Endorectal coil combined with a dedicated protocol for the assessment of colon abnormalities on a mouse model of colitis

Hugo Dorez[1], Raphaël Sablong[1], Laurence Canaple[2], Sophie Gaillard[1], Driffa Moussata[3] and Olivier Beuf[1]

[1]Université de Lyon, CREATIS CNRS UMR 5220 – INSERM U1044 – INSA Lyon 1, Villeurbanne, France
[2] Institut de Génomique Fonctionnelle de Lyon, Université de Lyon 1, UMR 5242 CNRS, ENS de Lyon, Lyon, France
[3]Hospice civil Lyon sud - Service hépato-gastroentérologie, Lyon, France

Background and purpose: imaging the wall of digestive tract requires an important spatial resolution but also different kind of contrast for visualizing wall layers(1) in detail. Using local endoscopic MR coils is drastically increasing the local SNR compared to external coils(2). The overall purpose of this project is to combine MRI with endoluminal optical modalities(3) to provide new tools and protocols for lesion characterization and staging (colorectal cancer and inflammatory bowel disease).

Materials and methods: endoluminal coils (EC) with active decoupling circuit were built. A dedicated protocol using FLASH and RARE sequences was also developed to obtain anatomical images but also quantitative information (T1 and T2 maps). The EC was first compared to a quadrature volume birdcage coil (QVBC) and then assess in-vivo on a mouse model of colitis(4). Imaging was done to explore rectal and colon areas up to 30mm from the sphincter.

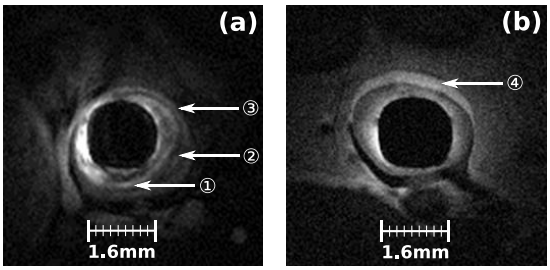

Figure 1 – High resolution MR images obtain with the EC.

Results: The EC designed fits with the mouse anatomy and show a huge improvement (10 times greater) in SNR compared to a QVBC. The overall protocol acquisition time is about 40min and provides high resolution anatomical images (up to 39x39µm², see figure 1) but, also, quantitative information (T1 and T2 maps – see figure 2). It becomes possible to well discriminate the different wall layers (①, ② and ③ white arrows on figure 1). On figure 2, ① identifies a thin muscle structure and ② the colon wall. Respectively, the relaxation times are 800ms +/- 100ms and 1200ms +/- 200ms. Then, looking at the T2 maps, mucosa layer and musclaris externa are clearly differentiable (③ and ④). T2 relaxation times are nearly identical, 80ms +/- 10ms for both structures. Finally, ✱ locates the submucosa which tends to have lower T2 values (50ms +/- 10ms). The fit quality maps show a reproducible method for T1 and T2 values with just a few points excluded in the field of view considered.

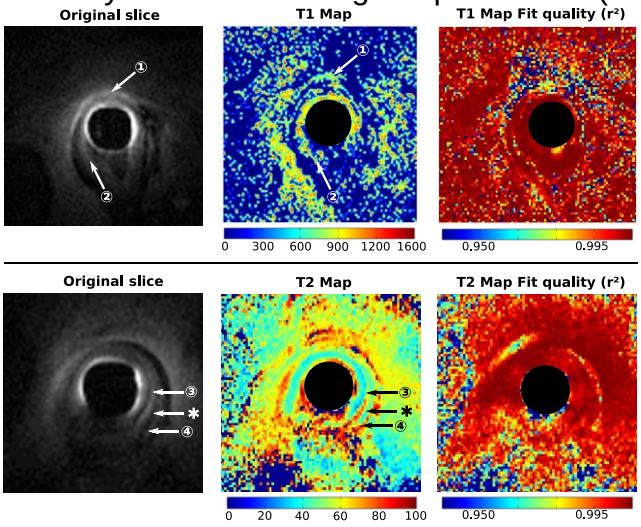

Figure 2 – T1 and T2 maps of two different slices.

Discussion: Using EC provide structural information that were not accessible with QVBC. The EC SNR and FOV are large enough to meet in vivo application requirements for parietal diagnosis (colon wall thickness of 0.1 to 0.8mm on mice). T1 and T2 maps can help to depict changes in the biochemical composition of the colon wall due to the evolution of the pathology.

References: **1.** Beaumont C, et al. Curr Probl Diagn Radiol. 2013. **2.** Inui K, et al. Endoscopy. 1995 **3.** Waldner MJ, et al. Nat Protoc. 2011. **4.** Tanaka et al. Cancer Science. 2003.

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