Medical Policy

Blue Cross Blue Shield Blue Care Network of Michigan

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(See policy history boxes for previous effective dates)

Title: Magnetic Resonance Angiography and Magnetic Resonance Venography

Description/Background

Magnetic resonance angiography (MRA) is an application of magnetic resonance imaging (MRI) that provides visualization of blood flow, as well as images of normal and diseased blood vessels, without the use of contrast agents or ionizing radiation. MRA is the general term used to describe magnetic resonance (MR) imaging of vascular structures, but when MR is used to image a vein instead of an artery, the term “magnetic resonance venography” (MRV) may be used. MRV is used to determine vein health. The MRV assesses blood flow and detects detrimental abnormalities such as blood clots or structural vein abnormalities. The technical capabilities of current MRA make it most suitable for evaluation of medium-to-large size vessels such as the Circle of Willis and major posterior circulation vessels and less suitable for providing detailed information about the small, peripheral, cerebral vasculature.

Contrast-enhanced MRA (CE-MRA) involves blood flow imaging after the patient receives an intravenous injection of a contrast agent. Gadolinium, a non-ionic element, is the foundation of all contrast agents currently in use. Gadolinium affects the way in which tissues respond to magnetization, resulting in better visualization of structures when compared to un-enhanced studies. Unlike ionic (i.e., iodine-based) contrast agents used in conventional contrast angiography (CA), allergic reactions to gadolinium are extremely rare. Additionally, gadolinium does not cause the kidney failure occasionally seen with ionic contrast agents. Digital subtraction angiography (DSA) is a computer-augmented form of CA that obtains digital blood flow images as contrast agent courses through a blood vessel. The computer “subtracts” bone and other tissue from the image, thereby improving visualization of blood vessels. Physicians elect to use a specific MRA or CA technique based upon clinical information from each patient.

MRA/MRV can image vessels with a high degree of sensitivity and specificity. However, the appropriate use of MRA/MRV in this setting must be coordinated with the use of the competing technologies, Duplex ultrasonography and angiography.

Regulatory Status:

On December 24, 2008, the United States Food and Drug Administration (FDA) approved Vasovist injection (gadofosveset trisodium, now marketed as Ablavar), the first contrast imaging agent for use in patients undergoing MRA. Gadofosveset reversibly binds to albumin providing extended intravascular enhancement compared with existing extracellular magnetic resonance contrast agents. Administration of gadofosveset provides a clearer image in patients who are suspected of having blockages or other problems with the blood vessels in their abdomen or extremities. The safety and effectiveness of Vasovist was established in two clinical trials of patients with known or suspected aorto-iliac disease. In the studies, patients underwent MRA with and without Vasovist and their scans were compared to standard X-ray pictures using contrast. Magnetic resonance angiography with Vasovist detected more arterial disease than MRA performed without Vasovist and the pictures were of improved technical quality.

Medical Policy Statement

The safety and effectiveness of magnetic resonance angiography (MRA) and magnetic resonance venography (MRV) specified conditions of the head, chest, abdomen, pelvis, spinal canal, upper/lower extremities and allergy have been established. They may be considered useful diagnostic options in patients with documented allergy to iodinated contrast material and in patients who have accelerating hypertension and/or accelerating renal insufficiency.

Inclusionary and Exclusionary Guidelines

Note: MRV can be used instead of MRA when clinically appropriate.

MRA/MRV Inclusions:

MRA/MRV for Head, Neck, Chest, abdomen, pelvis or extremities

- In the diagnosis and management of congenital or developmental vascular anomalies, not otherwise specified in one of the condition-based indications within these inclusionary guidelines.
- For the diagnosis and management of traumatic vascular injuries or vasculitis.
- Vascular anatomic delineation prior to surgical and interventional procedures, not otherwise specified in one of the condition-based indications within these inclusionary guidelines. Except for stenting or angioplasty of the dural venous sinus, which is excluded.
- MRA is used for vascular evaluation prior to transcatheter aortic valve implantation/replacement. MRA of neck requires duplex arterial ultrasound first.
- Evaluation for suspected vascular complications following a procedure.

Head and Neck

- MRA/MRV for the diagnosis and management of:
    - Stenosis or occlusion of vertebral or basilar arteries
        1. Diagnosis of suspected stenosis or occlusion:
            - Evaluation of syncope following exclusion of valvular heart disease and rhythm disturbance as the etiology
            - Subclavian steal syndrome
        2. Management of known stenosis or occlusion with worsening neurologic symptoms or signs attributable to the posterior circulation
    - Extracranial (carotid or vertebral) aneurysms,
    - Arteriovenous malformation (AVM) or fistula (AVF),
    - Dissection-intracranial or extracranial,
    - Fibromuscular dysplasia
    - For the diagnosis and management of intracranial hemorrhage in all pediatric patients and in adults with **either** intracerebral hemorrhage with clinical or imaging features atypical for hypertensive hemorrhage **OR** subarachnoid hemorrhage suggested by lumbar puncture or by imaging
    - For the diagnosis and management of extracranial venous thrombosis or compression following nondiagnostic venous ultrasound
    - Intracranial venous thrombosis or compression (includes dural venous sinus thrombosis, venous sinus thrombosis, and cerebral vein thrombosis) for **ANY** of the following:
        1. Exclusion of venous sinus thrombosis in the initial evaluation of idiopathic intracranial hypertension (IIH, also known as pseudotumor cerebri)
        2. Patients with risk factors for venous thrombosis, or elevated D-dimer, or following suspicious or nondiagnostic CT or MRI, associated with **ANY** of the following signs or symptoms:
            - Unexplained headache
            - Seizure
            - Focal neurologic abnormality
            - Altered mental status
        3. History of intracranial venous sinus thrombosis, with current signs or symptoms of recurrent thrombosis
        4. Follow-up of known venous sinus thrombosis
        5. To exclude venous compression by an adjacent intracranial mass
- MRA/MRV for the evaluation of a suspected vascular lesion in **ANY** of the following:
    - Horner's syndrome,
    - Pulsatile tinnitus,
    - Trigeminal neuralgia
- MRA/MRV for the following:
    - intracranial stenosis or occlusion,
        1. diagnosis of suspected intracranial stenosis
            - Persons with predisposing congenital or genetic disease
            - To exclude a tandem stenosis or occlusion prior to carotid revascularization
            - prior to cranial stenting
        2. management of know intracranial stenosis with new or progressive symptoms

3. surveillance in patients with established Moya Moya disease who are being considered for revascularization

