

From the Southern Association for Vascular Surgery

Outcomes of thoracic endovascular aortic repair in adult coarctation patients

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ABSTRACT

Background: Aortic coarctation (AC) is most commonly identified in pediatric patients; however, adults can present with late sequelae of untreated coarctation or complications of prior open repair. To date, there are limited data about the role of thoracic endovascular aortic repair (TEVAR) in this group of patients. The purpose of this analysis was to describe our experience with management of adult coarctation patients using TEVAR.

Methods: All TEVAR patients treated for primary coarctation or late sequelae of previous open repair (eg, pseudoaneurysm, recurrent coarctation or anastomotic stenosis related to index open coarctation repair) were reviewed. Demographics, comorbidities, procedure-related variables, postoperative outcomes, and reintervention were recorded. Computed tomography centerline assessments of endograft morphology were completed to delineate stent anatomy at the coarctation site. Survival and reintervention were estimated using life-table analysis.

Results: A total of 21 patients were identified (median age, 46 years [range, 33-71 years]; 67% male [n = 14]). Nine patients (43%) were treated for symptomatic primary (n = 6) or recurrent (n = 3) coarctation. Other indications included degenerative thoracic aneurysm (n = 6), pseudoaneurysm (n = 4), and dissection (n = 2). Technical success was 100% (95% confidence interval [CI], 84%-100%). No 30-day mortality or paraplegia events occurred; however, two patients (10%) experienced postoperative nondisabling stroke. In primary or recurrent coarctation patients with available computed tomography imaging (n = 8 of 9), nominal stent graft diameters were achieved proximal and distal to the coarctation (range, -0.4 to -1.2 mm of desired final stent diameter). Specific to the coarctation site, there was a significant increase in aortic diameter after TEVAR (before stenting, 11.5 [95% CI, 6.8-12.3] mm; after stenting, 15 [95% CI, 13.7-15.7] mm; $P = .004$). Concurrently, systolic arterial blood pressure at time of discharge was significantly lower (before stenting: 147 mm Hg; 95% CI, 137-157 mm Hg; after stenting: 124 mm Hg; 95% CI, 118-134 mm Hg; $P = .02$). For all patients, median clinical follow-up time was 8 months (interquartile range, 3-13 months; range, 1-106 months). Three endoleaks were detected, all of which were type II related to left (n = 2) or aberrant (n = 1) subclavian arteries. Four patients (19%) underwent reintervention (median time, 7 months; range, 2-12 months), with three of four being subclavian artery embolization; one was an aortic root replacement for ascending aneurysm with bicuspid aortic valve. One-year freedom from reintervention was 78% \pm 9% (95% CI, 42%-92%). The 1- and 3-year survival was 95% \pm 5% (95% CI, 71%-99%). One late death was related to complications from pre-existing congenital heart disease.

Conclusions: Adult AC patients can be treated safely with TEVAR, and the annular constriction of an AC can be successfully dilated by the stent graft. Given these findings, a greater number of patients with longer term follow-up is warranted to further define the role of TEVAR in the management of adult AC patients. (*J Vasc Surg* 2017;■:1-13.)

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Aortic coarctation (AC) is a focal constriction of the arterial wall and accounts for 5% to 8% of congenital heart defects.^{1,2} The juxtaductal lesion arises from embryologic failure in development of the fourth and sixth pharyngeal arch derivatives.³ The presence of the resulting stenosis chronically increases cardiac afterload, which may cause left ventricular hypertrophy and congestive heart failure.² A majority of patients present during infancy or adolescence and typically undergo open repair, with endovascular therapies predominantly reserved for decompensated patients as a bridge to operation.^{2,4} Notably, AC presentation is variable; 15% to 20% of subjects remain asymptomatic until adulthood, when AC can be a secondary cause of hypertension, congestive heart failure, premature coronary artery disease, stroke, aortic dissection, and sudden death.⁵ Without operation, adult AC has a mortality rate approaching 75% by the fifth decade of life.^{2,5}

Given excellent results, open repair of primary AC remains the "gold standard," especially in younger patients. However, late complications including aneurysm, pseudoaneurysm, dissection, and recurrent (secondary) coarctation occur in 11% to 24% of patients.^{6,7} Because of early and late morbidity of open reconstruction, bare-metal stents (BMSs) have largely supplanted open repair in many older children and adults.⁸ Unfortunately, the BMS is also associated with long-term complications, such as aneurysm, dissection, and recurrent coarctation from poor stent expansion in 5% to 25% of cases.^{1,9-13} An alternative solution is thoracic endovascular aortic repair (TEVAR) because several reports highlight its use in treating complications after open AC repair.¹⁴⁻¹⁶ To date, there are no series highlighting TEVAR of primary or recurrent AC in adults. Moreover, significant concerns exist about the efficacy of this strategy as stent grafts may not provide sufficient aortic expansion to treat the sequelae of coarctation.^{8,17}

The purpose of this analysis was to describe our experience with TEVAR in adults presenting with late sequelae of untreated coarctation or complications of the index repair.

METHODS

The University of Florida Institutional Review Board approved this study, and the requirement for patient consent was waived (No. 510-2015).

Database and patient cohort. This is a retrospective single-center review of a prospectively maintained endovascular aortic registry. All TEVAR procedures were reviewed ($n = 985$), and adult patients (aged ≥ 18 years) treated with TEVAR for primary coarctation or late sequelae of previous open repair (eg, pseudoaneurysm, recurrent coarctation or anastomotic stenosis related to index open coarctation repair) from January 2004 to June 2016 were included. During this time, the total

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective, single-center cohort study
- **Take Home Message:** Thoracic endovascular aortic repair of 21 adult thoracic coarctation patients resulted in 100% technical success, 10% nondisabling stroke rate, 78% 1-year freedom from reintervention rate, and 95% survival at 1 year.
- **Recommendation:** This study suggests that thoracic endovascular aortic repair with self-expanding covered stent grafts is a reasonable treatment option for adult patients with primary or recurrent thoracic aortic coarctations or complications of previous open repairs.

combined open coarctation repair volume (primary coarctation and late sequelae of open repair) among all adult and pediatric patients was 73 cases. None of these patients who were treated with TEVAR as part of this series subsequently presented again with complications.

No pediatric TEVAR cases (aged ≤ 18 years) for an AC or complication of prior open AC repair were identified in the registry. Elective and nonelective presentations, including emergency and ruptured indications, were analyzed. Open surgical repair of adult AC patients and complications after coarctation repair were excluded. The electronic medical record was reviewed to abstract demographics, comorbidities, procedure-specific details, reinterventions, and complications. The patient's death was confirmed using the Social Security Death Master File.

End points and definitions. Primary end points of the study included 30-day mortality and in-hospital complications. Secondary end points included technical success, diameter changes of the stenotic aortic segment over time, reintervention, and survival. Primary coarctation was defined as a native AC that was not associated with prior open repair. Secondary or recurrent coarctation was defined as an AC that occurred after the index open AC repair.

Zones of endograft attachment were defined according to current reporting standards for TEVAR,¹⁸ and technical success was defined as successful exclusion of the aneurysm, adequate coverage of the dissection, or sufficient treatment of the stenosis at the site of coarctation on completion angiography. Adequate treatment of the coarctation was confirmed by <10 mm Hg systolic gradient with intra-aortic manometry. Technical success for AC treatment was determined by lack of residual hemodynamic gradient and exclusion of concurrent aortic disease. Comorbidities were defined on the basis of previously published definitions from the Society for Vascular Surgery.¹⁸ Reintervention was defined as any

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