First In-human MR-Visualisation of Surgical Mesh Implants for Inguinal hernia treatment.

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TARGET AUDIENCE: Clinical Radiologists and Clinical Scientists

PURPOSE

Surgical treatment of abdominal hernia is one of the most frequently surgical procedures worldwide. Implant deformation is commonly blamed for severe mesh-related long-term complications. Conventional polymere based surgical mesh implants cannot be depicted using conventional radiologic methods including MRI. Consequently, exploratory laparotomy is currently the only reliable diagnostic method. We established an approach to visualize surgical textile implants using MRI (1). Tiny iron particles integrated into the mesh base material induce local susceptibility differences, which can be depicted as signal voids. In previous animal examinations, this approach was demonstrated in vivo (rats, rabbits and pigs) (3). After clinical approval of this mesh technology, this study was initiated to investigate textile implants in a more anatomically complex, clinical setting in patients treated for inguinal hernia. Purpose of this study was to establish an MRI protocol and to evaluate the immediate post-surgical findings. Therefore, different MRI sequences were compared.

METHODS

Approved by the ethics committee, a prospective study with patients surgically treated for inguinal hernia was performed between March and October 2012. In 13 patients an iron-loaded mesh implant was placed either using a laparoscopic technique (TAPP; n=8) or an open surgical procedure (Lichtenstein surgery; n=5). MRI examinations were performed on day 1 after surgery at a 1.5 Tesla scanner (Achieva, Philips, The Netherlands) with a 16 channel receiver coil using two different gradient echo sequences (GRE) and one turbo spin echo sequence (TSE) (sequence parameters see Tab 1.).

Three radiologists (one, five and ten years of experience in abdominal MRI) independently evaluated the MR images. Conspicuity of the mesh implant with respect to anatomical structures and post-surgical air and the diagnostic value of the referring sequence were rated using a semi-quantitative scoring system (1: insufficient, 2: sufficient, 3: good, 4: optimal, and additionally for diagnostic evaluation 0: not visible). Mesh deformation and localization were visually assessed. Statistical analysis was performed using Wilcoxon signed rank test.

RESULTS

In all 13 patients, the implants were successfully visualized by MRI. On GRE sequences, the mesh clearly delineates as a thick hypointense line (Fig. 2a, arrow) that was difficult to distinguish from other structures. Mesh deformation (2.4 on average with open technique, 2.7 with laparoscopic) and the diagnostic value of the referring sequence were rated using a semi-quantitative scoring system (1: insufficient, 2: sufficient, 3: good, 4: optimal, and additionally for diagnostic evaluation 0: not visible). Mesh deformation and localization were visually assessed. Statistical analysis was performed using Wilcoxon signed rank test.

DISCUSSION

In this study, we achieved mesh visualization using MRI for the first time in human patients. GRE1 best facilitated mesh delineation. However, the surrounding anatomy was not sufficiently depicted. In contrast, TSE was suited best for evaluating the surrounding anatomy, but the mesh was not adequately distinguishable as the refocusing pulses in a TSE sequence suppress the susceptibility differences. To evaluate the surgical success, both, assessment of mesh and anatomy combined, is mandatory. Taking both criteria into account, GRE2 showed the best results but achieved merely adequate ratings in the respective separate categories. Consequently, we propose a combination of the above mentioned sequences to achieve a maximum of diagnostic value.

CONCLUSION

The use of iron-loaded surgical textile implants offers the possibility to visualize mesh location and configuration. MRI could therefore be a non-invasive alternative to surgical revision if mesh-related complications are suspected. For the MRI protocol, we propose a combination of the above mentioned three sequences to properly visualise iron-loaded mesh implants.

REFERENCES