- MRA/MRV for screening for intracranial aneurysm may be used for screening in **ANY** of the following high risk groups:
    - Two (2) or more first-degree relatives with intracranial aneurysm or subarachnoid hemorrhage
    - Heritable condition that is associated with intracranial aneurysm (examples include autosomal dominant polycystic kidney disease and Ehlers-Danlos syndrome type IV)
    - Known fibromuscular dysplasia
- MRA/MRV may be used for the diagnosis of clinically suspected intracranial aneurysm when:
    - CT or MRI findings suspicious for aneurysm
    - Neurologic signs or symptoms (including headache) suggestive of intracranial aneurysm with **ANY** of the following:
        1. At least one first degree relative with intracranial aneurysm or subarachnoid hemorrhage
        2. Presence of a heritable condition associated with intracranial aneurysm (such as autosomal dominant polycystic kidney disease, Ehlers-Danlos syndrome type IV)
        3. Known fibromuscular dysplasia
    - Cranial nerve deficits
    - Focal nerve deficits unexplained by CT or MRI
    - Headache with **ANY** of the following features:
        1. Sudden onset worst headache of life (“thunderclap”)
        2. Brought on by and occurring in association with exertion or Valsalva
        3. Persistent headache that remains undifferentiated/unexplained by MRI in **ANY** of the following scenarios:
            a. Positional or orthostatic headache
            b. New onset of headache over age 50
            c. Change in headache pattern
            d. Abnormal neurological exam
            e. Unexplained and unexpected increase in frequency and/or severity of headaches
            f. Comorbid conditions that increase the likelihood of an intracranial lesion, including malignancy, immunosuppression, sarcoidosis, neurocutaneous disorders (phakomatoses), or pregnancy
            g. Initial evaluation of trigeminal autonomic cephalgia (TAC), including cluster, paroxysmal hemicrania/hemicrania continua, and short-lasting unilateral neuralgiform headache
- Management of known intracranial aneurysm:
    - Evaluation for aneurysm progression or recurrence based on new or worsening neurologic symptoms
    - Preoperative evaluation
    - Initial postoperative evaluation
- Surveillance: initial evaluation at 6 to 12 months following diagnosis, then annually
- Evaluation of extracranial carotid artery stenosis or occlusion in patients who are candidates for carotid revascularization (carotid endarterectomy or carotid artery stenting) when **EITHER** duplex arterial ultrasound cannot be performed, is

nondiagnostic, **OR** when duplex arterial ultrasound shows moderate to severe stenosis or occlusion with **ANY** of the following:

- Screening
    1. Starting 5 years post-neck irradiation and every 3 years thereafter
    2. Evaluation prior to cardiac surgery when needed to determine surgical strategy
- Diagnosis of suspected carotid stenosis
    1. Hollenhorst plaques (cholesterol emboli) or retinal neovascularity on retinal examination
- Management of known carotid stenosis
    1. Worsening neurologic symptoms or signs attributable to the anterior circulation
    2. Initial baseline evaluation, and one additional evaluation during the first year following carotid revascularization
- Surveillance of established carotid disease
    1. Stenosis or occlusion in asymptomatic persons with no prior revascularization
        a. Moderate (50%-69%) stenosis: every 12 months
        b. Severe (70% or greater) stenosis: every 6 months
    2. Post-revascularization after the first year: every 12 months

- Intracranial or extracranial evaluation of acute- stoke or transient ischemic attack (TIA)
    - Intracranial evaluation for **any** of the following:
        1. Acute (7 days or less) stroke/TIA in **ANY** of the following scenarios:
            a. Acute stroke in an interventional candidate
            b. Evidence of acute ischemia or infarct on brain imaging
            c. Evaluation following acute TIA
        2. Subacute (within 30 days) stroke/TIA in **EITHER** of the following scenarios:
            a. Signs or symptoms attributable to the anterior circulation, when the presence of intracranial stenosis will lead to use of dual antiplatelet therapy
            b. Signs or symptoms other than syncope attributable to the posterior circulation
    - Extracranial evaluation for **any** of the following:
        1. Acute (7 days or less) stroke/TIA in **ANY** of the following scenarios:
            a. Acute stroke in an interventional candidate
            b. Evidence of acute ischemia or infarct on brain imaging
            c. Evaluation following acute TIA
        2. Subacute (within 30 days) stroke/TIA in **EITHER** of the following scenarios:
            a. Signs or symptoms attributable to the anterior (carotid) circulation, in patients who are candidates for carotid revascularization
            b. Signs or symptoms other than syncope attributable to the posterior circulation
        3. Chronic (30 days or more) stroke/TIA when no carotid evaluation since the stroke/TIA event in **EITHER** of the following scenarios:
            a. Signs or symptoms attributable to the anterior (carotid) circulation, in patients who are candidates for carotid revascularization when

duplex arterial ultrasound cannot be performed is or nondiagnostic
    b. Signs or symptoms other than syncope attributable to the posterior circulation
- MRA and contrast angiography (CA) are not expected to be performed on the same patient for the diagnostic purpose prior to the application of anticipated therapy.

Spinal Canal

MRA/MRV is useful in the following circumstances:

- Preoperative or postoperative imaging
- Follow-up of prior imaging findings suggestive of a vascular lesion

Peripheral Arteries of Lower Extremities

- MRA/MRV for the diagnosis and management of venous thrombosis or occlusion when venous ultrasound cannot be performed or is nondiagnostic.
- Diagnosis, management and annual surveillance of peripheral arterial disease:
    - Diagnosis of suspected PAD:
        - Any sign or symptom with inconclusive physiologic testing (including exercise testing)
    - Management of known PAD in **ANY** of the following scenarios:
        - Prior diagnosis of PAD with **ANY** of the following new or worsening signs or symptoms:
            a. Resting ischemic pain, non-healing wounds, and gangrene
            b. Ischemic or discolored toes, and livedo reticularis
            c. Sudden onset of pain associated with pulselessness, pallor, loss of motor or sensory function
        - Persistent claudication following a trial of 3 months of conservative therapy including a supervised exercise therapy program in patients being evaluated for initial revascularization
        - Post revascularization with any new or worsening lower extremity non-joint pain not addressed above, following nondiagnostic physiologic testing (physiologic testing not required if venous graft was used)
        - Post revascularization when surveillance physiological testing is inconclusive (ABI > 1.40), borderline (ABI 0.91–0.99), or abnormal (ABI ≤ 0.90)
        - Baseline evaluation after surgical revascularization using a venous graft or after endovascular revascularization (angioplasty, stent, or atherectomy)
        - Surveillance:
            a. After surgical revascularization using a venous graft: At 3-month intervals within the first 2 years, and annually thereafter
            b. After endovascular revascularization (angioplasty, stent, or atherectomy): At 4-month intervals within the first year, and annually thereafter
- When imaging results are essential in establishing a diagnosis and/or direct management of **ANY** of the following conditions:
    - Arterial entrapment syndrome
    - Aneurysm/dilation
    - Arteriovenous malformation or arteriovenous fistula
    - Dissection or intramural hematoma

