Title
Magnetic Resonance MRI, MRA, MRV, MRS
Positional Magnetic Resonance Imaging
Functional MRI

See policy #331, MRI-guided high intensity ultrasound ablation of uterine fibroids

When services are covered

In accordance with local Medicare guidelines, for our Medicare HMO Blue, and Medicare PPO Blue members, we cover magnetic resonance imaging (MRI) for indications that are considered medically necessary and accepted in clinical practice.26,27

For other plans, we cover MRI for indications as noted below:

Head and Brain

MRI of the brain is covered for the evaluation of patients with any of the following22,23:

- Dementia: rapid onset, rapid or moderate progression, with or without focal neurologic signs or symptoms
- Epilepsy: new onset seizures (without obvious metabolic cause), complex partial seizures, seizures refractory to therapy, temporal lobe epilepsy, or atypical seizure disorders
- Hemorrhage: subacute CNS hemorrhage or hematoma 48 hours after onset
- CVA: acute CVAs, MRI may be especially useful for localizing infarcts
- TIA (transient ischemic attack)16
- Brain infections
- Structural brain lesions:
  - detecting or evaluating extra-axial tumors, A-V malformations, cavernous hemangiomas, small intracranial aneurysms, cranial nerve lesions, demyelinating disorders, and to detect pituitary tumor, and pituitary tumor in patients diagnosed with precocious puberty, or secondary testicular hypogonadism
  - Other: where soft tissue contrast is necessary; when bone artifacts limit CT, or coronal, coronosagittal or parasagittal images are desired, or for procedures in which iodinated contrast material is contraindicated; for developmental abnormalities of the brain, including neuroectodermal dysplasias; abnormal movement disorders or neuropsychiatric disorders.

MRI may be indicated for patients whose presentation indicates a focal problem or who have had a recent significant change in symptomatology. It may also be appropriate to evaluate late sequelae of head trauma, such as neurological deficits not adequately explained by CT scan or other modalities.11

Functional MRI is considered covered, only, for the preoperative evaluation of patients with seizures or brain tumors who are candidates for neurosurgical therapy when the results of testing will obviate the need for either the Wada test or direct electrical stimulation.40, 41
MRA of the head is covered for the evaluation of the following indications:\(^\text{3, 31}\)

- **Steno-occlusive disease** of IC arteries, in patients with symptoms of cerebrovascular disease (TIA, CVA)
- **Cerebral (intracranial) aneurysms**: in patients with known intracranial aneurysms (ICA), or suspected ICA because of family history, polycystic kidney disease, or symptoms compatible with an aneurysm
- **IC vascular malformations**: to detect, plan treatment, and follow-up after treatment in patients with known or suspected malformations
- **Cerebral venous sinus compression/thrombosis**: in patients at risk for, or with symptoms of thrombosis or compression by tumor.
- **Pulsatile tinnitus**: in patients with signs or symptoms suggestive of a vascular lesion
- **MRV of the head** is covered for cerebral venous sinus compression/thrombosis in patients at risk for, or with symptoms of thrombosis or compression by tumor\(^3\)
- MRV of the head is also covered for pseudotumor cerebri (often called a pseudotumor syndrome, or suspected idiopathic intracranial hypertension).\(^{36}\)
- Sudden onset of headache associated with exertion or positional changes.\(^{43}\)
- Complex migraine headache with a suspicion of a structural lesion.

**Note**: For diagnoses that are considered medically necessary for commercial products see footnote 31.

<table>
<thead>
<tr>
<th>Neck</th>
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<tbody>
<tr>
<td>MRI of the neck and upper body is covered for tumor staging and follow-up of tumors for the following:(^{23})</td>
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<tr>
<td>- Tumor staging of the neck, larynx, parathyroid, or thyroid.</td>
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</table>

MRI of the cervical spine may be indicated in trauma to evaluate patients for intrinsic injuries to the spinal cord, acute disc rupture with spinal cord or nerve root compression and ligamentous disruption not confirmed by other imaging.\(^{11, 25}\)

<table>
<thead>
<tr>
<th>MRA of the neck</th>
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<tbody>
<tr>
<td>is covered for the following indications:(^4, 31)</td>
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<tr>
<td>- Carotid stenosis or occlusion: for diagnosis in symptomatic patients (such as TIA or CVA), and for asymptomatic patients who are candidates for carotid endarterectomy surgery (CEA)</td>
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<tr>
<td>- Cervicocranial arterial dissection: in patients with suggestive signs or symptoms</td>
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<tr>
<td>- Other aneurysm of artery of the neck</td>
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<td>- Injury to carotid artery.</td>
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<table>
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<tr>
<th>Chest</th>
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<tbody>
<tr>
<td>MRI of the chest is covered for the following indications:</td>
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<tr>
<td>- Tumor staging of: chest, heart, pericardium, mediastinum, pulmonary hilae, and major vessels</td>
</tr>
<tr>
<td>- Vessel evaluation: aneurysms and dissections, congenital anomalies, AV malformations</td>
</tr>
<tr>
<td>- Cardiac: congenital heart disease, constrictive pericarditis, mass lesions.</td>
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</tbody>
</table>

MRI phase-velocity cine imaging is covered for children with cardiac or vessel abnormalities.\(^{20}\)

MRI of the thoracic spine may be indicated in trauma to evaluate patients for intrinsic injuries to the spinal cord, acute disc rupture with spinal cord or nerve root compression and ligamentous disruption not confirmed by other imaging.\(^{11, 25}\)

<table>
<thead>
<tr>
<th>MRA/V of the chest</th>
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<td>is covered for evaluation of the following conditions:(^1, 12, 33, 38)</td>
</tr>
<tr>
<td>- acquired disease of the thoracic aorta: including initial evaluation, treatment planning, and follow-up for conditions including thoracic aortic aneurysm (true or pseudoaneurysm), thoracic aortic dissection, stenotic/aneurysm occlusive disease, and aortitis</td>
</tr>
</tbody>
</table>
- developmental anomaly of thoracic vasculature: including initial evaluation, treatment planning, post-operative surgical shunt evaluation, and follow-up of patients with congenital heart disease (CHD) and disease of major blood vessels (i.e. coarctation of the aorta, right-sided aortic arch, double aortic arch, truncus arteriosus, persistent left superior vena cava, interrupted inferior vena cava, total anomalous pulmonary venous connection, partial anomalous venous connection, atresia or hypoplasia of the pulmonary arteries)
- systemic venous thrombosis or occlusion: including MRV evaluation of superior vena cava syndrome; or thrombosis or occlusion of the subclavian, brachiocephalic, or other deep veins in the chest.

NOTE: MRA of the chest may be considered medically necessary as an alternative to angiography for the evaluation of pulmonary embolus in patients who have contraindication to the use of IV iodinated contrast material (e.g., a history of severe contrast media allergy, such as anaphylactic shock or cardiac arrest; or high risk of contrast-induced renal failure such as diabetic patients with moderate renal insufficiency).

### Abdomen and Pelvis

MRI of the abdomen is covered.

MRI of the pelvis: differentiation of dermoids, endometrioma, and hemorrhagic cysts; cervical cancer.

MRCP (magnetic resonance cholangiopancreatography)\(^{14, 19}\)

MRA of the abdomen is covered for the following indications:\(^{6, 32, 35}\)
- Renal artery stenosis evaluation
- Abdominal aortic aneurysm evaluation, in patient undergoing elective repair
- Chronic mesenteric ischemia evaluation
- Portal and/or hepatic venous system evaluation
- Systemic venous system evaluation
- Suspected or proven systematic vasculitis evaluation\(^{29}\)
- Unexplained blood loss in the abdomen\(^{32}\)

MRA of the pelvis for the assessment of patients with the following clinical indications in whom angiography would otherwise be indicated and in whom a negative MRA would obviate the need for angiography:\(^{35}\)
- Renal artery stenosis evaluation
- Abdominal aortic aneurysm evaluation, in patient undergoing elective repair
- Chronic mesenteric ischemia evaluation
- Portal and/or hepatic venous system evaluation
- Systemic venous system evaluation

Renal MRA: for the evaluation of renal donors for the presence of accessory renal arteries\(^{34}\)

### Spine

MRI of the spine is covered for the following indications:\(^{25}\)
- Lesions in the spinal cord
- Syringomyelia
- Demyelination or inflammation of the spinal cord
- Tumors of the spine and spinal cord
- Infarcts of the spinal cord
- Trauma of the spinal cord
- Infection: discitis and osteomyelitis or epidural abscess
- Spinal dysraphism and other developmental abnormalities of the spine
- **Spinal stenosis**, cord compression or post-operative scarring
- **Herniation** of disc
- **Other**: where soft tissue contrast is necessary; when bone artifacts limit CT, or coronal, coronosagittal or parasagittal images are desired, or for procedures in which iodinated contrast material is contraindicated.

### Lower Extremity

**MRA of the lower extremity** with or without contrast material(s) is covered for the following indications:

- Atherosclerosis of native arteries of extremities, unspecified (440.20)
- Atherosclerosis of native arteries of extremities with intermittent claudication (440.21)
- Atherosclerosis of native arteries of extremities with rest pain (440.22)
- Atherosclerosis of native arteries of extremities with ulceration (440.23)
- Atherosclerosis of native arteries of extremities with gangrene (440.24)
- Other atherosclerosis of native arteries of extremities (440.29)
- Other aneurysm: of artery of lower extremity (442.3)
- Raynaud’s syndrome (443.0)
- Thromboangiitis obliterans [Buerger’s disease] (443.1)
- Peripheral angiopathy in diseases classified elsewhere (443.81)
- Erythromelalgia (443.82)
- Other peripheral vascular disease (443.89)
- Peripheral vascular disease, unspecified (443.9)
- Lower extremity (444.22)
- Arteriovenous fistula, acquired (447.0)
- Stricture of artery (447.1)
- Rupture of artery (447.2)
- Anomaly of peripheral vascular system, unspecified site (747.60)
- Lower limb vessel anomaly (747.64)
- Anomalies of other specified sites of peripheral vascular system (747.69)
- Common femoral artery (904.0)
- Superficial femoral artery (904.1)
- Femoral veins (904.2)
- Saphenous veins (904.3)
- Unspecified popliteal vessel(s) injury (904.40)
- Popliteal artery (904.41)
- Popliteal vein (904.42)
- Tibial vessel(s), unspecified (904.50)
- Anterior tibial artery (904.51)
- Anterior tibial vein (904.52)
- Posterior tibial artery (904.53)
- Posterior tibial vein (904.54)
- Deep plantar blood vessels (904.6)
- Other specified blood vessels of lower extremity (904.7)
- Unspecified blood vessel of lower extremity (904.8)
- Unspecified site. (904.9)

We also cover MRA of the **pelvis/lower extremities** for the assessment of patients with the following indications:

- Patients with suspected atherosclerotic disease of the lower extremity in whom angiography would otherwise be indicated and in whom MRA would obviate the need for angiography
- Patients with known atherosclerotic disease of the lower extremity who are being evaluated for bypass surgery and in whom angiography fails to identify runoff vessels suitable for bypass.

Other body parts

**MRI of the neck and upper body** is covered for tumor staging and follow-up of tumors for the following:
- **Tumor staging** of the neck, larynx, parathyroid, or thyroid.

**MRI of the musculoskeletal system** is covered for the following indications:
- **Tumor staging** of: extremities
- **Suspected or proven myositis evaluation:** of extremities
- **Evaluation** of avascular necrosis, joint cartilages or menisci of the knee or temporomandibular joints (TMJ)
- **Bone marrow** study. (Medicare HMO Blue and Medicare PPO Blue, ONLY)

When services are not covered

We do not cover MR for the following indications:
- **Brain MRI** is not covered for patients with stable dementia who have already been scanned.
- **MRI** is usually not the procedure of choice for the following:
  - Acute head trauma
  - Acute intracranial bleeding
  - Investigation of a skull fracture or other bone abnormality
- **Chest MRA** is not covered for evaluation of pulmonary embolism (PE) in patients without contraindications to the use of IV iodinated contrast agents. In the workup of a (PE) an MRA is not routinely the first imaging test performed. MRA is typically preceded by a ventilation perfusion scan. The necessity for a subsequent angiogram (or MRA in those who have contraindications for angiogram) is based on both the results of the ventilation perfusion scan and the clinical suspicion of pulmonary embolus.
- **Body MR:** We do not cover MRI, MRA or MRV for indications other than those listed above, because they have not been shown to improve the health outcome of patients.
- **Magnetic resonance spectroscopy (MRS)** is not covered since it is considered investigational and does not meet the BCBSMA Medical Technology Assessment Guidelines, #350.
- **Positional** (non-recumbent) **magnetic resonance imaging (MRI)** including but not limited to its use in the evaluation of patients with cervical, thoracic, or lumbosacral back pain because it is considered investigational as it does not meet our Medical Technology Assessment Guidelines, #350.
- **Functional MRI** is considered investigational for all other applications not noted above. All other indications for this application do not meet the BCBSMA Medical Technology Assessment Guidelines, #350.
- **Fetal MRI** is not covered because it is considered investigational as it does not meet our Medical Technology Assessment Guidelines, #350.

**NOTE:** We do not cover MRI, MRA, MRV and MRCP as a screening test in the absence of signs or symptoms of a disease or condition.

Individual consideration

All our medical policies are written for the majority of people with a given condition. Each medical policy is based on scientific evidence. However, for all our medical policies, individual exceptions are sometimes made based on unique clinical circumstances. For example, if a patient with possible pulmonary embolism has a strong contraindication to IV contrast dye (history of systemic dye anaphylaxis, or moderate renal insufficiency in a diabetic, or other contraindication to angiography, for example), and a VQ scan does not provide sufficient information for treatment decisions, then an MRA may be the best option.
For consideration of an individual patient, physicians may send clinical information to:

<table>
<thead>
<tr>
<th>For services already billed</th>
<th>Prior to performance of service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Cross Blue Shield of Massachusetts</td>
<td>Blue Cross Blue Shield of Massachusetts</td>
</tr>
<tr>
<td>Provider Appeals</td>
<td>Case Creation/Medical Policy</td>
</tr>
<tr>
<td>PO Box 986065</td>
<td>One Enterprise Drive</td>
</tr>
<tr>
<td>Boston, MA 02298</td>
<td>Quincy, MA 02171</td>
</tr>
<tr>
<td></td>
<td>Tel: 1-800-327-6716</td>
</tr>
<tr>
<td></td>
<td>Fax: 1-888-282-0780</td>
</tr>
</tbody>
</table>

**Managed care guidelines**
- Authorizations are not required.

**Indemnity and PPO guidelines**
- Authorizations are not required.

**Coding information**

Procedure codes are from current CPT, HCPCS Level II, Revenue Code, and/or ICD-9-CM manuals, as recommended by the American Medical Association, Centers for Medicare and Medicaid Services and American Hospital Associations. Blue Cross Blue Shield Association national codes may be developed when appropriate.

