

Clinical Appropriateness Guidelines: Advanced Imaging

Appropriate Use Criteria: Imaging of the Chest

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Description and Application of the Guidelines



AIM's Clinical Appropriateness Guidelines (hereinafter "AIM's Clinical Appropriateness Guidelines" or the "Guidelines") are designed to assist providers in making the most appropriate treatment decision for a specific clinical condition for an individual. As used by AIM, the Guidelines establish objective and evidence-based, where possible, criteria for medical necessity determinations. In the process, multiple functions are accomplished:

- To establish criteria for when services are medically necessary
- To assist the practitioner as an educational tool
- To encourage standardization of medical practice patterns
- To curtail the performance of inappropriate and/or duplicate services
- To advocate for patient safety concerns
- To enhance the quality of healthcare
- To promote the most efficient and cost-effective use of services

AIM's guideline development process complies with applicable accreditation standards, including the requirement that the Guidelines be developed with involvement from appropriate providers with current clinical expertise relevant to the Guidelines under review and be based on the most up to date clinical principles and best practices. Relevant citations are included in the "References" section attached to each Guideline. AIM reviews all of its Guidelines at least annually.

AIM makes its Guidelines publicly available on its website twenty-four hours a day, seven days a week. Copies of AIM's Clinical Appropriateness Guidelines are also available upon oral or written request. Although the Guidelines are publicly-available, AIM considers the Guidelines to be important, proprietary information of AIM, which cannot be sold, assigned, leased, licensed, reproduced or distributed without the written consent of AIM.

AIM applies objective and evidence-based criteria and takes individual circumstances and the local delivery system into account when determining the medical appropriateness of health care services. The AIM Guidelines are just guidelines for the provision of specialty health services. These criteria are designed to guide both providers and reviewers to the most appropriate services based on a patient's unique circumstances. In all cases, clinical judgment consistent with the standards of good medical practice should be used when applying the Guidelines. Guideline determinations are made based on the information provided at the time of the request. It is expected that medical necessity decisions may change as new information is provided or based on unique aspects of the patient's condition. The treating clinician has final authority and responsibility for treatment decisions regarding the care of the patient and for justifying and demonstrating the existence of medical necessity for the requested service. The Guidelines are not a substitute for the experience and judgment of a physician or other health care professionals. Any clinician seeking to apply or consult the Guidelines is expected to use independent medical judgment in the context of individual clinical circumstances to determine any patient's care or treatment.

The Guidelines do not address coverage, benefit or other plan specific issues. If requested by a health plan, AIM will review requests based on health plan medical policy/guidelines in lieu of AIM's Guidelines.

The Guidelines may also be used by the health plan or by AIM for purposes of provider education, or to review the medical necessity of services by any provider who has been notified of the need for medical necessity review, due to billing practices or claims that are not consistent with other providers in terms of frequency or some other manner.

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Administrative Guideline: Ordering of Multiple Studies



Requests for multiple imaging studies to evaluate a suspected or identified condition and requests for repeated imaging of the same anatomic area are subject to additional review to avoid unnecessary or inappropriate imaging.

Simultaneous Ordering of Multiple Studies

In many situations, ordering multiple imaging studies at the same time is not clinically appropriate because:

- Current literature and/or standards of medical practice support that one of the requested imaging studies is more appropriate in the clinical situation presented; or
- One of the imaging studies requested is more likely to improve patient outcomes based on current literature and/or standards of medical practice; or
- Appropriateness of additional imaging is dependent on the results of the lead study.

When multiple imaging studies are ordered, the request will often require a peer-to-peer conversation to understand the individual circumstances that support the medical necessity of performing all imaging studies simultaneously.

Examples of multiple imaging studies that may require a peer-to-peer conversation include:

- CT brain and CT sinus for headache
- MRI brain and MRA brain for headache
- MRI cervical spine and MRI shoulder for pain indications
- MRI lumbar spine and MRI hip for pain indications
- MRI or CT of multiple spine levels for pain or radicular indications
- MRI foot and MRI ankle for pain indications
- Bilateral exams, particularly comparison studies

There are certain clinical scenarios where simultaneous ordering of multiple imaging studies is consistent with current literature and/or standards of medical practice. These include:

- Oncologic imaging – Considerations include the type of malignancy and the point along the care continuum at which imaging is requested
- Conditions which span multiple anatomic regions – Examples include certain gastrointestinal indications or congenital spinal anomalies

Repeated Imaging

In general, repeated imaging of the same anatomic area should be limited to evaluation following an intervention, or when there is a change in clinical status such that imaging is required to determine next steps in management. At times, repeated imaging done with different techniques or contrast regimens may be necessary to clarify a finding seen on the original study.

Repeated imaging of the same anatomic area (with same or similar technology) may be subject to additional review in the following scenarios:

- Repeated imaging at the same facility due to motion artifact or other technical issues
- Repeated imaging requested at a different facility due to provider preference or quality concerns
- Repeated imaging of the same anatomic area (MRI or CT) based on persistent symptoms with no clinical change, treatment, or intervention since the previous study
- Repeated imaging of the same anatomical area by different providers for the same member over a short period of time

Administrative Guideline: Pre-Test Requirements



Critical to any finding of clinical appropriateness under the guidelines for specific imaging exams is a determination that the following are true with respect to the imaging request:

- A clinical evaluation has been performed prior to the imaging request (which should include a complete history and physical exam and review of results from relevant laboratory studies, prior imaging and supplementary testing) to identify suspected or established diseases or conditions.
- **For suspected diseases or conditions:**
 - Based on the clinical evaluation, there is a reasonable likelihood of disease prior to imaging; and
 - Current literature and standards of medical practice support that the requested imaging study is the most appropriate method of narrowing the differential diagnosis generated through the clinical evaluation and can be reasonably expected to lead to a change in management of the patient; and
 - The imaging requested is reasonably expected to improve patient outcomes based on current literature and standards of medical practice.
- **For established diseases or conditions:**
 - Advanced imaging is needed to determine whether the extent or nature of the disease or condition has changed; and
 - Current literature and standards of medical practice support that the requested imaging study is the most appropriate method of determining this and can be reasonably expected to lead to a change in management of the patient; and
 - The imaging requested is reasonably expected to improve patient outcomes based on current literature and standards of medical practice.
- If these elements are not established with respect to a given request, the determination of appropriateness will most likely require a peer-to-peer conversation to understand the individual and unique facts that would supersede the pre-test requirements set forth above. During the peer-to-peer conversation, factors such as patient acuity and setting of service may also be taken into account.

CPT Codes

- 71250..... Chest CT without contrast
- 71260..... Chest CT with contrast
- 71270..... Chest CT without contrast, followed by re-imaging with contrast
- G0297..... Low dose CT scan (LDCT) for lung cancer screening

Standard Anatomic Coverage

- Lung apices through costophrenic sulci
- Scan coverage may vary, depending on the specific clinical indication.

Technology Considerations

- In the majority of clinical situations, chest radiographs should be performed prior to advanced imaging with CT, preferably within 30 days of the chest CT exam request.
- CT chest is not appropriate for cardiac and coronary artery imaging. Please see guidelines for cardiac CT and CCTA.
- When the purpose of the study is imaging of the heart, including the coronary arteries, do not request both a chest CT and a dedicated cardiac/coronary artery CT.

Common Diagnostic Indications

Indications for chest CT are contained in general chest, pulmonary, mediastinal and hilar, pleural, chest wall and diaphragm.

