Liver ^{31}P MRSI Using an 8-Channel Dual-Tuned ^{31}P/^{1}H Coil at 3T

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Introduction: Liver metabolism correlates with inflammatory and neoplastic liver diseases, thereby altering the intracellular concentration of ^{31}P metabolites. Therefore, information on regional changes of ^{31}P metabolites in the liver, as obtained by magnetic resonance spectroscopic imaging (MRSI), can help in diagnosis and follow-up of various liver diseases [1]. To date mostly single-channel surface coils have been available for such studies, suffering from limited sensitivity in deeper tissue. However, phased-array coils allow for higher signal to noise ratio (SNR) and larger coverage [2, 3]. In this abstract, we present *in-vivo* results obtained at 3T from a novel eight-channel phased-array dual-tuned ^{31}P/^{1}H coil, which incorporates two ^{1}H channels for proton imaging and decoupling. The aim of this work was to investigate the quality and coverage of this coil for whole liver ^{31}P MRSI.

Methods: A dual tuned 8-channel ^{31}P/^{1}H coil was used for ^{31}P MRSI on a Siemens 3T TIM Trio whole body system scanner (Siemens Healthcare, Erlangen, Germany) on a healthy volunteer. The coil array consists of two plates (30x30 cm^2) each with four ^{31}P receive (RX) elements of about 24x20 cm^2 with filters for proton decoupling, one ^{31}P transmit (TX) element of about 30x30 cm^2, and one ^{1}H TX-RX element of about 27x25 cm^2 (Stark Contrast MRI Coils Research, Erlangen, Germany).
The following parameters were used for the acquisition of the data using a slice-selective MRSI sequence: TE 2.3msec, TR 1s, field of view (FOV) 400x250x30 mm^3, nominal voxel size 25x25x30 mm^3. Each free-induction-decay (FID) was acquired with 2048 points and a bandwidth of 5000 Hz. The acquisition took about 20 min for 50 weighted averages. The first point of each FID was used to determine the relative phases of each coil and to phase adjust the data before combining the signal. Further, an exponential filter of 25 Hz line-broadening and first order phase correction was applied to the combined signal.

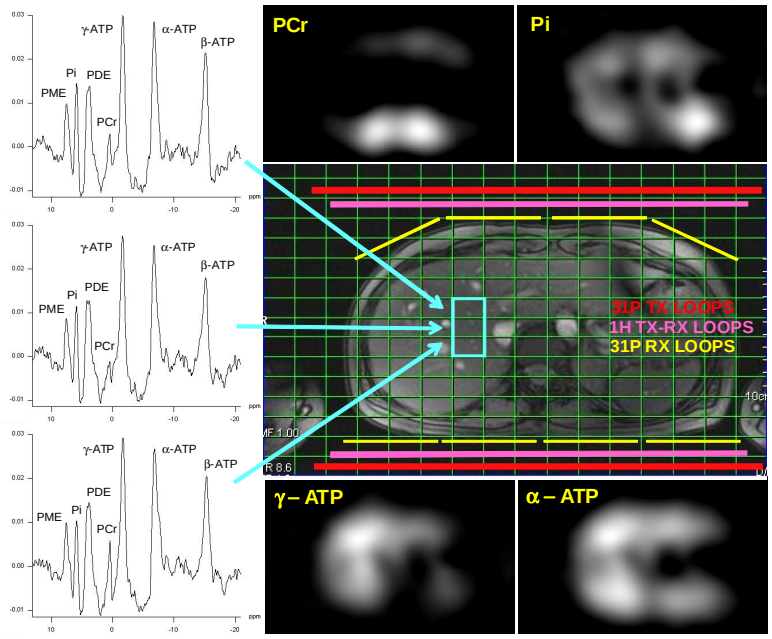

Figure1: Position of various coil loops with respect to the abdomen, sample spectra from three voxels in the liver at various depths, and phosphorus metabolite maps.

Results: Figure 1 shows the placement of various coil-elements with respect to the human abdomen superimposed on a localizer image acquired with the ^{1}H channels of the coil. It also shows the ^{31}P spectrum of three voxels placed in deep liver tissue and the metabolite maps of various ^{31}P metabolites over the whole slice. The metabolite maps in Figure 1 show that PCr mainly originates from muscle tissue, while Pi, γ-ATP, and α-ATP are highly concentrated in the liver and spleen. Figure 2 shows results of individual spectra obtained from each coil and the final phase-corrected combined result. Signal from channels further away from the selected voxel (1, 2 and 7, 8) contain more noise, but may still be phase corrected for optimal signal combination. Increasing the voxel size to 33x33x33 mm^3 allows for a reduction in scan time to about 8 min resulting in ^{31}P spectra with similar SNR.

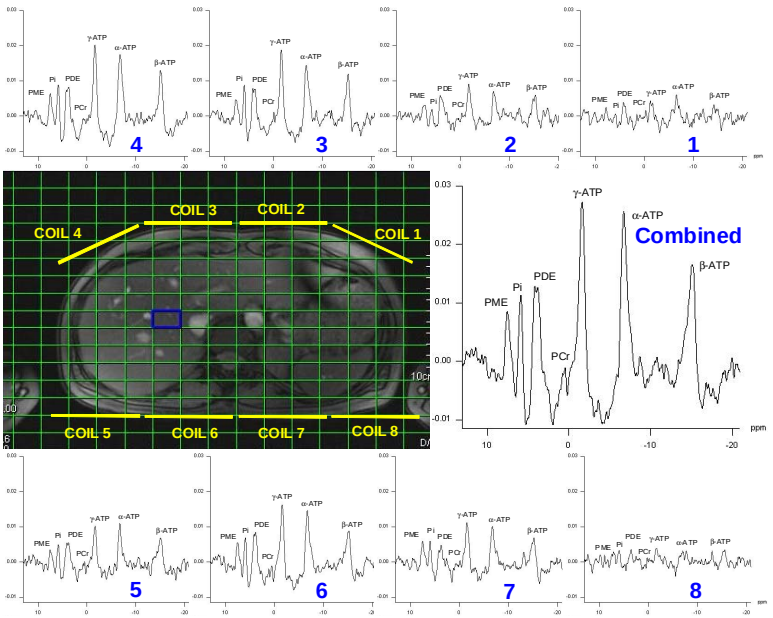

Figure 2: Uncombined spectra obtained from each channel (same intensity scale) and combined spectrum from the marked voxel.

Discussion/Conclusion: The above results clearly show that this dual-tuned phased-array ^{31}P/^{1}H coil allows obtaining spectra through a whole slice of the abdomen, which will be useful for applications requiring sensitivity throughout the whole liver (lesions in the middle of the body, multiple lesions). Work in progress includes optimization of the SNR by using proton decoupling, NOE enhancement, and the use of a 3D CSI sequence, allowing for whole liver coverage.

References

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