New Developments In The Understanding Of CSF Hydrodynamics

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Introduction:
Cerebrospinal fluid (CSF) formation rate had been extensively studied using the so-called «ventriculo-cisternal perfusion» technique. This technique and equation for calculation of CSF volume formation are based on the assumption that substance marker dilution happens because of newly formed CSF in choroid plexuses in lateral and third ventricles. However, it also had been shown that substance marker dilution inside the CSF system does not occur because of newly formed CSF but rather as a consequence of a number of other factors met in ventriculo-cisternal perfusion technique such as velocity of perfusion, changes in colloid and hydrostatic pressures during perfusion etc.

Material and methods:
Unlike classical ventriculo-cisternal perfusion technique we studied CSF formation rate in a cat animal model where the aqueduct of Sylvius was microsurgically opened and entire CSF from lateral and third ventricles was collected into external tube. The newly developed Time-Spatial Inversion Pulse (Time-SLIP) method makes it possible to directly visualize the flow of CSF using magnetic resonance imaging (MRI) technique and permitting the CSF hydrodynamics to be depicted in certain time frame.

Results:
The CSF dynamics and movement as visualized by Time-Slip method differ significantly from unidirectional and bulk flow classical understanding of CSF physiology. Direct measurement (without any substance marker) a in cat animal model suggests that under physiological pressure there is neither net CSF formation nor unidirectional circulation of CSF within the brain ventricles.

Conclusions:
Research of CSF dynamics has gone to higher level. By studying animal models and with innovative MR technique we have now better understanding of basic CSF physiology than ever before.