Can Susceptibility weighted with quantitative phase MR imaging be diagnostic in differentiation of Haemorrhagic from calcified female pelvic lesion? - A preliminary study

sakshi khurana[1], Rakesh Kumar Gupta[1], Mukta Kapila[2], Swati Mittal[2], Manavita Mahajan[2], Ritu Tyagi[1], and kirti verma[1]

[1]*Radiology, fortis memorial research institute, Gurgaon, Haryana, India,* [2]*gynaecology, fortis memorial research institute, Gurgaon, Haryana, India*

Target audience: Radiologist and Gynaecologist

Introduction: Although the presence of an adnexal lesion makes a woman anxious for the fear of malignancy but vast majority of these are benign. MRI is considered the modality of choice for evaluation of adnexal masses in women; however further characterisation of the calcification from haemorrhage with conventional MR imaging techniques may be difficult due to overlapping signal characteristics. Susceptibility weighted (SWI) with phase imaging has been extensively used in differentiation of haemorrhage from calcification in neuroimaging[1]. There is a single communication on the use of SWI alone in abdominal wall endometriosis which may not be able to resolve the discrimination of calcification from haemorrhage. To the best of our knowledge, this is the first attempt to use SWI with phase imaging in female pelvis. The purpose of this study was to assess the value of phase quantification in definitive characterisation of various stages of blood in the haemorrhagic adnexal lesions and to differentiate these from calcified pelvic lesions at 3.0T.

Materials and Methods: Conventional spin echo along with SWI and phase MR imaging was performed on 3 Tesla MRI scanner (Philips Ingenia, Netherland) using pelvic phased array coil in 47 female patients (age distribution from 25-45 years) provisionally diagnosed with pelvic lesions after an initial clinical and sonographic screening. Conventional multiplanar T2 with and without fat suppression, 3D mDixon and diffusion weighted axial imaging were performed along with SWI with phase imaging in axial plane. The SWI with phase imaging was acquired with following parameters: TR/TE= 31/6.2, 7.2 , flip angle=17^0 , matrix = 308 x 251, FOV= 230 x 188 x 100 mm^2 and effective slice thickness of 2mm. The diagnosis was confirmed by laparoscopic evaluation for the presence of haemorrhage in 11 patients and calcification was confirmed on CT where the SWI showed positive phase in 4 patients. conservative management and a regular follow up was done in 17 patients diagnosed with endometriomas on MRI. The ROI was placed in the areas of susceptibility in adnexal lesions and corresponding phase value was quantified.

Statistical analysis: One -way analysis of variance (ANOVA) with multiple comparisons using Bonferroni, post hoc test was performed to evaluate the differences in the phase values amongst various pelvic lesions and further differentiate the stages of haemorrhage . $P < 0.05$ were considered to be significant. SPSS 16 was used for all statistical analysis.

Results: On conventional MR imaging in 45 patients, a total number of 381 lesions on phase MR images were identified and analysed. Based on the conventional MRI findings 117/381 lesions were in acute stage, 81/381 were in subacute stage, 145/381 were in chronic stage and 38/381 were calcified lesions. The calcified lesion showed a positive phase value while Haemorrhagic cysts have negative phase values when quantified on phase imaging (Figure 1 and 2). The calcified and haemorrhagic lesion as well the different stages of haemorrhagic lesion (acute, subacute and chronic) showed significant quantitative difference in phase value (Table 1).

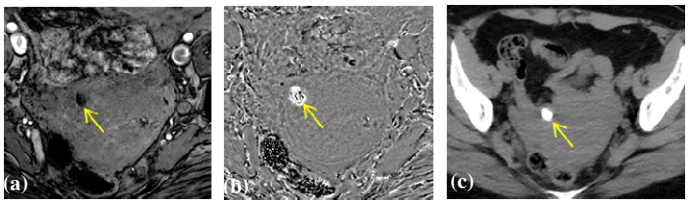

Figure 1: *Axial SWI image (a) showing susceptibility in uterine fibroid (arrow) with positive phase on corresponding phase image (b).Axial NCCT image (c) showing the calcified fibroid.*

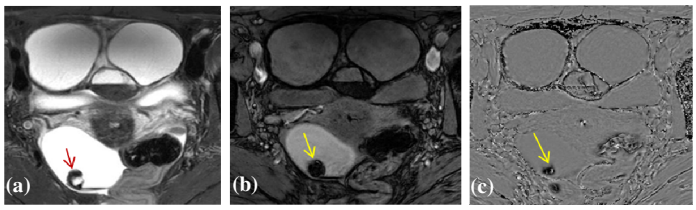

Figure 2: *Axial T2 SPAIR image (a) with area of chronic haemorrhage in the left ovary (arrow) showing susceptibility on SWI image (b) and a negative phase on the corresponding phase image (c).*

S. No.	Different stages of lesions	Phase value (degrees) Mean ± SD	P value
1.	Acute	-41.48± 5.30	0.000
2.	Subacute	-8.78 ± 3.81	0.000
3.	Chronic	-63.20 ± 10.05	0.000
4.	Calcification	+115.65 ± 14.20	0.000

Table*: The table shows significant difference in the phase values in different stages of haemorrhagic lesions (acute, subacute and chronic) and the calcification lesion. The analysis was done using One -way analysis of variance (ANOVA) with multiple comparisons using Bonferroni, post hoc test. All the groups were significantly different from each other with same level of significance. P <0.05 were considered to be significant.*

Discussion and conclusion: This study demonstrates significant differences among different stages of haemorrhage which may not show susceptibility (like sub-acute haemorrhage). Highest negative phase was observed in chronic haemorrhage and least was observed in sub-acute haemorrhage to suggest that hemosiderin shows strongest paramagnetic effect while methemoglobin shows least paramagnetic effect though it is not visible on SWI. Hemorrhagic lesions seen on SWI cannot be differentiated from calcification in the absence of phase imaging. Phase imaging also helped to separate calcification from haemorrhage as in patients with ovarian dermoid and calcified fibroid. Phase information requires no additional scan time but is an inherent part of MR image. SWI with phase imaging is an established technique in brain[2], how ever it also appears to be effective in the female pelvic lesions. We conclude that SWI with phase imaging should be added as a part of the imaging protocol in female patients with pelvic pathology.

References: 1. Gupta et al, J comput assist tomogor 2001; 25: 698-704. 2. Roy et al, JMRI 2011; 34: 1060-1064.