Formula 1

In this study, numerical simulations of blood flow in normal human carotid bifurcations were carried out to evaluate the wall shear characteristics in the region where the CSN is noted to insert into the wall adventitia. The blood is assumed to be incompressible Newtonian fluid. The Virtual Flow Simulator (VFS) code [6] is employed to simulate the blood flow in the carotid bifurcation. In VFS the blood flow is governed by the following incompressible Navier-Stokes equation and continuity equation:

$$\rho\left(\frac{\partial \boldsymbol{v}}{\partial t} + \boldsymbol{v} \bullet \nabla \boldsymbol{v}\right) = -\nabla p + \mu \nabla^2 \boldsymbol{v} \ + \ , \quad \nabla \bullet \boldsymbol{v} = 0,\#(1)$$

where ρ the fluid density, $\boldsymbol{v}$ is the blood velocity, t is the time, p is the pressure, μ is the dynamic viscosity. In the present work, $\mu = 0.0037\ Ns/m^2$, and $\rho = 1050\ Kg/m^3$. The geometry of the carotid is represented using the immersed boundary (IB) method [7]. The wall of the carotid is assumed to be rigid.

[…]

Formula 2

The wall shear stress (WSS) results were calculated and rendered using a WSS map (Figure B.) and the oscillatory shear index (OSI) was then derived using the following equation:

$$\mathrm{OSI} = \frac{1}{2}\left(1 - \frac{\left|\int_0^T \vec{\tau}_{\mathrm{w}}\, \mathrm{d}t\right|}{\int_0^T \left|\vec{\tau}_{\mathrm{w}}\right| \mathrm{d}t}\right)$$

where $\vec{\boldsymbol{\tau}}_{\boldsymbol{w}}$ represents the WSS vector and T represents the period of the cardiac cycle (Figure C.). It is a metric that depicts how aligned with the vector of greatest WSS is with the primary flow. An OSI of 0 suggests no change of direction between the WSS and the primary flow. An OSI of 0.5 suggests a complete change of direction. It is a means of quantifying the magnitude of change of direction of WSS.