FreeSurfer

http://freesurfer.net/

Freely available automated MRI analysis techniques are being increasingly used to investigate neuroanatomical abnormalities in patients with neurological disorders. It is important to assess the specificity and validity of automated measurements of structure volumes with respect to reliable manual methods that rely on human anatomical expertise. The thalamus is widely investigated in many neurological and neuropsychiatric disorders using MRI, but thalamic volumes are notoriously difficult to quantify given the poor between-tissue contrast at the thalamic gray-white matter interface. In the present study we investigated the reliability of automatically determined thalamic volume measurements obtained using FreeSurfer software with respect to a manual stereological technique on 3D T1-weighted MR images obtained from a 3 T MR system. Further to demonstrating impressive consistency between stereological and FreeSurfer volume estimates of the thalamus in healthy subjects and neurological patients, we demonstrate that the extent of agreeability between stereology and FreeSurfer is equal to the agreeability between two human anatomists estimating thalamic volume using stereological methods. Using patients with juvenile myoclonic epilepsy as a model for thalamic atrophy, we also show that both automated and manual methods provide very similar ratios of thalamic volume loss in patients. This work promotes the use of FreeSurfer for reliable estimation of global volume in healthy and diseased thalami¹⁾.

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Case series

2018

Patients (n=106) with refractory MTLE-HS submitted to corticoamygdalohippocampectomy (CAH) (57 left mesial temporal lobe epilepsy (MTLE); 45 males) were enrolled. To determine if the IQ was a predictor of seizure outcome, totally seizure-free (SF) versus nonseizure-free (NSF) patients were evaluated. FreeSurfer was used for cortical thickness and volume estimation, comparing groups with lower (<80) and higher IQ (90-109) levels.

In the whole series, 42.45% of patients were SF (Engel Class 1a; n=45), and 57.54% were NSF (n=61). Total cortical volume was significantly reduced in the group with lower IQ (p=0.01). Significant reductions in the left hemisphere included the following: rostral middle frontal (p=0.001), insula (p=0.002), superior temporal gyrus (p=0.003), thalamus (p=0.004), and precentral gyrus (p=0.02); and those in the right hemisphere included the following: rostral middle frontal (p=0.003), pars orbitalis (p=0.01), and insula (p=0.02). Cortical thickness analysis also showed reductions in the right superior parietal gyrus in patients with lower IQ. No significant relationship between IQ and seizure outcome was found.

This is the first study of a series of patients with pure MTLE-HS, including those with low IQ and their morphometric magnetic resonance imaging (MRI) features using FreeSurfer. Although patients with lower intellectual scores presented more areas of brain atrophy, IQ was not a predictor of surgical outcome. Therefore, when evaluating seizure follow-up, low IQ in patients with MTLE-HS might not contraindicate resective surgery ²⁾.

2016

Patients with mesial temporal lobe epilepsy (MTLE) with hippocampal sclerosis (HS) were selected. Clinical data were assessed pre-operatively and surgical outcome in the first year post surgery. One block of mid hippocampal body was selected for HS classification according to ILAE criteria. NeuNimmunoreactive cell bodies were counted within hippocampal subfields, in four randomly visual fields, and cell densities were transformed into z-score values. FreeSurfer processing of 1.5T brain structural images was used for subcortical and cortical volumetric estimation of the ipsilateral hippocampus. Univariate analysis of variance and Pearson's correlation test were applied for statistical analyses.

Sixty-two cases (31 female, 32 right HS) were included. ILAE type 1 HS was identified in 48 patients, type 2 in eight, type 3 in two, and four had no-HS. Better results regarding seizure control, i.e. ILAE 1, were achieved by patients with type 1 HS (58.3%). Patients with types 1 and 2 had smaller hippocampal volumes compared to those with no-HS (p<0.001 and p=0.004, respectively). Positive correlation was encountered between hippocampal volumes and CA1, CA3, CA4, and total estimated neuronal densities. CA2 was the only sector which did not correlate its neuronal density with hippocampal volume (p=0.390).

This is the first study correlating hippocampal volume on MRI submitted to FreeSurfer processing with ILAE patterns of HS and neuronal loss within each hippocampal subfield, a fundamental finding to anticipate surgical prognosis for patients with drug-resistant MTLE and HS³.

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