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Symposium Opening

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Ragnar Granit Institute organizes annually international symposia whose topics are selected in the field of the Institute's own research activities. The topic of this 8th symposium is modeling of cardiovascular hemodynamics. We have been active in modeling research for several years. In 2000 we joined the large international mathematical modeling project of the Academy of Finland with our project DynAMo which further increased our activities in this field.

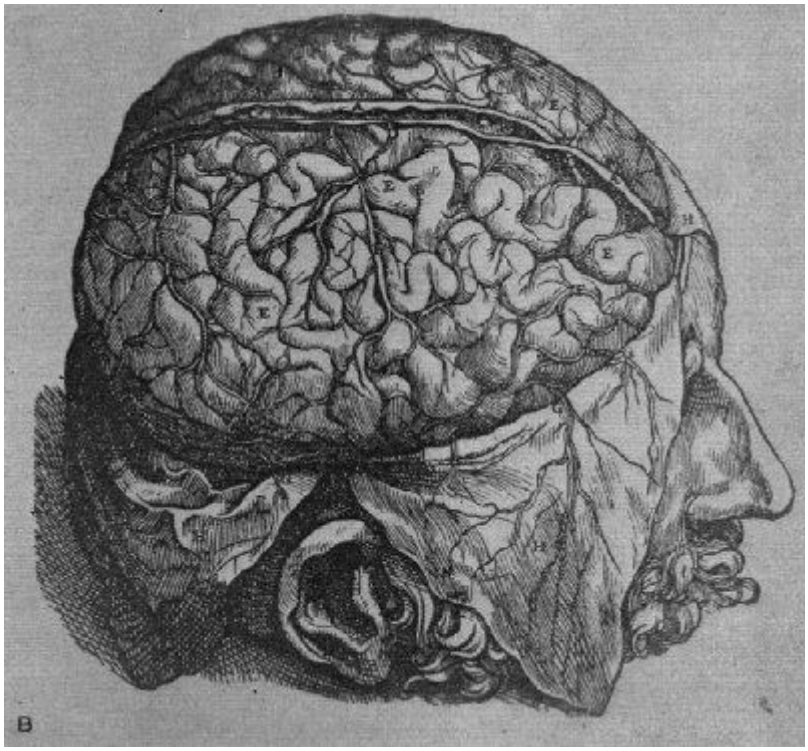
Cardiovascular Hemodynamics

Circulation of the blood is one of the most vital functions of the body. Though it was already known by the prehistoric man that the role of the heart in the body is central, understanding its function took place much later.

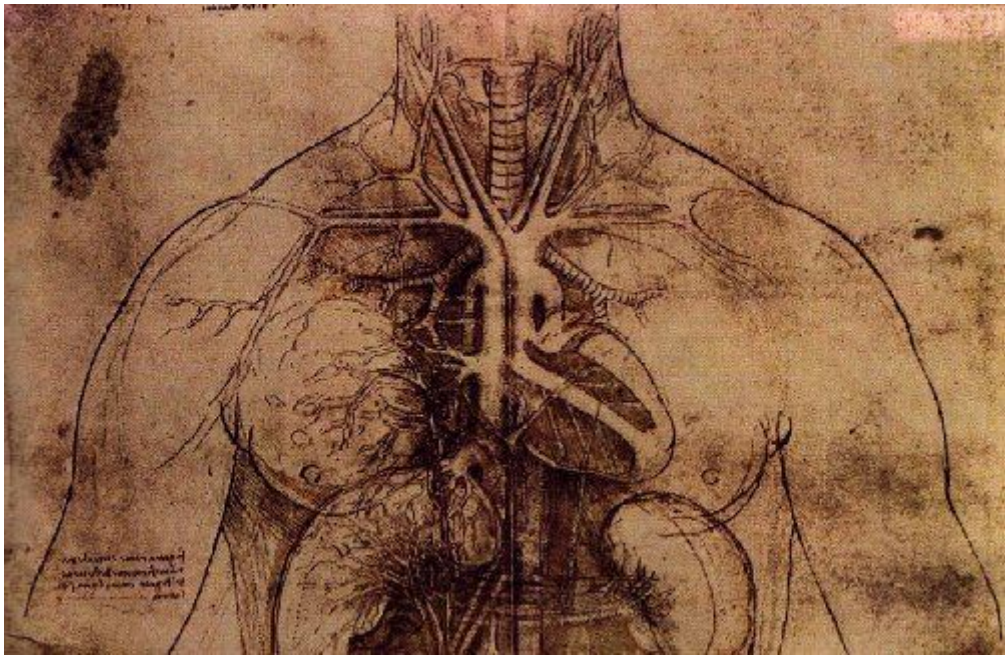
Perhaps the oldest anatomical drawing was made by the ancient man during the Paleolithic era, i.e. during the older part of the stone age. In the El Pindal cave in Spain there

