Parc ECG vs. ECG

The Parc ECG computerized screening analyzer differs from the traditional **ECG** analyzers because it is based on a new approach to **ECG** signal analysis – the **ECG Dispersion Mapping** (**ECG – DM**) method. The **DM** method uses traditional **ECG** signals only as the way of capturing low amplitude oscillations of surface potentials. Therefore, the result of **ECG** signal digital processing is not the traditional **ECG** data, but a viewable **MAP** of dispersion changes of the myocardium, which is formed on a computer screen as a so called ***"Parc ECG Image"***

The unique structural component of the ECG **DM** method is the dispersion analysis of low amplitude ECG signal oscillations during particular PQRST cardio cycle intervals. Low amplitude oscillation dispersion analysis is performed during 30-60 seconds of continuous ECG signal monitoring. Incoming Signals are provided by limb leads only **R** $_{Arm}$ **L** $_{Arm}$ **R** $_{Leg}$ **L** $_{Leg}$.

Amplitude dispersion medians are in range **5 … 30 micro volts**, being significantly lower than ECG wave amplitude medians.

Special analysis of such low amplitude signals (ECG fluctuation) ensures the reliable identification of slight deviations in myocardium polarization and re-polarization processes. This analysis is related to ECG (electrocardiogram) fluctuations with myocardial metabolism.

Monitoring of ECG fluctuations provides indirect conditional assessment of antioxidant systems, electrolyte shifts, ATP (adenosine triphosphate) concentration and other parameters of metabolism as an integral coefficient of metabolic changes.

The change of this coefficient allows determining even a minor disorder of myocardial depolarization and repolarization processes which are not available in other methods of ECG analysis.

In DM (dispersion mapping) method of ECG analysis even minor disorders are effective indicators of pathological changes of myocardium which are not sufficiently expressed in conventional ECG characteristics. As a result of such analysis you will get a map, showing deviations of low-amplitude characteristics with amplitude of such deviations and their presumable location by parts of the heart.

To allow a physician to have a comprehensive and easily assessed view of the myocardium changes, a dispersion map is projected onto the quasi picardium of a 3D digital heart model demonstrating the anterior and posterior heart surface. Expression and supposed localization of changes are identified according to colour changes of the quasi-epicardium, which, if consistently green, is considered normal.

An Ideal Heart Model

The **Parc ECG** compares a patient's dispersion characteristics and the dispersion model of 'an ideal heart'. Such a model corresponds to a heart of a healthy young man over the age of 20. If quasiepicardium performance fully coincides with the ideal heart model, it will be displayed in green on the patient's heart image.

A dispersion map is an indirect indicator of myocardium cell metabolism, therefore 'an ideal heart model' corresponds to the 'perfect' functional state of the myocardium, which is characterized by 'perfect' metabolism and corresponds to the norm. It is obvious that the functional status of a normal (that is, not pathological) myocardium may differ from this standard under some specific longitudinal conditions (during pregnancy or during an athlete's intensive physical training, for example). As a result, a certain borderline area, thoroughly controlled by the **Parc ECG** device, is observed between the 'perfect myocardium' and an abnormal myocardium. Thus, a physician has an opportunity to identify borderline conditions between a norm and an abnormality, that is, there is a possibility to observe myocardium changes at early stages preceding disease development.

A heart image is a 'snapshot' displayed on a computer screen as a result of computing median dispersion characteristics of low amplitude fluctuations during the ECG input. *A heart image* of the ventricular areas reflects the integral picture of dispersion changes, involving both ventricular depolarization and repolarization. Dispersion changes on *a heart image* of the atrium areas correspond to the depolarization phase only. The heart image colour changes are observed under deviations of amplitude dispersion characteristics as well as under changes regarding delay or acceleration of dispersion characteristics in time (phases of dispersion characteristics), which correlate with values of P-Q, Q-T, QRS intervals of ECG input signal. The location of amplitude and phase colour indicators on a heart image is shown in figures: left projection and right projection. Amplitude indicators correspond to the anatomical composition of a heart, and the location of phase indicators is an approximate projection of relevant depolarization fronts onto the 'quasi-epicardium' of a heart image.

