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Numerical modelling of electromagnetic influence of the use of surgical diathermy on the treatment team medical personnel

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Extended Abstract
The medical use of surgical diathermy units (SDU) causes emission of deeply modulated electromagnetic field (EMF) with the dominant components at 0.3-3 MHz frequency and occupational exposure of the treatment team determined, among others, by the patient's health, equipment settings and spatial organization of the treatment room, and organization of the work of the treatment team. Following the provisions of labour law (European Directive 2013/35/EU and legislation transposing them into legal systems in European Union countries), this exposure needs to be evaluated by the measurements of electric and magnetic field in the proximity to the SDU generator and cables supplying surgical electrodes. Because of the near field exposure conditions the workers' exposure evaluation needs also the analyses of parameters characterizing metrics of EMF impact on humans - the SAR coefficient and the strength of electric field induced in the body E-ind (because of the frequency of considered EMF) – usually with respect to the results of relevant numerical modelling.

This ongoing studies aimed at numerical modelling of treatment team EMF exposure and evaluation of electromagnetic hazards in realistic conditions of SDU use. This kind of numerical modelling cover significant problem of the complex spatial and electrical configuration of patient's and workers' bodies, and accessories used near SDU, together with the use of relevant dielectric properties of modelled objects and boundary conditions of the model of large space of treatment room, as well as experimental validation of analysed numerical models.

The pilot investigations were performed with the use of advanced computer simulations with models of exposure scenarios of various treatment teams (with single block, homogeneous models of the human body – patient and 1-10 people in the treatment team). The results showed significant influence of the dielectric properties of used models and electrical insulation of models used in particular geometrical configuration of the analysed EMF exposure scenarios. With insufficient electrical insulation, the SDU operator and others present in proximity to the patient, the effects of EMF exposure are up to 10 times stronger on workers and have a different spatial distribution than in the models insulated from the ground. The analysis of spatial distribution of unperturbed EMF near the SDU cables and near the human present in the proximity (measured in the laboratory condition or calculated in the numerical models) showed that near the floor (0-0.5 m height) and near the head location (1.5-2 m height) the electric field distribution is significantly influenced by the mentioned parameters of the numerical modelling and by measurements in the real surgery room it is possible to validate if the numerical model has relevant parameters. It was also found that others that the SDU operator may be exposed comparable to the operator (when staying next to the operator or on the opposite side of the patient).

Because of technical difficulties of discussed computer modelling required in evaluation of the EMF exposure of the surgical treatment team, till now this problem in occupational electromagnetic safety is insufficiently analysed to fully meet the requirements of labour law. More detailed simulation studies of the EMF exposure of surgical treatment teams are ongoing.

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