Entire replacement of the thoracic aorta for aneurysmal disease remains an overwhelming event for the patient who must undergo the procedure and constitutes a major challenge for the surgeon who has to deal with it. Surgical correction of this condition has been mainly the use of deep hypothermia combined with retrograde perfusion through the superior vena cava to provide optimal preservation of brain function. Recently, Cooley described a technique for retrograde replacement of the thoracic aorta in which a combined sternal and thoracic approach is used to replace the whole thoracic aorta in a retrograde fashion.
We report the case of a 43-year-old man who presented with a chronic degenerative aneurysm of the thoracic aorta, secondary to a type A aortic dissection, that was surgically corrected by this technique.

CASE REPORT

Four years before the current admission this 43-year-old man had presented with a type A aortic dissection. A successful replacement of the ascending aorta was carried out and the patient was discharged on hospital day 9. A beta-blocker (Lopresor, 100 mg twice daily) was prescribed. During the next 4 years, a progressively enlarging aortic aneurysm developed, involving the distal ascending, transverse and descending thoracic aorta. It was 7 cm in its largest diameter (Fig. 1). We elected to proceed with corrective surgery using Cooley’s retrograde technique.

Surgical technique

The patient was placed in a 30° position with the left arm kept down along the back. A double-lumen endotracheal tube was used. Pulmonary pressure was monitored with a Swan–Ganz catheter and radial arterial pressure was recorded. Aprotinin (2 × 10^6 IU) was added during the extracorporeal circulation. A sternotomy was first performed and bypass initiated through the left femoral artery and double-stage cannulation of the right atrium. The patient was cooled down to 18 °C during the mediastinal and aortic dissection. Once the ascending and transverse aorta were dissected out, a right anterolateral thoracotomy was carried out through the fourth intercostal space. The distal descending thoracic aorta was isolated 10 cm above the diaphragm. Then a self-inflated cannula (normally used for retrograde coronary sinus cardioplegia) was inserted in the superior vena cava for cerebral perfusion. Circulatory arrest was initiated, the patient exanguinated, the proximal superior vena cava cross-clamped and retrograde cerebral perfusion started. Meanwhile, myocardial protection was achieved through cold (15 °C) retrograde blood cardioplegia.

A 20-mm collagen-impregnated Dacron graft was sewn to the true lumen of the transected distal aorta by a 3-0 running monofilament polypropylene suture. The false lumen was plicated and included in the suture line. Then a 22-mm collagen-impregnated Dacron graft was sutured (end to side) to an aortic cuff, including the native arch vessels, with special care taken to reroute the endovascular lumen toward the true lumen. Both prostheses

FIG. 1. Preoperative magnetic resonance image (MRI) of the chest showing the entire aneurysmal aorta (left panel, sagittal view, arrow), the aneurysmal false lumen (upper right panel, transverse view, arrows) and the distal arch largest diameter (lower right panel, coronal view, arrow).

FIG. 2. Relationship between the initial surgery and the subsequent aneurysm, along with the superior vena cava cannula used for cerebral perfusion (left). Surgically corrected aneurysm is shown at right.
were then sutured together through the left chest cavity and proximally anastomosed to the 24-mm Dacron graft implanted during the previous surgery (Fig. 2). All running sutures were full-thickness, including a piece of Teflon felt. The total cardiopulmonary bypass time needed to perform the surgery was 150 minutes, including an 88-minute hypothermic circulatory arrest. During circulatory arrest, cerebral retrograde perfusion was maintained at a rate that kept the jugular vein pressure between 15 and 20 mm Hg. After routine hemostasis, both incisions were closed and drained as usual. In the immediate postoperative period, because of persistent bleeding, a left chest re-exploration was done to ensure hemostasis, after which the patient’s hemodynamic status was stable. The patient woke up 8 hours after the operation and was extubated on postoperative day 1 with no neurologic deficit. Nuclear magnetic resonance imaging of the chest performed 10 weeks after the procedure revealed a patent graft (Fig. 3).

Neuropsychologic performance (Table I) was assessed 1 day before and 1 and 8 weeks after the procedure and included the following cognitive spheres: attention (visual and verbal), frontal abilities, visual-motor abilities, and vigilance/reflexes (postoperative and 8-week follow-up only) (Table II). The patient was right-handed and had an education level corresponding to 11th grade. English was his first language and French his second.

