FRONTAL LOBE INVOLVEMENT IN P50-GATING DEFICIT ?

M. Röhrig*, M. Weisbrod*, J. Schröder*, M. Scherg#, A. Rupp#

* Psychiatric Department, University of Heidelberg, # Section of Biomegnetism, Dep. of Neurology

Introduction

Information-processing theory (Mc Ghie and Chapman, 1961) proposes deficient stimulus filtering (e.g. sensory gating deficit) in schizophrenic patients which results in defragmentation and causes schizophrenic symptoms. Reduced P50 suppression is thought to represent the sensory gating deficit in schizophrenic patients. Yet, the functional and neuroanatomical substrate of P50 suppression has not been demonstrated. There is a strong evidence for generators of the auditory P50 in both temporal lobes[1] and some evidence derived from magnetoencephalography (MEG) measurements[2] for generators in the lateral part of the AC. This study examined the functional substrate of P50 suppression applying spatio-temporal source analysis (BESA 99).

Methods

- Subjects:
  - 10 right handed healthy adults with normal pure tone audiometry (mean age = 29.9 years, SD=2.4, 6 females).
- Device:
  - 32-channel EEG (Neuroscan Synamps) and anatomic T1 weighted magnetic resonance images (MRI) obtained by a Picker MR Scanner (1,5 T).
- Stimuli:
  - 130 pairs of clicks (S1 = first and S2 = second click of the pair) at 60 dB above threshold (duration 0.04 ms, ISI 500 ms, ITI ~ 9 s) presented diotically in two runs.
- Instruction:
  - Subjects were asked to watch a silent video with muted sound while hearing the stimuli.
- Data analysis:
  - Spatio-temporal source analysis using BESA99 (MEGIS Software GmbH) assuming 3 regional sources: frontal and bilateral AC.
  - Since the equivalent dipole in the AC did not explain the data satisfactorily a third source was introduced. The additional source located consistently in the frontal lobe (the location in one exemplary subject is shown in figure 1).
  - For robust estimation of source waveforms, AC regional sources were seeded in the postero-lateral part of the Heschl's gyrus (according to Liégeois-Chauvel et al.[3]) in the individual MRI using BrainVoyager (R. Goebel). Orientation was fitted to individual EEG data. (Fig. 1)
  - A MANOVA on the N40-P50 amplitude and latency at Cz-electrode was perfomed to test the effects of component (N40 / P50) and condition (S1 / S2).
  - A MANOVA on amplitude and latency of the averaged Cz-electrode wave form was perfomed to test the effects of condition and location (frontal source / mean of both AC-sources).
  - Also a MANOVA on the P50 source wave form was performed to test for the effects of condition and location.

Results

- N40-P50: The P50 showes suppression, the N40 does not ["component" x "condition" interaction (p<0.01)]; there are no latency effects (fig. 2).
- P50-spatio-temporal source analysis: The amplitude reduction on S2 was more pronounced for the frontal source than for the AC-sources [interaction "condition" x "location" (p<0.05)]. The frontal P50 source peaked significantly later than the AC-sources ["location" (p<0.01)] (fig. 3).

Conclusion

P50 suppression was replicated in healthy controls using a P50 gating paradigm. Our results suggest that besides the AC-sources, an additional frontal source contributes to the P50 scalp potential. Differences in latency and modulation in the P50 gating paradigm demonstrate a functional separation of AC- and frontal sources. In particular frontal areas seem to be involved in the P50 suppression.

References

1 Braff DL and Geyer MA. Arch Gen Psychiatry 47, 181-188 (1990).
2 Scherg M, Hari R and Hämäläinen M. In: Williamson SJ, ed. Advances in Biomagnetism. New York:Plenum Publ. Corp., 1989: 97-100.
3 Liégeois-Chauvel C, Musolino A, Badier JM et al. Electroencephalogr Clin Neurophysiol 92, 204-214 (1994).

Acknowledgments
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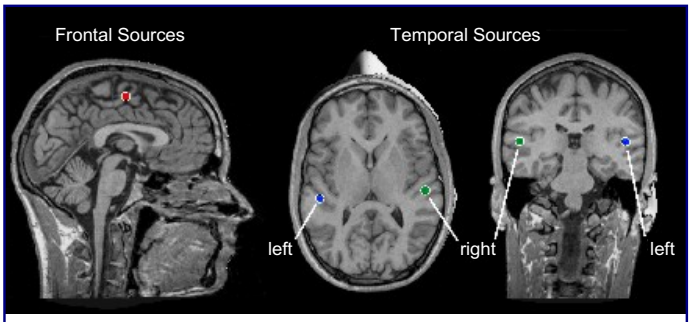


Fig. 1: Seeded locations of frontal and AC-sources in one subject.

