

## 2011 Imaging Criteria

Computed Tomographic Angiogram (CTA)/Magnetic Resonance  
Angiogram (MRA), Brain <sup>(1\*MDR, 2, 3, 4, 5)</sup>

ICD-9-CM: 88.41  
CPT: 70496, 70544, 70545, 70546  
I/O Setting: Outpatient

## INDICATION(S)

- 100 Subarachnoid hemorrhage (SAH)
- 200 Cerebral aneurysm
- 300 AVM
- 400 Suspected cerebral venous thrombosis
- 500 Suspected posterior circulation ischemia

- 100 Subarachnoid hemorrhage (SAH) **[Both]** <sup>(6, 7)</sup>
  - 110 Angiography not planned <sup>(8, 9, 10)</sup>
  - 120 Findings **[One]**
    - 121 SAH by CT/MRI
    - 122 CSF blood/xanthochromia by LP <sup>(11)</sup>
- 200 Cerebral aneurysm **[Both]** <sup>(8, 10)</sup>
  - 210 Angiography not planned <sup>(8, 10)</sup>
  - 220 Findings **[One]**
    - 221 Suspected cerebral aneurysm **[One]**
      - 1 SAH/intracerebral hematoma by CT/MRI
      - 2 Isolated cranial nerve (CN) deficit **[One]** <sup>(12)</sup>
        - A) CN II
        - B) CN III <sup>(13)</sup>
        - C) CN IV
        - D) CN V <sup>(14)</sup>
        - E) CN VI
    - 222 Screening study for cerebral aneurysm **[One]** <sup>(15)</sup>
      - 1 First degree relative with cerebral aneurysm
      - 2 Hx/first degree relative with polycystic kidney disease
      - 3 First-degree relative with multiple meningiomas
    - 223 Follow-up study for known cerebral aneurysm **[One]** <sup>(8, 9)</sup>
      - 1 Follow-up ≥ 6 mos
      - 2 Baseline study post procedure <sup>(16)</sup>

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- 3 Follow-up at 3 mos/6 mos post procedure<sup>(16)</sup>
- 4 New/worsening Sx/findings ♦

300 AVM **[Both]**<sup>(17, 18, 19)</sup>

- 310 Angiography not planned<sup>(10)</sup>
- 320 Follow-up study **[One]**
  - 321 Preoperative evaluation/procedure planning
  - 322 Baseline study post procedure
  - 323 Follow-up assessment ≥ 1 yr after Rx
  - 324 New/worsening Sx/findings ♦

400 Suspected cerebral venous thrombosis **[Both]**<sup>(20, 21)</sup>

- 410 Headache **with** associated Sx/findings **[One]**
  - 411 Papilledema by PE<sup>(22)</sup>
  - 412 Focal neurologic finding by PE<sup>(23)</sup>
  - 413 Mental status changes by Hx/PE<sup>(24)</sup>
  - 414 Seizure by Hx/PE
- 420 Finding **[One]**
  - 421 Hypercoagulable state<sup>(25)</sup>
  - 422 Skull fracture over dural sinus
  - 423 Calvarial mass<sup>(26)</sup>
  - 424 Infection **[One]**
    - 1 Rhinosinusitis
    - 2 Otitis media

500 Suspected posterior circulation ischemia **[Both]**<sup>(27\*RIN, 28, 29)</sup>

- 510 Angiography not planned
- 520 Sx/findings of vertebrobasilar stenosis/occlusion by PE **[One]**
  - 521 Weakness/paralysis of contralateral extremities/ipsilateral face<sup>(30)</sup>
  - 522 Numbness/paresthesias of contralateral extremities/ipsilateral face<sup>(30)</sup>
  - 523 Impaired coordination/ataxia<sup>(31, 32)</sup>
  - 524 Visual impairment **[One]**
    - 1 Hemianopsia/bilateral vision loss<sup>(33)</sup>
    - 2 Diplopia and ophthalmologic exam normal<sup>(34)</sup>
    - 3 Visual field impairment
- 525 Vertigo **with** associated Sx/findings **[One]**<sup>(35)</sup>
  - 1 Headache
  - 2 Central nystagmus<sup>(36, 37)</sup>

## Notes

**(1)-MDR:**

Historically, conventional angiography has been the preferred preoperative study used to demonstrate the vessels supplying a neoplasm. In some instances, CTA and MRA are being performed in place of angiography. While CTA is a less invasive study than angiography, the study is limited in the evaluation of the distal arterial segments and the smaller, deep venous structures. MRA is not as sensitive as angiography or CTA for demonstrating a neoplasm and provides insufficient visualization of distal cerebral arteries (Mechtler, *Neurol Clin* 2009; 27(1): 171-201, ix; Debnam et al., *Arch Pathol Lab Med* 2007; 131(2): 252-260). Therefore, requests for MRA of the brain for cancer require secondary medical review.

