

## Contrast agent leakage to lateral ventricle after transient cerebral ischemia

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### Background and purpose

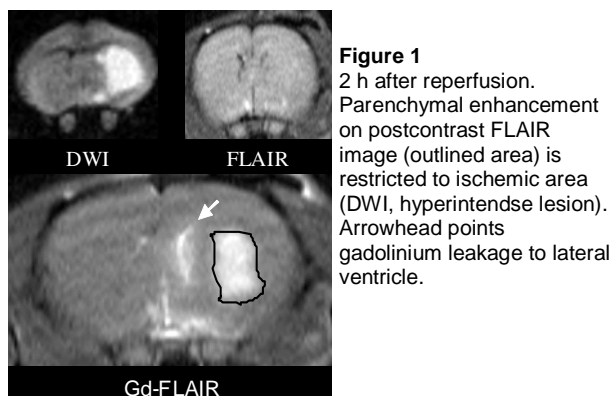
Little is known about post-ischemic blood-cerebrospinal fluid (CSF) disruption. The source of CSF, choroid plexi, are selectively vulnerable to cerebral ischemia (1). This was previously addressed only in one experimental study by means of magnetic resonance imaging (MRI) (2). Evaluating past contrast-enhanced MRI studies executed in the acute phase of stroke, we noticed a common imaging finding, lateral ventricle enhancement on the ischemic hemisphere side. We, therefore, using gadolinium-enhanced MRI, systematically investigated post-ischemic BBB and blood-CSF barrier integrity, in order to explore whether these two barriers of the rat brain respond similarly to transient ischemic insult.

### Methods

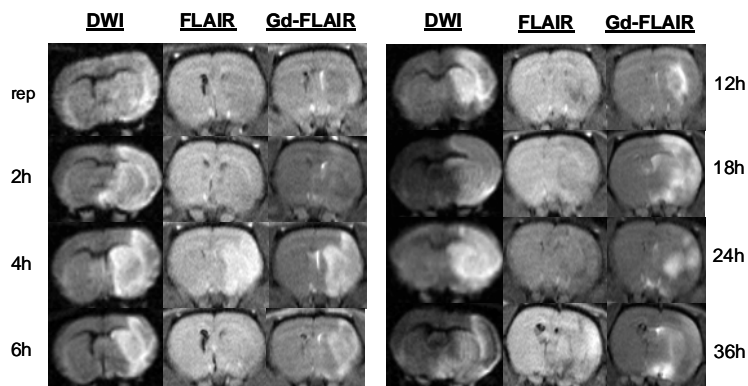
Adult male Wistar rats (weight=240-340g, n=94, n=4-8 per group) were allocated to 15 groups according to time point of imaging after ischemia-reperfusion (0, 2, 6, 12, 18, 24, 36, 48, and 72h, 1, 2, 3, 4, and 5 weeks). Imaging protocol included diffusion weighted imaging (DWI), T2-weighted imaging, T1-weighted imaging, fluid-attenuated inversion recovery imaging (FLAIR, before and after gadolinium injection, 0.1ml/kg) obtained at 4.7 Tesla scanner (PharmaScan, Bruker BioSpin, Germany). Middle cerebral artery occlusion was induced intraluminally. We qualitatively analyzed FLAIR images regarding enhancement patterns in the lateral ventricle and parenchyma.

### Results

Overall 117 imaging were performed. Lateral ventricle enhancement (Figure 1) in the ischemic hemisphere side has been found as an early and transient phenomenon occurring most often at 0-12 hours after reperfusion (in 40 of 54 imaging, 74%,  $p < 0.05$ ), less often in the subsequent (18-36h) period (in 5 of 21 imaging, 24%), and never seen thereafter (Figure 2). This early and transient pattern of lateral ventricle enhancement was clearly different than ischemic parenchymal enhancement pattern, which showed a continuous course (3). Lateral ventricle enhancement was more often in animals with large infarcts than those with smaller lesions (82% to 30% respectively,  $p < 0.05$ ).



**Figure 1**  
2 h after reperfusion. Parenchymal enhancement on postcontrast FLAIR image (outlined area) is restricted to ischemic area (DWI, hyperintense lesion). Arrowhead points gadolinium leakage to lateral ventricle.



**Figure 2** Enhancement of the lateral ventricle on the ischemic hemisphere side at different reperfusion times (0-36h after reperfusion).

### Conclusions

In a rat model of transient cerebral ischemia, we found that gadolinium is leaking to the lateral ventricle in the ischemic hemisphere side as an early (seen most often at 0-12 hours after reperfusion) and transient phenomenon (undetected after 36 h). This leakage pattern is clearly different than of continuous parenchymal enhancement (up to 5 weeks) due to BBB leakage. We suggest the lateral ventricle enhancement MRI finding is the consequence of blood-CSF barrier functional disruption and deserves further studies to elucidate its pathological significance.

### References

1. Ennis, S. R., and Keep, R. F. (2006) *J Cereb Blood Flow Metab.* **26**, 675-83.
2. Nagahiro, S., Goto, S., Korematsu, K. et al. (1994) *Brain Res.* **633**, 305-11.
3. Strbian, D., Durukan, A., Pitkonen, M. et al. (2008) *Neuroscience.* **153**, 175-81