MRCP, initial experience at 3Tesla.

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Introduction

Magnetic resonance cholangiopancreaticography (MRCP) is a clinically established tool at 1.5 Tesla magnetic field strength and below[1]. Image quality at 3 Tesla may theoretically be superior owing to the higher signal-to-noise ratio at the higher field strength. However, RF inhomogenieties and susceptibility effects from bowel gas or bowel movement may inversely affect image quality. In addition, the specific absorption rate (SAR) limits at 3Tesla may require longer delay times between radiofrequency pulses possibly resulting in longer acquisition time, which may be critical for breath-hold techniques used in MRCP. We studied the feasibility of MRCP at 3 Tesla and compared the imaging results with a 1.5 Tesla Scanner.

Materials and Methods

The study was approved by the Hammersmith ethics committee and informed consent was obtained from all patients. The study consisted of 8 patients, 5 of which had a MRCP at 1.5 Tesla (Philips, Intera) using a body-array wrap-around coil and a second MRCP at 3.0 Tesla field strength (Philips, Intera) using the built-in body coil. Three patients had MRCP at 3 Tesla alone. All images were acquired under breath hold. At 1.5 Tesla a 2D, thin-slice 4-mm HASTE with a repetition time of 658ms and an echo time of 80 ms. In addition a coronal 40-mm thick-slice 2D turbo-spin echo sequence was used with a repetition time of 8000 ms and a echo time of 800 ms. Identical sequence parameters were chosen at 3T, where possible. Where SAR limits were encountered scan-times were increased by up to 25%. The data of the 5 patients with studies on both systems were analyzed qualitatively on a 5-category scale ranging from none-diagnostic (1), to poor (2), moderate (3), good (4) and excellent (5). Criteria for a good image quality were: homogenous display of the common bile duct, visibility of 3rd order intra-hepatic bile ducts and visibility of the major and minor pancreatic duct. In addition, operator defined regions-of-interest were placed in the common bile duct and an adjacent region-of-interest without any high signal intensity structures, which was preferentially liver or fat. Signal intensity ratios were calculated (Signal intensity the common bile duct / signal intensity of background). The ratios were compared with the t-test with $p<0.05$.

Results

All patients tolerated the imaging well. Ear defenders and ear plugs were provided to assure patient comfort at 3 Tesla. The image quality with the thin slice HASTE sequence at 1.5 Tesla was good (n=3) or excellent (n=2) and not different at 3T in four patients, good (n=3) and excellent (n=1), but suffered from extensive bowel gas which caused substantial signal loss and resulted in poor image quality (n=1). The image quality with the thick-slab technique resulted in a moderate (n=2) or good (n=3) image quality at 1.5 and a good (n=3) or excellent (n=2) image quality at 3 Tesla. Duct visibility at 3 Tesla tended to be superior within the liver and pancreas as compared to the cystic duct or papilla, which are adjacent to bowel structures. The analysis of the quantitative data showed similar signal intensity ratios (common bile duct/surrounding structures) with the HASTE sequence of 5.9±7.7 at 1.5 vs. 7.7±2.1 at 3.0 Tesla field strength (p=0.13). Using the thick-slab technique signal the corresponding intensity ratios were 12.7±5.5 vs. 13.2±7.0 with p=0.9, respectively.

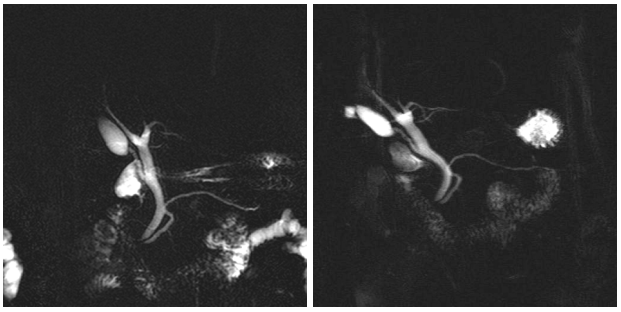

Figure 1: Thick-slice TSE sequences of a patient at 1.5 Tesla (left) and 3.0 Tesla magnetic field strength (right). There is a similar overall image quality with slightly better display of the intra-hepatic bile ducts at 3.0 Tesla.

Conclusion

Our initial experience shows that MRCP is technically feasible at 3 Tesla and overall equal image quality was good when compared with 1.5 Tesla. One limitation was the usage of a whole-body coil at 3 Tesla as opposed to a superior surface-coil at 1.5 Tesla. Even with this we observed better resolved bile and pancreatic ducts within solid organs. Further improvement of MRCP will be achieved using body-array coils. SAR limits did not affect the thick slice sequences of 8 seconds duration but the thin slice scan time was necessarily increased by 25%. Multiple breath holds were required for these scans. Dietary and medical preparation for reducing bowel gas may be advisable.

References

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