

Mechanical Occlusion of the Vertebral Artery

A New Clinical Concept

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Acute insufficiency of the basilar artery, in the absence of organic disease, has been encountered in 20 patients. Attacks are transient and are precipitated by turning the head laterally and upwards. Two conditions are extant: (1) obliteration of vertebral artery flow by the contraction of the longus colli muscle and the scalene muscle at the level of the vertebral foramen of the sixth cervical vertebra and (2) a hypoplastic contralateral artery which does not adequately supply the basilar circulation. Vertebral angiography confirms the diagnosis by demonstrating one hypoplastic artery and a large contralateral artery that occludes upon forced lateral rotation of the head. The treatment consists of clearing the sixth vertebral foramen of all tendonous attachments and interposing a fat pedicle amongst the severed tendons to obviate their reattachment.

Since the advent of vascular surgery, insufficiency of the great arteries of the head and neck has become the object of intensive study. The increasing interest in this subject undoubtedly stems from the fact that cerebrovascular disease constitutes a major cause of disability in the adult American population, outranked only by heart disease and cancer, respectively.

While the bulk of this research work has dealt with the carotid arteries, several contributions have been made concerning Insufficiency of the vertebral arteries. Compromised vertebral blood flow due to intrinsic disease, like that of the carotids, has been clearly outlined and its management fairly well standardized. Insufficiency due to extraluminal factors such as scar tissue, osteoarthritis and osteophyte, abnormal origin of the vertebral artery, and others has also been reported. The purpose of this communication is to present observations relative to a new clinical concept in vertebral- artery insufficiency and to submit a definitive method of treatment.

Materials and Methods

The clinical material consists of 20 patients, 12 men and eight women. Ages ranged from 27 to 66 years with a mean of 40. The presenting symptom in all patients was dizziness. This was intermittent and brought about by sudden movements of the head and neck such as turning the head to the side or looking upward or both. In addition, vertigo, blurring of vision, unsteady gait, nausea, fainting, headache, and tingling of the upper extremity were present in some of the patients (Table). One patient, a 54-year-old woman, was so disabled by this

condition that she resorted to complete bed rest for two weeks prior to her admission on to the hospital. Two others gave up driving, and one patient relinquished his bowling game because of the repeated episodes of dizziness associated with movements of the head and neck.

All patients received a complete neurological workup including electroencephalography and spinal-fluid studies. The clinical evaluation failed to reveal any definite neurological deficit. Turning the head to the side precipitated dizziness in most patients, and a murmur became audible in the supraclavicular fossa in eight. Four patients had an associated scalenus anticus syndrome. Arteriography of the great arteries of the head and neck was also undertaken in all cases. Arteriograms of the vertebral arteries were obtained in the "head drop." anteroposterior (AP) projection, and in rotational positions of the head.

Signs and Symptoms

	No. of Patients	%
Dizziness	10	100
Vertigo	8	40
Headache	6	30
Scalenus anticus	4	25
Loss of consciousness	4	25
Gait disturbance	3	15
Visual disturbance	3	15
Nausea	2	10
Numbness or tingling of upper extremity	2	10

Fifteen to twenty two milliliters of 50% sodium diatrizoate (Hypaque Sodium) were injected percutaneously into the brachial artery at the antecubital fossa by hand or with a pressure injector at 150 to 300 pounds per square inch (psi). Six exposures were obtained of every projection with a rapid cassette changer at 0.5- or 0.6-second intervals. The quality of the arteriograms obtained by this technique was excellent. Only patients in whom lateral rotation of the head effected a mechanical

occlusion of an otherwise normal vertebral artery were included in this study. The arteriographic findings were as follows: The vertebral arteries appeared normal in all patients in the AP-projection.

When the head was turned to the side, occlusion as demonstrated in the contralateral artery. The occlusion corresponded to the level of the sixth cervical vertebra and was bilateral in five patients. In 18 of the patients, the artery on one side was considerably smaller in diameter than that on the opposite side and, in most instances, effected a poor or nondemonstrable communication with the basilar artery. In the unilateral cases, the block always involved the larger of the two vertebral arteries. In the remaining two, the arteries were comparable in size and in the extent of communication with the basilar artery. In one, however, a large plaque at the origin of the unoccluded artery reduced its lumen by, at least, 60%.

Treatment

All patients were treated surgically. A transverse supraclavicular approach was used. During the course of dissection of the vertebral artery, it was observed that the tendonous origin of the scalenus anticus muscle from the rim of the vertebral canal of the sixth cervical vertebra was wide and interdigitated with tendonous slips of origin of the longus colli and scalenus medius muscles. Tension on these interdigitations caused the latter to impinge on the vertebral artery just prior to its entry into the vertebral foramen. In view of these findings, six anatomic dissections were carefully undertaken. In every one, interdigitations between the scalenus anticus and longus colli tendons were demonstrated at their origin from the transverse process of the sixth cervical vertebra. The mechanism of occlusion is obviously related to these tendons; fibers arising from the-lateral rim of the vertebral canal, crossing anterior or posterior to the vertebral artery to join the longus colli muscle could effect a complete block of that vessel when they are tensed up by muscular contraction. Similarly, tendons arising from the medial lip of the foramen to join the scalenus anticus or scalenus medius muscle could also effect a mechanical occlusion of that artery.

