Summary

Title: Hydrodynamics of the cerebrospinal fluid in the spinal canal

Pulsations of cerebrospinal fluid (CSF) are important for correct function and blood supply of central nervous system. In region of cervical spine and craniocervical junction flow of CSF is of highest velocities. For deeper understanding of pathological processes knowledge of hydrodynamical properties of those regions is essential. The objective of the work was to create a hydrodynamical model which would include specific features of spinal canal on the basis of experimental shape and flow measurements. A 3D model of subarachnoidal space was created from axial MRI scans. Velocity of CSF flow was measured on 2 levels of cervical spine. Flow of CSF during cardiac cycle has shown typical velocity course. Caudal velocity at C2 level was -0,962±0,0534 cm/s and -1,063±0,128 cm/s at C4 level, cranial velocity at C2 level was 0,724±0,0509 cm/s and 0,862±0,074cm/s at C4 level. Phase shift between these two levels was 28,6±11,2ms. Hydrodynamical model was created on the basis of anatomical data and was derived from balance of mass and momentum when flow is modeled as one-dimensional flow in system of elastic tubes of given cross-sectional area derived from MRI. Obtained velocity curves correspond with measured data in amplitude and shape of the velocity curve. It is demonstrated significant influence of compliance on pressure and velocity characteristics. Preliminary results show that shape of the cervical subarachnoidal space and compliance of dural sac have a significant effect on CSF dynamics in the spinal canal.

Keywords: cerebrospinal fluid, pulsatile flow, spinal canal, modelling