Interaction of Electromagnetic Field from Cellular Base Station Antennas on Cardiac Pacemakers

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Background. The aim of this study was to investigate the possible interaction of pulsed elec-tromagnetic (EM) fields affecting the cardiac pacemakers. Pulse modulated fields typical for cellular GSM system have been considered for this study. In the literature, only interaction of electromagnetic field emitted from cellular handsets to pacemakers has been described. It has been proved that this kind of radiation is rather "safe" for pacing process. Only in same lit-erature a minimum safety distance of few centimeters from handset to the patient body was suggested. Nevertheless, no one assesses the threshold of electric field strength when pace-makers change the shape of emitted pulses or even when they inhibit of the pacing process. This is because measurements of electric field in the vicinity of handset is difficult and there is a need to assess all components of electric field vector. However, there is no information about possible interaction of radiation emitted from base station antennas on pacemaker functions. This information whether electromagnetic field from base stations can be danger for pace-makers is important for people dwelling in the vicinity of these antennas.

Our intention was to recognize whether the radiation from GSM base stations can affect pacemaker functions. All investigations were carried out in the anechoic chamber where the level of exposure and type of polarization can be precisely determined.

Methods. The base station panel antenna (Kathrein antenna type 738573) has been chosen as a source of EM field. The antenna has been fed from external generator and amplifier allowing to expose of pacemakers to EM field up to $300\,\mathrm{W/m^2}$. Microwaves (940 MHz) have been modulated with $577\,\mu$sec pulses and 867 Hz repetition frequency - every second time slot was fulfilled. In this case EM field is a pulse modulation function comparable to field emitted from base station antennas when base station is linked with 4 persons. Each pacemaker was situated in anechoic chamber with 3 typical orientation (polarization) regarding to the electric vector of the incident field. To find the susceptibility threshold to electromagnetic interference all ori-entations of pacemakers were sought to find the critical polarization of electric field.

Results. Pacemakers signals have been analyzed in function of power density of incident mi-crowaves and the following changes in pacemaker signals have been studied:

-changes of the amplitude and shape of pulses,
-changes of the repetition frequency of the pulses
-falling out of one or few pulses,
-the inhibition of the pacing process.

Values of electric field strength when the above changes occurred were found. Nevertheless, it should be underlined that the above changes occurred in strong electromagnetic field and they are dependent of the type of pacemakers and polarization of the electric field.