

# Question and Answer



## Question

Because the indications for CT have been expanded, we have been asked on many occasions to examine pregnant women for urinary tract calculi, pulmonary thromboembolism, and acute appendicitis. What guidelines should be used in examining these patients? Should standard protocols be altered?

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## Answer

Performing CT on pregnant women causes anxiety for all concerned. Fetal exposure to ionizing radiation can be alarming to parents, and the involved doses and risks generally are not well understood by the general public or health care providers. Radiation-induced teratogenesis is primarily a concern from the 10th to 17th weeks of gestation. The potential results are growth retardation, microcephaly, intellectual deficits, and other central nervous system defects arising from cumulative pregnancy doses exceeding 50 mGy (5 rad). Radiation-induced childhood malignancies, predominantly leukemia, can be caused at any point during gestation and are thought to probably require a dose of at least 10 mGy. Above this level, the estimated risk of childhood cancer per 10 mGy exposure is as much as three and one-half times the normal incidence. Because a causal relationship between a radiation dose of as much as 100 mGy and a specific deleterious effect in humans has never been directly established,

exposure to diagnostic X rays during pregnancy is almost never considered an indication for pregnancy termination [1, 2].

When presented with a pregnant patient with suspected urinary tract calculi or appendicitis, one should attempt to perform the evaluation with sonography. No adverse fetal effects from diagnostic sonography (including Doppler sonography) have been documented, and there are no contraindications to its use during pregnancy. Because dilatation of the renal collecting system occurs in more than 90% of asymptomatic women during pregnancy (occurring three times more commonly on the right side), the assessment for obstructing urinary tract calculi is challenging. However, a normal examination will provide useful information, and determination of the resistive index with Doppler sonography has shown promise in differentiating physiologic from pathologic collecting system dilatation [3]. Unfortunately, sonographic assessment of the appendix can be difficult even in early pregnancy, and it may become impossible in the third trimester.

MR imaging has been advocated as a useful problem-solving modality in pregnant patients. No adverse effects on the fetus from MR imaging have been documented. When possible, however, MR imaging should be delayed until the second or third trimester. Use of gadolinium chelates is not recommended; these paramagnetic agents cross the placenta, and their long-term effects are not known. Although MR imaging has been shown to be valuable in the characterization and staging of neoplastic disease in pregnant women, its usefulness in the evaluation of acute abdominal pain has not been clearly shown. The role of

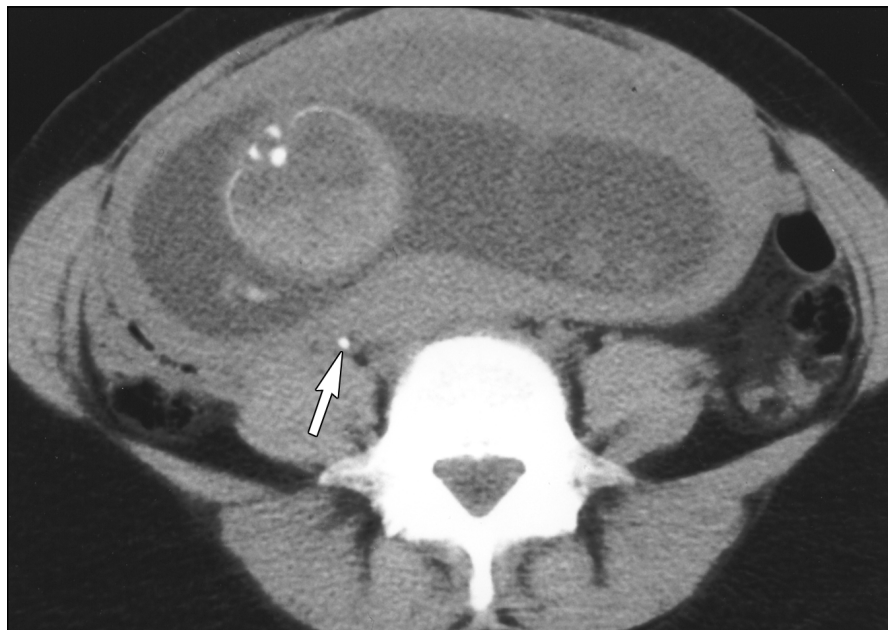
MR imaging in the assessment for urinary tract calculi and appendicitis may increase in the future, but currently it is seldom used for this purpose [4].

