



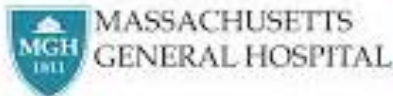
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Volumetric Navigated MEGA-SPECIAL for real-time motion corrected GABA MRS

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INTRODUCTION: GABA

- γ -aminobutyric acid (GABA): Inhibitory neurotransmitter and accounts for almost half of the synaptic activity
- Concentration approx. 1 mM
- Variations linked to several disorders

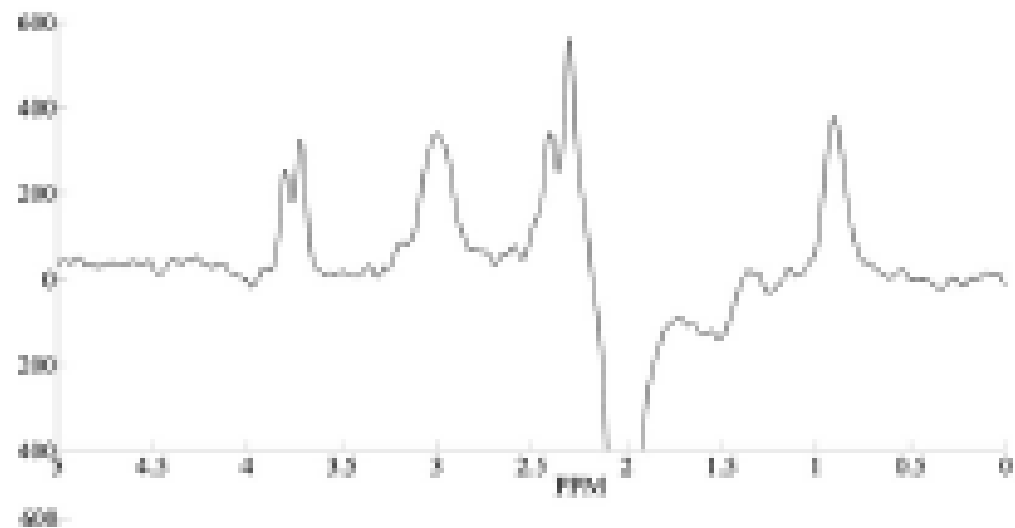


Figure 1: Typical GABA-edited spectrum from occipital lobe

INTRODUCTION: MEGA-SPECIAL (MSpc)

➤ Unlike MEGA-PRESS (MP), MSpc (Figure 2):

1) allows longer frequency selective-editing pulses

2) permits Henry's method: GABA without MM

3) has reduced spatial variations (Figure 3)

4) 10% improvement in editing efficiency

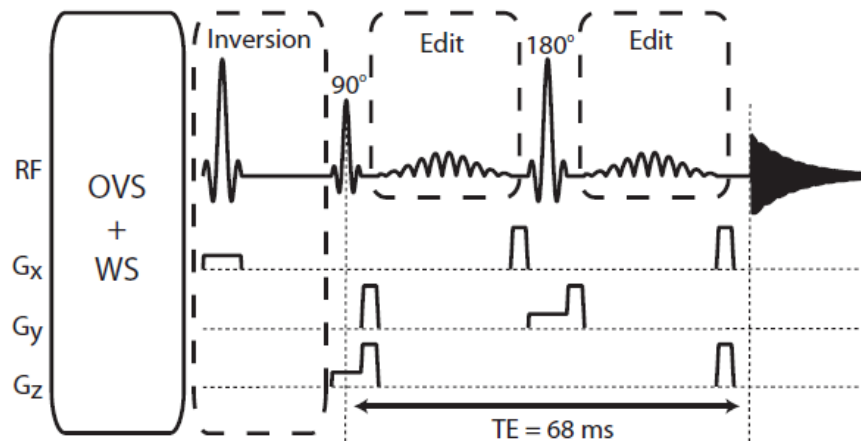


Figure 2: MSpc sequence

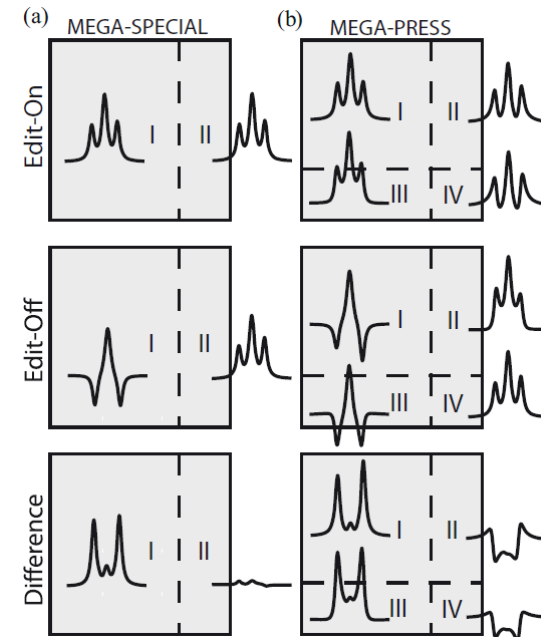


Figure 3: Reduced spatial variations in a)MSpc relative to b)MP

OBJECTIVES

- MSpC requires four acquisitions, thus motion sensitive
- Artefact corrections: retrospective correction and navigator echoes
- AIM: 1) Incorporate EPI volumetric navigator (vNav) into the MSpC
2) Validate vNavMSpC sequence in two healthy volunteers

