FLOW BEHAVIOR THROUGH PHYSICAL AND COMPUTATIONAL MODEL OF ABDOMINAL AORTIC ANEURYSM

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Abdominal Aortic Aneurysm (AAA) is defined as a focal and permanent dilatation of the arterial wall, most often occurring in between the renal and iliac arteries, as consequence of arterial wall weakness or because of an abnormal solicitation of that normal structure. This disease primarily affects elderly population over 65 years of age, and the most important risk factors are smoking, hypertension, family history and chronic obstructive pulmonary disease.

In the last years, the prevalence is rising up almost twice the diagnosed cases in the United States (Bonamigo and Von Ristow, 1999). Nowadays, AAA is the thirtieth cause of death in the United States, in the elderly masculine population over 65 years of age, and in case of ruptured aneurysm, it is the third cause of sudden death in the United States. The overall mortality rate is about 80% in countries with systematic and compulsory evaluation of death cause. This is due to the fact that substantial intra-abdominal hemorrhage is often accompanied by delays in transport and diagnoses, and the need for emergency surgery in elderly patients that frequently have significant renal and cardiopulmonary comorbidity.

It is suggested that the formation and expansion of the AAA are accompanied by wall stress increasing and / or decreasing in the tissue capacity to withstand this stress. The rupture occurs when the wall stress exceed the stress the tissue can accept. The risk of rupture increases with aneurysm expansion, wall stress increasing and it is exacerbated when associated with arterial hypertension.

In the present work, morphological data from thoracic region of the patient was acquired by using multi-slice CT (Computed Tomography). These DICOM images had been treated to select only the interest region, getting a three-dimensional infra-renal aortic and iliacs model. Then, it was made a physical model by using rapid prototyping.

This model was used for "in vitro" experimentation in a computer controlled mock system, in which it is possible to replicate physiological and pathological characteristics of human being cardiovascular system. Some parameters such as pressure, flow, temperature, vascular resistance and compliance can be reproduced by the use of a mock circulatory system. These parameters were used as initial boundary conditions in order to calibrate a computational model. It was adopted normotensive and hypertensive patterns and computational and experimental results were analyzed and compared. The paper proposes a methodology which allows the acquisition of anatomical and hemodynamic data on the vessel segment affected by the pathology, with the goal of providing additional information in the diagnosis of aortic aneurysm.