DCE-MRI and T_2* Measurement in Women with Heavy Menstrual Bleeding Treated with Dexamathasone

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Introduction: A million women a year seek medical help for menstrual bleeding complaints, which have a high impact on both healthcare costs and quality of life. Current therapies are often ineffectual with serious side effects. Previous work (1) has shown that dexamethasone (Dex) could be beneficial in returning altered blood vessel structures in the uterus to normal. The aim of this study was to investigate the feasibility of performing high temporal-resolution DCE-MRI for measurement of plasma flow (F_p), plasma volume (v_p) and permeability surface-area product (PS) in women with heavy menstrual bleeding (HMB) during the luteal phase phase before and after treatment with Dex.

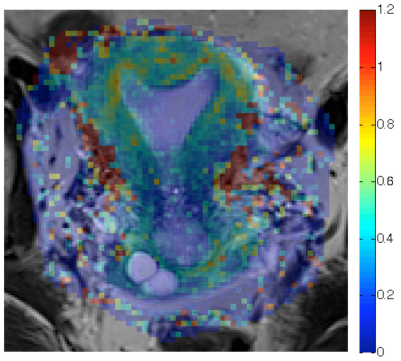

Fig 2 – F_p map superimposed on T_2w image. Colour bar scale ml/ml tissue/min

Methods: Five women with HMB (blood loss >50 ml) were recruited to this study and imaged at 3 T (MAGNETOM Verio, Siemens AG Healthcare Sector, Erlangen, Germany) at baseline and after 2 months of 0.75 mg Dex twice daily for 5 consecutive days during the luteal phase. Each study visit was timed to be 2-3 days before menstruation. At each visit, the MR examination consisted of high resolution axial T_2w images followed by location-matched inversion-recovery (IR) trueFISP measurement of T_1 (TI = 160, 300, 600, 1000, 1500, 2500 ms, TE/TR = 1.2/5000 ms) and 3D dynamic FLASH (TR/TE 1.89/0.66, flip 13, 128x128, FOV 420x420, 240 dynamics, tres 1.75 s). In the fifth patient's second visit, voxel size was decreased to 2.1 mm and temporal resolution to 2.5 s. During FLASH imaging, 0.05 mmol/kg Gadovist was injected at 2 ml/s using a power injector, followed by a saline flush at 2 ml/s. T_2* was measured in a single slice through the centre of the uterus using a pixel-based T_2* mapping Siemens WIP sequence based on a segmented multi gradient-echo acquisition. Uptake curves were converted from signal intensity to contrast agent concentration using T_1 values estimated voxelwise by fitting an inversion-recovery curve to the IR-trueFISP data. DCE-MRI parameter maps were calculated in a single slice through the centre of the uterus using the AATH model (2) and an arterial input function measured from a single pixel inside the external iliac artery. Regions of interest were drawn with reference to the high-resolution T_2w imaging in the endometrium and myometrium to derive mean values (± standard deviation) for the DCE-MRI parameters and T_2*, compared between visits using a paired t-test.

Results: Patients were scanned a mean of 2.3 days (range -1 to 5) before menstruation. An AIF was unobtainable for patient 2 visit 1 due to partial volume effect, therefore the AIF from visit 2 was used to calculate parameter maps. Mean (± standard deviation) values for F_p, v_p, PS in endo- and myometrium for each patient are shown in figure 1, and T_2* values in table 1, though in some cases the filling of the bladder had moved the uterus by the end of the imaging session so that the T_2* map was no longer in a central slice, making regions of interest too difficult to define. There were no significant differences in parameters between visits. An example map of F_p is shown in figure 2, superimposed onto the matched T_2w image. Example single-pixel curves from two patients in endometrium and myometrium are shown in figure 2.

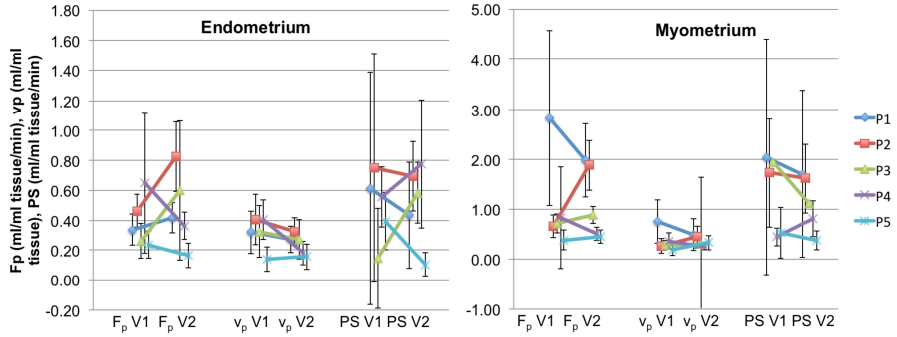

Fig 1 – Parameter values for endo and myometrium in each patient (P1-5) visit (V1 = visit 1, V1 = visit 1)

	T_2* / ms	
	Endometrium	Myometrium
P1 V1	53 ± 17	38 ± 8
P1 V2		
P2 V1	54 ± 9	40 ± 5
P2 V2	52 ± 7	39± 5
P3 V1		
P3 V2	41 ± 5	23 ± 8
P4 V1	52 ± 12	36 ± 6
P4 V2		
P5 V1	45 ± 4	33 ± 8
P5 V2	40 ± 5	34 ± 5

Table 1 – T_2 values in endo- and myometrium for each patient visit*

Discussion: The DCE-MRI parameter values are similar to those reported in (3) for normal volunteers, though PS was lower in our study. This could be due to differences in the tracer kinetics modelling, or may indicate that HMB is associated with lower vessel permeability. T_2* values were lower than those reported in (4) but this might be due to a differing measurement protocol or again due to a difference between normal and HMB patients. Curve shapes in the myometrium varied between patients, indicating that simple metrics such as the area under the concentration-time curve may not be adequate to capture microvascular changes. There were no significant differences in any parameters between the two visits but this small study was intended only to develop a feasible imaging protocol. Quantitative analysis of blood loss in these patients has not yet been completed, but this might reveal further correlation with measured parameters. In future work the improved spatial resolution protocol will be applied in a larger cohort.

Conclusion: DCE-MRI and T_2* measurement in the uterus is feasible at 3 T in this patient group, with parameter values similar to those found in the literature.

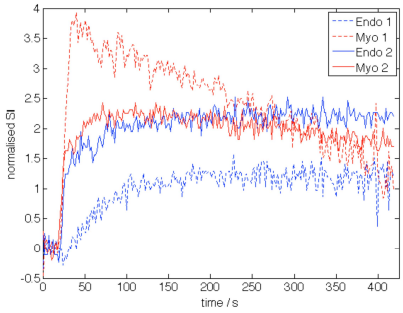

Fig 2 – Normalised SI for 2 patients (dashed, solid line) imaged 2 days before menstruation. Blue – endometrium, red – myometrium (single pixel)

References: (1) Rae M, Mohamad A, Price D, Hadoke PW *et al* Cortisol J Clin Endocrinol Metab 2009; 94:1443-1450. (2) St Lawrence KS, Lee TY. JCBFM 1998; 18:1378–85. (3) Thomassin-Naggara I, Balvay D, Cuenod CA, *et al.* Eur. Radiol. 2010; 20:984–94. (4) Kido A, Koyama T, Kataoka M, *et al.* JMRI 2007; 26:695–700.

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