

Report for Graduate Student Exchange Program
based on the Academic Exchange Agreement

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Research Period
2011.10.01 - 2012.09.30

Research Theme
Simulation of Hemodynamics in Artery with Aneurysm and Stenosis

Research Results etc.

Idealized geometries of straight blood vessel with aneurysm and stenosis happened simultaneously have been simulated. As the disease develops, the percent stenosis also increases. Two separate studies were performed in this research, stenotic arteries with a mild stenosis of 30% or a moderate stenosis of 50%, to obtain and analyze detailed flow patterns. Considering the reattachment of blood flow, the distance between the stenosis and the aneurysm should range widely to show the relationship between the recirculation and the different distances. Models with the distance of 1mm, 10mm and 30mm between stenosis and aneurysm were established respectively.

With the increase of percent stenosis, the maximum velocity of the flow as well as the maximum WSS increase and they are distributed in the stenosis area. These maximum values keep in approximate consistent numbers with the same percent stenosis. As to the low velocities, they appear in the aneurysm and the recirculation area locates at the distal zone of stenosis. In several areas close to the wall after the stenosis, the velocity is so small that made the flow little short of static. The distribution of low WSS is influenced by that of velocity, while the low WSS affected by the recirculation appears at the radial plane of the reattachment point.

Simulation results show that as the degree of stenosis increases, the reattachment point moves to the downstream of the parent artery. Differences of reattachment length and position of aneurysm have greatly affected the flow pattern inside the aneurysm.

For the 30% stenosis cases, the reattachment length is about 1.6mm on the aneurysm side, which means under the case of 1mm distance, the reattachment point appears at the aneurysm neck, causing the direction of the velocity at inflow zone different from the normal flow pattern. Instead of flowing along the aneurysm wall, this inflow runs directly to the center of the aneurysm in a straight line from the distal neck and separates the flow zone inside the aneurysm into two rotations.

This study gives the basic hemodynamic condition of flow in artery suffered with both stenosis and aneurysm, and provides elementary understanding for further research and treatment of this complicated arterial disease.

Comments to this program

This is a great program which has provided an extensive view of studying this topic, promoting the further study and thorough understanding of this work. The student exchange and lab cooperation has also encouraged the communication between different university and research team. It is very glad to have the chance taking part in this program.