

## PHYSICAL FOUNDATIONS FOR THE SELECTION OF DIAGNOSTIC PARAMETERS OF ATHEROSCLEROTIC PLAQUE GROWTH

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**Summary:** The paper presents derivation of a diagnostic parameter that may become the basis for estimation of the level of blocking the carotid artery lumen with plaques. The diagnostic parameter is defined by relative increase of plaques on the radius. The mathematical analysis showed that with a 60% increment in the atherosclerotic lesions, the diagnostic parameter changes rapidly – above that value total blockage of the arterial lumen might occur.

The deposition of the plaques may take various forms. It depends on the shape of the plaques deposited on the arterial walls. 4 cases have been analyzed: circular, laminar, lenticular and eccentric growth of plaques. It appeared that the determined parameter is independent of the shape or geometry of the depositing plaques. Such independence has been obtained through reducing the variable radius of artery with plaques to hydraulic radius.

The results obtained through analysis were compared to numerical studies. A straight-line channel of 8 mm diameter was modeled with plaques depositing in it and reducing the diameter to a range between 7 mm (12.5%) to 1 mm (87.5%). The purpose of the simulations was to find out the impact of the deposit thickness on significant reduction of the flow through the channel and whether the value determined following the numerical studies will converge with that of the analytical studies. The growths were modeled as a turbulence occurring on one side of the channel or as a channel with bilateral turbulence. The analysis of the simulation results has shown that with a ca. 60% stenosis, the energy of turbulence grew rapidly and the whirlpools that occurred were sufficiently large to cause destabilization of the flow. Above 75% of blocking of the arterial lumen, the whirlpools occupied most of the area after the turbulence, which could significantly reduce further arterial flow.

The studies carried out represent analytical evidence that if a patient's deposits on the arterial wall exceed 60% of the arterial wall lumen, such patient will be explicitly qualified for operation of the plaque removal, because any further growth of the plaques is very rapid and may cause blood flow blockage