METHODS

- vNav executed prior to the MSpc localization
- PACE: Image registration and motion estimation (Appendix)
- Siemens Allegra 3T MR scanner and single channel T/R volumetric coil
- The MM-suppressed MSpc parameters: $(3 \text{ cm})^3$ voxel in the parieto-occipital region, 2048 points, BW 2 kHz, 192 averages and TR/TE 3000/68 ms

METHODS

➤ Data acquired with:

A) standard MSpc no intentional motion,

B) vNavMSpc with no intentional motion,

C) vNavMSpc with motion and no correction (NoMoCo),

D) vNavMSpc with motion and MoCo

METHODS

- Motion: chin up-down and left-right rotations of about 7°
- Subjects returned to their original position after every acquisition
- All data were processed using the Gannet toolkit
- Fitting quality (FitErr) and spectral quality through FWHM of C4-GABA were compared between MSpc and vNavMSpc in absence and presence of motion

RESULTS

- Figures 4 and 5 show, respectively, typical motion profiles determined by vNav and GABA spectra for the four different acquisitions

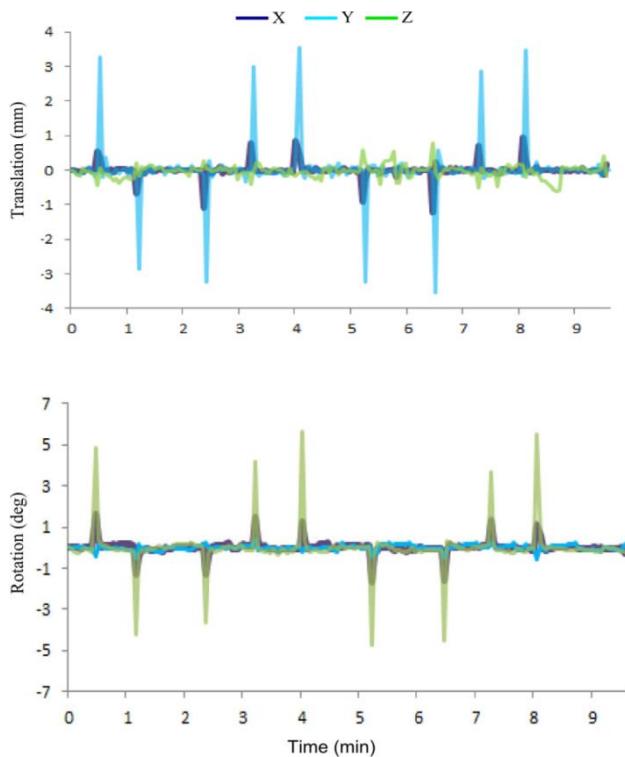


Figure 4: Changes in motion. Translation (A) and Rotation (B) in X, Y and Z directions.

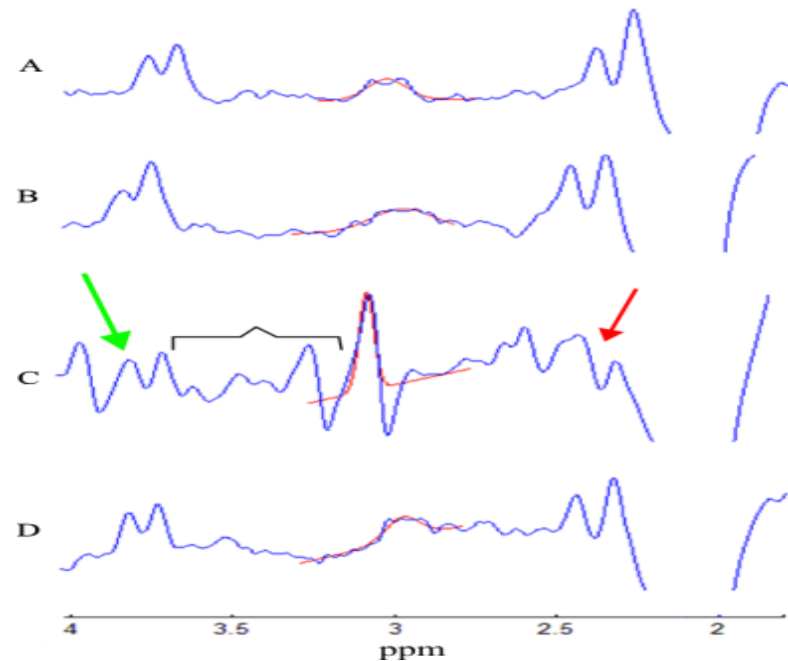


Figure 5: C4-GABA GABA spectra and fitting from standard sequence (no motion) (A) and vNavMSpc sequence during no motion (B), during motion but NoMoCo (C), and during motion with MoCo (D). C shows distorted GABA (red arrow), Glx (green arrow) and baseline (bracket).

