Outcomes of percutaneous endovascular intervention for type II endoleak with aneurysm expansion

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Objective: **Type II endoleak (T2EL) with aneurysm expansion is believed to place patients at risk for aneurysm-related mortality (ARM). Treatment with glue and/or coil embolization of the aneurysm sac, inferior mesenteric artery (IMA), and lumbar branches via translumbar or transarterial approaches has been utilized to ablate such endoleaks, and thus decrease ARM. We evaluated the midterm results of percutaneous endovascular treatment of T2EL with aneurysm expansion.**

Methods: **Single-institution, 5-year (January 2003 to August 2008) retrospective study of all endovascular interventions for T2EL with sac expansion. Blinded, independent review of all available pre- and post-T2EL intervention computed tomography (CT) scans was performed. Aneurysm sac maximal transverse diameters and aneurysm sac growth rates prior to and following T2EL intervention were analyzed.**

Results: **Forty-two patients (34 male, eight female; mean age, 75) underwent T2EL intervention at 26 ± 20 months after endovascular aneurysm repair (EVAR) and were subsequently followed for 23 ± 20 months. Seven out of 42 patients (17%) underwent repeat T2EL intervention. Interventions included 44 translumbar sac embolizations, and transcatheter embolizations of nine IMAs and seven lumbar/hypogastric arteries. Aneurysm diameter was 6.1 ± 1.6 cm at EVAR, 6.6 ± 1.5 cm at initial T2EL treatment, and 6.9 ± 1.7 cm at last follow-up. There were no significant differences in the rates of aneurysm sac growth pre- and post-T2EL treatment. At last follow-up imaging, recurrent or persistent T2EL was noted in 72% of patients. Of 42 patients, nine (21%) received operative endoluminal correction of occult type I or type III endoleaks that were diagnosed during the T2EL angiographic intervention. There were no aneurysm ruptures or ARMs during follow-up; overall mortality for the 5-year study period was 24%.**

Conclusions: **In this series, percutaneous endovascular intervention for type II endoleak with aneurysm sac growth does not appear to alter the rate of aneurysm sac growth, and the majority of patients display persistent/recurrent endoleak. However, diagnostic angiographic evaluation may reveal unexpected type I and III endoleaks and is therefore recommended for all patients with T2EL and sac growth. While coil and glue embolization of aneurysm sac and selected branch vessels does not appear to yield benefit in our series, the diagnosis and subsequent definitive treatment of previously occult type I and III endoleaks may explain the absence of delayed rupture and ARM in our series. (J Vasc Surg 2012;55:1263-7.)**

Endovascular aneurysm repair (EVAR) has become established as an alternative to open abdominal aortic aneurysm repair over the past 2 decades.[1,2] The early advantages in morbidity and mortality conferred by EVAR are substantially offset by the need for serial endograft surveillance and frequent reinterventions.[2-5] There is little debate regarding the merit of prompt treatment of type I and III endoleaks. The necessity, optimal timing, and most efficacious type of secondary intervention for type II endoleak (T2EL) have generated greater controversy, although it is widely accepted that intervention is unnecessary if the aneurysm sac size remains stable or diminishes.[6-8]

As the natural history of T2EL is not fully understood, proposed treatment algorithms are in part based upon anecdotal experience[9] or outcomes of retrospective studies evaluating all patients diagnosed with T2EL, rather than those patients with accompanying sac enlargement.[6-8,10] Specifically, these reports promote the selective use of angiographic modalities to treat T2EL but do not detail mid- and long-term outcomes of these interventions. Such information is necessary to define whether these treatments offer complete or partial success in halting aneurysm sac growth and preventing rupture. As our institution followed a routine policy of percutaneous endovascular intervention for all T2ELs associated with aneurysm sac growth of >5 mm, the purpose of this study was to specifically evaluate results of our 5-year experience with this technique.

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Author conflict of interest: Dr Geraghty is a consultant for Cook Medical and Ascension Venture Capital and a scientific advisory board member for Pulse Therapeutics and Medrad Cotavance. Dr Curci has research support from Symphony Capital/Renavance and is a consultant for SurgExpert.com. Dr Sanchez has consulting and research relationships with the following organizations: Cook, Inc, W. L. Gore and Associates, Aptus Endosystems, Inc, CVRx, Inc, CryoLife, Inc, Endologix, Inc, Lombard Medical, Inc, Medtronic, Inc, and TriVascular, Inc. Dr Rubin is a consultant for Medtronic, Inc.

Presented at the Thirty-fourth Annual Meeting of the Midwestern Vascular Society, Indianapolis, Ind, September 9-11, 2010.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the JVS policy that requires reviewers to decline review of any manuscript for which they may have a competition of interest.

