

SUMMER RESEARCH PROGRAM 2011/2012

Title : Fluid structure interaction, application to plaque bursting in arteries

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PROBLEM BACKGROUND

The process of formation and rupture of plaques in arterial vessels leads to the major health problems of cardiac arrest and stroke (figure 1-a). The general purpose of the ongoing ARC project "Measurement and prediction of vulnerable plaque formation and rupture" is to understand the mechanisms responsible for plaque growth and rupture and to develop tools to predict them. One approach consists in using numerical methods to study the forces induced by the blood flow on the fibrous cap. This study will determine both the most vulnerable zones and the dependence of the plaque behaviour with the characteristic parameters of the problem.

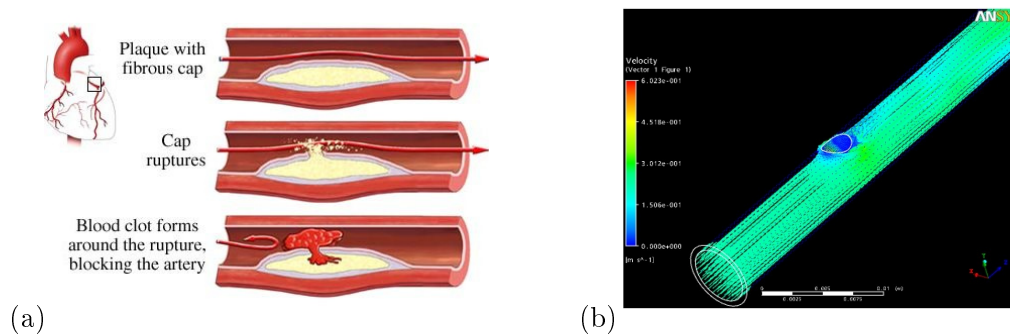


FIGURE 1 – (a) Schematic of plaque rupture and clot formation (see www.pleacemotivate.com). (b) Velocity plots for 45% axis-asymmetric stenosed artery from Chen et al, ANZIAM J. (2010).

THE PROJECT

This project will focus on understanding the impact of the physical features of the problem (viscosity, oscillating blood flow frequency, nature of the materials, asymmetry of the geometry...) on the coupled motion of the blood and arteries in idealized geometries (figure 1-b). The multiphysics software ANSYS will be used to solve the coupled Navier-Stokes, Newtonian system. The efficiency of the numerical methods will be tested comparing the obtained data with existing results (C. X. Chen, Y. Ding J. A. Gear, ANZIAM J. 51, pp586, 2010) and eventually with other software available in Monash. The data acquired will be used to model the complex phenomena which develop in realistic situations.

THE STUDENTS

This project is well-suited for students who would like to experience research in diversified fields and to develop engineering skills (work with the widely used code ANSYS). The student will have some interest in programming and multidisciplinary problems.