Abdominal and Pelvic MR Imaging with a VIBE (Volumetric Interpolated Breath-hold Examination) Sequence: Pictorial Review

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Introduction

Volumetric Interpolated Breath-hold Examination (VIBE) sequence is a recently developed fat-suppressed 3D-FLASH sequence, which permits dynamic and high-resolution imaging under breath-hold. Compared to 2D-FLASH sequence, the VIBE sequence provides similar image quality (SNR, CNR) with increased slice selective spatial resolution (2 to 3 mm). Because of its volumetric acquisition, the matrix is near-isotropic and multiplanar reconstruction (MPR) and other reconstruction techniques can be used. With this technique, not only parenchymal but also vascular information can be obtained simultaneously. The purpose of the study is to evaluate the usefulness of dynamic 3D-VIBE sequence in the diagnosis and defining various pathologies in the abdomen and pelvis.

Methods

Over 500 patients underwent MR study of the abdomen or pelvis using 3D dynamic VIBE sequence from February 2000 to October 2000. The studies were conducted on a 1.5T superconducting MR unit (Magnetom Vision or Symphony; Siemens, Iselin, NJ). A torso phased-array coil was used. Imaging parameters were TR/TE/flip angle of 4.5/1.9/15° and matrix of 256 x 128 x 72 (after interpolation). Fat suppression was used in all cases. For liver protocol, typically the FOV was 330 x 250 mm and slab thickness was 200 mm, which gives a spatial resolution of 1.3 x 2.0 x 2.8 mm. The spatial resolution along the slab direction ranged from 2 mm to 3 mm after interpolation in most cases in other body part. We performed this sequence before and 3 times (arterial, venous and delayed phases) after injection of 20 ml of Gd-DTPA. The studies were done under breath-hold, and typically the acquisition time was less than 25 seconds.

Images were analyzed at dedicated workstations (MagicView or Virtuoso, Siemens) and post-processing of the 3-D data sets was performed using MPR, MIP or volume rendering techniques. These cases were retrospectively reviewed, and utility of the VIBE sequence was evaluated.

Results

We studied various pathological processes using the VIBE sequence. In the hepatobiliary system, hepatocellular carcinoma, hepatic adenoma, focal nodular hyperplasia, cavernous hemangioma, cholangiocarcinoma, metastases, cirrhosis with regenerating nodules were studied. In the pancreas, ductal adenocarcinoma, pancreatitis, cystic neoplasms were examined. In the kidneys, renal cell carcinoma, renal cysts, transitional cell carcinoma, and angiomylipoma were examined. In the pelvis, the sequence was utilized for evaluation of uterine fibroids before and after uterine artery embolization. Other pathology that was examined included adrenal tumors, splenic masses, transitional cell carcinomas of the ureter and bladder, and uterine and ovarian malignancies.

The VIBE sequence was particularly useful for the evaluation of soft tissue and vasculature simultaneously. This included evaluation of hepatic artery and portal vein for hepatic tumors, renal artery and vein for renal tumors, celiac artery, superior mesenteric artery, and portal vein for pancreatic tumors and uterine artery prior to embolization of the fibroids. Use of 3D reconstruction (MPR, MIP, volume rendering) was very useful in these instances. The sequence also proved useful in contrast-enhanced urography.

Outside the abdomen and pelvis, this sequence was also applied in evaluating breast disease and brachial plexus masses.

Discussion

Dynamic 3D-VIBE sequence provides high spatial resolution images under breath-hold, and provides useful diagnostic information in the abdomen and pelvis. 3D post-processing with MPR, MIP or volume rendering is very useful when evaluating vascular system and its relationship to abdominal and pelvic masses. At our institution, this technique has replaced dynamic 2D-FLASH sequences in the imaging of the abdomen and pelvis.