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# Simulating Low-Frequency Sonic Pulsations to Achieve Thrombolysis

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## ABSTRACT

Cardiovascular thrombosis may result in critical ischemia to a range of anatomical regions, constituting a leading cause of death in the United States. Current invasive treatments for such arterial blockages often yield blood clot recurrence, resulting in repeated hospitalization of patients. This research aims to show how internally introduced pressure oscillations may be used to initiate thrombolysis. We present a novel computational model for determining the resonant frequency and corresponding deformation of an idealized thrombus. Sinusoidal pressure differences across the thrombus induce axial displacements of frequency dependent amplitude. The maximum peak displacement occurs at a resonant frequency of 73 Hz for 2 mm radius clot and 140 Hz for a smaller, scaled 1.3 mm radius clot. For a larger, scaled 2.5 mm radius clot, a resonant frequency of 67 Hz induced maximum displacement. Strains exceeding 160%, a value sufficient for clot lysis, occurred at only ±1.0 mmHg axial pressure gradients at 73 Hz (2 mm radius). This simple test case constitutes preliminary feasibility for the concept of vibration induced thrombolysis. Finally, we are left with a convincing indication that internal ultrasonic pulsation may be employed for degrading proximal and distal clot fragments.

## KEYWORDS

Thrombolysis, resonance, blood clot, pressure pulsation, modelling