The following codes are included below for informational purposes. Inclusion or exclusion of a code does not constitute or imply member coverage or provider reimbursement. Please refer to the member’s contract benefits in effect at the time of service to determine coverage or non-coverage as it applies to an individual member.

**Magnetic Resonance Imaging (MRI)**

**Orbit, face and neck**

CPT codes:
- **70540**: magnetic resonance (eg, proton) imaging, orbit, face and neck without contrast material(s)
- **70542**: magnetic resonance (eg, proton) imaging, orbit, face and neck with contrast material(s)
- **70543**: magnetic resonance (eg, proton) imaging, orbit, face and neck without contrast material(s), followed by contrast material(s) and further sequence

**Head/Brain**

CPT codes:
- **70551**: magnetic resonance (eg, proton) imaging, brain (including brain stem) without contrast material(s)
- **70552**: magnetic resonance (eg, proton) imaging, brain (including brain stem); with contrast material(s)
- **70553**: magnetic resonance (eg, proton) imaging, brain (including brain stem); without contrast material(s), followed by contrast material(s) and further sequence

**Temporomandibular joint(s)**

CPT code:
- **70336**: magnetic resonance (eg, proton) imaging, temporomandibular joint(s)

**Functional Magnetic Resonance Imaging**

CPT codes:
- 70554: magnetic resonance imaging, brain, functional MRI; including test selection and administration of repetative body part movement and/or visual stimulation, not requiring physician or psychologist administration
- 70555: magnetic resonance imaging, brain, functional MRI; requiring physician or psychologist administration of entire neurofunctional testing

Neck
CPT codes:
- 70540: magnetic resonance (eg, proton) imaging, orbit, face and neck without contrast material(s)
- 70542: magnetic resonance (eg, proton) imaging, orbit, face and neck with contrast material(s)
- 70543: magnetic resonance (eg, proton) imaging, orbit, face and neck without contrast material(s), followed by contrast material(s) and further sequence

Chest:
CPT codes:
- 71550: magnetic resonance (eg, proton) imaging, chest (eg. for evaluation of hilar and mediastinal lymphadenopathy); without contrast material(s)
- 71551: magnetic resonance (eg, proton) imaging, chest (eg. for evaluation of hilar and mediastinal lymphadenopathy); with contrast material(s)
- 71552: magnetic resonance (eg, proton) imaging, chest (eg. for evaluation of hilar and mediastinal lymphadenopathy); without contrast material(s), followed by contrast material(s) and further sequences
- 75557: cardiac magnetic resonance imaging for morphology and function without contrast material
- 75559: cardiac magnetic resonance imaging for morphology and function without contrast material; with stress imaging
- 75561: cardiac magnetic resonance imaging for morphology and function without contrast material(s), followed by contrast material(s) and further sequences
- 75563: cardiac magnetic resonance imaging for morphology and function without contrast material(s), followed by contrast material(s) and further sequences; with stress imaging
- 75565: Cardiac magnetic resonance imaging for velocity flow mapping (New procedure code, effective 1/1/2010)

Note: MR phase-velocity cine imaging (75565) is covered for children with cardiac or vessel abnormalities

Spine
CPT codes:
- 72141: magnetic resonance (eg. proton) imaging, spinal and contents, cervical; without contrast material
- 72142: magnetic resonance (eg. proton) imaging, spinal and contents, cervical; with contrast material(s)
- 72146: magnetic resonance (eg. proton) imaging, spinal and contents, thoracic; without contrast material
- 72147: magnetic resonance (eg. proton) imaging, spinal and contents, thoracic; with contrast material(s)
- 72148: magnetic resonance (eg. proton) imaging, spinal and contents, lumbar; without contrast material
- 72149: magnetic resonance (eg. proton) imaging, spinal and contents, lumbar; with contrast material(s)
- 72156: magnetic resonance (eg. proton) imaging, spinal and contents, without contrast material, followed by contrast material(s) and further sequences; cervical
- 72157: magnetic resonance (eg. proton) imaging, spinal and contents, without contrast material, followed by contrast material(s) and further sequences; thoracic
- 72158: magnetic resonance (eg. proton) imaging, spinal and contents, without contrast material, followed by contrast material(s) and further sequences; lumbar

Abdomen/Pelvis

CPT codes:
- 74181: magnetic resonance (eg. proton) imaging, abdomen; without contrast material(s)
- 74182: magnetic resonance (eg. proton) imaging, abdomen; with contrast material(s)
- 74183: magnetic resonance (eg. proton) imaging, abdomen; without contrast material(s) followed with contrast material(s) and further sequences
- 72195: magnetic resonance (eg. proton) imaging, pelvis; without contrast material(s)
- 72196: magnetic resonance (eg. proton) imaging, pelvis; without contrast material(s)
- 72197: magnetic resonance (eg. proton) imaging, pelvis; without contrast material(s) followed by contrast material(s) and further sequences

Musculoskeletal

CPT codes:
- 70336: magnetic resonance (eg. proton) imaging, temporomandibular joint(s)
- 73218: magnetic resonance (eg. proton) imaging, upper extremity, other than joint; without contrast material(s)
- 73219: magnetic resonance (eg. proton) imaging, upper extremity, other than joint; with contrast material(s)
- 73220: magnetic resonance (eg. proton) imaging, upper extremity, other than joint; without contrast material(s) followed by contrast material(s) and further sequences
- 73221: magnetic resonance (eg. proton), any joint of upper extremity, without contrast material(s)
- 73222: magnetic resonance (eg. proton), any joint of upper extremity, with contrast material(s)
- 73223: magnetic resonance (eg. proton), any joint of upper extremity, without contrast material(s), followed by contrast material(s) and further sequences
- 73718: magnetic resonance (eg. proton), lower extremity other than joint, without contrast material(s)
- 73719: magnetic resonance (eg. proton), lower extremity other than joint, with contrast material(s)
- 73720: magnetic resonance (eg. proton), lower extremity other than joint, without contrast material(s), followed by contrast material(s) and further sequences
- 73721: magnetic resonance (eg. proton) imaging, any joint of lower extremity; without contrast material(s)
- 73722: magnetic resonance (eg. proton) imaging, any joint of lower extremity; with contrast material(s)
- 73723: magnetic resonance (eg. proton) imaging, any joint of lower extremity; without contrast material(s), followed by contrast material(s) and further sequences

Needle Placement

CPT code:
- 76393: magnetic resonance guidance for needle placement (e.g. for biopsy, needle aspiration, injection or placement of localization device) radiological supervision and interpretation.

Bone marrow blood supply

CPT code:
- 76400, magnetic resonance (e.g. proton) imaging, bone marrow blood supply

Note: covered for Medicare HMO Blue and Medicare PPO Blue only.

Magnetic Resonance Angiography (MRA)

Head/Neck

CPT codes:
- 70544: magnetic resonance angiography, head, without contrast material(s)
- 70545: magnetic resonance angiography, head, with contrast material(s)
- 70546: magnetic resonance angiography, head, without contrast material(s), followed by contrast material(s) and further sequences
- 70547: magnetic resonance angiography, neck, without contrast material(s)
- 70548: magnetic resonance angiography, neck, with contrast material(s)
- 70549: magnetic resonance angiography, neck, without contrast material(s), followed by contrast material(s) and further sequences

**Chest**

**CPT code:**
- 71555: magnetic resonance angiography, chest (excluding myocardium), with or without contrast material(s)

**Abdomen**

**CPT code:**
- 74185: magnetic resonance angiography, abdomen, with or without contrast material(s)

**Pelvis**

**CPT code:**
- 72198: magnetic resonance angiography, pelvis, with or without contrast material(s)

**Lower Extremity**

**CPT code:**
- 73725: magnetic resonance angiography, lower extremity, with or without contrast material(s)

**Magnetic Resonance chohangiopancreatography (MRCP)**

**HCPCS code**
- S8037: magnetic resonance chohangiopancreatography

**Magnetic Resonance Venography (MRV)**

**Head**

**CPT codes:**
- 70544: magnetic resonance angiography, head, without contrast material(s)
- 70545: magnetic resonance angiography, head, with contrast material(s)
- 70546: magnetic resonance angiography, head, without contrast material(s), followed by contrast material(s) and further sequences

**Chest**

**CPT code:**
- 71555: magnetic resonance angiography, chest (excluding myocardium), with or without contrast material(s)

**Modifiers**
- 26: professional component.
- TC: technical component

**Facility**

**ICD.9.CM procedure codes:**
- 88.91: magnetic resonance imaging of brain and brain stem
- 88.92: Magnetic resonance imaging of chest and myocardium
• **88.93:** Magnetic resonance imaging of spinal canal  
• **88.94:** Magnetic resonance imaging of musculoskeletal  
• **88.95:** Magnetic resonance imaging of pelvis, prostate, and bladder  
• **88.96:** Other intraoperative magnetic resonance imaging  
• **88.97:** Magnetic resonance imaging of other and unspecified sites

The procedures noted below will reject as non-covered, *for commercial products and for Medicare HMO Blue and Medicare PPO Blue products*, leaving no patient balance, as these procedures do not meet our Medical Technology Assessment Guidelines, #350.

**CPT Codes:**

- **70554:** magnetic resonance imaging, brain, functional MRI, including test selection and administration of repeatative body part movement and/or visual stimulation, not requiring physician or psychologist administration
- **70555:** magnetic resonance imaging, brain, functional MRI; requiring physician or psychologist administration of entire neurofunctional testing
- **70557:** magnetic resonance (e.g. proton) imaging, brain (including brain stem and skull base), during open intracranial procedure (e.g. to assess for residual tumor or residual vascular malformation); without contrast material
- **70558:** magnetic resonance (e.g. proton) imaging, brain (including brain stem and skull base), during open intracranial procedure (e.g. to assess for residual tumor or residual vascular malformation); with contrast material(s)
- **70559:** magnetic resonance (e.g. proton) imaging, brain (including brain stem and skull base), during open intracranial procedure (e.g. to assess for residual tumor or residual vascular malformation); without contrast material(s), followed by contrast material(s) and further sequences
- **72159:** magnetic resonance angiography, spinal canal and contents with or without contrast material(s)
- **73225:** magnetic resonance angiography, upper extremity, with or without contrast material(s)
- **76390:** magnetic resonance spectroscopy

The procedure noted below will reject as non-covered, leaving no patient balance, as this procedure does not meet our Medical Technology Assessment Guidelines. However, in accordance with CMS guidelines, the following procedure is covered for *Medicare HMO Blue and Medicare PPO Blue only.*

**CPT code:**

- **77084:** magnetic resonance (e.g. proton) imaging, bone marrow blood supply

**Other information**

For anesthesia services associated with MRI or any medical (non-surgical) service control, see Medical Policy 148, Anesthesia.

For sedation with or without analgesia (conscious sedation), please see CPT codes 99141 (Sedation with or without analgesia, conscious sedation; intravenous, intramuscular or inhalation) and CPT code 99142 (sedation with or without analgesia, conscious sedation; oral, rectal and/or intranasal.

For Medical Technology Assessment Guidelines refer to document #350.

For the Medical Technology Assessment Guidelines Non-Covered procedure list refer to document #400.

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**Policy #106: Magnetic Resonance MRI, MRA, MRV, MRS**

