A CFD study of steady flow of a Newtonian and non-Newtonian fluid through a mildly curved tube with stent-like wall protrusions patterns.

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Early stent designs caused vessel straightening post-implantation and motivated the exploration of flow in the stent vicinity using straight pipe models with stent-like protrusion patterns. Recent advancements in stent design allow the device to better conform to the native vessel curvature. The present study focuses on the investigation of steady flow through mildly curved pipes with protrusion patterns that emulate current stent designs using computational fluid dynamics (CFD). The modeled geometries include various protrusion frequencies, heights, and widths with flow behavior within the range of physiologically relevant Dean numbers. The results are compared to smooth wall curved pipe models as well as straight pipe protrusion studies. Differences in flow behavior pre/post stent implantation will be discussed. Particular attention will be paid to flow characteristics, such as wall shear stress (WSS) magnitude and WSS gradients, indicative of potential stent failure. Newtonian and non-Newtonian fluid models will be utilized to discuss their impact on flow patterns. The study findings can be used to optimize stent design to mitigate flow conditions associated with stent failure.