A BIOPHYSICAL APPROACH TO THE PROBLEM OF SAFETY OF DIAGNOSTIC ULTRASOUND

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Every application of ultrasonic technique in medical diagnostics involves the deposition of energy in tissue which can lead to some biological effects. It is necessary to ascertain whether these effects constitute a risk to the patient.

The energy flux of an ultrasonic beam is characterized by the intensity. For most diagnostic devices ultrasound is not radiated continuously but in a series of short pulses. From the point of view of spatial and temporal energy distribution, the ultrasonic intensity can be expressed in average as well as in peak values. The importance of individual types of intensity quotation for assessment of biological effectiveness of ultrasound is very different. The values directly related to possible bioeffects are the spatial-peak temporal-average intensity (SPTA) and the spatial-peak temporal-peak intensity (SPTP). At given elastic properties of medium examined the SPTA intensity determines the local heat production and the SPTP intensity appoints the peak values of acoustic pressure.

The dependence of biological effects on physical characteristics of the ultrasonic field is often nonlinear. On the one hand most of the mechanical factors of ultrasound are nonlinearly related to the intensity. On the other hand metabolic and regulatory processes of the given biological subject cause its nonlinear response to ultrasonic action. The nonlinearity increases with the higher level of biological organization. The biophysical approach to the problem of biological safety of diagnostic ultrasound consists in detailed assessment of relations between the acting ultrasonic impuls and the registered alteration of the biological system.