Experimental subarachnoid hemorrhage

The aim of a study was to detect differences in functional outcome after experimental subarachnoid haemorrhage (SAH) in rodents with different hormonal status. For this purpose, the endovascular perforation model was applied to four groups of Sprague-Dawley-Rats: male intact, male neutered, female intact and female neutered animals. Initial impact was measured by ICP, CPP and cerebral blood flow in the first hour after SAH. From day 4-14, the modified hole board test was applied to assess functional and neuro-cognitive outcome. Histological outcome was examined in the motor cortex and hippocampus of each hemisphere. Mortality was highest in the female intact group albeit not statistically significant. Physiologic parameters did not differ significantly between groups either. In the modified hole board test, male intact animals showed a greater impairment of declarative memory than the female intact and neutered groups. However, male intact animals showed greater avoidance behaviour and male animals revealed higher anxiety levels independent of hormonal status. No differences in histological damage of hippocampus and motor cortex between groups could be shown. We therefore speculate that the marginal deficits in cognitive performance that are shown by the male intact group in the modified hole board test are mostly caused by higher anxiety levels and cannot be interpreted as pure cognitive impairment [1)].

SAH was induced in rats via intracranial endovascular perforation (perforation model), blood injection into the cisterna magna (300 microl), or blood injection into the prechiasmatic cistern (200 microl). The subarachnoid blood volume was quantitatively measured. Cerebral blood flow (CBF) (as assessed with laser Doppler flowmetry), intracranial pressure, and mean arterial blood pressure were recorded for 90 minutes after SAH. Mortality was recorded, and neuronal death was assessed in animals that survived 7 days after SAH.

The subarachnoid blood volume was close to the injected amount after prechiasmatic SAH. In the other models, the volume varied between 40 and 480 microl. The mortality rates were 44% in the perforation SAH group, 25% in the prechiasmatic SAH group, and 0% in the cisterna magna SAH group; the corresponding values for neuronal death were 11, 44, and 28%. Cerebral perfusion pressure approached baseline values within 5 minutes after SAH in all three models. CBF decreased to approximately 35% of baseline values immediately after SAH in all groups; it gradually increased to normal values 15 minutes after SAH in the cisterna magna SAH group and to 60 and 89% of baseline values 90 minutes post-SAH in the perforation and prechiasmatic SAH groups. CBF was significantly correlated with the subarachnoid blood volume.

The prechiasmatic SAH model seems to be the most suitable for study of the sequelae after SAH; it produces a significant decrease in CBF, an acceptable mortality rate, and substantial pathological lesions, with high reproducibility. The CBF reduction is predominantly dependent on the amount of subarachnoid blood [2)].

Books

Neurovascular Events After Subarachnoid Hemorrhage: Towards Experimental and Clinical Standardisation (Acta Neurochirurgica Supplement)

This book contains articles presented at the 12th International Conference on Cerebral Vasospasm,

held in Lucerne, Switzerland, in July 2013. The included papers represent a balanced cross-section of the enormous progress achieved in basic and clinical research on aneurysmal subarachnoid hemorrhage and its sequelae, including early neurovascular events and delayed cerebral vasospasm. The section on basic research covers a broad range of aspects, with a special focus on animal models for the study of acute events after experimental subarachnoid hemorrhage. The section on clinical topics encompasses imaging and endovascular management, surgical innovations and techniques, management and monitoring in neurocritical care, the status of clinical trials, and factors involved in aneurysm formation. This edition is of interest not only for basic researchers but also for clinicians who wish to apply state-of-the-art knowledge to the research and management of this devastating condition.

1)
Kagerbauer SM, Kadera V, Gordan LM, Blobner M, Török E, Schmid S, Podtschaske AH, Jungwirth B. Influence of sex and hormonal status on initial impact and neurocognitive outcome after subarachnoid haemorrhage in rats. Behav Brain Res. 2019 Jan 28. pii: S0166-4328(18)31669-3. doi: 10.1016/j.bbr.2019.01.050. [Epub ahead of print] PubMed PMID: 30703399.
2)
Prunell GF, Mathiesen T, Diemer NH, Svendgaard NA. Experimental subarachnoid hemorrhage: subarachnoid blood volume, mortality rate, neuronal death, cerebral blood flow, and perfusion pressure in three different rat models. Neurosurgery. 2003 Jan;52(1):165-75; discussion 175-6. PubMed PMID: 12493115.