Peripheral Arteries of Upper Extremities

- For the diagnosis, management and surveillance of PAD
    - Diagnosis of suspected PAD--Any sign or symptom with inconclusive physiologic testing (including exercise testing)
    - Management of know PAD in **ANY** of the following scenarios:
        - Resting ischemic pain or signs of atheroembolic disease of the upper extremities (such as ischemic or discolored fingers, livedo reticularis etc.)
        - Atypical symptoms with inconclusive physiological testing
        - Persistent claudication despite a trial of conservative therapy in initial revascularization candidates
        - Baseline study following percutaneous or surgical revascularization
        - Post-revascularization, with any new or worsening upper extremity signs or symptoms
        - Post revascularization when surveillance physiological testing is inconclusive
    - Surveillance—At 6 months, then annually following surgical revascularization
- Vascular access procedures when ultrasound cannot be performed or is nondiagnostic in **ANY** of the following scenarios:
    - Evaluation of native arteries prior to AVF for dialysis access
    - Planned harvest of the radial artery (e.g., for CABG)
    - Complications of a vascular access procedure suggested by **ANY** of the following:
        - Pulsatile mass, bruit, or thrill at the access site
        - Significant (more than expected post procedure) hematoma at the access site
        - Severe (more than expected post procedure) pain at the access site
        - Signs of ischemia or embolism in the involved extremity (such as ischemic or discolored fingers, livedo reticularis)
- For the diagnosis and management of venous thrombosis or occlusion when ultrasound cannot be performed or is nondiagnostic.
- When the results of imaging are essential to establish a diagnosis and/or direct management of any of the following conditions:
    - Aneurysm
    - Arterial entrapment syndrome
    - AVM or AVF
    - Dissection or intramural hematoma

Abdomen and/or Pelvis

- Imaging in acute aortic syndrome (includes aortic dissection, rupture, intramural hematoma, penetrating ulcer, and pseudoaneurysm) for **ANY** of the following scenarios:
    1. Initial diagnosis of suspected aortic disease
    2. Management of known aortic disease
    3. Annual surveillance of clinically stable aortic disease
- Aneurysm of the abdominal aorta or iliac arteries for management, surveillance with surgical repair, or when duplex arterial ultrasound cannot be performed or is non-diagnostic in **ANY** of the following scenarios:
    1. Screening (one time evaluation)

a. Males between 60 and 75 years who have ever smoked **OR** have a first-degree relative with an abdominal aortic aneurysm (AAA)
b. Females between 60 and 75 years who have ever smoked **AND** have a first-degree relative with AAA
c. Previously diagnosed aneurysm of the thoracic aorta, iliac, femoral or popliteal arteries

2. Diagnosis (in patients with suspected aortic or iliac aneurysm presenting with **ANY** of the following)
    a. Pulsatile abdominal mass or bruit
    b. Other imaging that is suggestive but not diagnostic
    c. Decreased or absent femoral pulses or bruit
    d. Lower extremity claudication
    e. Suggestive physiologic testing
    f. Signs or symptoms of atheroembolic disease in the lower extremities (e.g., ischemic or discolored toes, livedo reticularis)
3. Management
    a. New or worsening symptoms or signs of aortic disease or enlargement by imaging
    b. Pre-procedure planning
    c. Baseline and initial 12-month evaluation following endograft repair
    d. Every 6 months for endografts that are increasing in size or endoleaks
4. Surveillance
        a. Stable aortic aneurysm without prior repair
            i. 4.5 cm or greater: every 6 months
            ii. 3.5 to 4.4 cm: 6 months and 12 months following diagnosis, then annually
            iii. 3 to 3.4 cm: At one year following diagnosis, then every 3 years
        b. Stable iliac aneurysm without prior repair
            i. 3 cm or greater: every 6 months
            ii. Less than 3 cm: annually

- Stable aneurysms treated with open surgical repair: every 5 years
- Diagnosis and management of arteriovenous malformation or fistula.
- Diagnosis and management of hematoma/hemorrhage within the abdomen
- Diagnosis and management of mesenteric ischemia or portal hypertension
- In patients suspected of having renal artery stenosis (RAS)/Renovascular hypertension
- Stenosis or occlusion of the abdominal aorta or branch vessels, not otherwise specified (in **ANY** of the following scenarios):
    1. Diagnosis of suspected aortoiliac stenosis or occlusion based on **ANY** of the following signs or symptoms:
        a. Abdominal or femoral bruit
        b. Decreased or absent femoral pulse
        c. Atypical lower extremity claudication (including buttocks or thighs)
        d. Leriche's syndrome (buttock and thigh claudication, absent or decreased femoral pulses, erectile dysfunction)
        e. Evidence of atheroembolic disease of the lower extremities such as ischemic or discolored toes or livedo reticularis
        f. Physiological testing suggesting aorto-iliac disease
        g. Established femoral or popliteal artery aneurysm

2. Management of known stenosis, presurgical evaluation or aortoiliac stenosis or occlusion when endovascular or surgical intervention is being considered
3. Surveillance (annual) of surgical bypass grafts

- Diagnosis and management of venous thrombosis or occlusion of major abdominal vessels in **EITHER** of the following scenarios:
  1. Evaluation of the hepatic or portal veins when duplex venous ultrasound cannot be performed or is nondiagnostic
  2. Evaluation of all other abdominal venous structures
- Diagnosis, management and surveillance of visceral artery aneurysm involving **ANY** of the following arteries: renal, celiac, splenic, hepatic or superior/inferior mesenteric arteries and their branches
- MRA/MRV is used for vascular evaluation prior to transcatheter aortic valve implantation/replacement

Chest

MRA/MRV of the chest is appropriate for **ANY** of the following conditions:

- For acute aortic syndrome (aortic dissection, rupture, intramural hematoma, penetrating ulcer, and pseudoaneurysm) in **ANY** of the following scenarios:
  1. Initial diagnosis of suspected aortic disease
  2. Management of known aortic disease
  3. Annual surveillance of clinically stable aortic disease
- For screening, diagnosis, management and surveillance for aortic aneurysm in **ANY** of the following scenarios:
  - Screening—annual evaluation of patients with connective tissue disease or genetic mutations that predispose to aortic aneurysms as an alternative to screening with echocardiography or when echocardiography is nondiagnostic
  - Diagnosis of suspected thoracic aneurysm based on signs, symptoms, or other imaging studies suggesting the diagnosis.
  - Management
    1. Evaluation for disease progression based on new or progressive signs, symptoms or enlargement by imaging.
    2. 6-month follow up of newly diagnosed aneurysms to establish stability
    3. Endoleak evaluation
    4. Pre-procedure (surgical or endovascular repair) planning
  - Surveillance
    1. Annual surveillance for aneurysms ≤ 4.4 cm
    2. Every 6 months for aneurysms larger than 4.4 cm
- Atheromatous disease in adults only, to evaluate the thoracic aorta as a distal emboli source when a cardiac source has not been identified on echocardiography and CTA is non-diagnostic or cannot be performed
- MRA/MRV for the diagnosis and management of **ANY** of the following conditions:
  - Hematoma
  - pulmonary ateriovenous malformation
  - pulmonary sequestration
  - subclavian steal syndrome
  - Superior vena cava syndrome
  - systemic venous thrombosis or occlusion
  - thoracic outlet syndrome

- MRA/MRV is used for vascular evaluation prior to transcatheter aortic valve implantation/replacement

Allergy/Contraindications
The use of MRA is appropriate in patients with documented allergy to iodinated contrast material and in patients who have accelerating hypertension, or accelerating renal insufficiency or when the patient is at significant risk for contrast-induced renal failure.

MRA/MRV Exclusions:
For any other indications not meeting inclusionary criteria.

