The THAI Journal of SURGERY 2007; 28:69-72.
Official Publication of the Royal College of Surgeons of Thailand

Successful Aortic Root Replacement with Aortic Arch Aneurysm Repair: A Case Report

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Abstract **We report a successful first stage repair in a patient with extensive aortic aneurysm. A 61 year-old woman with hypertension for 4 years came to the hospital with problems of congestive heart failure. Physical examination and investigations revealed severe aortic regurgitation with compromised cardiac function (45% of ejection fraction) and a long segment of aortic aneurysm from the aortic annulus to the level of renal arteries. At surgery, aortic root replacement was performed first, then the lower body circulation was temporarily stopped and modified elephant trunk operation was done. The heart was then allowed to beat while re-warming process was being done. The last step was to reconnect the two head vessels to the graft with bifurcated Dacron graft. Two hours postoperatively, the patient gained consciousness with good motor responses and remained in ICU for 3 days and was discharged home on day 9 with antihypertensive agents and warfarin. She was planned for completion of the treatment within 4 months postoperatively.**

Case Report

To repair an extensive aortic aneurysm is a challenging task because it poses problems of bleeding, end organ ischemia, underlying diseases and staged repairs. We report a successful first stage repair of a patient with extensive aortic aneurysm. The patient was a 61 year-old woman with hypertension for 4 years. Her blood pressure had been under control and she remained asymptomatic until one month before admission. She came to the hospital with congestive heart failure. Physical examination and investigations revealed severe aortic regurgitation with compromised cardiac function (45% of ejection fraction) and a long segment of aortic aneurysm from the aortic annulus to the level of renal arteries (Figure 1 and 2). However, her coronary angiogram revealed no coronary stenosis. The diameter of the aneurysm was 5.7 cm at the ascending aorta, 5.5 cm at the aortic arch and 5.0 cm at the descending aorta down to the level of renal arteries.

She was informed of her disease and the plan of treatment. She decided to undergo surgery with informed consent.

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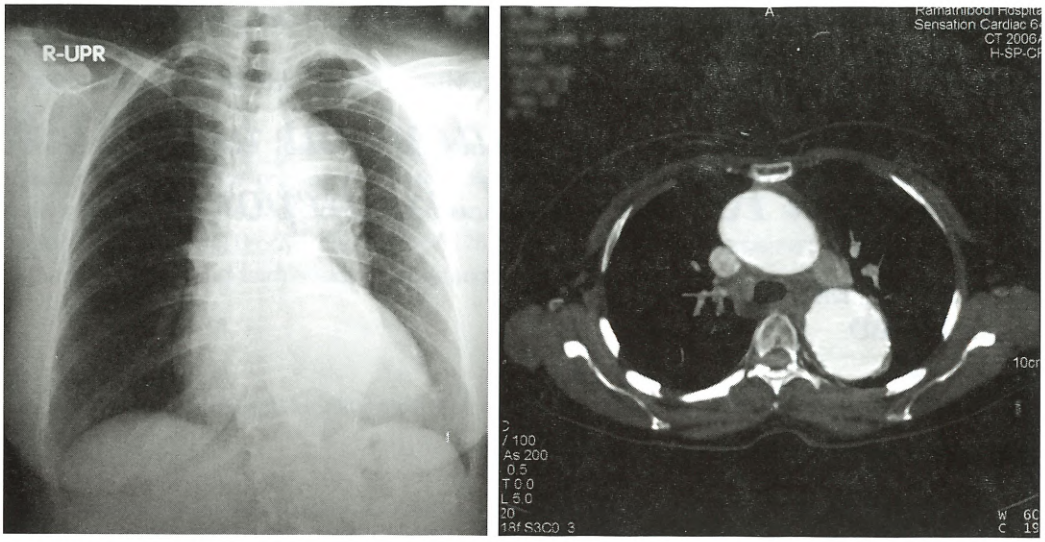

Figure 1 Chest x-ray and CT scan show aneurysm of both ascending and descending aorta and cardiomegaly

Corrective procedures

Aortic root replacement was done first with two 18 Fr arterial accesses via left femoral and brachiocephalic artery. Flow rate was adjusted to achieve mean arterial blood pressure measured at the right arm and right femoral artery not less than 50 mmHg. The venous return was dual staged into the right atrium inferior vena cava. The operation was performed at 25° Celsius.

After completion of aortic root procedure (cold blood cardioplegia directly into the coronary ostia with topical hypothermia every 30 minutes), the lower body circulation was temporarily stopped while the mean head-perfusion pressure had been controlled between 50-60 mmHg by adjusting the pump flow. At 25° Celsius and for 56 minutes of lower body circulatory arrest, the modified elephant trunk operation was done (Figure 3). The heart was then allowed to beat while re-warming process was carried out. The last step was to reconnect the two head vessels to the graft with a piece of bifurcated 16-8-8 mm Dacron graft (Figure 4). Conclusively, aortic clamped time was 218 minutes and total pump time was 303 minutes.

