Algorithms to reanimate the heart

October 2 2007

When an adult suffers a cardiorespiratory arrest the rapid application of an electrical discharge with a defibrillator can avoid sudden death in many cases. Nevertheless, defibrillation also has its impediment or enemy: time. For every minute that passes from the moment of the attack, the possibilities of survival drop by 10%. This is why, in order to avoid avoidable deaths, more and more easy-to-handle, automatic defibrillators are being designed, sold and installed.

Automatic defibrillators or AEDs (Automatic External Defibrillators) have been around now for some ten years. The main elements of these devices are based on algorithms that help undertake a study and diagnosis of the electrical signals from the heart. The defibrillator reads the patient's heartbeat and carries out a continuous report of the state of the organ. Once this analysis is completed, it communicates whether or not an electric discharge is necessary, i.e. it will tell if, on applying electro-treatment, the heart will recover its usual pace or not.

In fact, this last was the starting point for researchers at the Department of Electronics and Telecommunications at the Higher Technical Engineering School in Bilbao (the University of the Basque Country - UPV-EHU); i.e. drawing up algorithms for defibrillators designed for adults. In this research, however, they are investigating algorithms that are reliably applicable for children and overcoming that obstacle of time.

AEDs for children

The use of automatic defibrillators for adults is quite widespread. The heartbeat of a child under 8, however, is quite different from that of an adult. What happens when a child suffers a cardiorespiratory arrest" The use of such devices with children has been authorised for some two years now, and the UPV-EHU researchers are focusing on this application.

To this end, it is essential to have a pediatric database, not an easy task given that few children suffer from a cardiorespiratory arrest. To draw up this database, researchers needed data on hundreds of normal heartbeats and life-threatening ones and for this they had the help of hospitals and doctors registering the heartbeats of children.

Once the database was drawn up, reliable algorithms suitable for children were designed, i.e. digitalised signals or the electrocardiograms registered by the computers were processed and a number of parameters analysed such as, for example, the frequency of the electrical signals, their morphology, their spectrum and the most significant time/frequency parameters. Depending on all these parameters, the researchers carry out a classification of the signals, thus enabling a decision to be made if there is a life-threatening heart rate.

The obstacle of time

As mentioned before, time makes the difference between life and death in many of these cases. Often, a massage is sufficient to reanimate the heart and recover a normal heartbeat. Sometimes, however, a massage is insufficient and this is when time may be lost. In fact, when a massage is given, an electrocardiogram signal cannot be analysed nor can an electric discharge be applied. So,

until a study of the electric signals is carried out and a check made to see if an electro-treatment will save a patient from almost certain death, seconds and minutes will have passed; seconds and minutes that make a difference between life and death The UPV-EHU engineers have looked at the option of unifying the automatic defibrillator analysis and the massage. The problem is that the signal received by the AED from the skin is distorted by the movement due to the massage, and so the result of the diagnosis is not very reliable. The UPV-EHU researchers have undertaken research on specific methods which avoid these distorsions and obtain a more reliable diagnosis.

They apply specific methods in order to distinguish the clean signal without distorsions. For example, they obtain samples of certain electrocardiograms or signals and apply specific algorithms to them. Aided by these algorithms, the aim is to differentiate the noise or distorsion of the signal from the undistorted one. When this is achieved, there is no obstacle to applying defibrillation and the massage at the same time.

The methods applied to date, in various areas, are providing fascinating results. The goal of the UPV-EHU researchers is to publish these in the near future..

Source: Elhuyar Fundazioa

provided for information purposes only.