Proceedings

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Congress President: Keizo Matsumoto

SPECIAL LECTURE

Intraoperative monitoring for ischemic brain with dynamic deviation ratio topography (DRT). - Matsumoto, K. (Department of Neurological Surgery, School of Medicine, The University of Tokushima, Japan).

Intraoperative monitoring for ischemic condition of the brain is an essential procedure in vascular neurosurgery. At present, two kinds of modalities are used for this purpose, one of which is based on examination of electrophysiological cortical functions with EEG and the evoked potentials and the other based on observation of cerebral hemodynamics with Ultrasonic Doppler Sonography and/or Near infrared Spectroscopy. In 1988, we proposed a novel EEG evaluation method, DRT, which is able to display significant EEG changes in individuals both sequentially and spatially. Since then, we have been routinely applied DRT for intraoperative monitor to detect the occurrence of critical ischemic conditions of the brain during clamping of the internal carotid artery in the case of carotid endarterectomy (CEA). The principles of DRT have already been reported in previous meetings. This time, how we use DRT in the operating room was presented by VIDEO. DRT and simultaneous use of cerebral hemodynamic monitoring with Ultrasonic Doppler Sonography and Near infrared Spectroscopy suggested us that DRT was able to cover whole brain with reasonable sensitivity, whereas Doppler was specially sensitive to detection of flying embolic fragments in the middle cerebral artery. Near infrared was not positive for exact critical level of oxygen saturation ratio, although the cases are limited in number.

Brain electrical activity topography dynamics during the continuous performance task (CPT) in schizophrenia. - Ciorciari, J., Silberstein, R.B., Line, P., Nield, G., Wright, J.J., and Copolov, D. (Center for Applied Neurosciences, Swinburne Univ. of Technology, Australia).

Previous work we have presented suggests that transient reductions in the amplitude of the steady state visually evoked potential (SSVEP) may index cognitively related increases in cortical activity. In this study we examine the changes in SSVEP topography when 15 chronic male schizophrenics (DSM-IIIR) and 15 normals undertake the "AX" version of the CPT. In this task, subjects are required to respond on the appearance of the letter "X" which has been preceded by an "A". Letters were presented at a rate of one per 1.8 sec for 246 sec. The SSVEP was recorded from 64 scalp sites and elicited by a spatially uniform 13 Hz visual flicker. The SSVEP magnitude and phase changes were presented as animated topographic maps. In normals, the appearance of the "A" coincided with a transient SSVEP amplitude reduction in the prefrontal region followed by a parietal amplitude reduction lasting app. 800 msec. In schizophrenics, the prefrontal SSVEP attenuation coinciding with the appearance of the "A" was delayed and reduced. When analyzing fast and slow responses separately, the schizophrenic subjects exhibited a large differences in prefrontal and parietal SSVEP attenuation following the appearance of an "A". This data suggests that schizophrenics exhibit second to second instability in their capacity to activate specific neural networks which are required to perform the "AX" variant of the CPT. This work was supported by an NHMRC grant.

Brain field microstates, the atoms of cognition. - Lehmann, D. (The KEY Institute for Brain-Mind Research, University Hospital of Psychiatry, Switzerland).

Maps of human brain field potential distributions over time change discontinuously, step-like. Spontaneous and event-related series of momentary brain field maps show brief epochs in the sub-second range, characterized by near-stable field topography (landscape), called microstates; they are concatenated by rapid landscape changes. Since different potential distributions must have been caused by activity of different neural generators, it is suggested that different microstates subserve different brain functions. Hence, brain function-oriented analyses should parse the multichannel brain field records into these microstates. Utilizating different data-driven strategies (know-all vs sequential, extracted features vs global map assessments) lead to converging results about the time borders of the microstates. Experimental design yields identification of the functional significance of these putative "atoms of thought", representing steps or modes of mentation: Language-triggered ERP microstates (with Dr. Koenig) distinguished between nouns and verbs at 116-172 ms post-stimulus, and at 300-396

electric activities which are closely related to generators of higher brain functions such as short-term memory and cognitive processes. ii) Detection and analysis of opposingly directed generators or quasi-circular current sources associated with spontaneous delta activities. iii) Estimation of traveling sources in the fissual cortex associated with auditory evoked magnetic fields. iv) Modeling and simulation of propagation of spreading current sources as a population of exciting neurons inside a regional area in the cortex.

Comparison of different approaches to EEG and MEG reconstructions. - Fuchs, M., Wagner, M., Wischmann, H.-A., and Drenckhahn, R. (Philips GmbH Forschungslaboratorien, Germany).