General Chest

Broncho-pleural fistula

Congenital thoracic anomalies

Cough persisting three (3) or more weeks with normal chest X-ray

- Unresponsive to medical treatment and/or after evaluation for other causes (e.g., post-nasal drainage, asthma, gastroesophageal reflux disease and medication effects); **OR**
- Cough in immunosuppressed (e.g. HIV, after organ or bone marrow transplant, on infliximab or other tumor necrosis factor antagonists individual (In these individuals, a higher level of suspicion is warranted); **OR**
- Other etiologies for chronic cough which include, but are not limited to:
 - Smoking
 - Chronic bronchitis
 - Cough-inducing medications (e.g., ACE inhibitors)
 - Exposure to an environmental irritant
 - Respiratory infection
 - Neoplasm

Fever of unknown origin

- Lasting more than three weeks with exceptions for immunocompromised patients
- Following standard work-up to localize the source

Hemoptysis

- Following non-diagnostic chest radiographs

Horner's syndrome

Common Diagnostic Indications

Infectious and inflammatory processes when not otherwise specified

- For initial evaluation and surveillance

Note: This indication is for evaluation of infectious and inflammatory processes not specifically referenced elsewhere in this guideline (e.g., pneumonia complications, mediastinitis, sternal infection, lung abscess and empyema).

Lung abscess

Lung cancer screening

- For annual screening of lung cancer (**all of the following**)
 - Patient has no signs or symptoms suggestive of underlying cancer
 - Patient's age is equal to or greater than 55 and less than or equal to 80
 - There is at least a 30 pack-year history of cigarette smoking (and if former smoker, quit date is within previous 15 years)
 - Patient does not have a health problem that substantially limits life expectancy or the ability/willingness to undergo an intervention with curative intent

Note: One (1) pack-year of smoking equals smoking one pack (20 cigarettes) per day for one year or 7300 cigarettes annually. CT should be performed using a low-dose technique (LDCT).

Mediastinitis

- Includes:
 - Mediastinal infection/abscess
 - Fibrosing mediastinitis

Paraneoplastic syndrome with unknown primary

Note: This includes Lambert Eaton syndrome, myasthenia gravis, paraneoplastic cerebellar degeneration, opsoclonus-myoclonus ataxia, positive paraneoplastic panel, anti-GAD antibody syndrome (stiff-person's syndrome), voltage-gated K⁺ channelopathy (epilepsy syndrome), limbic encephalitis (rapidly progressive dementia syndromes with abnormal lumbar puncture), dermatomyositis/polymyositis, and anti-NMDA

Persistent pneumonia

- Repeat radiographs show no improvement following at least four (4) weeks of medical treatment
- Recurrent pneumonia in the same location within six months
- Patient is immunosuppressed

Pneumonia, complications

(any **one** of the following)

- Following non-diagnostic chest radiograph
- Immunosuppressed patient

Note: Complications of the mediastinum, lung parenchyma, or pleura include abscess, bronchopleural fistula, complicated or loculated parapneumonic effusion, empyema, necrotic pneumonia, and purulent pericarditis

Positive sputum cytology for malignancy

Post-operative or post-procedure evaluation

Preoperative or pre-procedure evaluation

Note: This indication is for preoperative evaluation of conditions not specifically referenced elsewhere in this guideline.

Pulmonary embolism

- For moderate or high clinical suspicion of pulmonary embolism or follow-up when recurrent thromboembolism is a concern in patients on adequate medical therapy

Common Diagnostic Indications

Sarcoidosis

- Initial evaluation and periodic follow-up

Sternal infection and dehiscence

Note: Rare complication of cardiothoracic surgery

Structural abnormalities on chest X-ray, which require further clarification with CT

Trauma

- Injury involving the chest wall, cardiomeastinal structures and/or lungs

Tumor (primary neoplasm or metastatic disease)

Management of biopsy-proven malignancy

- For renal cell carcinoma (where biopsy is contraindicated) when surgical resection is planned, ultrasound or CT findings highly suspicious for cancer may constitute documentation of malignancy

Exclusions—advanced imaging is not indicated in the following scenarios:

- Breast cancer
 - Staging of low risk breast cancer (stage 2B or less) in the absence of signs or symptoms suggestive of metastatic disease
 - Surveillance of breast cancer in the absence of signs or symptoms of recurrent disease
- Colon cancer
 - Surveillance imaging of colon cancer in remission, **unless one of the following high risk features is present:**
 - Lymphatic or venous invasion
 - Lymph node involvement
 - Perineural invasion
 - Poorly differentiated tumor
 - T4 tumor
 - Associated with bowel obstruction
 - Close, indeterminate or positive margins
 - Fewer than 12 nodes examined at surgery
 - Localized perforation
- Gynecologic malignancies
 - Surveillance imaging in patients with previously treated gynecologic malignancies including ovarian, endometrial, cervical, vaginal or vulvar cancer (**Note:** This exclusion does not apply to sarcoma or other rare histologies not typically associated with these structures).
- Non-Hodgkin's lymphoma
 - Surveillance imaging of non-Hodgkin's lymphoma for a patient in remission and there has been at least two (2) years since the most recent course of chemotherapy
- Prostate cancer
 - Staging of low risk prostate cancer: Gleason score equal to six (6), PSA less than 10 ng/mL, and stage T1 or T2
 - Follow up or surveillance of prostate cancer following completion of therapy in the absence of a rising PSA

Note: Surveillance applies to patients with no signs or symptoms of recurrent or persistent disease.

Unexplained weight loss – significant weight loss exceeding 10% of desirable body weight, over a short time interval (6 months or less), after initial evaluation for other causes

Common Diagnostic Indications

Pulmonary

Asbestos-related benign and malignant lesions, involving the lungs and pleura

- Pleural plaques
- Interstitial lung disease
- Malignant mesothelioma
- Pleural effusion
- Lung cancer

Bronchiectasis

- Consider high resolution chest CT (HRCT) technique

Interstitial lung disease / pulmonary fibrosis

- Consider high resolution chest CT (HRCT) technique

Occupational lung disease (pneumoconioses)

- Diagnosis and management of any one of the following:
 - Silicosis
 - Coal workers pneumoconiosis
 - Progressive massive fibrosis
 - Hard metal pneumoconiosis
 - Talcosis
 - Caplan's syndrome (in patients with Rheumatoid Arthritis)

Pulmonary mass or suspicious parenchymal abnormality on recent chest X-ray or other imaging exam

Pulmonary nodule(s) – without a known primary malignancy

A nodule is defined as a rounded or regular opacity measuring up to 3 cm in diameter. Nodules are classified as solid or subsolid. Solid nodules are further classified as calcified or non-calcified. Follow-up recommendations are based on classification, as well as patient risk stratification. For calcified nodules, risk may be correlated with patterns of calcification. Those nodules with benign-appearing calcifications do not generally require follow up.

In patients under the age of 35 years, primary lung cancer is rare, and the risks associated with radiation exposure are increased. Therefore, patients in this age range fall outside of the recommendations established by the Fleischner Society with regard to follow up.

Patients who are immunosuppressed, or who have known or prior malignancy, or who have growing nodules are excluded from Fleischner Society recommendations. In these patients, follow-up imaging is at the discretion of the treating physician.

Follow-up imaging of multiple nodules should be based on the recommendations pertinent to the most suspicious nodule.

An incomplete thoracic CT refers to a CT that includes only a portion of the lung parenchyma such as a CT or CTA of the abdomen, neck or extremity.

Common Diagnostic Indications

Non-calcified nodules

- Age < 35 years:
 - Nodules \geq 1 cm
 - Nodules with suspicious morphology
- Age 35 years or older:
 - Solid nodules – see Table 1
 - Subsolid nodules – see Table 2

Nodules identified on incomplete thoracic CT

- Less than 6 mm – no follow-up imaging required
- 6 mm to 8 mm – 3- to 12-month follow up with complete chest CT with subsequent follow up per Table 1 or Table 2
- More than 8 mm or suspicious morphology – complete chest CT with subsequent follow up per Table 1 or Table 2

Calcified nodules

- Nodules with benign calcification patterns do not require routine follow up. This includes granulomas and nodules with popcorn calcifications.
- Follow up of nodules with other types of calcification patterns is at the discretion of the ordering provider.

