National Imaging Associates, Inc.	
Clinical guidelines **BRAIN (HEAD) MRA/MRV**	**Original Date: September 1997**
CPT Codes: 70544, 70545, 70546	**Last Revised Date: ~~March 2022~~ May 2023**
Guideline Number: NIA_CG_004-2	**Implementation Date: January 2024~~3~~**

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.*
- *Where a specific clinical indication is not directly addressed in this guideline, medical necessity determination will be made based on widely accepted standard of care criteria. These criteria are supported by evidence-based or peer-reviewed sources such as medical literature, societal guidelines and state/national recommendations.*

INDICATIONS FOR BRAIN (HEAD) MR Angiography/MR Venography

Brain MRI/MRA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain MRI/Brain MRA 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)

For evaluation of suspected intracranial vascular disease[1, 2]

- **Aneurysm screening**
  - Screening for ~~suspected~~ intracranial aneurysm ~~in patient with~~if two or more ~~a~~ first-degree ~~familial~~ family members ~~history~~ (parent brother, sister, or child) with history of intracranial aneurysm

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        - ~~Note:~~ Repeat study is recommended every 5 years[3]
    - For one first degree relative with aneurysm, asymptomatic screening is not indicated - would require a neurological sign or symptom supporting clinical concern for aneurysm.[4-6]
    - Screening for aneurysm in polycystic kidney disease (in adults), ~~(after age 30),~~ Loeys-Dietz syndrome*, fibromuscular dysplasia, spontaneous coronary arteries dissection (SCAD), or known aortic coarctation (after age 10)[7-15]
      *For Loeys-Dietz imaging should be repeated at least every two years

- **Vascular abnormalities**
    - 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 (i.e. aneurysm or reversible cerebral vasoconstriction syndrome) after initial negative brain imaging ~~> 6 hours after onset~~[16]

      Note: Negative brain CT < 6 hours after headache onset excludes subarachnoid hemorrhage in neurologically intact patients[11]. MRI lacks sensitivity in excluding subarachnoid hemorrhage less than 24 hours after headache onset.[17, 18]

    - Headache associated with exercise, exertion, Valsalva, or sexual activity[18]
    - Isolated third nerve palsy (oculomotor) with pupil involvement to evaluate for aneurysm[19]
    - Pulsatile tinnitus to identify a suspected arterial vascular etiology[20, 21]

      Note: MRI is the study of choice for detecting cavernomas, developmental venous anomalies and capillary telangiectasia (see background)[22]

- **Cerebrovascular Disease**
    - Ischemic
        - Recent ischemic stroke or transient ischemic attack (See background)[23, 24]

          Note: For remote strokes with no prior vascular imaging, imaging can be considered based on location/type of stroke and documented potential to change management

        - 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[19, 25-27]
    - Hemorrhagic
        - Known subarachnoid hemorrhage (SAH) – CTA is favored over ~~MRI~~ MRA ~~unless there is a contradiction~~[28]
        - Known cerebral intraparenchymal hemorrhage with concern for underlying vascular abnormality
    - Venous-MRV†

        - Suspected central venous thrombosis (dural sinus thrombosis)[28, 29]
        - Distinguishing benign intracranial hypertension (pseudotumor cerebri) from dural sinus thrombosis[30, 31]
    - Sickle cells disease (ischemic and/or hemorrhagic)[32, 33]
        - 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

- **Vasculitis with initial laboratory workup (such as ESR, CRP, serology)[34]**
    - Suspected secondary CNS vasculitis based on neurological sign 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[35, 36]
    - Giant cell arteritis with suspected intracranial involvement[37-40]

- **Other intracranial vascular disease**
    - Suspected Moyomoya disease[41, 42]
    - Suspected reversible cerebral vasoconstriction syndrome[43]

For evaluation of known intracranial vascular disease[1, 2]

- Known intracranial aneurysm, treated aneurysm, or known 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[25, 27]
- Known vasculitis, reversible cerebral vasoconstriction syndrome or Moyomoya disease[35, 41-44]

Pre-operative/procedural evaluation for brain/skull surgery

- Pre-operative evaluation for a planned surgery or procedure
- Refractory trigeminal neuralgia when done for surgical planning[45]

Post-operative/procedural evaluation[46, 47]

- 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

Further evaluation of indeterminate or questionable findings on prior imaging:

- For initial evaluation of an inconclusive finding on a prior imaging report that requires further clarification.
- One follow-up exam of a prior indeterminate MR/CT finding to ensure no suspicious interval change has occurred. (No further surveillance unless specified as highly suspicious or change was found on last follow-up exam)

Indications for Brain MRA/Neck MRA combination studies[1, 2]

