collection of blood within the brain parenchyma or ventricular system, which is not due to trauma.
 - Includes parenchymal hemorrhage after CNS infarction
- **Stroke due to Intracerebral Hemorrhage**
 - Rapidly developing clinical signs of neurologic dysfunction due to a focal collection of blood within the brain parenchyma or ventricular system which is not due to trauma.
- **Silent Cerebral Hemorrhage**
 - A focal collection of chronic blood products within the brain parenchyma subarachnoid space, or ventricular system on neuroimaging or neuropathological examination which is not due to trauma, without a history of acute neurological dysfunction attributable to the lesion.

Definitions

- Subarachnoid hemorrhage
 - Bleeding into the subarachnoid space (the space between the arachnoid membrane and the pia matter of the brain or spinal cord)
- Stroke Due to Subarachnoid Hemorrhage
 - Rapidly developing signs of neurologic dysfunction and/or headache due to subarachnoid hemorrhage (the space between the arachnoid membrane and the pia mater of the brain or spinal cord), which is not caused by trauma.

Definitions

- **Stroke Due to Cerebral Venous Thrombosis**
 - Infarction or hemorrhage in the brain, spinal cord, or retina due to thrombosis of a cerebral venous structure. Symptoms or signs due to reversible edema without infarction or hemorrhage do not qualify as stroke.
- **Stroke, not otherwise specified**
 - An episode of acute neurological dysfunction presumed to be caused by ischemia or hemorrhage, persisting ≥ 24 hours or until death, but without sufficient evidence to be classified as one of the above

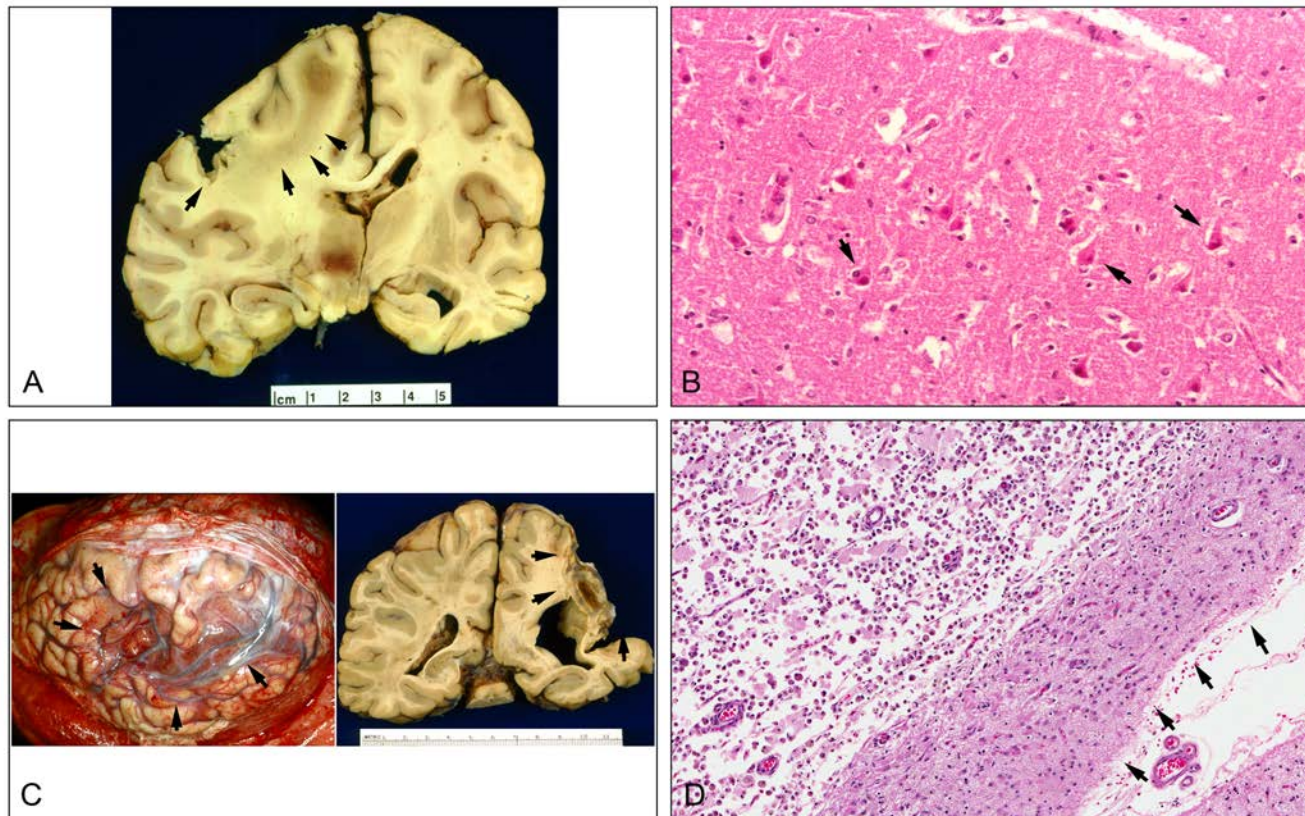
History

- For over 2000 years, physicians have struggled to define the term stroke
- Originally, acute non-traumatic brain injuries were known as *apoplexy*
 - Greek for “thunderstruck down by lightning”

