OLFACTORY SULCAL DEPTH AND OLFACTORY BULB VOLUME IN PATIENTS WITH SCHIZOPHRENIA: AN MRI STUDY

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ABSTRACT

Prior empirical studies have demonstrated that the olfactory sulcus (OS) is deeper on the right in comparison to the left side in healthy individuals and that patients with schizophrenia exhibit reduced olfactory bulb volume when compared to healthy controls. The goal of this study is to investigate olfactory sulcal depth and olfactory bulb volume, respectively, as a probe into the peripheral and central olfactory system, in patients diagnosed with schizophrenia (SZ) in comparison to healthy controls (NC).

Twenty-five male group matched participants diagnosed with schizophrenia and twenty-five healthy males from the Boston VA Healthcare System received 3T magnetic resonance imaging to measure the olfactory bulb and sulcus.

In healthy individuals, but not in schizophrenics, we found that the right olfactory sulcus was deeper than the left (p<0.016 vs. p=0.92). We also found less sulcal depth asymmetry in schizophrenic patients vs. healthy individuals but between groups difference were statistically non-significant (L1: p=0.945, R1: p=0.439). Repeated measure ANOVA yielded a main effect for side (p=0.003).

In the right NC vs. right SZ, there was a 10.7% olfactory bulb volume reduction ([mean=4.335 mm³, SD=0.86] vs. [mean=3.95 mm³, SD=0.72], p=0.047).

Generally, the right olfactory bulb was also larger than the left olfactory bulb in both NC (4.335 mm³ vs. 3.367 mm³) and SZ (3.95 mm³ vs. 3.56 mm³), by 24% and 11.5%, respectively. Asymmetry coefficients p=0.025. Repeated measure ANOVA yielded a main effect for side diagnosis (p=0.019).

Clinically, there was a significant correlation between the bulb volume and the general positive PANSS score and the general hallucination score (p=0.015, r=-0.405) but no significant correlation at this time with negative symptoms. The olfactory sulcal asymmetry observed in healthy individuals and one olfactory bulb findings suggest there is lateralization in olfactory processing, in which the right side predominates. Our data suggest that there are both central and peripheral abnormalities in the olfactory system in SZ in that the paired-test for olfactory sulcal depth was significantly different when compared to NC (R1-L), but not in SZ, and the significance findings of olfactory bulb volume reduction in the right side of NC vs. SZ.

BACKGROUND

An odor stimulus is transmitted via bilateral olfactory nerve fibers through the cribiform plate of the ethmoid bone to the olfactory bulb.

Axons from the olfactory nerve synapse in the olfactory bulb which in turn send axonal projections through the olfactory tract, which lies in the olfactory sulcus (OS).

Axons Ebbon from the olfactory tract project to the anterior olfactory nucleus, and then project further to the primary olfactory cortex, e.g., piriform cortex, and to association olfactory cortices (e.g., orbitalfrontal and parts of the medial temporal cortex).

Abnormal olfactory function has been reported in SZ patients with deficit syndromes and in neurodegenerative disorders, such as Alzheimer’s and Parkinson’s diseases. In this project, we explored the central olfactory system, e.g., olfactory sulcus depth, and the peripheral olfactory system by measuring the olfactory bulb shape and further correlated emotive measures in these regions with positive and negative symptoms in SZ.

METHODS

Twenty-five right-handed male patients diagnosed with schizophrenia (mean age = 44.48, mean PSYSS = 2.63) and twenty-five healthy right-handed male controls (mean age = 41.56, mean PSYSS = 2.33) matched for age (p=0.194) and parental socio-economic status (PS) (p=0.385) recruited from the Boston VA Healthcare System.

Images were acquired on a 3T GE shorthead magnet with the following parameters: TR: 3.46 ms, TE: 3 ms, FOV 256 mm, 1 mm slice thickness, 176 axial slices.

To measure the olfactory sulcus we utilized a method from prior studies of the olfactory sulcal depth and took measurements of the OS at the plane of the lateral ventricle through the olfactory sulcus (OS) located coronally (Figure 2). Once the sulci were traced the depth was calculated by summing the lengths of the vessels. Olfactory bulb measurements were performed on previously described methods at the level of the anterior commissure plane (Figure 1). The bulb was located symmetrically for the two hemispheres (including both T1 and T2 images) and measured on three slices so as to obtain a decent measure given the minute volume of the structure. These three slices were summed and then normalized for brain size.

RESULTS

Olfactory Sulci Depth

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<td>NC (p=0.016)</td>
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Olfactory Bulb Volume

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<td>SZ (p=0.003)</td>
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<td>NC (p&lt;0.001)</td>
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Table 1: Healthy controls showed significant difference in sulcal depth by homanshe (p=0.016, R-L) while there was no significant difference in schizophrenic patients (p=0.23).

Table 2: Both schizophrenic patients and healthy controls showed significant difference between hemispheres (p=0.003 and p=0.001 respectively; R-L) and there was a significant difference between groups in the right hemisphere (p=0.007, NC-SZ).

Table 3: The bulb volume of schizophrenic patients was negatively correlated (Pearson) with the sum of positive PANSS scores (r=-0.437, p=0.021) while there was no correlation between the negative PANSS scores and bulb volume (r=0.16, p=0.593).

CONCLUSIONS

- The olfactory sulcal asymmetry observed in healthy individuals suggests there is lateralization in olfactory processing, in which the right side predominates.
- Our data suggest that there may be a central abnormality in the olfactory system in SZ in that the paired-test for olfactory sulcal depth was significantly different when compared to NC (R-L), but not in SZ.
- Our data also suggest that there are peripheral abnormalities as there was mild reduction of the right olfactory bulv volume in SZ vs. NC (p=0.047). Our data also showed that, generally, the right olfactory bulv were larger vs. the left in both NC and SZ, which further suggest that the right side predominance within the olfactory system.
- Our data showed correlations between olfactory bulv volumes with positive PANSS scores and not with negative symptoms.

SELECTED REFERENCES