- Recent ischemic stroke or transient ischemic attack (TIA)[24] (also in combo section)
- Note: For remote strokes with no prior vascular imaging, imaging can be considered based on location/type of stroke and documented potential to change management
- 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[25-27]
- Suspected carotid or vertebral artery dissection; secondary to trauma or spontaneous due to weakness of vessel wall[48, 49]
- Follow-up of known carotid or vertebral artery dissection within 3-6 months for evaluation of recanalization and/or to guide anticoagulation treatment[50-52]
- 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[53-55]
- 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[53, 56]
- Pulsatile tinnitus to identify a suspected arterial vascular etiology[20, 21]

Indications for Brain MRI/Brain MRA combination studies[1, 2]

- Recent ischemic stroke or transient ischemic attack (TIA)
- Thunderclap headache with continued concern for underlying vascular abnormality (i.e., aneurysm or reversible cerebral vasoconstriction syndrome) after initial negative brain imaging[16]

  ~~**with continued concern for underlying vascular abnormality after initial negative brain imaging > 6 hours after onset**~~ ~~[7 9]~~

  Note: Negative brain CT < 6 hours after headache onset excludes subarachnoid hemorrhage in neurologically intact patients.~~[11]~~ MRI lacks sensitivity in excluding subarachnoid hemorrhage less than 24 hours after headache onset.[17, 18]

- Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm
- Headache associated with exercise, exertion, Valsalva or sexual activity[18]
- Suspected venous thrombosis (dural sinus thrombosis) – MRI/MRV†

- 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

Indications for Brain MRI/Brain MRA/Neck MRA combination studies

- Recent ischemic stroke or transient ischemic attack (TIA)[1, 2, 57]
- 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[58]

Any Combination of Brain MRA/Neck MRA/Brain MRI with IAC

- Pulsatile tinnitus with concern for a suspected arterial vascular and/or intracranial etiology[20, 57]

***Note:** CTA and MRA are generally comparable noninvasive imaging alternatives each with their own advantages and disadvantages. Brain MRI can be combined with Brain CTA/Neck CTA.

BACKGROUND

Magnetic resonance angiography (MRA) or magnetic resonance venography (MRV) can be used as a first-line investigation of intracranial vascular disease. It is an alternative to invasive intra-catheter angiography that was once the mainstay for the investigation of intracranial vascular disease. MRA/MRV may use a contrast agent, gadolinium, which is non-iodine-based, for better visualization. It can be used in patients who have history of contrast allergy and who are at high risk of kidney failure. A single authorization covers both MRA and MRV.

The three different techniques of MRA/MRV include time of flight (both 2D and 3D TOF), phase contrast (PC), and contrast-enhanced angiography. Time of flight MRA takes advantage of the phenomena of flow-related enhancement and is the preferred MRA technique due to the speed at which the exam can be acquired.

MRA and Cerebral Aneurysms – Studies that compared MRA with catheter angiography in detecting aneurysms found that MRA could find 77% - 94% of the aneurysms previously diagnosed by catheter angiography that were larger than 5 mm. For aneurysms smaller than 5 mm, MRI detected only 10% - 60% of those detected with catheter angiography. On the other hand, aneurysms that were missed by catheter angiography in patients with acute subarachnoid hemorrhage were detected with MRA due to the much larger number of projections available with MRA.[59] The decrease in specificity, when compared with CTA, is reported to have false-positive cases related to normal vascular variants of infundibular origin of vessels and vessel loops. Limitations of MRA head include required safety screening and relatively long acquisition time in urgent clinical scenario.

MRA and PCKD[13-15, 60]

Screening imaging every 5 years, and annual follow-up imaging in patients in with a known intracranial aneurysm is recommended. The current literature recommends initial screening by the age of 30 years and earlier if there is a strong family history of intracranial aneurysm. Screening is generally not recommended is the pediatric population (less than 18 years). No upper age limit for screening patients with ADPKD has been recommended.

MRA and Cerebral Arteriovenous Malformations (AVM) – Brain arteriovenous malformation (AVM) may cause intracranial hemorrhage and is usually treated by surgery. 3D TOF-MRA is commonly used during the planning of radiosurgery to delineate the AVM nidus, but it is not highly specific for the detection of a small residual AVM aft er ~~radio-surgery~~radiosurgery. There is no evidence to support screening of first-degree relatives for AVMs[61]. The risk of having ~~a~~an AVM may be higher than in the general population, ~~the but~~but absolute risk is low.

MRA 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.[1, 2, 22]

MRA vs CTA for CVA – Preferred vascular imaging of the head and neck includes non-contrast 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. For acute stroke, CTA is preferred after CT (to rule out hemorrhage) and to look for thrombus/possible intervention that is time sensitive.[62]

MRA 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."[63] 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.[64] 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."[65] 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.[66]

Therefore, 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). 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.[64] 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.[23]

Patients with a history of stroke and recent workup 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.