The surgical approach was therefore standardized and consisted of (1) resection of the lower segment of the scalenus anticus muscle up to and including the slips arising from the sixth cervical vertebra, (2) sectioning of the longus colli tendon in that same location so that the rim of the vertebral foramen is entirely free, (3) absolute hemostasis, and (4) development of a fat pedicle from the scalene fat pad to interpose between the two tendons in an effort to prevent reattachment.

Results

In 19 patients, the symptoms were dramatically and completely alleviated. The remaining one showed moderate improvement, enough to resume his bowling game. Eight patients were followed up for 3 1/2 years, two for 2 1/2 years, and ten for 1 1/2 years. The patient that was bedridden for two weeks prior to the operation was walking the next morning in disbelief. Vertebral arteriograms were repeated one week to one year postoperatively, and demonstrated a patent artery in all positions of the head and neck.

Comment

From the foregoing material, it is evident that the basic pathology in this group of patients is one of mechanical obstruction. It does not seem related to the sympathetic supply or to an abnormal origin of the vertebral artery as reported by previous investigators. Occlusion was clearly demonstrated in all patients in forced lateral rotation of the head and neck and its relief was dramatically effected by eliminating the mechanical cause. **In 95% of the cases here presented, the contralateral vertebral artery did not contribute an adequate supply to the basilar artery either by virtue of its being, congenitally, considerably smaller than the involved artery (18 cases), or by having severe organic stenosis as seen in one patient. Thus, when the main supply to the basilar system is cut off by mechanically occluding the larger vertebral artery, acute basilar insufficiency becomes manifest. The anatomic variation observed in this clinical study undoubtedly underscores this fascinating clinical entity. Interesting observations have been made regarding the effect on the cerebral circulation of turning the head. Rotation of the head to the side has been demonstrated to significantly reduce the blood flow in the contralateral carotid and vertebral arteries. This reduction in the flow of blood is ordinarily compensated for by an increased flow through the other carotid and vertebral arteries. If, however, the vertebral artery on the same side of the reduced carotid flow is completely arrested by turning the head, especially in people with a marginal flow through the circle of Willis, the acute reduction of cerebral blood flow could conceivably be enough to manifest itself clinically.** This may apply to the only remaining patient in the series with equally good vertebral arteries.

The value of periarterial sympathectomy, as advocated by Powers and his group, is seriously questioned by this study. Since periarterial sympathectomy was introduced by Jaboulay and popularized by LeRiche, the test of time has shown that the value of this procedure in improving blood flow is, at best, temporary. Furthermore, in the case of the vertebral artery, the extent of the sympathectomy performed falls very short of achieving a complete denervation of that vessel. The

vertebral sympathetic plexus is very rich and, in part, not accessible to the surgeon. In addition to the two vertebral nerves that can readily be removed surgically, the plexus acquires branches from the middle and superior cervical ganglia, filaments from the first and second cervical nerves, and occasionally branches from the hypoglossal and vagus nerves, thereby obviating a complete surgical denervation.

The interdigitations between the slips of origin of the scalenus anticus and the longus colli muscles are real and cannot be considered "redundant or abnormal fascial bands." They were observed in all the operated cases and in the anatomic material studied. Furthermore, in this group of patients, no abnormal origin of the vertebral arteries was encountered. It is interesting to speculate on the possibility that the scalenotomy, routinely performed during the periarterial sympathectomy and during the clearing of the "abnormal fascial bands," was the cause of the improvement seen in those patients.

This syndrome appears to lend itself admirably to the treatment outlined, ie, clearing the vertebral foramen of the sixth cervical vertebra from all tendonous attachments, absolute hemostasis, and interposing a fat pedicle in the space created in an effort to prevent scarring and reattachment of the tendons in question. Treatment should be instituted early to prevent possible traumatic injury to the vertebral artery. It may be speculation to carry this mechanical phenomenon a little further and ascribe to it some form of trauma to the vertebral artery. It has long been known that the occlusion of the superficial femoral artery practically always begins at the site where the artery enters the tendon of the adductor magnus muscle. A similar situation could conceivably develop in the case of the vertebral artery. Indeed, two patients, not included in this series, demonstrated clinical and operative evidence of occlusion of the vertebral artery in spite of the absence of significant arteriosclerotic disease at its origin from the subclavian artery.

Conclusion

Mechanical occlusion of the normal vertebral artery may occur by turning the head. It is believed that this phenomenon is triggered by the action the longus colli and the scalene muscles on the artery just prior to its entry into the vertebral foramen of the sixth cervical vertebra. It is also felt that acute interruption of blood flow through one vertebral artery may not necessarily cause symptoms unless the contralateral artery is considerably small, diseased, or effects a poor communication with the basilar artery. Results of the proposed surgical treatment for this syndrome are dramatic and lasting.

References

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THE SPIRIT OF THE NATURAL SCIENCES. It was indeed true, as was emphasized by Asclepiades of Bithynia, the leader of the old school of methodologists, that it is the method of investigation which is essential and decisive. For what other reason has Lord Bacon become so worthy of the admiration of the ages—a man who (as James Fenimore Cooper cogently remarks) was a rascal, even though a philosopher? It was because he, for the first time with full understanding, after a long period of speculation, taught the scientific method,

from which the natural sciences then quickly developed. It is a method which differentiates the Harveys, the Hallers, the Bells, the Magendles, and the Mullers from their lesser contemporaries. This method is the spirit of the natural sciences.

Disease, Life, and Man: Selected Essays by Rudolf Virchow, L. J. Rather (trans.-ed.), New York: Collier Books, 1962, p 57.