evaluation of the literature we are not taking a cavalier attitude towards this operation. The exact opposite is true. We are attempting to face the known facts. The important issue, of course, is to ensure that the real risks of this surgery are identified. There is no virtue in attempting to smite an imaginary dragon. It is obvious that the hemodynamic risks in carotid endarterectomy have been greatly exaggerated in the literature. Old assumptions need to be re-evaluated, rather than to be accepted on faith. The key to success appears to relate most to patient selection and surgical skill. It is not advocated, however, that anyone discard a practice in which they feel confident. Although in theory a few patients who are at significant hemodynamic risk might benefit from the use of a shunt, they can not yet be accurately identified. There are potential problems with the use of a shunt, and as a result the net benefit from it’s use has yet to be convincingly demonstrated.

The purpose of the Editorial was to prompt discussion (which it appears to have done) in the hope that this might help resolve the controversies regarding the safest method of performing this surgery. Time will tell if the viewpoint of the Editorial is correct.

Gary G. Ferguson, M.D., F.R.C.S.(C)
University of Western Ontario
London, Ontario, Canada

References


Does the Geometry of the Carotid Bifurcation Affect its Predisposition to Atheroma

To the Editor:

It has been suggested that the characteristics of flow patterns at the carotid bifurcation may have a bearing on its frequent involvement by atheroma. Flow separation occurs opposite the orifice of side branches like the external carotid artery and has been implicated in the development of plaques at the junction of the common and internal carotid arteries. Platelet collisions, with each other, and with the vessel wall are increased in vortices at such sites.

It seemed possible that individual variations in the geometry of the carotid bifurcation might be relevant to the risks of development of atheroma. The absolute size of the carotid vessels might also be relevant, a previous study having suggested that the smaller of the 2 internal carotid arteries was more likely to show angiographic evidence of wall disease.

Angiograms from 150 patients were traced and the diameter of the common (CC) and internal carotid (IC) arteries measured. The maximal diameter of the sinus was recorded, and that of the internal carotid artery above the sinus. The angles between the common, internal, and external carotid (EC) arteries were taken from whichever angiographic view showed the greater separation of the IC and EC.

As the table shows there were no significant differences in the size of the common carotid artery and the undiseased upper parts of the internal carotid artery and the undiseased upper parts of the internal carotid artery.

| Table
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<th>Geometry of bifurcation</th>
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<td>Angiography</td>
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<tr>
<td>Normal</td>
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<td>(n = 102)</td>
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<td>Plaque</td>
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<td>(n = 48)</td>
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<td>Significance</td>
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carotid artery when 48 patients with atheromatous changes at the bifurcation were compared with 102 with normal appearances. There was a reduction in the maximal diameter of the diseased segment of the internal carotid artery which may be a reflection of the difficulty in measuring the vessel width when there are plaques present.

The angle between the IC and EC was not significantly different in the two groups but there was a suggestion that the line of the common carotid and internal carotid artery was straighter in those with atheroma.

These results suggest that major differences in the geometry of the carotid bifurcation are unlikely to explain the different predisposition to carotid atheroma of different individuals. The minor changes detected seem more likely to reflect the effects of disease.

M.J.G. Harrison
J. Marshall
Department of Neurological Studies,
The Middlesex Hospital,
Mortimer Street, London W1,
England

References


Editor’s Note: Comments on the above Dr. Harrison and Dr. Marshall letter were solicited from Dr. Louis Caplan and Dr. Frank LoGerfo. Their comments follow.

To the Editor:

The observation that one carotid artery may have severe occlusive disease while its opposite seems uninvolved is an incontrovertible fact. A search for an explanation of this problem is clearly worthwhile for it might unlock some of the factors in the etiology of ischemic stroke. Harrison and Marshall put forth data that argues against size or angulation as important causative factors.

In our study of vessel size, we carefully chose vessels with severe obstruction (less than 2 mm residual lumen) as clearcut examples of significant occlusive disease. Harrison and Marshall analyze patients with ”atheromatous change” at the bifurcation and contrasted their vessel size with those with "normal appearance." It is not clear what is meant by atheromatous change. Are these shallow plaques, ulcerated plaques, or stenosis? If stenosis, to what degree?

These points are important since the capability of arteriography to differentiate small plaques from normal is questionable. Also, the relationship of that shallow plaques to stroke is uncertain. Stenosis and occlusion are undoubtedly related to stroke. When a vessel is examined directly at surgery or post-mortem, there is usually some atheromatous change, often insufficient to encroach on the lumen but making the vessel hard and yellow. Baker in his study of atherosclerosis used these atheromatous changes to study the epidemiology of atherosclerosis.
Since changes of this nature are nearly ubiquitous with aging and many patients do not have strokes, the relationship of small plaques to stroke disease remain uncertain. It seems to me that one must look at unequivocal examples of severe stenosis and compare these to “normals” if meaningful data are to come forth. Also, since there are many other factors, the best place to search would be patients with severe disease on one side and relatively normal contralateral vessels, for in these patients factors other than flow physics should be well controlled.

Louis R. Caplan, M.D.
Michael Reese Hospital and Medical Center,
Chicago, Illinois 60616

To the Editor:

Drs. Harrison and Marshall refer to work done by my colleagues and me in which we demonstrated the presence of flow separation in a plastic model arterial bifurcation. Subsequently Wood, using a sophisticated ultrasound technique, demonstrated flow separation at the normal carotid bifurcation, and Zarins documented a relationship between the site of flow separation and the site of atherosclerotic plaque in an autopsy study. We noted the same association on arteriographic findings. In our work, we have shown that the presence of flow separation and the rate of movement of fluid within the separated region is highly dependent upon both the angle of bifurcation and the flow split. In particular, small differences in flow split can cause dramatic differences in flow separation. This raises the question of whether differences in the angle and flow split at the carotid bifurcation might explain why only some patients with atherosclerosis elsewhere develop a plaque at the carotid bifurcation. Drs. Harrison and Marshall have attempted to define a relationship between one of these factors, the angle of the carotid bifurcation, and the development of atherosclerotic plaque. Their results seem to show a relationship between the common carotid-internal carotid angle and plaque formation. They also make note of a possible relationship to the relative size of the vessels involved. These are interesting observations and should not be dismissed. The fact that there are not “major differences” in carotid geometry is not surprising based on our previous work documenting the delicate balance of factors involved in flow separation. Therefore, the possibility that size relationships, bifurcation angles, and flow split are important factors in carotid atherosclerosis remains viable and further studies are encouraged.

If the precise near-wall fluid dynamics, which lead to atherogenesis, can be defined, it will in all likelihood provide some insight into the biologic mechanisms involved. For example, we have recently made some further observations on the details of flow separation which indicate the possibility that shear activation of platelets is likely to be a factor in the development of plaque in the separated region.

Frank W. LoGerfo, M.D.
Associate Professor of Surgery,
University Hospital,
Boston, MA 02118

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Does the geometry of the carotid bifurcation affect its predisposition to atheroma?

*Stroke.* 1983;14:117-118
doi: 10.1161/01.STR.14.1.117

*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

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