C A S E R E P O R T

Hybrid endovascular operation for ruptured thoracic aortic aneurysm

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The rupture of a thoracic aortic aneurysm is a life-threatening emergency. Conventional open surgical repair carries a high mortality and morbidity. We report an elderly patient who suffered from rupture of a proximal descending thoracic aortic aneurysm close to the aortic arch. A hybrid operation consisting of a right-to-left carotid bypass followed by endovascular repair of the descending thoracic aorta was carried out. The patient recovered uneventfully. A hybrid endovascular repair should be considered the treatment of choice for rupture of a thoracic aortic aneurysm near the arch.

Case report

In September 2005, a 74-year-old man with good past health was admitted for sudden onset of chest pain. A chest X-ray showed a widened mediastinum and left pleural effusion. A computed tomographic (CT) scan with contrast revealed a 7.3-cm leaking descending thoracic aortic aneurysm arising just distal to the origin of the left subclavian artery (LSA). The left common carotid artery (LCCA) arises very close to the LSA (Fig 1). There was an associated haemothorax and a haemomediastinum. The patient was assessed by a cardiothoracic surgeon then referred to us for an endovascular repair. We decided to perform a hybrid endovascular repair with a cross carotid bypass.

Under general anaesthesia, the carotid arteries on both sides were exposed. A side-to-side bypass between the left and the right common carotid artery was performed using an 8-mm supported Gore-tex graft (WL Gore & Associates, Sunnyvale [CA], US) through a retropharyngeal tunnel. The LCCA was then transected proximal to the anastomosis.

The right common femoral artery was exposed. A 0.035″ Terumo guidewire (Terumo Medical Cooperation, Somerset [NJ], US) and sheath were then inserted via the right femoral artery. The right brachial artery was punctured percutaneously and a pigtail catheter was introduced to the ascending aorta. Angiography of the aortic arch and the descending thoracic aorta showed a thoracic aortic aneurysm arising just distal to the origin of the LSA, in close proximity to the LCCA and LSA, and a patent cross carotid bypass. The Terumo guidewire was exchanged for superstiff Lunderquist's wire (William A Cook Australia Pty Ltd, Brisbane, Australia). A Cook Zenith stent-graft TX2-42-38-158 (William A Cook Australia Pty Ltd, Brisbane, Australia) was introduced through the right common femoral artery into the aortic arch. Under angiographic guidance, the stent-graft device was deployed just distal to the innominate artery origin, covering the LCCA and the LSA. A completion angiogram showed complete exclusion of the aneurysm sac from the circulation (Fig 2). A chest drain was then inserted to release the blood (1 litre) that had accumulated in the left pleural cavity.

The patient was extubated immediately after the operation. His left upper limb circulation was satisfactory and there was no subclavian steal syndrome or neurological deficit. The patient resumed an oral diet on day 2, and the chest drain was removed on day 9. A follow-up contrast CT scan performed 1 month after the operation showed a patent stent-graft lumen with no perigraft leakage. The contrast CT scan was repeated 1 year later and showed no change in the aneurysm sac size and no evidence of any type I or II endoleak.

Discussion

A ruptured thoracic aortic aneurysm is a vascular emergency that carries a poor prognosis. Only 40% of patients with ruptured thoracic aneurysms reach hospital alive and only 24% survive for 24 hours after the onset of symptoms without surgical intervention.[1]

Open thoracic aneurysm repair is the conventional treatment for a ruptured proximal descending thoracic aortic aneurysm, which involves cardiopulmonary bypass, hypothermic

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FIG 1. Three-dimensional reconstruction of the computed tomographic arteriogram of the patient's thoracic aorta and the aneurysm

circulatory arrest, and aortic cross clamping. These procedures impose great surgical trauma on patients who are usually elderly and have major medical co-morbidities. The mortality rate in emergency open thoracic aneurysm repair varies between 15 and 73%.[2-4]

The development of an endovascular stent-grafting technique provides a new and less invasive treatment option for managing ruptured thoracic aortic aneurysms. The stent-graft device is introduced through the femoral artery, reaching the healthy thoracic aorta and excluding the aneurysm to achieve sealing of the rupture site. A study comparing endovascular treatment (n=32) and open thoracic surgery (n=28) for acute rupture of the thoracic aorta (including aneurysm, dissection and trauma) reported a lower mortality in the endovascular group, compared to the open repair group (3.1% vs 17.8%).[5] Other single arm studies on endovascular repair of acute ruptured thoracic aortic aneurysms report peri-operative mortality rates ranging from 14.3 to 27.3%.[6-8]