MRA and Intracerebral Hemorrhage – MRA is useful as a screening tool for an underlying vascular abnormality[67] 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.

MRV – A pitfall of the TOF technique, particularly 3D TOF, is that in areas of slowly flowing blood, turbulence, or blood which flows in the imaging plane there can be regions of absent or diminished signal. The signal loss can be confused with vascular occlusion or thrombi. To avoid this pitfall, MRA performed after the intravenous administration of gadolinium-based contrast agents is utilized at many facilities.

Intracranial magnetic resonance venography (MRV) is used primarily to evaluate the patency of the venous sinuses. The study can be performed with TOF, Phase contrast and IV contrast-enhanced techniques. Delayed images to allow for enhancement of the venous system are required to obtain images when intravenous gadolinium-enhanced studies are undertaken.

Saturation pulses are utilized in studies not undertaken with intravenous contrast to help eliminate flow-related signal in a specified direction and thus display the desired arterial or venous structures on

their own. In cranial applications, saturation pulses applied at the inferior margin of the imaging field eliminate signal from arterial flow in order to visualize the veins. Conversely, superior saturation pulses are used to eliminate venous flow-related enhancement when evaluation of the arterial structures is desired.[68]

†MRV and Central Venous Thrombosis – a MR Venogram is indicated for the evaluation of a central venous thrombosis/dural sinus thrombosis. The most frequent presentations are isolated headache, intracranial hypertension syndrome (headache, nausea/vomiting, transient visual obscurations, pulsatile tinnitus, CN VI palsy, papilledema),[69] 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. COVID-19 infection is associated with hypercoagulability, a thromboinflammatory response, and an increased incidence of venous thromboembolic events (VTE).[70, 71] Since venous thrombosis can cause SAH, infarctions, and hemorrhage, parenchymal imaging with MRI/CT is also appropriate.[72-74]

Combination MRI/MRA of the Brain – This is one of the most misused combination studies and other than what is indicated above these examinations should be ordered in sequence, not together. Vascular abnormalities can be visualized on the brain MRI.

Patients presenting with a new migraine with aura (especially an atypical or complex aura) can mimic a transient ischemic attack or an acute stroke. If there is a new neurologic deficit, imaging should be guided by concern for cerebrovascular disease, not that the patient has a headache.[16]

MRA 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.[48, 75-77] 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 of the head and neck is warranted.[49, 78]

~~**POLICY HISTORY**~~

~~**Date**~~	~~**Summary**~~
~~March 2023~~	~~Updated and reformatted references~~ ~~Updated background section~~ ~~Added:~~

	~~Section on further evaluation of indeterminate or questionable findings on prior imaging~~ ~~Follow-up of known carotid or vertebral artery dissection within 3-6 months for evaluation of recanalization and/or to guide anticoagulation treatment (Combo Brain/Neck MRA)~~ ~~Note: For remote strokes with no prior vascular imaging, imaging can be considered based on location/type of stroke and documented potential to change management (also in combo section)~~ ~~Note on CTA VS MRA~~ ~~Clarified:~~ ~~Screening for aneurysm in polycystic kidney disease (in *adults*)~~ ~~Screening for intracranial aneurysm if *two or more* first-degree family members (parent brother, sister, or child) with history of intracranial aneurysm~~ ~~*For one first degree relative with aneurysm, asymptomatic screening is not indicated – would require a neurological sign or symptom supporting clinical concern for aneurysm.*~~ ~~Thunderclap headache with continued concern for underlying vascular abnormality (*i.e. aneurysm or reversible cerebral vasoconstriction syndrome) after initial negative brain imaging*~~ ~~*Note: MRI lacks sensitivity in excluding subarachnoid hemorrhage less than 24 hours after headache onset (also in Combo Brain MRI/MRA section)*~~ ~~Headache associated with exercise, *exertion, Valsalva* or sexual activity (Also in Combo Brain MRI/MRA)~~ ~~Known subarachnoid hemorrhage (SAH) – CTA is favored over MRA~~ ~~Deleted:~~ ~~Vascular abnormality visualized on previous brain imaging that is equivocal or needs further evaluation~~
~~March 2022~~	~~Updated and reformatted references~~ ~~Updated background section~~ ~~Added New Combo statement~~ ~~Clarified:~~ ~~• Aneurysm screening in aortic coarctation after age 10~~ ~~• MRI is the study of choice for detecting cavernomas, developmental venous anomalies and capillary telangiectasia (see background)~~ ~~• Follow-up of known intracranial aneurysm, *treated aneurysm*, or known vascular malformation~~ ~~• Pulsatile tinnitus to identify *a suspected arterial* vascular etiology~~

