Preoperative Inferior Mesenteric Artery Embolization before Endovascular Aneurysm Repair: Decreased Incidence of Type II Endoleak and Aneurysm Sac Enlargement with 24-month Follow-up

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ABSTRACT

Purpose: To review the effect of preoperative embolization of the inferior mesenteric artery (IMA) before endovascular aneurysm repair (EVAR) on subsequent endoleaks and aneurysm growth.

Materials and Methods: Between August 2002 and May 2010, 108 patients underwent IMA embolization before EVAR. Coil embolization was performed in all patients in whom the IMA was successfully visualized and accessed during preoperative conventional angiography. In this cohort, the incidences of type II endoleak, aneurysm sac volume enlargement at 24 months, and repeat intervention were compared with a group of 158 consecutive patients with a patent IMA on preoperative computed tomography angiography but not on conventional angiography, who therefore did not undergo preoperative embolization.

Results: The incidence of type II endoleak was significantly higher in patients not treated with embolization (49.4% [78 of 158] vs 34.3% [37 of 108]; $P = .015$). The incidence of secondary intervention for type II endoleak embolization was also significantly higher in those who did not undergo embolization (7.6% [12 of 158] vs 0.9% [one of 108]; $P = .013$). At 24 months, an increase in aneurysm sac volume was observed in 47% of patients in the nonembolized cohort (21 of 45), compared with 26% of patients in the embolized cohort (13 of 51; $P = .03$). No aneurysm ruptures or aneurysm-related deaths were observed in either group. One patient in the embolization group developed mesenteric ischemia and ultimately died.

Conclusions: Preoperative embolization of the IMA was associated with reduced incidences of type II endoleak, aneurysm sac volume enlargement at 24 months, and secondary intervention.

ABBREVIATIONS

AAA = abdominal aortic aneurysm, EVAR = endovascular aneurysm repair, IMA = inferior mesenteric artery

Since it was first described more than 20 years ago, endovascular aneurysm repair (EVAR) has become first-line therapy for abdominal aortic aneurysms (AAA) (1,2). The EVAR 1 trial (3) produced the first data from a randomized controlled trial and demonstrated decreased 30-day mortality and aneurysm-related deaths with EVAR compared with open repair. This benefit was balanced against higher complication rates, notably endoleaks, and an increased need for secondary interventions (3).

An endoleak, defined as persistent blood flow in the aneurysm sac external to the endograft, can broadly be broken down into high-pressure and low-pressure endoleaks (4). Type I and type III endoleaks are high-pressure leaks, for which secondary intervention is widely advocated. Type II and type IV endoleaks are more controversial, and the appropriate follow-up and need for secondary intervention is a topic of debate (5).

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The principal indication for secondary intervention after EVAR is continued aneurysm sac enlargement, with intervention performed to reduce the risk of rupture. In a review of 10,228 patients by Schanzer et al (6), the presence of an endoleak on postprocedural imaging was found to be the primary predictive factor for aneurysm sac enlargement. In a review of 270 cases of AAA rupture after EVAR reported by Schlösser et al (7), the presence of an endoleak was the primary reported cause in 160 of the 235 cases in which the cause of rupture was described, with type II endoleaks responsible for 23 of the 235 ruptures.

The incidence of type II endoleak after EVAR ranges from 8% to 45%, with most series reporting a high rate of spontaneous resolution: 40%–67% (8–15). Studies stratified by anatomic factors have demonstrated even higher rates of type II endoleak in certain populations, with 67% of patients with greater than six patent lumbar vessels and a patent inferior mesenteric artery (IMA) found to have a type II endoleak on follow-up (16). Preoperative embolization of aortic side branches, including patent lumbar arteries and IMAs, has been previously investigated as a method to decrease this high incidence of type II endoleak (17–19). Given the significant contribution of the IMA to the formation and maintenance of type II endoleak, as well as the relative speed and ease with which the IMA is accessed compared with other aortic side branches, the effect of preoperative embolization of the IMA in patients undergoing EVAR was investigated.

MATERIALS AND METHODS

All patients underwent EVAR approximately 4–8 weeks after conventional angiography, with the number and type of stent-graft detailed in **Table 1**. All data concerning these procedures, as well as follow-up and rates of repeat intervention, were prospectively entered into an endovascular database at the performing institution. The institutional review board approved the protocol for EVAR in all patients and the retrospective review of the patient's records for the present study.

Table 1. Stent-grafts Used

Stent	Embolization (n = 108)	No Embolization (n = 158)	*P* Value
Excluder	47 (44)	91 (58)	.024
Talent	34 (31)	46 (29)	.96
Zenith	1 (1)	8 (5)	.067
Endurant	1 (1)	6 (4)	.15
AneuRx	21 (19)	7 (4)	< .001
Aptus	2 (2)	0	.086
Fortron	2 (2)	0	.086

Values in parentheses are percentages. Manufacturers are as follows: Excluder (W.L. Gore and Associates, Flagstaff, Arizona); Talent, Endurant, and AneuRx (Medtronic, Minneapolis, Minnesota); Zenith (Cook, Bloomington, Indiana); Aptus (Lumbard, Tempe, Arizona); and Fortron (Cordis, Bridgewater, New Jersey).

Patients

Over a 10-year period at a single tertiary referral center, 108 patients with AAAs and a patent IMA visualized on preprocedural computed tomographic (CT) angiography and subsequent conventional angiography underwent preoperative IMA embolization. The patients who underwent embolization were compared with 158 consecutive patients with a patent IMA visualized on preprocedural CT angiography but not on conventional angiography. It was postulated that patients with a patent IMA on CT angiography but not conventional angiography had retrograde filling of the IMA via collateral vessels and a stenotic origin that prevented visualization on conventional angiography. As a result, these patients did not have preprocedural IMA embolization. Selected images from preoperative imaging, conventional angiography with IMA coil embolization, and follow-up imaging of a patient is provided in **Figure 1**.

Preoperative patient characteristics (**Table 2**) including age, sex, and maximum aneurysm diameter were not significantly different between groups. The number of patent second through fifth lumbar arteries observed on preprocedural CT angiography was significantly higher in the IMA embolization group (mean, 7.0 [range, 2–8] vs 6.3 [range 2–8]; $P < .001$), and mean follow-up duration was longer (mean, 985 d [range, 8–3,343 d] vs 645 d [range, 4–1,819]; $P < .001$). Patients with type I and type III endoleaks were excluded, as the effect of patency or embolization of the IMA with respect to type II endoleak, aneurysm sac volume, and need for secondary intervention were the clinical outcomes of interest.

CT Angiography

Preoperative CT angiography was performed in all patients. Helical images were obtained from the diaphragm through the femoral heads before and after intravenous bolus administration of Isovue 300 (iopamidol injection 61% [Bracco Diagnostics Inc, Princeton, New Jersey]) at a rate of 4 mL/s for a total volume of 100 mL. Diameter measurements in the axial plane were made at the level of the renal artery origins, maximum aortic diameter, and common iliac artery bifurcations. Sagittal and coronal images were reconstructed to grossly assess the feasibility of EVAR, including angulations of the aorta and patency of renal and mesenteric arteries. Diameter measurements were made by one of six board-certified radiologists with Certificates of Added Qualifications in vascular and interventional radiology.

Pre- and postoperative CT angiography was performed with multislice scanners (Siemens, Erlangen, Germany), reconstructed with volume measurements on Vitrea software (Vital Images, Plymouth, Minnesota), and read by interventional radiologists (routine protocol, 2.5-mm thin axial slices with 0.6-mm spacing).