- 10 -
Policy update history
Revised 6/96 to include local Medicare guidelines for MRI, MRA head & neck. Revised 1/97 to include MRV coverage for cerebral sinus eval, and to specify indications for head MRA: steno-occlusive disease, intracranial aneurysms, cerebral venous thrombosis/compression, and pulsatile tinnitus; and neck MRA: carotid stenosis or occlusion and cervicocranial arterial dissection. Updated 5/97 to cover abdominal MRA for renal artery stenosis, pre-AAA repair, suspected chronic mesenteric ischemia, analysis of portal/hepatic venous system, systemic venous system, and to exclude coverage for potential renal donors to eval accessory arteries. Updated 8/97 to include coverage for MRA/V of the chest for acquired thoracic aortic disease, developmental anomaly of thoracic vasculature, systemic venous thrombus/occlusion, and to exclude coverage for PE (except for strong contraindications to IV contrast). Updated 9/97 to include coverage for MRA of the lower extremity in accordance with CMS regulations. Updated 12/97 to add 1998 CPT code 76390. No changes in coverage were made. Updated 1/98 to include coverage for MRI for new onset seizures; and policy exceptions for patients with possible pulmonary embolism with strong contraindication to IV contrast dye (history of systemic dye anaphylaxis, or moderate renal insufficiency in a diabetic), and a VQ may be the best option. Reviewed 4/98; no changes in coverage were made. Updated 7/98; billing information added. Reviewed 1/99, no changes in coverage were made. Updated 1/00 to include coverage for MRI of the brain to evaluate late sequelae of head trauma, such as neurological deficits not adequately explained by CT scan or other modalities; MRI of the cervical and thoracic spine to evaluate patients for intrinsic injuries to the spinal cord; acute disc rupture with spinal cord or nerve root compression and ligamentous disruption not confirmed by other imaging; and MRI for cervical cancer. Updated 5/00 to include coverage for magnetic resonance cholangiopancreatography. Updated 1/01 to include coverage for MRI for transient ischemic attacks and to exclude coverage for MRV (magnetic resonance spectroscopy). Updated 6/01 to exclude coverage for MR, MRA, MRV and MRCP as screening test in the absence of signs or symptoms of a disease or condition, effective 7/01/01. Updated 11/01 to include coverage for phase-velocity cine MR imaging in children with cardiac or vessel abnormalities. Reviewed 5/02, no changes in coverage were made. Updated 7/02 to include covered diagnoses, effective 9/1/02, under footnotes 22-25. Updated 10/02 to clarify coverage for MRI for indications that are considered medically necessary and
accepted in clinical practice, for Blue Care 65 (Medicare HMO Blue) members; effective 10/15/02. Reviewed
1/03 MPG Neurology, no changes in coverage were made. Reviewed 4/03 MPG Cardiology, no changes in
coverage were made. Reviewed 10/03 MPG ob/gyn and infertility, no changes in coverage were made.
Updated 11/03 to include coverage for abdominal MRA for suspected or proven vasculitis evaluation; and
added coverage for extremity MRI for suspected or proven myositis evaluation. Reviewed MPG pediatrics, no
changes in coverage were made. Updated 1/04 MPG neurology, coverage added for c-spine MRI for
radiculopathy. Reviewed 5/04 MPG pediatrics, no changes in coverage were made. Updated 6/04 to include
coverage for renal MRA for evaluation of accessory renal arteries in prospective renal donors, effective June
2004; and to include coverage for MRA of the pelvis, effective June 2004. Reviewed 11/04 MPG
gastroenterology, nutrition and organ transplantation, no changes in coverage were made. Reviewed 10/04
MPG obstetrics and gynecology, no changes in coverage were made. Reviewed 11/04 MPG gastroenterology,
nutrition and organ transplantation, no changes in coverage were made. Updated 1/05 MPG neurology to
clarify policy guidelines on dementia as follows: rapid onset, rapid or moderate progression or with or without
focal neurologic signs or symptoms; and to clarify coverage for MRV for pseudotumor cerebri. Updated 1/05
to include references and non-covered rationale of MRS from the 2004 BCBSA national policy. Reviewed
3/05 MPG Pulmonology, Allergy and ENT/Otolaryngology, no changes in coverage were made. Reviewed
5/05 MPG- Pediatrics, no changes in coverage were made. 6/05 Medicare PPO Blue product reference noted in
medical policy when covered indications are limited to Medicare related products. 8/05 Updated covered
clinical indication for MRI abdomen to include ICD-9-CM diagnoses V59.6, and V70.8 for preoperative
evaluation of a donor prior to donor surgery for liver transplant (effective 8/1/05). 10/05 Updated to clarify
non-covered indications for MRA of the Chest in accordance with BCBSA national policy #6.01.17. National
policy references and rationale added to footnote #39. Reviewed 10/05 MPG Obstetrics/Gynecology, no
changes in coverage were made. 11/30/05 updated to include coverage for ICD-CM-9 diagnoses 259.1
(precocious puberty), and 759.5 (tuberous sclerosis) MRI-Brain, footnote # 22. Reviewed 11/05 MPG
gastroenterology, nutrition and organ transplantation, no changes in coverage were made. Reviewed 1/06
MPG-Neurology, no changes in coverage were made. Reviewed 3/06 after review of BCBSA national policy
issued 12/05 with no change in coverage exclusion of magnetic resonance spectroscopy. Reviewed 3/06 MPG-
Pulmonology, Allergy, ENT/Otolaryngology, no changes in coverage were made. Reviewed 4/06 MPG -
Cardiology, no changes in coverage were made. Reviewed 10/06 MPG – Obstetrics and Gynecology, no
changes in coverage were made. Reviewed 11/06 MPG-Gastroenterology, Nutrition and Organ Transplants, no
changes in coverage were made. 12/06 expanded the list of covered clinical indications for Chest MRA, i.e.
Congenital Heart anomalies, to support language of medical policy; NOTE: effective 12/06 going forward-see
footnote #33. 3/07 updated ICD-9-CM diagnosis 784.9 to include required 5th digit code, 784.99, see footnote
23 (MRI of orbit face, and neck). 4/07 added coverage for MRI-brain for the clinical indication, pituitary
tumor in patients with secondary testicular hypogonadism (ICD-9-CM 257.2)-see footnote #22, effective April
2007. Reviewed 3/07 MPG – Pulmonology, Allergy, ENT/Otolaryngology, no changes in coverage were made.
4/07 comparison review completed of the new BCBSA medical policy, Positional MRI - new
technology investigational BCBSMA policy updated to benchmark the BCBSA policy; and footnote #39
developed- BCBSA policy rationale and references; non-coverage effective immediately (4/2007). Reviewed
4/07 MPG Cardiology, no changes is coverage were made. 5/07 comparison review completed of new BCBSA
medical policy Functional MRI- covered for clinical indications noted in this policy based on the BCBSA
document, effective October 2007; all other indications considered investigational; see foot note #40.
Comparison review completed of BCBSA policy- Magnetic Resonance Spectroscopy, policy statement
unchanged- technology investigational; related footnote, #15 edited. 6/07 the clinical indication- hereditary
hemorrhagic telangiectasia (ICD-9-CM diagnosis, 448.0) added as a covered indication for MRI of the brain
and abdomen; and MRA of the head/neck, effective June 2007 going forward. Reviewed 5/07 MPG-Pediatrics,
no changes in coverage were made. Policy updated to include ICD-9-CM diagnoses which represent covered
clinical indications defined in this medical policy for Functional MRI and associated service. Reviewed 10/07
MPG – Obstetrics and Gynecology, no changes in coverage were made. Reviewed 11/07 MPG-
Gastroenterology, Nutrition and Organ Transplants, no changes in coverage were made. Reviewed 1/08 MPG-
Neurology, no changes in coverage were made. Updated 3/08, to include ICD-9 CM diagnosis code 237.70,
for patients with Schwannomatosis. Reviewed 3/08 MPG- Pulmonology, Allergy and ENT/Otolaryngology, no
changes in coverage were made. Reviewed 4/08 MPG-Cardiology, no changes in coverage were made. 5/08

Policy #106: Magnetic Resonance MRI, MRA, MRV, MRS

- 13 -
Comparison review of BCBSA National medical policy Functional MRI, completed; medically necessary and investigational coverage status unchanged which BCBSMA benchmarks; related footnote edited adding references and rationale. 5/08 Comparison review of BCBSA National medical policy, Positional Magnetic Resonance Imaging (MRI), investigational policy statement unchanged which BCBSMA continues to benchmark; related footnote #39 edited to include references. 7/08 comparison review completed of BCBSA policy- Magnetic Resonance Spectroscopy, which BCBSMA benchmarks; policy statement unchanged-technology investigational; related footnote, #15 edited; Managed care, and Indemnity and PPO guidelines clarified. 8/08 footnotes 24 and 32 edited to include correct coding specificity of a 5th digit, MRI Abdomen: 567.21-567.29, 567.81-567.89, 959.12, 996.40-996.49 billed with V43.64, 255.10-255.14; MRA Abdomen: code correction- 747.61. Reviewed 10/08 MPG-obstetrics/gynecology, no changes in coverage were made. Reviewed 11/08 MPG – Gastroenterology, Nutrition & Organ Transplants, no changes in coverage were made. 12/08 updated new 2008-2009 ICD-9-CM diagnosis code range for the covered indication of hematuria when billed with MRI Abdomen; ICD-9-CM codes 599.70–599.72, footnote #24. Reviewed 1/09 MPG – Neurology and Neurosurgery, no changes in coverage were made. 2/09 updated new 2008-2009 ICD-9-CM diagnosis code range for the covered indication of dysphagia when billed with MRI: Orbit. Face and Neck; ICD-9-CM codes 787.20-787.29, footnote #23. Reviewed 3/09 MPG – Pulmonology, Allergy/Asthma/Immunology and ENT/Otolaryngology, no changes in coverage were made. 04/09 Clarified footnote #22 pertaining to covered ICD-9-CM diagnosis code ranges for sensorineural hearing loss when billed with MRI-brain (389.10, 389.11, 389.12, 389.13, 389.14, 389.15, 389.16, 389.17, 389.18, 389.20, 389.21,389.22, 389.8, 389.9) Updated 4/09 by clarifying the covered diagnoses for MRA of the Abdomen-foothnote 32. Reviewed 4/09 MPG – Cardiology, no changes in coverage were made. Updated 5/09, clarified covered indications for MRI head/brain-foothnote 22, and covered indications for MRI orbit/face/neck-foothnote 23. Reviewed 5/09 MPG-Pediatrics, no changes in coverage were made. Updated 6/09 based on the comparison review of the BCBSA new National medical policy, Updated 6/09 based on a comparison review of the BCBSA national medical policy, Positional Magnetic Resonance Imaging; BCBSA’s investigational non-coverage language is unchanged; BCBSMA benchmarks the BCBSA medical policy; footnote 39 edited, including an additional reference, 7. Updated 7/09 with a clarification to footnote 24: added ICD-9-CM diagnosis code V10.47, and a clarification to footnote 22: added five digit ICD-9-CM diagnosis codes 780.60-780.62, 780.64-780.65. Updated 9/09 following a comparison review of the BCBSA national policy, Magnetic Resonance Spectroscopy (MRS); BCBSMA’s non-coverage of MRS is unchanged which aligns with the BCBSA policy. Footnote 15 updated with the following: references 22 and 25 deleted, references 34-39 added, and references renumbered. Reviewed 10/2009 MPG-Obstetrics and Gynecology, no changes in coverage were made. Reviewed 11/2009 MPG – Gastroenterology, Nutrition and Organ Transplantation, no changes in coverage were made. Updated 12/09 to add one new 2010 CPT code, and remove deleted CPT codes 75558, 75560, 75562 and 75564 effective 1/1/10 and 75552, 75553, 75554, 75555, and 75556 effective 1/1/2008 from Coding Information section. Clarified covered indications for MRA of the head to include, sudden onset of headache associated with exertion or positional changes, and edited footnote 31 adding ICD-9-CM diagnoses codes 339.43, 339.84, 339.85, and 339.89 that support these medically necessary covered indication. Reviewed 1/2010 MPG-Neurology and Neurosurgery, no changes in coverage were made. Updated 2/10 to clarify medically necessary ICD-9 CM diagnoses range with additional 5th digits 784.51-784.59 when billed with CPT codes 70551, 70552 and 70553, noted under footnote 22. Reviewed 3/2010 MPG – Pulmonology, Allergy/Asthma/Immunology, ENT and Otolaryngology, no changes in coverage were made. Reviewed 4/2010 MPG-Cardiology, no changes in coverage were made. Reviewed 5/2010 MPG-Pediatrics, no changes in coverage were made. Updated 7/10 to add five digit ICD-9-CM diagnosis codes 780.60-780.62, 780.64-780.65 to footnote 24, MRI of the abdomen (CPT codes 74181, 74182, and 74183.) Reviewed based on a comparison review of the BCSA policy, Positional Magnetic Resonance Imaging, investigational policy statement unchanged which BCBSMA benchmarks; footnote 39: rationale updated and added references 8 and 9. Updated 8/10 to clarify covered ICD-9-CM diagnosis codes billed with CPT codes 74181, 74182, and 74183 (MRI abdomen); ICD-9-CM diagnosis codes V10.50, V10.51, V10.52, V10.53 added to footnote 24. Policy edited to remove information regarding MRI of the breast, which is now addressed on a new document, #230 and MRI to monitor silicone gel filled implants which is now addressed on new document #139. Updated 8/16/10 to clarify the covered ICD-9-CM diagnosis codes for MRI of the abdomen by adding the following code: V10.59 (footnote 24.). Updated 10/2010 to include references on functional MRI based on BCBSA’s literature review through April
Scientific background, Rationale and References

1 Based upon the 7/97 TEC (Technology Evaluation Center) assessment of scientific literature from 1992 through 7/97 on MRA/V of the chest, excluding cardiac indications. The following topics were addressed: acquired disease of the thoracic aorta, developmental anomaly of thoracic vasculature, systemic venous thrombosis or occlusion, and pulmonary embolism (PE). Comparisons were made to thoracic angiography in most cases, although arguably angiography is not universally considered the gold standard for every indication. As well, comparisons were made to ultrasound (US), various forms of CT scanning, ventilation-perfusion scanning, transesophageal echo, and other techniques, depending on the clinical indication under review. Diagnostic accuracies were compared, and weighed against the risks associated with the “gold standard” diagnostic test for each indication. These risks include nephrotoxicity from IV contrast, end-organ damage from emboli, and arterial injury, as well as systemic allergic reactions to IV contrast material.

acquired disease of the thoracic aorta: The literature reports on various indications for the initial evaluation, treatment planning, and follow-up for conditions such as thoracic aortic aneurysm (true or pseudoaneurysm), thoracic aortic dissection, and steno-occlusive vascular disease. Patients who are medically unstable, particularly acute trauma patients, or those who are on life-support equipment incompatible with MR equipment, are not generally suited to this technology. Sensitivity ranges from 92-100% for thoracic aortic dissection and thoracic aortic aneurysm. Specificity ranges from 93-100% for dissection and was 100% for aneurysm. Compared to CT/CT angiography or transesophageal/transthoracic echo, the diagnostic performance of MRI/MRA is at least as good. In some cases, MR showed superior sensitivity for subtle contour-deforming intramural dissections, compared with angio. MRI/A is reliable enough to provide information for treatment planning, including pre-op assessments, thus obviating the need for angio in many cases. By avoiding the attendant risks of angio, with no loss in diagnostic accuracy, health outcomes are improved.

developmental anomalies of the thoracic vasculature: MRI/A is capable of diagnosing vascular anomalies of the great thoracic arteries and veins, and has the advantage of large field of view and virtually unlimited image orientation. In some cases, additional hemodynamic info may be required, and echo may supplement MR techniques. In other cases, angio may also be required. Nonetheless, by avoiding angio and its attendant risks, health outcomes are improved. In these often young patients who will need repeated follow-up exams, a non-invasive strategy is often ideal.

systemic venous thrombosis or occlusion: Direct venography of the central venous circulation is complicated by various anatomical and technical issues. Visualization requires complete opacification of the blood inside the vessel of interest. However, contrast from other feeder veins may mix with the blood in the vessel of interest, creating a “wash-in” effect. As well, venography only demonstrates the peripheral extent of the thrombus, and may provide little information about the vessel beyond the thrombus. Injection of radiographic contrast material may itself result in thrombus formation or propagation. Non-invasive imaging methods include vascular ultrasound.
(US) and contrast-enhanced CT (CECT). US exams of the central chest veins is limited by bones, and venous compression is rarely possible. CECT depends on the degree of venous enhancement, which is variable with dynamic CT methods; artifacts from mixtures of unopacified blood may lead to difficulty in interpretation. With MRA, slow-flowing blood may mimic an intraluminal filling defect, but such issues are often resolved with alternative scanning sequences and alterations in image orientation. However, MRA/V is reliable and accurate for diagnosing thrombo-occlusive disease in the thoracic (systemic) central veins. Sensitivity is usually reported in the 97-100% range, though may be lower in smaller caliber veins, such as those in the shoulder area (83%). Specificity ranges from 94-100%. Compared to venography, MR techniques may provide a superior assessment of alternative venous access sites. Adequate MRA/V images can guide clinical decision-making, obviating the need for venography. By avoiding the attendant risks of angio, with no loss in diagnostic accuracy, health outcomes are improved.