is an old painting illustrating a mammoth with dark smudge at shoulder which may represent heart.

In ancient times it was believed that the soul is located in the heart. This is easy to understand because the heart reacts to various moods of the mind. Even today we call a kind and friendly person to be "warm hearted", we sign a kind letter "cordially", or we describe some occasions to be "heart-stirring" or "hear-braking", just to mention some expressions. For instance the Greek people believed that the role of the brain is only to cool the blood.

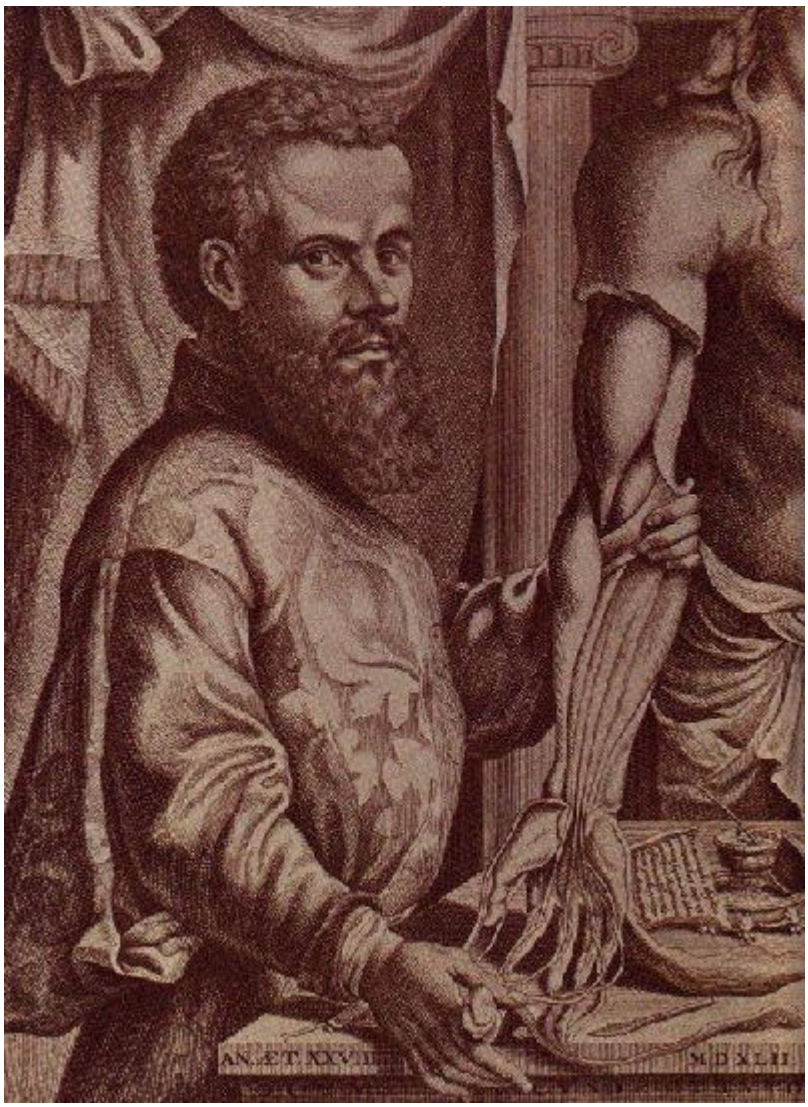


The Chinese believed the heart to be the body's main organ. The body, in turn, was a miniature copy of the universe. So the heart was an emperor who ruled the body, and its pericardium was his place, walled in by the chest. Highly gifted Chinese were thought to have seven heart chambers, and a talented man five, while an average Chinese made do with only two. As for an idiot, he had just one little chamber.

