Resection of an Aneurysm of the Arch of the Aorta with Preservation of the Lumen of the Vessel

By Olivier Monod, M.D., and André Meyer, M.D.

A case is reported of a 20 year old woman, without history, stigmata, or serologic evidence of syphilis, who presented a mediastinal mass just above and lateral to the arch of the aorta which was originally mistaken for tuberculous lymph nodes. The diagnosis of saccular aneurysm was made after direct puncture of this mass under pleuroscopy. Exploratory thoracotomy was performed and a saccular aneurysm of the terminal part of the arch of the aorta was found. The aneurysm was removed and the aorta sutured without interrupting the continuity of the artery or narrowing its lumen. The authors believe that this is the second successful resection of an aortic aneurysm and the first in which resection was accomplished with preservation of the lumen of the aorta.

We WISH to present an unusual case report of a 20 year old girl from whom a saccular aneurysm of the arch of the aorta was removed without disturbing the flow of blood through the aorta. Since we have been unable to find a similar report in the literature, we are reporting the case history in detail.

Case Report

On Nov. 29, 1947 a 20 year old unmarried woman was admitted to the Boucicaut Hospital on Dr. André Meyer's service for evaluation of a rounded opacity shown by roentgenographic studies of the chest.

Early in 1945 she had had a persistent occipital headache which was accompanied by fever and which lasted three weeks. No treatment was given. In October 1945 the patient felt a "stitch" in the side at the right lung base which was accompanied by weight loss and a cough. A chest film seemed to reveal a few "spots" on the right side and a rounded opacity on the left side which was considered a tuberculous cavity. The tuberculin skin test was positive. The patient spent fifteen months in a sanatorium. Hemoptysis was never present and repeated gastric washings before and after admission to the sanatorium were negative for the Koch bacillus.

The past medical history revealed the occurrence of chicken pox, measles, and mumps in childhood. At the age of 7 years a small node which contained "some black blood" was removed from the left axilla.

From Laennec Hospital, Department of Thoracic Surgery, Service of Dr. Olivier Monod, and Boucicaut Hospital, Service of Dr. André Meyer, Paris, France.

Roentgenographic Studies. When we saw the patient in November 1947, x-ray films of the chest revealed a more or less circular shadow localized just at the outside and to the left of the aortic arch (fig. 1). The opacity was homogeneous and the shadow had a sharply demarcated outline. The surrounding pulmonary tissue was normal. A lateral film showed the opacity to be in the central part of the mediastinum. At 7.0 cm. from the dorsal plane, tomography revealed the opacity to be in continuity with the opacity of the aorta (fig. 2). This opacity measured 4.0 by 5.0 by 5.0 centimeters. Except for this shadow, the chest was considered to be normal. The ribs were not notched and radioscopicaly did not show any pulsation or expansion of the abnormality after a left-sided pneumothorax was induced (fig. 3). The temporary lack of Diodrast prevented us from making serial arteriographs.

As a result of these studies the diagnosis of a tuberculous lesion was abandoned and the lesion was considered to be probably a mediastinal tumor of neurogenic origin.

Pleuroscopy. A pleuroscopic examination, which is customary in such cases, was made on December 9, 1947 and a smooth, yellowish-white, spherical tumor was observed.* No intrinsic pulsations were noted and the tumor seemed to move in unison with the pulsations of the aorta. The metallic "palpateur" revealed the tumor to be quite hard. It was independent of the lobes of the lungs and was localized.

* The pleuroscopic examination was made by Dr. Nico.
opposite the forward part of the vertebral bodies on the superior and left side of the aortic arch. Under direct vision the tumor was punctured by a needle and pure bright red blood was withdrawn. Following removal of the needle a pulsatile stream of blood ran from the puncture for a few moments.

In view of these findings the diagnosis of neuroma was abandoned and the diagnosis of a vascular tumor or aneurysmal sac of a large artery, probably the aorta, was substituted.

The urine was within normal limits, as were the tendon and cutaneous reflexes. The electrocardiogram revealed sinus rhythm, a heart rate of 120, and "predominance of the right side."

In view of these findings the diagnosis of neuroma was abandoned and the diagnosis of a vascular tumor or aneurysmal sac of a large artery, probably the aorta, was substituted.