**Pulmonary embolism (PE):** There is only limited data on the diagnostic performance of MRA for PE. Given the high prevalence of PE, the literature addresses relatively few patients. Several studies used a prospective, blinded design (n=190 total): Meaney (1997, n=30), Loubeyre (1994, n=23), Laissy (1995, n=28; 1995 n=7), Erdman (1994, n=64), and Grist (1993, n=20), Schiebler (1993, n=18), Remy-Jardin (1996, n=75). In most cases (76%), angiography served as the reference standard. In some studies, there was a high rate of technically limited scans (45% in one 1993 study).

Sensitivity ranges from 85-88%, and specificity from 85-94%, depending on use of gadolinium enhancement. CT angiography provides roughly equivalent performance (83% sensitivity, 91% specificity). Comparisons to V-Q scanning is complicated by what is considered to be a positive VQ scan. When counting intermediate or high prob VQ scans as positive, sensitivity of VQ and MRA (of CTA) are equally sensitive, but VQ is less specific. When only high-prob VQ scans are considered positive, then VQ scanning is equal more specific than MRA or CT, but the sensitivity of VQ scanning is much lower.

**Summary:** While the data on PE addresses relatively few patients, the trend in the literature, especially with more recent faster, higher-dose gadolinium-enhanced MRA techniques, is for improving diagnostic accuracy. However, the current reported level of diagnostic performance is insufficient to suggest that MR can replace PA gram. Thus, health outcomes could not be expected to improve by attempting to replace PA gram with MRA. However, both CT angio and PA gram, which require IV contrast, pose risks which may be unacceptable to patients with contraindications to IV contrast material. If after VQ scan, there is persistent clinical uncertainly about PE, and PA-gram and CTA are unrealistic because the patient has a contraindication to IV contrast, then the use of MRA would be expected to result in improved health outcomes.

2 Also based upon a 1992 TEC (Technology Evaluation Center) assessment of medical literature up to 8/92, on MRA for intracranial disease, carotid disease, thoracic disease, abdominal disease, and peripheral vascular disease.

**Intracranial:** Warach, Li, Ronthal and Edelman (1992) reported on 36 patients with symptoms less than 48 hours. Those with + MRAs had good correlation to lesions identified on MRI. There were no false + MRAs. However, patients were neither randomly nor systematically selected. There was no blinding of MRIs and MRAs. (see footnote on updated intracranial indications below)

**Carotid:** Polak, Bajakian, O’Leary, et al. (1992) studied 23 consecutive patients with “high clinical suspicion” for carotid disease. Angiography identified lesions over 50% stenosed in 21 patients. MRA had a sensitivity of 96%, and a specificity of 62% for lesions over 50% occluded, compared to angiography. Doppler had a sensitivity of 96% and a specificity of 71% in the same patients. There were 5 false + on MRA, and 4 on doppler, and one false negative for each. There were methodologic flaws in this study as well. (see footnote on updated intracranial carotid below)

**Thoracic:** Only descriptive literature was available at that time.
Intraabdominal: Muller-Schimpfle (1992) evaluated MRA combined with MRI for planning subdiaphragm XRT in 9 cases of Hodgkin’s and 5 cases of NHL. There was no discussion addressing if or how MRA would affect treatment decisions. (see footnote on updated abdominal indications below)

Peripheral vascular: Owen (1992) evaluated patients with symptomatic PVD of the legs using MRA and angiography. The results were discrepant in 18 limbs (72%). MRA detected all vessels found patent at surgery, while conventional angio failed to detect 22% of run-off vessels. MRA would have altered treatment in 4 cases (17%), in which a suitable vessel for bypass grafting was found by MRA. While these results are promising, there were many methodologic problems, including incomplete blinding of all studies. Only 20 of all 23 patients underwent operation. Data from the 3 other patients is not specifically addressed. No long-term outcome was reported.

3 1/97 TEC (Technology Evaluation Center) assessment evaluating medical literature from 1985-12/96 on MRA of the head and transcranial doppler ultrasound for steno-occlusive disease of intracranial (IC) arteries, cerebral aneurysm, intracranial AVM, cerebral venous sinus compression/thrombosis, and pulsatile tinnitus.


MRA performed well against cerebral angiography (CA); although varying definitions of what was considered a positive test result make absolute between studies comparisons difficult. Sensitivities and specificities were generally over 85%, with a few exceptions. Korogi (1994, n=502 major vessels) found a sensitivity of 85-88% and a specificity of 96-97% for ICA and MCA stenoses. There was a tendency for MRA to underestimate degree of stenosis (other studies suggest the opposite). Dagirmanjian (1995) suggested higher reader confidence when addressing proximal arterial segments rather than distal.

MRA has excellent sensitivity for middle to large caliber IC arteries, with sensitivity near 100% with ACA, MCA, PCA, and SCA. Sensitivity may be lower with smaller caliber vessels: anterior and posterior communicating: 60-95%; anterior inferior cerebellar artery: 52%; posterior inferior cerebellar artery 89%. Collateral flow through the Circle of Willis may be seen with high sensitivity on MRA, but collaterals from the ophthalmic artery are less reliably sensitive (67%). Katz (1995) found MRA and CA roughly equivalent in sensitivity, while MRA was more specific.

Most studies comparing MRA to TCD showed roughly equivalent visualization of larger caliber vessels and IC collateral flow pathways. The ability to detect stenotic and/or occlusive lesions varied according to the specific location of the vessel. In the vertebobasilar region, MRA had superior sensitivity (97% vs 76%), while both were specific (99%). For evaluating collaterals through the ophthalmic artery, Furst (1993) showed a lower sensitivity for MRA. Furst (1996) showed 100% sensitivity for congenital vascular anomalies in 30 cases.

In summary, for symptomatic patients with suspected intracranial steno-occlusive disease, guidance of anticoagulant therapy based upon MRA results represents improved health outcome. The false positive and false negative results may result in inappropriate treatment, but this risk is balanced by the avoidance of adverse effects associated with invasive diagnostic methods.

cerebral (intracranial) aneurysms: Autopsy evidence estimates intracranial aneurysms (ICA) at 0.2-9.9%, with a mean of 5%. Certain subgroups have increased risk: those with family history, polycystic kidney disease; there is an age-related increase in both prevalence and tendency to bleed. Ruptured aneurysms often result in subarachnoid hemorrhage (SAH), in 1-1.4% of those with known aneurysms (size correlates to risk of rupture). SAH from ICA rupture carries a high risk of death or disability; those undergoing elective, rather than emergent surgery, fare better.
Studies by Korogi (1996 n=100) (1994 n=126), Wilcock (1996, n=39), Anzalone (1995 n=27), Bosmans (1995 n=14), Stock (1995 n=50), Ronkainen (1995 n=396), Huston (1994 n=16), Horikoshi (1994 n=96), Ogawa (1996 n=65), Hope (1996 n=80), and others were examined. For aneurysm >= 5 mm in diameter, MRA was about 85-90% sensitive. With smaller aneurysms, sensitivity decreases to less than 60%. Specificities, when reported, were high, 92-100%, except for the large series by Korogi, who noted specificities of 76% (all aneurysms included, many were small, and it was not possible to sort out those >= 5 mm). MRA achieves sensitivity comparable to angiography.

In summary, in patients with increased suspicion for ICA, MRA is sensitive and specific. All true and false positive patients would likely undergo angiography in preparation for treatment planning, thus no false positives would be subjected to unnecessary invasive treatment. The small number of false negatives (<0.75%) is acceptable, weighed against avoiding adverse effects associated with more invasive diagnostic methods, especially considering that it is the smaller aneurysms that are likely to be missed, and these are less likely to bleed.

**IC vascular malformations (ICVM):** IC AVMs may be congenital or acquired. Each lesion comprises arterial feeding vessels, collateral arterial vessels, a nidus, and venous outflow, without a defined capillary bed. The arterial supply defines whether an AVM is parenchymal/pial (often congenital) vs. dural (often acquired). IC hemorrhage from ruptured AVMs cause lasting morbidity, and may be fatal. Risk of hemorrhage is about 2-3% per year, and risk of death 1% per year. Mortality risk with first hemorrhage is 10%, and survivors risk a 6% chance of rebleed in the same year, after which the risk returns to 2-3%. Mortality with second hemorrhage increase to 13%, and 20% for subsequent bleeds. Patients may present with seizure, headache, or progressive neuro deficits. Treatment options include open microsurgery (+/- preceded by embolization to diminish bleeding), embolization (difficult due to feeding arteries), and radiosurgery (single dose results in slow obliteration over months to years, during which patient remains at risk for bleeding). Successful treatment has been traditionally judged by complete obliteration on follow-up angiogram.

Initial Dx of ICVM: Stock (1995), Huston (1991), Chen (1992), Marchal (1990), Edelman (1989), Nussel (1991), Smith (1988), and Putman (1996) were examined. Sensitivity is high except for lesion < 1 cm. MRA is not more sensitive than MRI for detection of AVMs, but has the advantage of defining associated vasculature (and outperforms angiography in this regard). For detection of small AVMs, MR spin-echo may be more sensitive than MRA. However, angiography has superior spatial resolution, ability to map temporal flow patterns, and to detect areas of slow flow.


Treatment planning for known ICVM: Levy (1996), Kondziolka (1994), Guo (1993), Petereit (1993), Inoue (1995), and Harburg (1995) were reviewed. Stereotactic MRA as an adjunct to angiography may optimize target delineation, and may allow reduced radiation of nearby normal tissue during radiosurgery. As well, angiography is limited by radiodense structures.

Follow-up imaging post-tx: Mukherji (1995), Morikawa (1996), Abe (1995), Guo (1995), Petereit (1993), Oyama (1993), Kauczor (1993) Quisling 1991, Smith (1988) and Duong (1994) were reviewed. Most studies followed patient after radiosurgery, while two addressed post-embolization. There was good agreement between MRI/MRA and angiography for lesion >= 1 cm. However, Mukherji noted poor sensitivity by MR for flow through small (<1cm) lesions. While absence of flow by MR usually agreed with angiographic obliteration, it was not perfect in this regard. Some authors suggested that confirmatory angiography remains necessary prior to finally determining obliteration.

**cerebral venous sinus compression/thrombosis:** Possible causes for cerebral venous thrombosis (CVT) include infection, hypercoaguable states, oral contraceptives, puerperium, pregnancy, malignancy, dehydration, trauma,
and others. Heparin has been shown to decrease symptom severity scores in patients with venous sinus thrombosis. Even when accompanied by intracranial hemorrhage, heparin did not appear to result in worsened outcomes. Small studies of symptomatic dural sinus thrombosis treated with urokinase have noted improvement with therapy. Compression may occur from tumor masses, such as meningiomas. Treatment is directed at tumor removal, with removal of the adjacent sinus in some cases.

Vogl (1994), Insensee (1994), Mattle (1991), Tsuruda (1991), and McArdle (1987) were reviewed. MRV appears reliable for evaluation of cerebral venous sinus thrombosis. Vogl noted 100% sensitivity and specificity using 2D TOF MRV. Others suggest MRA/MRV to be useful, including for large venous structures such as dural sinuses. However, there are limitations to TOF MRV used alone for venous sinus thrombosis: the bright signal of subacute thrombus on T1 images may mimic flow. On T1 spin echo sequences, thrombus is readily visible as distinct from the surrounding flow void. Phase contrast MRV may be helpful, as it is not affected by tissues with high T1 signal. Hence, TOF MRV may require combination with spin-echo MRI for optimal imaging.

Obstruction of cerebral sinuses by adjacent tumor: Wilms (1995), Kadota (1993), Daniels (1989) were reviewed. All 3 studies reported 100% accuracy in detecting venous sinus invasion and occlusion. CT venography is a new application of CT angiography, with reportedly good correlation with MRV, including demonstration of tumors to surrounding vessels.

**pulsatile tinnitus:** While tinnitus is common, pulsatile tinnitus is rare. Vascular etiology is more likely if the sound is synchronous with the patient’s pulse, and is audible by the examiner as well as the patient. A soft tissue mass visible behind the tympanic membrane on otologic exam greatly increases suspicion for a vascular abnormality. Lesions responsible for pulsatile tinnitus include A-V lesion such as dural A-v fistulae, glomus tumors, carotid artery lesions, and dural sinus abnormalities such as stenosis. Benign intracranial hypertension may account for symptoms of those without vascular lesions (42%). Treatment depends on location of the lesion, and may include endovascular embolization or surgical resection. Studies by Dietz (1994) and Vogl (1994) confirmed excellent sensitivity and specificity for combined MRI/MRA technique. This can spare patients invasive angiography if no vascular lesion, or a benign lesion is seen. Some patients with positive findings may still require conventional angiography.

4 Based upon the 1/97 TEC (Technology Evaluation Center) assessment of MRA of the neck, reviewing literature from 1985 through 12/96.

**Background:** Conventional angiography is increasingly replaced by ultrasound + MRA. Not only is conventional angio associated with some adverse effects, there are inter-rater reliability problems reading films. As well, the number of views with this technique does not compare to the multiple computer-generated images available with MRA; hence the latter technique can demonstrate the most severe degree of stenosis at a given level. IASDA (intra-arterial digital subtraction angiography) is a common alternative to conventional angiographic filming, though slightly inferior in quality, it requires lower doses of contrast, and shorter cath times. DSA (ivDSA) involves an IV injection of contrast, not an intra-arterial one. There is poor opacification and lack of details are limiting.

**Carotid artery steno-occlusive disease:** According to NASCET (North Am. Symptomatic Carotid Endarterectomy Trial) and other studies, stroke rates per year are as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>General population over age 70</td>
<td>0.6% per year</td>
</tr>
<tr>
<td>Asymptomatic bruit</td>
<td>1.5%</td>
</tr>
<tr>
<td>Asymptomatic carotid stenosis</td>
<td>2%</td>
</tr>
<tr>
<td>Hx TIA</td>
<td>12% first year out, and 30% over 5 years out</td>
</tr>
<tr>
<td>TIA and &gt;70% stenosis</td>
<td>13%</td>
</tr>
<tr>
<td>Prior ischemic CVA</td>
<td>9%</td>
</tr>
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The 1995 American Heart Association’s Guidelines for CEA suggest that proven CEA indications include:
- symptomatic good-risk patients with carotid stenosis >70% AND either one/more TIA in past 6 months, or a “mild stroke” within the last 6 months. They suggest the surgery be performed by a surgeon whose surgical morbidity and mortality is less than 6%.

- Asymptomatic good-risk patients with carotid stenosis >60%. They suggest the surgery be performed by a surgeon whose surgical morbidity and mortality is less than 3%.

They suggest that the use of CEA in symptomatic patients with carotid stenosis of 50-69% is acceptable but not proven. For asymptomatic patients, they state that CEA with combined risk of stroke and mortality in excess of 5% is inappropriate.

