

**American College of Radiology
ACR Appropriateness Criteria®**

Clinical Condition: Incidentally Discovered Adrenal Mass

Variant 1: No history of malignancy; mass 1-4 cm in diameter. Initial evaluation.

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen without IV contrast	8	Presumes that a noncontrast CT has not already been performed and that there are no suspicious imaging features. Should be evaluated by radiologist to determine if contrast administration is needed.	⊕⊕⊕
CT abdomen without and with IV contrast	8	Indicated if noncontrast CT is not diagnostic or if there are concerning imaging features of malignancy. Delayed imaging obtained to calculate washout.	⊕⊕⊕⊕
MRI abdomen without IV contrast	8	May be helpful when nonenhanced CT is equivocal or if there is suspicious imaging features. Appropriate for patient with iodinated contrast allergy.	O
MIBG	2	Only for suspicion of pheochromocytoma.	⊕⊕⊕
MRI abdomen without and with IV contrast	2		O
US adrenal gland	1		O
Biopsy adrenal gland	1		Varies
CT abdomen with IV contrast	1		⊕⊕⊕
X-ray abdomen	1		⊕⊕
Iodocholesterol scan	1	This agent may be used to detect functionally active adenomas.	⊕⊕⊕⊕
FDG-PET/CT skull base to mid-thigh	1		⊕⊕⊕⊕
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 2: No history of malignancy; mass 1-4 cm in diameter. Follow-up evaluation for indeterminate lesion on initial evaluation.

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen without IV contrast	8	Alternative to MRI without contrast to assess for size change in 12 months.	⊕⊕⊕
MRI abdomen without IV contrast	8	Alternative to CT without contrast to assess for size change in 12 months.	O
MRI abdomen without and with IV contrast	1		O
CT abdomen with IV contrast	1	Contrast unnecessary to assess for size change.	⊕⊕⊕
CT abdomen without and with IV contrast	1		⊕⊕⊕⊕
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Clinical Condition: Incidentally Discovered Adrenal Mass

Variant 3: No history of malignancy; mass >4 cm in diameter. (If not typical for adenoma, myelolipoma, hemorrhage, or simple cyst, consider resection.)

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen with IV contrast	8	As part of preoperative staging. Alternative to MRI.	☼☼☼
MRI abdomen without and with IV contrast	8	As part of preoperative staging. Alternative to CT.	O
FDG-PET/CT skull base to mid-thigh	5	As part of preoperative staging.	☼☼☼☼
MIBG	2	Only for suspicion of pheochromocytoma.	☼☼☼
CT abdomen without and with IV contrast	2		☼☼☼☼
MRI abdomen without IV contrast	1		O
US adrenal gland	1		O
CT abdomen without IV contrast	1		☼☼☼
X-ray abdomen	1		☼☼
Iodocholesterol scan	1	This agent may be used to detect functionally active adenomas.	☼☼☼☼
Biopsy adrenal gland	1		Varies
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Clinical Condition: Incidentally Discovered Adrenal Mass

Variant 4: History of malignancy; mass <4 cm in diameter. Initial evaluation.

Radiologic Procedure	Rating	Comments	RRL*
CT abdomen without IV contrast	8	Should be evaluated by radiologist to determine if contrast administration is needed.	☼☼☼
CT abdomen without and with IV contrast	8	Indicated if noncontrast CT is indeterminate (attenuation >10 HU) or lesion does not lose signal on out-of-phase images. Delayed imaging obtained to calculate washout.	☼☼☼☼
MRI abdomen without IV contrast	8	Alternative to CT without contrast.	O
FDG-PET/CT skull base to mid-thigh	8	Alternative to CT and MRI.	☼☼☼☼
Biopsy adrenal gland	5	A biopsy should only be performed for mass with suspicious imaging characteristics that cannot be characterized as benign and if pheochromocytoma is excluded. CT or US guidance could be used.	Varies
MIBG	2	Only for suspicion of pheochromocytoma.	☼☼☼
MRI abdomen without and with IV contrast	1		O
US adrenal gland	1		O
CT abdomen with IV contrast	1		☼☼☼
X-ray abdomen	1		☼☼
Iodocholesterol scan	1	This agent may be used to detect functionally active adenomas.	☼☼☼☼
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 5: History of malignancy; mass >4 cm in diameter.

