OCCLUSION OF ARTERIES WITHIN THE CHEST FOR HEMOSTASIS DURING SURGERY ON THE HEAD

W. James Gardner, M.D.,* Jorge Angel, M.D.,† and Nathaniel R. Hollister, M.D.‡

(Received for publication January 28, 1959)

In order to reduce bleeding during the removal of a large arteriovenous malformation involving the left temporal muscle, hypothermia was combined with occlusion at the aortic arch of the innominate, the left common carotid and left subclavian arteries.

CASE REPORT

A 25-year-old woman noticed a swelling in the left temporal region. A faint port-wine stain had been present over this area since birth. One year prior to admission, during the first trimester of her first pregnancy, she became aware of a swelling beneath the cutaneous lesion. Within a few days this rapidly enlarged and a rushing sound, synchronous with the pulse, developed in the left ear. The mass became so prominent toward the end of pregnancy that her physician feared it might rupture during the stress of labor. Delivery, however, was uneventful and the mass then became smaller. Two months later it again increased in size and the bruit became louder. Brief episodes of dizziness associated with transient numbness of the right arm led the patient again to seek help.

Roentgenograms of the skull disclosed a concentration of dilated vascular channels in the upper left temporal region (Fig. 1). An attempted exposure of the left common carotid for arteriography was given up because of almost uncontrollable bleeding from engorged venous channels about the carotid sheath. One month later ligation of the left external carotid artery was successfully accomplished after another prolonged struggle with bleeding. Prior to closure, a left internal carotid arteriogram showed that branches of the middle cerebral artery approached closer than usual to the inner table of the skull beneath the site of the lesion. Although there was visualization of some enormous venous channels in the extracranial mass, an actual communication with the middle cerebral artery could not be seen. However, it was assumed that such communication was present since the middle meningeal and other branches of the external carotid contained no dye. The external carotid ligation was followed by disappearance of the bruit and some reduction in the size of the mass. Three days later the bruit reappeared and soon became as loud as before.

One month following this operation, examination revealed a large, pulsating mass in the left preauricular area (Fig. 2). There was a faint port-wine stain over the lower portion of the swelling. A loud bruit and a thrill synchronous with the pulse were present and were scarcely altered by compression of one or both carotid arteries. There were no abnormal neurological signs. The blood pressure was 100/60 mm. Hg and the electrocardiogram was normal. The diagnosis was arteriovenous malformation in the temporal muscle.

Previous experience with a lesion similar in appearance (Fig. 3), which proved to be confined to the temporal muscle, led to the hope, despite radiological and clinical evidence to the contrary, that the actual fistula in the present case also was entirely extracranial. In view of the threatening character of this lesion it was decided to undertake its removal with the patient rendered hypothermic and with provisions made for temporary occlusion of the blood supply to the head. The usual practice of occluding the vessels in the neck†‡ did not appear feasible in this case because of the serious difficulty that had been encountered at the previous

---

* 2020 East 93rd St., Cleveland 6, Ohio.
† Calle 49 No. 9-37, Apto. 102, Bogota, D.E., Colombia.
‡ 1007 Reibold Building, Dayton 2, Ohio.
dissections of the neck. Furthermore, bilateral digital compression of the vessels in the neck had not diminished the bruit or the tension of the mass. It was decided, therefore, to expose the vessels at the aortic arch where, it was naively anticipated, occlusion would be completely effective.

**Operation.** On April 24, 1956, with the patient anesthetized with Pentothal Sodium, and an endotracheal tube in place, the temperature was lowered to 85°F. by immersion in ice water. A cannula was introduced into the dorsalis pedis artery for direct recording of the intra-arterial pressure on a Tycos manometer after the method of Hale. A right thoracotomy was performed, tapes were placed about the innominate and the left common carotid arteries, and the left subclavian artery was occluded by an atraumatic clamp. While the thoracic surgeon held the tapes in a Rumel tourniquet the head was draped for exposure of the lesion.

