Successful Resection of an Ascending Aortic Aneurysm under Cardiopulmonary Bypass Associated with Carotid and Coronary Perfusion

Ken-ichi Asano, M.D., Yoshifumi Sakurai, M.D., Takao Irisawa, M.D., and Shigetaka Kasuya, M.D.

Summary

Successful resection of an ascending aortic aneurysm under cardiopulmonary bypass associated with auxiliary carotid and coronary perfusion is reported. The advantages of the cardiopulmonary bypass such as the present method in surgery of aneurysms of the ascending aorta and aortic arch are discussed.

Additional Indexing Words:
Aneurysm of the ascending aorta Cardiopulmonary bypass Auxiliary carotid and coronary perfusion

CARDIOPULMONARY bypass with pump-oxygenator is frequently applied to surgical treatment of aneurysms of the ascending aorta. If, however, the aneurysm is extensive and involves the proximal transverse aortic arch, an additional circuit is necessary to maintain cerebral circulation during aortic occlusion. This article is purposed to report the successful resection of an ascending aortic aneurysm by this principle.

Case Report

A 36-year-old woman entered into the University of Niigata Hospital with complaints of dizziness, left-sided hemiparesis and palpitation which had occurred about 1 year ago. She had been already suspected as the mediastinal tumor since 6 years ago but had been left untreatedly.

Physical examinations revealed aortic pulsations and slight systolic murmurs (1/6) at the 2nd intercostal space along the right sternal border. Blood pressure was 130/82 mm Hg, and no abnormalities were found in electrocardiograms. Serum syphilitic reactions were negative and no abnormal values except slight anemia were demonstrated in laboratory studies.

Chest X-ray films revealed a calcified shell-shaped tumor (I) at the upper anterior mediastinum and another uncalcified tumor (II) behind the tumor (I) at
the right upper thorax (Fig. 1).

The angiocardiograms taken after injection of contrast medium into the right atrium demonstrated the obstruction of the right pulmonary artery (Fig. 2). The retrograde aortography showed that the contrast medium entered into the tumor (I) but not into the tumor (II) (Fig. 3). Venous pressure of the antecubital vein was 10 cm.H₂O and no subcutaneous venous dilatation was found.

Operation was performed under the diagnosis of the ascending aortic aneurysm on March 20, 1969. The mediastinum was explored through the median sternotomy. The tumor (I) was entirely bony hard and did not show any pulsation. Its upper margin extended just proximal to the innominate artery and its lower margin.

**Fig. 1.** Preoperative chest X-ray findings.

**Fig. 2.** Preoperative angiocardiograms, taken after injection of contrast medium into the right atrium.
adhered to the right atrium and ventricle. The tumor (II) was demonstrated to be situated behind the right pulmonary hilum by the additional right anterior thoracotomy. It was fist-sized, far softer than the tumor (I), but not pulsating. Superior vena cava was behind the tumor (I) and its opening at the right atrium was demonstrated to be completely occluded by the intracardiac digital examination (Fig. 4).

Cardiopulmonary bypass by a disposable bubble oxygenator and roller pumps was instituted with the cannulation into the right atrium and the femoral artery. The calcified tumor (I) was partially incised with knife and partially sheared with bone longeur after clamping the pulmonary artery and the ascending aorta just proximal to the innominate artery. The tumor (I) was communicated with the
Fig. 6. Diagram of cardiopulmonary bypass.
G—A woven teflon tube graft
P.O.—Pump-oxygenator
P₁—Arterial pump
P₂—Carotid perfusion pump
P₃—Coronary perfusion pump
P₄—Coronary suction pump

Fig. 7. The graft is occluded after the distal anastomosis.
tumor (II) which was filled by massive thrombus. The ascending aorta was divided at the upper margin of the tumor (I) after re-cross-clamping of the aorta just distal to the left carotid artery. Then, 2 cannulas from the arterial line of the pump-oxygenator which were threaded through a woven teflon tube graft were introduced into the orifices of the innominate and left carotid arteries through the lumen of the opened ascending aorta. These cannulas were held in place by tapes placed externally around those vessels (Fig. 5 and 6). A combined flow rate into both carotid arteries of 800 ml./min. was maintained. Constant electroencephalographic monitoring did not demonstrate any abnormalities.

After completion of the anastomosis between the graft and the distal stump of the ascending aorta, these 2 cannulas were withdrawn. Another aortic clamp was placed onto the graft and the distal clamp was removed to allow cerebral perfusion from the distal aorta via the femoral artery in the usual manner during cardiopulmonary bypass (Fig. 7). Then, the proximal aorta was divided and the proximal anastomosis was performed. The coronary circulation, also, was maintained by the left-sided coronary perfusion using the previously described method6) during this procedure (Table I).

After the ascending aorta was reconstructed and the cardiopulmonary bypass terminated the residual aneurysmal wall of the tumor (I) was removed and the

<table>
<thead>
<tr>
<th>Body weight Kg.</th>
<th>Temperature C.</th>
<th>Body flow rate (ml./min.)</th>
<th>Cardiopulmonary bypass (min.)</th>
<th>Carotid perfusion Flow (ml./min.)</th>
<th>Carotid perfusion Time (min.)</th>
<th>Coronary perfusion Flow (ml./min.)</th>
<th>Coronary perfusion Time (min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>41.8</td>
<td>31.2</td>
<td>31.0</td>
<td>2,700</td>
<td>72</td>
<td>800</td>
<td>150</td>
<td>21</td>
</tr>
</tbody>
</table>

Fig. 8. Completion of aneurysmectomy.
(a) shows the aortic reconstruction and the communication with the tumor (II) adjacent to the graft.
(b) shows the calcified aneurysmal wall of the tumor (I) and the massive thrombus in the tumor (II).
massive thrombus in the tumor (II), that is, the secondarily developed pseudoaneurysm was scraped out through the communication with the tumor (I) (Fig. 8).

The postoperative course was uneventful and she was discharged 27 days after operation.

**DISCUSSION**

Surgical treatment of some of ascending aortic aneurysms as well as the aortic arch aneurysm needs certain auxiliary methods, especially to prevent the cerebral damage. One of them is the transient graft bypass method, devised originally for aortic arch aneurysmectomy by Cooley and associates.2) The pump-oxygenator is not necessary for this method, but many anastomotic procedures may be cumbersome for surgeons. Besides, this method is not always applicable because there must be a space for anastomosis at the aortic root.

The other method is the profound hypothermia under 20 degrees C, induced by extracorporeal circulation, but it is disadvantageous that the time of circulatory arrest is limited and the cerebral damage induced by rapid temperature exchange may be complicated by this method.3)

Therefore, the cardiopulmonary bypass by pump-oxygenator with additional carotid and coronary perfusion appears the most universal auxiliary method for surgical treatment of aneurysms of the ascending aorta and aortic arch. This report is probably the first successful aneurysmectomy by this principle in Japanese literatures.

This method was first described by Bloodwell and associates1) in 1966 for surgical correction of the ascending aortic aneurysm associated with aortic insufficiency and, thereafter, was applied also to the aortic arch aneurysm by the above authors.5) They recommended the blood flow of each carotid artery to be 250–350 ml./min., respectively, under normothermic cardiopulmonary bypass and to be maintained under electroencephalographic monitoring. In the present patient the body flow rate was 65 ml./Kg./min. and the combined cerebral flow rate was 800 ml./min. The cerebral circulation appeared to be satisfactorily maintained by this flow rate and an early recovery from anesthesia was noted and no cerebral complications occurred after operation.

**References**