Late Rheoencephalographic Assessment of the Cerebral Circulation After Ligation of the Common Carotid Artery

Z. Mariak, J. Lewko, J. Lebkowski, and M. Smółka

Department of Neurosurgery, Medical Academy, Białystok, Poland

Summary

A series of 17 patients was investigated following common carotid ligation. The period between operation and examination ranged from 2–7 years. Cerebral circulation was estimated by use of the rheoencephalographic method.

Statistical analysis of the reg plot was performed by comparing an age-matched normal population with patients. A comparison was also made of the ligated and nonligated sides for the patients. The following results were obtained: a significant decrease in the amplitude of the reg waves, an extension in the anacrotic part of the wave, and a decrease in the angle of its inclination. This was intensified more on the side of the common carotid ligation.

These findings may suggest that after common carotid ligation the cerebral circulation is changed for a long period of time. They would also seem to indicate that postoperatively, the cerebral circulation does not return to normal—if it ever does.

Keywords: Common carotid ligation; cerebral circulation; rheoencephalography.

Although the literature of recent years has been increasingly concerned with microsurgical techniques, common carotid ligation is still sometimes used in the treatment of intracranial aneurysms. The value of this latter form of management has been discussed by many authors. Some have suggested, on the basis of angiographic data, that the rapid development of collateral circulation may reduce the effect of this treatment.

There are several methods available of estimating cerebral circulation. One of these is rheoencephalography (rheo). We have previously described the result of such a study in the early postoperative period. We found that a diminution in the amplitude of rheoencephalographic waves persisted during a 2 week period of observation. In order to estimate the state of the cerebral circulation in the late post-operative period, 17 patients have been reinvestigated from 2 to 7 years after surgery.

Clinical Material and Methods

17 patients with aneurysms of the anterior part of the circle of Willis were investigated following common carotid ligation (9 women, 8 men, aged 21–60 years). The period between operation and investigation ranged from 2 to 7 years.

The following parameters of the rheo-waves were analysed:

— The amplitude of the wave, which reflects pulsatile cerebral blood flow.
— The time of the anacrotic part of the wave, reflecting the elasticity and flexibility of the cerebral vessels.
— The time interval between the QRS complex and the onset of the wave—the spreading time, which is accepted as an indicator of the state of large vessels, like the internal carotid or middle cerebral arteries.

We made a statistical (t-test) comparison of the “reg” parameters of our patients with the healthy population as well as analysing the rheo-traces taken from the ligated and unligated sides.

Results

The amplitude of the waves was diminished on both sides in the majority of cases. Six of them showed marked asymmetry with smaller amplitude on the ligated side. Small, but symmetrical amplitudes appeared in the remaining cases.

Fig. 1 presents the mean values of wave amplitudes in healthy subjects who were divided by age, in ten year intervals. The dotted lines represent the range of values of rheo wave amplitudes between the 10th and 90th percentiles taken as the norm in the healthy population. The reo-wave amplitudes of the patients examined are plotted in the same figure (× — ligated side, ○ — unligated side). All but one of the values are below the
mean of the standard, and the majority of them lie below the lower limit of values for the healthy population. Thus, the amplitude of the rheo-waves is diminished on both ligated and unligated sides, as compared to normal subjects. The difference is statistically highly significant (for the ligated side \( t = 4.66 \), for the unligated side \( t = 4.06 \), \( p < 0.01 \)).

The anacrotic phase of the waves is significantly prolonged on both sides in patients treated surgically, compared to healthy subjects (\( t = 6.55 \) for the ligated side, \( t = 7.12 \) for the unligated side, \( p < 0.01 \)). (Fig. 2) The spreading time of the wave is longer on the ligated side. The difference is statistically significant, as determined by the paired “t” test (\( t = 2.14 \), \( p < 0.05 \)). (Fig. 3)

Comments

The results of our rheoencephalographic investigations confirm the persistence of signs of the bilateral diminution of the cerebral blood supply. The symmetrically diminished plots of rheo-waves suggest a similar distribution of cerebral blood flow in both hemispheres. In some cases there appears a lower amplitude on the ligated side, which is due to the relatively smaller effectiveness of the collateral circulation.

The prolonged anacrotic phase of the waves on the ligated side suggests that blood is forced to take a longer route in reaching the hemisphere on the operated side.

In the light of these results we cannot accept the view that the cerebral circulation returns to the pre-operative state within a short period of time after surgery, as some authors have suggested\(^3, 7, 8\). On the contrary, the rheoencephalographic picture of cerebral circulation several years after surgery is similar to that in the immediate post-operative period. Only an insignificant tendency toward normalisation is observed.

Acknowledgements

We thank Dr. Barbara Politynska from Cambridge University, England for assistance in language editing.