Active regulation of CSF flow with the subarachnoid basal cisterns as one of the key regulators: a novel concept and review of the literature

Background: CSF (Cerebrospinal fluid) has numerous physiological roles and its movement through the ventricular system and subarachnoid spaces is believed to be largely passive. The mechanisms, which maintain and modulate CSF flow are not completely understood.

Objectives: We hypothesize that CSF flow is actively and strictly controlled/regulated by four major systems where the basal subarachnoid cisterns play a major role.

Methodology: In anesthetized mice fluorophores (microspheres, 0.02 µm diameter or Alexa, 759 MW) injected intracisternally were allowed to circulate for one hour before brains were analyzed for fluorescence distribution. Tissue factor (TF) activity was blocked by specific antibodies injected intracerebroventricularly one hour before the fluorophores injection, non-specific IgG was used as control. Distribution of TF in the brain was explored with immunohistochemistry.

Results: After the intracisternal injection of fluorophores, microspheres were distributed over 3±3% and Alexa were distributed over 21±14% of the ventral surface preferentially along the para-arterial spaces. Administration of TF antibodies one hour before the fluorophores injection increased spread of microspheres to 23±14% (p=0.03) and Alexa to 35±28% (p=0.04). Immunohistochemistry revealed expression of TF co-localized with GFAP immunoreactivity of glia limitans on the brain and ventricular surfaces.

Conclusions: Our data supports the fact that active regulation of CSF flow occurs at least at the level of the basal cisterns as an inherent flow regulator. CSF flow is not just a passive flow of CSF after its secretion by choroid plexuses and ependyma in ventricular system. It is rather an extremely complex highly regulated system with multiple overlapping mechanisms involved.

Biography
Gavin W Britz earned his MBCh Degree from the University of the Witwatersrand School of Medicine, Republic of South Africa (1987). He completed a surgical internship in general surgery and fellowship in general surgery at Johns Hopkins Hospital, Baltimore in 1993 and in 2002 he completed his residency in neurosurgery respectively. During his residency he attended St. Georges, University of London, UK (Medical School) and served as a Neurosurgical Registrar and Senior Registrar. After residency, he took a Cerebrovascular Fellowship in 2002 and an Interventional Neuroradiology Fellowship in 2003 at the University of Washington Medical School, Seattle. In 2003 he earned his MPH at the University of Washington, Seattle. He also obtained an MBA from George Washington University in 2015. He held faculty appointments at the University of Washington and Duke University before becoming a Member of Houston Methodist Research Institute in 2014.

gbritz@houstonmethodist.org