Abstract

The interaction between blood, vessel walls and flow is of great importance in medicine and therefore of utmost interest for biofluid mechanics. It is thus the central issue of this work. The topic has a long tradition and is related in a special way to the city of Berlin. Starting in the 19th century, the pathologist Rudolf Virchow observed in his frequent autopsies changes of the vessel wall and thrombus formations. In so doing, Virchow discovered the interaction between flow, walls and blood in pathological vessel wall changes, such as atherosclerosis, as well as in thrombus formation. Originating from these observations, the concept of the 'Virchow Triad', named after its discoverer, was developed. This interaction has been studied extensively over the last 150 years, but up to now still remains the central problem of biofluid mechanics. The main interest of research in this field is a medical interest to reveal the effect of vessel and blood properties on pathological changes. Mainly biochemical relations are currently being investigated.

Physical relations, e.g. the influence of the flow on the blood and vessel walls, are studied to a much smaller degree. This is the area in which methods of engineering science can make a significant impact on the study of the Virchow Triad. As a part of the methods of biofluid mechanics, measuring technology plays a big role. Optical techniques are particularly important because they do not affect the flow. Many of these methods are directly applicable to flows in the human body, but it is often necessary to work with models, often upscaled ones. The present works are thus supplemented by numeric models.

The aim of this work is to describe the contribution of engineering science to the study of the core problem of biofluid mechanics. This will be done using several examples in order to present the progress that has been achieved, as well as potential future core issues.

Of special interest is the flow close to the vessel wall, because this is where many transport processes and mechanical interactions take place, e.g. the flow acting on the wall and the changed wall outline acting on the flow. In pathological cases, these may lead to hemolysis (destruction of red blood cells), the above-mentioned thrombus formation, and to atherosclerosis.