DETECTABILITY OF CALCIFICATIONS IN BREASTS BY MEANS OF THE ULTRASONIC ECHO METHOD

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Reactions showed by breast tissue cells in the early stage of the cancer cause microcalcifications, which in the later stage are developing up to milimeter size. Although microcalcifications were reported not to be detectable when examinating women breasts with ultrasound, it is interesting to answer the question what is the minimum size of potentially detectable calcifications.

The author analyzed this problem assuming two theoretical models of the calcification in the soft tissue: an elastic and a rigid spheres. Elastic parameters were assumed as of the skull bone. The far field form function $f_\infty(ka)$ was computed for various values of the Poissin ratio. It was shown that for small products $ka < 1.5$ /k- wave number, a- radius of the sphere/ the Poisson ratio does not influence significantly the result of the computations. For $ka > 5$ the value $f_\infty(ka) \cong 1$ can be accepted, as the calcification shape is not regular and the calcification surface is not smooth. In this case the internal resonances of the sphere can be neglected.

Assuming the electric dynamic range of the ultrasonograph to be 148 dB, transducing losses 15 dB, tissue attenuation 1.1 dB/MHz.cm and a weakly focusing transducer, the size of the minimum calcification which give signal equal to the electronic noise could be determined.

However due to breast tissue inhomogenities one obtains a high level of small disturbing echoes, which form the tissue noise. This level was measured in 4 woman breasts by means of a typical ultrasonograph with the frequency of 3 MHz. One obtained the tissue noise level 31 dB higher than the electronic noise level.

Extrapolating this result one could show that calcifications with the diameters of o.1, o.3 and 2 mm, located in the breast depths of 2, 4 and 6 cm, respectively, give echo levels 20 dB higher than the tissue noise level and thus potentially can be detected. The dependence of the detectable calcification size on the depth is the result of the tissue attenuation mainly.