Diffusion-Weighted Imaging in the MR Evaluation of Acute Abdominal Pain in Pregnancy

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Purpose

Assessment of the patient with acute abdominal and pelvic pain in pregnancy by MR imaging is best addressed using non-IV-contrast techniques, given the FDA "C" classification of gadolinium-contrast agents in pregnancy (1,2). Common techniques include motion-insensitive T2W single-shot fast spin echo for anatomic assessment of structures; and T1W in-and-out of phase, T2W fat-suppressed, and time of flight imaging for characterization of structures based on intrinsic tissue contrast, flow, and susceptibility. Our goal was to analyze the utility of breathhold diffusion-weighted MR imaging as an additional imaging technique providing another form of image contrast to help increase the diagnostic confidence in this challenging patient population.

Method

Between June 2006 and September 2007, 61 pregnant patients were referred for MR evaluation of their abdominal pain. All patients were imaged on a 1.5T magnet using our routine clinical MRI protocol, which includes 3-plane T2W single-shot fast spin echo (SSFSE), axial fat-saturated SSFSE, axial T1W in-phase/opposed phase gradient echo, and axial time-of-flight (TOF). Axial single-shot echo-planar diffusion weighted imaging (DWI) was obtained in 37 patients and represents our study group. All sequences were acquired during suspended respiration. DWI was obtained from the kidneys to the symphysis pubis at b=0 and b=1000 (TR/TE 10,000/86 ms; 32 cm FOV; 5 mm axial slice, no slice gap; 64 x 64 matrix; anterior-posterior diffusion direction. The b-value of 1000 was empirically chosen for high suppression of signal from background tissues. Only a single direction diffusion gradient was utilized to keep the imaging time within a breathhold, and the AP direction empirically chosen.. The b=1000 diffusion weighted images were used during the initial interpretations of the MR examinations as they are part of our clinical protocol. In addition, a retrospective evaluation of the 37 consecutive examinations which included diffusion weighted images was also performed to evaluate the signal of the appendix, as identified on SSFSE images, on the b=1000 images.

Results

Out of the 37 examinations, the visualized portions of the kidneys, placenta, fetus, bowel, ovaries, and bone marrow were frequently observed to have hyperintense signal compared to background, when evaluated on b=1000 diffusion-weighted images. Seven patients were taken to surgery based on clinical and MR evaluation, with all seven either having a surgical or pathological diagnosis of appendicitis. Five of these examinations demonstrated high signal within the appendix on b=1000 images, when compared to background; two of the seven did not. The remaining 30 examinations were read as negative for appendicitis; the appendix was not hyperintense to background on any of these studies. There were no false negative MR examinations. DWI was helpful in diagnosing alternative diagnosis that may have been responsible for the abdominal pain by identifying increased signal intensity in degenerating fibroids (n=2), and in the right external iliac vein in a patient with possible venous thrombus on other sequences. DWI was equivocally hyperintense in the kidney in a patient with focal pyelonephritis.

Discussion

Diagnosing the common causes of abdominal and pelvic pain is more difficult in the setting of pregnancy, due to clinical syndromes common to pregnancy that mimic other conditions. Examples include uterine contractions, hydronephrosis of pregnancy, alterations of the normal ranges in body temperature and leukocytosis. Efforts by clinicians to avoid the use of ionizing radiation or intravenous MR contrast agents for the safety of the fetus should be encouraged. Several pathologic processes which can cause pain during pregnancy would be expected to result in restricted diffusion; it is postulated that pus within an obstructed appendix would show restricted diffusion. Similarly, distinction between pus and urine in the renal collecting system has been described on DWI, with pus in the collecting system (pyonephrosis) demonstrating marked restricted diffusion compared to that of the urine-filled pelvicalyceal system in the hydronephrotic kidney (1). In this small series, we found the presence of restricted diffusion within the appendix to be specific to the diagnosis of appendicitis, although not necessarily sensitive enough to serve as a stand-alone technique for such diagnosis. Nonetheless, we find that the diffusion-weighted images increase the confidence of diagnosis of entities such as early acute appendicitis and degenerating fibroids as causes of pain during pregnancy. However, given the susceptibility artifacts inherent in body echo planar imaging, as well as the high degree of background signal suppression at the high b-value we employed, it is prudent to use diffusion-weighted images as an adjunct, rather than a replacement for the previously described sequences when assessing acute pain in pregnancy.

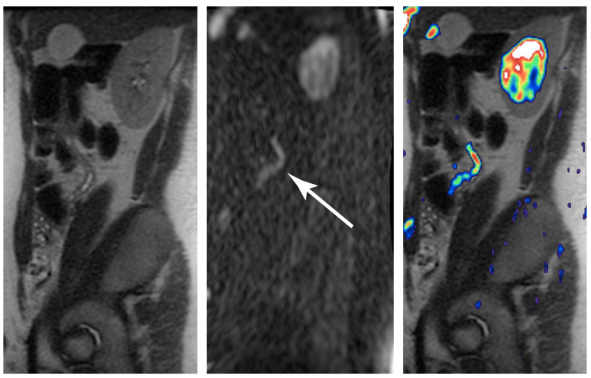
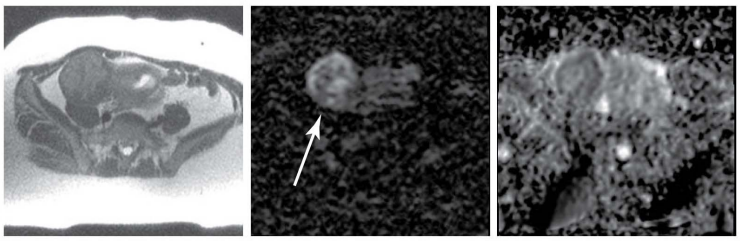


Figure 1 (left): From left to right, sagittal SSFSE, b=1000 diffusion-weighted, and fused images show the serpentine appendix in a patient with acute appendicitis.

Figure 2 (below): From left to right, axial SSFSE, b=1000 diffusion-weighted images, and ADC map demonstrate a degenerating fibroid. The fibroid was tender to palpation during ultrasound evaluation.



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