CPT/HCPCS Level II Codes *(Note: The inclusion of a code in this list is not a guarantee of coverage. Please refer to the medical policy statement to determine the status of a given procedure)*

Established codes:

70544	70545	70546	70547	70548	70549
71555	72159	72198	73725	74185	73225

Other codes (investigational, not medically necessary, etc.):

N/A

Rationale

Head and Neck
Kasner et al (1997) reported on an unblinded case series to monitor carotid and vertebral artery dissections.[1] All patients with angiographically proven carotid and/or vertebral artery dissection from July 1994 to June 1996 were followed for a median duration of 10.5 months. Of these 29 patients (44 vessels), 18 were concurrently evaluated with MR, and a target group of 9 patients (17 vessels) was prospectively followed with MR at 3-month intervals. In the 18 patients with both imaging studies at baseline, angiography revealed 30 dissected vessels while MR detected 27 (90%). In the target group of 9 patients, initial MR identified 15 of the 17 dissections diagnosed with angiography. Serial MR revealed complete healing in 5 vessels, improvement in 6 vessels, no change in 4 vessels, and worsening in 2 vessels. The radiographic features most likely to resolve were stenosis and mural hematoma, while occlusion and luminal irregularity tended to persist. Late ischemic events occurred in 2 patients, both with persistent MR evidence of dissection, one while subtherapeutic on warfarin therapy and the other occurring 1 week after warfarin was discontinued.

Atlas et al (1997) assessed MRA for the detection and characterization of angiographically proved intracranial aneurysms by using an advanced method of postprocessing, in a blinded-reader study.[2] One hundred fifty-eight vessels were examined with catheter angiography and three-dimensional time-of-flight MR angiography in 44 patients with 63 aneurysms and 15 patients with no aneurysm at catheter angiography. Postprocessing was performed off-line with an advanced multi-feature-extraction, ray-tracing algorithm. MR angiograms were interpreted independently by three neuroradiologists blinded to the catheter angiographic results for presence, location, size, and morphology of the aneurysm. Proof of diagnosis was

consensus reading of catheter angiograms. Mean sensitivity for detection of aneurysms was 75% (range, 70%-79%). As a screening tool (i.e., detection of at least one aneurysm necessitating catheter angiography), mean sensitivity was 91% for all aneurysms and 95% for aneurysms larger than 3 mm. This method was not adequate for detection of lobulation or size of aneurysm. MR angiography with an advanced method of postprocessing can result in highly sensitive, specific studies for the diagnosis of intracranial aneurysms that are of sufficient size to be considered for surgical treatment, but it is inadequate for characterization of aneurysms.

Stock et al (1995) compared the reliability of MRA performed with magnetization transfer suppression and variable flip angle excitation with that of intraarterial digital subtraction angiography (DSA) in imaging of the cerebral arteries.[3] Fifty nonconsecutive patients referred for intraarterial DSA gave informed consent to also undergo MRA of the intracranial arteries. MRA had a sensitivity of 100% and a specificity of 95% for detection of vessel occlusion (10 abnormalities). For detection of substantial vessel stenosis (seven abnormalities), sensitivity and specificity were both 86%; for detection of aneurysm (six abnormalities), sensitivity was 83% and specificity was 98%. Sensitivity and specificity were 100% for detection of arteriovenous malformation (three abnormalities), vessel displacement (three abnormalities), and extracranial-intracranial bypass (two abnormalities). MRA diagnosis of disease of the intracranial vasculature has high sensitivity and specificity but still is limited in comparison with intraarterial DSA.

Li et al (2011) prospectively investigated the diagnostic accuracy of contrast free 3D time of flight MRA with volume rendering (VR) at 3.0 T to detect intracranial aneurysms in a large cohort or patients.[4] In all 369 patients investigated, VR-DSA revealed 307 aneurysms in 246 patients (66.7%) and no aneurysm in 123 patients. The patient-based evaluation by VR 3D-TOF-MRA at 3.0 T yielded an accuracy of 97.6%, a sensitivity of 99.2%, specificity of 94.4%, PPV of 97.2%, and NPV of 98.3% in the detection of intracranial aneurysms. The aneurysm-based evaluation yielded an accuracy of 98.3%,sensitivity of 99.3%, specificity of 96.9%, PPV of 97.8%, and NPV of 99.1%. The vessel-based evaluation yielded accuracy of 98.8%, sensitivity of 99.2%, specificity of 98.5%, PPV of 97.5%, and NPV of 99.6%.The evaluation based on aneurysm sizes yielded similar results.
Romano et al (2015) described experience with time-resolved imaging of contrast kinetics-MRA (TRICKS-MRA) in the assessment of head-neck vascular anomalies (HNVAs).[5] Six consecutive patients with clinically suspected or diagnosed HNVAs were prospectively studied. All of them underwent TRICKS-MRA of the head and neck as part of the routine for treatment planning. A digital subtraction angiography (DSA) was also performed. TRICKS-MRA could be achieved in all cases. Three subjects were treated based on TRICKS-MRA imaging findings and subsequent DSA examination. In all of them, DSA confirmed the vascular architecture of HNVAs shown by TRICKS-MRA. In the other three patients, a close follow up to assess the evolution of the suspected hemangioma was preferred.

Spinal Canal
Mordasini et al (2012) reported on preoperative mapping of the arterial spinal supply prior to thoracoabdominal aortic aneurysm repair.[6] Twenty-four consecutive patients prior to surgical thoracoabdominal aortic aneurysm repair were investigated. All patients underwent steady-state MRA of the spinal vasculature with 3-T MRI. The sequence used was a steady-state coronary 3D FLASH with 0.7-mmisotropic voxels. MRA was performed using an intravasal contrast agent. Studies were evaluated by three readers including delineation of arterial spinal supply including both aortic origin and spinal canal entry by three readers. Identification and

localization of the Adamkiewicz artery and its spinal canal entry was successful in all patients. Overall depiction of the vascular anatomy was graded as very good in 3(12.5%), good in 14 (58.4%), sufficient in 5 (20.8%), and poor in 2 (8.3%) patients. Depiction of segmental artery aortic exit level was graded as good in 6 (25.0%), sufficient in 10 (41.7%), poor in 4(16.7%) and not identifiable in 4 (16.7%) patients. Delineation of segmental artery entry level into the spinal canal was graded as very good in 4 (16.7%), good in 11 (45.8%), sufficient in 6 (25.0%), and poor in 3 (12.5%) patients.

Mathur et al (2017) hypothesized that first-pass contrast-enhanced MRA could diagnose and localize spinal epidural arteriovenous fistulas (AVFs) with intradural venous reflux and distinguish them from other spinal AVFs.[7] Forty-two consecutive patients with a clinical and/or radiologic suspicion of spinal AVF underwent MR imaging, first-pass contrast-enhanced MRA, and DSA at a single institute(2000-2015). MR imaging/MRA and DSA studies were reviewed by 2 independent blinded observers. DSA was used as the reference standard. On MRA, all 7 spinal epidural AVFs with intradural venous reflux were correctly diagnosed and localized with no interobserver disagreement. The key diagnostic feature was arterialized filling of an epidural venous pouch with a refluxing radicular vein arising from the arterialized epidural venous system.