Revised Definitions

- 2009 Definition of Transient Ischemic Attack
 - “a transient episode of neurological dysfunction caused by focal brain, spinal cord or retinal ischemia without acute infarction”
- Increased understanding of anatomy, pathology, and modern neuroimaging necessitate new definition of stroke

Pathology of cerebral infarction



A. Subacute cerebral infarction involving left cerebral hemisphere (indicated by arrows). B. Subacute infarct, microscopic features. Note pronounced eosinophilia of neurons (indicated by arrows). C. Old cystic cerebral infarcts (observed at autopsy) in two different individuals. Arrows indicate a large cavity in the middle cerebral artery territory. Brain (coronal section) at right shows a large right MCA territory infarct (indicated by arrows). D. Characteristic microscopic appearance of edge of an old cystic infarct. Arrows indicate pial surface and subpial regions of preserved. (Courtesy of H. Vinters)

Hallmarks of Revised Approach

- Assessment of infarction made on diagnostic methodologies such as neuroimaging and a secondary focus on time
- Clinical diagnosis of stroke based on attribution of neurological deficits to pathological or imaging assessment.
 - In the absence of a clinical syndrome, the result is a “silent” lesion

Stroke Mimics

- Clinical questions that need to be answered:
 - Do clinical deficits result from a vascular cause?
 - Where in the CNS is the lesion and what are the parent vessels involved?
 - What is the mechanism (ischemia or hemorrhage)?

Stroke Mimics

- Neuro-imaging considerations:
 - CT is useful for excluding mimicks such as tumor, subdural hematoma, and to identify mechanism
 - MRI diffusion weighted imaging (DWI) should be read with apparent diffusion coefficient (ADC) and T2 based sequences

Central Nervous System Infarction

- Definition of ischemic stroke should be limited to focal ischemia and not include global ischemia
 - Mechanism and pathology are unique
- Definition of CNS infarction is limited should be limited to brain, spinal cord, and retina
 - Unique differences in peripheral nervous system for mechanism, recovery and structure

Central Nervous System Infarction

- Definition includes unusual neurological syndromes that result from a vascular etiology
 - Vasculitis – CADASIL, CNS Vasculitis
 - Energy failure – MELAS
- In the absence of pathological or imaging evidence, infarction can be used for focal ischemic symptoms lasting greater than 24 hours

Silent Stroke: Silent Cerebral Infarctions and Microbleeds

	Silent cerebral infarctions	Cerebral microbleeds
Clinical features	Any of the following: None Absence of focal symptoms attributable to lesion	Any of the following: None Absence of focal symptoms attributable to the lesion Cognitive impairment
Imaging	CT: Focal areas of hypodensity MRI: acute DWI abnormality, focal T1/FLAIR hypointense, T2 hyperintense lesions (similar to cerebrospinal fluid)	CT: rarely seen MRI: Focal hypointensity on T2, gradient echo, and/or susceptibility weighted sequences
Size	≥ 3 mm	Any size
Location	Cortical or subcortical	Cortical or subcortical
Number	Single or multiple	Single or multiple

Intracerebral Hemorrhage

Non-traumatic intracranial hemorrhage within the ventricles or brain parenchyma

- Includes:
 - Intraventricular hemorrhage
 - Hemorrhages from arterio-venous malformations
 - Does not include subdural or epidural hemorrhage
- The term “hemorrhagic stroke” should be abandoned

Subarachnoid Hemorrhage

- Requires confirmation of bleeding in the subarachnoid space, typically by neuroimaging or spinal fluid analysis
- Non-traumatic

Cerebral Venous Thrombosis

- Definition requires infarction or hemorrhage due to thrombosis of a cerebral venous structure
- Does not include:
 - Consequences of isolated edema secondary to venous thrombosis, even if they result in focal neurological deficits
 - Focal neurological deficits secondary to increased intracranial pressure

Implications of Updated Definition

- Tissue based definition enhances diagnostic criteria and incorporates modern neuroimaging in the acute phase of the stroke.
- Explicitly identifies urgency of acute diagnostic evaluation while pathological injury is begin defined, analogous to “acute coronary syndrome”

Implications of Updated Definition

- Highlights the need to further understand the natural history, evaluation and management of patients with “silent” diagnoses
- Clinical research studies may need to incorporate both clinical and tissue definitions
- New definitions may increase incidence of stroke and decrease mortality rates

Flow chart depicting a proposed decision tree for determination of cerebrovascular event definition

