CEREBROSPINAL FLUID MOVEMENT AND STABLE GRADIENTS OF HYDROSTATIC CEREBROSPINAL FLUID PRESSURE IN DIFFERENT BODY POSITIONS

Klarica M[1], Radoš M[1], Erceg G[1], Petošić A[2], Orešković D[3]

[1]University of Zagreb, School of Medicine, Department of Pharmacology and Croatian Institute for Brain Research, Zagreb, Croatia

[2]University of Zagreb, Faculty of Electrical Engineering and Computing, Department of Electroacoustics, Zagreb, Croatia

[3]Ruđer Bošković Institute, Department of Molecular Biology, Zagreb, Croatia

Aim

Factors which determine cerebrospinal fluid (CSF) pressure inside the craniospinal system during body position changes aren't well defined. It is known that body verticalization is followed by transient fall of hydrostatic CSF pressure inside the cranium, presumably due to CSF and blood shift from cranium to lower body parts. We hypothesized that these effects are not related to the cranial fluid volume changes, but depend on biophysical characteristics of cranial and spinal intradural spaces and laws of fluid mecahnics.

Methods

CSF pressure changes in anaesthetized cats with or without normal cranio-spinal communication were compared with those in artificial model of CSF consisting of non-distensible „cranial“ and distensible „spinal“ part. The measuring cannulae were introduced into the lateral ventricle (4 cm from foramen magnum) and lumbar subarahnoid space in cats fixed in a prone position on a board. Recording instruments were fixed on the board at the same hydrostatic level as the corresponding measuring cannulae, so there was no need to additionally adjust the transducers during cat or model position changes. Cervical stenosis is performed by positioning a plastic semiring into the epidural space at C2 level. Spinal CSF volume change is produced by adding 0.1 ml of mock CSF or by withdrawing 0.1 ml of CSF from cisterna magna.

Results

In the horizontal position, pressures were similar in cranial and lumbar regions in both animal (n=8) and artificial model (n=5). In the vertical position, CSF pressure (cm H_2O) inside the cranium (-3.8+/-1.2) and lumbar region (+32.8+/-1.4) of cats with normal cranio-spinal communication was almost the same as in „cranial“ (– 4.1+/-0.1) and „lumbar“ (+30.9+/-0.1) model regions. Negative intracranial pressure was stable during recording in animals with nornal CSF pathways. Intraspinal CSF volume changes significantly changed intracranial CSF pressure.

Conclusion

Results implicate that CSF pressure in the cranium in an upright position is determined by laws of fluid mechanics, but not by cranial CSF and blood volume changes, and does not depend on the CSF secretion, unidirectional circulation and absorption. It seems that blood and CSF cranial volume remains constant in all body positions, which enables a good blood brain perfusion during everyday life activities.