Upper/Lower Extremities

Koelemay et al (2001) investigated the diagnostic performance of MRA in patients with lower extremity arterial disease.[8] Studies were included that allowed construction of 2 x 2 contingency tables for detection of stenosis greater than 50% or occlusion with MRA or arteriography in patients with claudication or critical ischemia. Two observers graded the following elements of study quality: consecutively enrolled patients, prospective study design, clear cut-off levels, blinded assessment, and clear description of MRA technique. Summary receiver operating characteristic analysis was performed to examine the influence of year of publication, all methodological criteria, arterial tract, number of subdivisions within arterial tracts, and MRA technique on diagnostic performance. Of 3583 studies initially identified, 34 were included that evaluated MRA in 1090 patients (72% men; median age, 65 years). Magnetic resonance angiography was highly accurate for assessment of all lower extremity arteries. Three-dimensional gadolinium-enhanced (3-D Gd) MRA improved diagnostic performance compared with 2-D MRA (relative diagnostic odds ratio, 2.8 [95%confidence interval, 1.2-6.4]), adjusted for number of subdivisions within arterial tracts. The estimated points of equal sensitivity and specificity were 94% and 90% for 3-D Gd MRA and 2-D MRA, respectively.

Bode et al (2012) evaluated non-contrast enhanced (NCE) MRA for the assessment of upper extremity and central vasculature to compare it with contrast enhanced (CE) MRA.[9] NCE and CE-MRA images were acquired in 10 healthy volunteers and 15 patients with ESRD. In each data set, two observers analysed 11 arterial and 16 venous segments with regard to image quality (0-4), presence of artifacts (0-2) and vessel-to-background ratio. More arterial segments were depicted using CE-MRA compared to NCE-MRA (99% vs. 96%, p= 0.001) with mean image quality of 3.80 vs. 2.68, ($p < 0.001$) and mean vessel-to-background ratio of 6.47 vs. 4.14 ($p < 0.001$). Ninety-one percent of the venous segments were portrayed using NCE-MRA vs. 80% using CE-MRA ($p < 0.001$). Mean image quality and vessel-to-background ratio were 2.41 vs.2.21 ($p = 0.140$) and 5.13 vs. 3.88 ($p < 0.001$), respectively.

Wu et al (2016) compared image quality and diagnostic performance of non-contrast enhanced Quiescent Interval Single Shot (QISS) MRA at 3 T versus CT angiography for evaluation of lower extremity Peripheral Arterial Disease (PAD).[10] Thirty-two consecutive patients (23 male, 9 female, age range 40-81 years, average age 61.97 years) with clinically suspected lower extremity PAD underwent QISS MRA and CTA. Nineteen of 32 patients underwent Digital Subtraction Angiography (DSA). Image quality of QISS MRA was rated 3.70 ± 0.49 by reader 1, and 3.72 ± 0.47 by reader 2, significantly lower than that of CTA (3.80 ± 0.44 and 3.82 ± 0.42, $P < 0.001$ for both readers). Intermodality agreement between MRA and CTA was excellent for assessment of stenosis (Kappa =0.923 ± 0.013 for reader 1, 0.930 ± 0.012 for reader 2). Interobserver agreement was 0.936 ± 0.012 for CTA and 0.935 ± 0.011 for MRA. For readers 1 and 2 respectively, the sensitivity of QISS was 94.25 and 93.26 % (versus 90.11 and 89.13 % for CTA, $P > 0.05$), and specificity of QISS was 96.70 and 97.75 % (versus 96.55 and 96.51 % for CTA, $P > 0.05$). For heavily calcified segments, sensitivity of QISS (95.83and 95.83 %) was significantly higher than that of CTA (74.19 and 76.67 %, $P < 0.05$).

In 2019, Marinelli et al compared imaging and clinical aspects of stenosis and pseudostenosis in a cohort of large-vessel vasculitis (LVV), including giant cell arteritis (GCA) and Takayasu's arteritis (TAK).[11] Patients with LVV and comparator conditions (healthy or vasculopathies) underwent MRA of the aortic arch vessels. The subclavian and axillary arteries were systematically assessed for presence of stenosis and pseudostenosis by two independent readers. Serial and delayed imaging and clinical assessments were used to confirm suspected pseudostenoses. Multivariable regression analyses were used to identify associations between angiographic pathology and clinical findings. One hundred eight four MRA scans were analyzed from patients with GCA (n=36), TAK (n=47), and comparators(n=25). Pseudostenoses were frequently observed (48/184 scans, 26%) in the distal subclavian artery only on the side of injection and were shorter in length compared to true stenoses (25 mm vs. 78 mm, $p<0.01$). There was no difference in prevalence of pseudostenosis by diagnosis (GCA=33%, TAK=23%,comparator=20%, p=0.44), disease activity status (p=0.31), or treatment status (p=1.00). Percent and length of true stenosis was independently associated with pulse and blood pressure abnormalities in the upper extremity. Adjusting for length and stenosis degree, absence of collateral arteries was associated with arm claudication (odds ratio=2.37, p=0.03).

Ravesh et al (2021) investigated the feasibility of an optimized electrocardiogram (ECG) triggered Cartesian quiescent interval slice selective (QISS) technique for MRA of hand arteries.[12] Both hands of 20 healthy volunteers (HVs) were examined using an optimized QISS-MRA pulse sequence at 1.5 Tesla. Cross-sectional areas (CSA) of all arterial segments were measured. None of the arterial segments were contaminated by venous enhancement. The image quality of arterial segments for both hands was considered as diagnostic in 87.2% of all 1440 segments. An interobserver agreement of 0.67 for both hands was determined for image quality of arterial segments using a five-grade scoring system. Optimized QISS-MRA allows as the first MRA technique the classification of superficial palmar arch (SPA) and deep palmar arch (DPA) variants. Five new SPA and 6 new DPA variants could be classified using QISS-MRA in comparison with previous studies using CE computed tomography angiography and using fixed cadaver hands.

Varga-Szemes et al (2021) evaluated the diagnostic accuracy of NCE QISS MRA combined with MRI-based vascular calcification visualization for the assessment of arterial stenosis in patients with lower extremity peripheral artery disease (PAD).[13] Twenty-six prospectively

enrolled PAD patients (70 ± 8 years) underwent lower extremity CTA and 1.5-T or 3-T PDIP-SOS/QISS MRI prior to digital subtraction angiography (DSA). Two readers rated image quality and graded stenosis (≥ 50%) on QISS MRA without/with calcification visualization. Sensitivity, specificity, and area under the curve (AUC) were calculated against DSA. Image quality ratings were significantly higher for CTA compared to those for MRA (4.0 [3.0-4.0] and 3.0 [3.0-4.0]; p = 0.0369). The sensitivity and specificity of QISS MRA, QISS MRA with MRI technique, and CTA for ≥ 50% stenosis detection were 85.4%, 92.2%, and 90.2%, and 90.3%, 93.2%, and 94.2%, respectively, while AUCs were 0.879, 0.928, and 0.923, respectively. A significant increase in AUC was observed when MRI technique was added to the MRA protocol (p = 0.0266). Quantification of calcification showed significant differences between MRI technique and non-contrast CT using paired test (80.6 ± 31.2 mm vs. 88.0 ±29.8 mm; p = 0.0002) with high correlation (r = 0.77, p < 0.0001) and moderate mean of differences(- 7.4 mm).

