AmeriHealth Caritas Louisiana

National Imaging Associates, Inc.*	
Clinical guidelines **BRAIN (HEAD) CTA**	**Original Date: September 1997**
CPT Codes: 70496	**Last Revised Date: ~~April~~ March 2022~~1~~**
Guideline Number: NIA_CG_004-1	**Implementation Date: January 2022**

INDICATIONS FOR BRAIN CTA

Brain CT/CTA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain CT/Brain CTA combination studies section**. If there is a combination request* for an overlapping body part, either requested at the same time or sequentially (within the past 3 months) the results of the prior study should be:**

- **Inconclusive or show a need for additional or follow up imaging evaluation OR**
- **The office notes should clearly document an indication why overlapping imaging is needed and how it will change management for the patient.**

(*Unless approvable in the combination section as noted in the guidelines)

Patients with claustrophobia, limited ability to cooperate, ~~or~~ an implanted device **or in an urgent scenario** may be better suited for CTA; whereas those with renal disease or iodine contrast allergy should have MRA ~~(Chen, 2018)~~.[1]

For evaluation of suspected intracranial vascular disease[2, 3]

~~(Robertson, 2020; Salmela, 2017)~~

Aneurysm screening

- Screening for suspected intracranial aneurysm in patient with first-degree family history (parent, brother, sister, or child) of intracranial aneurysm
  Note: Repeat study is recommended every 5 years[4] ~~(Chalouhi, 2011)~~
- Screening for aneurysm in polycystic kidney disease (after age 30), Loeys-Dietz syndrome‡, fibromuscular dysplasia, spontaneous coronary arteries dissection (SCAD), or known aortic coarctation[~~5, 6~~] **(after age 10)**[5-9] [~~5, 6~~7] ~~(Hayes, 2018; Hitchcock, 2016)~~
  ‡For Loeys-Dietz**,** imaging should be repeated at least every two years

Vascular abnormalities

* National Imaging Associates, Inc. (NIA) is a subsidiary of Magellan Healthcare, Inc.

- Suspected vascular malformation (arteriovenous malformation (AVM) or dural arteriovenous fistula) in patient with previous or indeterminate imaging study
- Thunderclap headache with continued concern for underlying vascular abnormality after initial negative ~~work-up (Whitehead, 2019, Yeh, 2010, Yuan, 2018)~~**brain imaging > 6 hours after onset**[10-13] ~~7-9~~
  Note:
  Negative **b**~~B~~rain CT~~; AND Negative Lumbar Puncture; OR Negative Brain MRI~~ **< 6 hours after headache onset excludes subarachnoid hemorrhage in neurologically intact patients**[13]
- Headache associated with exercise or sexual activity[14] ~~(ICHD-3, 2018)~~
- Isolated third nerve palsy (oculomotor) with pupil involvement to evaluate for aneurysm[15] ~~(Pula, 2016)~~
- Pulsatile tinnitus to identify a **suspected arterial** vascular etiology[16, 17] ~~(Hofmann, 2013; Pegge, 2017)~~

Note: MRI is the study of choice for detecting **low flow malformations (see background)** ~~18~~cavernomas[18-20] ~~(Morrison, 2016; Zyck, 2021)~~

Cerebrovascular Disease

Ischemic

- Recent ischemic stroke or transient ischemic attack (See **b~~B~~ackground section**)[21, 22] ~~(Sanelli, 2014; Wintermark, 2013)~~
- Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia, weakness in both sides of the body, or abnormal speech[23, 24] ~~(Lima-Neto 2017; Searls, 2012)~~

Hemorrhagic

- Known subarachnoid hemorrhage (SAH)[25] ~~(Colen, 2007)~~
- Known cerebral intraparenchymal hemorrhage with concern for underlying vascular abnormality

Venous and MRV is contraindicated or cannot be performed[26]- CTV**
~~(Walecki, 2015)~~

- Suspected venous thrombosis (dural sinus thrombosis)[27, 28] ~~(Ferro, 2017; Saposnik, 2011)~~
- Distinguishing benign intracranial hypertension (pseudotumor cerebri) from dural sinus thrombosis[29, 30] ~~(Agarwal, 2010; Higgins 2005)~~

Sickle cells disease (ischemic and/or hemorrhagic) and ~~MRV~~ MRA is contraindicated or cannot be performed[31]
~~(Thust, 2014)~~

- Neurological signs or symptoms in sickle cell disease
- Stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity > 200

Vasculitis with initial laboratory workup (such as ESR, CRP, serology)[32]
~~(Berlit, 2014)~~

- Suspected secondary CNS vasculitis based on neurological signs or symptoms in the setting of an underlying systemic disease with abnormal inflammatory markers or autoimmune antibodies
- Suspected primary CNS vasculitis based on neurological signs and symptoms with completed infectious/inflammatory lab work-up[33, 34] ~~(Godasi, 2019; Zuccoli, 2011)~~

Other intracranial vascular disease

- Suspected Moyomoya disease[35, 36] ~~(Ancelet, 2015; Tarasow, 2011).~~
- Suspected reversible cerebral vasoconstriction syndrome[37] ~~(Singhal, 2016)~~
- Giant cell arteritis with suspected intracranial involvement[38] ~~(Conway, 2018)~~

For evaluation of known intracranial vascular disease[2, 3]
~~(Robertson, 2020; Salmela, 2017)~~

- Known intracranial aneurysm**, treated aneurysm, or known** ~~or~~ vascular malformation (i.e., AVM or dural arteriovenous fistula)
- Vascular abnormality visualized on previous brain imaging that is equivocal or needs further evaluation
- Known vertebrobasilar insufficiency with new or worsening signs or symptoms (VBI)[23, 24] ~~(Lima-Neto, 2017; Searls, 2012)~~
- Known vasculitis, reversible cerebral vasoconstriction syndrome or Moyomoya disease[33, 35-37] ~~(Ancelet, 2015; Godasi, 2019; Signhal, 2016; Tarasow, 2011)~~

Pre-operative/procedural evaluation for brain/skull surgery

- Pre-operative evaluation for a planned surgery or procedure

Post-operative/procedural evaluation[39, 40]
~~(Sanelli, 2004; Wallace, 2007)~~

- A follow-up study may be needed to help evaluate a patient's progress after treatment, procedure, intervention, or surgery. Documentation requires a medical reason that clearly indicates why additional imaging is needed for the type and area(s) requested.