Table 1: Follow-up recommendations for solid non-calcified pulmonary nodules

Solid nodule size	Risk factors	Solitary	Multiple
Less than 6 mm	Low	No follow up	
	High*	Optional follow-up exam at 12 months	
6 mm to 8 mm or Lung-RADS 3	N/A	1) 6 to 12 months 2) 18 to 24 months	1) 3 to 6 months 2) 18 to 24 months
More than 8 mm	N/A	1) 3 months 2) 6 months 3) 18 to 24 months unless diagnostic PET-CT or tissue sampling performed	
Any size when prior imaging has documented 24 months of stability	N/A	No follow up	

*High risk is defined by any of the following:

- Smoking history (any)
- First-degree relative with lung cancer
- Significant exposure to asbestos, uranium and/or radon, typically through high risk profession

Table 2: Follow-up recommendations for subsolid non-calcified pulmonary nodules

Subsolid nodule size	Solitary ground glass	Solitary part solid	Multiple subsolid
Less than 6 mm	No routine follow up	No routine follow up	1) 3 to 6 months 2) 24 months 3) 48 months
Greater than or equal to 6 mm or Lung-RADS 3	1) 6 to 12 months 2) Every 2 years thereafter for a total of 5 years	1) 3 to 6 months 2) Every year for 5 years	1) 3 to 6 months 2) Follow up based on most suspicious nodule (part solid or ground glass)

Tables 1 and 2, Abbreviation: Lung-RADS™, American College of Radiology Lung CT Screening Reporting and Data System. Adapted from MacMahon H, Naidich DP, Goo JM, et al. Radiology. 2017;284(1):228-243.

Pulmonary sequestration

Common Diagnostic Indications

Mediastinal and Hilar

Hilar enlargement on recent chest X-ray

Hoarseness, dysphonia or vocal cord weakness/paralysis

Initial evaluation when **at least one** of the following applies:

- Following laryngoscopy, when findings suggest recurrent laryngeal nerve dysfunction or identify a suspicious lesion
 - Symptoms persisting longer than one month which are unexplained by laryngoscopy
 - Presence of **at least one** of the following high-risk features:
 - Tobacco use
 - Alcohol abuse
 - Hemoptysis
 - History of radiation therapy
 - Known head and neck malignancy
-

Known hilar and/or mediastinal lymphadenopathy / mass

- Periodic follow-up
-

Mediastinal widening on recent chest X-ray

Penetrating atherosclerotic aortic ulcer

Superior vena cava (SVC) syndrome

Thoracic aorta evaluation

Acute aortic syndrome (any **one** of the following)

- Diagnosis and management
- Periodic surveillance in patients with established acute aortic syndrome undergoing medical management

Note: *Initial diagnosis of acute aortic syndrome is considered a medical emergency. This indication includes aortic rupture, dissection, pseudoaneurysm, mural hematoma, and penetrating ulcer mediastinal hematoma.*

Non-acute thoracic aorta (any **one** of the following)

- In patients with suspected thoracic aortic aneurysm
- In patients with confirmed thoracic aortic aneurysm with new or worsening signs/symptoms
- For ongoing surveillance of stable patients with confirmed thoracic aortic aneurysm who have not undergone imaging of the thoracic aorta within the preceding six months
- In patients with confirmed aortic dissection in whom surgical repair is anticipated (to assist in preoperative planning)
- For ongoing surveillance of stable patients with confirmed aortic dissection who have not undergone imaging of the thoracic aorta within the preceding year
- In patients with confirmed aortic dissection or thoracic aortic aneurysm who have undergone surgical repair within the preceding year and have not undergone imaging of the thoracic aorta within the preceding six months
- In patients being evaluated for potential transcatheter aortic valve implantation/replacement (TAVI or TAVR) provided that the patient has not undergone CTA or MRA of the chest within the preceding 60 days

Note: *See acute aortic syndrome (section above) for complications of aneurysm including aortic dissection.*

Thymoma

- Note that approximately 15% of patients with myasthenia gravis will have a thymoma
-

Tracheobronchial lesion evaluation

Common Diagnostic Indications

Traumatic aortic injury

Vasculitis of the thoracic aorta or branch vessel

Pleural, Chest Wall and Diaphragm

Abnormal pleural fluid collection, including effusion, hemothorax, empyema and chylothorax

Note: Ultrasound should be considered as the initial imaging modality and prior to a diagnostic or therapeutic pleural tap.

Chest wall mass

Diaphragmatic hernia

Pleural mass

Pneumothorax – unexplained or recurrent

Thoracic outlet syndrome

Unexplained diaphragmatic elevation or immobility

References

1. Akira M, Yamamoto S, Inoue Y, Sakatani M. High-resolution CT of asbestosis and idiopathic pulmonary fibrosis. *AJR Am J Roentgenol.* 2003;181(1):163-169.
2. Alkadhi MD, Wildermuth S, Desbiolles L, et al. Vascular emergencies of the thorax after blunt and iatrogenic trauma: multi-detector row CT and three-dimensional imaging. *Radiographics.* 2004;24(5):1239-1255.
3. American Academy of Otolaryngology — Head and Neck Surgery Foundation. Choosing Wisely: CT scans or MRIs for Hoarseness. ABIM Foundation; February 21, 2013. Available at <http://www.choosingwisely.org/clinician-lists/american-academy-otolaryngology-head-and-neck-surgery-ct-scans-or-mris-for-hoarseness/> Accessed August 25, 2016.
4. American College of Radiology. ACR-NASCI-SPR Practice Parameter for the Performance AND Interpretation of Cardiac Magnetic Resonance Imaging (MRI) . Revised 2016. Available at http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/MRI_Cardiac.pdf. Accessed August 26, 2016.
5. American College of Radiology. ACR-NASCI-SPR Practice Parameter for the Performance of Body Magnetic Resonance Angiography (MRA). Revised 2015. Available at http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/Body_MRA.pdf. Accessed August 25, 2016.
6. American College of Radiology. ACR-SCBT-MR-SPR Practice Parameter for the Performance of Thoracic Computed Tomography (CT). Revised 2013. Available at http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/CT_Thoracic.pdf Accessed August 25, 2016.
7. American College of Radiology. ACR-STR Practice Parameter for the Performance of High-Resolution Computed Tomography (HRCT) of the Lungs in Adults. Revised 2015. Available at http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/HRCT_Lungs.pdf. Accessed August 25, 2016.
8. American College of Radiology. Choosing Wisely: Imaging for suspected pulmonary embolism without moderate or high pretest probability. ABIM Foundation; 2012. Available at <http://www.choosingwisely.org/clinician-lists/american-college-radiology-imaging-for-suspected-pulmonary-embolism-without-moderate-or-high-pretest-probability/> Accessed August 25, 2016.
9. American Society of Hematology. Choosing Wisely: Limit surveillance CT scans following treatment for lymphoma. Philadelphia, PA: ABIM Foundation; December 4, 2013 and December 3, 2014. Available at www.choosingwisely.org. Accessed August 15, 2016.
10. American Thoracic Society. Diagnosis and initial management of nonmalignant diseases related to asbestos. *Am J Respir Crit Care Med.* 2004;170(6):691-715.
11. American Urological Association. Choosing Wisely: CT scans for low-risk, localized prostate cancer. Philadelphia, PA: ABIM Foundation; February 21, 2013 and June 11, 2015. Available at www.choosingwisely.org. Accessed August 15,

2016 29.