Wu et al (2022) investigated the diagnostic value of CTA and MRA in anterior dislocation of the shoulder.[14] The detection of inferior glenohumeral ligament injuries, anterior inferior labrum injuries, and bone and cartilage injuries by the two examination procedures was observed and compared with the results of arthroscopy or surgery on patients with anterior dislocation of shoulder. A total of 36 patients with shoulder injuries were gathered for this study. Thirty-two cases with anterior inferior labrum tearings (27 cases detected by CTA and 30 cases by MRA), 24 cases with inferior glenohumeral ligament tearings (14 cases detected by CTA and 22 cases by MRA), 24 cases with inferior glenohumeral ligament tearings (14 cases detected by CTA and 22 cases by MRA), and 24 cases with inferior glenohumeral ligament tearings (14 cases detected by CTA and 22 cases by MRA)were detected. There were 30 bone and cartilage injuries, including 18 fractures (CTA identified 18), 10 bone contusions (CTA detected 0), and 5 cartilage damage (CTA detected 0) (CTA detected 0, MRA detected 5). The detection rate of MRA is better than that of CTA for inferior glenohumeral ligament injuries. For anterior inferior labrum injury, the detection rate of CTA and MRA was similar.

Abdomen/Pelvis

Marchand et al (2000) examined whether 3D enhanced MRA allowed for an accurate diagnosis of proximal renal artery stenosis (RAS) without the risks associated with nephrotoxic contrast agents, ionizing radiation or arterial catheterization.[15] MRA was initially performed without contrast media injection using two- or three-dimensional Time-of-Flight (TOF) or Phase-Contrast (PC) techniques. Sensitivity and specificity of non-enhanced MRA in detection of proximal RAS are comprised between 53%-100% and 47%-97% respectively. Main limitations of non-enhanced MRA are the long acquisition time, i.e. 5-8 min, the short field of view with lack of kidney visualization and major artifacts. Recent improvements allowed a three-dimensional acquisition during a single breath-hold (18-23 sec), associated to a bolus injection of agadolinium chelate demonstrating a lack of nephrotoxicity. Firstly, kidney localization and morphologic imaging is performed before a 3D MRA data acquisition without injection. Secondly two successive 3D MRA sequences are performed synchronized with the gadolinium chelate bolus injection: the first acquisition corresponds to the arterial enhancement and the second one to the venous enhancement. At last, a three-dimensional phase contrast could also be performed. After data acquisition, image post-processing is performed including image subtraction, maximum intensity projection (MIP) and reformation images of each renal artery, the abdominal aorta and its main branches 3D enhanced-MR angiography present several advantages in comparison to nonenhanced MRA: 1) a great field-of-view (30-36 cm) could be used allowing visualization of the abdominal aorta as well as its main branches; 2) the fast acquisition time allows an arterial imaging followed by a venous

enhancement; 3) the kidneys are analyzed: kidney length, cortical thickness, corticomedullary differentiation and renal enhancement are well evaluated; 4) an accurate sensitivity and specificity in detection of proximal RAS comprised between 88%-100% and 71%-100% respectively. Because a severe RAS (i.e. degree of stenosis > 50%) may cause renal ischemia leading to a blood pressure elevation that is often difficult to control with medical therapy, imaging has to assess the severity of RAS. MRA assessment of hemodynamic significance of RAS can be further refined by considering additional factors: arterial stop of signal, post stenotic dilatation, delayed renal enhancement and functional changes in the renal parenchyma (i.e. reduced kidney length and parenchymal thickness, loss of corticomedullary differentiation). Precise evaluation of degree of stenosis requires the development of dedicated software such as MARACAS (MAgnetic Resonance Angiography Computer ASsisted analysis) software.

In 2013, Sada et al studied MRA as an alternative to traditional catheter based angiography in pediatric abdominal and pelvic vascular imaging.[16] According to the authors, MRA offers several advantages in that it is noninvasive, can be performed without ionizing radiation, and does not necessarily rely on contrast administration. The ability of modern MRA techniques to define variant vascular anatomy and detect vascular disease may obviate traditional angiography in some patients.

Weinrich et al (2018) set out to determine the type and frequency of vascular and organ malformation in adults with thalidomide embryopathy (TE) using non-contrast MRA and to assess the effect of the observed malformations on renal function.[17] The institutional ethics committee approved this prospective study and written informed consent was given by all 78 subjects (50 females) with TE (mean age: 55±1.1 years), who were examined by non-contrast MRA at 3T. ECG-triggered balanced turbo field echo images of the chest, abdomen and pelvis were obtained in coronal and sagittal orientations. Two observers assessed the frequency of vascular and organ malformations. Serum creatinine and estimated glomerular filtration rate (eGFR) were obtained to assess renal function. In 58 subjects, 99 vascular anomalies were observed, including 68 arterial (69%) and 31 venous anomalies (31%); 15 patients had 16 abdominal organ malformations including 12 kidney anomalies and 4 cases of gallbladder agenesis. Most vascular anomalies affected the renal vessels (n=66, 67%) or supra-aortic arteries (n=28, 28%). Serum creatinine and eGFR revealed normal renal function in all subjects.

Chest

Adler et al (2017) evaluated contrast-enhanced MRA in diagnosis of inflammatory aortic involvement in patients with clinical suspicion of large-vessel vasculitis.[18] Seventy-five patients, mean age 62 years (range 16-82 years), 44 female and31 male, underwent gadolinium-enhanced MRA and were evaluated retrospectively. Thoracic MRA was performed in 32 patients, abdominal MRA in 7 patients and both thoracic and abdominal MRA in 36 patients. Temporal arterial biopsies were obtained from 22/75 patients. MRA positivity was defined as increased aortic wall signal in late gadolinium-enhanced axial turbo inversion recovery magnitude(TIRM) series. The influence of prior glucocorticoid intake on MRA outcome was evaluated. MRA was positive in 24/75 patients, with lesions located in the thorax in 7 patients, the abdomen in 5 and in both thorax and abdomen in 12. Probability for positive MRA after glucocorticoid intake for more than 5 days before MRA was reduced by 89.3%. Histology was negative in 3/10 MRA-positive patients and positive in 5/12 MRA-negative patients. All 5/12 histology positive / MRA-negative patients had glucocorticoids for >5 days prior to MRA and

were diagnosed as having vasculitis. Positive predictive value for MRA was 92%, negative predictive value was 88%.

Van den Heuvel et al (2020) investigated the sensitivity of contrast-enhanced MRA (CE-MRA) in the detection of pulmonary arteriovenous malformations (PAVMs) with feeding artery diameters (FAD) >2 mm.[19] Patients with a grade 2 or 3 shunt on screening transthoracic contrast echocardiography (TTCE) were asked to participate. Included patients underwent chest CT and CE-MRA. CT was considered the reference standard. CT and CE-MRA scans were anonymized and assessed for the presence of PAVMs with FAD > 2 mm by one and two readers, respectively. Data analysis was performed on per patient and per PAVM basis. Fifty-three patients were included. One hundred five PAVMs were detected on CT, 45 with a FAD ≥ 2 mm. In per patient analysis, sensitivity and specificity of CE-MRA were 92% and 97% respectively for reader 1 and 92% and 62% for reader 2. Negative and positive predictive value (NPV/PPV) were 93% and 96% for R1 and 90% and 67% for R2. In per PAVM analysis, sensitivity, specificity, NPV and PPV were 96%, 99%, 100% and 86% for R1 and 93%, 96%, 100% and 56% for R2, respectively. CE-MRA has excellent sensitivity and NPV for detection of PAVMs with FAD ≥ 2 mm and can therefore be used to detect these PAVMs.