Indications for Brain CTA/Neck CTA combination studies

- Recent ischemic stroke or transient ischemic attack[21] ~~(Sanelli, 2014)~~
- Known or suspected vertebrobasilar insufficiency (VBI) in patients with symptoms such as dizziness, vertigo, headaches, diplopia, blindness, vomiting, ataxia, weakness in both sides of the body, or abnormal speech[23, 24] ~~(Lima-Neto, 2017; Searls, 2012)~~
- Suspected carotid or vertebral artery dissection; **secondary** ~~due~~ to trauma or spontaneous due to weakness of vessel wall[41, 42] ~~(Franz, 2012; Shakir, 2016)~~
- Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate[43-45] ~~(Brott, 2011; DaCosta, 2019; Marquardt, 2010)~~

- Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g., carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate[43, 46] ~~(AAN, 2010; Brott, 2011; Rerkasem, 2011)~~
- Pulsatile tinnitus to identify a suspected arterial vascular etiology[16, 17] ~~(Hofmann, 2013; Pegge, 2017)~~

Indications for Brain CT/Brain CTA combination studies[2, 3]
~~(Robertson, 2020; Salmela, 2017)~~

- Recent ischemic stroke or transient ischemic attack (TIA) when MRI is contraindicated or cannot be performed
- Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm
- Headache associated with exercise or sexual activity when ~~MRI~~ MRI is contraindicated or cannot be performed[14] ~~(ICHD-3, 2018)~~
- Suspected venous thrombosis (dural sinus thrombosis) ~~– CTV~~ and MR~~I~~ is ~~are~~ contraindicated or cannot be performed – **CT/CTV****
- **Neurological signs or symptoms in sickle cell patients when MRI is contraindicated or cannot be performed**
- **High stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity > 200 when MRI is contraindicated or cannot be performed**

Indications for Brain CT/Brain CTA/Neck CTA combination studies
- Recent ischemic stroke or transient ischemic attack (TIA)[2, 3] when MRI is contraindicated or cannot be performed ~~(Robertson, 2020; Salmela, 2017)~~
- Approved indications as noted above and being performed in high-risk populations (in whom MRI is contraindicated or cannot be performed) and will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology

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BACKGROUND
Computed tomography angiography (CTA) is recognized as a valuable diagnostic tool for the management of patients with cerebrovascular disease. With its three-dimensional reconstructions, CTA can simultaneously demonstrate the bony skull base and its related vasculature. CTA use of ionizing radiation and an iodine-based intravascular contrast medium is a disadvantage when compared to magnetic resonance angiography (MRA), but it is quicker and requires less patient cooperation than MRA. CTA is much less invasive than catheter angiography which involves injecting contrast material into an artery.

CTA for Evaluation of Aneurysm – CTA is useful in the detection of cerebral aneurysms. The sensitivity of CTA to detect cerebral aneurysms ≤ 5 mm is higher than that with digital subtraction angiography (DSA). Most aneurysms missed with CTA are ≤ 3mm. Aneurysms in the

region of the anterior clinoid process may extend into the subarachnoid space where they carry the threat of hemorrhage. CTA can help delineate the borders of the aneurysm in relation to the subarachnoid space and may help detect acute ruptured aneurysms. It may be used in the selection of patients for surgical or endovascular treatment of ruptured intracranial aneurysms.

CTA for Screening of Patients with first-degree relative (parent, brother, sister or child) who have a history of aneurysm – Data has suggested that individuals with a parent, brother, sister, or child harboring an intracranial aneurysm are at increased risk of aneurysms. It is likely that multiple genetic and environmental risk factors contribute to the increased risk.

CTA for evaluation of Arteriovenous Malformation (AVM) – A good correlation has been found between catheter angiography and CTA in the detection of arteriovenous malformations. CTA allows calculation of the volume of an AVM nidus and identifies and quantifies embolic material within it. CTA may be used for characterization and stereotactic localization before surgical resection or radiosurgical treatment of arteriovenous malformations.

CTA and non-aneurysmal vascular malformations – Non-aneurysmal vascular malformations can be divided in low flow vascular malformations and high flow vascular malformations. Low flow vascular malformations include dural venous anomalies (DVA), cavernomas, and capillary telangiectasias. High flow vascular malformations include AVM and dural arteriovenous fistulas (dAVF). For low flow malformations, MRI is the study of choice. There is limited medical literature to support vascular imagining (CTA or MRA). CTA plays a limited role in the assessment of cavernoma but may be used to demonstrate a DVA. MRA is not usually helpful in the assessment of cavernoma, capillary telangiectasia, and DVA. Vascular imaging is indicated in high flow vascular malformations ~~(Lee, 2012; Robertson, 2020; Salmela, 2017)~~.[2, 3, 20]

MRA vs CTA for CVA – Preferred vascular imaging of the head and neck includes noncontra~~s~~t head MRA and contrast-enhanced neck MRA. MRA may not be able to be performed in patients with claustrophobia, morbid obesity, or implanted device, but it can be useful in patients with renal failure or contrast allergies. In patients with high radiation exposure, MRA as an alternative should be considered. For acute stroke, CTA is preferred after CT (to rule of hemorrhage) and to look for thrombus/possible intervention that is time-sensitive.[47]

CTA and recent stroke or transient ischemic attack – A stroke or central nervous system infarction is defined as "brain, spinal cord, or retinal cell death attributable to ischemia, based on neuropathological, neuroimaging, and/or clinical evidence of permanent injury. … Ischemic stroke specifically refers to central nervous system infarction accompanied by overt symptoms, whereas silent infarction causes no known symptoms" ~~(Sacco, 2013)~~.[48] If imaging or pathology is not available, a clinical stroke is diagnosed by symptoms persisting for more than 24 hours. Ischemic stroke can be further classified by the type and location of ischemia and the presumed etiology of the brain injury. These include large-artery atherosclerotic occlusion (extracranial or intracranial), cardiac embolism, small-vessel disease and less commonly dissection, hypercoagulable states, sickle cell disease and undetermined causes ~~(Kernan, 2014)~~.[49] TIAs in contrast, "are a brief episode of neurological dysfunction caused by focal brain or retinal

ischemia, with clinical symptoms typically lasting less than one hour, and without evidence of acute infarction on imaging" ~~(Easton, 2009)~~.[50] On average, the annual risk of future ischemic stroke after a TIA or initial ischemic stroke is 3–4%, with an incidence as high as 11% over the next 7 days and 24–29% over the following 5 years. This has significantly decreased in the last half century due to advances in secondary prevention ~~(Hong, 2011)~~.[51]

When revascularization therapy is not indicated or available in patients with an ischemic stroke or TIA, the focus of the work-up is on secondary prevention. This includes noninvasive vascular imaging to identify the underlying etiology, assess immediate complications and risk of future stroke. The majority of stroke evaluations take place in the inpatient setting. Admitting TIA patients is reasonable if they present within 72 hours and have an ABCD (2) score ≥ 3, indicating high risk of early recurrence, or the evaluation cannot be rapidly completed on an outpatient basis ~~(Easton, 2009)~~.[50] Minimally, both stroke and TIA should have an evaluation for high-risk modifiable factors such as carotid stenosis atrial fibrillation as the cause of ischemic symptoms ~~(Kernan, 2014)~~.[49] Diagnostic recommendations include neuroimaging evaluation as soon as possible, preferably with magnetic resonance imaging, including DWI; noninvasive imaging of the extracranial vessels should be performed, and noninvasive imaging of intracranial vessels is reasonable ~~(Wintermark, 2013)~~.[22]

Patients with a history of stroke and recent work-up with new signs or symptoms indicating progression or complications of the initial CVA should have repeat brain imaging as an initial study. Patients with remote or silent strokes discovered on imaging should be evaluated for high-risk modifiable risk factors based on the location and type of the presumed etiology of the brain injury.