12. Aquino SL. Imaging of metastatic disease to the thorax. *Radiol Clin N Am*. 2005;43(3):481-495.
13. Bach PB, Kattan MW, Thornquist MD, et al. Variations in lung cancer risk among smokers. *J Natl Cancer Inst*. 2003;95(6):470-478.
14. Bach PB, Mirkin JN, Oliver TK, et al, Qaseem A, Detterbeck FC. Benefits and harms of CT screening for lung cancer: a systematic review. *JAMA*. 2012;307(22):2418-2429.
15. Benamore RE, Warakaulle DR, Traill ZC. Imaging of pleural disease. *Imaging*. 2008;20:236–225.
16. Center for Medicare and Medicaid Services. *National Coverage Determination (NCD) for Lung Cancer Screening with Low Dose Computed Tomography (LDCT) (210.14)*. Available at <http://www.cms.gov/medicare-coverage-database/>. Accessibility verified December 13, 2016.
17. Chiles C, Carr JJ. Vascular diseases of the thorax: evaluation with multidetector CT. *Radiol Clin N Am*. 2005;43(3):543-569.
18. Cronin P, Sneider MB, Kazerooni SM, et al. MDCT of the left atrium and pulmonary veins in planning radiofrequency ablation for atrial fibrillation. *AJR Am J Roentgenol*. 2004;183(3):767-778
19. Dyer DS, Mohammed TL, Kirsch J, et al.; American College of Radiology Expert Panel on Thoracic Imaging. ACR appropriateness Criteria® chronic dyspnea: suspected pulmonary origin. *J Thorac Imaging*. 2013;28(5):W64-W66.
20. Fasola G, Belvedere O, Aita M, et al. Low-dose computed tomography screening for lung cancer and pleural mesothelioma in an asbestos-exposed population: baseline results of a prospective, nonrandomized feasibility trial--an Alpe-adria Thoracic Oncology Multidisciplinary Group Study (ATOM 002). *Oncologist*. 2007;12(10):1215-1224.
21. Fedullo PF, Tapson VF. The evaluation of suspected pulmonary embolism. *N Engl J Med*. 2003;349(13):1247-1256.
22. Ghaye B, Szapiro D, Dacher JN, et al. Percutaneous ablation for atrial fibrillation: the role of cross-sectional imaging. *Radiographics*. 2003;23:S19-S33.
23. Gilkeson RC, Ciancibello L, Zahka K. Multidetector CT evaluation of congenital heart disease in pediatric and adult patients. *AJR Am J Roentgenol*. 2003;180(4):973-980.
24. Hansell DM, Bankier A a, MacMahon H, McLoud TC, Müller NL, Remy J. Fleischner Society: glossary of terms for thoracic imaging. *Radiology*. 2008;246(3):697-722.
25. Hartman TE. Radiologic evaluation of the solitary pulmonary nodule. *Radiol Clin N Am*. 2005;43(3):459-465.
26. Heitkamp DE, Albin MM, Chung JH, et al. ACR Appropriateness Criteria® acute respiratory illness in immunocompromised patients. *J Thorac Imaging*. 2015;30(3):W2-5.
27. Holmes DR Jr, Mack MJ, Kaul S, et al. 2012 ACCF/AATS/SCAI/STS expert consensus document on transcatheter aortic valve replacement. *J Am Coll Cardiol*. 2012 Mar 27;59(13):1200-1254.
28. Jongbloed MR, Dirksen MS, Bax JJ, et al. Atrial fibrillation: multi-detector row CT of pulmonary vein anatomy prior to radiofrequency catheter ablation--initial experience. *Radiology*. 2005; 234(3): 702-709.
29. Kanne JP, Jensen LE, Mohammed TL, et al.; American College of Radiology Expert Panel on Thoracic Imaging. ACR appropriateness Criteria® radiographically detected solitary pulmonary nodule. *J Thorac Imaging*. 2013;28(1):W1-W3.
30. Kazerooni EA. High-resolution CT of the lungs. *AJR Am J Roentgenol*. 2001;177(3):501-519.
31. Kazerooni EA, Austin JH, Black WC, et al. ACR-STR practice parameter for the performance and reporting of lung cancer screening thoracic computed tomography (CT): 2014 (Resolution 4). *J Thorac Imaging*. 2014;29(5):310-316.
32. Kruip MJ, Leclercq MGL, van der Heul C, Prins MH, Büller HR. Diagnostic strategies for excluding pulmonary embolism in clinical outcome studies. *Ann Intern Med*. 2003;138(12):941-951.
33. Lehman VT, Barrick BJ, Pittelkow MR, et al. Diagnostic imaging in paraneoplastic autoimmune multiorgan syndrome: retrospective single site study and literature review of 225 patients. *Int J Dermatol*. 2015;54(4):424-437.
34. Loch, T. Prostate cancer diagnostics: innovative imaging in case of multiple negative biopsies. *World J Urol*. 2011; 29(5), 607-614.
35. Low DE, Mazzulli T, Marrie T. Progressive and nonresolving pneumonia. *Curr Opin Pulm Med*. 2005;11(3):247-252.
36. Mabie M, Wunderink RG. Use and limitations of clinical and radiologic diagnosis of pneumonia. *Semin Respir Infect*. 2003;18(2):72-79
37. MacMahon H, Naidich DP, Goo JM, et al. Guidelines for Management of Incidental Pulmonary Nodules Detected on CT Images: From the Fleischner Society 2017. *Radiology*. 2017;284(1):228-243. (1527-1315 (Electronic)).
38. Macura KJ, Corl FM, Fishman EK, Bluemke DA. Pathogenesis in acute aortic syndromes: aortic aneurysm leak and rupture and traumatic aortic transection. *AJR Am J Roentgenol*. 2003;181(2):303-307.
39. Menéndez R, Perpiñá M, Torres A. Evaluation of nonresolving and progressive pneumonia. *Semin Respir Infect*.

2003;18(2):103-111.