Physical Examination and Laboratory Studies.
At this time the state of health was excellent in every way. There was no fever or emaciation. The heart sounds were normal. The blood pressure in the left arm on December 2, 1947 was 175/100 (Vaquez). On December 4, 1947, the blood pressure in the right arm was 150/115 with a maximum oscillometrical index of 6; in the left arm, 165/100 with an oscillometric index of 4 (Pachon). There were no signs of coarctation of the aorta such as pulsation of the intercostal, scapular, external mammary, or internal mammary arteries. The eyegrounds were normal. Cytologic and chemical examination of

![Fig. 1.—X-ray film made July 4, 1947. A rounded shadow is seen just outside and to the left of the aortic arch.](image1)

![Fig. 2.—Tomographic study at 7.0 cm. from the dorsal plane. The shadow is seen to be in continuity with the aorta.](image2)

![Fig. 3.—X-ray film made after left pneumothorax.](image3)

There was slight prominence of Q2 and Q3. The blood Wassermann reaction was negative on three occasions before and after the operation and there was no history or stigmata of syphilis. The blood urea nitrogen was 15 mg. per cent;
the red blood cell count was 3,320,000; and the white blood cell count was 4,800.

A thoracotomy was decided upon with the thought that, if a tumor or cyst was found, it would be removed. If it proved to be an aneurysm, a decision would be made at operation as to just what could be done surgically.

Operation. An operation was performed by one of us (O. M.) on December 24, 1947. The anesthetic* consisted of cyclopropane and ether, given by inhalation with tracheal intubation and a closed circuit. During the operation 300 cc. of physiologic saline, 500 cc. of plasma, and 800 cc. of whole blood were given intravenously.

A lateral thoracotomy was performed with resection of the fifth rib from the transverse process to the cartilage. The sixth rib was cut at the posterior angle and the pleura entirely freed. A subpleural tumor localized below and to the left of the terminal part of the arch of the aorta became visible. The tumor was very distended and did not pulsate. (We were aware that the absence of this last sign does not eliminate the possibility of an anortic aneurysm, as was shown by Alexander and Byron*). The pleura was mobile on the surface and it was easy to separate all of the surface of the tumor, as would be the case with a cyst without any pericystic reaction. The vagus nerve was seen in front of the arch of the aorta and on the right of the tumor which was connected with the left side of the aortic arch by a fairly large pedicle. During the separation of the tumor, a small tear occurred at the most bulging and thinnest part of the sac, but the hemorrhage was immediately stopped by forceps. The pedicle of the sac was then thoroughly isolated and the aorta was carefully stripped of its cellular sheath. Two Crawford clamps were set longitudinally on the aorta so as to exclude the zone of the pedicle without entirely stopping the aortic blood stream.

The pedicle was then cut. After the pedicle was severed, it could be seen that the opening of the aneurysmal sac into the aorta was fortunately in the form of a slit. The opening was along the long axis of the aorta, being approxi-

* Anesthesia was under the supervision of Dr. Delahaye.

mately 4.0 cm. long but relatively narrow. This made it possible to close the opening in the aortic wall without narrowing the lumen of this vessel. A continuous suture was carefully introduced to bring into apposition the endothelium of each lip. The stitches were placed about 0.2 mm. apart and extended into the arterial wall to a depth of 0.5 millimeters. A second continuous suture, also perforating the muscular wall of the aorta, was made for security. The temporary hemostasis was then loosened. The material used for the suture was a nonabsorbent and nonabsorbable silk.

During the operation, care was taken to respect the vagus and the left recurrent laryngeal nerves which crossed the aortic arch 2.0 mm. in front of the pedicle of the aneurysmal sac.

The region was then explored and it was noted that below the suture a large anomalous artery arose from the convexity of the terminal part of the aortic arch. This artery was directed upward and to the right, passing between the spine and the esophagus. It was from this trunk that the brachial and cephalic arteries arose.

The whole of the apex of the parietal pleura was detached, as if for extrapleural pneumothorax, to furnish a good pleural flap for the operative zone. In this way all the operative zone was covered with pleura. The wound was sutured in three planes after complete re-expansion of the lung.

In the course of the operation, no increased vascularization of the intercostal muscles was observed. The intercostal arteries, as well as the medium-sized and small vessels of the mediastinum, showed a normal caliber.

Pathologic Findings. The gross specimen was a saccular aneurysm that was nearly spherical. Externally it was fairly regular with, nevertheless, two broad bulging areas which were not particularly prominent. The surface was smooth, white, and anatomically and surgically well separated from surrounding structures. The wall was of moderate thickness but of less thickness than the aortic wall. It was very thin at the level of the two bulging areas. The internal surface of the sac was smooth and white. There was no sign of clot formation nor
of inflammation. The appearance was the same as that of the internal surface of the aorta. However, on certain parts of the surface, one could see small flattened areas, separated columns, and falceform folds.

The histologic examination was performed by Dr. Dobkevitch and Professor Lenègere and is reported verbatim. "The histologic examination enabled us to identify the elements of an arterial wall. The adventitia was abnormal, being very much sclerosed. A certain amount of inflammatory perivascular reaction with an accumulation of spongy cells was observed. The elastic substance was badly damaged. The elastic fibers of the media were irregularly thickened and discolored; the appearance was sometimes granular. These fibers were absent in whole areas. Elastic and muscular fibers were separated by fibrous tissue. The internal elastic lamina occasionally appeared to be discontinued or cleaved. Finally, there seemed to exist a certain amount of elastification of the intima.