Radiologic Procedure	Rating	Comments	RRL*
Biopsy adrenal gland	8		Varies
FDG-PET/CT skull base to mid-thigh	8	Alternative to biopsy to diagnose metastasis.	☼☼☼☼
MRI abdomen without and with IV contrast	1		O
MRI abdomen without IV contrast	1		O
US adrenal gland	1		O
CT abdomen with IV contrast	1		☼☼☼
CT abdomen without IV contrast	1		☼☼☼
MIBG	1		☼☼☼
X-ray abdomen	1		☼☼
CT abdomen without and with IV contrast	1		☼☼☼☼
Iodocholesterol scan	1		☼☼☼☼
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

INCIDENTALLY DISCOVERED ADRENAL MASS

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Summary of Literature Review

Introduction/Background

The adrenal “incidentaloma” is an unsuspected and asymptomatic mass, usually detected on computed tomography (CT) obtained for other purposes. Incidentally discovered adrenal masses can be of varying sizes, but in general the larger the lesion the more likely it is to be symptomatic. The majority of incidentalomas are benign, and most are adenomas. The prevalence of adenomas in the general population, as summarized by Gajraj et al [1], ranges from 1%-2%, although autopsy studies have shown rates as high as 6.6%-8.7% depending on the age distribution of the patient sample. The risk of primary adrenal cortical carcinoma in this population is quite small, on the order of 0.06%; however, among patients with adrenal masses the risk is reported to be as high as 4.7% [1]. Other adrenal malignancies include angiosarcoma, lymphoma, and pheochromocytoma. These are diminishingly rare in the general population.

Metastatic disease without a known history of primary malignancy is also unusual [1,2]. In a recent study of 1,049 incidental adrenal masses in patients with no known history of cancer, none were malignant. The majority of lesions were adrenal adenomas, myelolipomas, and cysts [3].

An incidental adrenal mass that is a metastasis in a patient who has no known primary malignancy is unusual. The situation is different for patients with a known history of malignancy. In this setting, the rate of metastatic disease has been reported to be as high as 25%-72% depending on the size and type of primary lesion [4-6]. For instance, bronchogenic and renal carcinomas and melanoma have a relatively higher rate of adrenal metastases than other epithelial malignancies. Despite this, a report found that even in patients with non-small-cell lung cancer, adenomas were more common than metastases [7].

The guidelines suggested here apply to masses detected incidentally during CT, ultrasound (US), or magnetic resonance imaging (MRI) evaluation. The patient may be free of symptoms, although the mass may later prove to be functional (ie, Cushing’s or Conn’s adenoma or pheochromocytoma). The appropriateness of performing additional studies to ascertain whether the mass is more likely benign or malignant is discussed here.

Size

Size is an important variable in predicting malignancy of an incidentally discovered adrenal mass. Smaller lesions are usually benign [8]. Conversely, larger lesions are often malignant. When considering size, however, it is important to distinguish between populations with and without a history of malignancy. Herrera et al [2] studied 342 patients without a history of malignancy and found that the rate of malignancy in adrenal modules was only 1.5% and that all malignant lesions were >5 cm. In a series of 887 patients who had adrenal incidentalomas, a diameter >4 cm was shown to have 90% sensitivity for the detection of adrenocortical carcinoma but low specificity; only 24% of lesions >4 cm in diameter were malignant [9].