CTA for Evaluation of Vertebrobasilar Insufficiency (VBI) – Multidetector CT angiography (MDCTA) may be used in the evaluation of vertebral artery pathologies. The correlation between MDCTA and color Doppler sonography is moderate. CTA is used for minimally invasive follow-up after intracranial stenting for VBI. It enables visualization of the patency of the stent lumen and provides additional information about all brain arteries and the brain parenchyma.

CTA and Intracerebral Hemorrhage – CTA is useful as a screening tool for an underlying vascular abnormality in the evaluation of spontaneous intracerebral hemorrhage (ICH). Etiologies of spontaneous ICH include tumor, vascular malformation, aneurysm, hypertensive arteriopathy, cerebral amyloid angiopathy, venous thrombosis, vasculitis, RCVS, drug-induced vasospasm, venous sinus thrombosis, Moyomoya disease, anticoagulant use and hemorrhagic transformation of an ischemic infarct. History can help point to a specific etiology. Possible risk factors for the presence of underlying vascular abnormalities include age younger than 65, female, lobar or intraventricular location, and the absence of hypertension or impaired coagulation ~~(Delgado, 2009)~~.[52]

CTV and Central Venous Thrombosis** – a CT Venogram is indicated for the evaluation of a central venous thrombosis/dural sinus thrombosis. The most frequent presentations are isolated headache, intracranial hypertension syndrome, seizures, focal neurological deficits, and

encephalopathy. Risk factors are hypercoagulable states inducing genetic prothrombotic conditions, antiphospholipid syndrome and other acquired prothrombotic diseases, such as cancer, oral contraceptives, pregnancy, puerperium (6 weeks postpartum), infections, and trauma. Since venous thrombosis can cause SAH, infarctions, and hemorrhage, parenchymal imaging with MRI/CT is also appropriate ~~(Bushnell, 2014; Courinho, 2015; Ferro, 2016; Walecki, 2015)~~.[26, 53-55]

~~MRA~~ CTA **and dissection**- Craniocervical dissections can be spontaneous or traumatic. Patients with blunt head or neck trauma who meet Denver Screening criteria should be assessed for cerebrovascular injury (although about 20% will not meet criteria). The criteria include: focal or lateralizing neurological deficits (not explained by head CT), infarct on head CT, face, basilar skull, or cervical spine fractures, cervical hematomas that are not expanding, glasgow coma score less than 8 without CT findings, massive epistaxis, cervical bruit or thrill ~~(Franz, 2012; Liang, 2013; Mundinger, 2013; Simon, 2019)~~.[41, 56-58] Spontaneous dissection presents with headache, neck pain with neurological signs or symptoms. There is often minor trauma or precipitating factor (i.e., exercise, neck manipulation). Dissection is thought to occur due to weakness of the vessel wall, and there may be an underlying connective tissue disorder. Dissection of the extracranial vessels can extend intracranially and/or lead to thrombus which can migrate into the intracranial circulation causing ischemia. Therefore, ~~MRA~~ vascular imaging of the head and neck is warranted ~~(Nash, 2019; Shakir, 2016)~~.[42, 59]

POLICY HISTORY

Date	Summary
March 2022	Updated and reformatted references Added New combo statement ~~as above?~~ Updated background Clarified: • ~~–~~ Aneurysm screening in aortic coarctation after age 10 • • ~~–~~ MRI is the study of choice for detecting low flow vascular malformations (see background) • • ~~–~~ Follow-up of known intracranial aneurysm, treated aneurysm, or known vascular malformation • • ~~–~~ Pulsatile tinnitus to identify a suspected arterial vascular etiology ~~16, 17~~ • • ~~–~~ Combo studies- CVA/TIA when MRI is contraindicated or cannot be performed

	Changed: • **Thunderclap headache with continued concern for underlying vascular abnormality after initial negative brain imaging > 6 hours after onset** **Added:** • **Brain MRI/Brain MRA combination (when MRI contraindicated)** ○ **Neurological signs or symptoms in sickle cell patients** ○ **High stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity > 200**
June 2021	• Updated references • Reformatted and reordered indications Added: • Brain CT/CTA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain CT/Brain CTA combination studies section • Headache associated with exercise or sexual activity (also in combo section if MRI contraindicated) • Note: MRI is the study of choice for detecting cavernomas • Giant cell arteritis with suspected intracranial involvement • Pre-operative evaluation for a planned surgery or procedure Clarified: • *For Loeys-Dietz imaging should be repeated at least every two years • Known vertebrobasilar insufficiency with new or worsening signs or symptoms • Vasculitis with initial laboratory workup (such as ESR, CRP, serology)
May 2020	• Updated background information references • Reordered and categorized indications and background information Clarified: • Screening for aneurysm: polycystic kidney disease (after age 30) • Suspected or known dural arteriovenous fistula as an example of a vascular malformation • Recent ischemic stroke or transient ischemic attack (also in all combo sections) • Cerebral intraparenchymal hemorrhage • Suspected secondary CNS vasculitis based on neurological sign or symptoms in the setting of an underlying systemic disease

	• Suspected primary CNS vasculitis based on neurological signs and symptoms
	• Vascular abnormality visualized on previous brain imaging that is equivocal or needs further evaluation
	• Reworded- Suspected carotid or vertebral artery dissection; due to trauma or spontaneous due to weakness of vessel wall leading to dissection – in the combo Neck/Brain CTA section
	• Approved indications as noted above and being performed in high risk populations (in whom MRI is contraindicated or cannot be performed) and will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology
	Added:
	• Patients with claustrophobia, limited ability to cooperate or an implanted device may be better suited for CTA, whereas those renal disease or iodine contrast allergy should have MRA
	• Screening for aneurysm: Loeys-Dietz syndrome
	• Thunderclap headache with continued concern for underlying vascular abnormality after initial negative work-up
	  ○ Negative Brain CT; AND
	  ○ Negative Lumbar Puncture; OR
	  ○ Negative Brain MRI
	• Isolated third nerve palsy (oculomotor) with pupil involvement to evaluate for aneurysm
	• Vasculitis with initial laboratory workup (such as ESR, CRP, plasma viscosity)
	• For venous studies that MRV is contraindicated or cannot be performed- CTV
	• Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm – in combo Brain CT/CTA section
	Deleted
	• Screening for aneurysm: Ehlers-Danlos syndrome, neurofibromatosis
	• Clinical suspicion of subarachnoid hemorrhage (SAH) (i.e., thunderclap headache)
	• Known or suspected carotid or cerebral artery occlusion in patients with a sudden onset of one-sided weakness or numbness, abnormal speech, vision defects, incoordination or severe dizziness - in the combo Neck/Brain CTA section

