MR fluoroscopy guidance for liver biopsies in a short, wide-bore 1.5T scanner – preliminary results

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Purpose

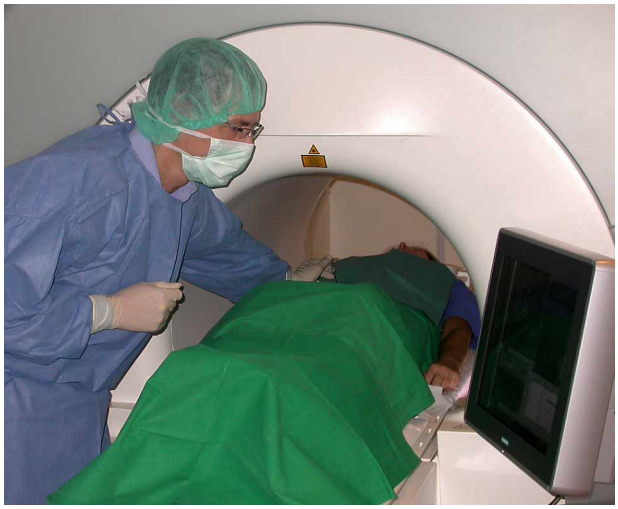
Most MR-guided biopsies have been performed with open-configuration MR scanners, which offer direct patient access but only limited real-time imaging capabilities due to low magnetic field strength and low-performance gradients. Our study aimed to evaluate MR-guided biopsy in the isocenter of a short, wide-bore high-field scanner using MR-fluoroscopy guidance.

Methods and Materials

Sixteen consecutive patients with focal liver lesions (median size 23 mm) underwent MR-guided biopsy using a 1.5 T MR (Magnetom Espree, Siemens). The scanner consists of a conventional closed-bore but a diameter of 70 cm and a length of only 125 cm and is equipped with high-performance gradients capable of 33 mT/m maximum amplitude and a slew rate of 200 mT/m/ms. In each patient, 3 different fast MR sequences were evaluated before biopsy: half acquisition single shot turbo spin echo (HASTE, 2000/100 [repetition time TR ms/echo time TE ms]), turbo gradient echo with inversion recovery (Turbo-FLASH, 1000/1.22/450 [TR/TE/ inversion time TI ms]), and a steady-state free precession sequence (True-FISP, 4.04/2.02 or 2.32/1.16). In the second half of the study (9 patients), a software update allowed further optimization of the True-FISP for better lesion visualization (reduction of TR/TE and a T2-preparation-pulse). The frame rates were: 2 seconds (HASTE), 1 second (Turbo-FLASH), and approximately 0.5 seconds (True-FISP). In all patients the sequence that seemed best suited regarding image quality and lesion visibility was chosen for defining the cutaneous entry site with finger-pointing and for the placement of an MR-compatible guidance needle (Fig. 1). Puncture time (time from start of finger-pointing until the guidance needle reached the target) was recorded.

Results

The short, wide-bore scanner offers sufficient access to the biopsy region in the magnet's isocenter. The needle entry site could be defined successfully with finger-pointing in all patients. In 12 of 16 patients, the guidance needle could be placed accurately using MR fluoroscopy. While in 5 of the initial 6 patients the HASTE was used due to superior lesion visibility, in 5 of the last 6 successful cases the improved True-FISP was used due to better imaging speed with satisfactory lesion contrast. In 4 patients, the relatively flexible MR-compatible needle could not be directed accurately to the target lesion, thus a conventional step-by-step procedure after insertion of a stainless-steel stylet had to be chosen. Diagnostic histological results were obtained with all 16 biopsies. Median puncture time with MR fluoroscopy guidance was 19 minutes (range 13-43 min.), and with the conventional technique it was 50 minutes (range 30-68 min.).



Conclusion

MR-guided biopsies can successfully be performed in this short, wide-bore, high-field MRI, which simultaneously offers good patient access and sufficient image quality and imaging speed. In 12 of 16 cases, MR-fluoroscopy guidance was fast and effective, while 4 cases compelled conventional, step-by-step needle placement. After sequence optimization, a steady state free precession sequence (True-FISP) was predominantly used for MR-fluoroscopy.

Figure 1: Liver biopsy in a short, wide-bore high-field scanner: sufficient patient access for direct needle placement under MR fluoroscopy guidance