A Comparison of MRS Data for SVS and 3D CSI in Human Brain Study

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MRS is to measure very small metabolite signals, whose resonant frequencies spread over the chemical shift range characteristic of the measured nucleus. The MR signal originates from the excited volume, which is a column of tissue divided into slices by gradient or rf encoding. The parameters that acquired data affected by TE, TR, and other variables. The higher spatial resolution of 3D CSI compared to SVS and its ability to examine regional metabolite variations for brain study.

Key words: MRS, 3D CSI (Chemical Shift Imaging), SVS (Single Voxel Spectroscopy)

INTRODUCTION

MR signal is mapped according to its frequency relative to the transmitter frequency ω_1.[1-4] While allowing a simple presentation of the frequencies generated by a collection of spins, the Fourier transformation produces a complication to the resulting spectrum. In recent years, improvements in hardware and software have made it possible to perform advanced in-vivo examination. In vivo MR spectroscopy combines the localization features of imaging with the ability for chemical analysis to provide a non-invasive method for the study of biochemical processes in a patient.[6] It is commonly accepted that the signal-to-noise ratio per unit time of proton MRS is linearly proportional to the volume.[3] The purpose of this study, we report the comparison of results of SVS and 3D CSI spectrum for brain study.

MATERIALS AND METHODS

1. Theoretical Observations

A clinically acceptable Magnetic Resonance Spectroscopy localization method has reached an plateau in hardware development.[5-7] However, To select of volume of interest (VOI) with distinct boundaries, using anatomical MR images for reference. From the defined volume scanning, we must have the spectra of peaks. It showed well-resolved, narrow peaks and a relatively clean baseline allowing accurate shaped quantitation. Typically, There are two sequences. PRESS (Point resolved spectroscopy) and STEAM(Stimulated echo acquisition mode) should be to use in routine clinical practice.

2. Measurement Technique and Parameters

Prior to actual human study, We do manifest accurate spectrum using MRS phantom(Fig. 1). MRS is to measure very small metabolite signals, whose resonant frequencies spread over the chemical shift range characteristic of the measured nucleus. The MR signal originates from the excited volume, which is a column of tissue divided into slices by gradient or rf encoding. We applied advanced 1.5T MRI/MRS sequences, From 3.375 cm^3 (i.e $1.5 \times 1.5 \times 1.5$ cm^3) to 8 cm^3 ($2 \times 2 \times 2$ cm^3) for PRESS in SVS examination. Voxel size and choice of the long TE (135/270 ms) are evaluated in 3D CSI.
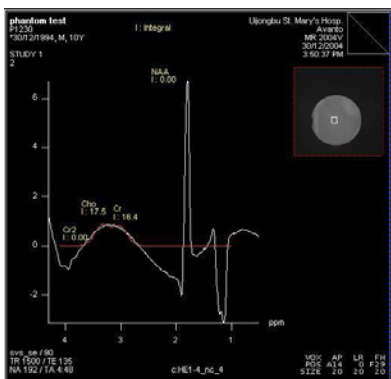
Fig. 1. Phantom spectrum after auto shimming.

Table 1. Metabolites and its chemical values.

Metabolites	PPM	Number protons	J ~Hz
CH₃ lactate	1.31	3	6.933
CH₃ NAA	2.01	3	None
N (CH₃) Cr	3.03	3	None
N (CH₃)₃ Cho	3.19	9	None
CH Glu	3.74	1	7.331
CH M-Ins	4.05	1	9.998
H₂ water~37°C	4.70	2	None

RESULTS

The most common TE values for ^{1}H MRS are 20 or 30 for a STEAM sequence, and 135 or 270 ms for either STEAM or PRESS. The parameters that acquired data affected by the echo time (TE), the repetition time (TR), the number of acquisitions, Normal brain spectra from an 4.096 cm^3 (1.6×1.6×1.6 cm^3) voxel acquired with PRESS, and 1 cm^3 (1×1×1 cm^3) in 3D CSI(Fig. 2, 3. TR/TE 3060/106). For the same TE, PRESS has more S/N than STEAM.[1]
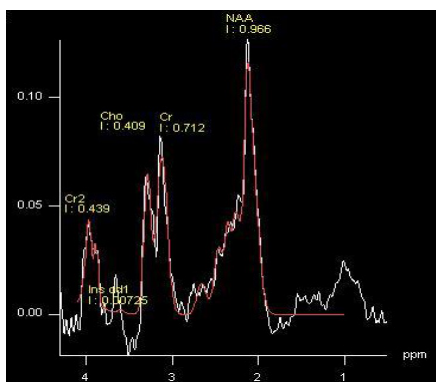

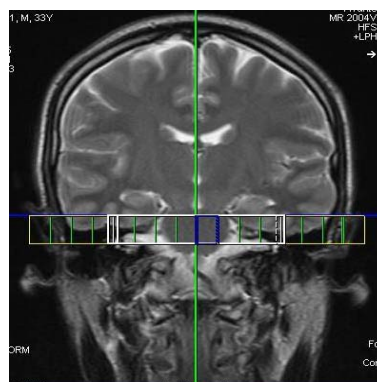Fig. 2. Spectrum of Lt mid brain.

Fig. 3. Coronal view of 3D CSI.

In order to CSI gets better resolution and achieves more appropriate for examining pathology that requires high spatial resolution to discriminate pathology. However, 3D CSI techniques need more clinical consideration. Previous in vivo proton MRS studies have reported mainly findings of the spectra patterns at higher magnetic fields.

CONCLUSION

We report a few sample of ^{1}H MRS measurements of SVS and 3D CSI for human study. Resonance intensities of the metabolites were expressed relative to the concentration of theorem. However, To use re-analyzed data of the human brain, It needed more reference spectrum in human.

ACKNOWLEDGEMENTS

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두경부 MRS검사의 SVS와 3D CSI 데이터의 비교 분석및
임상응용을 위한 연구

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자기공명분광법은 극소의 체적내애서 핵자기공명에 의하여 생화학적 성질들을 고유한 주파수에 따라서 대사물질의 신호를 얻는다. 핵자기공명의 신호는 경사자장 혹은 주파수의 크기를 조절하여 체내의 조직성분을 충분히 포함하여 통과시킨다. 획득되어진 원래 데이터는 TE, TR 등의 물리적 상수값의 변화에 의해서 영향을 받는다. 최근의 펄스 시퀀스는 고해상도 3D CSI 및 SVS가 국소적인 체적내의 대사물질의 변화량을 정성적으로 감지하므로 임상데이터로 활용하기 위한 연구가 더욱 절실하다.

중심단어: MRS, 3D CSI (Chemical Shift Imaging), SVS (Single Voxel Spectroscopy)