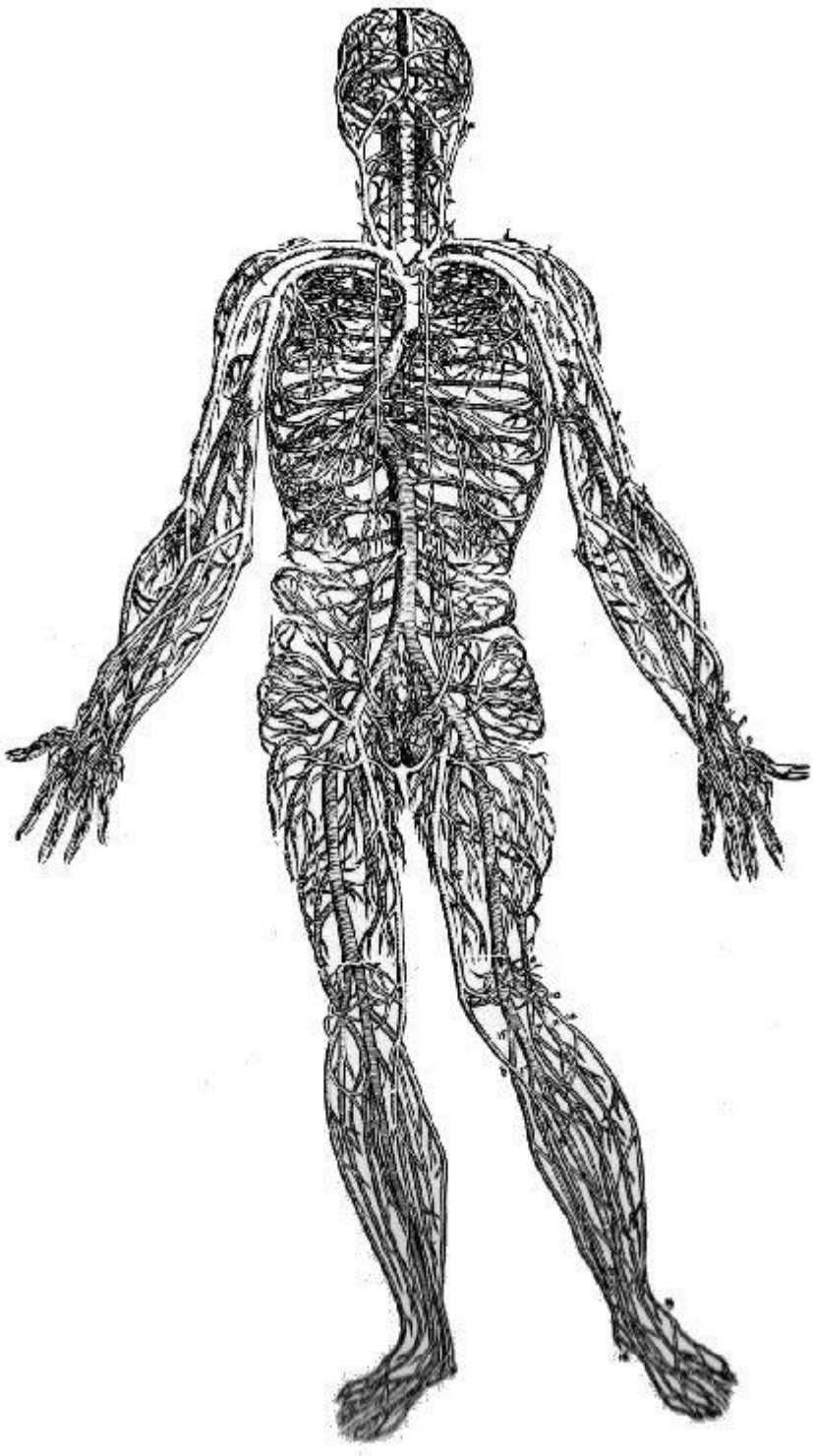


The anatomy of the heart and the main arteries and veins was clearly described by Leonardo da Vinci (1452-1519). When he served the Borgia family in Rome he dissected

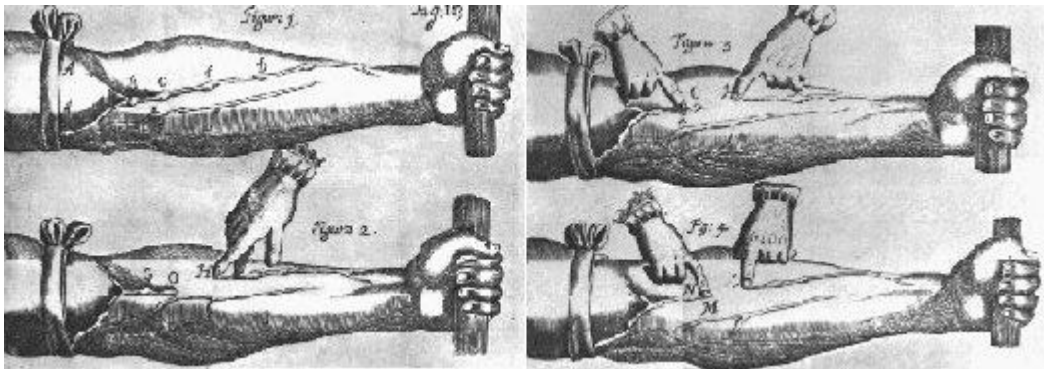
over thirty cadavers in candle light in the Santo Spirito mortuary. He accurately illustrated the coronary arteries but did not clearly understand the location of the septum. If he had, he possibly had invented the principle of circulation.



Andreas Vesalius (1514-1564) is considered the father of modern anatomy. In 1543, in the age of 28 he completed his main work *"De humani corporis fabrica"*. This work revolutionized