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In contrast, in patients with a history of malignancy, Candel et al [8] found that 87% of lesions <3 cm were benign and that more than 95% of lesions >3 cm were malignant. In a similar population, Lee et al [10] found that 79% of lesions <2.5 cm were benign. Van Erkel et al [11] in a mixed population showed that a threshold of 3.1 cm discriminated 93% of lesions. Overall, size is considered too unreliable to be used alone as a criterion for malignancy, although in general a 4 cm cut-off is currently used to make decisions regarding surgery for lesions that do not have diagnostic imaging features such as can be seen in myelolipoma. While only approximately 6% of lesions between 4 and 6 cm are malignant, adrenalectomy is often recommended for individuals who are at acceptable risk for surgery [10,12-15]. Masses \geq 6 cm are resected, since the malignancy rate in this patient group is reported to exceed 25% [1,13,16]. These recommendations are supported by a review of adrenal carcinoma that included 4,275 patients from the National Cancer database [17]. The review showed that only 16% of all carcinomas and 18.2% of localized carcinomas were <6 cm, while 91.1% of all masses and 89.5% of localized masses were >4 cm.

Interval growth of adrenal masses has also been advocated as a potential indicator of malignancy. There is, however, scant information on what size change over what time interval requires further investigation. Pantalone et al [18] found that a growth of 0.8 cm on follow-up CT had the highest combination of sensitivity (72%) and specificity (81%) when evaluating absolute size change, growth rate, and growth percent in 111 benign and 25 malignant pathologically proven adrenal lesions. While the unadjusted odds ratio for this threshold was 11.02, no threshold was found with 100% sensitivity or specificity.

Endocrinologic Function

Even though incidentally discovered adrenal masses are by definition asymptomatic, a proportion will show subclinical function. Caplan et al [19] found that 23% of patients who had an adrenal mass but no history of malignancy had detectable secretion of aldosterone, cortisol, or catecholamines. In a similar study Reincke et al [20] found that percentage to be 12%. Routine endocrinologic screening of patients with incidentalomas has been recommended [21,22]. The Swedish Cooperative Study of 388 patients with adrenal incidentalomas found that 5% of them were hypersecreting and included pheochromocytomas (70%) and functional cortical adenomas (30%) [23]. A follow-up Swedish study performed in 187 patients without malignancy, evaluated outside of a specialized endocrinologic group, found hormonally active tumors in 3% [24]. Further, all patients with primary hyperaldosteronism or catecholamine-producing tumors had clinically evident disease at the primary evaluation. Thus, testing for subclinical hyperfunction may be warranted in selected cases. Supporting this practice, two recent series have found a much higher percentage of pheochromocytomas discovered incidentally (29%-59%) than previous studies suggest [25,26].

Computed Tomography

CT not only detects incidentally discovered adrenal masses but also offers one of the best means of differentiating benign from the malignant masses. There are no data on CT accuracy in characterizing adrenal masses <1 cm. Anecdotally, many believe that masses <1 cm do not require imaging workup because most are believed to be adenomas. Based on their imaging features, some benign lesions such as cysts and myelolipomas are readily characterized by CT. Adrenal adenomas contain lipid to varying degrees, and this lowers their attenuation coefficient on noncontrast-enhanced CT. Lee et al [10] showed that when 0 Hounsfield units (HU) was used as a threshold value, the sensitivity for adenomas was 48% without any false positives. If the threshold was increased to 10 HU, the sensitivity was 56% with a 4% false positive rate. This has been confirmed by Singer et al [27]; however, van Erkel et al [11] found that no false positives were seen up to a threshold of 16.5 HU. Stadler et al [28] have shown that there is some variability in the density measurements on different CT scanners. A threshold value of 10 HU is generally accepted as a cutoff value for diagnosing a lipid-rich adenoma, as the 10 HU threshold has a 71% sensitivity and specificity of 98% for adenomas in a summary analysis of seven studies by Boland et al [29].

