More Performing Techniques for Identification of Comitial Focus and their Spreading

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ABSTRACT By measuring EEG frequencies by Burch method (analysis of periods), determining the exact times of various EEG frequencies, which the specialist sees by visual inspection, we can obtain more precise and certain information regarding the comitial focus than by FFT, as this technique provides wave indexes for each frequency. Frequency analysis by FFT also finds inexistent frequencies on the route, resulted by decomposing in Fourier sequences, and therefore sometimes the result is false. In order to observe the spreading of ample, super-voltage comitial-type discharges on the cerebral cortex, an original technique was implemented, which determines graphically by maps the time measured in milliseconds in which the comitial wave spreads on the cerebral cortex (time mapping).

KEY WORDS epilepsy, focus, Burch, time mapping

Introduction

In order to identify the spreading area of a comitial wave or peak, and also the time in which the wave spreads from the focus center progressively to great distances on the cortex, an original mapping technique was conceived, which shows by color code the time in which the said wave is generalized on the cortex.

According to the classical method, EEG mapping, after making the frequency analysis by FFT or Burch of a precisely determined EEG route, shows in four simultaneous mappings the places where the classical frequency appears and in case of FFT it also shows the energy of the those frequencies.

It is well known that EEG registered on the scalp area is obtained by summing the ionic currents having their origin in the main synaptic.

The main cells incriminated in producing EEG waves are the pyramidal waves, which, when simultaneously activated – in the same region – will determine the appearance of certain currents (bio-currents) sufficiently important to be detected and measured at the scalp surface.

From the physical point of view, we may consider that a given cortical region will behave as an electric dipole, respectively an equivalent dipole.

During activation, as seen in the chapter referring to EEG neurophysiologic bases, the basal region of the cell behaves as a current source (being the origin of an electric field which determines the circulation of free loads through the extra-cellular, peri-cellular environment), while the distal region acts as a conductor end (opposite pole).

However, there appear within the cell intra-cellular currents of a higher intensity and with the same orientation, which will contribute to the origin of a magnetic field traceable at distance.

This bipolar model represents the base of localization of inter-critical activities, the ones that should be located starting from a standard EEG route.

Cerebral charting systems associated to EEG collection ones allow the reconstruction of the distribution of potentials at a given moment, therefore providing a synthetic view upon the cerebral activity.

For a better localization of inter-critical activity sources it is necessary to put in the equation the observed phenomena.

The direct issue is determining the distribution of the potential on the scalp, staring from a source configuration. However, in practice, the issue is the other way around, as we know the value of the potentials measured for each electrode at a given moment and we have to establish their origin.

For a distribution of the potential obtained at the surface there are infinite arrangements of possible sources, for the same representation at the surface.

The potential distribution in the surface depends on six parameters, which vary linearly with the dipole moment.

The precision and robustness of the localization of a source depend a lot on the registration quality and the calculus logarithm of the said parameters.

Upon carefully analyzing inter-critical activities, we find that they are complex, both in time and in space. The distribution of electric
potential on the scalp is not always stable in time, which requires successive superposing – moment to moment – of the equivalent dipole, respectively repetitions, respectively resumptions, situation known as “moving dipole”.

Most times, while doing this, the appearance will be of an activity generator movable in the cortical space. This supposes either an effective movement of the paroxysmal activity (given by a unique bipolar generator) or, more plausibly, the existence of several generators of the paroxysmal activity, with fixed localization and orientation in case of cortical regions with paroxysmal activity. In time, only the amplitude of the different activities will be variable.

Therefore, considering that there are several active simultaneous sources, the appearance of apparent movement depending on time of the distribution at the surface of the potential (given the fact that only amplitude may vary) is generated by summing in time the different paroxysmal activities.

For a unique potential source there are six parameters to determine: if we consider two sources, then there will be 12 parameters to determine. As the number of electrodes is however limited, then it is more likely to have only two close, neighbor sources that can be determined at a given moment.

The calculus of inter-critical activity sources is made on a determined time interval. This is also the principle of spatiotemporal closeness introduced by Scherg in 1985, in the study of auditive evoked potential.

This way we can determine the localization and orientation of each (fixed) source, as well as the intensity of its dipolar moment, for each temporal sequence. In order to do so we use the product between the number of measurements (equal to the number of electrodes) and the number of time samples taken into consideration.

Argumentation

The mapping shows precisely the places of appearance and spreading of the four basic frequencies.

FFT actually determines the energy of the analyzed frequencies, and Burch the wave index of each frequency in each point on the scalp by color code.

Therefore, by excellence mapping provides spatial information with the presence of various frequencies, but it does not show their evolution in time, unlike EEG routes, which determine by excellence in time the routes of various frequencies mixed on the route, but it only provides few information on the spatial localization of a frequency or pathological graphoelements.

By mapping we can only obtain few, vague information on the evolution in time, and only by performing repeated mappings each second or for longer periods of 10, 60, 120, 360 seconds.

In the technique proposed by us there is a combination between mapping, which determines perfectly the spatial spreading but not the evolution in time and the routes, which determine perfectly the evolution in time but very little, incompletely and uncertainly the spatial spreading.

Discussions and conclusions

It is a time mapping showing on the spreading area of a graphoelement usually pathological on the scalp (by classical mapping), the time in which this graphoelement spreads and covers the entire scalp area.

So it is also a time mapping, showing the spreading on the scalp area each millisecond.

The technique is very important especially in case of epilepsy with very ample discharges as for example a complex wave peak 3 c/s pathognomonic for minor epilepsy usually in young people.

References


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