Cerebral hyperperfusion syndrome

see Cerebral hyperperfusion syndrome after subarachnoid hemorrhage.

see Cerebral Hyperperfusion Syndrome in Chronic Subdural Hematoma

Epidemiology

Knowledge of carotid hyperperfusion syndrome (CHS) among physicians is limited. Most studies report incidences of CHS of 0-3% after carotid endarterectomy. CHS is most common in patients with increases of more than 100% in perfusion compared with baseline after carotid endarterectomy and is rare in patients with increases in perfusion less than 100% compared with baseline [1].

Risk factors

The most important risk factors in CHS are diminished cerebrovascular reserve, postoperative hypertension, and hyperperfusion lasting more than several hours after carotid endarterectomy. Impaired autoregulation as a result of endothelial dysfunction mediated by generation of free oxygen radicals is implicated in the pathogenesis of CHS. Treatment strategies are directed towards regulation of blood pressure and limitation of rises in cerebral perfusion. Complete recovery happens in mild cases, but disability and death can occur in more severe cases. More information about CHS and early institution of adequate treatment are of paramount importance in order to prevent these potentially severe complications [2].

Clinical features

Cerebral hyperperfusion syndrome (CHS) after carotid endarterectomy is characterised by ipsilateral headache, hypertension, seizures, and focal neurological deficits.

Diagnosis

Quantitative DSA with cerebral circulation time imaging

Preprocedural prolongation and greater periprocedural change of cerebral circulation time (CCT) are associated with the occurrence of hyperperfusion phenomenon (HPP) . Periprocedural evaluation of CCT may be useful for predicting HPP [3].

Complications

If not treated properly it can result in severe brain edema, intracerebral or subarachnoid haemorrhage, and death. Time-dependent intraoperative parameters from the intraoperative qualitative Indocyanine green videoangiography transit curve provide quantitative information regarding cerebral circulation time with quality and utility comparable to information obtained by PET.

These parameters may help predict the occurrence of postoperative HPS [4].

Case series

Cerebral hyperperfusion syndrome (CHS) is a common complication after direct bypass surgery in patients with Moyamoya disease (MMD). Since preventive measures may be inadequate, Yang et al. assessed whether the blood flow difference between the superficial temporal artery (STA) and recipient vessels (△BF) and the direct perfusion range (DPR) are related to CHS.

They measured blood flow in the STA and recipient blood vessels before bypass surgery by transit-time probe to calculate △BF. Perfusion changes around the anastomosis before and after bypass were analyzed with FLOW 800 to obtain DPR. Multiple factors, such as △BF, DPR, and postoperative CHS, were analyzed using binary logistic regression.

Results: Forty-one patients with MMD who underwent direct bypass surgery were included in the study. Postoperative CHS symptoms occurred in 13/41 patients. △BF and DPR significantly differed between the CHS and non-CHS groups. The optimal receiver operating characteristic (ROC) curve cut-off value was 31.4 ml/min for ΔBF, and the area under the ROC curve (AUC) was 0.695 (sensitivity 0.846, specificity 0.500). The optimal cut-off value was 3.5 cm for DPR, and the AUC was 0.702 (sensitivity 0.615, specificity 0.750).

Postoperative CHS is caused by multiple factors. △BF is a risk factor for CHS while DPR is a protective factor against CHS [5].

[1] [2]
van Mook WN, Rennenberg RJ, Schurink GW, van Oostenbrugge RJ, Mess WH, Hofman PA, de Leeuw PW. Cerebral hyperperfusion syndrome. Lancet Neurol. 2005 Dec;4(12):877-88. Review. PubMed PMID: 16297845.

[3]
Yamauchi K, Enomoto Y, Otani K, Egashira Y, Iwama T. Prediction of hyperperfusion phenomenon after carotid artery stenting and carotid angioplasty using quantitative DSA with cerebral circulation time imaging. J Neurointerv Surg. 2017 Sep 2. pii: neurintsurg-2017-013259. doi: 10.1136/neurintsurg-2017-013259. [Epub ahead of print] PubMed PMID: 28866638.

[4]
Kobayashi S, Ishikawa T, Tanabe J, Moroi J, Suzuki A. Quantitative cerebral perfusion assessment using microscope-integrated analysis of intraoperative indocyanine green fluorescence angiography versus positron emission tomography in superficial temporal artery to middle cerebral artery anastomosis. Surg Neurol Int. 2014 Sep 15;5:135. doi: 10.4103/2152-7806.140705. eCollection 2014. PubMed PMID: 25298917.

[5]
Yang D, Zhang X, Tan C, Han Z, Su Y, Duan R, Shi G, Shao J, Cao P, He S, Wang R. Intraoperative transit-time ultrasonography combined with FLOW800 predicts the occurrence of cerebral hyperperfusion syndrome after direct revascularization of Moyamoya disease: a preliminary study. Acta Neurochir (Wien). 2020 Oct 2. doi: 10.1007/s00701-020-04599-w. Epub ahead of print. PMID: 33006072.