THE ROLE OF CT AND MR IMAGING IN THE EVALUATION OF OVARIAN CANCER*

Funda OBUZ

Dokuz Eylül University Faculty of Medicine Department of Radiology

SUMMARY

The main goals of imaging in the evaluation of an ovarian mass are detection of malignancy and the evaluation of tumour extent. Magnetic resonance (MR) imaging is highly accurate in the characterisation of complex adnexial masses. MR imaging and computed tomography (CT) provide staging information for preoperative planning and determination of surgical resectability, demonstrate tumor response to therapy, and allow detection of persistent or recurrent disease.

Key words: Ovary, neoplasm, MR, CT

ÖZET

Overdeki bir kitlenin değerlendirilmesinde görüntüleme yöntemlerinin temel amacı, malignitenin saptanması ve tümörün uzanımının belirlenmesidir. Manyetik rezonans görüntüleme (MRG) kompleks adneksiyal kitlelerin karakterize edilmesinde yüksek doğruluk oranına sahiptir. MRG ve bilgisayarlı tomografi (BT) preoperatif evrelemede, cerrahi rezektabiliteyi belirlemede, tümörün tedaviye yanıtını değerlendirmede, persistan veya rekürren hastalığın saptanmasında yararlı bilgiler vermektedir.

Anahtar sözcükler: Over, neoplazm, MR, BT

Ovarian cancer is the second most common gynecologic malignancy in the United States and causes more deaths than any other cancer of the female reproductive system. Approximately two-thirds of patients have tumors that have spread beyond the pelvis at the time of diagnosis. There are two major diagnostic challenges when an ovarian mass is detected: the determination of malignancy and the evaluation of tumor extent (staging). Diagnostic studies that allow accurate confirmation of benignity might reduce unnecessary surgery and diagnostic studies that allow accurate cancer staging should help surgical and chemotherapeutic planning. These studies can also demonstrate tumor response to therapy, and allow detection of persistent or recurrent disease (1-3).

Characterization

Transvaginal sonography (TVUS) combined with color Doppler is the primary imaging modality for the assessment and characterization of adnexal masses, and TVUS features that indicate benignity are well established. However, the reported specificity of TVUS for the diagnosis of benignity varies from 60% to 98%. In particular, as many as 20% of adnexal lesions in premenopausal women are classified as indeterminate by using TVUS, even when they are interpreted in conjunction with clinical findings and CA-125 levels (4-12).

Computed tomography (CT) features suggestive of malignancy include a) lesion diameter greater than 4 cm; b) papillary projections, which are often seen on contrast enhanced images; c) walls and septa more than 3 mm thick; d)a partially cystic, partially solid mass; e) a lobulated solid mass; and f) the presence of tumor vessels on contrast enhanced images. None of these features are specific enough to indicate the diagnosis preoperatively. In general, however, the likelihood of malignancy increases with increasing solid-tissue elements and thicker septa (1,13,14). Care must be taken not to mistake every cystic ovarian lesion seen at CT for a tumor. A multitude of benign cysts can mimic the CT appearance of ovarian cancer, including follicular cysts, corpus luteum cysts, polycystic ovaries, and endometriosis. In addition,

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ovarian metastases can mimic the appearance of a primary ovarian tumour (15).

Magnetic resonance imaging (MRI) is considered to be a problem-solving technique in the assessment of adnexal masses because it has excellent soft tissue contrast resolution and multiplanar imaging capability. Contrast-enhanced MR imaging is significantly more accurate in lesion characterization than nonenhanced MR imaging (2,3,16-18) (Figure 1a-b). It has a high rate of depiction of both benign (93%) and malignant lesion (95%). MR imaging findings that are most predictive of malignancy are the presence of solid components in a cystic lesion and necrosis in a solid lesion (Figure 2a-b). It should be noted that cystic teratomas (ie, dermoid cysts) are an exception to the conclusion that solid components in a cystic lesion imply malignancy (Figure 3). The presence of fat in a cystic adnexal lesion is diagnostic of a cystic teratoma, even if solid components (e.g. Rokitansky nodules) also are present (3,19,20). Fat-suppressed T1-weighted imaging helps to differentiate fat from blood product as a cause of the high T1 signal intensity. T2-weighted images may be helpful in the characterization of ovarian fibromas and subserous myoma extending to the adnexal region.

