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*Clinical Research*

# Transapical Endovascular Repair of Thoracic Aortic Pathology

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**Background:** Alternative access for thoracic endovascular aortic repair (TEVAR) has been explored for patients with unsuitable femoral and iliac access, but few cases of transapical access have been described. We report our experience with transapical access for various aortic pathologies.

**Methods:** We reviewed 6 cases undergoing transapical access for endovascular repair of thoracic aortic pathology between December 2013 and August 2015. Five patients had an aortic arch aneurysm and 1 patient presented with Stanford type A subacute aortic dissection. Transapical access was indicated to avoid approach through the severely atherosclerotic thoracic descending aorta in 4 patients and severely kinked aorta in 1 patient and to treat an ascending aortic dissection lesion in 1 patient.

**Results:** Transapical endografting was completed in all patients. Significant aortic valve regurgitation occurred in 3 patients when a large bore sheath was placed across the aortic valve. There was 1 death attributed to global cerebral ischemia due to carotid dissection after carotid bypass and chimney stent-graft insertion. There were no access-related complications. Computed tomography revealed complete exclusion of the aortic aneurysm in 4 patients, and shrinkage of the false lumen in 1 patient with aortic dissection.

**Conclusions:** Transapical access for TEVAR would be a potential alternative when the anatomy is unfit for routine retrograde approach. This method might have potential benefit of reducing the risk of embolism in patients with severe atherosclerotic thoracic descending aorta. However, certain safety concerns must be addressed, including maintenance of hemodynamics, wire exteriorization for navigation of the device tip, and rapid pacing during deployment.

## INTRODUCTION

Thoracic endovascular aortic repair (TEVAR) is an important technique for treating various aortic pathologies. Transfemoral or transiliac access is sometimes unsuitable in patients with a calcified, tortuous, or narrowed iliac artery or aorta, and alternative access sites have been explored, including transaxillary, transcarotid, transaortic, and transventricular apex.[1–5] Another indication for transapical access is to obtain direct access to ascending aortic pathology, such as type A aortic dissection and ascending aortic aneurysm.[6–8] In addition, severely atherosclerotic thoracic aorta with abundant plaques or mural thrombi is sometimes encountered, which carries a substantial risk of fatal atheroembolism.[9–15] We previously reported the

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transapical deployment of a stent graft to treat an aortic arch aneurysm in a patient with severely atherosclerotic thoracic descending aorta.[16] In this study, we reviewed cases undergoing transapical TEVAR and evaluated the feasibility, safety, and pitfalls of this approach.

## MATERIALS AND METHODS

### Patients and Lesion Characteristics

This study was performed at Osaka City University Graduate School of Medicine, Osaka, and Chibanishi General Hospital, Chiba, Japan.

We reviewed all cases treated by TEVAR performed by a single operator (T.M.) between December 2013 and August 2015, and selected all cases with a transapical approach for various aortic pathologies. During the same period, 91 patients with a variety of pathologies underwent TEVAR. TEVAR from a transapical access was offered in 6 patients who were deemed unsuitable for a transfemoral or transiliac retrograde approach for TEVAR. The present cohort includes the patient who was reported in our previous experience with this approach. The surgery was performed for patients 1–3 in Chiba-Nishi General Hospital and for patients 4–6 in Osaka City University Hospital. Exclusion criteria for transapical access included aortic stenosis, mechanical aortic valve prosthesis, atherosclerotic lesions on the ascending aorta, and left ventricular aneurysm. Therapeutic options were discussed in detail, and all 6 patients consented to transapical endovascular repair of the aortic pathologies. This study was approved by institutional ethics committees of the aforementioned hospitals and met the guidelines of the Declaration of Helsinki.

### Operative Procedure

The details of the procedure were reported previously.[16] In brief, patients were positioned in the supine position with the left thorax slightly elevated. Several types of neck vessel bypass, or debranching, were performed prior to endovascular repair when necessary, as shown below. A left minithoracotomy incision was made in the fifth intercostal space. The apex was first accessed with a smaller caliber long sheath, which was advanced to the ascending aorta under fluoroscopic and transesophageal echocardiography (TEE) guidance to avoid entrapment of the mitral chordae by the sheath. This was usually confirmed by the anterior course of the wire inside the left ventricle and no deterioration of mitral regurgitation. A 400-cm long curved hydrophilic Radifocus guidewire (Terumo Corp, Tokyo, Japan) was advanced into the abdominal aorta, snared, and exteriorized through the femoral sheath, establishing a through-and-through wire. There were no patients with stenosis or occlusion of the iliofemoral arteries in our series. Partial cardiopulmonary bypass (CPB) was used in all cases, with an arterial inflow to either the right axillary artery or a bypass graft to the neck vessels, and a venous drainage tube inserted from the femoral vein. A smaller caliber sheath was exchanged with a 24-Fr Gore DrySeal sheath (WL Gore & Associates, Flagstaff, AZ) in cases using a conformable Gore TAG endoprosthesis (Gore & Associates). When a Zenith TX2 Pro-Form endograft (Cook Medical, Bloomington, IN) was indicated as an endoprosthesis, the delivery system directly replaced the small-caliber sheath. Carefully controlling the tension of the through-and-through wire by pulling both ends of the wire simultaneously was useful when advancing the graft, thus navigating the tips of the delivery system through the curvature of the aortic arch with minimal contact (Fig. 1A). When a chimney stent graft was indicated, the device was inserted from the common carotid artery to the appropriate position. The proximal ends of both stent grafts were precisely adjusted and deployed under rapid ventricular pacing. The large bore sheath was withdrawn from the apex of the left ventricle under hypotension using rapid pacing, and hemostasis was confirmed. After weaning the patient from CPB, coil embolization was performed when necessary (Fig. 1B).

## RESULTS

Clinical characteristics of the patients are listed in Table I. Five of the patients had an aortic arch aneurysm, and 1 patient presented with Stanford type A subacute aortic dissection. The risk of open surgery in each patient was estimated by Japan SCORE,[17] which is dedicated to calculating the risk of open cardiac and thoracic aortic surgery. Five patients had severe comorbidities, which precluded open repair; 2 of the patients (nos. 3 and 4) had high predicted operative mortality (>30%) based on Japan SCORE; 1 patient (no. 1) required quick recovery for the following pancreatectomy; 1 (no. 2) had frailty and disability after previous stroke; and 1 (no. 5) had severe chronic obstructive pulmonary disease (COPD) and sarcopenia. In one patient (no. 6) with low risk for open surgery, TEVAR was indicated for Zone 3 proximal landing. Transapical