**Modeling Microbubble Oscillation and Vessel Wall Deformation in Ultrasound-Induced Drug Delivery**

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**Abstract**

Microbubbles are widely used as drug carriers in ultrasound-induced drug delivery, as they can be manipulated to create transient pores in cell membranes, allowing for more targeted and efficient delivery of drugs. However, the potential risks associated with this technique, such as hemorrhage and immunogenicity, make it necessary to control ultrasound parameters to minimize these risks. This study aims to investigate the correlation between vessel deformation and ultrasound parameters, highlighting the importance of vessel deformation and shear stress in ultrasound-induced drug delivery. To study microbubble oscillation in a capillary filled with viscous fluid, it is essential to consider the interactions in the gas-liquid-solid system. Therefore, fluid pressure is applied to the bubble surface, the no-slip condition is considered, and the fluid is coupled back to the vessel wall deformation, which impacts fluid pressure, velocity, and bubble oscillation. An elastic model is employed to simulate the vessel wall, treating it as a homogeneous, isotropic, linear elastic material. In this study, the microbubble-fluid-vessel model was resolved using COMSOL Multiphysics 5.6.0. The results show that the radial variations of the bubble and vessel wall occur almost in phase, but the peak values of oscillation between the microbubble and vessel differ considerably. The influence of acoustic pressure and acoustic frequency on the microbubble's radial oscillation and vessel wall deformation was also examined. The data suggests that the effect of acoustic field parameters is nonlinear and should be carefully considered for developing more accurate numerical models and optimizing ultrasound parameters for more efficient and safe drug delivery using microbubbles.