40. Moore CM, Robertson NL, Arsanious N, et al. Image-guided prostate biopsy using magnetic resonance imaging-derived targets: a systematic review. *Eur Urol*. 2013; 63(1), 125-140.
41. Mottet N, Bellmunt J, Bolla M, et al. EAU-ESTRO-SIOG Guidelines on Prostate Cancer. Part 1: Screening, Diagnosis, and Local Treatment with Curative Intent. *Eur Urol*. 2016;pii: S0302-2838(16):30470-5.
42. Moyer VA. Screening for lung cancer: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med*. 2014;160(5):330-338
43. Munden RF, Bruzzi J. Imaging of non-small cell lung cancer. *Radiol Clin N Am*. 2005;43(3):467-480.
44. Naidich PM, Bankier AA, MacMahon H, et al. Recommendations for the Management of Subsolid Pulmonary Nodules Detected. *Radiology*. 2013;266(1).
45. National Lung Screening Trial Research Team, Aberle DR, Adams AM, et al. Reduced lung-cancer mortality with low-dose computed tomographic screening. *N Engl J Med*. 2011 Aug 4;365(5):395-409.
46. NCCN Imaging Appropriate Use Criteria for Breast Cancer (Version 2.2017). Available at <http://www.nccn.org>. ©National Comprehensive Cancer Network, 2017.
47. NCCN Imaging Appropriate Use Criteria for Colon Cancer (Version 2.2017). Available at <http://www.nccn.org>. ©National Comprehensive Cancer Network, 2017.
48. NCCN Imaging Appropriate Use Criteria for Prostate Cancer (Version 2.2017). Available at <http://www.nccn.org>. ©National Comprehensive Cancer Network, 2017.
49. Nelson AW, Harvey RC, Parker RA, et al. Repeat prostate biopsy strategies after initial negative biopsy: meta-regression comparing cancer detection of transperineal, transrectal saturation and MRI guided biopsy. *PLoS One*. 2013;8(2):e57480.
50. Ost D, Fein AM, Feinsilver SH. The solitary pulmonary nodule. *N Engl J Med*. 2003;348(25):2535-2542.
51. Parker MS, Matheson TL, Rao AV, et al. Making the transition: the role of helical CT in the evaluation of potentially acute thoracic aortic injuries. *AJR Am J Roentgenol*. 2001;176(5):1267-1272.
52. Paul BC, Branski RC, Amin MR. Diagnosis and management of new-onset hoarseness: a survey of the American Broncho-Esophagological Association. *Ann Otol Rhinol Laryngol*. 2012;121(10):629-634.
53. Pipavath S, Godwin JD. Imaging of interstitial lung disease. *Radiol Clin N Am*. 2005;43(3):589-599.
54. Quiroz R, Kucher N, Zhou KH, et al. Clinical validity of a negative computed tomography scan in patients with suspected pulmonary embolism. *JAMA*. 2005;293(16):2012-2017.
55. Ravenel JG, Rosenzweig KE, Kirsch J, et al. ACR Appropriateness Criteria non-invasive clinical staging of bronchogenic carcinoma. *J Am Coll Radiol*. 2014;11(9), 849-856.
56. Revel MP, Fournier LS, Hennebicque AS, et al. Can CT replace bronchoscopy in the detection of the site and cause of bleeding in patients with large or massive hemoptysis? *AJR Am J Roentgenol*. 2002;179(5):1217-1224.
57. Sadoughi B, Fried MP, Sulica L, Blitzer A. Hoarseness evaluation: a transatlantic survey of laryngeal experts. *Laryngoscope*. 2014;124(1):221-226. doi:10.1002/lary.24178.
58. Schwartz SR, Cohen SM, Dailey SH, et al. Clinical practice guideline: hoarseness (dysphonia). *Otolaryngol Head Neck Surg*. 2009;141(3 Suppl 2):S1-S31.
59. Society of Gynecologic Oncology. Choosing Wisely: Routine Imaging for Surveillance of Gynecologic Cancer. Philadelphia, PA: ABIM Foundation; October 31, 2013. Available at www.choosingwisely.org. Accessed August 15, 2016
60. Talti S, Yucel EK, Lipton MJ. CT and MR imaging of the thoracic aorta: current techniques and clinical applications. *Radiol Clin N Am*. 2004;42(3):565-585.
61. Tan BB, Flaherty KR, Kazerooni EA, et al. The solitary pulmonary nodule. *Chest*. 2003;123(1):89S-96S.
62. Tarver RD, Teague SD, Heitkamp DE, Conces DJ Jr. Radiology of community-acquired pneumonia. *Radiol Clin N Am*. 2005;43(3):497-512.
63. Talti S, Yucel EK, Lipton MJ. CT and MR imaging of the thoracic aorta: current techniques and clinical applications. *Radiol Clin N Am*. 2004;42(3):565-585.
64. Therasse E, Soulez G, Giroux MF, et al. Stent-graft placement for the treatment of thoracic aortic diseases. *Radiographics*. 2005;25(1):157-173.
65. Tunick PA, Krinsky GA, Lee VS, Kronzon I. Diagnostic imaging of thoracic aortic atherosclerosis. *AJR Am J Roentgenol*. 2000;174(4):1119-1125.
66. Tüzün E, Dalmau J. Limbic encephalitis and variants: classification, diagnosis and treatment. *Neurologist*. 2007;13(5):261-271.
67. Yu H. Management of pleural effusion, empyema, and lung abscess. *Semin Intervent Radiol*. 2011 Mar;28(1):75-86.

CT Angiography (CTA) Chest (Non-Coronary)



CPT Codes

71275..... CTA of chest (non-coronary), with contrast material(s), including non-contrast images, if performed, and image post-processing

Standard Anatomic Coverage

- Scan coverage varies depending on the clinical indication. This exam does not include cardiac and coronary artery indications.
- Chest CTA may be used for anatomic depiction from the pulmonary apices through the costophrenic sulci.

Technology Considerations

Advantages of CTA:

- Rapidly acquired exam, with excellent anatomic detail afforded by most multidetector CT scanners

Disadvantages of CTA:

- Potential complications from use of intravascular iodinated contrast administration

Biosafety Issues:

- Ordering and imaging providers are responsible for considering safety issues prior to the CTA exam. One of the most significant considerations is the requirement for intravascular iodinated contrast material, which may have an adverse effect on patients with a history of documented allergic contrast reactions or atopy, as well as on individuals with renal impairment, who are at greater risk for contrast-induced nephropathy.

Ordering Issues:

- CTA chest is not appropriate for cardiac and coronary artery imaging. Please review guidelines for cardiac CT and CCTA.
- Pulmonary embolus is rare in the absence of elevated blood D-dimer levels and certain specific risk factors.

Common Diagnostic Indications

Indications for chest CTA are contained in general chest, thoracic aorta and great vessel, and pulmonary artery and vein.

General Chest

Developmental anomalies of the thoracic vasculature

- Examples of congenital thoracic vascular anomalies include but are not limited to the following:
 - Aortic coarctation
 - Double aortic arch
 - Hypoplastic or atretic pulmonary arteries
 - Inferior vena caval interruption
 - Partial anomalous pulmonary venous return
 - Persistent left-sided superior vena cava
 - Right-sided aortic arch
 - Total anomalous pulmonary venous return
 - Truncus arteriosus

Post-traumatic vascular injury

Post-operative or post-procedure evaluation

Common Diagnostic Indications

Preoperative or pre-procedure evaluation

Note: This indication is for preoperative evaluation of conditions not specifically referenced elsewhere in this guideline.

Systemic venous thrombosis or occlusion, including superior vena cava (SVC) syndrome

Subclavian steal syndrome

Thoracic outlet syndrome

Vascular involvement from neoplasm in the chest

Thoracic Aorta and Great Vessel

Atheromatous disease

- Evaluation of the thoracic aorta as a source of distal emboli when transthoracic and/or transesophageal echocardiography are non-diagnostic

Hematoma

Post-operative or post-procedure evaluation

Stent graft evaluation, including detection of an endoleak

- Pre-procedure assessment and post-procedure follow-up

Thoracic aorta evaluation

Acute aortic syndrome

(any **one** of the following)

- Diagnosis and management
- Periodic surveillance in patients with established acute aortic syndrome undergoing medical management

Note: Initial diagnosis of acute aortic syndrome is considered a medical emergency. This guideline includes aortic rupture, dissection, pseudoaneurysm, mural hematoma, and penetrating ulcer mediastinal hematoma

Non-acute thoracic aorta

(any **one** of the following)

- In patients with suspected thoracic aortic aneurysm
- In patients with confirmed thoracic aortic aneurysm with new or worsening signs/symptoms
- For ongoing surveillance of stable patients with confirmed thoracic aortic aneurysm who have not undergone imaging of the thoracic aorta within the preceding six months
- In patients with confirmed aortic dissection in whom surgical repair is anticipated (to assist in preoperative planning)
- For ongoing surveillance of stable patients with confirmed aortic dissection who have not undergone imaging of the thoracic aorta within the preceding year
- In patients with confirmed aortic dissection or thoracic aortic aneurysm who have undergone surgical repair within the preceding year and have not undergone imaging of the thoracic aorta within the preceding six months
- In patients being evaluated for potential transcatheter aortic valve implantation/replacement (TAVI or TAVR) provided that the patient has not undergone CTA or MRA of the chest within the preceding 60 days

Note: See acute aortic syndrome section for complications of aneurysm including aortic dissection

Vasculitis

Common Diagnostic Indications

Pulmonary Artery and Vein

Pulmonary arterial hypertension

Pulmonary arteriovenous malformation (AVM)

Pulmonary embolism

- For moderate or high clinical suspicion of pulmonary embolism or follow-up when recurrent thromboembolism is a concern in patients on adequate medical therapy
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Pulmonary sequestration

References

1. American College of Radiology. ACR–NASCI–SIR–SPR Practice Parameter for the Performance and Interpretation of Body Computed Tomography Angiography (CTA). Revised 2016. Available at http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/Body_CTA.pdf. Accessed August 25, 2016.
2. Holmes DR Jr, Mack MJ, Kaul S, et al. 2012 ACCF/AATS/SCAI/STS expert consensus document on transcatheter aortic valve replacement. *J Am Coll Cardiol*. 2012 Mar 27;59(13):1200-1254.
3. Ketai LH, Mohammed TL, Kirsch J, et al.; American College of Radiology Expert Panel on Thoracic Imaging. ACR Appropriateness Criteria® Hemoptysis. *J Thorac Imaging*. 2014;29(3):W19-W22.
4. Schoepf UJ, Costello P. CT angiography for diagnosis of pulmonary embolism: state of the art. *Radiology*. 2004; 230(2):329-337.