RESULTS

Table: Fitting and spectral quality comparisons expressed as mean \pm standard deviation (SD)

Parameters	MSpC sequence	vNavMSpc with MoCo
FitErr (%)	15 \pm 1	12 \pm 2
FWHM (Hz)	15 \pm 0	13 \pm 1

DISCUSSION

- The vNav neither affected the edited spectrum (Figures 5A and 5B) nor increased the scan time
- The MoCo scan resulted in a well edited C4-GABA spectrum with FWHM and FitErr similar to previously reported values
- The MSpc sequence resulted in slightly higher FWHM and FitErr than the vNavMSpc, probably due to the presence of involuntary motion such as swallowing

CONCLUSION

- Inclusion of the vNav:
 - A) did not affect the spectral and fitting quality,
 - B) corrected very well for motion in real-time,
 - C) no increase in scan time, and
 - D) resulted in a well edited GABA spectrum
- Technique can greatly benefit GABA-editing, which is challenging due to low signal often necessitating long acquisition times

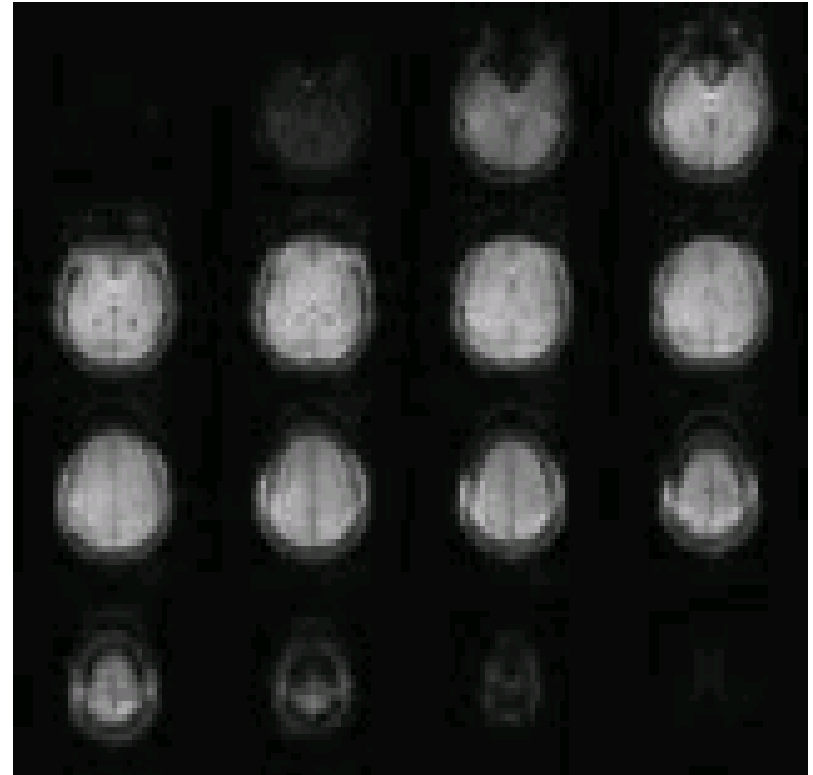
ACKNOWLEDGEMENTS

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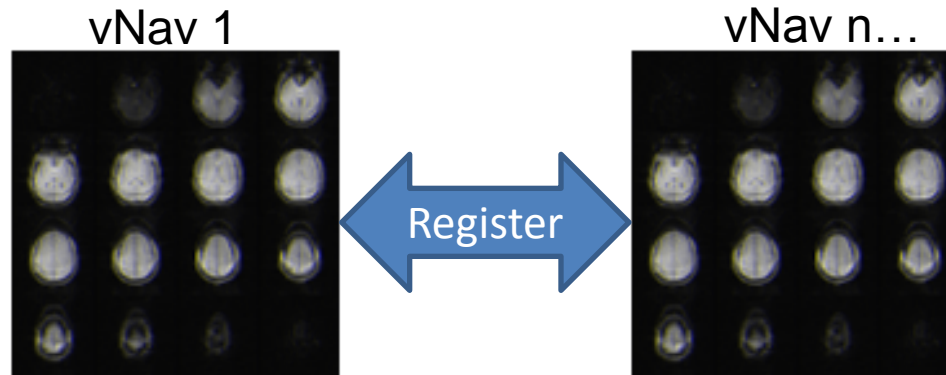
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Appendix: Volume Navigator (vNav)

- Imaging Navigator
 - Provide “snapshot” image
 - Repeated every TR
- 3D EPI of whole head
 - 500 ms, 8 x 8 x 8 mm³ voxels
 - 3906 Hz bandwidth
 - 32 x 32 x 28



Appendix: Measuring Motion with vNav



- Co-register subsequent volumes to first volume using PACE*
- Volume reconstruction + position estimate < 80 ms
- Update scanner coordinates