Oral Contraceptives and Uterine Peristalsis: Evaluation with MRI

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Introduction: OCs are effective and the most widely used methods of contraception. The primary mechanism for all OCs is the inhibition of ovulation by suppressing hypothalamic gonadotropins-releasing factors, which result in the suppression of the cyclic peaks of estrogen and progesteron. However the contraceptive actions are multiple and their possible role in altered tubal and uterine motility or on endometrial maturation or cervical mucus is unclear[1]. Myometrial contractility had been previously evaluated only by inserting intrauterine pressure or intrauterine electrodes and is not easy to assess. However, the recent development of ultrafast MR imaging techniques have enabled direct visualization of these myometrial contractilities non-invasively. With the use of cine MR imaging, the surging wave that is caused by a subtle and rhythmic contraction of the inner myometrium has been clearly shown and is called uterine peristalsis[2]. The direction and frequency of uterine peristalsis varies among menstrual cycle phases and has been supposed to be regulated by the level of ovarian hormones and related to sperm transportation and fertilization [2, 3]. This study aimed to evaluate the effects of OC on uterine contractility in the mid cycle uterus using cine MR imaging and to correlate these kinematic findings with those of static representations obtained with conventional T2-weighted images (WI).

Materials and Methods: The subjects were 15 healthy female volunteers of reproductive age taking combined OCs and as controls 15 healthy volunteers not taking contraceptives(age range: 21-47year). MR studies were performed on the periovulatory phase(CD11-15) in the control group and at mid cycle, which corresponds to the inhibited "periovulatory" phase in the OC-taking group. MR studies were performed twice for each woman and a total 60 examinations were carried out with a 1.5 T magnet(Symphony, Siemens Medical Systems) using a body array coil. In addition to sagittal fast-spin echo T2WI and spin echo T1WI, sequential T2-weighted half-Fourier acquisition single-shot turbo spin echo(HASTE) images were obtained sequentially in a mid sagittal plane of the uterus under quiet breathing, and displayed in cine mode. One image was obtained every three seconds allowing 60 serial images to be obtained within three minutes. Image analysis was performed by a computer-assisted software program. Evaluation of uterine peristalsis was performed with attention towards two elements according to a previous report: 1) recognition of wave conduction on the longitudinal axis within the junctional zone and 2) recognition of endometrial stripping movements[2]. The evaluated points were: the signal intensity of the myometrium on T2WI and of the cervical canal on T1WI, the thickness of the endometrium, the junctional zone and the myometrium. Analysis was performed using public domain software ImageJ. Comparisons of the peristaltic wave evaluation and myometrial appearance between two groups were assessed with an unpaired Student t–test.

Results: On cine mode evaluation, uterine peristalsis was identifiable in only three of the 30 studies of OC users, whereas all 30 studies in the control group showed peristalsis. The peristaltic frequency was 0.90/min in the OCs-uses in contrast to 2.55/min in the control group. The identifiable direction of the peristalsis was cervicofundal in all the studies in both groups. In the static images, the junctional zone was identifiable in 14 out of 15 subjects taking OCs. The endometrium was significantly thinner in OC-users compared with controls (statistically significant difference, $p<0.05$). The myometrium was significantly thicker in the OC-users than the control group both in the anterior and posterior walls. The junctional zone thickness was 0.41cm in OC-users and 0.49cm in the control group, but this difference was not statistically significant. However, the junctional zone proportion of the myometrial thickness (JZ/myometrium(%)) was significantly reduced in the OC-users compared with the control group in both the anterior and posterior walls. The signal intensity of both myometrium on T2-WI and the cervical endometrium on T1-WI in the OC-users were slightly higher than the control group, but the difference was not significant.

Discussion: Rhythmic contractions of the inner myometrium were first displayed by Oike et al, in 1990 and have almost always been evaluated using a TVUS [4]. It has been speculated that they may have an important role in sperm transport, discharge of menstrual blood, and conservation of the gestational sac during the early stages of pregnancy [3]. However, the literature is still limited and their physiologic mechanism and role have yet to be described.

Uterine peristalsis, which is defined as surging waves caused by subtle and rhythmic contractions of the inner myometrium in our series, was dramatically suppressed at mid cycle in OCs users. Uterine peristalsis was identifiable in only 10 % of OC users in contrast to 100 % in the control group, and less frequently in the OC users (0.90/min vs. 2.55/min). These findings seem to indicate that uterine peristalsis is closely regulated by cyclic estrogen and progesterone, possibly disturbing upward transport of the sperm. Since OCs suppress the peak of the mid cycle estrogen, the finding that oral contraceptives suppress peristalsis indicates the physiologic role of follicular estrogen as a stimulator of mid cycle contractility [5].

Our results concurred well with those reported by Maslow and Lyon with the use of TVUS. Maslow et. al. have recently shown that fifty percent of women using OCs had no mid cycle contractions whereas all controls had contractions [5]. The incidence and directions of identifiable contractilities, and the rate of suppression were different from those of ours. These differences were probably caused by differences in the variety of contractilities evaluated and the modalities used. We only evaluated contractility presenting as surging waves, which were caused by subtle and coordinated contractions of the inner myometrium, while Maslow and Lyon included both coordinated and uncoordinated contractilities [5].

Static MR images demonstrated small endometrial width, relatively bright and swollen myometrium on T2-WI, and cervical mucus of slightly high signal intensity on T1-WI. All these findings well reflect pathological features such as endometrial atrophy, myometrial edema and viscous cervical mucus and are well in accordance with descriptions in the limited number of reports describing MR appearance of the uterus[6]. The ratio of the junctional zone width within the myometrium was significantly lower in OC users than in the control group. Because the appearance of the junctional zone on static MR images probably represents sum up image of the appearance of the subendometrial myometrium on all the ultrafast images, the thin junctional zone on the static images might be closely related to reduced uterine peristalsis in OCs users [2]. However, our results also showed that the junctional zone, although thin, was identifiable in the uterus that did not have peristalsis, indicating that an identification of the junctional zone might not only be related to the peristalsis but also related to multiple factors. Further studies will be necessary to clear up the problem of the junctional zone's appearance.

In conclusion, our results have shown OC markedly suppressed uterine peristalsis, which is important in sperm transport, and displayed a small uterus with a thin junctional zone. MR imaging provides information about the uterus, not only with respect to morphologu, but also kinematics, and might help in the future to further elucidate the function of the uterus.

1.Cunningham, F.G., in *Williams Obstetrics*, 2001 2..Nakai, A., et al., JMRI, in press. 3.de Vries, K.et al., AJOG, 1990. 4.Oike, K. et al., Nippon Sanka Fujinka Gakkai Zasshi, 1990. 5.Maslow, K.D. et al. FS, 2003 6.McCarthy, S., et. al., lRadiology, 1986.