European Journal of Neurodegenerative Diseases
ISSN 2974-6345 / 2024 vol. 13, ISSUE N. 2, May-August

Letter to the Editor

CEREBROVASCULAR DAMAGE PREVENTION: SURGICAL ASPECTS

D. Lauritano[1*] and F. Carinci[2]

[1] Department of Translational Medicine, University of Ferrara, Italy;
[2] Department of Morphology, Surgery and Experimental Medicine, University of Ferrara, Italy.

**Correspondence to*:
Dr. Dorina Lauritano,
Department of Translational Medicine,
University of Ferrara,
44121 Ferrara, Italy.
e-mail: dorina.lauritano@gmail.com

KEYWORDS: *brain, vascular, surgery, cerebrovascular disease, CNS*

INTRODUCTION

Globally, life span continues to increase, and the World Health Organization (WHO) predicts that in 2050, two billion individuals will be over 65 years of age. This prolongation of life leads to the progressive deterioration of physical and mental health which occurs with ageing, and this leads to the requirement for greater social and medical care (1).

In past centuries, no one could anticipate that the surgical aspect in the field of cerebrovascular diseases would occupy such a large part of medical-scientific activity (2). However, today the prevention of cerebrovascular diseases must be considered not only in terms of pharmacological treatment, to which we were accustomed, but the surgical aspect must also be considered. In tackling the prevention of this important disorder, which currently represents the third leading cause of death and the most serious cause of disability, the risk factors must be studied, which is not straightforward, as it involves challenging epidemiological aspects.

DISCUSSION

There are two prevention methods for cerebrovascular damage: the pharmacological method and the surgical method, and these can be considered antithetical. Both require a preliminary diagnosis of stenosis or obstruction of an artery which vascularizes the brain, that is, if the obstruction affects the large vessels of the neck such as the carotid or vertebral arteries.

Considering a high-risk for developing cerebrovascular disease, the surgical approach will be indicated (3). If it is a stenosis or an obstruction of several small vessels at the level of the brain, the subject of medical prevention will arise. Therefore, close collaboration between the neurologist and the vascular surgeon is important for diagnosis and therapy.

In any case, however, the situation needs to be carefully evaluated and it is currently possible to make use of instrumental noninvasive and repeatable techniques. In recent years, there has been a notable development of techniques that offer good reliability and prediction ability. Using these techniques when faced with a cerebrovascular pathology, it is possible to avoid trauma and risks to the patient that other tests would inevitably entail.

The diagnostic approach involves the use of the well-known Doppler ultrasound method (4). A further improvement of the ultrasound technique consists of the Doppler examination called “Eco-flow” which allows, with the reconstruction of the reflection of ultrasonic waves, the visual highlighting of the vessel. The image provided by this completely safe

Received: 02 May, 2024
Accepted: 09 May, 2024
2974-6345 (2024)

and noninvasive technique reproduces, with excellent reliability, results superimposable to those of an angiography, an invasive examination which is not completely risk-free, allowing the surgeon to confront any obstructive lesion.

This technique is followed by another one that is used with considerable frequency, called angioscintigraphy, a method that involves the intravenous injection of an isotope, such as technetium, and to following its progression with suitable instruments at the level of the neck arteries. The different concentration of the isotope at the level of the vascular structures translates into the reconstructed image on the display, which is portrayed in different intensities on a defined chromatic scale. For example, obstruction of a carotid artery will result in a reduction in the quantity of isotope in the ipsilateral hemisphere, which will be evident in comparison with the opposite hemisphere. This method also allows medical professionals to reconstruct the transit curves of the tracer in the two hemispheres and in the different vessel segments (middle cerebral carotid artery, etc.), indicating the perfusion speed but not of the blood flow. Remaining with the example of an obstructive lesion of the carotid artery, in this case, a slowing of transit will be observed in the damaged vessel compared to the contralateral one, indicated by a reduced increase in the ascending phase of the curve. This possibility of analyzing the speed of transit can also be applied to the study of the middle cerebral arteries of which similar curves will be highlighted.

The task that then arises is to evaluate the functionality of the cerebral structures, which can be an indication for considering a surgical approach. If there is stabilized damage to the nerve cells, an increase in perfusion which is obtainable with unblocking or other surgical techniques (bypass), will not result in a clear functional recovery. Noninvasive techniques such as Computerized Axial Tomography (CAT) have provided a precise anatomical description of the brain structures but not of their functionality (5).