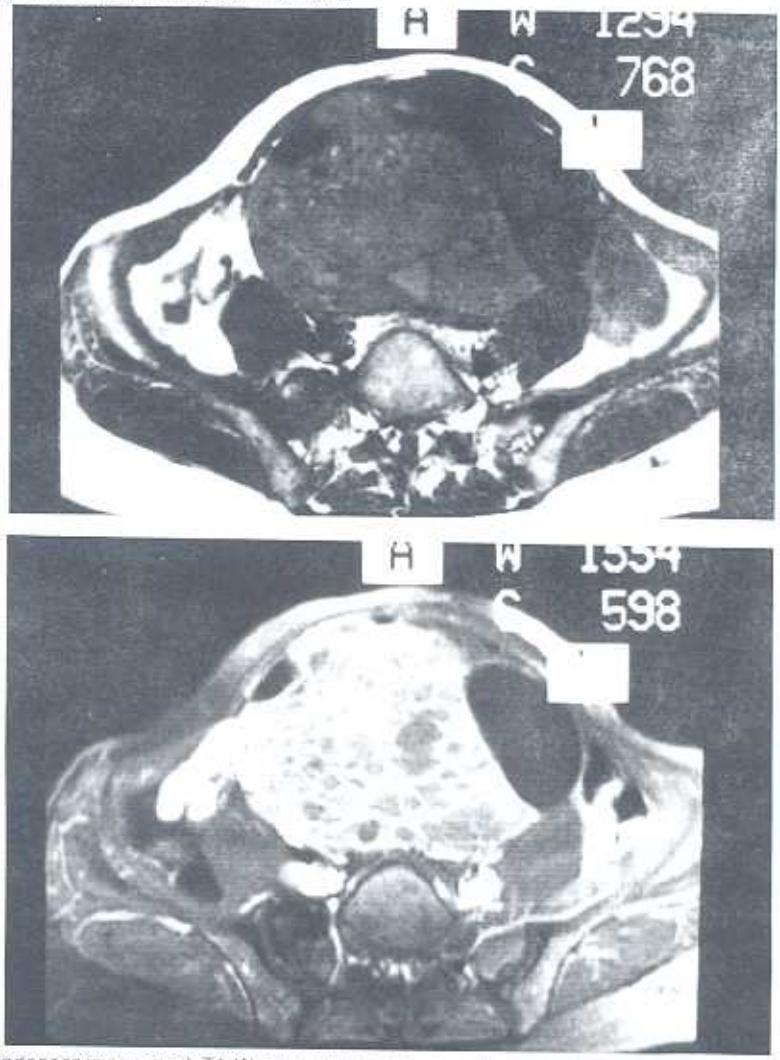


Figure 1. Mucinous cystadenocarcinoma. a) T1-W axial image shows multiseptated complex cystic mass and hyperintense content which is consistent with mucine. b) Contrast-enhanced fat-saturated MR image clearly delineated multiple, thick, contrast-enhanced septations.