	• Clinical suspicion of subarachnoid hemorrhage (SAH) (i.e., thunderclap headache) in the combo Brain CT/CTA section

August 2019	• Reversible cerebral vasoconstriction syndrome or Moyomoya disease
	• Clinical suspicion of subarachnoid hemorrhage (SAH) (i.e., thunderclap headache)
	• Spontaneous intracerebral hemorrhage with concern for underlying vascular abnormality
	• Suspected primary CNS vasculitis with infectious/inflammatory lab work-up, reversible cerebral vasoconstriction syndrome or Moyomoya disease
	• Stroke risk in sickle cell patients (2 - 16 years of age) with a transcranial doppler velocity >200.
	• Neurological signs or symptoms in sickle cell disease
	• Further clarified:
	  ○ Suspected vertebrobasilar insufficiency (VBI) symptoms
	  ○ CTV for suspected central venous thrombosis
	• For Brain CTA/Neck CTA combination studies:
	  ○ Removed the past two-week restriction from 'recent stroke or TIA'
	  ○ Clarified CVA symptoms to include - known or suspected carotid or cerebral artery occlusion with sudden onset of numbness or incoordination
	  ○ Added spontaneous injuries due to weakness of vessel wall leading to dissection
	  ○ Added Asymptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 70%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate
	  ○ Added Symptomatic patients with an abnormal ultrasound of the neck or carotid duplex imaging (e.g. carotid stenosis ≥ 50%, technically limited study, aberrant direction of flow in the carotid or vertebral arteries) and patient is surgery or angioplasty candidate
	• Added section for Brain CT/Brain CTA combination studies, including:
	  ○ Clinical suspicion of subarachnoid hemorrhage (SAH) ie thunderclap headache
	  ○ Suspected venous thrombosis (dural sinus thrombosis)
	• Added section for Brain CT/Brain CTA/Neck CTA combination studies, including:

	○ Recent stroke or transient ischemic attack (TIA) ○ Approved indications as noted above and being performed in a child under 8 years of age who will need anesthesia for the procedure and there is a suspicion of concurrent intracranial pathology • Updated background info and refs

REFERENCES

American Academy of Neurology (AAN). Carotid Endarterectomy - An evidence-based review. 2010.

Ancelet C, Boulouis G, Blauwblomme T, et al. Imaging Moya-Moya disease. *Rev Neurol* (Paris). 2015 Jan; 171(1):45-57. Epub 2014 Dec 30.

Agarwal P, Kumar M, Arora V. Clinical profile of cerebral venous sinus thrombosis and the role of imaging in its diagnosis in patients with presumed idiopathic intracranial hypertension. *Indian J Ophthalmol*. 2010 Mar-Apr; 58(2):153-5.

Berlit P, Kraemer M. Cerebral vasculitis in adults: what are the steps in order to establish the diagnosis? Red flags and pitfalls. *Clin Exp Immunol*. 2014; 175(3):419–424. doi:10.1111/cei.12221.

Brott TG, Halperin JL, Abbara S, et al. 2011 ASA/ACCF/AHA/AANN/AANS/ACR/ASNR/CNS/SAIP/SCAI/SIR/SNIS/SVM/SVS guideline on the management of patients with extracranial carotid and vertebral artery disease: executive summary. A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, and the American Stroke Association, American Association of Neuroscience Nurses, American Association of Neurological Surgeons, American College of Radiology, American Society of Neuroradiology, Congress of Neurological Surgeons, Society of Atherosclerosis Imaging and Prevention, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of NeuroInterventional Surgery, Society for Vascular Medicine, and Society for Vascular Surgery. *Circulation*. 2011;124(4):489-532. doi:10.1161/CIR.0b013e31820d8d78.

Bushnell C, Saposnik G. Evaluation and management of cerebral venous thrombosis. *Continuum (Minneap Minn)*. 2014 Apr; 20(2 Cerebrovascular Disease):335-51.

Chalouhi N, Chitale R, Jabbou P, et al. The case for family screening for intracranial aneurysms. *Neurosurg Focus*. December 2011; 31(6):E8.

Chen X, Liu Y, Tong H, et al. Meta-analysis of computed tomography angiography versus magnetic resonance angiography for intracranial aneurysm. *Medicine (Baltimore)*. 2018; 97(20):e10771.

Colen TW, Wang LC, Ghodke BV, et al. Effectiveness of MDCT angiography for the detection of intracranial aneurysms in patients with nontraumatic subarachnoid hemorrhage. *AJR Am J Roentgenol*. 2007; 189:898-903. http://www.ajronline.org/doi/pdf/10.2214/AJR.07.2491.

Conway R, Smyth AE, Kavanagh RG, et al. Diagnostic utility of computed tomographic angiography in giant-cell arteritis. *Stroke*. 2018;49(9):2233-2236. doi:10.1161/STROKEAHA.118.021995.

Courinho JM. Cerebral venous thrombosis. *J Thromb Haemost*. 2015 Jun; 13 Suppl 1:S238-44.

DaCosta M, Tadi P, Surowiec SM. Carotid endarterectomy. In: *StatPearls*. StatPearls Publishing; 2021. Accessed August 4, 2021. http://www.ncbi.nlm.nih.gov/books/NBK470582/.

Delgado Almondoz JE, Schaefer PW, Forero NP, et al. Diagnostic accuracy and yield of multidetector CT angiography in the evaluation of spontaneous intraparenchymal cerebral hemorrhage. *AJNR Am J Neuroradiol*. 2009 Jun; 30(6):1213-21. Epub 2009 Apr 2.

Easton JD, Saver JL, Albers GW, et al. Definition and evaluation of transient ischemic attack: A scientific statement for healthcare professionals from the American Heart Association/American Stroke Association Stroke Council; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular Radiology and Intervention; Council on Cardiovascular Nursing; and the Interdisciplinary Council on Peripheral Vascular Disease. The American Academy of Neurology affirms the value of this statement as an educational tool for neurologists. *Stroke*. 2009 Jun; 40(6):2276-93.

Edlow JA. Managing patients with nontraumatic, severe, rapid-onset headache. *Ann Emerg Med*. 2018 Mar; 71(3):400-408.

Farsad K, Mamourian A, Eskey C, et al. Computed tomographic angiography as an adjunct to digital subtraction angiography for the pre-operative assessment of cerebral aneurysm. *Open Neurology Journal*. 2009; 3:1-7. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2682841/.

Ferro JM, Bousser M-G, Canhão P, et al. European Stroke Organization guideline for the diagnosis and treatment of cerebral venous thrombosis - Endorsed by the European Academy of Neurology. *Eur Stroke J*. 2017;2(3):195-221. doi:10.1177/2396987317719364.