CT has emerged as the modality of choice for examining nonpregnant patients for urinary tract calculi and appendicitis. CT should also be considered for pregnant women with these suspected conditions in cases in which sonographic findings are inconclusive and further imaging is deemed necessary. Informed consent is not mandatory but is recommended. Iodinated contrast agents cross the placenta, but they are not contraindicated. Attempts should be made to minimize the fetal radiation dose (e.g., use of low milliamperere-seconds, high pitch, and a limited scanned area), but the technical quality of the study should not be substantially compromised. With these modifications, the estimated fetal dose can be as low as 3 mGy per examination. The use of CT to diagnose appendicitis during pregnancy recently has been advocated, and CT can be a valuable examination in assessing pregnant women for urinary tract calculi [5] (Fig. 1).

When presented with a pregnant patient with a suspected pulmonary embolism, one should choose lower extremity venous sonography as the initial examination. Treatment can be instituted on the basis of the documentation of deep vein thrombosis alone. Like sonography, D-dimer assays do not pose any risk to the fetus, and their use in diagnosing acute thromboembolic disease is increasing. However, D-dimer levels normally are elevated during pregnancy. Therefore, a positive result is not necessarily useful, and a negative result may be unlikely.

The journal invites readers to submit short, well-focused questions about specific topics that trouble them in their practice. The questions should be typed double-spaced and must not be longer than one-half page. The author's name and address should be included, but these will not be published if so requested. Questions will be answered by consultants selected by the Editor. All questions are subject to editing and will be published as space permits. Answers supplied by radiologist consultants should not be considered inclusive of all approaches to a problem or exclusive of other methods of obtaining the same result. Consultants' recommendations on any specific radiologic procedure or course of conduct should be considered in light of the circumstances presented by an individual patient's situation.

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**Fig. 1.**—40-year-old woman who presented in 26th week of pregnancy with severe right flank pain and hematuria. Unenhanced helical CT scan (100 mA; tube rotation, 1 sec; section thickness, 10 mm; pitch, 1.5:1) shows 2-mm right ureteral calculus (arrow). Mild proximal ureteral and collecting system dilatation (not shown) were also present.

The use of ventilation–perfusion imaging in pregnant women is well established and has been shown to be an appropriate and safe examination in this setting. The radionuclide doses can be reduced by approximately 50%, with fetal exposure estimated at less than 0.1 mGy [6]. MR angiography has sometimes been shown to be useful in the diagnosis of pulmonary embolism in patients who are not pregnant. However, high-quality angiograms typically require administration of IV gadolinium, which is not recommended during pregnancy.

The use of CT in diagnosing pulmonary embolism is becoming commonplace in pa-

tients who are not pregnant. In pregnant patients with normal findings on venous sonography and intermediate or indeterminate findings on ventilation–perfusion imaging, the use of thoracic CT should be considered as well. Informed consent is not mandatory but is recommended. Because the abdomen and pelvis are not directly imaged, only scattered radiation will reach the fetus. With no technical modifications other than pelvic shielding, the fetal dose should be less than 0.2 mGy per examination. The increased use of CT to diagnose pulmonary embolism has resulted in pulmonary angiography becoming a much less

commonly performed examination. If performance of pulmonary angiography is deemed absolutely necessary in a pregnant woman, using pelvic shielding and minimal imaging time can keep the fetal dose to less than 0.5 mGy.

In summary, the use of CT in pregnant women obviously should be avoided whenever possible. However, with appropriate clinical indications and minor technical modifications, patients, parents, the public, and health care providers can be assured that the doses are relatively small and the potential benefits outweigh the risks.

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