Examples of heart images as manifested under various conditions are provided in The Gallery of Portraits Parc ECG

The computer screening analyzer Parc ECG (generator of the image of the heart) allows an instant evaluation of the condition of the heart using ECG-signals from the limbs (4 electrodes).

In addition to instant visual analysis of the image, the system forms an automatic conclusion which includes:

• An integral deviation index of the dispersion characteristics of the low-amplitude ECG variations (index of metabolic changes) from the norm, on a scale of 0 to 100%.

• An integral index of rhythm disturbance on a scale of 0 to 100% (a total deviation of statistical characteristics of rhythm variability).

• A text screening-evaluation.

Parc ECG quickly and accurately ascribes the heart to one of four groups:

Normal
In-between state
Ulterior pathology
Acute pathology

At the same time, visual information is given on the intensity and the most probable localization of the center of the changes. In addition, this information allows controlling the pre-clinical "near-threshold" changes of the state of the heart.

Exposure time (duration of the ECG data intake) – 30 or 60 sec.

The image of the heart can be obtained without undressing the patient, while he or she is sitting up. The time it takes the image to form after the intake of ECG data is 5 to 20 seconds, and the time it takes to inspect the image of the heart from two views (from the right and from the left) does not exceed 60 seconds. The image of the heart is simultaneously formed from two views: from the right side and from the left side. In the normal state, the epicardium is green in the image. If there is a center of pathological changes in the myocardium, the correspondent area of the heart image will change its color from green to red according to the degree of intensity of the pathology. The image of the heart gives overall information on dispersion changes in all the cardiac chambers and can be easily interpreted within 15 to 20 seconds.

Parc ECG presents the unique ability to observe the tendencies of changes in the heart's state by analyzing sequences of images through heart dynamics monitoring option.

Parc ECG includes the standard view and analysis functions of the ECG data from the 6 standard limb deflections I…aVF. The screening-test is recorded (blank conclusion). The unit has functions which allow for managing the patient database and heart image database.

Principle of Analysis

Amplitudes directly measured on ECG, and indirect parameters calculated on the basis of new mathematical model of bio generator of the heart vary within minor ranges in successive PQRST-complexes.

Amplitude and phase characteristics of these variations have a heightened sensitivity to the changes in the processes of myocardial depolarization and repolarization. It is the dispersion of the stated variations that is analyzed in **Parc ECG**. The term dispersion corresponds to the generally accepted in cardiology determination of the difference between the maximum and the minimum of the varying value. Dispersive changes give an integrative estimate of changes in an ample quantity of structural characteristics of the myocardium that depend on blood parameters, electrolyte balance, blood pressure and similar factors. At that dispersive changes are observed both in cases of presence of standard electrocardiographic changes in the ECG, and in cases of their absence, for example in at the early stages of myocardial changes.**Parc ECG** allows direct screen observation of the picture of the quasi-epicardium changes in the computer heart model that reflects with a certain precision both the size and the localization of myocardial changes. The information on abnormality of myocardial depolarization-repolarization processes is presented in the form of quasi-epicardium color changes on 3D image of the heart – *heart portrait*.

Take note of the fundamental methodical peculiarity of the heart portrait in the Parc ECG

Visualization of dispersive characteristics on the heart portrait reflects **integral** (summary) changes in morphological, electrophysiological and other such structural parameters of the myocardium. As a result the map of color changes in the quasi-epicardium of the heart portrait of a specific patient has its own stable individual characteristics peculiarity resulting from personal features of current metabolic changes of patient's myocardium. As a result, the heart portrait is highly specific with respect to individual structural characteristics of the myocardium. However, the same reason causes the fact that portraits of different patients with the same clinical diagnosis may differ substantially in individual characteristics of localization, area and degree of the changes. And vice versa: similar changes in the portraits may in some cases correspond to different pathologies. The indicated peculiarities in no way affect the sensitivity and specificity of the screening assessment, i.e. the reliability of the differentiation of norm/abnormality states.