Neuronal generator patterns of olfactory event-related potentials (OERP) in schizophrenia

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Abstract

Background: Deficits in olfactory threshold sensitivity, discrimination and identification are common in schizophrenia, presumably originating from brain structures also linked to their cognitive and emotional disturbances. However, the neurophysiological processes underlying olfactory dysfunction in schizophrenia have only been studied by Turetsky et al. (2003) who found reduced N1 and P2 amplitudes. Methods: Nose-referenced 30-channel ERPs were recorded from 33 healthy adult and 39 male patients with schizophrenia (n=18/11 males) during an odor detection task. Hydrogen sulfide (H2S) stimuli (200 ms duration) at concentrations of 50% and 100% were presented to the left or right nostril by a computer-controlled olfactometer (Pell 5 0-25, s). Time of odor stimulation was not cued. Subjects indicated whether they perceived a low or high odor intensity. To identify and measure neuronal generator patterns underlying ERPs, unrestricted Varimax-PCA was performed on their reference-free current source densities (spherical splines).

Results: Patients’ behavioral performance was on par with that for healthy controls for high (25.5%) vs. low (4.4%) odor concentrations. Patients showed similar olfactory ERP and CSD waveforms when compared to controls, but their N1 sink (300 ms, bilateral frontal/mid-temporal) and P2 source (615 ms, mid-patalia maximum) amplitudes were smaller. However, both groups had greater N1 sinks and P2 sources to higher low odor intensities. Concluding, OERP amplitude reductions to H2S stimuli in schizophrenia appear to reflect reduced activity of frontal, insular, hippocampal, and parietal regions.

Introduction

• Olfactory dysfunction deficits are common in schizophrenia.
  • Reduced threshold sensitivity.
  • Impaired discrimination.
  • Poorer odor identification.

These deficits presumably originate from brain structures also linked to cognitive and emotional disturbances in schizophrenia.

The dependent variables included in the recording reference location (e.g., nose, left, right nostril, average) and the definition and measurement of appropriate ERP components (e.g., specific time segments for each event sequence, average and peak amplitudes at selected scalp sites) (200 samples).

The ERP components were defined as follows:

1. N1 (250-300 ms, peak latency), an average of artifact-free trials, correct responses only, low pass filtered at 250 ms.
2. P2 (300-400 ms, peak latency), an average of artifact-free trials, correct responses only, low pass filtered at 100 ms.
3. CSDs were computed for each ERP (sharpen topographies, eliminate volume-conducted activity) using spherical splines (Kayser et al., 2003).

• ERP Recording and Data Analysis:
  • ERP data were acquired at 10-30 Hz band pass (-60db/octave).
  • EEG differences (Fp2-Fp1, etc.) were analyzed.

Subjects Factors and Artifacts (Epoch EEG) were linear regressions of lateral recording reference location.

ERP Recording and Data Analysis

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Stimuli and Procedure

- ERP data were acquired at 10-30 Hz band pass (-60db/octave).

Participants

Mean, Standard Deviation (SD), and Range for Demographic and Clinical Variables

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schizophrenia-Depressive (n=3)</td>
<td>25.5</td>
<td>6.4</td>
<td>13.5-30.5</td>
</tr>
<tr>
<td>Schizophrenia-Catatonic (n=1)</td>
<td>25.5</td>
<td>6.4</td>
<td>13.5-30.5</td>
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<tr>
<td>Schizophrenia-Undifferentiated (n=9)</td>
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<td>6.4</td>
<td>13.5-30.5</td>
</tr>
<tr>
<td>Schizophrenia-Paranoid (n=15)</td>
<td>25.5</td>
<td>6.4</td>
<td>13.5-30.5</td>
</tr>
<tr>
<td>Schizophrenia-Clinical schizoaffective (n=3)</td>
<td>25.5</td>
<td>6.4</td>
<td>13.5-30.5</td>
</tr>
<tr>
<td>Controls</td>
<td>25.5</td>
<td>6.4</td>
<td>13.5-30.5</td>
</tr>
</tbody>
</table>

Behavioral Data

- Mean percentage of missed responses revealed equal performance for healthy adults and schizophrenic patients. In both groups, H2S stimuli were more often correctly perceived than lower intensity odors.

Summary and Conclusions

- Patients and controls produced highly comparable ERP/CSD waveform topographies (Figs. 2-4).
- N1 and P2 factors scores were larger and more representative of the associated CSD components in healthy vs. schizophrenia patients, adding topographies and axes within factors to the design.

Current Source Densities

- Comparing to healthy adults, N1 sinks and P2 sources appeared to be reduced in schizophrenia patients. However, both groups showed comparable intensity-related effects on both CSD components.

References

- Turetsky et al. 2003
- Kayser & Tenke 2003
- Tenke & Kayser 2005
- Schwenkreis et al. 2003
- Perrin et al. 1989
- Turetsky et al. 2008