Evaluation of Pelvic Adhesion: Multiphase-multislice MR imaging with Kinematic Approach

M. Katayama, T. Masui, S. Kobayashi, T. Ito, H. Sakahara*, A. Nozaki**
Seirei Hamamatsu General Hospital and * Hamamatsu University School of Medicine, Hamamatsu, Shizuoka, Japan,
** GE Yokogawa Medical System, Hino, Tokyo, Japan.

Introduction

Pelvic adhesions are very common and costly condition among women with gynecologic disorders. They cause pain and can be obstacles for surgical procedures. Accurate diagnosis for the pelvic adhesions is very valuable in the therapeutic planning. MR is noninvasive and consistently demonstrates normal and pathologic pelvic anatomy. So far, MR evaluation of adhesions was mainly dependent on the anatomical recognition of distortion or retraction of the pelvic organs. A half-Fourier acquisition single shot fast spin echo (SSFSE) sequence enables us to obtain a high temporal image with certain tissue contrast within a second. By acquiring multiphase-multislice imaging mode with SSFSE sequence, kinematic information can be obtained. It might improve recognition of pelvic adhesion by MR imaging. On ultrasonography with similar kinematic approach, the sliding sign (two adjacent organs moving differently during respiratory movement) was suggested to be helpful in localizing an abdominal adhesion. The purposes of this study were to demonstrate kinematic imaging of pelvis and to evaluate the effectiveness of kinematic imaging for assessing the pelvic adhesion.

Subjects

Thirty-two patients (aged 15-76 years; mean 42.6 years) with gynecologic disorders were included in this study (13 uterine fibroids, 11 benign ovarian tumor, 4 malignant uterine tumor, 3 malignant ovarian tumor, 1 endometriosis). All patients underwent surgery within 58 days (mean, 26days) of MRI and existence or absence of pelvic adhesions was verified.

MR Imaging: MR imaging was performed with a superconducting imager at 1.5T unit (Signa Horizon LX; GE Medical Systems, Milwaukee, WI). MR image was obtained in the sagittal plane with a phased array coil. SSFSE images were obtained with the following parameters: effective TE, 94msec; number of excitation, one; matrix size, 256x160; rectangular field of view, 35x21cm; echo train length, 85; echo spacing, 4.8msec; received bandwidth, 62.5Hz; slice thickness, 5mm; interslice gap, 2mm. The acquisition time per slice was about 1sec. The one set of about 20 section images (per one phase) covered the entire pelvis, and 10-15 imaging acquisitions were repeated under free respiration. The total acquisition time was about 5 to 6 minutes for 200 to 300 images.

Image Evaluation: All images were reviewed on the workstation (Advantage window 3.1; GE Medical Systems, Milwaukee, WI). They were sorted according to location and at each location, images were sorted according to time. Then all images were sequentially displayed on a monitor in a cine mode at a frame rate of 10 frames per second.

1) We classified the movement patterns of adjacent organs into 3 categories: type 1= sliding (adjacent organs moving differently each other greater than 1cm), type 2= fine motion (adjacent organs moving less than 1cm), furthermore, type 2 was divided into two subgroups, type 2-A= asynchronous fine movement (moving independently against the adjacent organ), type 2-B= synchronous fine movement (moving accordant to the adjacent organ), type 3= no motion (no movement).

Above classification was applied to all pelvic organs for the evaluation of adhesion. In addition, existence or absence of peristalsis (wave like muscular contractions) of the rectum, colon, and small intestine was evaluated respectively.

Exclusion criteria for the evaluations

The following cases were excluded from the evaluations: 1) prior surgical removal, 2) organs which were not identified on SSFSE images, 3) adhesions of organs in the left-to-right sided dimensions. Because of kinematic imaging was obtained in the sagittal plane, evaluations of adhesions over slices of different location were not considered as accurate.

Analysis:

According to classification of the movement pattern, MR findings of existence or absence of adhesions were verified by surgical findings.

2) From the results of the first part of the study, positive or negative findings, which might suggest existence of absence of pelvic adhesions, were selected. And according to these selected findings, sensitivity, specificity and accuracy for diagnosis of adhesions with MR kinematic approach were obtained.

Results

Exclusion: 1) Of the 32 patients, two patients had the history of excision of pelvic organ (total oophorohysterectomy, right ovarectomy). 2) Ovaries (4 right and 1 left) could not be detected on SSFSE images and referential standard T2-weighted images. 3) 4 cases of relation between the ileum and uterus, 4 cases between the right ovary and uterus, 7cases between the left ovary and uterus, 3 cases between the right ovary and intestine, and 5cases between the left ovary and intestine were excluded.

1) MR kinematic findings and surgical results were summarized in Table. Findings of sliding and asynchronous fine movement were relatively high negative predictive value for adhesions (7/7 (100%) and 128/134 (95.5%), respectively). Those of no motions were observed in 7 of 9 (77.8%) without proved adhesions.

Existence of peristalsis was observed in18 cases (56%) at rectum, 26 cases (81%) at colon, and 31 cases (97%) at ileum.

2) When findings of sliding and asynchronous fine movement, and those of synchronous fine movement and no motion were regarded as negative and positive findings of adhesions, respectively, sensitivity, specificity and accuracy were 72.7%, 80.1%, 79.2%, respectively.

Conclusion

With kinematic multiphase-multislice MR imaging, information of existence or absence of pelvic adhesions and peristalsis can be constantly obtained. This method may give new diagnostic approach to the evaluation of the pelvic pathology.

Table. The findings of adhesion : Four criteria compared with laparoscopic findings

finding	relation between uterus and rectum adhesion (-)	adhesion (+	total	uterus and intesitine (except rectum) adhesion (-)	adhesion (+	total
sliding	1	0	1	4	0	4
asynchronous movement	24	1	25	43	2	45
synchronous movement	0	1	1	6	2	8
no movement	4	1	5	1	0	1
total	29	3	32	54	4	58
finding	uterus and both ovaries adhesion (-)	adhesion (+	total	both ovaries and intestine adhesion (-)	adhesion (+	total
sliding	1	0	1	1	0	1
asynchronous movement	26	1	27	29	2	31
synchronous movement	11	6	17	8	5	13
no movement	1	1	2	1	0	1
total	39	8	47	39	7	46