The patient returned to ICU in hemodynamically stable condition and with satisfactory hemostasis. At two hours postoperatively, she gained consciousness with good motor responses. On the following day, she could be weaned off from the ventilator. However, she suffered from transient renal dysfunction for two days

Figure 2 Reconstructed picture of aortic aneurysm

without hemodialysis or peritoneal dialysis. Her highest BUN and Creatinine was 45 mg/dL and 2.5 mg/dL respectively on the second postoperative day and returned to preoperative level on the forth postoperative day (18 mg/dL and 1.2 mg/dL). She was in ICU for 3 days and was discharged home on day 9 with antihypertensive agents and warfarin and was

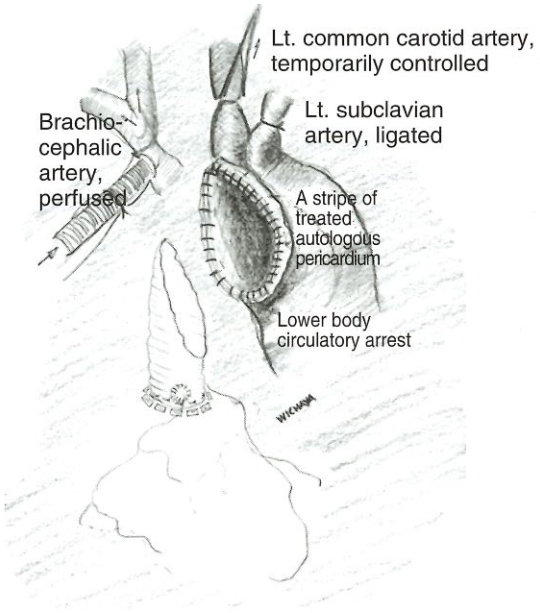

Figure 3 Illustration of selective cerebral perfusion while performing the modified elephant trunk procedure. The Dacron graft used was No. 28

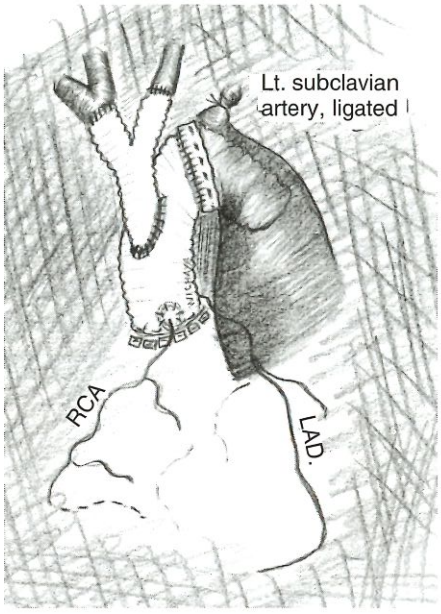

Figure 4 Illustration of final operative results

planned for completion of the treatment, for example, endovascular graft repair or classical surgery within 4 months postoperatively.

Discussion

To address an aortic aneurysm that involves extensive area of the aorta is a challenging work especially in cases with abnormalities of the aortic root. Ideally, all aneurysmal tissue should be excluded from the circulation; if left untreated, it tends to become more dilated and complicates the clinical course.[1,2] However, for this patient, such an extensive operation i.e. single stage subtotal aortic replacement was regarded as too risky. Therefore, a staged-approach, i.e. aortic root replacement (Bentall's operation) combined with aortic arch aneurysm repair (modified elephant trunk operation) was proposed.

Classically, for aortic arch aneurysms, total arch replacement needs deep hypothermia and circulatory arrest to reconnect the head vessels to the circuit.[3,4] To protect brain injury, the anastomosis of all head vessels has to be completed within 45-60 minutes under such condition. In this case, we decided not to use this technique because we had an impression that the operation could not be completed in time. With growing evidence of good results from selective brain perfusion, this technique was selected.[8-10] Alternatively, retrograde cerebral perfusion (RCP) is another method that could prolong the safe ischemic time of the brain. With artheromatous plaque in arch vessels or the aorta, it is prudent to use RCP while antegrade brain perfusion stops. However, we decided to use antegrade cerebral perfusion in this case as there was no artheromatous plaque in the arch vessels and the teams were more familiar with antegrade cerebral perfusion. With this technique, the patient gained consciousness without neurodeficit within few hours postoperatively.

There are debates about the most suitable method to protect kidney and spinal cord. Carrel[5] et al, in 2000 reported that renal protection was better in those who underwent selective upper body perfusion and circulatory arrest of the lower body under deep hypothermia (temperature of 20-22 °C), compared with mild hypothermia and continuous lower body perfusion. Carlson[7] et al. supported the idea of distal perfusion in terms of organ protection. Coselli[6] et al, in 1996, did not support the idea of profound hypothermia with circulatory arrest of lower body as the best way to protect visceral organs; they use it selectively. With experience from this case, there are rooms to improve for the transient renal dysfunction postoperatively such as applying cooler temperature

or trying to occlude the elephant trunk and perfuse lower body while finishing the elephant trunk with the ascending aorta.

Conclusion

By using selective antegrade brain perfusion, aortic arch typed surgery is a more surgeon friendly operation. We report this case because with some fine adjustments, in the future, operative results are believed to be more predictable and satisfactory.

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