Comparisons across studies were difficult due to differences in grading stenoses, and different cut-offs for what is considered significant. The assessment considered numerous studies, including: Patel (1995), Anderson (1994), Young (1994), De Marco (1994), Nokes (1994), Mittl (1994), Turnipseed (1993), Laster (1993), Pavone (1992), Mattle (1991), White (1994), Sartera (1993), Buijs (1993), Chiesa (1993), Anderson (1992), Huston (1993), Anson (1993), Polak (1992), Riles (1992), Hesiseman (1992), Litt (1991), Wilkerson (1991), Pan (1995), and Polak (1993). These studies, including a recent meta-analysis, the ACAS (Asymptomatic Carotid Atherosclerosis Study), NASCET demonstrate that although MRA is imperfect in measuring carotid stenosis, this is acceptably weighed against the adverse effects associated with invasive angiography. A meta-analysis (Blakeley 1995) estimated MRA’s sensitivity at 91% (95% CI 85-96%) and specificity 89% (95% CI 80-94%). In one study, sensitivity and specificity were 10 points higher for 3-D TOF (sensitivity 92-94%, and specificity 83-85%) compared to 2-D.

The combination of MRA and duplex ultrasound appear to be more beneficial than either test alone. This combination may replace confirmatory angiography in patients with concordant finding on MRA and duplex. However, due to imperfections in these studies, there may be patients with false positive results that undergo unnecessary surgery (although the risks and benefits of CEA for moderate stenosis of 30-69% is debated). Hence, the small number of such patients is acceptably weighed against the adverse effects of invasive angiography.

**Cervico-cranial dissection:** Cervicocranial dissection (CCD) may occur spontaneously or from local trauma. Extracranial internal carotid lesions have peak frequency in early forties, and are seen slightly more often in males. Unilateral headache and Horner’s syndrome are 2 common presentations, in addition to diffuse head or neck pain, and symptoms of focal brain ischemia. Resultant cerebral ischemia due to luminal narrowing or emboli may cause dramatic cerebral consequences. Treatment consists of anticoagulation or surgery. Vertebral dissection is associated with excessive head rotation, and has been reported with chiropractic manipulation. Luminal narrowing or occlusion, and embolization may result. Collateral flow to the brain is often provided by the contralateral artery, thus medical management often suffices, while surgery is reserved for those with persistent emboli despite anticoagulation.

As this condition is rare, evidence is small. Evidence by Bakke (1996), Levy (1994), Kitanaka (1994), Bui (1993), Quint (1990), Gelbert (1991), and Goldberg (1986) was reviewed. The well-designed prospective blinded study by Levy compared MR, MRA, and conventional angio in patients with dissection and healthy controls. MRA appears highly sensitive and specific for carotid dissection, while less sensitive and yet highly specific for vertebral artery dissection. MR has superior sensitivity to MRI for carotid dissection, and MRI has superior sensitivity for vertebral artery dissection. The results of MRI/MRA can guide antithrombotic therapy, for improvement in net health outcome, while avoiding adverse effects associated with conventional angiography.

6 Based on a 5/97 TEC (Technology Evaluation Center) assessment of medical literature from 1985 to 3/97 on MRA of the abdomen. The following indications were addressed: evaluation of renal artery stenosis (RAS), pre-op elective AAA repair, suspected chronic mesenteric ischemia, evaluation of the portal and/or hepatic venous system, evaluation of the systemic venous system, and evaluation of potential renal donors for the presence of accessory renal arteries.

**RAS:** MRA appears to be sensitive and specific for diagnosing occlusion or hemodynamically significant stenosis, in the proximal portion of the renal artery. NPV is 88-100% in studies with a wide range of disease prevalence (8-

**Pre-op AAA**: MRA appears to provide reliable assessments in pre-op patients undergoing AAA repair selectively. MRA is generally comparable to conventional angiography for defining extent of the aneurysm. By avoiding angiography, patients would be expected to avoid its side effects, when MRA gives an adequate image (78-82% of patients). For MRA with Gad: Petersen (1995), Fox (1996), Prince (1995), Laisse (1995), Douek (1995) were evaluated. Without gad, Ecklund (1994), Sallevelt (1994), and Durham (1993) were evaluated. Comparative technologies were addressed in Cohan (1995), Rubin (1993), and Todd (1991).

**Chronic mesenteric ischemia**: The role of non-invasive testing for this indication are still evolving. Compared to angiography, gad-enhanced MRA performs well, with a sensitivity of 100%, and specificity of 82-100% for the proximal portions of the 3 mesenteric arteries. By avoiding the risks of angiography, patient outcomes may be improved. Those with 2 or more significantly stenotic mesenteric arteries may have to undergo angio to plan for surgical bypass. For mesenteric arteries, with gad, Prince (1997), Holland (1996), Petersen (1995), Prince (1994); and without gad, Wasser (1996), and Durham (1993) were evaluated. Comparative technologies were addressed in Cohan (1995), Rubin (1993), and Todd (1991).


7 See Magnetic resonance cholangiography: comparison with endoscopic retrograde cholangiopancreatography. Soto JA, et al. Gastroenterology 1996 Feb; 110:589-97. This small study (n=46) of patients referred for elective ERCP were evaluated with MRC with body coil. Images were read by 2 radiologists. Within 24 hours, all patients underwent direct cholangiography. Diagnostic images were obtained in 44 pts. (96%). Normal common bile duct/ common hepatic/ intrahepatic ducts were correctly identified in 16/17 patients, specificity 95%. Common bile duct dilatation and site of obstruction was noted in 26/27 pts (sensitivity 96%). Sensitivity for biliary strictures (n=10) was 90%; intraductal abnormalities (n=7) was 100%. MR is not operator-dependent, as are some imaging modalities. While this small study is promising, large controlled prospective studies are required to determine the role of MRC in the clinical work-up of various biliary diseases.

11 Based on recommendations from Dr. Harold Wilkinson, Chief of Neurosurgery at Newton Wellesley Hospital on EBR, and Drs. Weinberg and Rizzoli, President and Vice President of the Massachusetts Neurologic Association at the January 2000 MPG meeting.

12 In accordance with Blue Cross and Blue Shield Association national policy 6.01.17, issued 1/16/98.

13 Based on recommendations from Drs. Weinberg and Rizzoli, President and Vice President of the Massachusetts Neurologic Association, at the January 2000 MPG meeting.

14 Based on recommendations from Dr. Guenter Spanknebel; Medical Policy Group meeting, May 2000.

15 In accordance with BCBSA national policy 6.01.24, Magnetic Resonance Spectroscopy, issued 7/2009.

Validation of a new imaging technique involves the following steps:

Demonstration of its technical feasibility, including assessment of its reproducibility and precision.

An understanding of normal and abnormal values as studied in different clinical situations. For accurate interpretation of study results, sensitivities, specificities, and positive and negative predictive values compared to a reference standard must be known.

The clinical utility of an imaging study is related to how the results of that study can be used to benefit patient management. The clinical utility of both true positive and true negative tests must be assessed. Relevant outcomes of a negative test (i.e., suspected pathology is not present) may be avoidance of more invasive diagnostic tests or avoidance of ineffective therapy. Relevant outcomes of a positive test (i.e., suspected pathology is present) may also include avoidance of a more invasive test plus the institution of specific, effective therapy. Use of the imaging study should result in net health benefit.

The published data do not indicate that the second and third criteria have been met for magnetic resonance spectroscopy (MRS). While MRS has been investigated in a wide variety of clinical situations, there are limited studies focusing on its sensitivity and specificity in specific clinical situations. No studies demonstrate that patient management based on the results of MRS improves patient outcomes. For example, MRI is a sensitive tool for identifying space-occupying CNS lesions, but it is relatively nonspecific in distinguishing between benign and malignant lesions. MRS can provide a chemical profile of the lesions that may help in this
determination. However, there are not sufficient data detailing the sensitivity and specificity of MRS in distinguishing benign and malignant lesions. (3, 4) In known malignancies, MRS has been used to assess tumor histology before resection. (5-8) However, this information may not always influence treatment decisions. For example, the standard approach to CNS tumors is complete surgical resection—exact tumor histology may not be necessary. (9) In this setting, a high negative predictive value is probably the most critical statistic, so there is a minimal chance of missing a diagnosis of malignancy. After initial treatment, the distinction between tumor recurrence and radiation necrosis is frequently a difficult clinical issue. However, there are not sufficient data about whether MRS can be used to make this distinction. (10)

Lack of definitive studies demonstrating clinical value of MRS extends to its use in multiple sclerosis, cerebrovascular injury, prostate cancer, breast cancer, and mitochondrial disorders. A 2003 TEC Assessment concluded that MRS does not meet TEC criteria for evaluation of suspected brain tumors. (11) The Assessment identified 7 studies including a total of 271 subjects. MRS would be judged to produce a beneficial effect on a health outcome if MRS correctly determines the presence or absence of a tumor and avoids the need for a brain biopsy.

One study of 12 children treated with radiation for a brain tumor had an MRI suggestive of either progressive/recurrent tumor or delayed cerebral necrosis. (12) MRS identified 5 of 7 recurrent tumors, for a sensitivity of 71%. MRS identified 4 of 5 cases (80%) of delayed necrosis, and a fifth case was considered inconclusive.

Five studies evaluating a heterogeneous group of patients, some with known prior tumor, some with unknown new masses, showed variable diagnostic test characteristics for MRS with sensitivities ranging from 79% to 100% and specificity ranging from 74% to 100%. (13-18) The positive predictive value ranged from 92% to 100%, while the negative predictive value ranged from 60% to 100%. The wide range reported for diagnostic performance in these studies may reflect heterogeneous groups of patients, differences in MRS protocols, or both.

One study evaluated 51 patients with intracranial cystic lesions. (18) MRS properly assigned the correct diagnosis in 47 of 51 patients (92%). However, MRS interpretation was based on investigator judgment, rather than on formal criteria.

Summary
The available studies all have some degree of shortcomings, and the overall body of evidence does not provide strong and consistent evidence regarding the diagnostic test characteristics or clinical utility of MRS for any condition. Studies of diagnostic performance often included a heterogeneous mix of patients that had clinically important differences and did not clearly delineate how MRS information would be used to guide patient management. Furthermore, differences in MRS technique and methods of analysis across studies made it difficult to synthesize findings from different studies.

2005 Update A search for pivotal publications on the use of MRS for several conditions did not find any studies for the use of MRS for any condition that provide strong evidence for clinical utility.

2006 Update A search for key publications on the use of MRS did not find any studies that provide strong evidence for its clinical utility. A recent systematic literature review on MRS for the characterization of brain tumors concluded that the evidence on MRS for characterizing brain tumors is promising, but that additional high-quality studies are needed. (19) Many of the articles reviewed were flawed, in some cases because of research design and in other cases because key information needed to evaluate the study was not reported (e.g., how many days elapsed between the imaging test and the biopsy, which served as the reference standard). A search of studies published after the period covered by the systematic review (2005–2006) (e.g., 20, 21) did not identify any that provided sufficient evidence to alter the conclusions of this policy.
The utility of MRS has also been investigated for identifying whether prostate cancer is confined to the organ, which has implications for prognosis and treatment. Wang et al. (22) found that the addition of MRI findings—both endorectal MRI and MRS—improved the accuracy of the staging nomograms traditionally used to predict the likelihood of organ-confined prostate cancer. Although the study was not ideally designed to assess the incremental value of MRS over MRI alone, it found that the area under the ROC curve was larger when MRS was included, but the difference was not statistically significant.

Another use of MRS that is being investigated is to improve the specificity of MRI of the breast. One of the weaknesses of MRI of the breast is that it has a high false-positive rate. Bartella et al. conducted a preliminary study using MRS to evaluate suspicious lesions 1 cm or larger identified on MRI. (23) They found that the addition of MRS increased the specificity of MRI in the specific population examined to 88% (23/26) and could have prevented unnecessary biopsies; the sensitivity was 100% (31/31). As the authors note, these findings need to be confirmed in larger studies and with a more diverse set of lesions. In particular, their sample only included 1 ductal carcinoma in situ (DCIS), and other studies have suggested that the choline peak they used to indicate a positive MRS result may be less likely to occur with DCIS.

2008 Update Although a number of studies have examined the use of MRS to differentiate between brain tumor recurrence and radiation necrosis, the cumulative evidence is weak. The studies tend to have small sample sizes (24, 25); they provide incomplete histopathologic data to serve as the reference standard (26); they find that combined imaging modalities, such as MRS and perfusion MRI or diffusion-weighted MRI outperform MRS by itself (27, 28); or they identify the patterns of interest and the cutoff values for making a diagnosis without providing validation studies (29, 30). In some cases, a mixed reference standard is used, with histopathologic findings for lesions that are excised, biopsied, or reviewed at autopsy and longer follow-up for patients not undergoing surgery (27, 29). Although having a mixed reference standard is not optimal, it may be the only feasible option in patients with brain tumors, some of which are located in parts of the brain not amenable to surgery. Some studies report mostly on primary brain tumors (27, 31), while others focus mostly on metastases of cancers in other parts of the body (24, 26). Studies on the use of MRS to categorize newly diagnosed brain tumors (31); to distinguish between tumors and abscesses or other infectious processes (32); or to diagnose mitochondrial diseases (33) identify the MRS patterns associated with each type of lesion but once again do not include the necessary validation study or they report MRS findings that overlap across the categories of interest. Many are also retrospective (e.g., 29, 32). Preliminary studies done in Asia with a 3T MRI machine for detecting tumor versus radiation injury reported diagnostic quality MRS studies in 26/28 (93%) cases, and the sensitivity and specificity for those 26 patients based on cutoffs identified in the study were 94.1% and 100%. (31; see also 27). Validation studies using the same cutoffs in larger samples are needed. (31)

No studies were found that provide sufficient evidence to warrant a change in the policy.

2009 Update The results of the American College of Radiology Imaging Network (ACRIN) study 6659 were published in April 2009. This prospective, multicenter study compared the use of MRI with and without MRS to identify the extent of prostate cancer by sextant prior to prostatectomy in 134 patients. (34) The results from centralized histopathologic evaluation of prostate specimens served as the reference standard; MRI and MRS images were independently reviewed by 8 readers. With complete data on 110 patients, no difference was found in the area under the receiver operating characteristic curve (ROC) for MRI alone versus MRI and MRS combined. That is, the use of MRS provided no incremental value in identifying the extent of prostate cancer.