**(2)**

MRA is an application of MRI that produces images of blood vessels for noninvasive evaluation of the arterial as well as venous circulation. Unlike a conventional angiogram or CTA, MRA does not involve ionizing radiation or the administration of iodinated IV contrast which is nephrotoxic and can cause an allergic reaction in some patients. MRA is not usually performed in addition to an angiogram, but as a substitute for angiogram.

**(3)**

The following are examples of relative and absolute contraindications to the use of magnetic resonance imaging:

- Implanted devices that are electrically or magnetically activated (e.g., cardiac pacemakers, automatic cardioverter defibrillators, drug infusion pumps, cochlear implants)
- Ferromagnetic metal objects (e.g., cerebral aneurysm clips, intraocular metallic foreign body, prostheses, screws)
- Pregnancy, first trimester
- Renal insufficiency in cases when magnetic resonance imaging is performed with gadolinium-based contrast

**(4)**

CTA is an application of CT which allows visualization of the arterial and venous circulation. CTA combines the use of x-rays with computerized analysis of cross-sectional images that are then assembled in a computerized three-dimensional picture. Unlike a conventional angiography where contrast material is injected into an artery, CTA is less invasive as the contrast material is injected intravenously. MRA is not usually performed in addition to an angiogram but as a substitute for angiogram.

**(5)**

MRA is not appropriate for patients with contraindications for MRI. Contraindications to CTA are similar to those for angiography and include renal impairment (e.g., elevated creatinine) and iodine contrast allergy.

**(6)**

SAH due to aneurysm rupture occurs in 25,000 to 30,000 people in the U.S. annually with mortality approaching 45% (Bederson et al., *Guidelines for the management of aneurysmal subarachnoid hemorrhage: a statement for healthcare professionals from a special writing group of the Stroke Council, American Heart Association. 2009 [cited 40 3]*). Usually asymptomatic until they rupture, intracranial aneurysms are the cause of approximately 85% of SAH. Other causes include trauma, AVMs, dural sinus thrombosis, arterial dissection, bleeding diseases, and drugs (Ferro et al., *J Neurol* 2008; 255(4): 465-479; van der Schaaf et al., *Cochrane Database Syst Rev* 2005; (4): CD003085). There is an increased risk for SAH in first degree relatives of patients with a history of SAH (Bederson et al., *Guidelines for the management of aneurysmal subarachnoid hemorrhage: a statement for healthcare professionals from a special writing group of the Stroke Council, American Heart Association. 2009 [cited 40 3]*; Manno, *Neurol Clin* 2004; 22(2): 347-366). The typical presentation is a severe, sudden headache associated with nausea, vomiting, stiff neck, focal neurological deficits, and sometimes loss of consciousness. Some patients present with only mild symptoms, which can lead to a delayed diagnosis or misdiagnosis. The most immediate risks of SAH are recurrent hemorrhage, vasospasm, and cerebral ischemia (van der Schaaf et al., *Cochrane Database Syst Rev* 2005; (4): CD003085).

**(7)**

MRA or CTA may be performed to determine the source of the bleeding. Information from these studies is used to determine whether surgery is indicated, as well as to plan the surgical procedure.

**(8)**

Cerebral angiography is considered the gold standard diagnostic and pretreatment planning study for the identification of aneurysms and for localizing possible leaking aneurysms as the source of SAH. Increasingly, multi-detector CTA and MRA are being used as less invasive alternatives to catheter angiography (Bederson et al., *Stroke* 2009; 40(3): 994-1025). CTA has reported sensitivities of 85% to 98% when aneurysms are  $\geq 3$ mm (Edlow et al., *J Emerg Med* 2008; 34(3): 237-251; Karamessini et al., *Eur J Radiol* 2004; 49(3):

212-223; Chappell et al., *Neurosurgery* 2003; 52(3): 624-631; discussion 630-621). The sensitivity for MRA is 85% to 100% with aneurysms  $\geq$  5 mm (Bederson et al., *Stroke* 2009; 40(3): 994-1025).

**(9)**

Some facilities have adopted a protocol of CTA in place of cerebral angiogram as the only diagnostic and pretreatment planning study for patients with cerebral aneurysms (ruptured and unruptured). In one study, patients with suspected cerebral aneurysms underwent diagnostic imaging evaluation for cerebral aneurysms. The aneurysm detection rate by CTA was 100%. Treatment was initiated on the basis of CTA alone for 82% of the patients (Hoh et al., *Neurosurgery* 2004; 54(6): 1329-1340; discussion 1340-1322).

