

New Aortic Balloon for Safe Compression of an Aortic Stent Graft: Report of a Case

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Abstract: Caudal migration of stent grafts is a concern during balloon compression for endoleakage following stent-grafting in the descending thoracic aorta. Although we have performed balloon compression for endoleakage via the brachial artery to prevent caudal migration of stent grafts, we report a new aortic balloon that can enable this procedure to be performed safely via the femoral artery. This device has a somewhat rigid 18-Fr shaft and a large lumen (4.0 mm in diameter) that allows blood flow distal to the aortic balloon, so that balloon compression of stent grafts, even in the descending thoracic aorta, can be safely performed via the femoral artery. Systemic blood pressure at the radial artery using a conventional balloon was higher than using the new device, and mean blood pressure at the femoral artery using the new device was higher than that using a conventional balloon. This new device facilitates aortic endovascular stent-grafting. (*Jpn. J. Vasc. Surg.*, 14: 667-669, 2005)

Key words: Aortic balloon, Stent graft, Endoleakage, Migration

Introduction

Aortic stent-grafting has had a large impact on the treatment of thoracic aortic diseases. Endovascular stent-grafting for the thoracic aorta is technically more demanding than that for the abdominal aorta. Among the various techniques used, balloon compression of stent grafts is one of interventional techniques for endoleakage. However, caudal migration of stent grafts during balloon compression is more likely to occur in the descending thoracic aorta.^{1,2)} We report a new device for safe balloon compression of stent grafts in the descending thoracic aorta.

Case report

A 76-year-old man was admitted to our hospital for descending thoracic aortic aneurysm. We recommended endovascular stent-grafting for the patient because of pulmonary dysfunction secondary to interstitial pneumonia in addition to a previous operation for cancer of the left lung. Endovascular stent-grafting was performed in March 2005. Stent grafts were hand-made using 32 and 34-mm Ube prosthetic vascular grafts (Ube Corp., Ube, Japan) and 40-mm Gianturco Z stents (Cook Inc., Bloomington, IN) that had been modified to fit the aortic tortuosity. Two stent grafts were deployed using 20-Fr long introducer via the right femoral artery at the descending thoracic aorta from the level of Th 5 to Th 12. Digital subtraction angiography showed a small amount of contrast medium between the proximal stent graft and the native aorta even without endoleakage into the aortic aneurysm. Although we have performed balloon compression for endoleakage through the brachial artery with care taken to prevent caudal migration of stent grafts, we were able to

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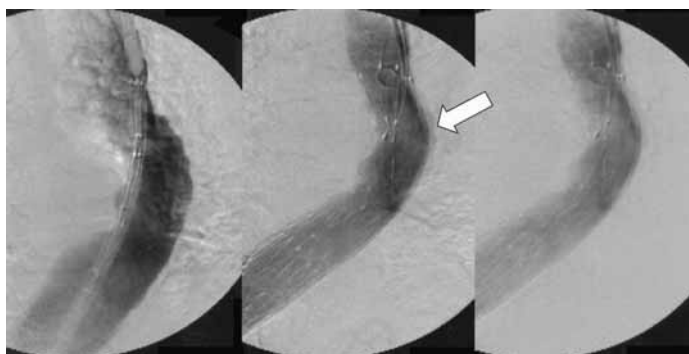


Fig. 1 Digital subtraction angiography during stent-grafting. Although descending aortic aneurysm (Left) was excluded by the stent grafts (Middle), a small amount of contrast medium between the proximal stent graft and the native aorta was detected (white arrow). Balloon compression reduced this endoleak (Right).

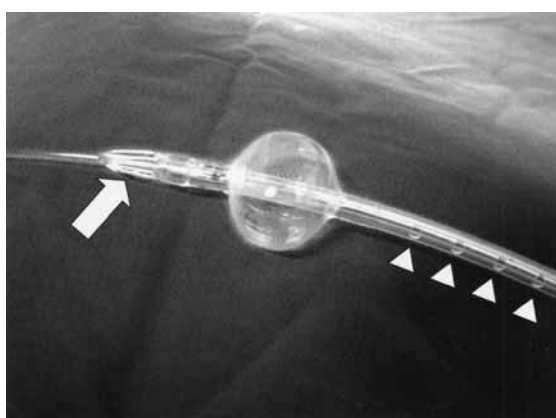


Fig. 2 The new stent-graft compression device. The white arrow indicates a space for blood inflow. White arrow heads indicate holes for blood outflow.

perform balloon compression from the femoral artery safely by using a new stent-graft compression balloon (Tokai Medical Products, Inc., Kasugai, Japan) (**Fig. 1**).