not only anatomy, but also scientific teaching in general. This book included a very detailed illustration of the veins of the body.



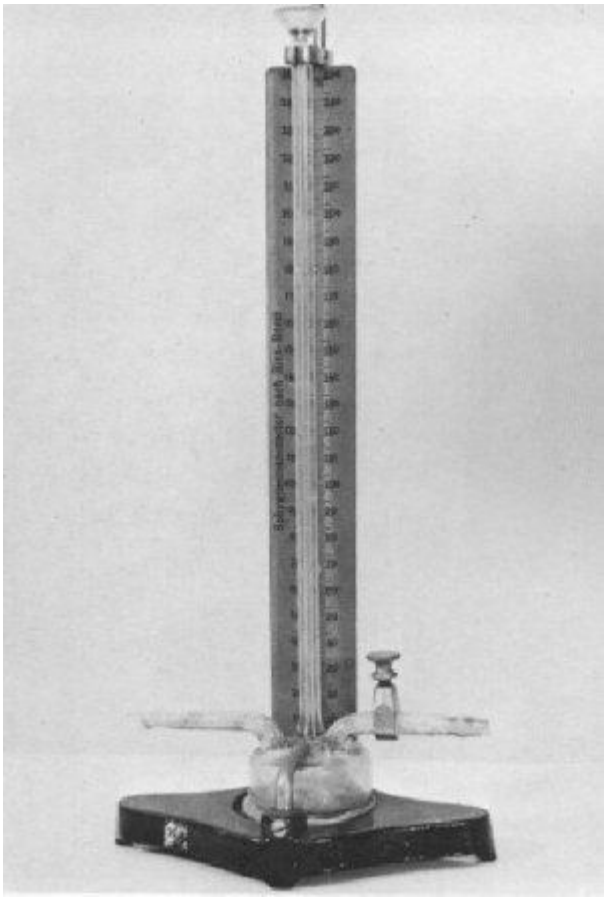
It is generally accepted that it was William Harvey (1578-1657) who invented the principle of blood circulation. Although Harvey's lecture notes show that he believed in the circulation of the blood as early as 1615, he did not publish his findings until thirteen years later in 1628 his work *"Exerciatio Anatomica de Motu Cordis et Sanguinis in Animalibus"* (On the Movement of the Heart and Blood in Animals). This is considered one of the most important works in medicine and biology.



