Magnetic Resonance of Pelvic and Gastrointestinal Emergencies

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KEY WORDS

• Magnetic resonance imaging • Pelvic emergencies • Gastrointestinal emergencies • Degenerating leiomyoma • Ovarian torsion • Pelvic inflammatory disease • Testicular torsion • Acute appendicitis

KEY POINTS

- Magnetic resonance (MR) imaging of the abdomen and pelvis is playing an increasing role in the emergency setting, both in primary diagnosis and as a problem-solving modality.
- MR imaging is especially useful in patients in whom exposure to ionizing radiation is a concern, including patients who are pregnant, children, and patients with chronic diseases that necessitate multiple scans, such as Crohn disease.
- MR sequences should be tailored to the patient's specific clinical presentation with the aim of minimizing scan time while maximizing diagnostic accuracy.

INTRODUCTION

Magnetic resonance (MR) imaging is an established imaging method for the evaluation of many abdominal and pelvic diseases. The ability to distinguish different types of soft tissues based on their intrinsic signal intensity, multiplanar capability, and the identification of pathology without exposing patients to radiation are the major advantages of MR imaging. Although imaging of the gastrointestinal (GI) tract can be a challenge for MR imaging because of peristalsis, fast MR techniques allow accurate depiction of many acute GI conditions. MR imaging can provide clear, valuable information for clinical management in patients with acute pelvic pain, acute scrotum, and suspected appendicitis. In addition to these conditions, acute pancreaticobiliary diseases, such as acute cholecystitis, cholelithiasis, choledocholithiasis, cholangitis, and pancreatitis also can be depicted with MR imaging and MR cholangiopancreatography (MRCP), which are discussed in the article (See Bates DDB, LeBedis CA, Soto J, et al: Use of MR in Pancreaticobiliary Emergencies, in this issue). In this article, the authors discuss MR imaging protocols and findings of acute pelvic, scrotal, and GI pathologies.

NORMAL ANATOMY AND IMAGING TECHNIQUES

Female pelvic structures (uterus, cervix, vagina, ovary, and adnexa) are readily demonstrated on MR imaging. T2-weighted imaging is the mainstay sequence for differentiation of zonal anatomy of the uterus. Three distinct zones (**Fig. 1**) of the

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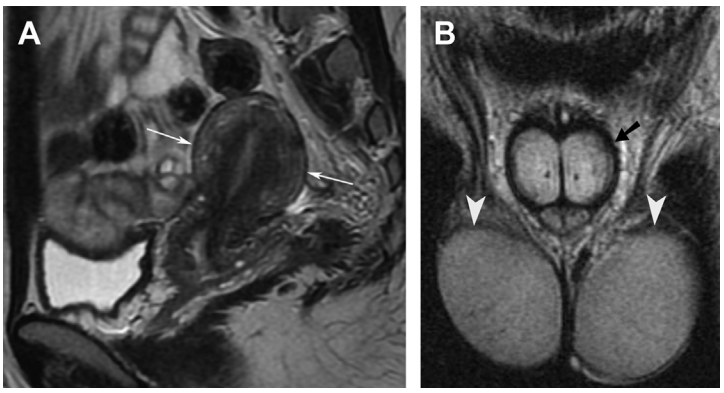

Fig. 1. Normal anatomy. (*A*) Sagittal T2-weighted MR image of the female pelvis shows a uterus in an anteflexed position (*arrows*) with 3 distinct layers of innermost endometrium (high signal intensity), junctional zone (low signal intensity), and outermost myometrium (intermediate signal intensity). Zonal anatomy also can be observed in the uterine cervix with central hyperintense endocervical mucosa, middle hypointense zone, and outer intermediate signal intensity. The vagina has a thin, smooth fibromuscular wall of hypointensity with central hyperintense mucosa. (*B*) Coronal T2-weighted MR image of the testicles (*arrowheads*) demonstrates homogeneous slightly hyperintense signal of the testicular parenchyma. A thin, hypointense stripe surrounding the testicles represents tunica albuginea and the visceral layer of tunica vaginalis. Paired corpora cavernosa and a corpus spongiosum of the penis is seen (*arrow*).

premenopausal uterus include an innermost layer of uterine endometrium, middle layer (junctional zone), and outermost layer. The innermost high T2 signal intensity represents the endometrium with varying thickness depending on age and menstrual cycle. Generally, an endometrial thickness of less than 10 mm is considered normal in reproductive-age women, whereas thickness of less than 5 mm is considered normal in postmenopausal women.[1] The middle layer is the junctional zone, which represents the inner myometrium. The junctional zone has low signal intensity relative to the adjacent outermost layer. The outermost layer is the myometrium, which has intermediate signal intensity on T2-weighted images. The uterine cervix also demonstrates zonal anatomy on T2-weighted images: central hyperintense zone of endocervical mucosa, middle hypointense zone of fibromuscular stroma, and outer intermediate signal intensity of loose stroma. This zonal anatomy is indistinct in the postmenopausal uterus, in which the junctional zone may not be visualized. On T1-weighted images, the uterus is isointense to the muscle and zonal anatomy is not appreciated. The normal ovarian stroma has intermediate signal intensity on T1-weighted images. On T2-weighted images, ovarian follicles demonstrate very high signal intensity. The ovarian medulla usually has higher signal intensity than the ovarian cortex. The vagina also demonstrates zonal anatomy on T2-weighted images: central hyperintense signal of mucosa and intraluminal fluid, middle hypointense zone of submucosal and muscularis layer, and outer hyperintense zone of adventitial layer and vascular plexus.[1]

The testicles lie within each hemiscrotum and are suspended by the spermatic cords. They have homogeneously intermediate signal intensity on T1-weighted images and are slightly hyperintense on T2-weighed images. Normal testicles show slow and steady contrast enhancement after gadolinium administration.[2] The surrounding tunica albuginea and the visceral layer of tunica vaginalis are seen as a thin stripe of low signal intensity on both T1-weighted and T2-weighted images due to their fibrous component (see **Fig. 1**). The epididymes are located along the superolateral aspect of the testicle and consist of head, body, and tail. The epididymal tail continues as the vas deferens to the spermatic cord. The epididymis has signal intensity similar to the testicular parenchyma on T1-weighted images and lower signal intensity than that of testicular parenchyma on T2-weighted images.

Distended bowel loops contain T2 hyperintense fluid, which serves as a natural contrast medium. The normal bowel wall is barely visible when the bowel loops are distended. Its thickness is up to 1 to 2 mm for small bowel and 3 mm for the large bowel. The small bowel diameter is usually less than 2.5 cm in diameter.[3] The appendix is a blind-ended tubular structure arising from the cecum with T1 hypointensity and T2 hyperintensity. Its wall thickness is less than 2 mm and the total axial diameter is usually less than 6 mm. Air bubbles within the lumen may be depicted. When fat suppression technique is applied adequately, the periappendiceal tissues appear hypointense.

IMAGING PROTOCOLS

MR imaging in the emergency setting requires the use of streamlined protocols to minimize imaging