Bae et al [30] have demonstrated that using histograms of pixel values rather than the average value of the region of interest allows more adenomas to be identified while preserving a high specificity. If 5% or more of the pixels of a lesion are less than 0 HU, the lesion is very likely to be an adenoma. This is of particular relevance when a contrast agent has been administered. Although sensitivity is reduced compared to nonenhanced CT, the use of histogram analysis can improve the sensitivity for adenoma from 10%-36% if >5% of pixels are negative [30]. However, Remer et al [13] in a study of 208 pathologically proven adrenal masses, showed that negative pixels were seen in metastases, adrenal carcinomas, and pheochromocytomas. In addition, the authors noted that using a 5% negative pixel threshold improved specificity for adenoma diagnosis; however, the low sensitivity precluded

clinical usefulness. Ho et al [12] have recently shown that histogram analysis is superior to density measurements for diagnosing lipid-poor adenomas on unenhanced CT, with 51.6% of 31 lipid-poor adenomas having >10% negative pixels with no false positives (specificity 100%). Halefoglu et al [31] in a prospective study showed that using a 10% negative pixel threshold has a higher sensitivity than the ≤ 10 HU mean attenuation threshold method to discriminate adenomas from nonadenomas on unenhanced CT while maintaining a 100% specificity.

Unenhanced CT is a relatively inexpensive yet highly specific test for differentiating adenomas and some benign nonadenomas from malignant lesions. Korobkin et al [32,33] have shown that delayed enhanced CT and use of washout percentages are better able to distinguish adenomas from metastases than unenhanced CT alone. Both lipid-rich and lipid-poor adenomas tend to wash out faster after administration of intravenous contrast [34,35]. This may result from the increased “leakiness” of malignant vessels compared with benign lesions. Korobkin et al [32,33] showed that following a delay of 15 minutes after the administration of intravenous contrast, the sensitivity and specificity of CT could be greatly improved (sensitivity >95%, specificity >97%). Szolar et al [36] had similar results using 30-minute delay times (sensitivity 97%, specificity 100%). The accuracy of washout values was validated by Caoili et al in a study of 166 adrenal masses, accurate characterization being achieved in 96% of masses [37]. Thus, this technique is the main tool that is used at many institutions for distinguishing between adenomas and nonadenomas and is superior to nonenhanced CT [38,39].

Magnetic Resonance Imaging

Qualitative and quantitative MRI methods have been used to attempt to distinguish between adenomas and nonadenomas. MRI with chemical-shift (in and opposed phase) imaging (CSI), introduced by Leroy-Willig et al [40] in 1989, relies on differentiating lesions by their relative lipid content, malignant lesions having virtually no lipid. Mitchell et al [41] showed that CSI was correct in 96% of cases, and Tsushima et al [42] showed that the technique was 100% correct when using a slight variation. Unfortunately, all of these studies were performed in a mixed population of patients with regard to the history of malignancy, so results may not be directly applicable to populations either with or without known malignancy (patient mix will greatly influence results).

Since then, several authors have shown excellent results in a relevant population using simpler CSI techniques [43-45]. Analytic approaches have also varied from simple visual assessment of signal loss on out-of-phase (OOP) imaging compared to in-phase (IP) imaging to quantitative measures of signal loss. Fujiyoshi et al [46] concluded that a signal intensity index (IP-OOP/IP) was superior to other methods that normalized signal to spleen, liver, or muscle [47,48].

Haider et al [49] demonstrated substantial advantages to applying CSI imaging in cases where the CT density measurement was between 10 and 30 HU (ie, indeterminate by CT). For instance, in adenomas with densities between 10 and 30 HU, 89% of the lesions were correctly characterized by CSI. Similar results have been obtained by Israel et al [50], who concluded that up to 60% of lesions misclassified by unenhanced CT density measurements can be correctly characterized as adenomas by chemical-shift MRI. Gabriel et al [51] have demonstrated that even heterogeneous loss of signal is evidence of a benign lesion. Thus, chemical-shift MRI may have better sensitivity and specificity than nonenhanced CT. However, Park et al [52] in a study with a small sample size compared delayed enhanced and chemical-shift MRI and showed that delayed enhanced CT was slightly superior to chemical-shift MRI in characterizing adrenal masses measuring more than 10 HU on unenhanced CT. A prospective study found a higher sensitivity to adenoma with CSI (97%) using an adrenal-to-spleen chemical-shift ratio of less than 0.71 compared to 91% for CT histogram analysis using a 10% negative pixel threshold on unenhanced scans, each with 100% specificity [53].