In Table II the standard deviation (SD) criteria are as follows: 1.5 SD below the mean is generally considered as mild impairment, 1.5 to 2 SD as mild to moderate, 2 to 2.5 SD as moderate and over 2.5 as severe impairment.11 The patient’s performance before surgery was found to be normal for all cognitive spheres except for verbal fluency (-3.5 SD), because the task was done in French, the patient’s second language. The patient’s 1-week postoperative performance showed a marked decrease in each sphere of functioning. However, the 8-week follow-up revealed a return to the preoperative performance level.

**Table I**

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digit span test</td>
<td>Measures verbal attention and mental control capacity and uses part of the Ottawa–Wechsler IQ scale. The patient is asked to repeat a series of digits presented orally in both forward and reverse order.</td>
</tr>
<tr>
<td>Bells test</td>
<td>Quantifies visual attention. The patient is asked to identify, without losing time, schematics of bells among common objects shown in a drawing. An error rate of 8.5% or more suggests a possible deficit.</td>
</tr>
<tr>
<td>Verbal fluency</td>
<td>Evaluates spontaneous word production under alphabetical constraints. For instance, the patient is asked to produce as many words as possible starting with a specific letter in a limited period of 60 s.</td>
</tr>
<tr>
<td>Trail test B</td>
<td>Evaluates attention and mental flexibility. The patient has to associate a number to a specific figure. This test is very sensitive for detecting left cerebral damage and is part of the Ottawa–Wechsler IQ test.</td>
</tr>
<tr>
<td>Substitution</td>
<td>Measures visual-motor speed and efficiency. The subject has to associate a number to a specific figure. This test is very sensitive for detecting left cerebral damage and is part of the Ottawa–Wechsler IQ test.</td>
</tr>
<tr>
<td>Visual and auditory reaction time</td>
<td>Measures the latency period between visual or verbal stimulus and the patient’s reaction. The normal response period is between 220 and 300 ms for the visual stimulus and between 170 and 250 ms for the auditory stimulus. This test is one of the best for measuring the cerebral system’s integrity.</td>
</tr>
</tbody>
</table>
DISCUSSION

Acute dissection of the thoracic aorta is a common acute illness that occurs in the human aorta 2 to 3 times more frequently than acute rupture of an abdominal aortic aneurysm. More than 80% of patients who have this condition will die in less than 2 weeks unless surgical correction is carried out promptly. The aim of the surgical procedure is to repair or replace the ascending aorta to prevent retrograde dissection and intrapericardial rupture with acute tamponade. However, even with successful surgery, an aneurysm will develop subsequently in up to 45% of the survivors, associated with a 5-year actuarial survival of less than 10%. Frequently, these aneurysms involve an extensive segment of the aorta which requires major resection. Multistage repairs with a conventional or "elephant trunk" procedure are generally advised for aneurysms involving both the ascending and descending aorta, although Massimo and colleagues have reported excellent results with a single-stage operation performed under circulatory arrest with an antegrade technique. Staged procedures even in good hands carry a significant surgical death rate and considerably increase the patient's anxiety about the procedure. Crawford and associates reported a combined death rate of 21% for staged procedures and a high rate of refusal for the second procedure, leading to an increased death rate from the original condition. Cooley described the retrograde replacement of the thoracic aorta as an "aortic pull-through." This technique combines, in a thoughtful fashion, a 1-stage surgical procedure with profound circulatory arrest. Initiating the procedure with the most distal suture line shortens the period of circulatory arrest. Also, the proximal suture is completed after extracorporeal circulation is reinstated. Since, in our case, we faced chronic dissection with aortic double-lumen and multiple lung adhesions, our procedure time was unusually long. Nevertheless, the use of cerebral retrograde perfusion allowed us to proceed without facing the potential cerebral damage related to an abnormally long circulatory arrest time. Since its introduction in 1990, the retrograde cerebral perfusion of cold blood through the superior vena cava during circulatory arrest has gained tremendous popularity. Experimental evidence suggests that the venous pressure during perfusion should be maintained between 15 and 20 mm Hg to optimize cerebral protection. Cerebral edema can occur at higher pressures, and optimal brain protection is not achieved at lower ones. To perform this technique we found it convenient to use a separate cannula inserted in the superior vena cava at the time of the circulatory arrest combined with a standard double-stage venous cannula.

CONCLUSION

Retrograde aortic replacement with concurrent cerebral retrograde perfusion is a convenient technique that allows extensive aortic resection without jeopardizing cerebral cognitive function.

References

2. Wechsler D. Échelle d’intelligence Ot...
REPLACEMENT OF THE THORACIC AORTA