**(10)**

If cerebral angiogram has already been performed or is planned, MRA or CTA is not warranted.

**(11)**

Xanthochromia refers to a yellowish discoloration of the spinal fluid suggestive of past hemorrhage, develops 2 to 12 hours after bleeding, and takes at least 2 weeks to clear. Spectrophotometry of the CSF is the recommended method of analysis and should be done on the final sample of CSF collected (Bederson et al., *Guidelines for the management of aneurysmal subarachnoid hemorrhage: a statement for healthcare professionals from a special writing group of the Stroke Council, American Heart Association. 2009* [cited 40 3]; Suarez et al., *N Engl J Med* 2006; 354(4): 387-396).

**(12)**

Isolated cranial nerve deficits may be seen in association with intracranial aneurysms. Because the cranial nerves listed are located in areas along the cerebral vasculature where aneurysms most commonly occur, deficits of these cranial nerves raise the suspicion of an aneurysm.

**(13)**

Intracerebral aneurysms most commonly involve the oculomotor nerve (CN III) and result in anisocoria (e.g., unequal pupillary size) and diplopia (e.g., double vision).

**(14)**

Trigeminal neuralgia is not an indication for MRA or CTA in the majority of cases.

**(15)**

Screening for cerebral aneurysms in first degree relatives of patients with a known cerebral aneurysm has been questioned. Although MRA can identify the presence of an aneurysm, the question remains as to how to best manage these patients. The slight increase in life expectancy resulting from surgery (0.9 months per person screened) does not outweigh the postoperative risks (Magnetic Resonance Angiography in Relatives of Patients with Subarachnoid Hemorrhage Study Group, *N Engl J Med* 1999; 341(18): 1344-1350). MRA screening does not appear to be beneficial for individuals with only one relative identified as having a cerebral aneurysm. However, patients < 30 years of age with more than one first degree relative with a history of cerebral aneurysm have a higher incidence of aneurysm and a higher lifetime risk of rupture. For this subgroup of patients, surgical risk may be balanced by the lifetime potential of aneurysm rupture (Rinkel, *Lancet Neurol* 2005; 4(2): 122-128). Whether to screen patients with a family history of cerebral aneurysm is a complex decision and ultimately, a matter of clinical judgment.

**(16)**

MRA can only be performed for follow-up after surgery if the aneurysmal clip is MRI compatible or the aneurysm was wrapped or thrombosed (and not clipped) at the time of surgery.

**(17)-DEF:**

An arteriovenous malformation (AVM) is a vascular lesion consisting of dilated feeding arteries and a core of tangled vascular loops that terminate in draining veins.

**(18)**

AVMs typically present between the ages of 20 and 40. Ruptured cerebral AVMs account for 1% to 2% of all strokes and 9% of cases of SAH. The most common presentation of an AVM is intracranial hemorrhage, with approximately 50% of patients presenting with hemorrhage (Bashir et al., *Neurol Clin* 2008; 26(4): 1099-1127, x; Choi and Gershenwald, *Surg Oncol Clin N Am* 2007; 16(2): 403-430). Each hemorrhagic event is associated with significant morbidity and 30% mortality (Cockroft, *Stroke* 2007; 38(12): 3310-3311; Al-Shahi and Warlow, *Cochrane Database Syst Rev* 2006; (1): CD003436; Choi and Mohr, *Lancet Neurol* 2005; 4(5): 299-308). The risk of recurrent hemorrhage is estimated to be 25% within the first year following the initial hemorrhage (Khatri et al., *Neurol Clin* 2009; 27(1): 109-137, viii).

**(19)**

Cerebral angiogram is considered the gold standard for assessing AVMs. Sensitivity for MRA in diagnosing AVMs is 70% to 87% (Jankowitz et al., *Neurosurg Clin N Am* 2005; 16(2): 241-248, vii). MRA has low spatial and temporal resolution (Matsumoto et al., *AJNR Am J Neuroradiol* 2007; 28(2): 299-304).

**(20)**

Cerebral venous thrombosis (CVT) is an occlusion of the cerebral veins and can lead to infarction of the involved cerebral territories. This disorder may present as a slowly progressive process or as an acute neurologic emergency. Risk factors for the development of cerebral venous thrombosis include dehydration, systemic and local infection, head trauma, pregnancy, puerperium, cancer, trauma, and coagulopathies (Stam, *N Engl J Med* 2005; 352(17): 1791-1798). The clinical presentation of CVT is often nonspecific. Common presenting symptoms include recent onset, progressive headache frequently associated with focal neurologic deficits, seizures, and altered consciousness. A syndrome of intracranial hypertension that includes headache and papilledema can account for up to 40% of cases (Poon et al., *AJR Am J Roentgenol* 2007; 189(6 Suppl): S64-75).