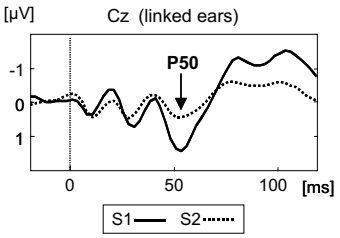
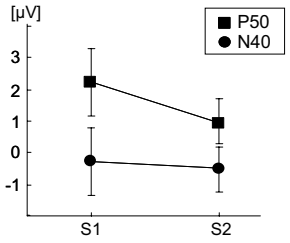


Fig. 2: Grand average over Cz (averaged over both, the first and the second run).



Mean and SD of the N40- and P50-amplitude on Cz.

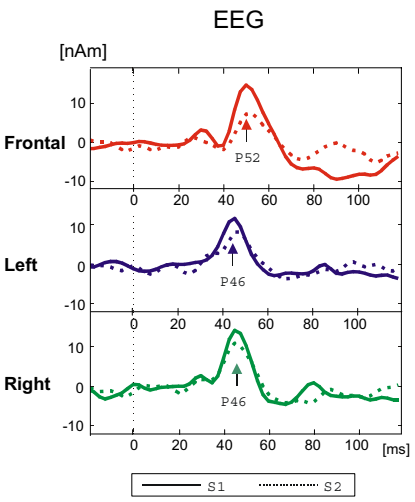


Fig. 3: P50 source wave formes averaged over both runs.

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Corresponding author: miriam.roehrig@med.uni-heidelberg.de
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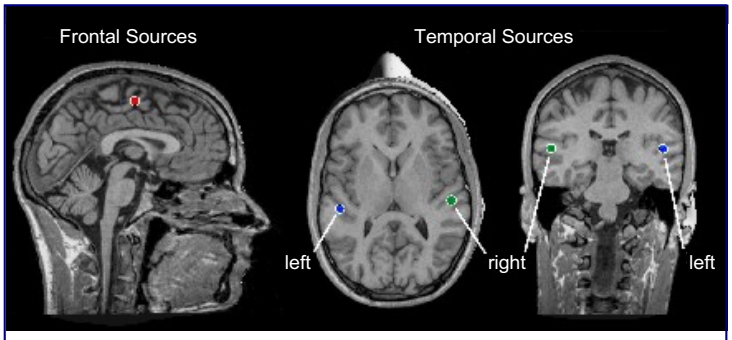

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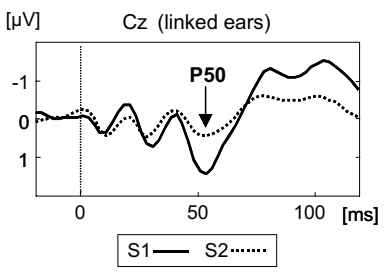

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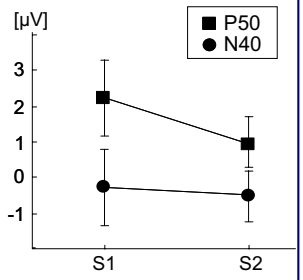

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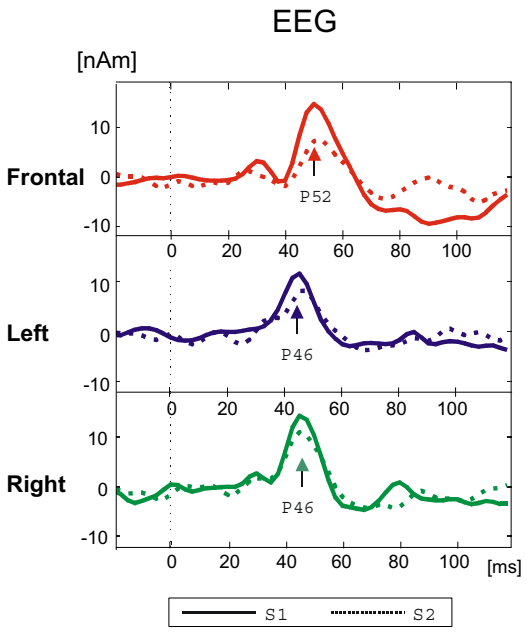

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