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PHYSIOLOGICAL INVESTIGATIONS OF EXTRACORPOREAL CO_2-REMOVAL WITH REGARD TO CLINICAL APPLICATION.

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Advanced lung diseases with respiratory insufficieny are usually treated by respiratory therapy. In more serious cases an increase of ventilation parameters over physiological values in combination with enhancement of oxygen concentrations is necessary in order to overcome the pathophysiological diffusion barrieres. Barotraumas and oxygen toxicity can be the following complications. A promising approach seemed to be the extracorporeal membrane oxygenation (ECMO) until 1976. Since the oxygenator should replace the total function of the natural lung in a long time perfusion (up to weeks), the biotechnical difficulties such as large membrane areas, high extracorporeal flow rates and disturbances in governing the blood clotting system, are reasons that this method could be regarded as a disappointment. Fortunately the new idea of extracorporeal CO_2-elimination promises a new succesfull alternative, which is based on recent positive clinical results. Here we report about the physiological aspects of this method, where in experiments with dogs and sheeps, undergoing a veno-venous bypass, the CO_2 is eliminated so that the natural ventilation could be reduced (down to respiratory frequencies of only 3 or 4min^{-1}) with a blood flow rate below 40% of cardiac output. The blood gas data of the animals could be maintained at physiological ranges. This was even the case in the status of apnoe up to 12 h by slightly flushing the lung with oxygen. Analytical considerations together with experimental measurements allow to derive the important relationships between the blood flow rate, the demanded CO_2-elimination rate and the low respiratory frequency.

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MEASUREMENT OF ENDOGENOUS EVENT-RELATED FIELD POTENTIALS IN CORTICAL AND SUBCORTICAL STRUCTURES OF THE CAT BRAIN

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Several investigators have shown the human endogenous event-related potentials to be related to human information processing since its discovery by Sutton et al. (1). However, only few investigators have started investigations with recording of cats to demonstrate in experimental animals if a correspondence is to be established with components of the human event-related potentials (2). We used five adult cats implanted chronically with subdural electrodes in the cortex, reticular formation and hippocampus. The cats have been stimulated during slow-wave sleep with repetitive tone bursts of 2000 Hz. Every fourth stimulation have been omitted. Since the cognitive endogenous potentials of the brain have usually very small amplitudes we could use only selected epochs of event-related potentials to omitted stimuli and EEG prior to omitted stimuli by using a combined EEG-ERP algorithm (3) which allowed an efficient signal/noise extraction. According to the preliminary results it can be stated that in the cortex, reticular formation and hippocampus a stabilization and phase reordering of EEG in frequency channels between 1 and 15 Hz seems to be task relevant and may be the cause of the endogenous P300 wave. It is to note that omitted stimulation even might elicit higher frequency responses of brain activity in frequency channels of 40 Hz and 70 Hz in hippocampus and reticular formation. These results indicate that endogenous auditory potentials can be related to several neural generators distributed in the brain.

(1) S. Sutton et al.: Science, 150, 1187 (1965)
(2) M.B. Wilder et al.: Science, 211, 605 (1981)
(3) E. Başar: EEG-Brain Dynamics, Elsevier/North-Holland, Amsterdam, New York, 411 pp. (1980)

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AN OPTO-ELECTRONICAL SYSTEM FOR ANALYSING CONTRACTION PATTERNS OF SINGLE MYOCARDIAL CELLS

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For optical recording of the isotonic contractions of isolated adult heart cells a simple electronic optodetector system was developed which can be attached to standard microscopes. Unlike systems based on TV technology, this system is free of biases due to the TV frame-frequency. The picture of the cell is focused on a photodetector converting light intensity into an electrical signal. With cell contraction light intensity in the visual field is modulated resulting in a modulated detector signal. The primary electrical signal is amplified and noise filtered. The output of the system consists of recordings of cellular length, the speed of length changes and the rate of contractions. With use of this system it has been demonstrated that the contraction-suppressive effect of high Ca^{2+} antagonist doses is a temperature dependent phenomenon. Use of the system is further illustrated by demonstrating frequency-contraction depth effects. This system represents a low-cost recording device suitable for pharmacological screening on the cellular level.

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MICROPROCESSOR AIDED CORRECTION OF THE Ca^{2+} ERROR IN THE SIGNAL OF A Na^+-SELECTIVE MICROELECTRODE

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In physiology thin glass micropipette electrodes, filled with a liquid ion exchanger or neutral carrier, are used for measurements of intra- and extracellular ion activities, e.g. of K^+, Na^+, H^+, Ca^{2+} or Cl^-. However, in addition to their specific selectivity, these ion-selective liquid membranes are sensitive more or less to other ion species as well. Often both, the Na^+ and Ca^{2+}activity change simultaneously during (patho)physiological phenomena. In this situation no exact Na activity recording can be obtained. Measuring the Na^+- and Ca^{2+} activity at the same time makes it possible to correct the Na^+ activity for the Ca^{2+} interference. The wellknown behavior of these ion-selective electrodes conform the Nicolsky equation allowed real time correction using a fast signal processing system. The measuring and correcting system was used to study the Na^+ and Ca^{2+} activity changes in more detail during repetitive waves of spreading depressions (SDs) in the cerebral cortex of the rat. The experiments were performed on anaestetized and artificially ventilated animals. SDs were elicited by application of a small KCl crystal to the cortical surface. The experiments showed that in contrast to the uncorrected Na^+ signal, a decrease in Na^+ concentration did not always appear in the corrected Na^+ signal. In this case a Na^+ decrease was obviously feigned by the Ca^{2+}interference. The pooled data of all experiments showed that a decrease of extracellular free Ca^{2+}concentration down to ca. 0.4 mmol/l seems to be necessary to elicit a Na^+ concentration decrease. In previous investigations we have observed a similar threshold-like behavior for Cl^- shifts during SDs.

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