0741-5214/$36.00

doi:10.1016/j.jvs.2011.10.131

METHODS

A 5-year (January 2003 to August 2008) retrospective study of all patients treated for aneurysm enlargement associated with T2EL was performed within the Barnes-Jewish Care Network. This study was conducted in accordance with the approval of the Institutional Review Board of Washington University Medical School. Patient demographics, including concurrent illnesses, medications, radiologic follow-up, and treatment modalities, were catalogued in a database created via Microsoft Access (Microsoft Inc, Redmond, Wash).

All obtainable follow-up imaging reports after initial EVAR were recorded, and all available radiographic images were compiled. Fifty-nine percent of pre-T2EL intervention images from referring institutions were not available for review due to Institutional Review Board-related constraints. In those instances, the written imaging reports were used to document the presence of endoleak and the size of the abdominal aortic aneurysm (AAA) sac. Ninety-one percent of post-T2EL intervention images were available for review, including 137 computed tomography (CT) scans and two abdominal ultrasounds, as almost all patients were followed at our institution after these interventions. To standardize our image review, all available images (both pre- and post-T2EL intervention) were independently reviewed by an abdominal imaging radiologist who was blinded to the initial reported findings of the studies. The independent radiologist reviewer documented the AAA sac size, presence of endoleak, and type of endoleak.

Deaths were recorded by reviewing hospital records and by interrogating the Social Security Death Index (SSDI). The follow-up period was defined as the time from initial EVAR to the most recent imaging study. Closeout of the study was February 2009, allotting at least 6 months of follow-up from the last T2EL treatment recorded in this study.

In addition to calculating the absolute changes in AAA sac size, we also analyzed whether percutaneous endovascular intervention favorably altered the rate of growth of the sac. "Slope" values represent the regression line calculated by plotting aneurysm sac size against time. Two time periods were compared: the interval between EVAR and initial intervention for T2EL, and the interval between initial intervention for T2EL and last documented follow-up imaging. A minimum of two imaging studies within each time interval were required to generate a slope value. The equation for the slope of the regression line is:

$$b = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$

Slope values prior to and following T2EL intervention were compared using the Mann-Whitney *t*-test.

Statistical analysis was performed using the statistical software package InStat (GraphPad Software Inc, La Jolla, Calif) and Microsoft Excel (2003) (Microsoft Inc).

Table I. Demographics and comorbidities

Demographic/comorbidity	*Percentage of patients*
Female	19
Hypertension	86
Coronary artery disease	60
Diabetes mellitus	17
COPD/home O_2 use	12
CRI (creatinine >2)	5
ESRD	0
Active smoking	14
EF <40%	0
PAD/cerebrovascular disease	24
Symptomatic AAA at EVAR	7
Ruptured AAA at EVAR	5

AAA, Abdominal aortic aneurysm; *COPD*, chronic obstructive pulmonary disease; *CRI*, chronic renal insufficiency; *EF*, ejection fraction; *ESRD*, end-stage renal disease; *EVAR*, endovascular aneurysm repair; *PAD*, peripheral arterial disease.

Table II. Initial angiographic approach to type II endoleak

Angiographic approach	*Number of patients (%)*
Transabdominal	1 (2)
Transaxillary	1 (2)
Transfemoral	10 (24)
Transfemoral, then translumbar	13 (31)
Translumbar	16 (38)
Translumbar, then transfemoral	1 (2)
Total	42 (100)

RESULTS

Forty-two consecutive patients were identified as having undergone angiographic intervention for T2EL with aneurysm sac expansion. The average age of the patient was 75 (range, 52-89). Patient demographics and medical comorbidities are classified in Table I. At the time of T2EL intervention, mean aneurysm sac diameter was 6.5 cm (range, 4.0-10.6 cm). The approaches used for diagnostic angiography are detailed in Table II. Percutaneous endovascular interventions, inclusive of repeat treatments, comprised 44 translumbar embolizations, seven transcatheter embolizations of lumbar or hypogastric vessels, and nine inferior mesenteric artery embolizations. Seven out of 42 patients (17%) required a repeat percutaneous T2EL intervention after initial treatment, while nine out of 42 patients (21%) required subsequent redo femoral cut-down and placement of additional endografts to repair type I or III endoleaks. There were no instances of aneurysm rupture or aneurysm-related mortality. Overall mortality rate in the 5 years of follow-up from study initiation was 24% (10 of 42 patients).

Incidence of type 2 endoleak accompanied by sac growth. We could not obtain the total number of EVARs performed at the referring institutions during the study period and therefore cannot provide a global denominator to assess the incidence of T2EL accompanied by sac growth. However, 16 of the 42 patients underwent initial