Effects of Brain Retraction on Regional Cerebral Blood Flow in Aneurysm Surgery

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Introduction

Brain retraction is essential in many neurosurgical operations and may lead to the development of cerebral damage. The aim of the study was to determine the influence of the brain retraction on cerebral blood flow in early and late period after clipping ruptured aneurysm using single photon emission computed tomography (SPECT).

Methods

A prospective series of 30 patients with ruptured intracranial aneurysms were examined using SPECT with Technetium-99m-d, 1-hexamethylpropyleneamineoxime (HMPAO), respectively 5-7 days and 15-20 months after early surgery. Furthermore, a brain SPECT imaging was performed on a control group of 30 healthy individuals. A total of 60 HMPAO scans were performed on patients in whom clinical vasospasm did not develop. Additionally, the time of brain retraction during surgery was measured. Areas of hypoperfusion, their site and extent were recorded. For each of the areas identified as being hypoperfused, a semi-quantitative analysis was performed.

Statistical analysis

Nonparametrical methods were conducted. The values of asymmetry index (AI) in the examined groups and the control group were compared using Mann-Whitney test. The values of AI in the group I and group II were compared using Wilcoxon's test. Correlation between the time of brain retraction and AI in the region of brain retraction (ROI) was evaluated by calculating the Spearman's index. The p-value less than 0.05 was considered significant. The data were expressed as the mean +/- standard deviation (SD).

Results

Focal areas of diminished regional cerebral blood flow (rCBF) were found near the operative site in 30 patients 5 -7 days after surgery, and in 22 patients 15-20 months after surgery (**Table 1, Figure 1**). Moreover focal and diffuse areas of hypoperfusion were found in other regions of the brain (**Table 1**). The time of brain retraction correlated with the AI in the regions of retraction (**Figure 2**).There was a correlation between AI in the regions of brain retraction and basal ganglia (*p<0.05, R=0.36; p<0.05, R=0.49*) and thalami (*p<0.05, R=0.44; p<0.05, R=0.37*) in the group I and group II respectively. Deficits of perfusion expressed as AI in the region of brain retraction decreased significantly by 34,2% 15-20 months after surgery (p<0.001) whereas in the basal ganglia and thalami persisted in all patients (**Table 2**).

Figures and tables

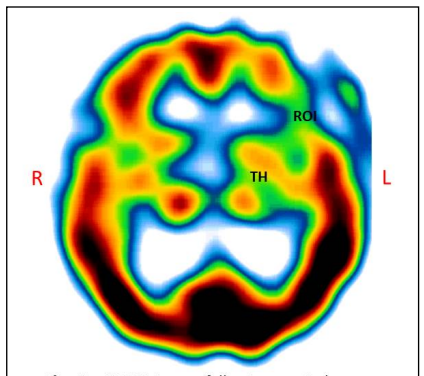

Fig. 1. SPECT image following surgical aneurysm clipping. Note focal perfusion defects in the area of brain retraction (ROI) and in the left thalamus (TH). R-*right hemisphere*, L-*left hemisphere*.

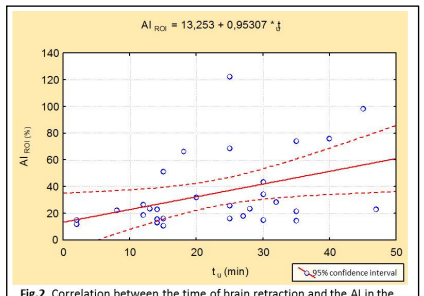

Fig.2. Correlation between the time of brain retraction and the AI in the areas of brain retraction (p<0.05, R=0.39). AI- *asymmetry index*, ROI- *region of brain retraction*, t_d-*time of brain retraction*.

Table 1. Interhemispherical uptake differences in the group I (5-7 days after surgical treatment) and group II (15-20 months after surgical treatment) compared to the control group. (mean±SD).* p<0.05, **p<0.001

Region	control group Asymmetry index (AI)	group I Asymmetry index (AI)	group II Asymmetry index (AI)
Surgical manipulation site	3,13 ± 2,43	35,11 ± 28,10**	23,09 ± 23,07**
Frontal lobe	2,96 ± 2,08	15,63 ± 15,26*	14,97 ± 16,15*
Temporal lobe	2,78 ± 1,67	9,03 ± 5,89*	5,29 ± 3,80*
Occipital lobe	4,08 ± 3,39	8,36 ± 5,35	8,26 ± 6,05
Parietal lobe	3,42 ± 2,83	5,06 ± 5,85	8,90 ± 7,91
Basal ganglia	4,08 ± 2,96	9,37 ± 11,88*	8,92 ± 7,93*
Thalami	5,34 ± 3,74	9,92 ± 8,61*	10,99 ± 10,47*

Table 2. Interhemispherical uptake differences between group I and group II (mean±SD). **p<0.001

Region	group I Asymmetry index (AI)	group II Asymmetry index (AI)	
Surgical manipulation site	35,11 ± 28,10	23,09 ± 23,07	**
Frontal lobe	15,63 ± 15,26	14,97 ± 16,15	
Temporal lobe	9,03 ± 5,89	5,29 ± 3,80	
Occipital lobe	8,36 ± 5,35	8,26 ± 6,05	
Parietal lobe	5,06 ± 5,85	8,90 ± 7,91	
Basal ganglia	9,37 ± 11,88	8,92 ± 7,93	
Thalami	9,92 ± 8,61	10,99 ± 10,47	

Conclusions

- This study indicates that most patients after surgical clipping of ruptured aneurysms experience alterations in regional cerebral blood flow that depend on the time of brain retraction.
- Interestingly, some perfusion defects at the site of surgical manipulation might resolve within the time.
- Further studies will be necessary to understand the clinical and pathophysiological significance of these observations.

Learning Objectives

This study highlights the deleterious effects of brain retraction on the regional cerebral blood flow following aneurysm surgery. The audience will be informed about the localisation, pathophysiology and evolution of the cerebral perfusion defects related to surgical manipulation in early and late period following ruptured aneurysm clipping.

References

1. Albin M. S., et al. Brain pressure during intracranial procedures. Surg Forum 1975; 26:499–500.

2. Andrews R. J., Bringas J. R. A review of brain retraction and recommendations for minimizing intraoperative brain injury. Neurosugery 1993; 33:1052–064.

3. Rosenorn J., et al. Reduction of regional cerebral blood flow during brain retraction pressure in the rat. J Neurosurg 1982; 56:826–829.

4. Zhong J., et al. Brain retraction injury. Neurol Res. 2003 Dec;25(8):831-8.