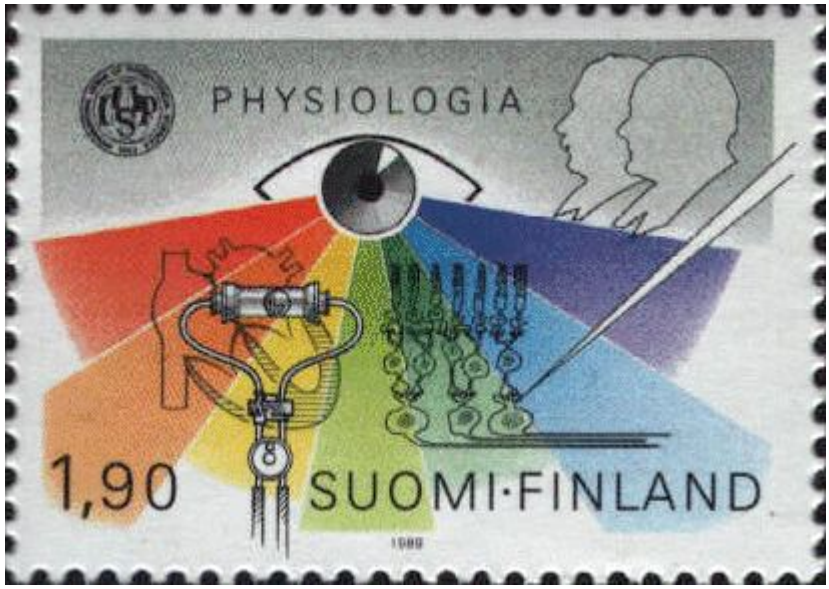
It is worth of noting that the thoughts of blood circulation were already presented, though perhaps only as a good guess, in ancient China in the book Nei Tsing produced by the emperor Huang Ti (2698-2598 B.C.). It is also known that examining patient by feeling the pulse was, perhaps, the most important feature of ancient Chinese medical diagnosis.

More accurate understanding on the cardiovascular hemodynamics was obtained when the clergyman Stephen Hales in 1733 inserted a hollow tubing into the neck artery of a horse and was astonished to see the blood rise nine feet in a glass column.

This obviously impractical method was improved on clinically applicaple level by Scipione Riva-Rocci, who invented the sphygmomanometer in 1895.

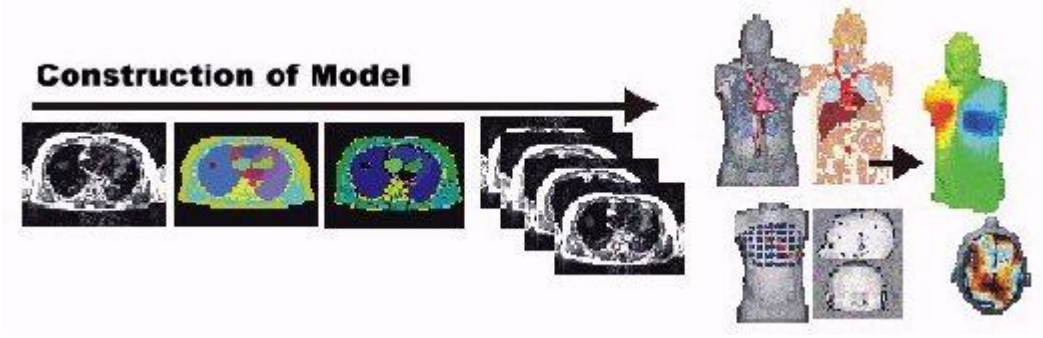


In this connection I also have to mention Robert Tigerstedt, the famous Finnish physiologist who studied the hemodynamics. Tigerstedt shown in this postage stamp together with the Finnish Nobel Prize winner, Ragnar Granit.