CPT Codes

- 71550..... MRI chest, without contrast
- 71551..... MRI chest, with contrast
- 71552..... MRI chest, without contrast, followed by re-imaging with contrast

Standard Anatomic Coverage

- Chest MRI studies are often performed as problem-solving exams, following chest CT. In these circumstances, anatomic coverage will depend on the specific indication for the study.
- MRI of the chest should not be performed for imaging of the heart. For cardiac indications, see Cardiac MRI guideline section and corresponding CPT codes 75557–75563, 75565.

Technology Considerations

Advantages of chest MRI:

- Chest MRI may be helpful after a CT in the following scenarios:
 - Defining mediastinal and hilar lymphadenopathy (particularly after an unenhanced chest CT exam)
 - Determining direct lung tumor invasion into the mediastinum and hilar structures, without the need for iodinated contrast material in CT
 - Assessing spinal canal extension from a postero-medially located thoracic mass
 - Evaluating a suspected Pancoast tumor (also referred to as apical pleuro-pulmonary groove or superior pulmonary sulcus tumors) for direct chest wall extension, given the multiplanar capability of MRI

Disadvantages of chest MRI:

- Lung lesions are usually better imaged with CT when compared with MRI, given the superior spatial resolution of CT.
- MRI should not be performed in patients with certain implanted devices that are not MRI compatible, such as pacemakers.

Ordering issues:

- For initial evaluation of most thoracic lesions, such as pulmonary nodules and masses, chest CT is considered the study of choice.
- Contrast utilization for chest MRI is at the discretion of the ordering and imaging providers.
- For cardiac and coronary artery imaging, see Cardiac MRI guidelines.

Common Diagnostic Indications

Developmental anomalies of the thoracic vasculature

- Examples of congenital thoracic vascular anomalies include but are not limited to the following:
 - Aortic coarctation
 - Double aortic arch
 - Hypoplastic or atretic pulmonary arteries
 - Inferior vena caval interruption
 - Partial anomalous pulmonary venous return
 - Persistent left-sided superior vena cava
 - Right-sided aortic arch
 - Total anomalous pulmonary venous return
 - Truncus arteriosus

Common Diagnostic Indications

Documented malignancy – primary neoplasm and metastatic disease

- For staging and periodic surveillance
- To evaluate the mediastinum, hila, pericardium, heart, chest wall and paraspinal region

Horner's syndrome

Mediastinal and hilar mass lesions – when abnormal findings cannot be thoroughly evaluated with CT

- Particularly in patients who have an allergic history to intravascular iodinated CT contrast material or who have renal insufficiency and thus are at greater risk for contrast-induced nephropathy
- Chest MRI may be helpful in the following circumstances:
 - To differentiate mediastinal and hilar lesions from vascular structures; **OR**
 - To assess vascular invasion by tumor; **OR**
 - To detect spinal extension from a postero-medially located chest mass

Pancoast tumor

- To evaluate for chest wall extension at the superior pulmonary sulcus

Superior vena cava syndrome

Thoracic aorta evaluation

Acute aortic syndrome (any one of the following)

- Diagnosis and management
- periodic surveillance in patients with established acute aortic syndrome undergoing medical management

Note: *Initial diagnosis of acute aortic syndrome is considered a medical emergency. This guideline includes aortic rupture, dissection, pseudoaneurysm, mural hematoma, and penetrating ulcer mediastinal hematoma.*

Non-acute thoracic aorta (any one of the following)

- In patients with suspected thoracic aortic aneurysm
- In patients with confirmed thoracic aortic aneurysm with new or worsening signs/symptoms
- For ongoing surveillance of stable patients with confirmed thoracic aortic aneurysm who have not undergone imaging of the thoracic aorta within the preceding six months
- In patients with confirmed aortic dissection in whom surgical repair is anticipated (to assist in preoperative planning)
- For ongoing surveillance of stable patients with confirmed aortic dissection who have not undergone imaging of the thoracic aorta within the preceding year
- In patients with confirmed aortic dissection or thoracic aortic aneurysm who have undergone surgical repair within the preceding year and have not undergone imaging of the thoracic aorta within the preceding six months
- In patients being evaluated for potential transcatheter aortic valve implantation/replacement (TAVI or TAVR) provided that the patient has not undergone CTA or MRA of the chest within the preceding 60 days

Note: *See acute aortic syndrome (section above) for complications of aneurysm including aortic dissection.*

Thoracic outlet syndrome

Thymoma evaluation or history of myasthenia gravis

Note: *Approximately 15% of patients with myasthenia gravis will have a thymoma.*

References

1. American Academy of Otolaryngology — Head and Neck Surgery Foundation. Choosing Wisely: CT scans or MRIs for Hoarseness. ABIM Foundation; February 21, 2013. Available at <http://www.choosingwisely.org/clinician-lists/american-academy-otolaryngology-head-and-neck-surgery-ct-scans-or-mris-for-hoarseness/> Accessed August 25, 2016.
2. Ghaye B, Szapiro D, Dacher JN, et al. Percutaneous ablation for atrial fibrillation: the role of cross-sectional imaging. *Radiographics*. 2003;23:S19-S33.
3. Holmes DR Jr, Mack MJ, Kaul S, et al. 2012 ACCF/AATS/SCAI/STS expert consensus document on transcatheter aortic valve replacement. *J Am Coll Cardiol*. 2012 Mar 27;59(13):1200-1254.
4. Konen E, Merchant N, Provost Y, et al. Coarctation of the aorta before and after correction: the role of cardiovascular MRI. *AJR Am J Roentgenol*. 2004;182:1333-1339.
5. Kreitner KF, Ley S, Kauczor HU, et al. Chronic thromboembolic pulmonary hypertension: pre- and postoperative assessment with breath-hold MRI imaging techniques. *Radiology*. 2004;232(2):535-543.
6. Kunz RP, Oberholzer K, Kuroczynski W, et al. Assessment of chronic aortic dissection: contribution of different ECGgated breath- hold MRI techniques. *AJR Am J Roentgenol*. 2004;182(5):1319-1326.
7. Munden RF, Bruzzi J. Imaging of non-small cell lung cancer. *Radiol Clin N Am*. 2005;43(3):467-480.
8. Orel SG, Schnall MD. MR imaging of the breast for the detection, diagnosis, and staging of breast cancer. *Radiology*. 2001;220(1):13-30.
9. Ravenel JG, Rosenzweig KE, Kirsch J, et al. ACR Appropriateness Criteria non-invasive clinical staging of bronchogenic carcinoma. *J Am Coll Radiol*. 2014;11(9), 849-856.
10. Talti S, Yucler EK, Lipton MJ. CT and MR imaging of the thoracic aorta: current techniques and clinical applications. *Radiol Clin N Am*. 2004;42(3):565-585.
11. Tan BB, Flaherty KR, Kazerooni EA, et al. The solitary pulmonary nodule. *Chest*. 2003;123(1):89S-96S.
12. Tarver RD, Teague SD, Heitkamp DE, Conces DJ Jr. Radiology of community-acquired pneumonia. *Radiol Clin N Am*. 2005;43(3):497-512.
13. Talti S, Yucler EK, Lipton MJ. CT and MR imaging of the thoracic aorta: current techniques and clinical applications. *Radiol Clin N Am*. 2004;42(3):565-585.
14. Tunick PA, Krinsky GA, Lee VS, Kronzon I. Diagnostic imaging of thoracic aortic atherosclerosis. *AJR Am J Roentgenol*. 2000;174(4):1119-1125.

