

Kolloquium

Biomedizinische Technik und verwandte Gebiete

Wintersemester 2018/2019

Donnerstag, 24.01.2019, 16:00 – 17:30 Uhr

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(Moderation: Univ.- Prof. Dr.-Ing. Klaus Radermacher,
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„Cerebral Blood and CSF flows.

What can we see, what would we like to see soon! “

Abstract:

The large and rapid amplitude change of cerebral arterial input flow increases the brain volume over the intracranial subarachnoid spaces (large red arrows). In these areas, resistance to flow is low and as CSF viscosity is low, CSF is quickly displaced out of the cranium toward the compliant spinal canal; ICP increase is therefore limited. Nevertheless, this first CSF response is scanty and has to be supplemented with the cerebral blood venous outflow. Due to blood viscosity, this venous contribution is slower but bring a greater volume displaced. Finally, the decrease in pressure at the brain periphery induce a CSF ventricular flow, out of the fourth ventricle and through the aqueduct of Sylvius, resulting in a small inner displacement of the brain directed toward the ventricles (small red arrows). After this series of flow events during the systolic phase of cardiac cycle, arterial inflow equals venous outflow and cervical CSF flush stops. After this brief equilibrium pressure moment, venous heart aspiration increase the cerebral venous outflow, decrease ICP and reverse the cervical CSF flow to fill the cranium and prepare the next cycle. Cerebral hydrodynamic's knowledge has benefited considerably from the introduction of phase-contrast magnetic resonance imaging (PCMRI). Using post-processing software, key parameters of flow can be easily calculated. In ten minutes CSF flow is quantified in the spinal subarachnoid spaces, the pontine cistern, the foramen of Magendi and the aqueduct of Sylvius. Blood flow is quantified in the internal carotid and the vertebral arteries, straight and sagital sinus, jugular and epidural veins. The objective of this presentation is to describe the power and the limit of such clinical 2D PCMRI protocol and present the last developments in MR imaging concerning CSF and blood flow. Amplitude of the CSF oscillations through the different compartments of the cranio spinal system is function of the geometry, the compliance of the compartments but could also be impacted by the cardiac frequency. To study these complex CSF flow interactions we have developed a simple numerical modeling of the CSF flow interaction between the cerebral ventricles, the intracranial subarachnoid spaces, the spinal canal and the brain tissue.

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