Journal of Acoustical Engineering Society of Iran, Vol. 11, No. 1, 2023

(Research Article)
Evaluating optimal ultrasound to deform the blood clot in a vessel

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Received: 2023/07/31, Accepted: 2023/09/16

Abstract

The goal of the present paper is to gain an optimal intensity of ultrasound to achieve required pressure field generated by the collapsing bubble in blood to break down blood clots. Due to the direct relationship between the pressure caused by the collapse of bubbles caused by ultrasound and the intensity of the waves, determining the optimal intensity of the ultrasound is of great importance. For this purpose, the collapse pressure within the bubble has been calculated using Rayleigh–Plesset (RP) equation. Moreover, a coupling simulation of the flow and clot structure is performed using the full Navier-Stokes equations, which governs the blood domain, and linearized discrete equations for the clot medium to calculate the desired bubble collapsing pressure necessary to break down the clots, which has immense importance in medical applications. Using the obtained parameters for the minimum pressure pulse required to deform the clot and the ultrasound intensity required to create the minimum pressure, simulations have been performed and it has been shown that the clot's shape changes when confronted with the the applied pressure which confirms the effectiveness of the proposed method.

Keywords: Ultrasound, Bubble dynamic, Collapsing pressure, 3D CFD, Blood clot deformation.

pp. 73-83 (In Persian)

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