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| Title | 数値流体力学による重複大動脈瘤の治療前評価に関する研究 |
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| Citation | |
| Issue Date | 2014-03 |
| Type | Thesis or Dissertation |
| Text version | none |
| URL | http://hdl.handle.net/10119/12104 |
| Rights | |
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## Abstract

This is the investigation of surgical procedure for double aortic aneurysms using computational fluid dynamics. Aorta is the main circulation system to supply blood from a left ventricle to whole body. The abnormal dialation of aortic wall is called an aortic aneurysm. The high fatality rate of aortic aneurysm rupture is infamously known. The formation, growth and rupture mechanism are not clarified. Base on numerous evidences from biomolecular mechanics, clinical statistics and hemodynamics, wall shear stress is assumed to be related to there processes. The aortic aneurysm is often found in elders and found in the post ruptured state because of unawareness. From clinical observation, an aortic aneurysm is often formed at the aortic arch and abdominal aorta. Generally if the size of the aneurysm is increased to the surgical criteria, it is repaired by surgical operation. If two or more aortic aneurysms are formed on an aorta, it is called multiple aortic aneurysms. For the treatment, the staged surgical procedure is normally used because of high success rate. For such case, an abdominal aortic aneurysm is repaired first. However, this method is not supported by the scientific proof. Moreover, the residual, the remaining aneurysm(s) after the first surgery, rupture cases were reported.

In this thesis, the low risk surgical procedure was investigated by computational fluid dynamics. For geometry models, seven ideal and three CT reconstructed models were used. Three ideal geometries represents multiple aortic aneurysms and four describes the post first surgery models. All models had a thoracic aneurysm on aortic arch and an abdominal aortic aneurysm on abdominal part. The governing equation assumed isothermal, incompressible external body force absence condition. Steady state and chronological cyclic flow rate and pressure profiles were applied. To calculate pressure profile, simulation by fixed flow rate boundary condition was repeated five cycles first. Then sampled pressure curved was used to solve the equation by pressure difference. Solution by pressure difference was used for pressure analysis and the flow rate solution was used for wall shear stress investigation. The calculate pressure illustrated similar wave profile to other numerical and physiological researches at the ascending and abdominal aorta. From both ideal and CT reconstructed models pressure increase in the residual thoracic aortic aneurysm was confirmed. This was caused by the increase of shear stress by the abdominal aortic aneurysm.

On the other hand, in the residual abdominal aortic aneurysm the sac pressure dropped. The large change in wall shear stress distribution was found on upstream of the outer thoracic aortic aneurysm wall. However, low wall shear stress region at downstream side of the outer thoracic aortic aneurysm wall was hardly changed. Hence, from computational hemodynamics perspective, the treatment priority should be on a thoracic aneurysm to reduced the rupture risk of the residual aneurysm.

**Keywords: Multiple Aneurysms, Residual Aneurysm Rupture, Staged Surgery, Palsatile Flow, Computational Fluid Dynamics**