Allergy
An MRA exam may or may not use contrast material. If needed, an injection of a gadolinium-based contrast material may be used. Gadolinium is less likely to cause an allergic reaction than the iodinated contrast material used in CT angiography.

SUPPLEMENTAL INFORMATION

PRACTICE GUIDELINES AND POSITION STATEMENTS

American Imaging Management (AIM)[20]
According to AIM radiology criteria for imaging, 2021, MRA/MRV for head/neck, spinal canal, upper/lower extremities, abdomen/pelvis, chest and in case of allergies may be useful for patients when criteria is met.

American College of Radiology (ACR)/North American Society for Cardiovascular Imaging (NASCI) and Society for Pediatric Radiology (SPR)[21]
The American College of Radiology (ACR)/North American Society for Cardiovascular Imaging (NASCI)/Society for Pediatric Radiology (SPR)'s practice guideline on "The performance of pediatric and adult body magnetic resonance angiography (MRA)" (ACR-NASCI-SPR, 2010) stated that abdominal and pelvic MRA can be used for post-procedure assessment for detection of suspected leak following aortic aneurysm surgery or MR-compatible aortic stent graft placement". Moreover, the ACR's Appropriateness Criteria on "Abdominal Aortic Aneurysm: Interventional Planning and Follow-up" (2012) stated that "For detection and sizing of endoleak, MRA is at least as sensitive as, and probably better than CTA …. 3D contrast enhanced MRA and time resolved MRA are highly sensitive to endoleaks". The ACR's recommendation was given a "7" rating; and 7, 8, and 9 "ratings" denote "Usually appropriate".

Government Regulations
National: check for updates

National Coverage Determination (NCD) for Magnetic Resonance Imaging (220.2), Publication Number 100-3, Section 220.2, effective 7/7/11:

Magnetic Resonance Angiography (MRA) is a non-invasive diagnostic test that is an application of MRI. By analyzing the amount of energy released from tissues exposed to a strong magnetic field, MRA provides images of normal and diseased blood vessels, as well as visualization and quantification of blood flow through these vessels.

Contrast-enhanced MRA (CE-MRA) involves blood flow imaging after the patient receives an intravenous injection of a contrast agent. Gadolinium, a non-ionic element, is the foundation of all contrast agents currently in use. Gadolinium affects the way in which tissues respond to magnetization, resulting in better visualization of structures when compared to un-enhanced studies. Unlike ionic (i.e., iodine-based) contrast agents used in conventional contrast angiography (CA), allergic reactions to gadolinium are extremely rare. Additionally, gadolinium does not cause the kidney failure occasionally seen with ionic contrast agents. Digital subtraction angiography (DSA) is a computer-augmented form of CA that obtains digital blood flow images as contrast agent courses through a blood vessel. The computer “subtracts” bone and other tissue from the image, thereby improving visualization of blood vessels. Physicians elect to use a specific MRA or CA technique based upon clinical information from each patient.

Currently covered indications include using MRA for specific conditions to evaluate flow in internal carotid vessels of the head and neck, peripheral arteries of lower extremities, abdomen and pelvis, and the chest. Coverage is limited to MRA units that have received FDA premarket approval, and such units must be operated within the parameters specified by the approval. In addition, the services must be reasonable and necessary for the diagnosis or treatment of the specific patient involved.

Head and Neck
Effective April 15, 2003, studies have proven that MRA is effective for evaluating flow in internal carotid vessels of the head and neck. However, not all potential applications of MRA have been shown to be reasonable and necessary. All of the following criteria must apply in order for Medicare to provide coverage for MRA of the head and neck:

- MRA is used to evaluate the carotid arteries, the circle of Willis, the anterior, middle or posterior cerebral arteries, the vertebral or basilar arteries or the venous sinuses;
- MRA is performed on patients with conditions of the head and neck for which surgery is anticipated and may be found to be appropriate based on the MRA. These conditions include, but are not limited to, tumor, aneurysms, vascular malformations, vascular occlusion or thrombosis. Within this broad category of disorders, medical necessity is the underlying determinant of the need for an MRA in specific diseases. The medical records should clearly justify and demonstrate the existence of medical necessity; and
- MRA and CA are not expected to be performed on the same patient for diagnostic purposes prior to the application of anticipated therapy. Only one of these tests will be covered routinely unless the physician can demonstrate the medical need to perform both tests.

Peripheral Arteries of Lower Extremities
Effective April 15, 2003, studies have proven that MRA of peripheral arteries is useful in determining the presence and extent of peripheral vascular disease in lower extremities. This procedure is non-invasive and has been shown to find occult vessels in some patients for which those vessels were not apparent when CA was performed. Medicare will cover either

MRA or CA to evaluate peripheral arteries of the lower extremities. However, both MRA and CA may be useful in some cases, such as:

- A patient has had CA and this test was unable to identify a viable run-off vessel for bypass. When exploratory surgery is not believed to be a reasonable medical course of action for this patient, MRA may be performed to identify the viable runoff vessel; or
- A patient has had MRA, but the results are inconclusive.

Abdomen and Pelvis

- Pre-operative Evaluation of Patients Undergoing Elective Abdominal Aortic Aneurysm (AAA) Repair: Effective July 1, 1999, MRA is covered for pre-operative evaluation of patients undergoing elective AAA repair if the scientific evidence reveals MRA is considered comparable to CA in determining the extent of AAA, as well as in evaluating aortoiliac occlusion disease and renal artery pathology that may be necessary in the surgical planning of AAA repair. These studies also reveal that MRA could provide a net benefit to the patient. If preoperative CA is avoided, then patients are not exposed to the risks associated with invasive procedures, contrast media, end-organ damage or arterial injury.
- Imaging the Renal Arteries and the Aortoiliac Arteries in the Absence of AAA or Aortic Dissection: Effective July 1, 2003, MRA coverage is expanded to include imaging the renal arteries and the aortoiliac arteries in the absence of AAA or aortic dissection. MRA should be obtained in those circumstances in which using MRA is expected to avoid obtaining CA, when physician history, physical examination, and standard assessment tools provide insufficient information for patient management, and obtaining an MRA has a high probability of positively affecting patient management. However, CA may be ordered after obtaining the results of an MRA in those rare instances where medical necessity is demonstrated.

