

Age dependence of 1H MRS metabolite profiles in the prostate at 1.5T and 3T

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Target audience: general interest, non-brain spectroscopy

Purpose

Age dependence of citrate (Cit), (phospho)creatine (Cr) and cholines (Cho) concentrations in prostate has not been sufficiently studied so far. Majority of information were obtained at 1.5T and to our best knowledge only few papers are concerned to this problem at 3T. We used 3D spectroscopic imaging to measure age dependence of prostate metabolite concentration ratios in central zone (CZ) and peripheral zones separately in the left and right lobes (PZ) of healthy volunteers at 1.5T and 3T. The coefficients of asymmetry (C_{cit-as}) in the prostate PZ were calculated for the comparison with prostate tumor lesions.

Subjects/Methods

Healthy volunteers (age 19-71 years) with PSA level in physiological range were examined at 1.5T (Avanto) and 3T (Trio) Siemens systems with spine and body array coils. Water suppressed (1.5T: TR/TE/NA=690ms/120ms/10; 3T: TR/TE/NA=720ms/145ms/10) and water unsuppressed (1.5T: TR/TE/NA=690ms/30ms/1; 3T: TR/TE/NA=720ms/30ms/1) spectra were measured from the prostate using the PRESS-CSI sequence (FOV=90x90x90mm, matrix size 16x16x16) optimized according to the paper¹. CSI data were processed by jSIPRO software². The LCModel basis set included Cr, Cho and Cit signals simulated in the SIMPSON program³. In addition, lipid signals resonating at 2.4 ppm were simulated in LCModel.

Technical success of the examination was 76% at 3T and 75% at 1.5T. Three transversal representative CSI slices were selected for data analysis. Approx. 150 voxels were used for the evaluation in each subject. Concentrations of Cr, Cho, Cit and lipids in laboratory units and their ratios were calculated. All subjects were informed about the study and signed the written consent in agreement with Ethical committee rules.

Results

Typical spectra measured from prostate CZ at 1.5T and 3T show much better resolution of signals at 3T than at 1.5T. Correlation analysis between age and concentrations of Cit, Cr and Cho (in laboratory units) and their ratios was done. Spearman/Pearson coefficients show strong correlation between age and Cit, Cit/Cr+Cho, Cit/Cho at 3T and no correlation between age and concentrations of Cr, Cho and Cr/Cho in CZ and PZ. Similar findings we observed for 1.5T, nevertheless the correlation is much weaker. Linear regression was used to describe the dependency between age and Cit, Cit/Cho and Cit/(Cr+Cho) in central as well as peripheral zones. Data at 3T were pooled based on statistical results and are summarized in the Table and Figure. Linear dependences were found at 1.5T as well, nevertheless data cannot be pooled with the exception ratio Cit/(Cr+Cho) (see Table).

Table. Coefficients of linear equations of prostate metabolites vs age.

	Ratio; Concentration	Slope	Y intercept	R	Spearman r
1.5T (n=23)	Cit-CZ [lab.unit]	0.34	14.68	0.54	0.56
1.5T (n=23)	Cit/Cho+Cr	0.14	1.86	0.75	0.50 - 0.75
3 T (n=35)	Cit [lab.unit]	0.46	16	0.48	0.41 - 0.52
3 T (n=35)	Cit/Cho	0.41	14	0.64	0.61 - 0.65
3 T (n=35)	Cit/Cho+Cr	0.10	4.7	0.66	0.65 - 0.68

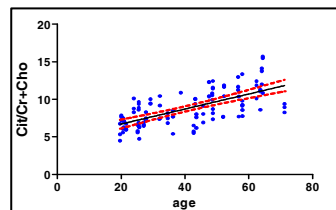


Figure. Age dependence of the Cit/(Cr+Cho) ratio calculated from 3T pooled data.

Coefficient of asymmetry of the concentration ratios for left and right PZ of the prostate was calculated according to the equation:

$$C_{cit-as} = 2 * \{ [Cit/(Cr+Cho)]_{dx} - [Cit/(Cr+Cho)]_{sin} \} / \{ [Cit/(Cr+Cho)]_{dx} + [Cit/(Cr+Cho)]_{sin} \}$$

The coefficient was found to be age independent and mean C_{cit-as} value was found 0.008 ± 0.075 at 3T and -0.02 ± 0.33 at 1.5T.

Discussion

Our data show strong age dependence of citrate concentration with age. According equation obtained at 3T, the concentration of citrate is doubled between 20 and 70 years (25.2 mM [lab.unit] vs 48.2 mM [lab.unit]) and similar increase of citrate can be seen from 1.5T. There are only few data on T1 and T2 of citrate in prostate. Considering $T1 = 838ms$ ⁴, $T2 = 198ms$ ⁵ at 1.5T and $T1 = 470ms$ and $T2 = 170ms$ at 3T resp.¹, the concentration after correction to the saturation effect can be assumed 82.3 and 75.4 mM at 20 and 157.5 and 144.3 mM at 70 years.

Conclusion

- 1) MR spectroscopy is considered as one of possible methods of complete prostate MR examination protocol according guidelines⁶. Age dependence of MR metabolic profiles in prostate can serve to better interpretation of clinical data.
- 2) The data from the control group show high homogeneity of metabolic profile in PZ. Preliminary data show that C_{cit-as} values in the localized prostate cancer are outside the interval of confidence.

References

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The study was supported by projects IGA MZ CR: NT13017 and Institutional support 00023001IKEM, Czech Republic.