Prognosis of Geometric Stenosis in Atherosclerosis

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The aim of this project is to investigate how differing geometric vessel shapes affect the fractional flow reserve value, given constant percent stenosis. The chosen geometry shapes were a control, circle, triangle, and heart. To model the stenotic vessels, sections of rubber tubing were filled with clay, modeled specifically so that each vessel hole had the same area, but different wetted perimeter. After being sealed, the stenotic vessels were connected to a longer piece of tubing, with one end attached to a pump, which is meant to imitate the heart submerged in a bucket of skim milk at 4°C, to match the viscosity of blood, and the other end has an electronic pressure gauge to measure the pressure within the tube. Through testing, the average pressure value derived for the control, circle, triangle, and heart shaped vessel: 12.3 kPa, 15.8 kPa, 16.8 kPa, and 17.8 kPa respectively. After, these values were used to find the fractional flow reserve for each stenotic artery: circle vessel 0.77, triangular vessel 0.73, heart shape vessel 0.69. Since a lower fractional flow reserve value means more severe, despite constant percent stenosis, the heart shaped vessel creates the most severe atherosclerosis, followed by the triangle and circle vessel. It can be concluded that geometry of the stenotic vessel is an important variable that affects the flow of blood, and in turn affects the severity of atherosclerosis. For future research, geometry of the stenotic vessel can be investigated more in detail to advance diagnosis of cardiovascular disease.

Awards Won: