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Contemporary Body Surface Potential Mapping in Electrocardiology and Its Perspectives

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Body surface potential mapping (BSPM) is the only approach for recording, displaying and analyzing the cardiac electrical field (Mirvis 1987). During the past three decades this method has contributed to the development of theoretical electrophysiology of the heart; furthermore, numerous investigators have suggested in their studies that BSPM is useful for diagnosing states not detectable by the standard 12-lead electrocardiogram (Ohta *et al.* 1982) and especially for assessing the size and severity of myocardial lesions (Mirvis 1981, Bell *et al.* 1989). This method has thus been developed to the phase when it can be clinically applied.

The possibility of its routine clinical use on the background of extremely rapid advancement of diagnostic methods in cardiology requires a reevaluation of this method and its perspectives. The advantages of the BSPM, summarized by Mirvis (1987) in four points (correlation of BSPM and epimyocardial events, detection of information not projected to localized torso regions, analysis of spatial as well as temporal features of the cardiac electrical field, evaluation of cardiac equivalent generator properties), are confronted in this situation with some basic questions of a practising cardiologist. Is diagnostic information supplemented by the use of BSPM essential for the improvement of therapeutic procedures? What are the indications for the BSPM examination? Cannot the same or even better information be obtained using other methods as for instance echocardiography ?

Studies undertaken by numerous investigators as well as those presented in this volume suggest the following answers. There are two indication fields in which the BSPM can provide fundamental information from the therapeutic or/and prognostic point of view.

1. Assessment of myocardial lesions and the evaluation of therapy

1.1. the diagnosis of acute non-Q myocardial infarction

1.2. effect of thrombolytic therapy of acute myocardial infarction

1.3. diagnosis of chronic myocardial infarction

1.4. detection of myocardial ischaemia

1.5. diagnosis of the graft rejection

2. Arrhythmias and pacemaking

2.1. localization of accessory atrioventricular bypass pathways in the preexcitation syndromes

2.2. determination of ventricular arrhythmogenic vulnerability

2.3. determination of the stimulation electrode displacement

Nevertheless, it should be mentioned that there are some limitations in this list of indications because satisfactory results can be obtained in many cases by other more universally used methods. Furthermore, some of the indications mentioned above need more explanation:

1.1. In acute myocardial infarctions the BSPM is valuable in cases without possibility of localizing the lesion by 12-lead electrocardiography especially in cases of non-Q wave infarctions.

1.2. The BSPM can accurately evaluate the thrombolysis effect which is normally only determined indirectly from the clinical manifestations (Janota *et al.* 1992).

1.3. In chronic myocardial infarctions the BSPM enables the diagnosis of older non-Q lesions when is of special value in cases with normal myocardial kinetics estimated by echocardiography (Šťovíček *et al.* 1992).

1.4. An important advantage of the BSPM is in the possibility of myocardial ischaemia detection especially in cases with clinical symptomatology but normal echocardiographic and ergometric findings (Kittnar *et al.* 1992). An interesting model is the possibility of restenosis detection after successful parameters transluminal coronary angioplasty (Tilšer *et al.* 1992).

1.5. The BSPM is useful for noninvasive monitoring of the cardiac graft rejection which makes it possible to limit the number of bioptic examinations (Janota *et al.* 1992).

2.1. For surgical or catheter ablation of accessory atrioventricular connections in patients with the Wolff-Parkinson-White syndrome, the identification and localization of these connections is needed. It was proved that the BSPM provides clinically useful information in these cases (Liebman *et al.* 1991). It is not necessary to emphasize that the definite diagnosis must be established by using an invasive method. However, the BSPM can significantly shorten the time necessary for the invasive examination.

2.2. Recently, the BSPM has been used to analyze clinical and experimental conditions prone to ventricular tachyarrhythmias. This application seems to be very promising, because the BSPM has proved to be capable of identifying the focus of the onset of ectopic ventricular activation (Sippens Groenewegen *et al.* 1990). Nevertheless, BSPM is not able, so far, to distinguish arrhythmogenic foci suspicious from being a source of malignant ventricular arrhythmias (such as reentry-type tachyarrhythmias) and thus to detect patients at high risk of sudden death.

2.3. A very prospective indication will clearly be the determination of stimulation electrode displacement. The detailed reference data base of depolarization integral maps of ectopic activation in localized endocardial segments has already been prepared (Sippens Groenewegen *et al.* 1990).

It can therefore be summarized that the BSPM is not only useful in the field of theoretical research of the cardiac electrical field and its physiological and pathophysiological characteristics, but it can also be implemented among noninvasive examination techniques in clinical cardiology. At the very end of this short review, we wish to mention very briefly the developing sphere of invasive mapping techniques which are very valuable in the surgical treatment of arrhythmias (identification of the depth of the onset of ectopic activation, the final localization of the accessory atrioventricular pathway or of the arrhythmogenic focus using the unipolar technique).

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