Gray matter volume changes in Idiopathic Generalised Epilepsy

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Introduction: Idiopathic generalized epilepsies (IGE) are common, typically have a childhood onset and are generally easily controlled on anti-epileptic medication. Electroencephalographic (EEG) features indicate bilateral cerebral hemisphere involvement from the seizure onset, often with a bifrontal dominance.[1] The cause of IGE is unknown, although genetic factors have been suggested. Visual inspection of high-resolution magnetic resonance imaging (MRI) is normal. Few studies by the same group reported subtle morphological abnormalities in IGE patients, either using a semi-automated MR segmentation and quantitation technique (volume-of-interest analysis)[2] or the automated technique of voxel-based-morphometry (VBM) .[3, 4] The last study assessed 20 patients with juvenile myoclonic epilepsy (JME), a subsyndrome of IGE and 30 controls. All these studies reported an increase in gray matter (GM) in the mesial frontal lobes of the patients compared to the controls.[3, 4] These findings could indicate presence of subtle dysplastic abnormalities in the frontal lobe, possibly causing IGE. The VBM methods used in these studies have since been improved by Good *et al.*[5]

The aim of our study is to assess structural volumetric abnormalities in patients with IGE using the optimised VBM analysis.[5]

Patients and Methods: We assessed 15 patients with IGE (mean age 19 years, range 8 to 31 years), all with ongoing seizures and typical EEG features of IGE at the time of scanning. They were compared to 95 healthy adult controls.

MRI was performed using a 3 Tesla GE Signa LX Horizon scanner (General Electric, Milwaukee, USA). A coronal 3D Fast Spoiled Gradient Recovery (FSPGR) sequence (TR/TE 8.9/1.9, flip angle 20, matrix size 256 x 256 and Field of view 25 x 18.75 cm) with contiguous coronal slices of 1.5 mm thickness, was used for volumetric studies. All MRIs were reviewed by an experienced neuroradiologists and reported as normal.

Data were analysed on a Unix workstation using iBrain® (an inhouse software program)[6], MATLAB 5.3 (MathWorks, Natick, MA), and SPM99 (Wellcome Department of Cognitive Neurology, London; http://www.fil.ion.ucl.ac.uk/spm)[7]. The structural data were processed using an optimised VBM protocol[5], involving segmentation, normalization, modulation and smoothing the images for voxel-by-voxel analysis.

Results: The voxel-based group comparison between the IGE patients and control subjects showed a decrease of gray matter in the left mesial occipital lobes (Figure 1) and an increase of gray matter in bilateral basal ganglia (Figure 2) at a corrected threshold of $p<0.05$.

Figure 1: SPM analysis of gray matter volume decrease in patients, compared to controls.

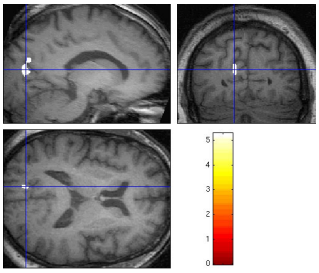
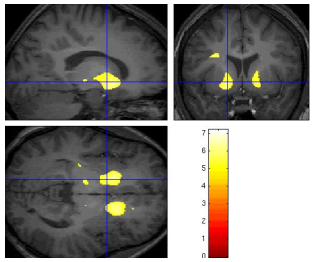


Figure 2: SPM analysis of gray matter volume increase in patients, compared to controls.



Conclusions: Using the objective technique of VBM in structural MRI, we found structural difference in cortical GM between groups of IGE patients and controls. The gray matter volume was increased in the basal ganglia of IGE patients. Subcortical deactivation has been shown previously with functional MRI, thus implicating their possible role in seizure inhibition. There was no cortical, particularly no frontal lobe gray matter increase, but a mesial occipital gray matter volume decrease. Our results could be interpreted as a consequence of seizures, with seizure associated occipital gray matter volume deficit, and subcortical volume increase along with increased inhibition. The difference between our study and those of Woermann *et al.* indicates that the previous findings of increased frontal lobe gray matter volumes cannot be generalized to the whole population of IGE. The controversial findings may be explained by differences in patient groups, disease severity, and VBM methods used.

References

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