

Case 88

2. Paramedian (thalamic perforating = Percheon) artery

【Progress】

Despite of daily rehabilitation, her neurological function was gradually getting worsened in our hospital. Namely, although paralysis of upper and lower extremities were improved, consciousness level reduced and dementia was advanced. The follow up CT twenty days later (Fig. 2) and two months later (Fig. 3, 4) showed dilatation of ventricles and atrophic change of medial sides (amygdalate and entorhinal cortex) of temporal lobes.

【Discussion】

Our patient experienced thalamus hemorrhage with intraventricular hemorrhage. The hemorrhage site was corresponded to median nucleus of the thalamus which functions consciousness and awakening. The median and medial nucleus are blood-supplied by para median artery (or thalamic perforating artery) branched from posterior cerebral artery (1, 2). As time progress following intraventricular hemorrhage, ventricular dilation occurred. In a literature, pathological study using canine with ventricular hemorrhage revealed that intraventricular hemorrhage causes disruption of ependymal lining, sub-ependymal gliosis and ischemic necrosis of neurons in the periventricular parenchyma of the third ventricle, the aqueduct and the fourth ventricle, leading to ventricular dilatation (3). It indicates that the CSF circulation in the ventricles is crucial to preserve brain parenchyma surrounding ventricles. Our patient got not only hemorrhagic damages of median nucleus but also periventricular parenchyma damage as time progress.

Cerebrospinal fluid (CSF) is produced by choroid plexus in the ventricles and after waste-clearance, absorbed by subarachnoid granules attached by venous sinuses (4-6). In 2010s, the new concept of 'glymphatic system' was emerged (7-9). As a CSF dynamic route, the waste products from brain cells are washed out from para-arterial influx of CSF to para-venous outflux by arterial pulsation (7,8). CSF come in from para-arterial space via aquaporin 4 (AQ4). Cerebral interstitial fluids including neuron waste products are washed out by arterial pulsating. Micro pores of AQ4 are formed by glia cells and play a role of selectively passing water molecules (3×10^9 water molecules/sec) of CSF. AQ4 water channel regulate glymphatic channel by expansion and contraction of extracellular space (7,8). When sleeping, glial cells contract and induces expansion of extracellular space, leading to the marked clearance of the waste substance such as β -amyloid peptide during sleeping (9). Pathologically, glymphatic pathway is impaired following subarachnoid hemorrhage because of the presence of coagulated clot in the para-arterial and or para-venous spaces, inducing accumulation of waste products (9).

In our case, after subarachnoid hemorrhage, her recognition level worsened with ventricular dilatation and decreased volume of amygdalate. It might be relevant with impairment of glymphatic pathway and accumulation of β -amyloid peptide.

【Summary】

We present a seventy eight-year-old female with thalamic (median nucleus) hemorrhage and intraventricular hemorrhage. As time progress, the patient neurological findings worsened, progressive consciousness disorder and dementia associated with ventricular dilatation and volume loss of amygdalate. The responsible artery was paramedian (thalamic striate) artery branched from posterior cerebral artery. Median nucleus functions alertness and awakening. Her neurological worsening indicates not only the hemorrhagic damage of median nucleus but also periventricular cerebral parenchymal damage due to intraventricular hemorrhage and dementia due to the impairment of glymphatic pathway. We should keep in mind that intraventricular hemorrhage causes periventricular cerebral parenchyma necrosis or gliosis, and glymphatic pathway impairment might cause dementia by accumulation of neuron waste products, β -amyloid peptide.

【References】

1. Louveau A, et al: Understanding the functions and relationships of the glymphatic system and meningeal lymphatics. *J Clin Invest* 127 : 3210—3219, 2017.
2. Roitberg BZ, et al. Bilateral paramedian thalamic infarct in the presence of an unpaired thalamic perforating artery. *Acta Neurochir (Wien)*. 2002 Mar;144(3):301-4; discussion 304.
3. Dai J, et al. The mechanism of pathological changes of intraventricular hemorrhage in dogs. *Neurol India*. 2009;57: 567-577 Sep-Oct.
4. Rennels ML, et al. Evidence for a 'paravascular' fluid circulation in the mammalian central nervous system, provided by the rapid distribution of tracer protein throughout the brain from the subarachnoid space. *Brain Res*. 1985 Feb 4;326(1):47-63.
5. Rennels ML Rapid solute transport throughout the brain via paravascular fluid pathways. *Adv Neurol*. 1990;52:431-9.
6. Amiry-Moghaddam M, et al. (2003). "The molecular basis of water transport in the brain". *Nature Reviews Neuroscience*. 2003; 4 (12): 991–1001. PMID 14682361. doi:10.1038/nrn1252.
7. Iliff JJ, et al. . "A Paravascular Pathway Facilitates CSF Flow Through the Brain Parenchyma and the Clearance of Interstitial Solutes, Including Amyloid β ". *Sci Trans Med*. 2013; 4 (147): 147ra111. PMC 3551275 . PMID 22896675. doi:10.1126/scitranslmed.3003748
8. Xie L, et al. Sleep Drives Metabolite Clearance from the Adult Brain. *Science*. 2013; 342 (6156): 373–377. PMC 3880190 . PMID 24136970. doi:10.1126/science.1241224. Retrieved 18 October 2013.
9. Gaberel T, et al. Impaired Glymphatic Perfusion After Strokes Revealed by Contrast-Enhanced MRI: A New Target for Fibrinolysis?. *Stroke*. 2014 Oct;45(10):3092-6. doi: 10.1161/STROKEAHA.114.006617. Epub 2014 Sep 4.

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