CPT Codes

71555..... MRA of chest (excluding the myocardium) without contrast, followed by re-imaging with contrast

Standard Anatomic Coverage

- Scan coverage varies depending on the clinical indication
- Chest MRA may be used for vascular anatomic depiction, from the pulmonary apices through the costophrenic sulci.

Technology Considerations

Advantages of Chest MRA:

- Use of MR imaging is advantageous over CT in avoiding ionizing radiation and allowing for direct multiplanar imaging.

Disadvantages of Chest MRA:

- With MRA, artifact due to patient motion may have a particularly significant impact on exam quality.
- MRA cannot be performed in patients with certain implanted devices that are not MRI compatible, such as pacemakers.

Common Diagnostic Indications

Chest MRA indications are contained in common chest MRA, thoracic aorta and great vessel, and pulmonary artery and vein.

Common Chest MRA

Developmental anomalies of the thoracic vasculature

- Examples of congenital thoracic vascular anomalies include but are not limited to the following:
 - Aortic coarctation
 - Double aortic arch
 - Hypoplastic or atretic pulmonary arteries
 - Inferior vena caval interruption
 - Partial anomalous pulmonary venous return
 - Patent ductus arteriosus
 - Persistent left-sided superior vena cava
 - Right-sided aortic arch
 - Total anomalous pulmonary venous return
 - Transposition of the great vessels
 - Truncus arteriosus

Post-traumatic vascular injury

Subclavian steal

Systemic venous thrombosis or occlusion, including superior vena cava (SVC) syndrome

Thoracic outlet syndrome

Vascular involvement from neoplasm in the chest

Common Diagnostic Indications

Thoracic Aorta and Great Vessel

Atheromatous disease

(**All** of the following)

- When CT is contraindicated
- Evaluation of the thoracic aorta as a source of distal emboli when transthoracic and/or transesophageal echocardiography are non-diagnostic

Post-operative or post-procedure evaluation

Stent graft evaluation, including detection of an endoleak

- Pre-procedure assessment and post-procedure follow-up

Thoracic aorta evaluation

Acute aortic syndrome

(any **one** of the following)

- Diagnosis and management
- periodic surveillance in patients with established acute aortic syndrome undergoing medical management

Note: *Initial diagnosis of acute aortic syndrome is considered a medical emergency. This guideline includes aortic rupture, dissection, pseudoaneurysm, mural hematoma, and penetrating ulcer mediastinal hematoma*

Non-acute thoracic aorta

(any **one** of the following)

- In patients with suspected thoracic aortic aneurysm
- In patients with confirmed thoracic aortic aneurysm with new or worsening signs/symptoms
- For ongoing surveillance of stable patients with confirmed thoracic aortic aneurysm who have not undergone imaging of the thoracic aorta within the preceding six months
- In patients with confirmed aortic dissection in whom surgical repair is anticipated (to assist in preoperative planning)
- For ongoing surveillance of stable patients with confirmed aortic dissection who have not undergone imaging of the thoracic aorta within the preceding year
- In patients with confirmed aortic dissection or thoracic aortic aneurysm who have undergone surgical repair within the preceding year and have not undergone imaging of the thoracic aorta within the preceding six months
- In patients being evaluated for potential transcatheter aortic valve implantation/replacement (TAVI or TAVR) provided that the patient has not undergone CTA or MRA of the chest within the preceding 60 days

Note: *See acute aortic syndrome (section above) for complications of aneurysm including aortic dissection.*

Vasculitis

Pulmonary Artery and Vein

Pulmonary arterial hypertension

Pulmonary arteriovenous malformation (AVM)

Pulmonary embolism

- Rarely requested and used only in selected cases, for example when intravenous iodinated contrast material for a CTA is contraindicated due to significant iodinated contrast allergy, and a diagnostic ventilation/perfusion (V/Q) study cannot be obtained
- For clinically suspected pulmonary embolism or follow-up when recurrent thromboembolism is a concern in patients on adequate medical therapy

Pulmonary sequestration

References

1. Ho VB, Corse WR, Hood MN, Rowedder AM. Magnetic resonance angiography of the thoracic vessels. *Semin Ultrasound CT MR*. 2003 Aug;24(4):192-216.
2. Holmes DR Jr, Mack MJ, Kaul S, et al. 2012 ACCF/AATS/SCAI/STS expert consensus document on transcatheter aortic valve replacement. *J Am Coll Cardiol*. 2012 Mar 27;59(13):1200-1254.
3. Maki DD, Siegelman ES, Roberts DA, Baum RA, Gefter WB. Pulmonary arteriovenous malformations: three-dimensional gadolinium-enhanced MR angiography-initial experience. *Radiology*. 2001;219(1):243-246.
4. Pereles FS, McCarthy RM, Baskaran V, et al. Thoracic aortic dissection and aneurysm: evaluation with nonenhanced true FISP MR angiography in less than 4 minutes. *Radiology*. 2002;223(1):270-274.
5. Sonnet S, Buitrago-Téllez CH, Scheffler K, et al. Dynamic time-resolved contrast-enhanced two-dimensional MR projection angiography of the pulmonary circulation: standard technique and clinical applications. *AJR Am J Roengenol*. 2002;179(1):159-165.
6. Wu C, Zhang J, Ladner CJ, et al. Subclavian steal syndrome: diagnosis with perfusion metrics from contrast-enhanced MR angiographic bolus-timing examination – initial experience. *Radiology*. 2005;235(3):927-933.

Magnetic Resonance Imaging (MRI) Breast

Also referred to as MR Mammography (MRM)



CPT Codes

77058..... MRI of breast, without and/or with contrast material(s); unilateral

77059..... MRI of breast, without and/or with contrast material(s); bilateral

Technology Considerations

Technique:

- It is strongly recommended that breast MRI examinations be performed with a dedicated breast coil.

Limitations:

- Breast MRI is not recommended as a screening technique in patients with average-risk for breast cancer.
- Breast MRI is not recommended to assess suspicious breast lesions in order to avoid a biopsy.
- Breast MRI should not be used to differentiate cysts from solid lesions, which is well evaluated with ultrasound.

Additional Comments:

- A bilateral MRI study of the breast is correctly coded to CPT 77059. Requesting two unilateral studies (77058) to perform a bilateral exam is inappropriate. Billing 77058 two times for the same date of service or separately over subsequent days in order to describe a bilateral procedure fragments the service into its component parts and is not allowed.

Common Diagnostic Indications

Breast MRI indications are contained in diagnostic evaluation and annual screening with breast carcinoma diagnosis and breast implant rupture not requiring a breast carcinoma diagnosis.

