Bilateral Carotid Ligation

Case Report

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Although bilateral carotid ligation is less extensively used and reported than the unilateral method in the treatment of intracranial vascular lesions, it nevertheless has produced good results in certain cases. This report describes a patient who had a large arteriovenous malformation in the diencephalon and who was treated successfully with bilateral carotid ligation.

Case Report

An 18-year-old Korean man was admitted to the Seoul Red Cross Hospital on September 26, 1964, because of repeated acute episodes of severe headache, vomiting, and stiffness of the neck over the past 3 years.

Examination. The patient was slightly confused and stuporous. The blood pressure was 120/60 mm Hg, pulse 84, respiration 24/min, and temperature 38.2°C. There was moderate neck stiffness. Bilateral Babinski responses could be elicited. The striking finding was a loud cranial systolic bruit which was best perceived over the eyes and temples. Percutaneous compression of the left common carotid artery resulted in disappearance of the cranial bruit; similar compression of the right common artery had no effect. The patient experienced no ischemic neurological signs as a result of carotid occlusion which was maintained for 20 minutes on each side.

Routine laboratory studies, which included estimation of hemoglobin, white blood cell count, and urinalysis, were normal. Lumbar puncture done shortly after admission yielded clear pink cerebrospinal (CSF) fluid. The CSF pressure was 600 mm H₂O. Bilateral carotid arteriography on the day of admission revealed a large arteriovenous malformation situated on the medial aspect of the right cerebral hemisphere (Fig. 1). Feeding arteries included the right anterior choroidal, right middle cerebral, and both anterior cerebrials. In retrospect, the study would have been more complete if the posterior circulation had been examined at this time.

Operation. It was elected to treat the intracranial vascular lesion by gradual ligation of the left common carotid artery. Accordingly, on October 5, a dissection of the left side of the neck was performed under local anesthesia (1% procaine). A Poppen-Blalock clamp was placed about the left common carotid artery approximately 2 cm proximal to its bifurcation. The clamp was initially given 3 of the 7½ turns necessary to accomplish complete occlusion of the artery. Immediately following surgery, closure of the clamp to within one-quarter turn of full occlusion produced a 30% reduction in the ipsilateral mean retinal artery pressure as measured by ophthalmodynamometry, but by the next morning the reduction was only 8%. At this time, the clamp was closed tightly about the artery with a resulting 16% reduction in ipsilateral retinal artery pressure. Two days following surgery, however, the mean retinal artery pressure on the side of the carotid ligation showed only a 7% reduction in comparison with the opposite eye. Ten days following surgery, the retinal artery pressures were equal.

There were no neurological sequelae as a result of ligation of the left common carotid artery. Ligation of the left carotid artery had produced a significant, but temporary, reduction in intensity of the intracranial bruit. On the day following complete occlusion of the carotid artery with the clamp, the intracranial bruit had returned to its original intensity. On October 8, the clamp was removed and the left common carotid artery ligated. Right carotid arteriography performed on October 19 demonstrated essentially no
change in the intracranial vascular lesion (Fig. 2).

Because of the recurrence of the bruit to its original intensity, the insignificant difference in retinal artery pressure following carotid ligation, and the unchanged appearance of the intracranial vascular lesion on postoperative arteriography, it was decided to perform carotid ligation on the right side. Beginning on October 21, percutaneous occlusion (Matas' test) of the right common carotid artery was performed daily. Initially,
the patient complained of dizziness and headache after 4 minutes of compression. Over a period of 18 days, tolerance to digital carotid compression increased to the point at which the patient could withstand 20 minutes of occlusion without symptoms. The intracranial bruit disappeared during the periods of compression.

Second Operation. On November 10, dissection of the right side of the neck was performed under local anesthesia, and a Poppen-Blalock clamp applied to the right common carotid artery immediately below its bifurcation. The clamp was turned down 4 turns of the 7 turns required for complete closure of the artery. Immediately following surgery, ophthalmodynamometry revealed a 69% reduction in mean retinal artery pressure of the right eye. An additional one-quarter turn of the clamp produced a severe headache but no motor weakness. At this clamp setting (4½ turns), there was a marked diminution in intensity of the intracranial bruit.

On the day following surgery, the bruit was louder, but a significant reduction (66%) in retinal pressure was still present. An additional one-half turn of the clamp resulted in a significant reduction in the intensity of the bruit. Three days following surgery, complete closure of the clamp resulted in a disappearance of the bruit. On November 16, the clamp was removed from the right common carotid artery and the vessel ligated.

On November 28, a right carotid and right vertebral arteriogram (Fig. 3) showed no change in the size of the intracranial vascular anomaly. There was no bruit throughout the remainder of the patient's hospital course. On December 5, ophthalmodynamometry revealed a 33% reduction in mean retinal artery pressure on the right side.

The patient was discharged on December 5. He has no further attacks of headache, vomiting, or neck stiffness and has been able to work as a farmer since discharge from the hospital.

Discussion

Since Dandy\textsuperscript{2} first ligated a single internal carotid artery in the neck as treatment for an intracranial arteriovenous malformation, several workers\textsuperscript{6,7,11} have tried this method of treatment. In general, however, the results of treatment of these lesions by unilateral carotid ligation have been disappointing, principally because of the well-developed collateral vessels which supply the arteriovenous
Fig. 3. Follow-up carotid and vertebral arteriograms following bilateral carotid ligation. Upper: Right carotid arteriograms reveal no change from the preoperative films. Lower: Vertebral arteriograms demonstrate that the anomaly is also fed by the vertebral system.

Olivecrona and Riives feel that unilateral carotid ligation in patients with arteriovenous malformations actually may be hazardous because of the possibility of cerebral ischemia due to short-circuiting of the blood through the malformation.

Although bilateral carotid ligation seems a formidable procedure because of the danger of concomitant cerebral hypoxia, a review of the literature reveals that the mortality and
morbidity are not excessively high. In his review of 33 cases of bilateral carotid ligation, Wyeth\(^2\) reported a mortality rate of 29%. Rivington\(^8\) collected 44 cases of bilateral carotid ligation with 6 deaths, 26 cures, and 5 failures. Ray\(^8\) performed bilateral carotid ligation successfully in two cases of arteriovenous malformation. It may well be that patients with large arteriovenous malformation of the brain tolerate bilateral carotid ligation better than do other patients because of the well-developed collateral circulation associated with malformation.

Favorable anatomical changes in intracranial aneurysms, such as thrombosis or significant reduction in size, have been reported following carotid ligation. In a series of internal carotid aneurysms reported by Tindall, et al.,\(^10\) either intra-aneurysmal thrombosis or significant reduction in size occurred in 74% of 58 cases. In our case, although the arteriovenous malformation did not undergo thrombosis following bilateral carotid ligation, the fact that the bruit disappeared and the patient has not experienced hemorrhage indicates that the pressure reduction in the lesion consequent to bilateral carotid ligation was an effective treatment.

**Summary**

We have reported a case in which a large cerebral arteriovenous malformation located in the diencephalon was treated by staged bilateral carotid ligation. Although this did not alter the myelographic evidence, it did produce disappearance of the cranial bruit, and elimination of symptomatic bleeding episodes over a follow-up period of 4 years.

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**References**

12. Wyeth, J. A. (Cited by Hamby, see ref. 3.)