COMBINED OPEN AND STENT GRAFT REPAIR OF AN ARCH AND DESCENDING THORACIC AORTIC ANEURYSM: THE HYBRID PROCEDURE

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INTRODUCTION

Surgeons at The Methodist Hospital and the Methodist DeBakey Heart Center have a long history of contributions to the treatment of thoracic aortic aneurysms. In the 1950s, Dr. Michael E. DeBakey pioneered the use of artificial grafts for aortic replacement and Drs. DeBakey and Denton Cooley introduced the use of cardiopulmonary bypass to repair aneurysms of the ascending aorta and aortic arch. Dr. Stanley Crawford then introduced surgical repair of the descending and thoracoabdominal aneurysm. Half a century later, the Methodist DeBakey Heart Center has now performed more descending and thoracoabdominal aortic aneurysm repairs than any other institution in the world.

Despite these advances, treatment of aneurysms involving both the ascending aorta/aortic arch segment and the descending thoracic aorta have continued to pose a formidable surgical challenge: aortic arch repair traditionally requires circulatory arrest and profound hypothermia via median sternotomy followed by a later descending thoracic aorta repair through a left thoracotomy.

Recently, a patient who had undergone previous ascending thoracic aortic aneurysm repair for dissection presented with a large arch and descending thoracic aortic aneurysm and a high risk of standard surgical repair. A unique, minimally-invasive hybrid approach of open and stent graft repair with aortic arch debranching was successfully employed, again advancing the field of thoracic aortic surgery at the Methodist DeBakey Heart Center.

CASE HISTORY

Mr. TF is an 81-year-old male with a history of previous graft replacement of his ascending thoracic aorta for dissection in 1996. His current medical history included hypertension, COPD with a 120-pack-year history of smoking, history of a CVA and parkinsonism. He presented with chest and back pain and a chest X-ray showing a wide mediastinum (Figure 1). Arteriography evaluation revealed a large aneurysm beginning at his distal ascending aortic graft and extending through his aortic arch into the distal descending thoracic aorta (Figure 2). Evaluation by the consulting medical services placed his risk of standard surgical repair at 30-50%. Further, the patient refused consideration of a standard open, two-stage repair because of prior difficulty in recovering from his **initial** dissection surgery.

A hybrid procedure of minimally-invasive debranching of the aortic arch and stent graft repair of the arch and