In a meta-analysis of 7 studies (of 140 screened) on using MRS to diagnose prostate cancer, the pooled weighted sensitivity was 0.82 (95% CI: 0.73–0.89); specificity, 0.68 (95% CI: 0.58–0.76); and the area under the curve, 83.40. (35) All of these results are based on a cutoff for identifying “definitive” tumor of 0.85 for the ratio of (choline + creatine) to citrate.

The possibility of using MRS to track treatment response and failure continues to be explored. A small (n=16), preliminary study of tamoxifen treatment for recurrent gliomas found MRS patterns differed between
responders and nonresponders. (36) Serial MRS demonstrated that metabolic spectra stabilized after initiation of therapy among responders and then changed in advance of clinical or radiological treatment failure. In other words, MRS might help predict imminent treatment failure.

Research continues on using MRS to identify dementia, especially in its early stages. A community-based study was conducted to evaluate whether MRS could distinguish between patients with normal cognition (Group 1), dementia (Group 2), or mild cognitive impairment (MCI; Group 3) in a population with a low Mini-Mental State Examination (MMSE) score. (37) From an initial population of 215 with low MMSE scores, MRS results were obtained for 56 patients. Comparing MRS to clinical diagnoses, the results were mixed for MRS, with statistically significant differences in metabolic patterns between patients with dementia (Group 2) and patients without dementia (Group 1 and Group 3) but not between patients with MCI and those with normal cognition (Group 1 vs. Group 3).

The National Comprehensive Cancer Network’s clinical practice guidelines on central nervous system tumors identifies MRS, along with MR perfusion or PET, as a modality that can be considered to rule out radiation necrosis, as compared to recurrence of brain tumors. (38) The authors also state that it may be helpful in grading tumors or assessing response, and that the most abnormal area on MRS would be best target for biopsy. The limitations include tumors near vessels, air spaces, or bone; the extra time required in an MRI machine; and the limitations occurring with any MRI, such as the exclusion of patients with implantable devices. The guidelines on prostate cancer and breast cancer do not mention MRS (see www.nccn.org).

The American College of Radiology updated its practice guideline on MRS of the central nervous system in 2008. (39) Most of the guideline is devoted to the actual performance of MRS, but it also lists 22 possible indications for MRS when MRI or CT is inadequate for answering specific clinical questions.

No studies were identified during this update that provide sufficient evidence to warrant a change in the current policy.

**Physician Specialty Society and Academic Medical Center Input**

In 2008, in response to requests, input was received from 3 physician specialty societies and 1 academic medical center while this policy was under review. While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process, through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted. The input received from these reviewers disagreed with the conclusions in the policy statement. In particular, information provided was in support of MRS in differentiating radiation necrosis from recurrent tumor and in the differential diagnosis of certain CNS tumors from non-tumors.

**Medicare Policy**

In January 2004, Medicare issued a decision memorandum for MRS for brain tumors that reaffirmed its national noncoverage determination. (40) After reviewing updated literature, a technology assessment it commissioned from the Agency for Healthcare Research and Quality, and the BCBSA TEC Assessment, Medicare found that there was not adequate evidence to conclude that MRS is reasonable and necessary for the diagnosis of brain tumors.

**References:**


16 Recommendations from Colin McDonald, MD, Massachusetts General Hospital; Electric Blue Review 1/01.

19 Radiology 1998 Apr; 207:21-32. Half-Fourier RARE MR cholangiopancreatography: Experience in 300 subjects. This study reported on (n=256) patients with suspected biliary or pancreatic ductal disease and (n=35) asymptomatic patients. Summary: The authors reported 100% specificity and 100% sensitivity. Evidence showed that MCRP is an excellent alternative to ECRP (endoscopic retrograde cholangiopancreatography), particularly in patients not requiring therapeutic intervention by ECRP.

20 Recommendations from Tal Geva, MD Pediatric Cardiologist, Children’s Hospital; MPG 11/01. Dr. Geva noted that this technique is helpful in any clinical circumstance in which the amount of blood flow across a valve or a vessel needs to be determined. Flow velocity mapping MRI is currently the most accurate non-invasive technique to quantify blood flow in a specific location within the cardiovascular system. The specific clinical circumstances are numerous and the list below is not all-inclusive:
- Quantification of mitral, aortic, pulmonary, or tricuspid valve insufficiency
- Quantification of left-to-right or right-to-left shunt (Qp/Qs)
- Congenital heart disease
- Flow quantification to a specific vascular bed (e.g., blood flow to each leg in a patient with a lower extremity hemangioma or another tumor)
- Flow reserve in response to pharmacological stress (e.g., dipyridamole coronary flow reserve).
- Quantification of cardiac output
- Quantification of pulmonary blood flow (right lung versus left lung).

The medical literature reviewed included:

BCBSMA approved diagnoses for MRI: BRAIN (70551, 70552, and 70553)

Note: These clinical indications are applied to commercial products.

In accordance with local Medicare and CMS guidelines for our Medicare HMO Blue, and Medicare PPO Blue members, we cover magnetic resonance imaging (MRI) for indications that are considered medically necessary and accepted in clinical practice.

013.00-013.46, 013.60-013.96, 036.0-036.1, 036.3. 042, 046.0, 046.11-046.19, 046.2046.8, 048, 052.0, 053.0-053.10, 054.3-054.72, 055.0, 056.00-056.01
140.0-140.9, 141.0-141.9, 142.0-142.9, 143.0-143.9, 144.0-144.9, 145.0-145.9, 146.0-146.9, 147.0-147.9, 148.0-148.9, 149.0-149.9, 160.0-161.9,162.2-162.9, 170.0-170.2, 171.0-171.9, 172.0-172.4, 172.8-172.9, 173.00-173.49, 173.8- 173.9, 174.0-174.9, 175.0-175.9, 176.0-176.2, 176.5-176.9, 190.0-190.9, 191.0-191.9, 192.0-192.9, 194.8, 195.0, 196.0, 198.3-198.5
200.00-200.88, 201.00-201.98, 202.00-202.68, 202.80-202.88, 204.00-204.91, 205.00-205.81, 225.0-225.9, 227.3-227.6, 228.02-228.03, 228.09, 235.0-235.6, 237.0, 237.4-237.6, 237.71-237.72, 237.9, 239.1, 239.6, 239.7, 253.0-253.8, 257.2 259.1, 277.30, 290.0, 290.10-290.13, 290.20-290.21, 290.3, 290.40-290.43, 290.8, 290.9, 293.0-293.9, 294.0-294.11, 294.8, 298.1, 298.9, 299.00-299.01
320.0-320.89, 321.0-321.8, 322.0-322.2, 322.9, 323.01-323.02, 323.1-323.2, 323.41-323.42, 323.51-323.52, 323.61-323.63, 323.71-32372, 323.81-323.82, 323.9, 324.0-324.1, 324.9, 325, 326, 330.00-330.8, 330.9, 331.0-331.9, 332.0-332.1, 333.0-333.91, 333.92, 333.93, 333.99, 334.0-334.8, 334.9, 335.22, 335.23, 340, 341.0-341.1, 341.20-341.22, 341.8, 341.9, 344.81, 345.00-345.91, 346.00-346.81, 347.00-347.11, 348.0-348.2, 348.30-349.39, 348.4-348.9, 349.1-349.2, 349.89, 350.1, 350.9, 349.81-349.82, 351.0, 351.1, 351.8, 351.9, 352.0-352.9, 358.0-358.1, 368.10-368.16, 368.2, 368.41-368.42, 368.44, 368.45, 368.46, 368.47, 377.00-377.04, 377.10, 377.11, 377.23, 377.30, 377.49, 378.50, 378.51, 378.52, 378.54, 386.00-386.03, 386.10-386.19, 386.2, 388.5, 389.10, 389.11, 389.12, 389.13, 389.14, 389.15, 389.16, 389.17, 389.18, 389.20, 389.21,389.22, 389.8, 389.9
430-438.0, 438.10-438.89, 448.0
739.0, 740.1, 740.2, 742.1-742.4, 747.81, 758.0, 758.81-758.89, 758.9, 759.5-759.6, 767.0, 767.11-767.19, 767.7-767.8, 768.2-768.9, 780.01, 780.02, 780.03, 780.09, 780.2, 780.31-780.39, 780.4, 780.60-780.62, 780.64-780.65, 781.3, 781.91, 781.92, 781.99, 782.0, 783.5, 784.0, 784.2, 784.3, 784.51-784.59, 786.03, 786.04, 786.8, 888.42, 793.0, 794.00-794.2, 797
Clarified 5/2009: updated covered indications for MRI brain,

- 094.1 (Neurosyphilis-general paresis)
- 291.2 (alcohol induced persisting dementia)
- 342.00-342.02, 342.1-342.12, 342.8-342.82, 342.90-342.92
- 343.0-343.9 (Infantile cerebral palsy-paralysis)
- 344.00-344.09, 344.1, 344.2, 344.30-344.32, 344.40-344.42, 344.5 (Other paralytic syndromes)
- 350.1-350.9 (Trigeminal nerve disorders)
- 351.0-351.9 (Facial nerve disorders)
- 359.3 (Muscular dystrophies-periodic paralysis)
- 379.50-379.59 (Nystagmus and other irregular eye movements)
- 386.04, (vertiginous syndromes)
- 388.30-388.32 (Tinnitus)
- 741.00-741.03 (Chiari malformations),
- 742.0 (Encephalocele, holoprosencephaly, macrocephaly, microcephaly, schizencephaly)
- 767.5 (Birth trauma-facial nerve injury)
- 781.1 (Disturbance-smell)
- 781.2, (Abnormal gait, lack of coordination)
- 781.4 (Transient paralysis of limb)
- 781.7 (Tetany)
- 907.1 (Late effect of injury to cranial nerve)

Developmental delay
- 315.00-315.09, 315.1, 315.2, 315.31-315.39, 315.4, 315.5, 315.8, 315.9

Encephalopathy
- 277.87 (mitochondrial)
- 310.2 (post contusion syndrome)
- 323.61 (acute necrotizing)
- 348.30-348.39 (encephalopathy not elsewhere classified)
- 349.82 (toxic)
- 437.2 (hypertensive)
- 487.8 (flu with encephalopathy)
- 572.2 (hepatic)
- 774.7 (bilirubin)

23 BCBSMA approved ICD-9-CM diagnoses for MRI: ORBIT, FACE, and NECK (70540, 70542, and 70543)

Note: These clinical indications are applied to commercial products.
In accordance with local Medicare and CMS guidelines for our Medicare HMO Blue, and Medicare PPO Blue members, we cover magnetic resonance imaging (MRI) for indications that are considered medically necessary and accepted in clinical practice.

015.60, 017.20-017.26, 017.30-017.36, 017.40-017.46, 017.50-017.56, 039.3, 041.00-041.09, 041.11-041.19, 041.2-041.7, 041.81-041.89, 041.9, 053.20-053.29, 054.41-054.49, 077.0-077.98, 091.50-091.52, 098.40-98.49
135, 140.0-141.9, 142.0-149.9, 160.0-161.9, 170.0-170.1, 170.2, 170.9, 171.0, 171.8, 172.0, 172.1, 172.2, 172.3, 172.4, 172.8, 173.0-173.49, 176.0-176.9, 190.0-190.9, 192.0-192.9, 193, 194.1, 194.3, 194.5, 194.8, 195.0, 196.0, 196.8, 198.3, 198.4, 198.5

200.0, 200.01, 200.08, 200.11, 200.18, 200.21, 200.28, 200.81, 200.88, 201.01, 201.11, 201.18, 201.21, 201.41, 201.48, 201.51, 201.68, 201.71, 201.72, 201.78, 201.91, 201.98, 202.01, 202.02, 202.11, 202.18, 202.21, 202.28, 202.31, 202.38, 202.41, 202.48, 202.51, 202.58, 202.61, 202.68, 210.0-210.9, 212.0, 212.1, 212.2, 213.0, 213.1, 214.0, 215.0, 216.0, 216.1, 216.2, 216.3, 216.4, 224.0-224.9, 226, 227.1, 228.02, 228.03, 230.0, 231.0, 231.1, 232.0, 232.1, 232.2, 232.3, 232.4, 234.0, 234.8, 235.0, 235.1, 235.6, 237.4, 239.7, 239.89, 240.0-246.9, 252.0-252.9

322.9, 323.0-323.8, 323.9, 324.1, 349.1, 349.89, 350.1-350.9, 351.0-351.9, 352.0-352.9, 359.0-359.3, 360.00-360.81, 368.2-368.47, 375.12-375.16, 375.31-375.89, 376.00-376.9, 377.00, 377.01-377.16, 377.22, 377.24, 377.30-377.75, 378.11, 378.14-378.18, 378.20-378.22, 378.41-378.45, 378.50-378.56, 378.60-378.63, 378.71-378.73, 378.81-378.87, 379.12-379.54, 379.90-379.99, 380.00-380.10, 381.00-381.89, 382.00-382.4, 383.00-383.89, 385.00-385.89, 386.00-386.8, 388.31-388.32, 388.41-388.44, 388.5, 388.61-388.69, 388.71-388.72, 388.8, 389.01-389.20

433.10-431.11, 442.81, 461.0-461.8, 462, 473.1-473.8, 474.00-474.8, 475, 476.0-476.1, 478.11-478.19, 478.22-478.26, 478.30-478.34, 478.4, 478.5

519.8, 524.01-524.09, 524.11-524.19, 524.20-524.29, 524.4-524.5, 524.61-524.62, 526.1-526.89, 527.0-527.8, 528.00-528.09, 528.3

683

722.0, 722.71, 729.2, 733.3, 743.03-743.06, 743.11-743.12, 743.21-743.22, 743.31-743.39, 743.41-743.49, 743.51-743.59, 743.8, 744.00-744.09, 744.1-744.29, 744.41-744.49, 744.5, 744.81-744.89, 748.0-748.3, 754.0, 784.2, 784.7, 784.8, 784.91-784.99, 786.1, 787.20-787.29

802.4, 802.5, 802.6, 802.7, 802.8, 803.00-803.99, 804.00-804.84, 830.0-830.1, 806.00-806.09, 806.10-806.19

900.00-900.9, 920, 921.0-921.3, 925.1-925.2, 933.0-933.1, 950.0-950.3, 951.0-951.8

V10.01, V10.02, V10.12, V10.21, V10.22, V10.81, V10.82, V10.83, V10.84, V10.85, V67.00, V67.09, V67.1, V67.2

202.80, 202.81, 227.5, 227.6, 228.09, 237.3, 237.70, 342.90, 348.0, 348.1, 348.4, 369.00, 369.61, 378.05

478.29, 478.74 722.4, 747.81, 759.89, 781.3, 784.3, V10.87

Clarified 5/2009: updated the covered indications for MRI, orbit, face, and neck.

