Arterial occlusions: does size matter?

Louis R Caplan

Are the smaller of paired arteries more vulnerable to occlusion?

"Such knowledge as we have of these steps is derived from casual glimpses afforded when, as the outcome of one of Nature's experiments, some particular line is interfered with..."
E Garrod. *Inborn errors of metabolism*

Giannopoulos and colleagues,¹ in a paper in this issue of *J Neurol Neurosurg Psychiatry*, report three instances of lateral medullary infarcts in young patients (average age 38 years) associated with occlusion of ipsilateral hypoplastic vertebral arteries (*see page 987*).¹ All three patients had high blood pressure and one had hyperlipidaemia.

The two vertebral arteries are very often asymmetrical. Chuang *et al* investigated 191 patients with acute ischaemic stroke and found that 11.5% had a unilateral hypoplastic vertebral artery.² They found a significant relationship between vertebral artery hypoplasia and ipsilateral posterior circulation infarction.² In the New England Medical Center Posterior Circulation Registry, we also noted that in patients with infarcts involving the proximal intracranial territory fed by the vertebral arteries (medulla and posterior inferior cerebellum), occlusive lesions favoured the smaller vertebral artery ipsilateral to the infarcts.³ These observations raise the larger question—among paired arteries, are the smaller arteries more likely to occlude? And, if so, why? Does size matter and how?

I became interested in this question more than a quarter of a century ago, stimulated by a single patient.⁴ A

47-year-old woman had attacks of left monocular visual loss and a right inferior quadrantanopia. She had claudication involving her left calf. Blood pressure was 180/90 mm Hg in the right arm. Examination showed that her left hemi-body and limbs were appreciably smaller than the right counterparts. She had no left hand or foot pulse and these extremities were cool. Angiography showed occlusions of her left internal carotid and left common iliac artery and severe stenosis of the left subclavian and the left vertebral artery. All of the left-sided arteries were considerably smaller than those on the right. The right-sided arteries were all normal. This clearly was an experiment of nature. All her vessels were supplied by the same bloodstream and yet all the smaller arteries of pairs were severely compromised while the larger counterparts were spared.

In order to formally study the issue of size, I investigated 20 patients in whom one internal carotid artery (ICA) was occluded or severely stenotic while the contralateral artery was spared.⁴ Among 12 patients with unilateral ICA occlusions, 10/11 with unequal arterial size had the occlusion on the smaller side. Among 20 patients with severe asymmetrical ICA stenosis, 13/17 with unequal sized arteries had the stenosis on the smaller side. Most of the patients had vascular risk factors. Lumenal size varied considerably from 2.8 to 9.5 mm.

These data, along with the observations of Giannopoulos *et al*¹ and Chuang *et al*,² lead to the inescapable conclusion that size does matter. The smaller of paired

arteries are more vulnerable to occlusion, especially if vascular risk factors are present. The main question is why? Nature may be suggesting an important lesson in pathophysiology, if we could only unlock the explanation.

Clearly the explanation cannot be size alone as many intracranial arteries are smaller than the hypoplastic or smaller arteries identified in these studies, and they are not predisposed to occlude. The answer must lie somehow in the physics of blood flow and shear forces. There must be an interaction between blood pressure, blood constituents and the rheology and physics of blood flow at various arterial locations that explains the data.

Lastly, I feel compelled to mention how often seeing single patients leads to observations and ideas that trigger investigations into basic principles. Keeping active at the bedside is a critical stimulus to new ideas. Case reports, an *n* of 1, are still extremely important in generating ideas and formal research. All of the answers do not lie in large analyses and meta-analyses of lumped, often heterogeneous, patients. There is great value in studying in depth the individual patient at the bedside and in the laboratory.

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