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Uterine contractions evaluated on cine MR imaging in patients with uterine leiomyomas☆

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Abstract

Purpose: Submucosal leiomyoma is one of the most recognized causes of infertility and habitual abortion. The purpose of this study is to evaluate uterine peristalsis, a cycle-related inherent contractility of uterus probably responsible for sperm transport and conservation of pregnancy, in patients with uterine leiomyomas using cine magnetic resonance (MR) imaging. *Materials and methods:* Study population consisted of 26 female patients (age range: 19–51 years, mean: 41 years), in which 16 patients had submucosal leiomyomas and 10 patients had intramural or subserosal leiomyomas. We prospectively performed MR imaging of the midsagittal plane of uterus using 1.5 T magnet (Symphony, Siemens Medical Systems) with a body array coil, and obtained 60 half-Fourier acquisition single shot turbo spin echo (HASTE) images (Echo time = 80 ms, FOV = 300 mm, slice thickness 5 mm, matrix 256 × 256) within 2 min, and displayed them on cine mode at 12× faster than real speed. Evaluated were peristaltic movements at the endometral–myometrial junction and focal myometrial movements, adjacent to leiomyomas, regarding presence, direction, frequency, and conduction. *Results:* The peristaltic movements were identified in 12/16 patients with submucosal lesions and 10/10 with other leiomyomas. The frequency and direction were cycle-related. Loss of peristalsis was noted adjacent to submucosal myomas in 4/12 patients, but was not in others. Focal myometrial movements were noted in 9/16 patients with submucosal myomas, but not in others. *Conclusions:* Uterine peristaltic movements were partly interrupted by submucosal leiomoymas, but not by myometrial or subserosal leiomyomas. Loss of peristalsis and focal myometrial movements was noted only adjacent to submucosal leiomyomas. These findings are considered to represent dysfunctional contractility, and may be related with pregnancy loss.

Keywords: Magnetic resonance imaging; Uterus; Leiomyoma; Contractility

1. Introduction

Submucosal leiomyoma is one of the most recognized causes of pregnancy loss or infertility [1–3]. Fifty percent of patients have been reported to conceive after a myomectomy [4]. Postulated causes of infertility include mechanical prevention of nidation due to the distortion of the endometrial cavity and atrophy and ulceration of the endometrium over the leiomyomas, prevention of the passage of the sperm upward, and possible hypercontractility caused by leiomyomas [5–7]. However, the role of leiomyomas in uterine factors of infertility and the mechanism of their influence have not been clarified until now [8].

It is recognized that the uterus has inherent contractility which appears to play a major contributory role in sperm transport [9]. Ultrasound, using a transvaginal probe (TVUS), has shown the presence of rhythmic and subtle contractions of the inner third of the myometrium that is associated with striping movements of the endometrium [10–13]. The wavy conduction of these subtle contractions is called uterine peristalsis. The direction and frequency

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of the waves have been reported to be cycle-dependent in order to contribute to rapid sperm transport and conservation of early pregnancy [10–14]. Many researchers have attempted to clarify the relation between dysfunctional contractility and a variety of gynecologic and obstetrical diseases, including infertility and pregnancy wastage on US, particularly TVUS [10–14].

Recent advances in MR imaging techniques have enabled us to see the inherent contractility of the uterus directly and clearly on cine mode display of MR images sequentially obtained in the same plane of the uterus using an ultrafast imaging technique requiring approximately 1 s per image [15,16]. The purpose of this preliminary study is to evaluate characteristics of the inherent contractility of the uterus with a focus on uterine peristalsis in patients with leiomyomas and to identify the difference between submucosal leiomyomas and subserosal/intratumoral leiomyomas, regarding their influences on contractility.

2. Materials and methods

2.1. Patient population

Thirty-five sequential patients with uterine leiomyomas detected on transvaginal ultrasonography were recruited to this prospective study. These patients were examined by transvaginal ultrasound with suspicious of uterine leiomyoma based on clinical assessment by the gynecologists.

However, nine patients were excluded from the study due to the failure to visualize the entire endometrial cavity in the same plane, or the inability to evaluate peristaltic movements due to severe compression of endometrium. Therefore, the study population consisted of 26 female patients (age range: 19–51 years, mean: 41 years). Sixteen patients had submucosal leiomyomas (a single lesion for each patient). Thirteen patients had intramural or subserosal leiomyomas. Three patients with submucosal leiomyomas had intramural and/or subserosal leiomyomas as well, and were included in the submucosal group. The leiomyomas ranged in size from 1.5 cm × 1.5 cm to 10 cm × 8 cm.

Of the 16 patients with submucosal leiomyomas, one patient was in menstrual phase, three were in follicular phase, one was in periovulatory phase, and 10 were in luteal phase. In one patient, menstrual phase was unclear because of hormonal therapy. In the remaining 10 patients with intramural or subserosal leiomoymas, two were in menstrual phase, two were in follicular phase, two were in periovulatory phase, and four were in luteal phase.

The protocol of this study was approved by the Ethics Committee, Kyoto University Graduate school of Medicine. Written informed consent was obtained from all subjects. Information regarding last menstruation period and cycle was obtained by history taking at the time of the MR studies.

2.2. MRI study protocol

MR studies were obtained on a 1.5-T magnet unit (Symphony: Siemens) using phased-array coil. Fast spin-echo (FSE) and half-Fourier acquisition single shot turbo spin echo (HASTE) techniques were used to obtain T2-weighted images. Under quiet respiration, 60 serial images were obtained every 2 s over 2 min by HASTE (Echo time = 80 ms, FOV = 300 mm, slice thickness 5 mm, matrix 256 × 256), in the midsagittal plane of the uterus. After HASTE images were obtained without premedication, 20 mg of Scopolamine Butylbromide (Buscopan) was administered by intramuscular injection. Subsequently, conventional axial and sagittal T1- and T2-weighted images were obtained using spin-echo and fast spin-echo techniques to perform routine MR imaging.

2.3. Image analysis

Serial HASTE images were displayed on 12× cine mode to facilitate evaluation of peristaltic movements. The serial images on cine mode were independently and separately evaluated by two radiologists, and later decisions were made by consensus. Assessment was based on the following aspects: (a) perception of peristaltic movements at the endometral–myometrial junction, (b) the direction and frequency of conduction of peristalsis, if perceptible, (c) focal loss of peristalsis adjacent to leiomyomas, (d) focal myometrial movements adjacent to leiomyomas, and (e) the direction and frequency of the focal movements, if present. The results were compared between patients with submucosal leiomyomas and those with intramural or subserosal leiomyomas.

3. Results

Peristaltic movements were detected on cine MR imaging in 12 out of 16 patients with submucosal leiomyomas and in all 10 patients with intramural or subserosal leiomyomas. All four patients with no apparent peristalsis were in luteal phase (day of cycle 19–27).

In patients with submucosal leiomyomas, direction was predominantly cervicofundal in the midcycle ($n = 4/5$), and was reversed as fundocervical during menstrual phase ($n = 1/1$). In patients with intramural and subserosal leiomyomas, direction was predominantly cervicofundal in the midcycle ($n = 2/3$), and was also reversed as fundocervical during menstruation ($n = 2/2$).

In patients with submucosal leiomyomas, the frequency of the movements was from 1 to 3 times in 2 min in the luteal phase (mean 2.5 times), and 2–5 times in 2 min (mean 3.2 times) in the remaining cycle. In patients with intramural or subserosal myomas, the frequency was 1–4 times (mean 2.5 times) in luteal phase, and 2–5 times (mean 3.3 times) in the remaining cycle.