**ICD-9-CM diagnoses:**
- 338.18, (pain not elsewhere classified, other acute post-op pain)
- 338.19, (pain not elsewhere classified, other acute post-op pain)
- 338.28, (pain not elsewhere classified, other acute pain)
- 338.3, Neoplasm related pain (acute) (chronic)
- 388.70, Otelgia, unspecified
- 472.1, Chronic pharyngitis
- 472.2, Chronic nasopharyngitis
- 784.0, Headache, facial pain
- 784.1, Throat pain

24 BCBSMA approved diagnoses for MRI: ABDOMEN (74181, 74182, and 74183)
Note: These clinical indications are applied to commercial products.
In accordance with local Medicare and CMS guidelines for our Medicare HMO Blue, and Medicare PPO Blue members, we cover magnetic resonance imaging (MRI) for indications that are considered medically necessary and accepted in clinical practice

006.3, 007.1, 014.00-014.86, 015.00-015.06, 016.00-016.06, 017.20-017.26, 017.60-017.66, 031.2-031.9
038.40, 040.2, 041.86, 042, 083.8, 086.1-086.2, 093.0, 097.9
114.3, 121.1, 122.9, 127.2, 136.1, 150.2, 151.0-151.9, 152.0-152.9, 153.0-153.9, 154.0-154.8, 155.0-155.2
156.0-156.9, 157.0-157.9, 158.0-158.9, 159.0-159.9, 171.5, 172.9, 174.1, 174.9, 176.9, 179-189.9, 193, 194.0
195.2, 196.2, 197.6, 197.7, 197.8, 198.0, 198.5, 198.6, 198.7
200.00, 200.10, 200.20, 201.10, 201.90, 201.98, 202.00, 202.03, 202.05, 202.06, 202.07, 202.08,
202.63, 202.65, 202.66, 202.67, 202.68, 202.80, 203.00-203.01, 203.00-203.01, 211.0-211.9, 215.5, 218.9, 220, 223.0, 227.0
228.04, 228.1, 230.2-230.9, 233.1, 235.2, 235.3, 235.4, 235.5, 236.5, 236.91, 237.70, 255.10-255.14, 255.2
272.7, 275.01-275.09, 277.30
289.2, 289.59
440.0, 441.02, 441.3, 441.4, 441.6, 441.7, 442.1, 442.83, 442.84, 444.01, 444.09, 446.4, 447.4, 448.0, 457.1
530.0, 530.12, 530.7, 531.40-531.41, 531.50-531.51, 531.53, 531.55, 533.90, 535.20, 535.40-537.3, 537.89, 540.0, 540.1,
540.9, 541.543.9, 550.00-553.9, 555.0, 555.9, 557.9, 558.9, 559.0-560.9, 562.10, 562.11, 564.0-564.2, 564.09,
565.1, 567.21-567.29, 567.81-567.89, 567.9, 568.0, 568.81, 568.82, 568.89, 569.1, 569.5,
569.60, 569.81, 569.82, 569.89, 570.571.5, 571.6, 571.8, 572.0, 573.3, 573.4, 573.8, 574.00-
574.91, 575.0, 575.10-575.12, 575.2, 575.4, 575.5
575.6, 575.8, 575.9, 576.1, 576.2, 576.3, 576.8, 577.0-577.9, 578.0, 578.1, 578.9, 579.0, 579.3, 579.9,
581.0, 583.9, 584.5, 590.10, 590.2, 590.80, 591.0, 592.0, 592.1, 592.2, 592.3, 593.4, 593.5, 593.81, 593.89
594.8, 595.9, 596.6, 599.0, 599.70-599.72, 599.9
601.2, 608.83, 614.2, 617.0, 639.8, 646.60, 660.90, 660.91, 660.93, 665.50, 682.2, 682.9
710.1, 720.89, 724.2, 728.81, 728.9, 729.1, 729.30, 747.29, 747.60-
747.61, 747.69, 750.7, 751.2, 751.4, 751.5, 751.6, 751.9, 7571.7, 752.31-752.39,
753.0, 753.12, 753.16, 753.17, 753.3, 753.4, 759.0, 759.5, 759.6, 678.0, 678.2, 678.5, 678.7
787.03, 787.99, 788.0, 788.9, 789.00-789.09, 789.1, 789.789.30-789.39, 789.51, 789.59, 789.9, 790.5, 793.3,
793.4, 794.4, 794.8
863.0-863.99, 864.00-864.10, 864.10-864.19, 865.00-865.59, 865.10-865.19, 866.00-866.10, 866.10-866.70-867.9, 868.00-868.09, 868.10-868.19, 869.0, 869.1, 876.0, 879.2, 879.3, 879.7
935.2, 958.4, 958.5, 959.12, 995.81, 996.00, 996.1, 996.2, 996.30,
996.40-996.49 billed with V43.64, 996.44, 996.59, 996.80, 996.81,
996.86, 998.2, 998.4, 998.51-998.59, 998.9
V42.7, V42.83-V42.89, V43.64 (when billed with 996.40-996.49), V44.3
135, 155.0, 150.9, 154.0, 154.1, 155.1, 155.2, 162.5, 162.8, 162.9, 170.7, 171.6, 174.4, 199.1, 212.3, 239.0,
239.7, 259.2, 289.50, 289.9, 441.2, 444.9, 456.1, 456.8, 585.1-585.9, 589.0, 620.2, 654.13 753.10 V10.3,
V10.43, V10.47, V10.50, V10.51, V10.52, V10.53, V10.59, V42.0, V42.1, V45.3, V45.73, V59.4, V59.6, V70.8

25 BCBSMA approved diagnoses for MRI: SPINE (72141, 72142, 72146, 72147, 72148, 72149, 72156,
72157, and 72158)
Note: These clinical indications are applied to Commercial products, only. In accordance with local Medicare and CMS guidelines for our Medicare HMO Blue, and Medicare PPO Blue members, we cover magnetic resonance imaging (MRI) for indications that are considered medically necessary and accepted in clinical practice.

170.2, 170.6, 185, 186.0, 187.1-187.7, 191.0-191.8, 192.0-192.8, 193, 194.0-194.8, 195.0-195.1, 196.0-196.1 197.0-197.3, 198.3-198.5, 199.0,

200.00-208.91, 213.2, 225.3-225.4, 228.00-228.1, 229.0-229.9, 237.5-237.6, 322.0-322.9, 323.0-323.9, 324.1, 334.8, 336.0-336.9, 340, 341.0-341.9, 342.00-342.82, 344.00-344.9, 353.1, 353.2, 353.3, 353.4, 353.8, 357.0-357.9

709.2, 715.00,715.09, 715.10,715.18, 715.20,715.28, 715.30,715.38, 715.80,715.89, 715.90, 715.98, 720.0-720.9, 721.0 721.1-721.91, 722.0-722.93, 723.0-723.4, 723.9, 724.00-724.6, 724.71, 724.79, 724.9, 729.2, 730.00, 730.08, 730.09, 730.10, 730.18, 730.19, 730.20,730.28, 730.29, 730.35-730.39, 733.00-733.09, 733.10, 733.13, 733.19, 733.20-733.29 733.40, 737.10, 737.20-737.29, 737.30, 737.31-737.33, 737.41, 737.42, 737.43, 738.4, 738.5-738.6, 741.02-741.03 741.92-741.93, 742.51-742.59, 754.2, 756.10-756.19, 759.6, 796.1,

805.00-805.9, 805.10-805.18, 806.00-806.09, 806.10, 806.11, 806.12, 806.13, 806.14, 806.15, 806.16, 806.17, 806.18, 806.19, 806.20, 806.21, 806.22, 806.23, 806.24, 806.25, 806.26, 806.27, 806.28, 806.29, 806.30, 806.31, 806.32, 806.33, 806.34, 806.35, 806.36, 806.37, 806.38, 806.39, 839.00-839.18, 839.20-839.21, 839-30-839.31, 839.41-839.42, 839.50-839.52

952.00-952.09, 952.10-952.19, 953.0-953.8

V10.81, V67.00, V67.09, V67.1, V67.2

162.8, 162.9, 174.9, 191.9, 198.81, 199.1, 225.0, 225.2, 237.70, 237.71, 237.72, 239.6, 330.0, 332.0, 333.99, 334.9, 342.90, 348.0, 348.4, 348.81, 348.82, 348.89, 435.0, 435.1, 436, 596.54, 710.4, 719.7, 722, 723.8, 737.34, 741.00, 741.90, 759.89, 781.0, 876.0-876.1

Based on the September 2002 Medicare B Resource Newsletter. Policy effective 10/15/02. For additional information see www.cms.gov and www.medicarenhic.com

Medicare notes that MRI is considered medically necessary when its use is considered accepted in clinical practice, such as:

- To establish a diagnosis when the patient presents with signs, symptoms of disease or injury
- To monitor the effects of surgery, radiotherapy, or chemotherapy
- To evaluate the progression of disease, to stage neoplasms, or to assess trauma
- To assist in therapeutic decision-making.

Medicare policy is developed separately from BCBSMA policy. While BCBSMA policy is based upon scientific evidence, Medicare policy incorporates scientific evidence with local expert opinion, and governmental regulations from CMS (Centers for Medicare and Medicaid Services) and the US Congress. While BCBSMA and Medicare policies may differ, our Blue Care 65 (Medicare HMO Blue) and Medicare PPO Blue members must be offered the same services as Medicare offers. In many instances, BCBSMA policies offer more benefits than does Medicare policy.

Recommendations from the Director of Rheumatology at Children’s Hospital, November 2003.
BCBSMA approved diagnoses for MRA: Head and/or Neck (70544, 70545, 70546, 70547, 70548, and 70549)

Note: These clinical indications are applied to commercial products. In accordance with local Medicare and CMS guidelines for our Medicare HMO Blue, and Medicare PPO Blue members, we cover magnetic resonance angiography (MRA) for indications that are considered medically necessary and accepted in clinical practice.

ICD-9-CM diagnoses:
403.00, 403.10, 404.00-404.93, 405.01, 405.11, 440.0, 440.1, 441.00, 441.02, 441.03, 441.4, 441.7, 441.9, 442.1, 442.2, 442.83, 442.84, 443.22, 443.23, 444.0, 444.81, 446.7, 447.0, 447.3, 452, 453.0, 453.2, 453.3, 453.8, 456.5, 456.6, 459.2,

573.8, 576.2, 584.5-584.9, 585.1-585.9, 588.0-588.9, 589.0-589.9,

747.61, 747.62, 753.10,

902.31-902.39

V59.4

ICD-9-CM diagnoses:
- 155.0-155.2, Malignant neoplasm of liver
- 156.0-156.9, Malignant neoplasm, gallbladder and bile ducts
- 197.7, Secondary malignant neoplasm of the liver
- 197.8, Secondary malignant neoplasm of other digestive organs and spleen
- 211.5, Benign neoplasm of liver and biliary passages
- 228.04, Hemangioma, of intra-abdominal structures, peritoneum, retroperitoneal tissue

BCBSMA approved diagnoses for MRA: Abdomen (74185)

Note: These clinical indications are applied to commercial products. In accordance with local Medicare and CMS guidelines for our Medicare HMO Blue, and Medicare PPO Blue members, we cover magnetic resonance angiography (MRA) for indications that are considered medically necessary and accepted in clinical practice.

ICD-9-CM diagnoses:

- 155.0-155.2, Malignant neoplasm of liver
- 156.0-156.9, Malignant neoplasm, gallbladder and bile ducts
- 197.7, Secondary malignant neoplasm of the liver
- 197.8, Secondary malignant neoplasm of other digestive organs and spleen
- 211.5, Benign neoplasm of liver and biliary passages
- 228.04, Hemangioma, of intra-abdominal structures, peritoneum, retroperitoneal tissue
- 230.8, Carcinoma in situ of digestive organs- liver
- 239.0, Neoplasm of unspecified nature, digestive system
- 235.3, Neoplasm of uncertain behavior of liver
- 568.81, 568.82, 568.89, Other specified disorders of the peritoneum, (hemoperitoneum, peritoneal effusion-chronic, cyst/granuloma)
- 571.2, 571.5, 571.6, Chronic cirrhosis, alcoholic cirrhosis, cirrhosis of liver without mention of alcohol, biliary cirrhosis
- 573.8, other specified disorders of the liver, i.e. cyst
- 751.62, congenital cystic disease of the liver
- 864.00-864.19, Injury to liver
- V59.6, Donors, liver
- V70.8, Examination of potential donor of organ or tissue

33 **BCBSMA approved diagnoses for MRA: Chest (71555)**

**Note:** These clinical indications are applied to commercial products.

In accordance with local Medicare and CMS guidelines for our Medicare HMO Blue, and Medicare PPO Blue members, we cover magnetic resonance angiography (MRA) for indications that are considered medically necessary and accepted in clinical practice.

093.0, 353.0

441.01, 441.03, 441.1, 441.2, 441.6, 441.7, 441.9, 415.0, 415.11, 415.19, 416.0, 416.8, 416.9, 417.1, 442.82, 444.1, 453.81-453.89, 459.2,

747.10, 747.11

The following diagnoses are effective for coverage 12/2006:

424.1-424.3,

745.0, 745.10-745.19, 745.2-745.5, 745.60-745.9, 746.00-746.09, 746.1-746.7, 746.81-746.89, 746.9, 747.0, 747.10-747.11, 747.20-747.29, 747.31-747.39, 747.40-747.49, 747.60, 747.83, 747.89, 747.9, 756.83 759.82 759.89

The following diagnosis, effective 1/2007

446.7

34 Based upon the 2003 Blue Cross Blue Shield Association National policy 6.01.16. BCBSA offered the following rationale:

Diagnostic performance of MRA of the abdomen for evaluation of renal anatomy in potential living renal donors has improved with the evolution of contrast-enhanced MRA techniques. Recent studies have shown contrast-enhanced MRA to have good sensitivity and specificity for detection of renal arterial and venous anomalies. Three studies reported sensitivity and specificity of 90% or higher for renal arterial anatomy. One study examined the ability of contrast-enhanced MRA to detect arterial, venous, ureteral, or parenchymal anomalies during the presurgical evaluation process for laparoscopic nephrectomy. This study found that preoperative MRA agreed completely with surgical findings in 21 of 28 cases (75%). In this study, the laparoscopic surgical procedure was successful in 27 of 28 cases (96%) and only 1 case required conversion to open nephrectomy, suggesting that some oversights on MRA may not be clinically significant. Furthermore, studies comparing contrast-enhanced MRA to alternatives such as computed tomographic angiography (CTA) and digital subtraction angiography have reported comparable results. However, concerns have been raised regarding the ability of MRA or CTA to detect mild or distal-moderate fibromuscular dysplasia (FMD) that can be seen on conventional renal angiography. The prevalence of FMD is about 2% to 6.6% in angiographic case
series, and it is unclear what effect donor nephrectomy may have on the subsequent development of hypertension in asymptomatic potential renal donors who have silent FMD.