Today, it is possible to use techniques that are similar to CAT scans, which utilize both gamma and positron emitting isotopes. If a non-fuse tracer, such as technetium, is injected during a tomoscintigraphic examination (gamma CAT), any areas of different uptake will be observed in a series of "slices" of the brain structure starting from the vertex. In an infarct area, the alteration of the blood-brain barrier (BBB) will cause diffusion of the tracer. It is clear that, in such a case, it is necessary to carefully determine whether there is the need for increased blood flow to the area in question or whether this would do more harm than good.

The current perspectives in the field of non-traumatic diagnostics also offer other much more precise possibilities. In fact, the use of C11-labeled glucose allows the distribution of the tracer to be visualized and is therefore able to provide an indicator of the metabolism in the central nervous system (CNS) (6). Similarly, techniques that use O_2-15, a positron emitter, allow the evaluation of both perfusion and cerebral consumption of oxygen (7).

These methods allow for the evaluation, not only of the distribution of the flow, but also for the ability of brain tissue metabolism. This information should be considered for evaluating the functionality of the brain tissue and the prospect of any surgical intervention aimed at restoring blood flow to injured areas. From this perspective of correlations between flow and metabolism, and with the continued collaboration of vascular surgeons, it is believed that in the not-too-distant future it will be possible to prevent and treat cerebrovascular pathology more effectively.

CONCLUSIONS

The ageing of the global population will increase the number of people affected by cerebrovascular diseases in the coming decades. It is important to focus on the prevention and treatment of these disorders, in order to ensure a higher quality of life for the ageing population. In recent decades, cardiovascular diseases, strokes, and obstruction of the cerebral vessels often require surgical interventions, which today have assumed fundamental importance. In recent years, there has been a notable development of surgical techniques that offer good reliability and predictive ability. The diagnosis of cerebrovascular diseases involves the use of Doppler ultrasound and "Eco-flow" which allow for visualization of the vessels and are very useful diagnostic techniques for the surgeon. Additionally, angioscintigraphy involves the intravenous injection of technetium, and highlights the different concentrations of the isotope at the level of the vascular structures. The utilization of CAT for investigating vascular pathologies provides a satisfactory anatomical description of brain structures. Other diagnostic methods are gamma CAT and the use of glucose labelled with C11. These methods are useful for describing the morphology of tissue, but not for the functionality of cerebral structures. These techniques assist neurologists and surgeons in the evaluation of the flow distribution and in deciding whether to carry out a possible surgical intervention aimed at restoring blood flow.

Conflict of interest

The authors declare that they have no conflict of interest.

REFERENCES

1. Grande G, Qiu C, Fratiglioni L. Prevention of dementia in an ageing world: Evidence and biological rationale. *Ageing Research Reviews*. 2020;64:101045. doi:https://doi.org/10.1016/j.arr.2020.101045
2. Gottesman RF, Latour L. What's the Future of Vascular Neurology? *Neurotherapeutics*. 2023;20(3):605-612. doi:https://doi.org/10.1007/s13311-023-01374-4
3. Ghali MGZ. Telovelar surgical approach. *Neurosurgical Review*. 2019;44(1):61-76. doi:https://doi.org/10.1007/s10143-019-01190-5
4. Craven CL, Sae-Huang M, Hoskote C, Watkins LD, Reddy U, Toma AK. Relationship between Brain Tissue Oxygen Tension and Transcranial Doppler Ultrasonography. *World neurosurgery*. 2021;149:e942-e946. doi:https://doi.org/10.1016/j.wneu.2021.01.070
5. Josephson CB, White PM, Krishan A, Al-Shahi Salman R. Computed tomography angiography or magnetic resonance angiography for detection of intracranial vascular malformations in patients with intracerebral haemorrhage. *Cochrane Database of Systematic Reviews*. 2014;2014(9). doi:https://doi.org/10.1002/14651858.cd009372.pub2
6. Takahashi S, Izawa Y, Suzuki N. Astroglial Pentose Phosphate Pathway Rates in Response to High-Glucose Environments. *ASN Neuro*. 2012;4(2):AN20120002. doi:https://doi.org/10.1042/an20120002
7. Initial Management. *Journal of Neurotrauma*. 2000;17(6_7):463-469. doi:https://doi.org/10.1089/neu.2000.17.463