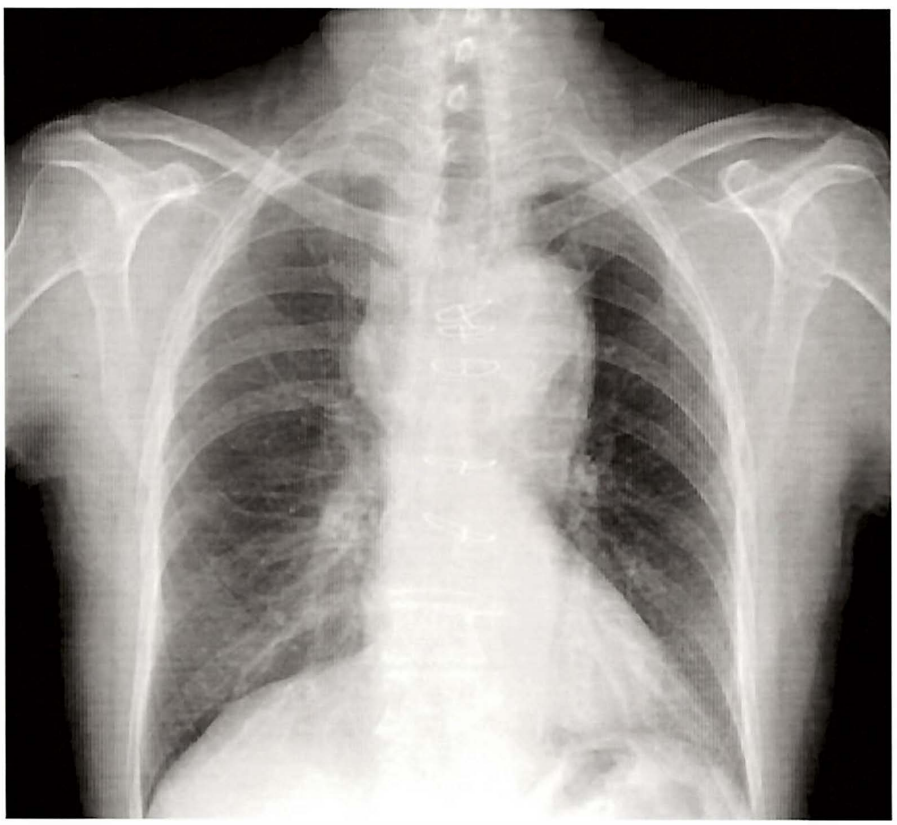

Figure 1. Chest X-ray showing wide mediastinum

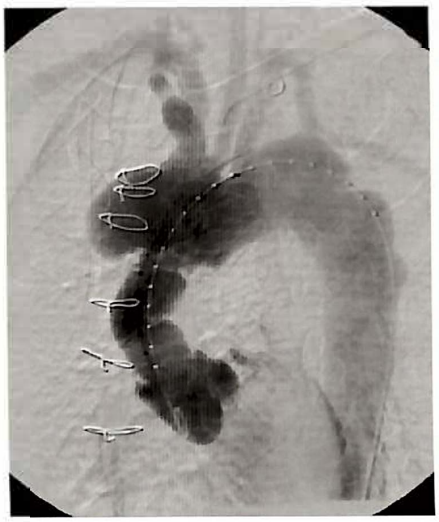

Figure 2. Arteriogram showing arch and descending aortic aneurysm

Figure 4. Left subclavian embolization

descending thoracic aortic aneurysm was offered as a therapeutic approach.

TRADITIONAL TECHNIQUE

The ascending aorta and aortic arch are typically approached via median sternotomy, and the descending thoracic aorta and thoracoabdominal aorta are approached through a left thoracotomy. Aneurysms involving both of these segments typically require a two-stage surgical approach. In addition, surgical repair of the aortic arch is usually performed under deep hypochermia wich circulatory arrest for neurologic protection. Standard repair of these problems represents a formidable undertaking even in relatively healchy patients. Furthermore, in most series, about 50% of patients who undergo Stage 1 refuse to undergo the second-stage surgical repair because of difficulties they encountered in recovering from their initial surgery.

Sinceourpacienc had multiple medical comorbidities, the risk would be very large. Our challenge was to design a one-stage, minimally-invasive approach accepcable co the patient. Surgical planning would include provisions for debranching and subsequent revascularization of the aorcic arch, provision of adequate "landing zones" or zones of attachment proximally and distally for the scent grafts, and access for introducing che scene grafts.

SURGICAL TECHNIQUE

Extra anatomic reconstruction of the aortic arch and debranching or disconnection of the arch vessels was provided via small right anterior thoracotomy, left and righc neck incisions for carotid artery access, and left supraclavicular incision for left subclavian artery access (Figure 3). A small right fourth incerspace ancerior choracotomy allowed exposure of the previous grafc and dissection of a proximal portion of chat graft. A side-biting clamp was placed on the graft, and a 14 mm Dacron graft was sewn into the side of his old ascending aortic graft.

Previously, chis graft had a 10 mm graft sewn into its side, forming an 'T' going superiorly where ir came off the ascending graft. The 14 mm graft allowed access ro che ascending aorta, and the 10 mm graft was brought up through the thoracic outlet and anasco-mosed in the side into the right carotid artery. An 8 mm Dacron graft was then taken from chis graft at the level of the carotid over to the left carotid artery, passing in a "U" fashion below the sternal notch. Another 8 mm graft was then taken from the graft to the left carotid artery and anastomosed end to side into the left subclavian artery.

The innominate artery was ligated and divided as was the left carotid arcery, disconnecting these two vessels from the aortic arch. The left subclavian artery then had coils placed proximally, occluding the takeoff left subclavian