Ferro JM, Canhão P, Aguiar de Sousa D. Cerebral venous thrombosis. *La Presse Med*. 2016 Dec; 45(12 Pt 2):e429-e450. Epub 2016 Nov 2.

Franz RW, Willette PA, Wood MJ, et al. A systematic review and meta-analysis of diagnostic screening criteria for blunt cerebrovascular injuries. *J Am Coll Surg*. March 2012; 214(3):313-327.

Godasi R, Bollu PC. Primary central nervous system vasculitis. [Updated 2019 May 6]. In: *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 Jan-. https://www.ncbi.nlm.nih.gov/books/NBK482476/.

Hayes SN, Kim ESH, Saw J, et al. American Heart Association Council on Peripheral Vascular Disease; Council on Clinical Cardiology; Council on Cardiovascular and Stroke Nursing; Council on Genomic and Precision Medicine; and Stroke Council. Spontaneous Coronary Artery Dissection: Current State of the Science: A Scientific Statement from the American Heart Association. *Circulation*. 2018 May 8; 137(19:e523-e557. Epub 2018 Feb 22.

Headache classification committee of the international headache society (IHS) the international classification of headache disorders, 3rd edition. *Cephalalgia*. 2018;38(1):1-211. doi:10.1177/0333102417738202.

Higgins JN, Tipper G, Varley M, Pickard JD. Transverse sinus stenoses in benign intracranial hypertension demonstrated on CT venography. *Br J Neurosurg*. 2005 Apr; 19(2:137-40.

Hitchcock E, Gibson WT. A review of the genetics of intracranial berry aneurysms and implications for genetic counseling. *J Genet Couns*. 2017 Feb; 26(1):21-31. Epub 2016 Oct 14.

Hofmann E, Behr R, Neumann-Haefelin T, et al. Pulsatile tinnitus: Imaging and differential diagnosis. *Deutsches Ärzteblatt International*. 2013; 110(26):451-458. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3719451/.

Hong KS, Yegiaian S, Lee M, et al. Declining stroke and vascular event recurrence rates in secondary prevention trials over the past 50 years and consequences for current trial design. *Circulation*. 2011 May 17; 123(19):2111-9. Epub 2011 May 2.

Kernan WN, Ovbiagele B, Black HR, et al. 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. *Stroke*. 2014 Jul; 45(7):2160-236.

Lee M, Kim MS. Image findings in brain developmental venous anomalies. *J Cerebrovasc Endovasc Neurosurg*. 2012 Mar; 14(1:37-43. Epub 2012 Mar 31.

Liang T, Tso DK, Chiu RY, et al. Imaging of blunt vascular neck injuries: A review of screening and imaging modalities. *AJR Am J Roentgenol*. 2013 Oct; 201(4):884-92.

Lima Neto AC, Bittar R, Gattas GS, et al. pathophysiology and diagnosis of vertebrobasilar insufficiency: A review of the literature. *Int Arch Otorhinolaryngol*. 2017; 21(3):302–307.

Marquardt L, Geraghty OC, Mehta Z, Rothwell PM. Low risk of ipsilateral stroke in patients with asymptomatic carotid stenosis on best medical treatment: a prospective, population-based study. *Stroke*. 2010;41(1):e11-17. doi:10.1161/STROKEAHA.109.561837

Morrison L, Akers A. Cerebral cavernous malformation, familial. In: Adam MP, Ardinger HH, Pagon RA, et al., eds. *GeneReviews®*. University of Washington, Seattle; 1993. Revised August 4, 2016. Accessed August 4, 2021. http://www.ncbi.nlm.nih.gov/books/NBK1293/.

Mundinger GS, Dorafshar AH, Gilson MM, et al. Blunt-mechanism facial fracture patterns associated with internal carotid artery injuries: recommendations for additional screening criteria based on analysis of 4,398 patients. *J Oral Maxillofac Surg*. December 2013; 71(12):2092-2100.

Nash M, Rafay MF. Craniocervical arterial dissection in children: Pathophysiology and management. *Pediatr Neurol*. 2019 Jun; 95:9-18. Epub 2019 Feb 2.

Pegge SAH, Steens SCA, Kunst HPM, et al. Pulsatile tinnitus: Differential diagnosis and radiological work-up. *Curr Radiol Rep*. 2017; 5(1):5.

Pirau L, Lui F. Vertebrobasilar Insufficiency. [Updated 2019 Mar 31]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK482259/.

Pula JH, Kwan K, Yuen CA, Kattah JC. Update on the evaluation of transient vision loss. *Clin Ophthalmol*. 2016 Feb 11; 10:297–303.

Rerkasem K, Rothwell PM. Carotid endarterectomy for symptomatic carotid stenosis. *Cochrane Database Syst Rev*. 2011;(4):CD001081. doi:10.1002/14651858.CD001081.pub2.

Robertson RL, Palasis S, Rivkin MJ, et al. ACR Appropriateness Criteria® Cerebrovascular Disease-Child. *J Am Coll Radiol*. 2020;17(5S):S36-S54. doi:10.1016/j.jacr.2020.01.036.

Sacco RL, Kasner SE, Broderick JP, et al. An updated definition of stroke for the 21st century: A statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2013 Jul; 44(7):2064-89.

Salmela MB, Mortazavi S, Jagadeesan BD, et al. ACR Appropriateness Criteria ® Cerebrovascular Disease. *J Am Coll Radiol*. 2017;14(5S):S34-S61. doi:10.1016/j.jacr.2017.01.051.

Sanelli PC, Mifsud MJ, Steig PE. Role of CT Angiography in guiding management decisions of newly diagnosed and residual arteriovenous malformations. *AJR Am J Roentgenol*. 2004; 183:1123-1126. http://www.ncbi.nlm.nih.gov/pubmed/15385318.

Sanelli PC, Sykesa JB, Ford AL, et al. Imaging and treatment of patients with acute stroke: An evidence-based review. *AJNR Am J Neuroradiol*. 2014; 35:1045-1051.

Saposnik G, Barinagarrementeria F, Brown RD, et al. Diagnosis and management of cerebral venous thrombosis: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2011;42(4):1158-1192. doi:10.1161/STR.0b013e31820a8364.

Searls DE, Pazdera L, Korbel E, Vysata O, Caplan LR. Symptoms and signs of posterior circulation ischemia in the new England medical center posterior circulation registry. *Arch Neurol*. 2012;69(3):346-351. doi:10.1001/archneurol.2011.2083.

Shakir HJ, Davies JM, Shallwani H, et al. Carotid and vertebral dissection imaging. *Curr Pain Headache Rep*. 2016 Dec; 20(12):68.