For Breast Carcinoma: Diagnostic Evaluation

BI-RADS category 3 findings

- A single follow-up MRI may be performed at 6 months following a breast MRI with BI-RADS category 3 findings

Differentiation of palpable mass(es) from surgical scar tissue

- Following breast surgery, breast reconstruction or radiation therapy

Invasion of breast cancer deep to fascia

- MRI evaluation of breast prior to surgical treatment may be useful in both mastectomy and breast conservation candidates to define the relationship of the tumor to the fascia and its extension into the pectoralis major, serratus anterior, and/or intercostal muscles

Invasive carcinoma and ductal carcinoma in situ (DCIS)

- To determine the extent of disease and the presence of multifocality and multicentricity

Lesion characterization

- When other imaging examinations, such as ultrasound and mammography, and physical examination are inconclusive for the presence of breast cancer, and biopsy could not be performed (e.g., possible distortion on only one mammographic view without a sonographic correlate)

Common Diagnostic Indications

Metastatic cancer

- Primary is unknown and suspected to be of breast origin.
- In patients presenting with metastatic disease and/or axillary adenopathy and no mammographic or physical findings of primary breast carcinoma.

Neoadjuvant chemotherapy

- MR mammography may be performed before, during and after chemotherapy to assess response to treatment and extent of residual disease, prior to surgery.

Post-lumpectomy with positive margins

- To evaluate for residual disease in patients whose pathology specimens demonstrate close or positive margins for residual disease

Post-operative tissue reconstruction

- To evaluate suspected cancer recurrence in patients with tissue transfer flaps (rectus, latissimus, dorsi, and gluteal)

Recurrence of breast cancer

- In women with a prior history of breast cancer and suspicion of recurrence when clinical, mammographic, and/or sonographic findings are inconclusive

For Breast Carcinoma: Annual Screening

Individuals who received radiation to the chest between ages 10 and 30 years

Individuals with a genetic predisposition to breast cancer, in either themselves or a first degree relative, which may include any of the following:

- Bannayan-Riley-Ruvalcaba syndrome
- BRCA1 and BRCA2
- Cowden syndrome
- Li-Fraumeni syndrome

Individuals known to have any of the following genetic mutations:

- ATM
- CDH1
- CHEK2
- PALB2

History of lobular carcinoma in situ (LCIS), atypical ductal hyperplasia (ADH) or atypical lobular hyperplasia (ALH) on biopsy

Lifetime risk ~ 20% or greater

- As defined by BRCAPRO or other models that are largely dependent on family history

For Breast Implant Rupture: Not Requiring Breast Carcinoma Diagnosis

Breast MRI is indicated to screen for asymptomatic rupture of a silicone breast implant beginning 3 years after implantation and every other year thereafter

Evaluation of symptomatic patients with breast implants, for detection of implant rupture

References

1. Afonso N, Bouwman D. Lobular carcinoma in situ. *Eur J Cancer Prev.* 2008;17(4):312-316.
2. Alberta Provincial Breast Tumour Team, Magnetic resonance imaging for breast cancer screening, pre-operative assessment, and follow-up. Edmonton (Alberta): Alberta Health Services, Cancer Care; 2012 Jan. 19 p. (Clinical practice guideline; no. BR-007).
3. American College of Radiology. ACR Practice Guideline for the Performance of Contrast-Enhanced Magnetic Resonance Imaging (MRI) of the Breast. Updated 2013. Available at http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/MRI_Breast.pdf. Accessed August 25, 2016
4. Bahrs SD, Baur A, Hattermann V, et al. BI-RADS 3 lesions at contrast-enhanced breast MRI: is an initial short-interval follow-up necessary? *Acta Radiol.* 2014;55(3):260-265.
5. Berg WA, Gutierrez L, NessAiver MS, et al. Diagnostic accuracy of mammography, clinical examination, US, and MR imaging in preoperative assessment of breast cancer. *Radiology.* 2004;233(3), 830-849.
6. Boisserie-Lacroix M, Ziade C, Hurtevent-Labrot G, et al. Is a one-year follow-up an efficient method for better management of MRI BI-RADS® 3 lesions? *Breast.* 2016;27:1-7.
7. Cardoso F, Loibl S, Pagani O, et al. The European Society of Breast Cancer Specialists recommendations for the management of young women with breast cancer. *Eur J Cancer.* 2012;48(18):3355-3377.
8. Chikarmane SA, Birdwell RL, Poole PS, et al. Characteristics, Malignancy Rate, and Follow-up of BI-RADS Category 3 Lesions Identified at Breast MR Imaging: Implications for MR Image Interpretation and Management. *Radiology.* 2016;280(3):707-15.
9. Degnim AC, Visscher DW, Berman HK, et al. Stratification of breast cancer risk in women with atypia: a Mayo cohort study. *J Clin Oncol.* 2007;25(19):2671-2677.
10. Fancellu A, Turner RM, Dixon JM, et al. Meta-analysis of the effect of preoperative breast MRI on the surgical management of ductal carcinoma in situ. *Br J Surg.* 2015;102(8):883-893.
11. Hlawatsch A, Teifke A, Schmidt M, Thelan M. Preoperative assessment of breast cancer: sonography versus MR imaging. *AJR Am J Roengenol.* 2002;179(6):1493-1501.
12. Huang W, Fisher PR, Dulaimy K, et al. Detection of breast malignancy: diagnostic MR protocol for improved specificity. *Radiology.* 2004;232(2):585-591.
13. IKNL (Comprehensive Cancer Centre the Netherlands) and the Knowledge Institute of Medical Specialists (KiMS). (2012). Breast Cancer - Imaging BI-RADS: Reporting in relation to the Breast Imaging Reporting and Data System (breast cancer): Richtlijnen. Available at http://richtlijnen database.nl/en/richtlijn/breast_cancer/diagnostics/imaging/bi-rads.html Accessed August 30, 2016
14. Kriege M, Brekelmans CT, Boetes C, et al. Efficacy of MRI and mammography for breast-cancer screening in women with a familial or genetic predisposition. *N Engl Med.* 2004;351(5):427-437.
15. Kuhl CK. Current status of breast MR imaging. Part 2. clinical applications. *Radiology.* 2007;244(3):672-691.
16. Lee CH, Dershaw DD, Kopans D, et al. Breast cancer screening with imaging: recommendations from the Society of Breast Imaging and the ACR on the use of mammography, breast MRI, breast ultrasound, and other technologies for the detection of clinically occult breast cancer. *J Am Coll Radiol.* 2010;7(1):18-27.
17. Lee CH. Problem solving MR imaging of the breast. *Radiol Clin N Am.* 2004;42(5):919-934.
18. Lee JM, Orel SG, Czerniecki BJ, Solin LJ, Schnall MD. MRI before reexcision surgery in patients with breast cancer. *AJR Am J Roengenol.* 2004;182(2):473-480.
19. Lee SG, Orel SG, Woo IJ, et al. MR imaging screening of the contralateral breast in patients with newly diagnosed breast cancer: preliminary results. *Radiology.* 2003;226(3):773-778.
20. Schnall M, Orel S. Breast MR imaging in the diagnostic setting. *Magn Reson Imaging Clin N Am.* 2006;14(3):329-337.
21. Song JW, Kim HM, Bellfi LT, Chung KC. The effect of study design biases on the diagnostic accuracy of magnetic resonance imaging for detecting silicone breast implant ruptures: a meta-analysis. *Plast Reconstr Surg.* 2011;127(3):1029-1044.
22. U.S. Food and Drug Administration (FDA). Update on the safety of silicone gel-filled breast implants. Executive Summary. June 2011. Available at <http://www.fda.gov/downloads/MedicalDevices/ProductsandMedicalProcedures/ImplantsandProsthetics/BreastImplants/UCM260090.pdf> Accessed August 26, 2016
23. Willey SC, Cocilovo C. Screening and follow-up of the patient at high risk for breast cancer. *Obstet Gynecol.* 2007;110(6):1404-1416.
24. Zhou WB, Xue DQ, Liu XA, et al. The influence of family history and histological stratification on breast cancer risk in women with benign breast disease: a meta-analysis. *J Cancer Res Clin Oncol.* 2011 Jul;137(7):1053-60.