We invented this device to prevent stent-graft migration during balloon compression, which is generally performed for type I endoleakage. This device has a somewhat rigid 18-Fr shaft and a large lumen (4 mm in diameter) that allows blood flow distal to the aortic balloon so that balloon compression of stent grafts even in the descending thoracic aorta can be safely performed via the femoral artery. The balloon and the shaft of this device are made of urethane and can compress a stent graft more than 45 mm in diameter (**Fig. 2**). Although this device allowed distal flow beyond the aortic balloon, femoral arterial pressure was reduced from 100 mmHg to 45 mmHg and the radial arterial systolic pressure was increased to 143 mmHg. Following balloon compression of the proximal

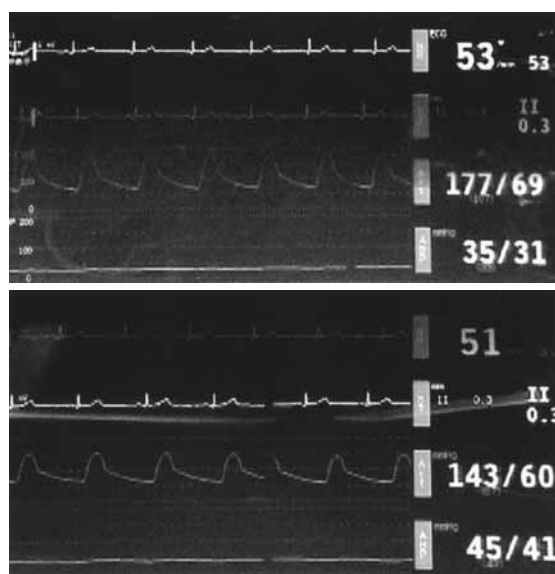


Fig. 3 Hemodynamic monitors during stent-graft compression using a conventional aortic occlusion balloon (Upper) and the newly invented stent-graft compression balloon (Lower). In each monitor, electrocardiograms, blood pressure at the radial artery and blood pressure at the left femoral artery are shown from top to bottom. Systemic blood pressure at the radial artery using a conventional balloon was higher than using the new device, and mean blood pressure at the left femoral artery using the new device was higher than that using a conventional balloon.

end using a new stent-graft balloon, the distal end of the stent graft was also balloon compressed using a conventional occlusion balloon via the brachial artery. The femoral arterial pressure was decreased from 100 mmHg to 35 mmHg and the radial arterial pressure was increased to 177 mmHg (**Fig. 3**).

The patient was discharged without any complication 10 days after stent-grafting.

Discussion

We have performed endovascular stent-grafting for treatment of aortic diseases, even in emergency situations,³⁾ in more than 190 cases since 2001 using hand-made stent grafts. From the first case in which stent-graft compression was necessary, we have performed the procedure for endoleakage via the brachial artery because of possible stent-graft migration when using an aortic occlusion balloon. However, the brachial artery was too small for insertion of an aortic occlusion catheter in some cases. Moreover, the procedure using the brachial artery is time-consuming. We therefore invented a new device that can be inserted via the femoral artery and enables aortic stent-graft compression to be accomplished safely.

Although this device allowed distal flow beyond the aortic balloon, distal arterial pressure was reduced and proximal arterial pressure increased. Considering the inevitable difference in blood pressures at proximal and distal sites of the aortic balloon, the rigid shaft of this device and a brachial guide-wire technique play an important role in prevention of stent-graft migration during balloon compression. However, maintaining the distal flow beyond the compression balloon

seems to have some value, based on the lower radial pressure compared with the higher radial pressure with a conventional occlusion balloon.

Urethane was employed as the material for the balloon in this new device. This material can resist high pressure and enables quick inflation and deflation of a balloon compared to latex. However, further improvement seems to be necessary considering the irregular surface and the rather large size of the deflated urethane balloon.

Currently used aortic stent-grafting systems, including commercially available devices, require further development. Future clinical and experimental studies are needed to achieve a better stent-grafting system.

References

- 1) Hinchliffe, R. J., Davidson, I. R. and MacSweeney, S. T. R.: Endovascular repair of a ruptured chronic type B aortic dissection. *J. Vasc. Surg.*, **36**: 401-403, 2002.
- 2) Shimizu, H., Ueda, T., Enoki, C., et al.: Surgical treatment of a distal arch pseudoaneurysm and migrated stent-graft after interrupted aortic arch repair. *Ann. Thorac. Cardiovasc. Surg.*, **6**: 339-341, 2000.
- 3) Morishita, K., Kurimoto, Y., Kawaharada, N., et al.: Descending thoracic aortic rupture: role of endovascular stent-grafting. *Ann. Thorac. Surg.*, **78**: 1630-1634, 2004.