Simon LV, Mohseni M. Vertebral Artery Injury. *StatPearls*.Treasure Island, FL: StatPearls Publishing; 2019. https://www.ncbi.nlm.nih.gov/books/NBK470363/.

Singhal AU, Topcuoglu MA, Fok JW, et al. Reversible cerebral vasoconstriction syndromes and primary angiitis of the central nervous system: Clinical, imaging, and angiographic comparison. *Ann Neurol*. 2016 Jun; 79(6):882-94. Epub 2016 Apr 28.

Tarasów E, Kułakowska A, Lukasiewicz A, et al. Moyamoya disease: Diagnostic imaging. *Pol J Radiol*. 2011; 76(1):73–79.

Thust SC, Burke C, Siddiqui A. Neuroimaging findings in sickle cell disease. *Br J Radiol*. 2014; 87(1040):20130699.

Walecki J, Mruk B, Nawrocka-Laskus E, et al. Neuroimaging of cerebral venous thrombosis (cvt) - old dilemma and the new diagnostic methods. *Pol J Radiol*. 2015 Jul 25; 80:368–373.

Wallace RC, Karis JP, et al. Non-invasive imaging of treated cerebral aneurysms, part II: CT angiographic follow-up of surgically clipped aneurysms. *AJNR Am J Neuroradiol*. August 2007; 28(7):1207-1212.

Whitehead MT, Cardenas AM, Corey AS, et al. ACR Appropriateness Criteria® Headache. *J Am Coll Radiol*. 2019; 16:S364-S377.

Wintermark M, Sanelli PC, Albers GW, et al. Imaging recommendations for acute stroke and transient ischemic attack patients: A joint statement by the American Society of Neuroradiology, the American College of Radiology, and the Society of NeuroInterventional Surgery. *AJNR Am J Neuroradiol*. 2013 Nov-Dec; 34(11):E117-27. Epub 2013 Aug 1.

Xu HW, Yu SQ, Mei CL, Li MH. Screening for intracranial aneurysm in 355 patients with autosomal-dominant polycystic kidney disease. *Stroke*. 2011;42(1):204-206. doi:10.1161/STROKEAHA.110.578740.

Yeh YC, Fuh JL, Chen SP, et al. Clinical features, imaging findings and outcomes of headache associated with sexual activity. *Cephalalgia*. 2010 Nov; 30(11):1329-35.

Yuan MK, Lai PH, Chen JY, et al. Detection of subarachnoid hemorrhage at acute and subacute/chronic stages: Comparison of four magnetic resonance imaging pulse sequences and computed tomography. *J Chin Med Assoc*. 2005 Mar; 68(3):131-7.

Zuccoli G, Pipitone N, Haldipur A, et al. Imaging findings in primary central nervous system vasculitis. *Clin Exp Rheumatol*. 2011; 29(1 Suppl 64):S104-109.

Zyck S, Gould GC. Cavernous venous malformation. In: *StatPearls*. StatPearls Publishing; 2021. Accessed August 4, 2021. http://www.ncbi.nlm.nih.gov/books/NBK526009/.

Reviewed / Approved by NIA Clinical Guideline Committee

~~**GENERAL INFORMATION**~~

~~It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.~~

1. Chen X, Liu Y, Tong H, et al. Meta-analysis of computed tomography angiography versus magnetic resonance angiography for intracranial aneurysm. *Medicine (Baltimore)*. May 2018;97(20):e10771. doi:10.1097/md.0000000000010771
2. Robertson RL, Palasis S, Rivkin MJ, et al. ACR Appropriateness Criteria® Cerebrovascular Disease-Child. *J Am Coll Radiol*. May 2020;17(5s):S36-s54. doi:10.1016/j.jacr.2020.01.036
3. Salmela MB, Mortazavi S, Jagadeesan BD, et al. ACR Appropriateness Criteria(®) Cerebrovascular Disease. *J Am Coll Radiol*. May 2017;14(5s):S34-s61. doi:10.1016/j.jacr.2017.01.051
4. Chalouhi N, Chitale R, Jabbour P, et al. The case for family screening for intracranial aneurysms. *Neurosurg Focus*. Dec 2011;31(6):E8. doi:10.3171/2011.9.Focus11210
5. Hayes SN, Kim ESH, Saw J, et al. Spontaneous Coronary Artery Dissection: Current State of the Science: A Scientific Statement From the American Heart Association. *Circulation*. May 8 2018;137(19):e523-e557. doi:10.1161/cir.0000000000000564
6. Hitchcock E, Gibson WT. A Review of the Genetics of Intracranial Berry Aneurysms and Implications for Genetic Counseling. *J Genet Couns*. Feb 2017;26(1):21-31. doi:10.1007/s10897-016-0029-8
7. Jung WS, Kim JH, Ahn SJ, et al. Prevalence of Intracranial Aneurysms in Patients with Aortic Dissection. *AJNR Am J Neuroradiol*. Nov 2017;38(11):2089-2093. doi:10.3174/ajnr.A5359

