PHYSICAL MATHEMATICS SEMINAR

Too much of a good thing?

MODELING OF THE POTENTIAL RISK OF CORONARY THROMBOSIS

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ABSTRACT:

Coronary artery disease is the single most common cause of death in the developed world, and most of these deaths are due to myocardial infarction (MI) that has an incidence of 7 million cases every year worldwide. The most frequent mechanism of an MI is the reduction of the myocardial oxygen supply to the cardiac muscle due to rupture or erosion of a vulnerable coronary atherosclerotic plaque, which results in endothelial injury, thrombosis, and occlusion of the coronary artery.

In the majority of cases, plaque ruptures take place in the absence of symptoms and they have also been identified in patients with stable angina or asymptomatic ischemia. It is the superimposed thrombus formation that leads to coronary artery occlusion and clinical expression of myocardial infarction, but it is unclear why thrombosis only occasionally occurs after coronary plaque disruption. There is evidence that besides genetic predisposition and modifiable cardiovascular risk factors, the presence of local factors such as hemodynamic conditions and coronary geometry play a major role in the progression, destabilization, rupture, and thrombosis of atherosclerotic coronary plaques. Complex and unsteady intracoronary flows fields may create zones of vortices and flow recirculation and promote thrombus formation. These concepts, however, have not been studied in vivo, and the Navier-Stokes equations have not been solved for application in the pulsatile, non-Newtonian coronary flow.

We aim to apply computer-based techniques of simulation of coronary flow as well as a phenomenological model for thrombus formation in patient-specific terms, in order to study the flow field and its implication to plaque rupture and thrombosis in the setting of coronary artery disease. We believe that a computational tool designed by an interdisciplinary team of scientists can facilitate the identification of coronary sites of potential MI. Such a tool should have enormous impact on human health both for risk stratification and therapy purposes.

TUESDAY, MARCH 10, 2015
2:30 PM
Building E18, Room 466A

Reception following in Building E17, Room 401A
(Math Dept. Common Room)

http://math.mit.edu/pms/

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