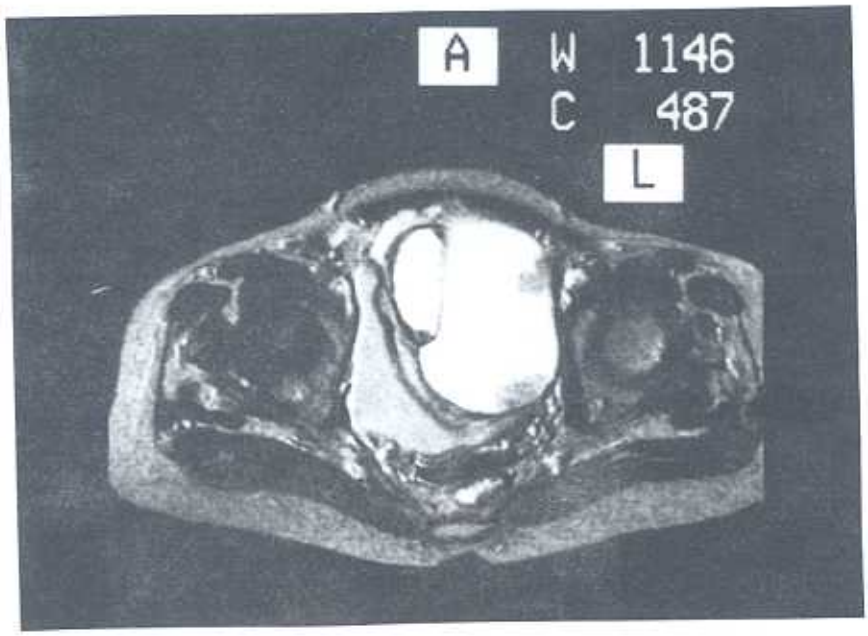
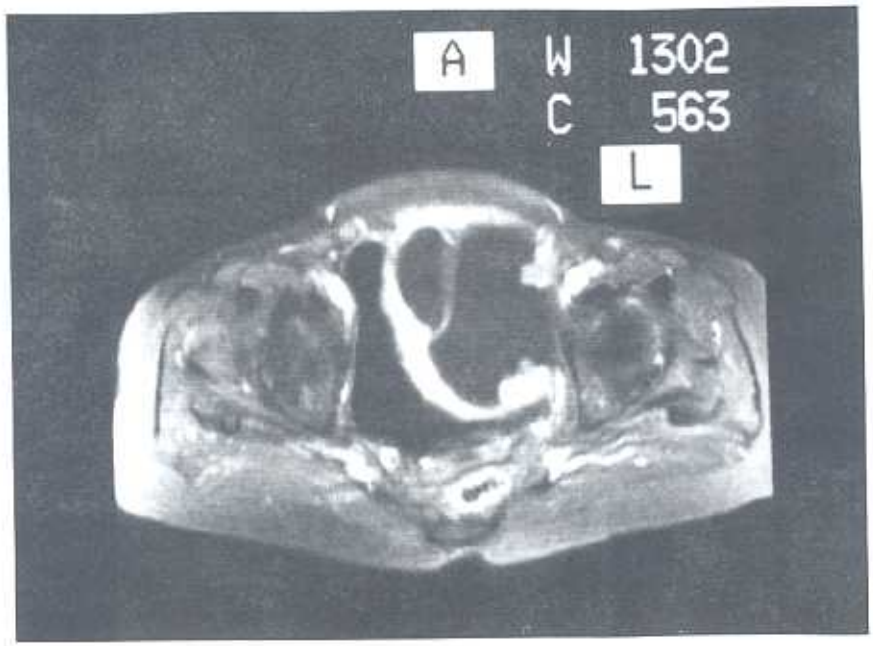


Figure 2. A malignant ovarian mass. a) On T2-W image, there is complex cystic lesion with mural solid nodules and thick walls and septations.



2b) Contrast-enhanced fat-saturated image demonstrates that solid portions and walls enhance.

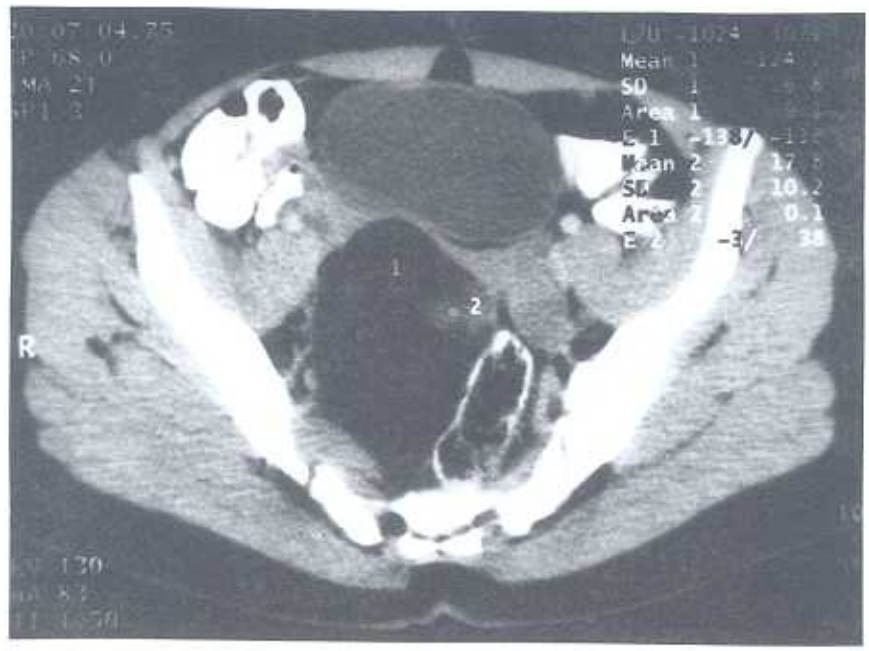


Figure 3. CT of an ovarian dermoid cyst with fatty content and mural solid nodule. Very low density measured in the cyst is consistent with fat.