Chest

- Diagnosis of Pulmonary Embolism: Current scientific data has shown that diagnostic pulmonary MRAs are improving due to recent developments such as faster imaging capabilities and gadolinium-enhancement. However, these advances in MRA are not significant enough to warrant replacement of pulmonary angiography in the diagnosis of pulmonary embolism for patients who have no contraindication to receiving intravenous iodinated contrast material. Patients who are allergic to iodinated contrast material face a high risk of developing complications if they undergo pulmonary angiography or computed tomography angiography. Therefore, Medicare will cover MRA of the chest for diagnosing a suspected pulmonary embolism when it is contraindicated for the patient to receive intravascular iodinated contrast material.
- Evaluation of Thoracic Aortic Dissection and Aneurysm: Studies have shown that MRA of the chest has a high level of diagnostic accuracy for pre-operative and post-operative evaluation of aortic dissection of aneurysm. Depending on the clinical presentation, MRA may be used as an alternative to other non-invasive imaging technologies, such as transesophageal echocardiography and CT. Generally, Medicare will provide coverage only for MRA or for CA when used as a diagnostic test. However, if both MRA and CA of the chest are used, the physician must demonstrate the medical need for performing these tests.

Local:

WPS Local Coverage Determination (LCD) for Magnetic Resonance Angiography (L31355): This LCD has been permanently retired effective 9/7/13.

Indications and Limitations of Coverage and/or Medical Necessity

MRA is an adaptation of the MRI in which three-dimensional views of arterial and venous blood vessels and blood flow is demonstrated without the need for intravascular injections of contrast agents. As a non-invasive diagnostic imaging technique that generates images of blood flow through vessels, this test utilizes the principals of MRI, in that any body part placed in magnetic field yields different signal intensity for blood flow in contrast to surrounding stationary vascular tissues. Multiple images are produced and processed to duplicate the route of the blood flow. The subsequent computer reconstruction presents a series of these cross-sectional images to create a vascular image similar to angiographic versions. The physician then may evaluate the anatomy of the vessels, the blood flow and the surrounding structures for diagnosis of a disease process or abnormality; determine or evaluate treatment; or observe an existing problem.

MRA can thus be used to demonstrate obstructive vascular lesions, eliminating the risk associated with angiography and the use of contrast material. Accordingly, MRA is generally covered only to the extent that it is used as a substitute for contrast angiography (CA). However, if the MRA is not conclusive, a CA may then be medically necessary.

Advantages of MRA include:

1. It is considered non-invasive
2. Multiple angles and three-dimensional images can be visualized
3. Conventional angiography utilizes contrast materials and sedation, which has a significant risk of adverse reactions
4. There is essentially no risk of arterial puncture-associated complications
5. MRA may be used for those patients with whom conventional angiography is contraindicated
6. MRA allows adjacent structures to be visualized; and
7. MRA is capable of evaluating any vessel of the body, regardless of its location. In contrast, ultrasonography (US) is limited to vessels, which are not obscured by bone, calcification, air or excessive fat.

In summary, Magnetic resonance angiography (MRA) is an application of magnetic resonance imaging (MRI) that provides visualization of blood flow, as well as images of normal and diseased blood vessels

A. Qualifications of the provider:

The physician should be qualified to perform these procedures and have advanced knowledge of the anatomy and the disease process of the study area.

B. Contraindications:

Patients with non-removable intradural and/or intraorbital devices including:

a) Metallic clips on vascular or intracranial aneurysms; or

b) Intraorbital metallic foreign body.

c) Patients with devices containing ferromagnetic materials (metal that could be magnetized) that cannot be removed or substituted for MRA compatible devices, including, but not limited to non-MRA compatible life support equipment or monitoring equipment.

In the absence of symptoms or signs of neurological concern, an MRA of the head and neck would be considered to be screening, thus non-payable by Medicare.

While the intent of this policy is to provide reimbursement for either MRA or CA, CMS is also allowing flexibility for physicians to make appropriate decisions concerning the use of these tests based on the needs of individual patients. CMS anticipates, however, low utilization of the combined use of MRA and CA. As a result, CMS has encouraged contractors to monitor the use of these tests and, where indicated, and require evidence of the need to perform both MRA and CA.

All other uses of MRA for which CMS has not specifically indicated coverage continue to be noncovered. Compliance with the provisions in this policy is subject to monitoring by post payment data analysis and subsequent medical review.

All codes are payable, including 72159 and 73225.

(The above Medicare information is current as of the review date for this policy. However, the coverage issues and policies maintained by the Centers for Medicare & Medicare Services [CMS, formerly HCFA] are updated and/or revised periodically. Therefore, the most current CMS information may not be contained in this document. For the most current information, the reader should contact an official Medicare source.)

Related Policies

Magnetic Resonance Spectroscopy

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The articles reviewed in this research include those obtained in an Internet based literature search for relevant medical references through December 2023, the date the research was completed.

Joint BCBSM/BCN Medical Policy History

Policy Effective Date	BCBSM Signature Date	BCN Signature Date	Comments
7/2/02	7/2/02	7/2/02	Joint medical policy established
11/18/03	11/18/03	11/18/03	Policy retired
3/1/07	12/28/06	1/14/07	Policy update added CPT 73225 as investigational.
1/1/09	10/13/08	12/30/08	Routine maintenance
3/1/13	12/11/12	12/31/12	Routine maintenance. Added MRA of spine to this policy. Updated rationale and references, reformatted on new template (The policy on MRA was previously retired as obsolete).
9/1/14	6/20/14	6/23/14	References and rationale updated. No change in policy status.
3/1/16	12/10/15	12/10/15	Routine policy maintenance. No change in policy status.
3/1/17	12/13/16	12/13/16	Routine policy maintenance. No change in policy status.
3/1/18	12/12/17	12/12/17	Routine policy maintenance. Policy retired.
9/1/22	TABLED		Unretired policy, added imaging of spinal canal (72159) as established with criteria.
1/1/23	12/20/22		Aligned coverage for MRA/MRV with AIM, rationale and references completely updated. Code 73225 now payable. No change in policy status.
3/1/24	12/19/23		Carelon coverage detail aligned with our inclusion/exclusion sections, no change in policy status. Vendor managed: Carelon (ds)

Next Review Date: 4th Qtr., 2024

Pre-Consolidation Medical Policy History

Original Policy Date	Comments
BCN: 5/8/01	Revised: N/A
BCBSM: 1/4/01	Revised: 2/12/01

BLUE CARE NETWORK BENEFIT COVERAGE
POLICY: MAGNETIC RESONANCE ANGIOGRAPHY (MRA) AND MAGNETIC RESONANCE VENOGRAPHY (MRV)

I. Coverage Determination:

Commercial HMO (includes Self-Funded groups unless otherwise specified)	Covered; criteria apply. 73225, Magnetic resonance angiography, upper extremity, with or without contrast material(s) is considered experimental and investigational.
BCNA (Medicare Advantage)	Covered; criteria apply. Medicare also pays for 73225 although the national coverage decision does not address MRA of the upper extremities. 72159 is covered for BCNA members.
BCN65 (Medicare Complementary)	Coinsurance covered if primary Medicare covers the service.

II. Administrative Guidelines:

- The member's contract must be active at the time the service is rendered.
- The service must be authorized by the member's PCP except for Self-Referral Option (SRO) members seeking Tier 2 coverage.
- Services must be performed by a BCN-contracted provider, if available, except for Self-Referral Option (SRO) members seeking Tier 2 coverage.
- Payment is based on BCN payment rules, individual certificate and certificate riders.
- Appropriate copayments will apply. Refer to certificate and applicable riders for detailed information.
- CPT - HCPCS codes are used for descriptive purposes only and are not a guarantee of coverage.