**(21)**

Since the clinical presentation may be variable, cerebral venous thrombosis can be difficult to diagnose. Early diagnosis is essential for prompt appropriate treatment and improved patient outcome. Magnetic resonance venography, a component of MRA to evaluate the venous circulation, provides more definitive information when performed in conjunction with MRI. MRI and magnetic resonance venography are appropriate when cerebral venous thrombosis is suspected. CT may be used as an initial screening tool to rule out other acute cerebrovascular disorders. CT venography is emerging as a competing technique for imaging of the cerebral venous system (Poon et al., *AJR Am J Roentgenol* 2007; 189(6 Suppl): S64-75; Khandelwal et al., *AJR Am J Roentgenol* 2006; 187(6): 1637-1643; Stam, *N Engl J Med* 2005; 352(17): 1791-1798).

**(22)-DEF:**

Papilledema is swelling of the optic disc, manifested by indistinct margins, hyperemia, venous engorgement, and lack of normal venous pulsations. Papilledema is a sign of increased ICP.

**(23)**

Focal neurologic finding refers to a specific deficit that corresponds to a particular area of the brain (e.g., right arm weakness from a left motor cortex insult).

**(24)**

Mental status changes include confusion, lethargy, disorientation, somnolence, stupor, and coma.

**(25)**

A hypercoagulable state can develop due to malignancy, sickle cell disease, coagulation disorders (e.g., protein C or S deficiency, antithrombin III deficiency), during pregnancy or the postpartum period, or from the use of oral contraceptives.

**(26)**

A mass arising from the skull (e.g., calvarium) can result in occlusion of the cerebral veins.

**(27)-RIN:**

**An MRA or CTA of the neck in addition to an MRA or CTA of the brain is appropriate to assess the vertebral arteries.**

**(28)**

The posterior circulation supplies the occipital and medial temporal lobes of the brain. Posterior circulation ischemia occurs as the result of pathology in the vertebrobasilar system. The symptoms that result are varied and may include oculomotor palsies, gait and limb ataxia, limb weakness, and oropharyngeal dysfunction (Savitz and Caplan, *N Engl J Med* 2005; 352(25): 2618-2626).

**(29)**

The diagnosis of a stroke or TIA is made on clinical grounds. A stroke is generally confirmed by CT or MRI. MRA or CTA of the brain is performed to help establish the diagnosis of stenosis or occlusion of the posterior circulation to determine appropriateness and timing of anticoagulation therapy.

**(30)**

Patients with posterior circulation ischemia present with crossed deficits. Sensory and motor deficits usually occur on the ipsilateral side of the face and the contralateral side of the extremities. In some instances of basilar distribution ischemia, there may be bilateral weakness. If the ischemia occurs above the level where all the sensory tracts have crossed (e.g., at the thalamus), the sensory symptoms will all be on one side (e.g., face, arm, leg on the contralateral side). This is in contrast to the deficits in anterior circulation ischemia which involve only the contralateral side of the face and body.

**(31)-DEF:**

Ataxia is incoordination or awkwardness in performance of a motor task. The term ataxia is often used to describe gait unsteadiness.

**(32)**

Impaired coordination suggests cerebellar pathology. Inability to perform rapid alternating movements, finger to nose testing, or heel to shin testing are examples of impaired coordination.

**(33)**

Homonymous hemianopsia, a loss of vision on the nasal half of one eye's visual field and the temporal half of the other eye's visual field, can occur with posterior circulation ischemia. The result is blindness of the corresponding half of the visual field (either right or left) in both eyes.

**(34)-DEF:**

Diplopia is double vision.

**(35)-DEF:**

Vertigo is a sensation of motion or spinning. Vertigo may be caused by disorders of CN VIII, the inner ear, the brainstem, or the cerebellum.

**(36)-DEF:**

Nystagmus is a form of involuntary eye movement. It is characterized by slow movement in one direction and a rapid corrective movement in the other direction. The direction of nystagmus has been traditionally defined as the direction of the rapid corrective component. It can be vertical, horizontal or rotatory.

**(37)**

This criteria point addresses new onset central nystagmus where there is suspicion of a CNS lesion. Several maneuvers help distinguish peripheral from central nystagmus (e.g., looking in various directions on command, tracking images with the head still).