	• **MRI/MRA combo** - Thunderclap headache with continued concern for underlying vascular abnormality after initial negative work-up *Unless there is clear documentation of a contraindication to LP or that LP is unable to be performed due to extenuating circumstances Added: • Pulsatile tinnitus in new combo section (MRI Brain with IAC/MRA Head/MRA Neck) • Brain MRI/Brain MRA combination: ○ 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 Changed: • Thunderclap headache with continued concern for underlying vascular abnormality after initial negative brain imaging > 6 hours after onset as well as in combo section
June 2021	Updated references Updated background section Reformatted and reordered indications Added: • Brain MRI/MRA are not approvable simultaneously unless they meet the criteria described below in the Indications for Brain MRI/Brain MRA combination studies section • Headache associated with exercise or sexual activity (also in combo section) • 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 MRA section~~ ~~Added:~~ • ~~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)~~ • ~~Thunderclap headache with continued concern for underlying vascular abnormality after initial negative work-up – in combo Brain MRI/MRA section~~ ○ ~~Negative Brain CT; AND~~ ○ ~~Negative Lumbar Puncture; OR~~ • ~~Acute, sudden onset of headache with personal history of a vascular abnormality or first-degree family history of aneurysm – in combo Brain MRI/MRA 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 MRA section • Clinical suspicion of subarachnoid hemorrhage (SAH) (i.e., thunderclap headache) - in the combo MRI/MRA section
July 2019	• Added: ○ 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 ○ Refractory trigeminal neuralgia when done for surgical planning • Further clarified: ○ Suspected vertebrobasilar insufficiency (VBI) symptoms ○ MRV for suspected central venous thrombosis • For Brain MRA/Neck MRA combo: ○ 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 MRI/Brain MRA combination studies, including:~~
	  ○ ~~Recent stroke or transient ischemic attack~~
	  ○ ~~Clinical suspicion of subarachnoid hemorrhage (SAH) ie thunderclap headache~~
	  ○ ~~Suspected venous thrombosis (dural sinus thrombosis)~~
	• ~~Added section for Brain MRI/Brain MRA/Neck MRA 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~~

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~~ADDITIONAL RESOURCES~~

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POLICY HISTORY

Date	Summary
May 2023	Updated and reformatted references Updated background section Added: - Section on further evaluation of indeterminate or questionable findings on prior imaging - Follow-up of known carotid or vertebral artery dissection within 3-6 months for evaluation of recanalization and/or to guide anticoagulation treatment (Combo Brain/Neck MRA) - Note: For remote strokes with no prior vascular imaging, imaging can be considered based on location/type of stroke and documented potential to change management (also in combo section) - Note on CTA VS MRA Clarified: - Screening for aneurysm in polycystic kidney disease (in *adults*) - Screening for intracranial aneurysm if *two or more* first-degree family members (parent brother, sister, or child) with history of intracranial aneurysm - *For one first degree relative with aneurysm, asymptomatic screening is not indicated - would require a neurological sign or symptom supporting clinical concern for aneurysm.* - Thunderclap headache with continued concern for underlying vascular abnormality (*i.e. aneurysm or reversible cerebral vasoconstriction syndrome) after initial negative brain imaging* - *Note: MRI lacks sensitivity in excluding subarachnoid hemorrhage less than 24 hours after headache onset (also in Combo Brain MRI/MRA section)* - Headache associated with exercise, *exertion, Valsalva* or sexual activity (Also in Combo Brain MRI/MRA) - Known subarachnoid hemorrhage (SAH) – CTA is favored over MRA Deleted: - Vascular abnormality visualized on previous brain imaging that is equivocal or needs further evaluation
March 2022	Updated and reformatted references Updated background section Added New Combo statement Clarified: • Aneurysm screening in aortic coarctation after age 10

	• MRI is the study of choice for detecting cavernomas, developmental venous anomalies and capillary telangiectasia (see background) • Follow up of known intracranial aneurysm, *treated aneurysm*, or known vascular malformation • Pulsatile tinnitus to identify *a suspected arterial* vascular etiology • **MRI/MRA combo** - Thunderclap headache with continued concern for underlying vascular abnormality after initial negative work-up *Unless there is clear documentation of a contraindication to LP or that LP is unable to be performed due to extenuating circumstances Added: • Pulsatile tinnitus in new combo section (MRI Brain with IAC/MRA Head/MRA Neck) • Brain MRI/Brain MRA combination: ○ 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 Changed: • Thunderclap headache with continued concern for underlying vascular abnormality after initial negative brain imaging > 6 hours after onset as well as in combo section

Reviewed / Approved by NIA Clinical Guideline Committee

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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.~~