Abnormalities in corpus callosum signal intensity in schizophrenia.

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Introduction
The corpus callosum (CC) is the major commissural pathway between the hemispheres and its integrity is crucial for normal inter-hemispheric communication. Various lines of research suggest that the CC is comprised of commissural connections that are topographically mapped to corresponding brain regions (1). Furthermore, CC brain regions mature post-natally through adolescence and into early adulthood (2). Schizophrenia is thought to be associated with abnormalities of the heteromodal association cortices mediated by abnormal brain development (3). Signal intensity (SI) measures on T1-weighted MRI scans provide valuable information about white matter characteristics (4). Based on these findings we predicted SI abnormalities in CC regions, specifically those that connect heteromodal association cortices, such as the genu and the anterior body. We also predicted that the normative developmental changes in SI would be absent in schizophrenia.

Methods
Thirty patients diagnosed with schizophrenia (SCZ), 14 patients with non-schizophrenic psychotic disorders (Non-SCZ) and 51 healthy controls (HC) participated in the study. CC morphometry was conducted on the mid-sagittal slice of T1-weighted MRI scans. Mean signal intensities were also computed within each sub-region and were normalized against the intensity of a circular region of interest within the vitreous humor. We assessed sub-regions of the CC (genu, body, isthmus and splenium) as well as the pons, a subcortical brain region.

Results
A MANOVA with group and sex as factors revealed significant differences of group (Rao’s $R^2=2.24$ (df=12,168), $p<.02$) and sex (Rao’s $R^2=3.75$ (df=6,84), $p<.01$). Further analysis indicated that the mean SI of the CC tissue in schizophrenia patients was significantly lower than the other groups in the genu ($p<.02$), anterior body ($p<.02$), and isthmus ($p<.05$, see Figure). Marginal differences were observed in the posterior body and the splenium ($p<.10$) and no differences were observed in the pons ($p>.30$). Regression analyses revealed clear anomalies in the developmental SI changes in the CC of schizophrenia patients. In normals, a significant linear inverse relationship was observed between age and signal intensity across all the sub-divisions of the CC ($p<.01$). However there was no significant relationship between age and signal intensity in any of the CC regions for the schizophrenia patients ($p>.10$).

Discussion
The results indicate that there are changes in the characteristics (myelin or axonal) of callosal white matter tissue in schizophrenia. These decreases are consistent with decreases in CC regions (5) and indicate pathophysiological alterations in the CC in schizophrenia. The differences were strongest in the genu and the anterior body which connect the sensorimotor association cortices of the two hemispheres. Smaller effects were observed in CC regions that connect the occipital cortices. Furthermore, the regression analysis revealed that alterations in normal CC SI were developmental in nature. Future studies that use more direct techniques to assess white matter integrity will be needed to understand the bases of these changes and their significance for abnormal brain development in schizophrenia.

References