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Hemodynamics and transient flow reversal in real deployed stents

RALPH METCALFE, MIRCEA IONESCU, University of Houston — Restenosis rates caused by neointimal hyperplasia are relatively high ($\sim 30\%$) after stent implantation in stenosed arteries. The flow around stent struts under steady and unsteady conditions using computational hemodynamics (CHD) was studied to identify contributing factors to the formation of low and oscillating wall shear stress regions that have been shown to promote endothelial dysfunction and atherosclerotic plaque formation in arteries. Datasets of the Neuroform, BxVelocity, and Taxus stents deployed in straight polymer tubes were obtained from high resolution micro computed tomography. Finite volume CHD simulations of steady and unsteady flow with and without flow reversal were performed. Stagnation zones were noticed adjacent to the strut junctions as the flow enters and exits the stent cells. The stagnation zones were larger in the case of the stents with larger strut diameter (BxVelocity, Taxus), wider strut junctions and larger angles between the struts. Unsteady flow simulations showed enhanced flow reversal with thicker struts and large regions of recirculation flow developing inside the stent at Reynolds numbers higher than 200. It was shown that alterations in blood flow due to real stent deployment (strut prolapse, junction misalignment) cannot be captured with computer generated stent models, that stent specific geometry, and time dependent flow effects can locally alter the wall shear stress and stagnation zones.

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