Diffusion-weighted MRI techniques have recently been used to help distinguish benign and malignant masses in various organ systems. Neither Miller et al [54] nor Tsushima et al [55] found that this technique could differentiate adrenal adenomas and nonadenomas.

Adrenal Biopsy

Biopsy of the incidental adrenal mass has been performed under CT guidance for over 25 years. Most studies on the efficacy of adrenal biopsy have been performed in a mixed population of patients. Biopsy samples insufficient to make a diagnosis are obtained in 4%-19% (mean = 15%) of cases [4,56-58]. When sufficient material is obtained, the accuracy of biopsy is 96%-100% for malignant lesions. Biopsy interpretation is more difficult in benign processes. Fine needle aspiration alone cannot be used to differentiate adrenocortical carcinoma from adrenal adenoma [59]. Careful correlation with clinical and endocrinological data is needed, combined with a knowledge of other features such as tumor size and imaging characteristics to distinguish adenoma from

carcinoma due to the possibility of sampling error [60]. Thus, biopsy is better suited to a population with a high risk of malignant lesions and is most useful when noninvasive studies are negative or inconclusive. The role of adrenal biopsy has evolved, and it is now performed to exclude the presence of metastases when noninvasive tests are inconclusive, or when enlarging adrenal masses are seen at follow-up imaging, or to confirm the presence of an adrenal metastasis [61]. Complication rates range from 8%-12% and consist of bleeding, pneumothorax, infection, and anecdotes of tumor tracking. Several deaths have been reported after an adrenal biopsy of a pheochromocytoma. Lumachi et al [62] demonstrated that when biopsy was compared to CT and MRI it had the highest combination of sensitivity and specificity (83% and 100%, respectively).

Radionuclide Studies

Iodocholesterol (NP 59) scans are rarely used in the United States and are confined to a few major centers. NP 59 studies will detect any lesion with functioning adrenal tissue. Thus, hyperfunctional adenomas (Conn's and Cushing's adenomas) and many nonhyperfunctioning adenomas will bind this agent. When the CT and NP 59 scan are concordant, the lesion is benign in all cases [5]. Francis et al [5], studying a population of patients with a history of tumor, showed that most (82%) of lesions with discordant uptake were metastatic; 11% were indeterminate. Thus, radionuclide studies are very useful if concordant, but overlap significantly if they are discordant with the CT findings.

Metaiodobenzylguanidine (MIBG) studies are useful in patients suspected of a pheochromocytoma, but this is rarely the case in the incidentally detected adrenal mass.

Fluorine-18-2-fluoro-2-deoxy-D-glucose (FDG)-labeled positron emission tomography (PET) can be used to identify metastases in oncologic patients with various cancers [63-67]. FDG-PET is sensitive to metabolically active lesions, and metastases usually show greater uptake than benign lesions. In several studies there have been few false positives with FDG-PET, lowering specificity to 85% in one study [68], but excellent sensitivity has been achieved [63-67]. False negative scans have occurred in renal cell carcinoma metastases [69].

