Comparison of Flow Patterns of Different Stents Within a Simulated Disease Model

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Abstract

With increasing awareness of coronary diseases, much research has been put into the effectiveness and benefits a coronary stent can bring to a patient with a diseased coronary artery. However, current research does not fully address the effects of restenosis on the vessel, given that it happens quite often. Furthermore, a known percentage of patients ultimately choose stents that are not suitable for their disease condition due to insufficient information such as hemodynamic pattern after stent implantation. In this project, a computational fluid dynamics (CFD) study is conducted to investigate the effect of different commercial stents in a coronary artery. Three stents were fitted into two geometry types, one a straight tube vessel and another a curved entrance vessel. Two test cardiac cycles were run within the geometry each round, with Wall Shear Stress (WSS), velocity streamlines and low WSS was demonstrated on various location of blood vessel on different time point in one cycle to identify factors that would affect hemodynamic pattern after various stent design implantation. Our results showed that low WSS (<0.5Pa) was found at proximal end of stent which can potentially trigger deposition. Open cell stent appears to have best hemodynamic performance in the presented study given it has smaller region exposed to low WSS. From this study, we can conclude that vessel geometry and stent structure will affect low WSS areas distribution, which would lead to plaque formation in those areas in the future. Patient vessel morphology and intended stent information must be present before a conclusive hypothesis of PCI success can be made.

Figures used in the abstract

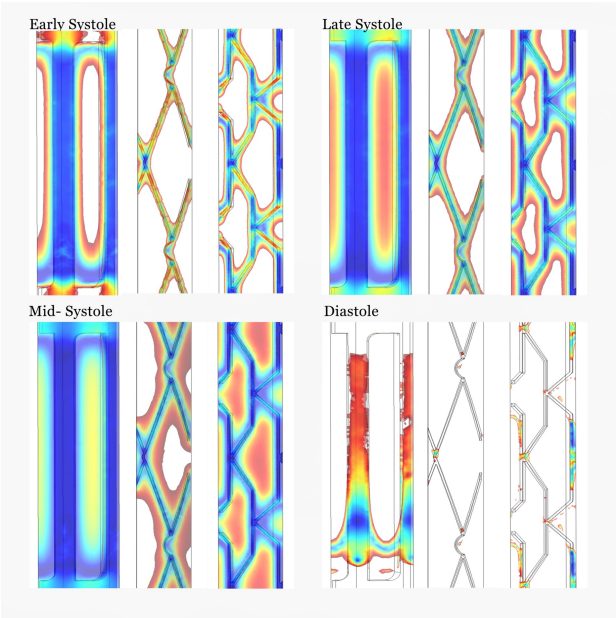

Figure 1: This image shows the Wall Shear Stress distribution along a section of stent within a simulated vessel. The main idea from this study is to identify plaque depository areas from a section of stent and vessel through fluid dynamics simulation.