References:


35 Based upon the 2003 Blue Cross Blue Shield Association National policy 6.01.16.

36 **MRV for pseudotumor cerebri:** Recommendations from 2005 Electric Blue Review and 2005 MPG-neurology meeting.

38 Based on Blue Cross Blue Shield Association National policy, 6.01.17, MRA of the chest for evaluation of pulmonary emboli in patients w/ contraindications to the use of IV iodinated contrast agents is considered investigational.

Rationale

MRA provides a reliable diagnostic assessment of acquired thoracic aortic diseases, vascular anomalies involving the great thoracic arteries and veins, and evaluation of the thoracic, systemic, and central veins for the diagnosis of thrombo-occlusive disease. However, the evaluation also concluded that diagnostic performance is not sufficiently accurate to allow replacement of pulmonary angiography in the diagnosis of pulmonary embolism (PE) in patients who have no contraindications to receiving IV iodinated contrast material. In this setting, MRA may be an acceptable alternative to angiography in patients who are allergic to or who have other contraindications (e.g., renal insufficiency) for iodinated contrast media. It should be noted that in all applications, MRA is considered an alternative to angiography. A 2003 review did not identify any published articles that addressed the limitations noted in the series of TEC Assessments; therefore, the policy statement is unchanged. Specifically, the appropriateness criteria of the American College of Cardiology (ACR) are consistent with the conclusions of the TEC Assessment. (5) For example, the ACR appropriateness criteria offer the following statement regarding MRA in a patient with suspected pulmonary embolism. “MRA is not indicated in the routine evaluation of patients with suspected pulmonary embolism…currently it is mainly used in certain centers with particular interest and expertise, and in patients in whom contrast administered for helical CT scans or even for pulmonary angiography is thought to be contraindicated….”

**2005 Update**

The literature was searched for the period of 2003 through November 2004, with a particular focus on MRA of the chest to detect pulmonary emboli. No published studies were identified that would prompt reconsideration of the
policy statement, which remains unchanged. Published studies do suggest that spiral CT scanning using multidetector CT has emerged as a noninvasive alternative to diagnostic pulmonary. Spiral CT scanning is widely available, and therefore, as noted in the policy statement, MRA would only be indicated in the subset of patients that have a contraindication to contrast media.

References:
1. 1997 TEC Assessment; Tab 8, MRA of the Chest-part I: Acquired Disease of the Thoracic Aorta
2. 1997 TEC Assessment; Tab 9, MRA of the Chest-part II: Developmental Anomalies of the Thoracic Vasculature
3. 1997 TEC Assessment; Tab 10, MRA of the Chest-part III: Systemic Venous Thrombosis of Occlusion
4. 1997 TEC Assessment; Tab 11, MRA of the Chest-part IV: Pulmonary Embolism
5. www.acr.org/dyna/?doc=departments/appropriateness_criteria/toc.html


Rationale
In evaluating this approach to imaging, it is important to first determine if positional magnetic resonance imaging (MRI) results in additional findings. However, it is also important to determine if treatment of these additional findings results in improved outcomes. This additional step is important given the previously described false-positive findings with MRI of the spine. Jarvik and colleagues reported that many MRI findings have a high prevalence in subjects without low back pain and that findings such as bulging discs and disc protrusion are of limited diagnostic use. They also reported that the less common findings of moderate or severe central stenosis, root compression, and disc extrusion were more likely to be clinically relevant. (1)

A number of studies have reported that positional MRI can identify abnormalities in patients in whom conventional (supine) MRI did not identify significant abnormal findings. Weishaupt and colleagues reported finding 13 instances of nerve root deviation in the seated extension position compared with 10 instances in the supine position in a group of 30 patients with chronic low back pain. (2) They also reported that positional pain score differences were related to foraminal size. Vitaz et al. reported changes in spinal cord compression, angulation, and alignment that occurred during physiologic movement in 20 patients with cervical spine disorders. (3) They reported excellent or good image quality in 90% of cases. Finally, Jinkins and colleagues concluded that supine MRI underestimated the presence and degree of gravity-dependent spinal pathology and missed pathology of a dynamic nature. (4) No studies were found that described clinical outcomes of patients whose treatments were selected on the new findings of positional MRI. In addition, the incremental benefit of this imaging in clinical practice is not yet known.

While this imaging approach is interesting, published results are in an early phase. Additional study is needed to first determine the characteristics of patients who might benefit from positional MRI studies. In addition, the clinical benefit of basing treatment decisions, including surgery, on these additional findings need to be established. Another concern that needs further study is that positional scans, which use lower strength magnets, may be of lesser quality than those from traditional supine MRI. Studies are also needed to determine if this technique might replace current diagnostic tests, such as myelography. Given this novel approach, randomized trials may be needed to adequately evaluate this technique.

2008 Update A search of the MEDLINE database for the period of January 2007 through February 2008 indicates that positional MRI remains in an early stage of development. One European study compared vertical (standing) MRI and recumbent MRI with axial loading in patients with lumbar spinal stenosis. (5) Sixteen patients with neurogenic claudication, experienced mainly during walking or in an erect position, were recruited for this phase of the study. Each patient underwent 4 scans with a 0.6 Tesla Upright MRI system, consisting of vertical, horizontal with compression at a load of 40% of body weight, horizontal with no load, and finally horizontal with a 50% axial load. All horizontal scans were conducted with a cushion placed below the lower back to induce extension of the lumbar spine. Results showed similar dural sac cross-sectional area
Another European study compared recumbent and upright-sitting positions in 89 patients with disc herniation or spondylolisthesis (cervical or lumbar spine). (6) Using a 0.6 Tesla Upright MRI system for both positions, pathology (disc herniation or spondylolisthesis) was identified in 68 patients (76%). Images from 18 (20%) patients were not interpretable due to motion artifact. Pathologic features were better identified (i.e., either only evident or seen to be enlarged) in 52 of the 68 (76%) patients when in the sitting position; 10 of these were only observed in the sitting position. Pathologic features were better identified in the recumbent position in 11 of the 68 patients (16%). The overall underestimation rate was calculated to be 62% for patients in the recumbent position and 16% for them in the upright-seated position. This early research suggests that there may be advantages when the position during imaging is matched with the positional symptoms of the patient. However, a more appropriate comparison group would be a standard recumbent clinical MRI system (e.g., field strength greater than 0.6 T). In addition, technical problems with motion artifact are due to poor stabilization in an upright-sitting position. Studies that correlate the positional MRI findings with patient symptoms and outcomes of treatment are also needed.

**2009 Update** An updated search of the literature for the period of March 2008 through March 2009 identified 1 study. Zou et al. conducted a quantitative comparison of axial-loaded MRI in neutral, flexion, and extension positions. (7) The study included 553 patients (mean age, 46 years; range: 18–76 years) with symptomatic back pain with/without radiculopathy who were referred for kinetic/positional MRI (0.6 Tesla). The disc bulge on MRI in the 3 positions (neutral, flexion, and extension) was quantified by MRI analysis software, and the bulge size was compared independently by 2 spine surgeons who were unaware of the patient’s history and clinical findings. Increased disc bulge at extension and flexion, in comparison with neutral, was seen in 16% and 12% of discs, respectively. Diagnosis of grade 2 disc bulge that had been categorized as grade 1 in neutral position (i.e., missed diagnosis) was 19.5% for extension and 15.3% for flexion MRI. This study investigated the effect of position on imaging results but did not evaluate health outcomes. The authors noted that “physicians have been experimenting with ways of using MRI to obtain positional images of spine. To help in a better understanding of the pathophysiology of the spine, there seems to be a need for further developments in functional clinical imaging.”

**2010 Update** A search of the MEDLINE database for the period of April 2009 through February 2010 identified 2 studies using upright MRI for basic human research on the spine; no clinical trials using positional MRI were identified. Another study compared radiographs of a patient’s sagittal alignment in the standing posture with computed tomography scans of a patient’s alignment in the supine position when utilizing a commercially available compression device. (8) In the 14 healthy young volunteers studied, this particular device was found to simulate lumbar segmental alignment with standing for L1/2, L2/3, L3/4, and L4/5, but not for L5/S1.

**Clinical Input Received through Physician Specialty Societies and Academic Medical Centers**

While the various physician specialty societies and academic medical centers may collaborate with and make recommendations during this process through the provision of appropriate reviewers, input received does not represent an endorsement or position statement by the physician specialty societies or academic medical centers, unless otherwise noted.

In response to the request for input through Physician Specialty Societies and Academic Medical Centers, information was received from the American College of Radiology and 1 academic medical center while the policy was under review in 2008. Both reviews agreed that positional MRI is considered investigational.

**Summary** Overall, the literature indicates that this technology has potential benefit for some patients, but the specific procedures and indications have yet to be established. The scientific evidence at this time does not permit conclusions concerning the effect of this technology on health outcomes. Therefore, the use of positional MRI is considered investigational.
Technology Assessments, Guidelines and Position Statements

A 2007 health technology assessment from the Washington State Health Care Authority determined that there was insufficient evidence to make any conclusions about upright MRI’s effectiveness, including whether upright MRI: accurately identifies an appropriate diagnosis; can safely and effectively replace other tests; or results in equivalent or better diagnostic or therapeutic outcomes. (9) Evidence considered the most compelling for this decision included:

Technology is 10 years old, but no accuracy studies and very few reliability studies
Of the studies available, most were poor quality and sample sizes were very small
Image quality is lower and some evidence of higher percentage of individuals not being able to complete the test due to pain from positioning
Other tests are currently available for diagnosing same conditions, even though it was noted that those tests might also have limitations
One study that was of higher quality raised the possibility that upright MRI might be less beneficial due to decreased findings
There are no evidence based clinical guidelines addressing appropriate upright MRI usage.

Medicare National Coverage

No national coverage determination

References:


Based on the Blue Cross Blue Shield Association policy, Functional MRI, reviewed 6/2011.

Studies have summarized the high degree of concordance of language lateralization of functional MRI and either the Wada test or direct electrical stimulation. (1) In this summary, functional MRI was concordant with the Wada test in 78 of 83 (94%) cases and with direct electrical stimulation in 23 of 26 (88%) cases.

Sabsevitz and colleagues reported on a series of 24 consecutive patients who underwent both functional MRI and Wada testing before left anterior temporal lobectomy for seizure disorders. While both tests were predictive of language changes, in this study functional MRI had a sensitivity of 100% and specificity of 57%, while results for the Wada test were 100% and 43%, respectively. (2)
Medina and colleagues evaluated 60 consecutive patients prior to surgery. (1) In 53 patients language mapping was performed; in 33 motor mapping was done, and in 7 visual mapping was conducted. The functional MRI study revealed change in anatomic location or lateralization of language-receptive (Wernicke) in 28% of patients and in language-expressive (Broca) in 21%. In 38 (63%) patients, functional MRI helped to avoid further studies, including Wada test. In 31 (52%) and 25 (42%) of the patients, intraoperative mapping and surgical plans were altered because of functional MRI results.

Petrella and colleagues reported on the impact of functional MRI preoperatively on 39 consecutive patients with brain tumors. (3) In 4 patients, additional tests, e.g., the Wada test, were not ordered because of the functional MRI result. Treatment plans differed in 19 patients after functional MRI, with a more aggressive approach recommended after imaging in 18 patients. However, the impact of the altered treatment plans on patient outcome was not assessed. Functional MRI resulted in reduced surgical time for 22 patients; it also led to decisions to perform craniotomy in 13 patients in whom less invasive approaches had been initially planned.

Thus, studies show that functional MRI is comparable to the Wada test and direct electrical stimulation in localizing certain eloquent functions; although there are less data for direct electrical stimulation. In patients who are to undergo neurosurgery for seizures or brain tumors, functional MRI may obviate the need for these tests. However, the impact of functional MRI on other outcomes in these patients is uncertain.

2007-2008 Update  A search of the MEDLINE database was performed for the period of December 2006 through January 2008. Current research appears to focus on improving and establishing standardized protocols for pre-surgical evaluation of the eloquent cortex. One report described a routine preoperative functional MRI protocol in 81 consecutive patients (70 with tumors on the left side and 11 with tumors on the right side and language deficits). (4) Patients were trained to recall simple sentences (picture cues) or to generate words in a category (word cues). Although 11 patients were not able to complete the more cognitively demanding word generation task, the combination of tasks allowed localization of both the Broca and Wernicke areas and determination of hemispheric language dominance in 79 (98%) patients. Surgical plans were modified in 9 (11%) patients based on the functional MRI findings (7 patients underwent radiation therapy instead of surgery and 2 patients had partial resection of large malignant gliomas). Results of the surgeries were not described. The authors noted that although functional MRI is capable of localizing the center of a functional area, resection borders can not be reliably determined by this technique.

In another report the preoperative localization of epileptic focus was assessed in 29 complex cases (unclear focus and/or multifocality) that had been rejected for epilepsy surgery. (5) Patients were included in the study if they had no contraindications for MRI, had more than 10 interictal discharges in 40 minutes of previously recorded electroencephalogram (EEG), and if the reason for rejection was the inability to localize a single source with EEG. Functional MRI results were considered robust if a consensus-defined interictal electrical discharge was associated with a significant positive blood oxygen level-dependent (BOLD) response. In 8 (28%) patients, a robust functional MRI response was considered to be topographically related to interictal electrical discharges. The EEG-functional MRI findings improved localization in 4 of 6 unclear foci and advocated one of multiple foci in another patient; in 4 other patients multiple foci were confirmed. As a result of the testing, 4 patients (14%) were considered to be surgical candidates and 1 of the 4 had undergone surgery at the time of the publication. The authors of this European-based study describe this as the first report of the clinical use of EEG-functional MRI. Although promising, the use of functional MRI to localize epileptic foci requires additional study.

References:

ICD-9-CM diagnoses supporting clinical indications for Functional MRI (CPT codes 70554 and 70555) and associated service; CPT code 96020
191.0-191.9, malignant neoplasm of the Brain
345.00-345.91, epilepsy and recurrent seizures

Clinical indication: sudden onset of headache associated with exertion or positional changes based American Imaging Management (AIM) recommendations, and approval by the MPA Associate Medical Director, 12/2009.