Specific uptake values (SUVs) are typically greater for metastatic disease [66]. However, mild activity can be seen in benign adenomas, thus leading to false positive interpretations. Studies have predominantly evaluated FDG-PET or PET/CT in the oncologic population. Tessonnier et al [70] evaluated 41 adrenal tumors in 37 patients who had no history of malignancy using FDG-PET/CT. All tumors were without diagnostically benign features on CT or MRI. In this small series, a tumor/liver SUV_{max} ratio >1.8, yielded 100% sensitivity and specificity for malignancy. Recently a new tracer for PET, 11C-metomidate, has been found to localize in adrenocortical tumors, and it is useful for determining whether a tumor is of adrenocortical origin. However, it cannot distinguish between benign and malignant tumors [69,71].

Summary

- For patients with no history of malignancy, most small (<4 cm) incidentally discovered adrenal masses are benign, and an extensive and costly workup is usually not justified. If a mass of any size has typical features of a benign lesion such as a lipid-rich adenoma or myelolipoma, no additional workup or follow-up imaging is needed. In those with nondiagnostic imaging features, if prior imaging is available and the lesion is stable for at least 1 year, it can be deemed benign with no additional imaging follow-up. While a specific size change threshold is unknown, if the lesion is enlarging, then it may be prudent to proceed to an adrenal biopsy or resection.
- If there is no prior CT or MRI examination for comparison, and if the lesion has benign imaging features on routine postcontrast CT but no unenhanced CT or adrenal-specific imaging is available, a diagnosis of a benign lesion can be presumed, and one may consider a follow-up unenhanced CT or CSI examination in 12 months [72]. However, if there are suspicious imaging features, then one should proceed with an unenhanced CT or CSI and from there proceed to an adrenal CT protocol with washout calculations if needed. If the lesion does not have imaging and washout features of a benign lesion, then a biopsy should be considered.
- If there is a history of malignancy and imaging features are not diagnostic for a benign lesion and no prior imaging is available, one can consider PET imaging or an unenhanced CT or CSI. If the lesion does not behave like a typical adenoma, then one should proceed to adrenal CT with washout. If the lesion does not show washout features of an adenoma or findings of an adenoma on PET imaging, then a biopsy is warranted.
- In patients with no history of cancer and an adrenal mass >4 cm, one may consider resection. If there is a history of prior malignancy, however, one may consider a PET scan or a biopsy.

- Endocrinologic evaluation may be considered, as subclinical hyperfunction has been reported to be present in 5% of adrenal incidentalomas per the recommendations of the National Institutes of Health consensus conference on adrenal incidentalomas [73].
 - Lesions >4 cm and not having imaging features diagnostic of benign lesions such as adenoma, myelolipoma are generally removed in most centers due to the higher risk of malignancy.
 - For patients with a history of malignancy it is important to exclude from further evaluation any patient with widespread nonadrenal metastases since, in this setting, the presence or absence of adrenal metastases is unlikely to influence the patient’s outcome. An unenhanced CT, and, if needed a delayed enhanced CT, can be used in this setting. If these cannot rule in an adenoma, FDG-PET, chemical-shift MRI or biopsy should be considered. Adrenal biopsy should be reserved for cases where the noninvasive techniques are equivocal and to confirm the presence of metastases. In patients suspected of having a functional lesion, Iodocholesterol, or 11C-metomidate, or MIBG studies may be useful.
 - Radiography and US have no role in characterizing adrenal lesions.

Anticipated Exceptions

Patients with pheochromocytoma should not have adrenal biopsy unless properly pretreated. This diagnosis should be excluded prior to biopsy with urinary or plasma catecholamine levels. In equivocal cases a glucagon stimulation test should be done before biopsy of a potential pheochromocytoma.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

Relative Radiation Level Designations		
Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
○	0 mSv	0 mSv
⊕	<0.1 mSv	<0.03 mSv
⊕⊕	0.1-1 mSv	0.03-0.3 mSv
⊕⊕⊕	1-10 mSv	0.3-3 mSv
⊕⊕⊕⊕	10-30 mSv	3-10 mSv
⊕⊕⊕⊕⊕	30-100 mSv	10-30 mSv

*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as “Varies”.

Supporting Documents

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.