Staging

The use of cross-sectional imaging in the preoperative evaluation of ovarian cancer is controversial because both staging and tumour debulking are undertaken at the time of exploratory laparotomy. However, cross-sectional imaging can provide staging information that may help in preoperative planning. In addition, neoadjuvant chemotherapy prior to debulking surgery has been used recently in patients with unresectable or stage IV disease, and cross-sectional imaging can help identify those patients who may benefit from preoperative neoadjuvant chemotherapy. The use of CT for staging of ovarian cancer has been extensively studied. The accuracy of CT for staging is 70%-90% (1, 21-24). CT is more sensitive than US for detection of abnormalities in the paraaortic lymph nodes, omentum, mesentery, and subdiaphragmatic regions (21). MR imaging has similar to CT for staging accuracy. However, accuracy of both modalities was highest in patients with stage III disease (2,24).

CT and MR imaging signs of tumor extension in the pelvic organs include a) localized distortion of the uterine contour, b) an irregular interface between the tumor and the myometrium, high signal intensity in the involved myometrium on T2-weighted images c) loss of a tissue plane between the solid component of the tumor and the wall of the sigmoid colon or the bladder, d) encasement of the sigmoid colon by the tumor or direct tumor extension to the sigmoid colon, e) distance between the tumor and the pelvic side wall of less than 3 mm, and f) iliac vessels surrounded or displaced by the tumor (1,24).

Peritoneal implants is diagnosed when nodular or plaque-like lesions are seen adjacent to or projecting from these peritoneal surfaces (Figure 4a-b). These implants may enhance after intravenous injection of contrast material. Serous cystadenocarcinoma contains calcification in 30% of cases, and CT may demonstrate calcified peritoneal metastases. The liver surface, porta hepatis, and intrahepatic fissure are

common sites of peritoneal deposits.

Nodular tumor implants on the parietal peritoneum of the right hemidiaphragm can indent the liver surface and may simulate capsular or parenchymal liver metastases. Criteria for diagnosis of mental and mesenteric involvement included infiltrative, nodular, or cakelike appearance of soft tissue in the omentum or mesentery (23-26) (Figure 5).

