Susceptibility-weighted imaging for the evaluation of gynecologic diseases

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[Introduction] Susceptibility-weighted imaging (SWI) combines magnitude and phase information, and visualizes the magnetic susceptibility effects generated by local inhomogeneity of the magnetic field caused by blood products (hemosiderin or deoxyhemoglobin) as signal voids. This technique has been applied in imaging of central nervous system, and recently it can be applied in body imaging. Endometriosis is a common disease in women of reproductive era. Because recurrent hemorrhage and repeated rupture of endometriomas may cause pelvic adhesions with infertility, early diagnosis is important for adequate treatment. Endometriomas with typical MR manifestations are easily diagnosed on routine MR examination. However, some endometriomas do not show typical MR images and may have a difficulty in diagnosis. Deposition of hemosiderin-laden macrophages in the cyst wall is a pathologic feature of endometriomas (Fig. 1). Signal voids due to hemosiderin deposition along the cyst wall may be well demonstrated in SWI and may be diagnostic for endometriomas, especially in the endometriomas with atypical MR findings. In this study we evaluated the usefulness of SWI in diagnosing endometriomas and various other gynecologic pathologies with hemorrhage.

[Materials and Methods] Surgically proven 60 ovarian cystic lesions (42 endometriomas and 18 non-endometrial benign cystic masses) were evaluated. Fast spin-echo T2-weighted images (TR/TE = 4000ms /99.3ms) and fat saturated spin-echo T1-weighted images (TR/TE = 600-700ms /7.9-9.6ms) were obtained in all patients on a system with a 1.5T superconducting unit (Signa Excite HD, General Electric, Milwaukee, WI) or on a system with a 3T superconducting unit (Signa 3T HD, General Electric, Milwaukee, WI). SWI (2D-FSPGR, TR/TE = 650-700ms /30ms; Flip angle = 15-20 degrees; Matrix = 288x192; FOV = 28cm; thickness /gap = 8mm /1mm; NEX = 2; scan time = 4 min. 34 sec.; To enhance the visibility of susceptibility-induced signal voids, post-processing was applied to the magnitude images multiplied with a phase mask generated from the filtered phase data) were obtained in all patients. SWI in various other gynecologic pathologies were retrospectively evaluated.

[Results] Punctate or curved linear signal voids along the cyst wall due to hemosiderin deposition were observed in 39 of 42 (92.9%) endometriomas (Fig. 2), and in none of 15 non-endometrial benign cystic masses (Fig. 3). Intra-cystic signal loss due to deoxyhemoglobin was observed in non-endometrial hemorrhagic cysts, however, signal voids along the cyst wall were not observed. In extra-ovarian endometriosis (urinary bladder, peritoneum, and abdominal wall) and adenomyosis, hemosiderin deposition due to obsolete hemorrhage from aberrant endometrial tissue was helpful for the diagnosis (Fig. 4, 5). In red degeneration of uterine leiomyoma, intravenous deoxyhemoglobin appeared as low intense rim at early phase of the disease, whereas characteristic high intense rim on T1-weighted images appeared at subacute phase (Fig. 6). SWI was also useful for the diagnosis of other gynecologic diseases such as ectopic pregnancy, placental polyp and uterine sarcomas by detecting hemorrhagic changes (Fig. 7).

[Conclusion] SWI can contribute to the diagnosis of endometriomas by demonstrating hemosiderin deposition in the endometrial cyst wall. SWI is also useful for the diagnosis of various gynecologic pathologies with hemorrhage.

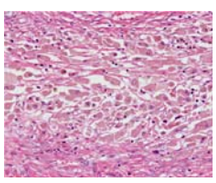


Fig.1

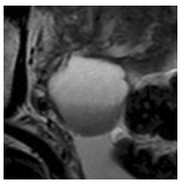
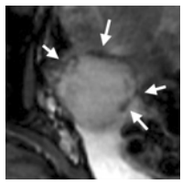


Fig.2a



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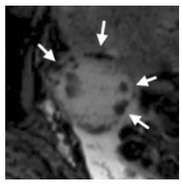

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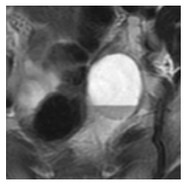


3a

3b

Fig. 1: Deposition of hemosiderin-laden macrophages in the wall of endometrioma (Hematoxylin & Eosin).

Fig. 2: Endometrioma: **a.** T2WI; **b.** T2*WI; **c.** SWI, Signal voids (arrows) along the cyst wall are more prominent on SWI than on T2*WI.

Fig. 3: Non-endometrial hemorrhagic cyst: **a.** T2WI; **b.** SWI, Hematocrit effect (arrow) by deoxyhemoglobin is demonstrated in the cyst, however, no signal voids are observed along the cyst wall.

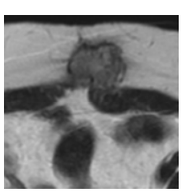
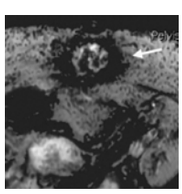


Fig.4a



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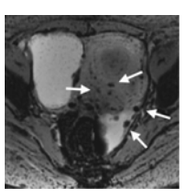


Fig.5a

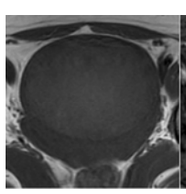
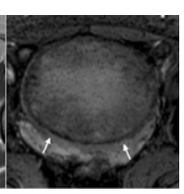


Fig.6a



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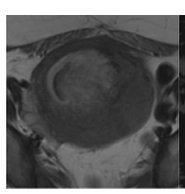
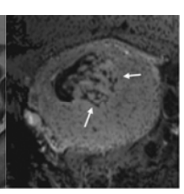


Fig.7a



7b

Fig. 4: Abdominal wall endometriosis: **a.** T2WI; **b.** SWI, Marked signal voids by hemosiderin are observed in the abdominal mass (arrow).

Fig. 5: Adenomyosis and peritoneal endometriosis: **a.** SWI, Small hemosiderin deposits (arrows) are observed in adenomyosis and on the peritoneum.

Fig. 6: Red degeneration of uterine leiomyoma at early phase: **a.** T1WI; **b.** SWI, No high intense rim is observed on T1WI. Low intense rim due to intravenous deoxyhemoglobin is observed on SWI.

Fig. 7: Endometrial stromal sarcoma: **a.** T2WI; **b.** SWI, Small intra-tumoral hemorrhagic foci suggesting malignant nature are observed on SWI.