EXERCISE ELECTROCARDIOGRAPHY AND MONITORING OF MYOCARDIAL INFARCTION WITH A CLINICAL MAPPING SYSTEM

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INTRODUCTION

Multiple thoracic leads supply more electrical information about the cardiac electric field than the standard ECG-leads (Taccardi, 1963; Kornreich, 1973; Abildskov et al., 1977). It has been shown in several studies, that this additional information can be used to increase sensitivity and specificity of the diagnosis of heart diseases, for example myocardial infarction and WPW syndrome (Flowers et al., 1976; Vincent et al., 1977; Yamada et al., 1975; de Ambroggi et al., 1976). Lead systems with up to 256 thoracic electrodes have been used to register a maximal information content. First computerized mapping systems have been developed to manage the immense data streams that are combined with the acquisition of multiple ECG signals (Cottini et al., 1972; Wyatt and Lux, 1974; Tiberghien et al., 1976). Investigations under laboratory environment conditions could be performed with these systems but the most clinical studies, especially with seriously ill patients in the coronary care units were impossible. Prior needed conditions for the widespread application of body surface mapping are small mapping systems for clinical routine use, which are self contained, mobile and easy to operate. Such systems will allow comprehensive studies with large numbers of normal and abnormal maps. This clinical experience is necessary to evaluate the diagnostic importance of the additional electrical information in the maps.

We developed a clinical mapping system and used it for monitoring ischemia and necrosis in patients with acute myocardial infarction and for detecting ischemia during stress tests in patients with suspected coronary heart diseases.
SYSTEM FOR ACQUISITION AND PROCESSING OF MULTIPLE ECGS

Figure 1 shows a diagram representing the realized mapping system with its main functional groups. The system based on a microprocessor has been designed for application of the measurement in the coronary care unit. Much importance has been attached to the construction points that ensure the least possible strain for the patient and no disturbance of the therapeutic interventions. The system must be easy to operate by the physicians as well as by the nurses of the CCU. Therefore we reduced the number of control elements to a minimal necessary set of buttons that is placed on a specially designed extensible panel. Ergonomic design principles have been applied consequently.

Figure 2 shows more details of the realized system. The microprocessor supervises the whole system according to a special control software. The main peripheral units work independently with a direct memory access (DMA). The selected double density floppy disk mass storage device offers large storage capacity and short access times in order to ensure a sufficient throughput of digitized ECG-signals.

All of the thoracic electrodes are connected to a highly flexible plastic sheet. The transparent realization of the sheet allows visual control of the tight contact between electrodes and the skin surface. Because the measurement system was used first for automated precordial ST-segment mapping, we chose a lead system similar to that proposed by Maroko et al. (1972) with 48 thoracic electrodes and standard leads I, II and III. All leads are sampled simultaneously during one heart complex. Up to now we either used only a 32 x 24 cm region of the surface potentials for further analysis or made records by placing the plate on 4 adjacent thoracic positions sequen-