MR spectroscopic imaging (MRSI) study using the diaper shaped RF coil array.

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Purpose: Interest in MR spectroscopic imaging (MRSI) has been driven by the need to map the functional characteristics of tumors to more specifically determine their location. MRI and MRSI both are used for detailed anatomic and metabolic evaluation of the prostate[1]. Especially, MRSI for the prostate enables assessment of tumor aggressiveness and the detection of metabolically active tumor recurrence after radiation therapy, both of which are observations that cannot be made with MR imaging alone[2-3]. However, low SNR caused by torso-pelvic coil and patient safety caused by endo-rectal coil have been serious issues in prostate MRSI. We implemented a new external RF coil to provide both competitive SNR and large FOVs for prostate MRI[4]. The purpose of this study is to describe how our diaper-shaped RF coil compares with other conventional RF coils for MRI and MRSI.

Methods: The diaper-shaped RF coil, Philips torso-pelvic RF coil (USAInstruments,Inc. Aurora, OH USA) and an endorectal coil (Medrad,Inc.Indiana, PA USA) were employed for MR Spectroscopy (MRS) study. The diaper-shaped RF coil consisted of five independent receivers as shown in figure 1. Philips torso-pelvic RF coil was a six-channel receive only coil. The endorectal coil was a single rectangular loop coil. To make the MRS phantom, we filled the solution of (9.62mL) containing approximate physiological concentrations of the major prostate metabolites in normal human body (choline (Cho) 9mM/L, creatine (Cr) 12mM/L, and citrate (Ci) 90mM/L) diluted with distilled water into the prostate ball phantom (4cm diameter, pink color ball as shown by figure 1a-b) [4-5]. Using this phantom we performed chemical shift imaging (CSI) using a 2D point-resolved spectroscopic sequence (PRESS) (TR/TE 2000/144 ms, slice thickness 5 mm, voxel size 4mm x 4mm x 5mm, reconstruction voxel size 1.67, NEX 1). The location of the phantom in the water container that was used as a human loading phantom was identical in the MRI study.

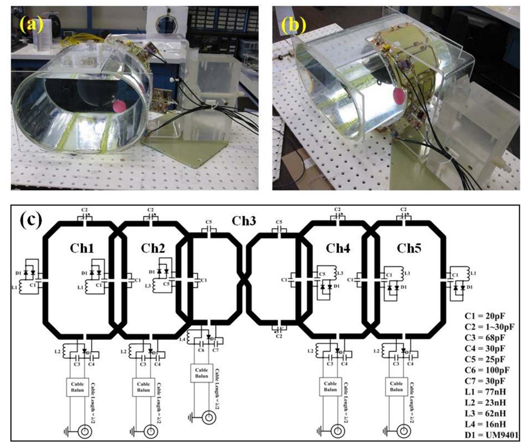

Figure1. The MRI experimental setup for RF coils array configurations and electric circuit diagram. (a): Side view, (b): Prospective view, (C): RF coils circuit diagram. Capacitors are values ±5% and inductors are values ±10%

Results: From MRS study, since we diluted relatively high concentration of Ci, the normal MR spectrum of the prostate ball phantom showed a prominent citrate peak [6]. All participated RF coils displayed the Ci resonance peak but the SNR of their spectra were different as shown by Figure 2. Even, at the selected voxel (red color box), Ci peak obviously was split due to J-coupling from the MRS acquired with the diaper and endorectal coils**.** It means that both spectra had high SNR to show the split though the amount of split Ci peak was different for the diaper coil and the endorectal coil. Ci peak obtained by the endorectal coil collapsed as we moved farther away from the coil but it was still seen by the diaper coil.

Discussion and Conclusion: We studied MRSI with a phantom to demonstrate "diaper" coil's performance. However, we should verify its efficiency by *in-vivo* studies. For *in-vivo* studies, patient comfort is an essential consideration since diaper coil is placed on a patient crotch, therefore, we may also think about making diaper coil as a flexible coil or semi flexible coil. The combined usage of diaper coil and the endorectal coil as the previous researchers did for the torso-pelvic coil and the endorectal coil can be possible. However, the mutual coupling between the torso-pelvic coil and the endorectal coil may be ignorable because they are distant geometrically, even if both coils are weakly coupled, and it can be removed by the low input impedance of LNA. In order to combine diaper coil with the endorectal coil, the mutual couplings among RF coil loop elements of the diaper coil and the endorectal coil should be further researched since their locations are physically closer than an assembly of the torso-pelvic coil and the endorectal coil. These preliminary results suggest a potential technical advantage and strongly encourage future clinical trials to assess the efficacy of diaper coil. These trials are currently under way.

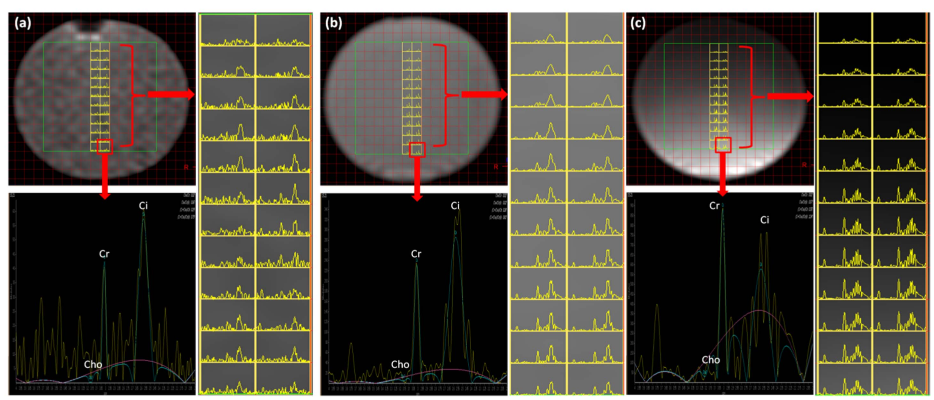

Figure 2. The MRSI voxels and spectra corresponding to the grid (yellow color) overlaid vertically on the axial image of the prostate phantom that was scanned with three different RF coils. The spectrum selected from the bottom voxel (red color box) of localized volume (green color box) was also shown below separate MRSI. (a) torso-pelvic coil, (b) diaper coil, and (c) the endorectal coil.

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