TARGETED LESIONS OF SOFT ANIMAL TISSUES INDUCED BY TANDEM SHOCK WAVES*

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The success of the extracorporeal shock wave lithotripsy in non-invasive treating patients with stone deceases (mostly kidney stones) stimulated research on applications of focused shock waves in other branches of medicine such as for noninvasive treatment of cancer tissues and a targeted drug delivery. However, there is a fundamental difference in treatment of kidney stones and in a possible treatment of cancer tissues. The stone represents relatively strong acoustical non-homogeneity in comparison with the surrounding liquid and soft tissues. Moreover, there is no acoustical non-homogeneity between cancer and healthy tissues. Therefore, great attention is paid to the investigation of the role of cavitations produced by focused shock waves. Collapsing cavitations can create secondary, very short wavelength shock waves, which can interact with cell scale structures. Recently, we have developed a generator of two successive (tandem) shock waves focused to a common focal point. The first shock creates at the focal region an acoustical non-homogeneity and cavitations, and the second shock dissipate on it. We have found that at time interval of 10-15 μs between the shocks the second, originally pressure wave, reaches the focus as a rarefaction wave. Amplitude of the pressure wave is up to 100 MPa, while the amplitude of the rarefaction wave falls down to -25 MPa, producing thus at the focus a large number of cavitations, which are considered to play the main role in cell membranes damage.

The purpose of this work was to demonstrate possibility to localize *in vivo* the action of the focused tandem shock waves at predictable region in acoustically homogenous medium such as soft tissues are. Rabbit's thigh muscles were exposed *in vivo* to the focused tandem shocks with a fixed time delay between the waves of 10 μs. Trials with exposure to 1600 shocks have been done. The MR images of rabbit thighs after exposure to the tandem shock waves clearly demonstrated targeted lesions deep inside the soft tissue. These results are important for further development of this technique focused on potential application of tandem shock waves for cancer treatment (e.g., enhancement of chemotherapy efficiency induced by tandem shock waves by increasing permeability of tumor cells membranes to cytostatic drugs).

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