"Thus, the lesion actually involved an arterial wall in which characteristic elements were recognized. This wall was severely damaged and misshapen. The elastic substance was especially damaged. Histologic examination justified no precise statement concerning the origin of this process."

Postoperative course. The postoperative course was quite normal. Cardiac drugs that might raise the blood pressure were avoided. One million units of penicillin were given daily for ten days. Thoracenteses were performed on the second day (350 cc.), third day (30 cc.), fifth day (50 cc.), sixth day (225 cc.), seventh day (25 cc.), and on the eighth day (10 cc.). The extrapleural space created by the mobilization of the pleura was also drained on the ninth day and 100 cc. of fluid were removed. The stitches were removed on the ninth day. Postoperatively, auscultation of the anterior chest revealed no cardiac abnormalities. Posteriorly, a systolic murmur was heard over the spine. This was thought to be due to the anomalous artery passing between the esophagus and the spine. Blood pressure readings in the four extremities were normal. A chest film taken seven weeks after operation revealed an opacity at the level of the pleural detachment (fig. 4).

The patient was seen again on March 20, 1948. She had resumed her normal life. At that time it was decided to examine her regularly as we remained dubious about the future of the aortic suture.

![X-ray film made seven weeks after operation. The opacity is the result of detachment of the pleura which was used to reinforce the sutured aorta.](image)

**DISCUSSION**

Our case is the first in which an aneurysm of the aorta was resected with preservation of the vessel's lumen and recovery of the patient. As far as we know, only one other aneurysm has been successfully resected, but in this instance interruption of the continuity of the artery was necessary. In this classic case, which was reported by Alexander and Byron, the aneurysm which was removed was a fusiform and not a saccular one. Their patient, a 19 year old man, whose blood Wasserman reaction was negative on three occasions, showed all the signs of occlusion of the aorta. The blood pressure was 100/70 in the arms and undetectable in the legs. Erosion of the ribs and other evidences of a developed collateral
circulation were present. At operation pulsation of the aorta was seen to be vigorous above the aneurysm and imperceptible below it. After removal of the involved portion of the aorta the blood pressure in the arms rose to 260/130 and after ten days dropped to a level around 220/130, at which level it remained until the patient's death from a cerebrovascular accident two years after operation.

Pathogenesis. Syphilis was not the etiology in our case; the history was not suggestive, the blood Wassermann reaction was repeatedly negative and there were no inflammatory lesions in the wall or in the cellular tissue. It was necessary to consider the possibility that the structure we dealt with was a congenital lesion, perhaps a diverticulum of the aorta. The coexistence of the aneurysm with an anomaly in the distribution of the branches of the aortic arch is not a very strong argument in favor of a congenital origin since such anomalies are comparatively frequent, whereas congenital aneurysms of a size comparable to the one which we removed must be exceptional, if they exist at all.

Fusiform or spherical dilations of the aorta have been known to exist below an aortic constriction but we found no sign of stenosis of the vessel.

We regard the lesion which we operated upon as a dissecting aneurysm, due, perhaps, to an embolus to a vessel of the aortic wall or to an arteritis resulting from variations of blood pressure. The areas of necrosis of the media led us to consider the last possibility.

Diagnosis. When the patient was first studied, the clinical findings suggested tuberculosis. When this disease was eliminated, a benign tumor was thought of. This consideration was based on the absence of suggestive symptoms and on the radiographic outline. Pleuroscopy, by which we were able to introduce a needle into the tumor and obtain pure blood, enabled us to correct the diagnosis. Within our personal experience, this is the third time that puncture under pleuroscopy made clear a diagnosis of aortic aneurysm.

Surgical Considerations. From the anatomic and surgical point of view, we will remember the characteristics of the sac wall. The constituents of the wall were well differentiated and showed under the microscope the differentiated layers of the aorta. The wall was thin, even very thin in some places. It was cleavable, dissecetable, and without adhesions due to inflammation. It was elastic and suturable, though very fragile. The stitches had to pass through the normal aortic coats in order to hold. The vagus nerve helped us find our bearings and to protect the recurrent nerve. The mobilization of the pleura by the use of the extrapleural pneumothorax, which has been our accustomed practice, was of invaluable aid in covering and strengthening the suture line.

The indications for operation are debatable. Our intervention was proposed as an exploratory operation. Only after seeing the aneurysm did we decide upon resection. Our case was an exceptional one. We do not believe, generally speaking, that syphilitic aneurysms can be removed.

Summary

We have presented what we think is the first case in which an aneurysm of the arch of the aorta was removed successfully without disturbance of the continuity of the lumen of the aorta.

REFERENCE

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OLIVIER MONOD and ANDRÉ MEYER

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