Circadian Rhythm of Uterine Peristalsis

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Introduction
The uterus has an inherent contractility. Recent investigations of the uterus’ inherent contractility have shown subtle and wave-like movements of the subendometrial myometrium and endometrial striping in women of reproductive age using cine mode MR imaging [1]. These movements have been called uterine peristalsis [2]. Reports have highlighted a close relationship between uterine peristalsis and menstrual cycle phases, indicating its possible role in functions such as sperm transport, discharge of menstrual blood, and continuation of early pregnancy [2,3]. However, there has been no investigation into possible fluctuations of peristalsis during the day. We sought to determine if there was circadian change present in uterine peristalsis in women of reproductive age.

Materials and Methods
The study was carried out in nine volunteers of reproductive age (age range: 22-33 years, mean: 25.1). MR images were obtained at three phases of the menstrual cycle: periovulatory phase, the menstrual phase that shows exaggerated uterine peristalsis [4], and the luteal phase that shows diminished peristalsis [2]. Volunteers were scanned four times a day, at 8.00, 13.00, 18.00 and 23.00.

MR studies were performed on a 1.5 T magnet (Symphony, Siemens Medical Systems) using a body array coil. In addition to sagittal fast spin echo T2-weighted images, sequential T2-weighted half-Fourier acquisition single-shot turbo spin echo (HASTE, TR=3751ms, TE=102ms, FOV=260mm, slice thickness 4mm, matrix 297x512) images were obtained in a midsagittal plane of the uterus sequentially under quiet breathing, and displayed on cine mode. One image was obtained every two seconds allowing 60 serial images to be obtained within 2 minutes. Cine mode was evaluated at x12 faster than real speed to enhance wave appearance.

Three radiologists carried out evaluations of uterine peristalsis, which was defined as wave-like conduction of subendometrial low intensity area or endometrial striping, independently. Evaluation by 1) the frequency of the peristaltic wave, 2) the direction of the peristaltic wave, and 3) the influence of contraction to the peristalsis, was undertaken and then compared to reach a consensus.

Result
There was no statistically significant circadian rhythm in frequency and direction of uterine peristalsis in any phases of the menstrual cycle in the population as a whole.(table1, 2) The range of frequency was 0-6.8/min (table1).

However, each volunteer had a small fluctuation in frequency and direction of the peristalsis over a day in 84% of the volunteers, although the range of fluctuation was less than 1/m and was not statistically significant. Suppression of peristalsis was observed in association with sporadic sustained contractions in 9 of 39 studies in the periovulatory phase, in which the suppression of the peristalsis by contraction was statistically significant. The frequency of the peristalsis was 2.43/2min with contraction, 4.52/2min without contraction in the periovulatory phase.

Discussion
Our results have shown that there is no circadian rhythm of uterine peristalsis; that there is no statistically significant change in the direction and frequency during a day among three phases of the menstrual cycle. This result seems to be in accordance with the hypothesis that estradiol concentrations may influence the frequency of peristalsis [1-3], and previous reports have shown that concentrations of either estrone or estradiol have no circadian rhythm throughout the day [5-7].

However, our results have shown that there was a small fluctuation in frequency and direction among individuals, and among the time of day of the measurements, although changes were not as a whole statistically significant. The change in direction and frequency in a day was observed in 84% of the volunteers. In the periovulatory phase, the frequency of the uterine peristalsis reduced with the existence of sustained contraction, which involves the entire myometrium, and lasts minutes [8]. In the presence of these strong contractions, the subtle contractions of the inner third myometrium that constitute uterine peristalsis are probably concealed.

In conclusion, uterine peristalsis has no circadian rhythm and it is probably related to the fact that there is no circadian rhythm in the serum levels of ovarian hormones. However sporadic changes in direction and frequency do occur and are partly related to the occurrence of sustained uterine peristalsis.

References

Table1: the range of frequency

<table>
<thead>
<tr>
<th>menstrual phase</th>
<th>ovulatory</th>
<th>luteal</th>
<th>menstrual</th>
</tr>
</thead>
<tbody>
<tr>
<td>range(f/min)</td>
<td>0-6.5</td>
<td>0-4.5</td>
<td>0-2.5</td>
</tr>
</tbody>
</table>

Table2: Frequency in each menstrual phase

<table>
<thead>
<tr>
<th>time (h)</th>
<th>frequency (f/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>800</td>
<td>ovulatory</td>
</tr>
<tr>
<td>1300</td>
<td>luteal</td>
</tr>
<tr>
<td>1800</td>
<td>menstrual</td>
</tr>
<tr>
<td>2300</td>
<td></td>
</tr>
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