Adequate proximal and distal landing zones (around 1.5-2 cm) are vital to the success of endovascular repair of an aortic aneurysm. Endovascular repair of a distal descending aortic aneurysm is straightforward. The real challenge comes from those aneurysms arising close to or even involving the great vessels of the aortic arch. There is a conflict between achieving a good attachment zone and the preservation of adequate circulation to the brain and the upper limbs. For, as the descending aortic aneurysm approaches the LSA, the LSA origin may be covered by the stent-graft in order to gain an adequate

以結合式腔內血管手術治療胸主動脈瘤破裂

胸主動脈瘤破裂屬致命性急症。傳統的切開修補手術的死亡率和病發率都很高。本文報告一名年長患者接近主動脈弓的近端下胸主動脈瘤出現破裂。病人先接受右至左頸動脈搭橋手術，繼而修補下胸主動脈的腔內血管，其後順利康復。對於接近主動脈弓的胸主動脈瘤破裂病症，應考慮以結合式腔內血管修補手術治療。

proximal landing zone. A routine bypass procedure for the LSA is not required as the chance of a posterior circulation stroke or critical left upper limb ischaemia is low[9,10] and the bypass procedure itself carries a small mortality risk.[11,12]

For aneurysms involving the LSA origin or in cases where the LCCA is very close to the LSA (as in this patient), a hybrid procedure is required. A cross carotid bypass was performed first to preserve the cerebral blood flow and to permit the stent-graft device to cover the origin of the LCCA safely. In view of the superior surgical outcomes of the endovascular repair/hybrid operation, these procedures are likely to replace open surgical repair as the first line of treatment for ruptured thoracic aortic aneurysms.[7]

Nonetheless, there are still areas needing refinement in the endovascular repair/hybrid operation for a ruptured thoracic aneurysm. The compliance of the stent-graft device to the curvature of the aortic arch and the descending thoracic aorta is critical to the outcome of

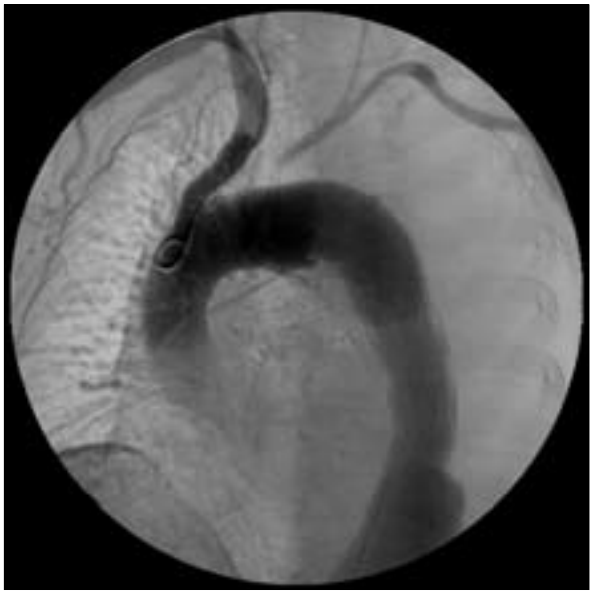

FIG 2. Completion aortogram showing successful exclusion of the aneurysm with the stent-graft. The left subclavian artery is perfused by collateral flow

the procedure. When a tube-shaped stent-graft is placed inside a curved descending aorta and aortic arch, there may be inadequate graft to wall contact in the lesser curve of the arch.[13] Endoleak might occur if the device fails to comply well with the aortic curvature.

One specific problem seen in endovascular treatment of thoracic aortic aneurysms in Asian patients (especially females) is the relatively small diameter of the access artery (common femoral and external iliac artery).[14] The size of the currently available commercial stent-grafts is usually in the range of 20-24F; this may result in access difficulty. To overcome problems with small-diameter femoral arteries, the iliac artery can be used for access, together with a conduit. If the iliac artery is also small or stenosed, a branched thoracic stent graft introduced through the carotid artery may be considered.[15] Use of this approach for management of ruptured aortic aneurysms has not been reported.

Conclusion

Combining an open bypass of the great vessels with endovascular aortic repair increases the versatility of endovascular repair for arch and proximal descending thoracic aortic aneurysms. Endovascular repair and the hybrid operation provide a better immediate outcome than conventional open surgery in patients with a ruptured thoracic aortic aneurysm and should be considered the first line of treatment in centres adequately equipped to perform it.

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