8. Egbe AC, Padang R, Brown RD, et al. Prevalence and predictors of intracranial aneurysms in patients with bicuspid aortic valve. *Heart*. Oct 2017;103(19):1508-1514. doi:10.1136/heartjnl-2016-311076
9. Rouchaud A, Brandt MD, Rydberg AM, et al. Prevalence of Intracranial Aneurysms in Patients with Aortic Aneurysms. *AJNR Am J Neuroradiol*. Sep 2016;37(9):1664-8. doi:10.3174/ajnr.A4827
10. Whitehead MT, Cardenas AM, Corey AS, et al. ACR Appropriateness Criteria® Headache. *J Am Coll Radiol*. Nov 2019;16(11s):S364-s377. doi:10.1016/j.jacr.2019.05.030
11. Yeh YC, Fuh JL, Chen SP, Wang SJ. Clinical features, imaging findings and outcomes of headache associated with sexual activity. *Cephalalgia*. Nov 2010;30(11):1329-35. doi:10.1177/0333102410364675
12. Yuan MK, Lai PH, Chen JY, et al. Detection of subarachnoid hemorrhage at acute and subacute/chronic stages: comparison of four magnetic resonance imaging pulse sequences and computed tomography. *J Chin Med Assoc*. Mar 2005;68(3):131-7. doi:10.1016/s1726-4901(09)70234-5
13. Chen CY, Fuh JL. Evaluating thunderclap headache. *Curr Opin Neurol*. Jun 1 2021;34(3):356-362. doi:10.1097/wco.0000000000000917
14. Headache Classification Committee of the International Headache Society (IHS) The International Classification of Headache Disorders, 3rd edition. *Cephalalgia*. Jan 2018;38(1):1-211. doi:10.1177/0333102417738202
15. Pula JH, Kwan K, Yuen CA, Kattah JC. Update on the evaluation of transient vision loss. *Clin Ophthalmol*. 2016;10:297-303. doi:10.2147/opth.S94971
16. Hofmann E, Behr R, Neumann-Haefelin T, Schwager K. Pulsatile tinnitus: imaging and differential diagnosis. *Dtsch Arztebl Int*. Jun 2013;110(26):451-8. doi:10.3238/arztebl.2013.0451
17. Pegge SAH, Steens SCA, Kunst HPM, Meijer FJA. Pulsatile Tinnitus: Differential Diagnosis and Radiological Work-Up. *Curr Radiol Rep*. 2017;5(1):5. doi:10.1007/s40134-017-0199-7
18. Morrison L, Akers A. Cerebral Cavernous Malformation, Familial. University of Washington, . Updated August 4, 2016. Accessed November 4, 2021. https://www.ncbi.nlm.nih.gov/books/NBK1293/
19. Zyck S, Gould GC. Cavernous Venous Malformation. StatPearls Publishing. Updated July 26, 2021. Accessed November 2, 2021. https://www.ncbi.nlm.nih.gov/books/NBK526009/
20. Lee M, Kim MS. Image findings in brain developmental venous anomalies. *J Cerebrovasc Endovasc Neurosurg*. Mar 2012;14(1):37-43. doi:10.7461/jcen.2012.14.1.37
21. Sanelli PC, Sykes JB, Ford AL, Lee JM, Vo KD, Hallam DK. Imaging and treatment of patients with acute stroke: an evidence-based review. *AJNR Am J Neuroradiol*. Jun 2014;35(6):1045-51. doi:10.3174/ajnr.A3518
22. Wintermark M, Sanelli PC, Albers GW, et al. Imaging recommendations for acute stroke and transient ischemic attack patients: A joint statement by the American Society of Neuroradiology, the American College of Radiology, and the Society of NeuroInterventional Surgery. *AJNR Am J Neuroradiol*. Nov-Dec 2013;34(11):E117-27. doi:10.3174/ajnr.A3690
23. Lima Neto AC, Bittar R, Gattas GS, et al. Pathophysiology and Diagnosis of Vertebrobasilar Insufficiency: A Review of the Literature. *Int Arch Otorhinolaryngol*. Jul 2017;21(3):302-307. doi:10.1055/s-0036-1593448

24. Searls DE, Pazdera L, Korbel E, Vysata O, Caplan LR. Symptoms and signs of posterior circulation ischemia in the new England medical center posterior circulation registry. *Arch Neurol*. Mar 2012;69(3):346-51. doi:10.1001/archneurol.2011.2083
25. Colen TW, Wang LC, Ghodke BV, Cohen WA, Hollingworth W, Anzai Y. Effectiveness of MDCT angiography for the detection of intracranial aneurysms in patients with nontraumatic subarachnoid hemorrhage. *AJR Am J Roentgenol*. 2007;189(4):898-903.
26. Walecki J, Mruk B, Nawrocka-Laskus E, Piliszek A, Przelaskowski A, Sklinda K. Neuroimaging of Cerebral Venous Thrombosis (CVT) - Old Dilemma and the New Diagnostic Methods. *Pol J Radiol*. 2015;80:368-73. doi:10.12659/pjr.894386
27. Ferro JM, Bousser MG, Canhão P, et al. European Stroke Organization guideline for the diagnosis and treatment of cerebral venous thrombosis - Endorsed by the European Academy of Neurology. *Eur Stroke J*. Sep 2017;2(3):195-221. doi:10.1177/2396987317719364
28. Saposnik G, Barinagarrementeria F, Brown RD, Jr., et al. Diagnosis and management of cerebral venous thrombosis: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. Apr 2011;42(4):1158-92. doi:10.1161/STR.0b013e31820a8364
29. Agarwal P, Kumar M, Arora V. Clinical profile of cerebral venous sinus thrombosis and the role of imaging in its diagnosis in patients with presumed idiopathic intracranial hypertension. *Indian J Ophthalmol*. Mar-Apr 2010;58(2):153-5. doi:10.4103/0301-4738.60092
30. Higgins JN, Tipper G, Varley M, Pickard JD. Transverse sinus stenoses in benign intracranial hypertension demonstrated on CT venography. *Br J Neurosurg*. Apr 2005;19(2):137-40. doi:10.1080/02688690500145563
31. Thust SC, Burke C, Siddiqui A. Neuroimaging findings in sickle cell disease. *Br J Radiol*. Aug 2014;87(1040):20130699. doi:10.1259/bjr.20130699
32. Berlit P, Kraemer M. Cerebral vasculitis in adults: what are the steps in order to establish the diagnosis? Red flags and pitfalls. *Clin Exp Immunol*. Mar 2014;175(3):419-24. doi:10.1111/cei.12221
33. Godasi R, Pang G, Chauhan S, Bollu PC. Primary Central Nervous System Vasculitis. StatPearls Publishing
Updated September 20, 2021. Accessed November 2, 2021.
https://www.ncbi.nlm.nih.gov/books/NBK482476/
34. Zuccoli G, Pipitone N, Haldipur A, Brown RD, Jr., Hunder G, Salvarani C. Imaging findings in primary central nervous system vasculitis. *Clin Exp Rheumatol*. Jan-Feb 2011;29(1 Suppl 64):S104-9.
35. Ancelet C, Boulouis G, Blauwblomme T, et al. [Imaging Moya-Moya disease]. *Rev Neurol (Paris)*. Jan 2015;171(1):45-57. Imagerie du Moya-Moya. doi:10.1016/j.neurol.2014.11.004
36. Tarasów E, Kułakowska A, Lukasiewicz A, et al. Moyamoya disease: Diagnostic imaging. *Pol J Radiol*. Jan 2011;76(1):73-9.
37. Singhal AB, Topcuoglu MA, Fok JW, et al. Reversible cerebral vasoconstriction syndromes and primary angiitis of the central nervous system: clinical, imaging, and angiographic comparison. *Ann Neurol*. Jun 2016;79(6):882-94. doi:10.1002/ana.24652
38. Conway R, Smyth AE, Kavanagh RG, et al. Diagnostic Utility of Computed Tomographic Angiography in Giant-Cell Arteritis. *Stroke*. Sep 2018;49(9):2233-2236. doi:10.1161/strokeaha.118.021995

