Cell sonoporation: from basics to targeted drug delivery

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Cell sonoporation is a novel therapeutic technique used for noninvasive drug and gene transfer to cells and tissues. Sonoporation can be induced during cell exposure to ultrasound (US) in the presence of an US contrast agent microbubbles (MB). The mechanism of cell sonoporation is not known in detail, however crucial role plays US-induced MB cavitation. Cavitating MB induce microstreaming and microjets that creates shear forces acting on the cell membranes. MB cavitation also results in the generation of reactive oxygen species and the formation of free radicals, therefore producing sonochemical effects on membranes, as well as in an increase of the local temperature that enhances the fluidity of the membranes. It has been shown that sonoporation can be used as an effective method for intracellular transfer of anticancer drugs, like bleomycin, camptomycin, mitoxantrone, and doxorubicin, used either for cytotoxicity increase *in vitro* or antitumor therapy *in vivo*. In addition, MB can be loaded with various agents and therefore can be exploited as drug carriers. The potential use of MB and sonoporation for clinical application will be discussed.