Physiologic changes of the normal ovaries on T2-weighted images and diffusion-weighted images during the menstrual cycle.

N. Morisawa[1], T. Koyama[2], A. Kido[3], K. Tamai[1], K. Fujimoto[1], and K. Togashi[1]

[1]Department of Diagnostic Radiology and Nuclear Medicine, Graduate School of Medicine, Kyoto University, Kyoto, Japan, [2]Department of Radiology, Kyoto University Hospital, Kyoto, Japan, [3]Department of Radiology, Kyoto Katsura Hospital, Kyoto, Japan

Introduction:

The normal ovaries in a reproductive woman show physiologic changes according to the hormonal changes during the menstrual cycle. The physiologic changes may be reflected on T2-weighted image (T2WI) and diffusion-weighted image (DWI), the latter is a recently emerging technique that provides tissue contrast and the ADC value based on water diffusion. The purpose of this study is to investigate the changes of MR findings on T2WI and DWI of normal ovaries during the menstrual cycle.

Materials and Methods:

Our study population included nine healthy females (age; 23-33, mean 27). MRI was performed three times at the menstrual, periovulatory and luteal phase in each subject, utilizing a 1.5-T unit (Symphony; Siemens) with a paired 6-channel coil. MR protocol included sagittal and axial fast spin-echo T2WI, and sagittal DWI with single-shot echo-planar sequence (TR/TE=4400/99ms, MPG of three directions with b-factors of 0, 500, and 1000 sec/mm^2). Initially, T2WI images of each phase in all subjects were evaluated concerning the maximum long axis diameter of the ovaries and the largest follicle. The contrast ratios of the ovarian stroma and the skeletal muscle were calculated by the following equation: (SI of the ovary - SI of the muscle) / SI of the muscle. The ADC values of the stroma were also measured on the ADC maps calculated from DWI. Qualitatively, the signals of the ovarian stroma on DWI (b-1000 sec/mm^2) were correlated with T2WI by creating the fusion images on the fusion software (Aquarious Net Viewer, Teraricon), and evaluated by blinded two radiologists in the conference manner with the following scoring: (1; none, 2; mild, 3; moderate,4; high).

Results:

The results of the qualitative analyses are summarized on the Table 1. The size of the largest follicle tends to be largest in the periovulatory phase without statistical significance. The contrast ratio between the ovarian stroma and the muscles in the menstrual phase was significantly lower intensity than that in the other phases (Fig.1). The signal intensity of the ovarian stroma on T2WI could not be successfully measured in one in the menstrual phase and two in the periovulatory phase. At the ADC maps, the ADC values of additional two ovaries in the luteal phase could not be measured due to the susceptibility artifact caused by the intestinal air. On DWI, the increased signal intensity (score 3 or 4) was seen in four ovaries in the periovulatory phase and five ovaries in the luteal phase (Fig.1).

Conclusion:

The size of the largest follicle tends to be largest in the periovulatory phase. The ovarian stroma on T2WI in the menstrual phase showed significantly lower intensity than those in other phases. At DWI, the ovaries tend to show increased signal in the periovulatory and luteal phase, but no significant change of the ADC values during the menstrual period.

Table 1.

	Diameter of the ovary (mm)	Diameter of the largest follicle (mm)	Contrast ratio	ADC value (10^{-3}mm^2/sec)
Menstrual phase	2.87±0.55	0.81±0.16	3.33±0.91*	1.47±0.35
Periovulatory phase	3.17±0.46	1.44±0.73	3.88±0.72	1.53±0.24
Luteal phase	3.14±0.69	1.01±0.74	4.34±0.97	1.49±0.30

(*showed significant difference by ANOVA test followed by Fisher's PSLD test for multiple comparison, p<0.05)

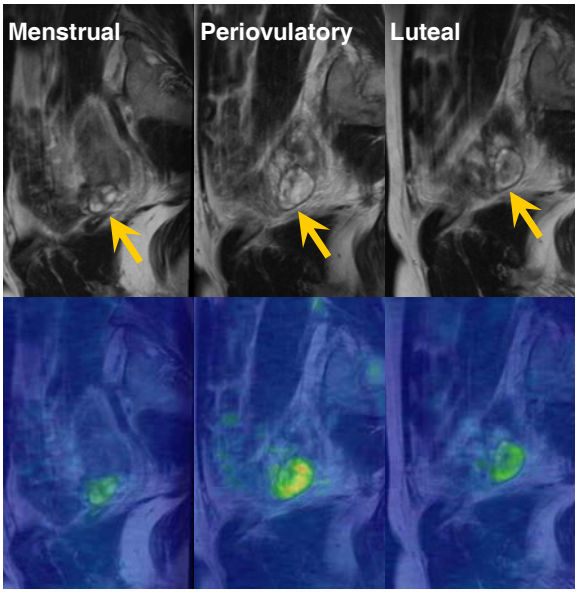

Figure 1. 24 y.o. female.

A series of sagittal T2-weighted images (upper row) obtained in the menstrual, periovulatory and luteal phases show the changes in MR findings of the right ovary (arrows), with the decreased signal intensity of the ovarian stroma in the menstrual phase. Fusion images with T2WI onto DWI of the corresponding menstrual phase (lower row) show the ovary with the strong signal intensity in the periovulatory phase and the moderate signal intensity in the luteal phase.