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Modelling feedback mechanisms regulating the cardiovascular system - on the track of syncope induced by orthostatic stress.

Abstract

During postural change in sit-to-stand and head-up-tilt experiments blood is first drawn by gravity from the upper body regions toward the lower body regions causing an immediately decrease in central pressure. The drop in arterial pressure is rapidly counteracted by various feedback mechanisms regulating the blood pressure resulting in the reestablishment of the normal blood pressure. The main feedback mechanism in this regulation is believed to be the short term *barorecepter feedback mechanism* controlling heart rate and vein compliances among others things.

The overall function of the baroreceptor feedback mechanism is roughly known. However, the underlying bio-chemical mechanistic processes are not fully understood and they are not easily investigated in vivo for ethical reasons. By a methodology called the mathematical microscope a mathematical model is developed making the invisible visible and the inaccessible accessible, making an *in silico* investigation of the feedback mechanism possible. In our case the methodology or rather strategy of *the mathematical microscope* will illustrate how access to the otherwise inaccessible separate links of the barorecepter feedback chain regulating the heart rate can be obtained. Hereby insight into an individuals control system like a "fingerprint" may be obtained which may be of relevance for the treatment of several diseases such as hypertension.

Syncope is the medical term for temporary loss of consciousness, described as "fainting" or "passing out". It is usually related to temporary insufficient blood flow to the brain and in our case caused by a sudden drop in blood pressure due to sit-to-stand and head-up-tilt. Injure as a result of syncope is a common problem, accounting for 3 percent of emergency room visits and 6 percent of hospital admissions. Syncope is a sudden incident believed by some to be the result of a crash in or breakdown of the control system. In contrast to the heart rate regulation a unifying description of pressure changes during sit-to-stand and head-up-tilt shows that multiple simultaneous control mechanisms may be important to understand both sit-to-stand and head-up-tilt experiments. This complex multi-input multi-output control system will be discussed in the talk.