Effects of Odor Valence and Arousal on Event-Related Potentials (ERPs) in Healthy Adults and Depressed Patients

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Purpose: The dissociation of N1 amplitude and arousal ratings in patients may suggest abnormal odor perception on an “early sensory” level in depression.

Methods: 49-channel ERPs were recorded from 25 clinically-depressed and 27 healthy controls during an odor detection task using pleasant (Citronella; CIT) and unpleasant (hydrogen sulfide; H2S) stimuli. High or low odor concentrations or blanks were presented unilaterally by a constant-flow olfactometer (ISI 15-21s). Subjects indicated odor presence via foot pedal. Neuronal generator patterns underlying ERPs were identified and measured by unrestricted Varimax-PCA of reference-free current source densities (CSD). Results: Replicating previous findings for H2S stimuli (Kayser et al 2010), CSD waveforms were characterized across odors by an early N1 sink (325 ms, bilateral centrotemporal) and a late P2 source (735 ms, mid-cortical). Whereas N1 sink varied with odor intensity, P2 source varied with odor valence (CIT > H2S) and topographies were highly correlated with individual ratings of valence (P2) in both groups but not arousal (N1) in controls only. However, CSD waveforms and topographies did not differ between groups. Likewise, depressed patients showed normal odor identification and thresholds (Sniffin’ Sticks), but did not differ in controls in detection accuracy for all conditions (76-90% vs. 74-91% correct).

Conclusions: Although ERP/CSD measures directly reflected valence and arousal properties of pleasant and unpleasant odors, there was no evidence of impaired olfactory/monosynaptic processing in depression, indicating that the dissociation of N1 amplitude and arousal ratings in patients may suggest abnormal odor perception on an “early sensory” level in depression.

Introduction

The study of olfactory and limbic structures involved in affect, emotion and depression, the study of olfacto-mood interactions for studying autonomic and emotional properties of emotions (olfactory) and odor intensity (aromarid) and the relationship of these two properties in depression.

Methods

ERP Recording and Data Analysis

ERP Recording

- Electrocorticogram (ECoG) recordings were obtained on an 11×11 cm grid using non-invasive EEG electrodes from 49 scalp sites with a nose reference (Perrin et al 1989). 49-channel ERPs were recorded from 25 clinically-depressed and 27 healthy controls. EEG data were high-pass filtered above 0.1 Hz and low-pass filtered below 70 Hz. EEG data were sampled at 500 Hz. All ERPs were artifact corrected (Perrin et al 1989).

Data Analysis

- ERP waveforms were characterized by reference-free varimax-PCA of current source densities (CSD). CSD waveforms were characterized across odors by an early N1 sink (325 ms, bilateral centrotemporal) and a late P2 source (735 ms, mid-cortical). Whereas N1 sink varied with odor intensity, P2 source varied with odor valence (CIT > H2S) and topographies were highly correlated with individual ratings of valence (P2) in both groups but not arousal (N1) in controls only. However, CSD waveforms and topographies did not differ between groups. Likewise, depressed patients showed normal odor identification and thresholds (Sniffin’ Sticks), but did not differ in controls in detection accuracy for all conditions (76-90% vs. 74-91% correct).

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References