

Volumetric analysis of the cingulate cortex in Alzheimer's disease

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Background: MRI-based volumetric measurements provide a useful technique for quantifying regional cerebral atrophy occurring in Alzheimer's disease (AD). Histopathological studies have shown the cingulate cortex, a cytoarchitecturally heterogeneous region, to be severely affected in AD. Volumetric analysis of the cingulate cortex presents specific difficulties owing to a high inter-individual variability in cingulate sulcal borders.

Methods: In this study, we developed and validated a segmentation protocol, based on cytoarchitectonic criteria that have been mapped to macroscopic gyri and sulci patterns. We then assessed whether there was a significant grey matter loss of the whole cingulate cortex and its cytoarchitectonic subdivisions, in AD using 3D-MR imaging in vivo. Subdivision of the cingulate cortex into, caudal anterior, rostral anterior, posterior cingulate and retrosplenial cortex was achieved using predetermined cut-offs relating to surrounding landmarks.

Cingulate cortical volumes of early-onset familial AD patients (n=10, average MMSE = 11) were compared with age- and sex-matched healthy controls (n=10, average MMSE = 30), after corrections for individual variations in intracranial volume.

Results: Whole cingulate intra- and inter-rater reliability coefficients were 98,8% and 98,5% respectively. Using ANOVA we demonstrated that there was a significant disease related atrophy in the whole left and right cingulate cortex (26% lower than controls, $p < 0.01$) and that this atrophy was significant for each of the cingulate subdivisions: rostral anterior (19.5% volume loss, $p < 0.05$), caudal anterior cingulate (21% volume loss, $p < 0.05$), posterior cingulate (41% volume loss, $p < 0.001$) and retrosplenial cortex (20.5% volume loss, $p < 0.05$).

Conclusion: Severe atrophy of the cingulate cortex and its subdivisions appears to be a feature of early-onset familial AD; further studies are currently being undertaken to establish the diagnostic utility of these measures in older and more mildly affected patients.

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Poster session: neuroscience 2