DynAMo Project - Modelling

DynAMo project considers better dynamic and adaptive (individual) mathematical modeling of the electric and magnetic fields of the heart and brain as well as blood (fluid) flow and cardiac mechanics. *www.tut.fi/dynamo*



The purpose of the project is to increase the accuracy and the viability of the mathematical modeling of physiological systems from the present theoretical and experimental level towards clinical applicability so that the emergent modeling methods can be employed to improve diagnostics and therapy in a clinical environment.

All around the world several projects exist now in the field of modeling. They are mainly based on computerized anatomy of the body and simulation of physiological phenomena with mathematical equations. However, modeling as a method is as old as the history of medicine. Only the modeling methods have changed and used the technology of that time.

As one of the first applications of modeling in medicine I would like to mention the ivory female statuette, which, for reasons of modesty, upper-class ladies made use of to indicate to doctors the location of their ailments. Since that the modeling methods in medicine have changed as much as the technology has developed.

Today, the anatomy of the body may be easily detected with CT, segmented and stored to a PC and the physiology and mechanics may be simulated with mathematical equations.

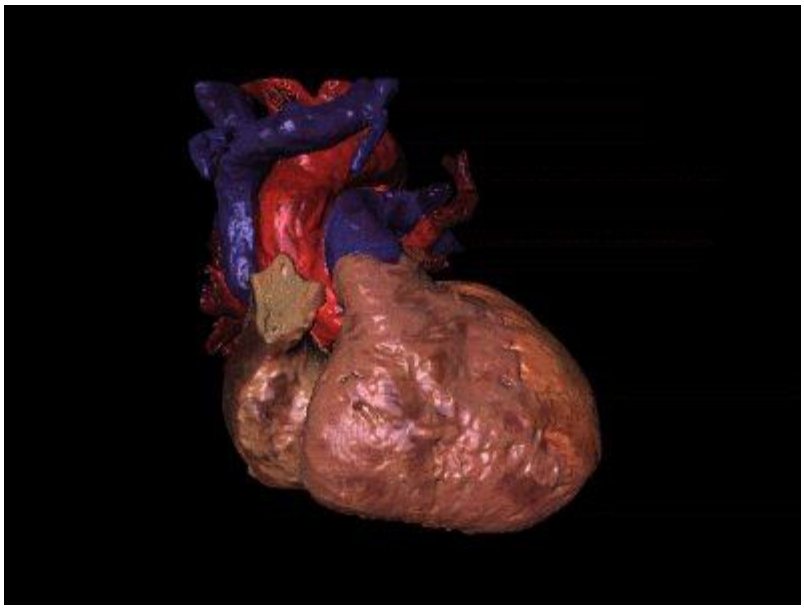
As an ultimate goal of modeling we may consider the concept of "virtual patient". In this concept with an accurate dynamic and adaptive model of the patient it is possible to perform virtual surgery.

Virtual surgery and virtual patient are emerging tools formed by recent development in medical imaging, measurements of physiological signals and computational modeling.

The Goal of this Symposium

It is the goal of this symposium to bring together clinicians, modelers, and persons working in medical imaging. Emphasis is on the present and emerging clinical application of modeling and new possibilities for measuring cardiovascular functions.

This symposium is jointly organized by the Ragnar Granit Institute and CSC Scientific Computing Ltd. We highly appreciate the excellent competence of CSC in computerized modeling. This institute also has very powerful supercomputer installations which enable high quality simulations.



We, the organizers, hope that this symposium will be an important landmark in developing the concept of "virtual patient" for the benefit of modern medicine.