



Modeling and simulation of biomimetic microvalves for fast injection

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ABSTRACT

This paper reports on a modelling and simulation study of a microvalve which mimics anatomic venous valves with a cone-shaped tube, allowing fluid flow in one direction while restricting flow in the opposite direction. This has potential applications in biomedicine and micro-electro-mechanical systems. A numerical study was performed by the finite element model using COMSOL multiphysics software. A fluid structure interaction method was integrated with an Arbitrary Lagrangian-Eulerian (ALE) approach. The impact of various mathematical boundaries, such as, the length of the anchor, the diameter at the base and the angle of the cone were investigated. An efficiency parameter Eff was employed to assess microvalve performance. It was found that a cone angle was the most important boundary influencing microvalve performance. For the best design, the forward flow rate was more than doubled compared to the reverse leakage rate for a given pressure.

Keywords: Fluid structure interaction; Arbitrary Lagrangian-Eulerian; COMSOL multiphysics; Flow rate

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