A scalp incision beginning at the eyebrow was carried upward beyond the attachment of the temporal muscle and then downward in front of the ear to the angle of the mandible.

**Fig. 1.** Vascular channels in the skull beneath the lesion.

**Fig. 2.** (A) Preoperative appearance. (B) Appearance 3 months after excision of the temporal muscle.
The scalp was reflected from the fascia of the temporal muscle to a level below the zygoma. At the lower end of the incision severe bleeding was encountered from large branches of the superficial temporal artery entering the temporal muscle. This was controlled by the application of hemostats, electrocautery, and packing with gauze. The thoracic surgeon clamped the vessels at the aortic arch as the temporal muscle was cut across at the level of the zygoma. Despite this precaution, severe arterial bleeding occurred from both ends of the divided muscle. It was temporarily controlled by the application of hemostats, electrocautery and gauze packing beneath the zygoma. The divided temporal muscle was then gradually reflected upward from the temporal bone. This maneuver was accompanied by severe bleeding from numerous large arterial channels emerging from the skull. As hemorrhagic hypotension developed, the height of the spurting geysers could be reduced to about one half by occlusion of the great vessels within the chest and with this aid it was finally possible to control the bleeding. In some instances when cautery and bone wax failed, hemostasis was accomplished by packing the emissary arterial channel with cotton and then applying cautery to the cotton. Following removal of the packing from beneath the zygoma severe bleeding recurred from branches of the superior maxillary artery. It was controlled by electrocoagulation. In the meantime, despite four transfusions, the pulse was imperceptible and the intra-arterial pressure had fallen below 20 mm. of Hg. With three additional transfusions the blood pressure gradually rose and the pulse became palpable as the scalp incision was being closed. The clamp was then removed from the left subclavian and the tapes from the left common carotid and innominate arteries, and the thoracotomy wound was closed. The body temperature was raised by immersion in warm water.

The pathological diagnosis was vascular hamartoma of the temporal muscle. The abnormal channels were very large and the capillary bed was extremely sparse as compared with that of the patient shown in Fig. 3.

Course. The patient had an uneventful postoperative course, the bruit was relieved and she was discharged 10 days after operation with a hemoglobin of 9.3 gm. as compared with a preoperative value of 13.1 gm. per 100 ml. Two days before discharge a left carotid arteriogram was obtained which showed no change from the preoperative arteriogram except that the extracranial venous channels were no longer seen. Three months after discharge, the patient stated that she had experienced one episode of numbness affecting the right half of

Fig. 3. (A) A case of a similar arteriovenous malformation in the temporal muscle treated in 1932. In this case, the feeding arteries were much smaller, none came from within the skull, and the removal of the temporal muscle was easily accomplished with no special precautions. (B) Postoperative appearance.
the face, right arm and hand, lasting for 15 minutes. There was no recurrence of the bruit or of the mass in the left temple. She was taking no medication. Thirty months after operation she reported that she was free of symptoms.

COMMENT

During several periods of severe bleeding the great vessels at the aortic arch were occluded for periods of 3 to 6 minutes. The occlusion of these vessels supplying not only the head and neck but also the upper extremities had no demonstrable effect on the bleeding so long as the patient was normotensive. Their occlusion, however, did reduce the rate of bleeding an estimated 50 per cent after hemorrhagic hypotension had developed. Despite this surprisingly small effect, it was the surgeons' impression that without this safeguard the patient might not have survived. For 25 minutes during the critical stage of the operation, the mean pressure in the dorsalis pedis artery was below 20 mm. of Hg.

The significance of this case is its striking demonstration of the ability of an arteriovenous fistula to attract collateral circulation. The supply of blood to the lesion which persisted during closure of the vessels at the aortic arch must have arrived there by way of anastomoses between the arteries of the neck and the mammary and intercostal arteries. Even more striking is the fact that the thirst of this purely extracranial fistula appeared to have attracted anastomoses through the skull from the middle cerebral artery.

REFERENCES