Source localizations from electric and magnetic brain examinations can be determined by equivalent current dipole models, spatial deviation scans, or minimum norm current density reconstructions. The different algorithms for EEG and MEG evaluations are compared regarding their resolving power, the influence of a more realistic volume conductor geometry by the Boundary Element Method, and anatomical constraints. An overlay of the reconstruction results with morphological images from Magnetic Resonance tomography yields further insight into the advantages and drawbacks of the different methods. With known signal to noise ratios deviation scans can be seen as spatial probability distributions for single equivalent dipole solutions. The method can easily be extended to two simultaneously active dipoles, while temporal aspects and constraints can be introduced by a principal component analysis of the measured data. Generalized minimum norm current density reconstructions with and without lead field normalization are another promising approach to the solution of the inverse problem. In this case no assumptions about the number of coherently active generators are necessary, but the strongly underdetermined problem yields solutions with limited spatial resolution. The comparison of the results of all approaches and combined EEG and MEG reconstuctions improve the source analysis of bioelectric and biomagnetic studies.

Comparison of MEG- and EEG-map patterns by two occipital sources in visual evoked responses for full filed stimuli. - Nakasato, N., Seki, K., Kanno, A., Kawamura, T., Ohtomo, S., Fujita, S., Hatanaka, K., and Yoshimoto, T. (Department of Neurosurgery, Tohoku University, Japan).

In visual evoked potentials for full visual-field stimuli, P100 map pattern indicates a single positive peak over the occipital area, although at least two generators are expected to be in the two occipital lobes. This fact is partially due to smearing effect of skull and scalp in EEG. MEG, on the contrary, is known to be less influenced by the inhomogeneous head conductivity. We applied a whole-head MEG system (CTF Systems and Osaka Gas) to separate two occipital sources in visual evoked magnetic fields (VEF) for full field stimuli. In 7 normal male subjects, checkerboard pattern reversal (PR) stimuli were delivered through a system of fiber optics. The MEG signals were averaged for 200 PR presentations. At the P100m peak, isofield maps indicated symmetrical two dipole patterns, overlapping each other across the occipital midline. Using a two-dipole model, P100m sources were estimated at the lateral bottom of the bilateral calcarine fissures in MRI. Our results indicate that MEG-map is useful to separate two adjacent sources that EEG-map alone may not. PR-VEF for the full filed stimuli can be applied to evaluate interhemispheric differences between bilateral visual function.

Information criteria can help to determine the number of sources from EEG and MEG. - Peters, M.J., Jagers, H.R.A., and Knosche, T. (University of Twente, The Netherlands).

A problem with analyzing EEG measurements is the reconstruction of the sources that generate the observed data. Most methods used to solve this problem are based on the assumption that the number of sources is known. Most methods to determine this number are based on the eigenvalues of the covariance matrix of the measured data, the so-called principal components. The assumption is that many of the smaller eigenvalues represent only noise. The decision, where to cut off the spectrum of eigenvalues, is often taken subjectively. Taking into account the properties of the noise, several criteria will be discussed, which allow a more objective choice. The effectiveness of these criteria is assessed by means of computer simulations and the analysis of measurements. Simulations were performed by adding noise to the signals that arise from two rotating current dipoles. The simulations show that the decision which criterion to use, has to be based on the available information about the noise. Besides, it depends on whether overestimation or underestimation of the number of sources would be less harmful. The criteria were also applied to measured data.

SYMPOSIUM 2: Pharmaco-EEG

Spatio-temporal monitoring system of pharmaco-EEG with deviation ratio topography (DRT). - Shichijo, F., Yoda, K., Nishitani, K., and Matsumoto, K. (Department of Neurological Surgery, School of Medicine, The University of Tokushima, Japan).

The deviation ratio topography (DRT), which was devised by us in 1984, has been used usually for the intraoperative monitoring, especially during the carotid surgery. The DRT is a system for comparing between two EEG topographies of the same patient under different conditions. With DRT system, not only the changes in frequency bands but also the spatial and sequential changes of EEG activities were visually evaluated statistically. In this paper, the DRT system was applied in the field of pharmaco-EEG. The dynamic EEG alterations after drinking of alcohol or smoking of cigarette have been evaluated with DRT. According to our pilot study, the power in the theta, slow alpha and beta bands all increased after drinking of alcohol, whereas the power in the theta band decreased and power in the fast alpha and beta bands increased after smoking of cigarette. According to the use of DRT system, the dynamic effects of drinking alcohol or smoking cigarette in electroencehphalographic activity were statistically evaluated easily.

EEG band centroids modifications in HIV subjects. - Comi, G., Fornara, C., Madaglini, S., Cursi, M., Locatelli, T., Castagna*, A., Cinque*, P., Lazzarin*, A., and Canal, N. (Dept. of Neurology and *Dept. of Infectious Diseases, HS. Raffaele, Italy).

Pharmaco-EEG demonstrated that the centroid can describe also small modifications of the electrical brain activity produced by drugs. Recent studies suggest the use of this parameter in the early phases of primary dementia (Saletu et al. 1988). Our study proposes the evaluation of this parameter in asymptomatic HIV subjects with normal EEG power spectra, We studied 23 HIV subjects (CDC Atlanta II and III) without neurological and cognitive impairments, with normal MRI: compared to 20 normal age-matched controls, HIV group showed a deceleration of delta centroid and an acceleration of beta 1 and beta 2 band centroids. Delta band modification was significantly related to