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Comparison of grey matter volume and thickness for analyzing cortical changes in chronic schizophrenia

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Background

Schizophrenia is a devastating disorder affecting millions of people around the world. The study of its etiology is on-going from many aspects, like genetics, environment, clinic and neuroimaging. Highlighted by the good tissue contrast and non ionizing radiation of vivo MRI, neuroimaging study has been increasingly utilized to investigate the etiology of schizophrenia. Among all MRI analysis techniques detecting brain morphometric changes, grey matter volume and cortical thickness are the two most widely used measures. However, these two measures only shared partial overlapping regions in identifying morphometric changes in schizophrenia. Grey matter volume was thought as a combination of several measures such as cortical thickness, surface area, gyrification and intensity contrast; however, few studies disambiguate the contributions of these factors to the differences of grey matter volume and thickness. In the present study, we first compared the grey matter changes in anatomical locations identified by VBM and cortical thickness. Then we explored the contributions of surface measures (including area, gyrification and intensity contrast) to the discrepancies between grey matter volume and thickness. As an additional aim, we also examined the power of grey matter changes in overlapping regions to discriminate patients with schizophrenia from healthy controls.

Methods

Twenty-two patients with schizophrenia and well-matched twenty healthy controls with high-resolution 3T MRIs were chosen for analyses. Grey matter volume and cortical thickness were first derived from voxel-based morphometry (VBM) and Freesurfer, respectively. In order to compare grey matter differences in anatomical locations between the grey matter volume and thickness, grey matter results from

VBM were then rendered onto surface template of Freesurfer. Finally, Support vector machine (SVM) was used to distinguish patients from healthy controls based on the grey matter measures of the overlapping regions.

Results

Our results demonstrated multiple overlapping regions of grey matter volume and thickness reductions involving in the superior temporal gyrus, prefrontal gyrus, lateral occipital gyrus and insula; and different regions where grey matter volume significantly decreased but without corresponding evidence of cortical thinning such as the rostral middle frontal, precentral, lateral occipital and superior frontal gyri. Further analysis revealed that surface area, grey/white matter intensity contrast and gyrification accounted for the discrepancies between grey matter volume and thickness. Grey matter measures of the overlapping regions showed a potential to discriminate patients with schizophrenia from healthy controls.

Conclusions

In conclusion, we identified different aspects of cortical developmental abnormalities such as surface area, gyrification and grey/white matter intensity contrast in chronic schizophrenia. The changes of these measures contributed to the differences between grey matter volume and thickness in schizophrenia. Significantly anatomical variations of different measures in the respective contributions to the discrepancies between grey matter volume and thickness suggest different measures might follow different processes of neurodevelopment. The potential of grey matter volume and thickness of overlapping regions to distinguish patients from controls suggests that grey matter volume and thickness are two reliable measures for charactering the structural abnormalities of schizophrenia. Overall, grey matter volume is sensitive to a combination of changes in different measures, combining it with cortical thickness together could be better informed for understanding the specific pathophysiology of schizophrenia.

Keywords: Schizophrenia, grey matter volume, cortical thickness, surface area, gyrification, intensity contrast