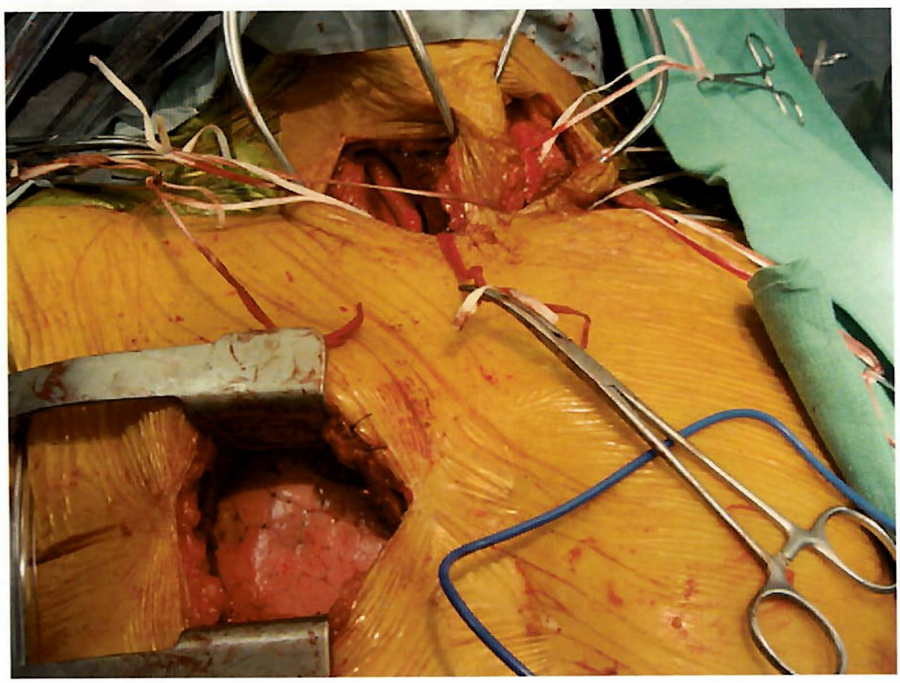

Figure 3. Surgical incisions

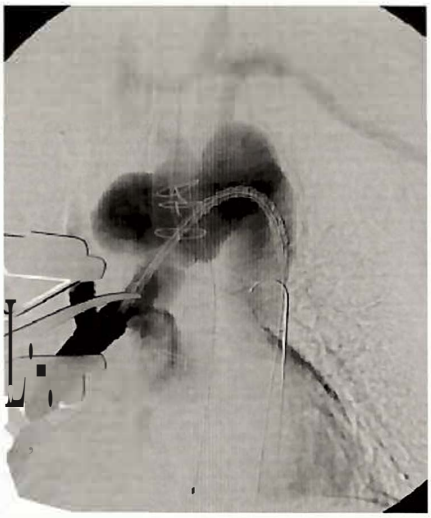

Figure 5. Graft deployment

Figure 6. Final graft placement

artery at its origin but allowing retrograde flow from our bypass grafts into the left vertebral artery (Figure 4). This resulted in an extra anatomic bypass of the aortic arch with disconnection of all the arch vessels. By placing the 14 mm graft low on the ascending graft, there was approximately 7 cm of ascending graft distal to this chat could be used as a proximal landing zone for our stent graft. Anatomically, che patient's aneurysm stopped at the distal descending aorta, leaving a 5 cm segment proximal to the celiac axis appropriate for a distal landing zone.

The 14 mm graft was then brought through a second, small stab incision in the right anterior chest through the eighth interspace. This allowed the angle of the graft approaching the ascending graft co be somewhat parallel. The introduction system for the scent graft was then placed through the 14 mm graft, and seems were deployed starting with an overlap at the preexisting ascending graft and extending down to the distal aorta (Figure 5). Completion of an aorcogram shows exclusion of the entire arch and descending aneurysm with good revascularizacion of che arch vessels (Figure 6).

RECOVERY

The patient recovered from chis procedure without neurologic sequelae and with good cardiac function. His wounds healed very quickly, and he experienced little impairment of activity because of his minimally-invasive incisions (Figure 7).

CONCLUSION

Aneurysms that involve both the arch and descending aorta can be approached in a one-stage hybrid procedure with debranching of the aortic arch and stem graft repair of che aneurysms. We believe this provides a simpler approach for our patients, with less risk and enhanced recovery.

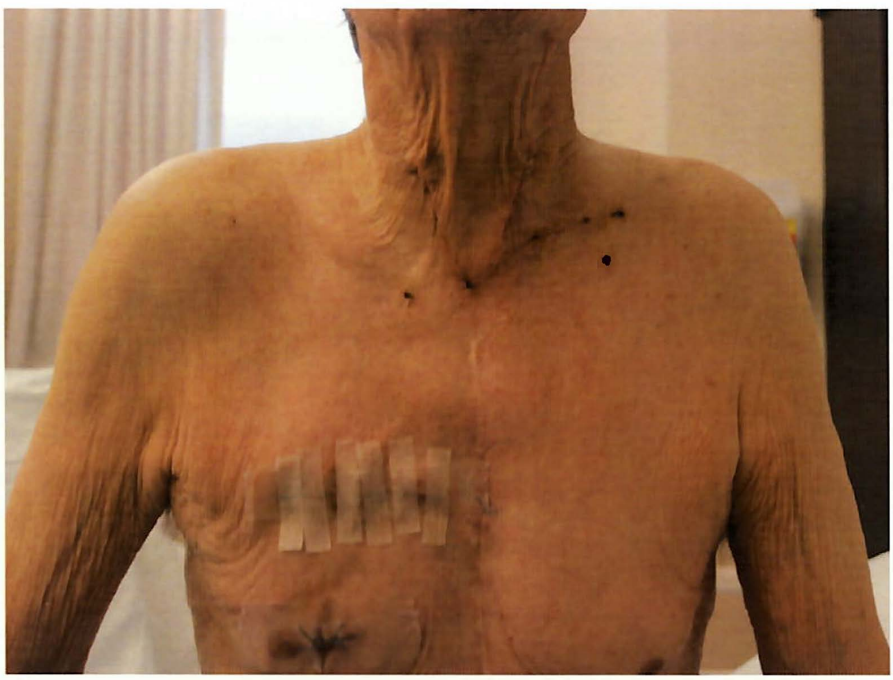

Figure 7. End result