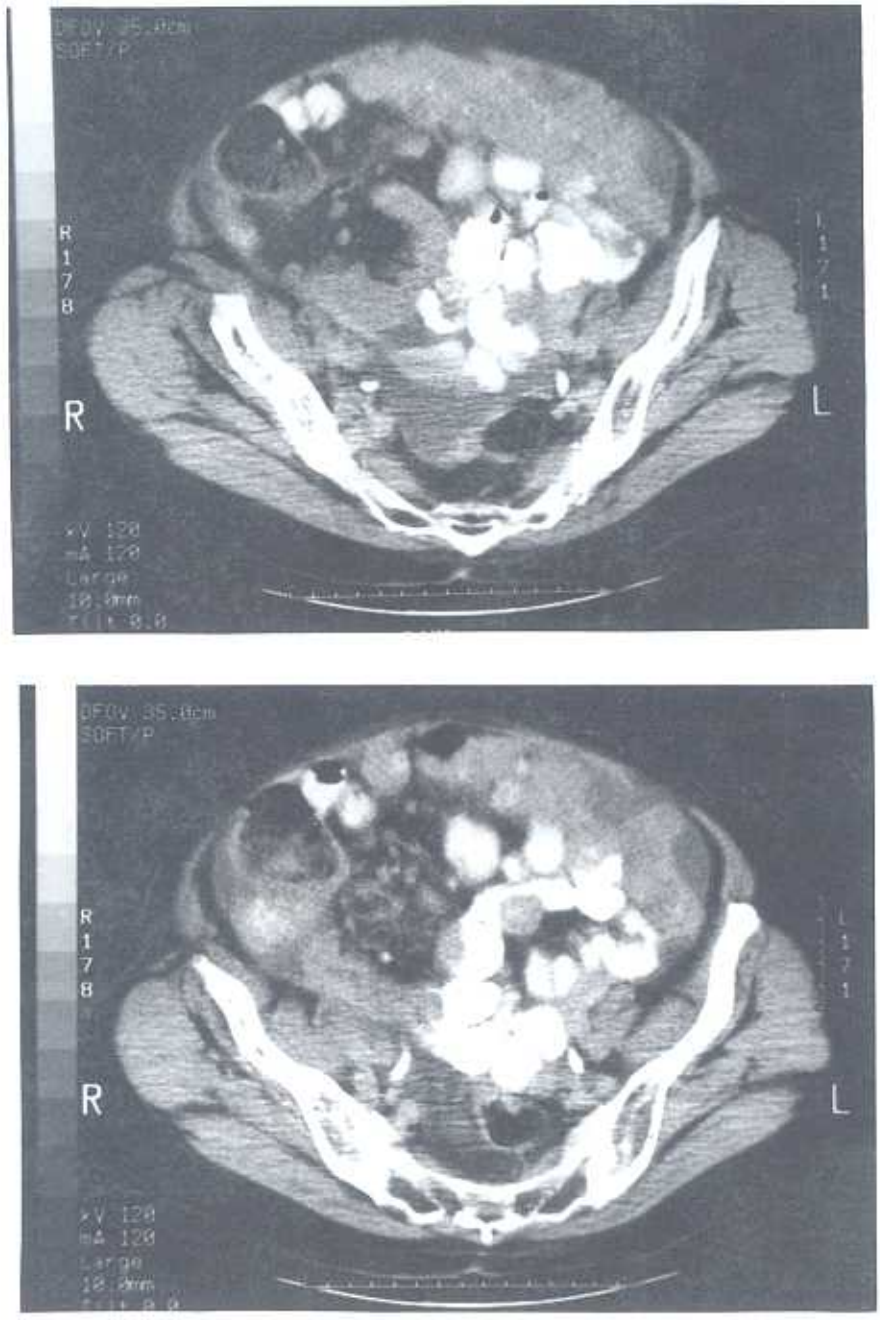


Figure 4. An advanced ovarian carcinoma. In sequential CT scans (a,b), there is an omental cake with milimetric calcifications, as well as mesenteric and peritoneal nodules. Please also note the presence of multiple nodules on the surface of the small bowel.

Figure 5. CT scan reveals an omental cake between the anterior abdominal wall and the small bowel loops.

CT allows detection of 50% of peritoneal implants as small as 5 mm in diameter in the subphrenic regions or profiled by ascites and 28% of implants smaller than 5 mm in diameter (23,26). The accuracy of MR imaging in detecting peritoneal disease is similar to CT (1-2,24). A major limitation of both CT and MR imaging is unreliable detection of lesions smaller than 10 mm and located on the bowel surface, mesentery, or peritoneum(23,24,26). The use of intraperitoneally administered contrast material has increased detection of peritoneal tumor implants as small as 5 mm in diameter. However, this technique is invasive and has not become widely used (27-28). Recent studies have shown that helical CT scanning and the use of fat-suppressed, gadolinium-enhanced MR imaging can improve the detection of small peritoneal implants (29-33). The inferiority of MR imaging for small lesion detection in the paracolic gutters and omentum may also be improved with the use of oral and rectal contrast media (33).

On CT and MR images, detected abdominal and pelvic lymph nodes are considered malignant when the diameter of the short axis exceeded 1 cm irrespective of the location. Overall accuracy for detection of pelvic and abdominal lymphadenopathy is 88% for CT and 94% for MR imaging. The limitation in both modalities is detection of microscopic invasion in small lymph nodes or the presence of reactive hyperplasia in large nodes (1,22,24).

Follow-up

CT is frequently used to detect persistent or recurrent ovarian cancer and demonstrate tumor response to subsequent therapy (Figure 6a-b). The sensitivity and specificity of CT performed before second-look surgery are 59-83% and 83-88%, respectively (34,35). MR imaging has similar sensitivity and specificity (36,37). Both modalities have limited sensitivity in detecting small peritoneal, mesenteric implants and small malignant lymph nodes. Dynamic MR imaging has been reported to be helpful in the differentiation of postoperative fibrosis and recurrent tumor (38).