39. Wallace RC, Karis JP, Partovi S, Fiorella D. Noninvasive imaging of treated cerebral aneurysms, Part II: CT angiographic follow-up of surgically clipped aneurysms. *AJNR Am J Neuroradiol*. Aug 2007;28(7):1207-12. doi:10.3174/ajnr.A0664
40. Sanelli PC, Mifsud MJ, Stieg PE. Role of CT angiography in guiding management decisions of newly diagnosed and residual arteriovenous malformations. *AJR Am J Roentgenol*. Oct 2004;183(4):1123-6. doi:10.2214/ajr.183.4.1831123
41. Franz RW, Willette PA, Wood MJ, Wright ML, Hartman JF. A systematic review and meta-analysis of diagnostic screening criteria for blunt cerebrovascular injuries. *J Am Coll Surg*. Mar 2012;214(3):313-27. doi:10.1016/j.jamcollsurg.2011.11.012
42. Shakir HJ, Davies JM, Shallwani H, Siddiqui AH, Levy EI. Carotid and Vertebral Dissection Imaging. *Curr Pain Headache Rep*. Dec 2016;20(12):68. doi:10.1007/s11916-016-0593-5
43. Brott TG, Halperin JL, Abbara S, et al. 2011 ASA/ACCF/AHA/AANN/AANS/ACR/ASNR/CNS/SAIP/SCAI/SIR/SNIS/SVM/SVS guideline on the management of patients with extracranial carotid and vertebral artery disease: executive summary. A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, and the American Stroke Association, American Association of Neuroscience Nurses, American Association of Neurological Surgeons, American College of Radiology, American Society of Neuroradiology, Congress of Neurological Surgeons, Society of Atherosclerosis Imaging and Prevention, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of NeuroInterventional Surgery, Society for Vascular Medicine, and Society for Vascular Surgery. *Circulation*. Jul 26 2011;124(4):489-532. doi:10.1161/CIR.0b013e31820d8d78
44. DaCosta M, Tadi P, Surowiec SM. Carotid Endarterectomy. StatPearls Publishing Updated September 29, 2021. Accessed November 4, 2021. https://www.ncbi.nlm.nih.gov/books/NBK470582/
45. Marquardt L, Geraghty OC, Mehta Z, Rothwell PM. Low risk of ipsilateral stroke in patients with asymptomatic carotid stenosis on best medical treatment: a prospective, population-based study. *Stroke*. Jan 2010;41(1):e11-7. doi:10.1161/strokeaha.109.561837
46. Rerkasem K, Rothwell PM. Carotid endarterectomy for symptomatic carotid stenosis. *Cochrane Database Syst Rev*. Apr 13 2011;(4):Cd001081. doi:10.1002/14651858.CD001081.pub2
47. American College of Radiology. ACR Appropriateness Criteria®Cerebrovascular Disease. American College of Radiology (ACR). Updated 2016. Accessed March 14, 2022. https://acsearch.acr.org/docs/69478/Narrative/
48. Sacco RL, Kasner SE, Broderick JP, et al. An updated definition of stroke for the 21st century: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. Jul 2013;44(7):2064-89. doi:10.1161/STR.0b013e318296aeca
49. Kernan WN, Ovbiagele B, Black HR, et al. 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. *Stroke*. Jul 2014;45(7):2160-236. doi:10.1161/str.0000000000000024
50. Easton JD, Saver JL, Albers GW, et al. Definition and evaluation of transient ischemic attack: a scientific statement for healthcare professionals from the American Heart

Association/American Stroke Association Stroke Council; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular Radiology and Intervention; Council on Cardiovascular Nursing; and the Interdisciplinary Council on Peripheral Vascular Disease. The American Academy of Neurology affirms the value of this statement as an educational tool for neurologists. *Stroke*. Jun 2009;40(6):2276-93. doi:10.1161/strokeaha.108.192218
51. Hong KS, Yegiaian S, Lee M, Lee J, Saver JL. Declining stroke and vascular event recurrence rates in secondary prevention trials over the past 50 years and consequences for current trial design. *Circulation*. May 17 2011;123(19):2111-9. doi:10.1161/circulationaha.109.934786
52. Delgado Almandoz JE, Schaefer PW, Forero NP, Falla JR, Gonzalez RG, Romero JM. Diagnostic accuracy and yield of multidetector CT angiography in the evaluation of spontaneous intraparenchymal cerebral hemorrhage. *AJNR Am J Neuroradiol*. Jun 2009;30(6):1213-21. doi:10.3174/ajnr.A1546
53. Ferro JM, Canhão P, Aguiar de Sousa D. Cerebral venous thrombosis. *Presse Med*. Dec 2016;45(12 Pt 2):e429-e450. doi:10.1016/j.lpm.2016.10.007
54. Bushnell C, Saposnik G. Evaluation and management of cerebral venous thrombosis. *Continuum (Minneap Minn)*. Apr 2014;20(2 Cerebrovascular Disease):335-51. doi:10.1212/01.CON.0000446105.67173.a8
55. Coutinho JM. Cerebral venous thrombosis. *J Thromb Haemost*. Jun 2015;13 Suppl 1:S238-44. doi:10.1111/jth.12945
56. Liang T, Tso DK, Chiu RY, Nicolaou S. Imaging of blunt vascular neck injuries: a review of screening and imaging modalities. *AJR Am J Roentgenol*. Oct 2013;201(4):884-92. doi:10.2214/ajr.12.9664
57. Mundinger GS, Dorafshar AH, Gilson MM, Mithani SK, Manson PN, Rodriguez ED. Blunt-mechanism facial fracture patterns associated with internal carotid artery injuries: recommendations for additional screening criteria based on analysis of 4,398 patients. *J Oral Maxillofac Surg*. Dec 2013;71(12):2092-100. doi:10.1016/j.joms.2013.07.005
58. Simon LV, Nassar AK, Mohseni M. Vertebral Artery Injury. StatPearls Publishing Updated July 21, 2021. Accessed November 4, 2021. https://www.ncbi.nlm.nih.gov/books/NBK470363/
59. Nash M, Rafay MF. Craniocervical Arterial Dissection in Children: Pathophysiology and Management. *Pediatr Neurol*. Jun 2019;95:9-18. doi:10.1016/j.pediatrneurol.2019.01.020

ADDITIONAL RESOURCES

1. Edlow JA. Managing Patients With Nontraumatic, Severe, Rapid-Onset Headache. *Ann Emerg Med*. Mar 2018;71(3):400-408. doi:10.1016/j.annemergmed.2017.04.044
2. Farsad K, Mamourian AC, Eskey CJ, Friedman JA. Computed tomographic angiography as an adjunct to digital subtraction angiography for the pre-operative assessment of cerebral aneurysms. *Open Neurol J*. 2009;3:1-7. doi:10.2174/1874205X00903010001
3. Pirau L, Lui F. Vertebrobasilar Insufficiency. StatPearls Publishing Updated September 25, 2021. Accessed November 4, 2021. https://www.ncbi.nlm.nih.gov/books/NBK482259/

4. Xu HW, Yu SQ, Mei CL, Li MH. Screening for intracranial aneurysm in 355 patients with autosomal-dominant polycystic kidney disease. *Stroke*. Jan 2011;42(1):204-6. doi:10.1161/strokeaha.110.578740

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GENERAL INFORMATION

It is an expectation that all patients receive care/services from a licensed clinician. All appropriate supporting documentation, including recent pertinent office visit notes, laboratory data, and results of any special testing must be provided. If applicable: All prior relevant imaging results and the reason that alternative imaging cannot be performed must be included in the documentation submitted.