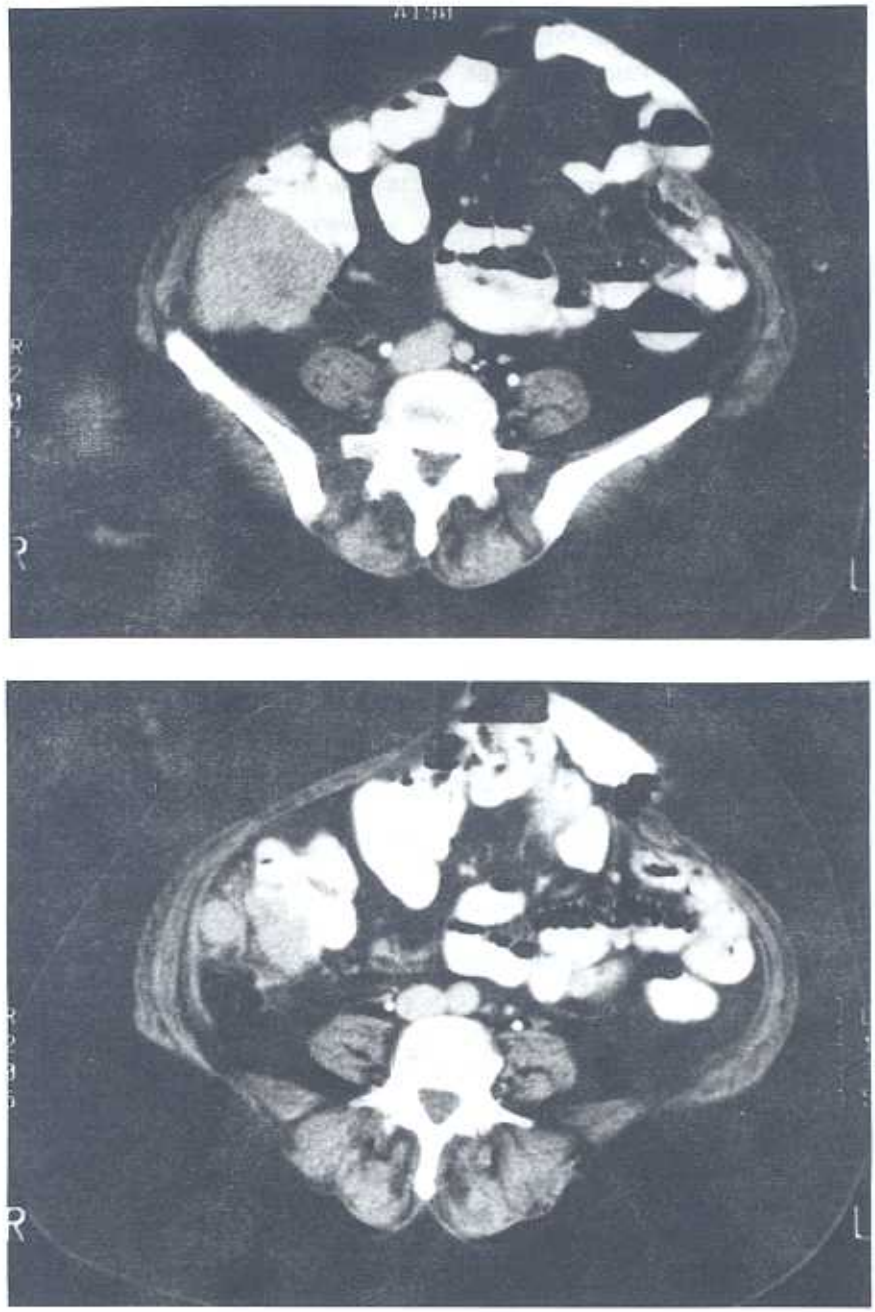


Figure 6. Postoperative recurrent ovarian carcinoma. In sequential CT scans (a,b), there is periceacal peritoneal mass and mesenteric heterogenity

In summary, both CT and MR imaging can be helpful adjuncts in the treatment planning of ovarian cancer. CT, because it is widely available, familiar to physicians, and lower in cost, should be considered as a primary imaging approach. MR imaging should be used in treatment planning in patients with contraindication to the use of iodinated contrast media (e.g., allergy, renal impairment), who are pregnant, and in whom CT findings are inconclusive.

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