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Partial open conversion with proximal aortic banding and endograft preservation is a safe option for the treatment of persistent type II endoleaks

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ABSTRACT

We have described our technique of open partial conversion (OPC; n = 5) with aortic banding and endograft preservation for the treatment of type II endoleaks. OPC significantly reduced the aortic clamping time (5.0 vs 32.5 minutes; $P = .01$) relative to endograft explantation (n = 2). Cross-clamping was avoided entirely in three of the procedures. The patients treated with OPC showed a trend toward a decreased operative time (4.8 vs 5.9 hours) and shorter hospital stay (5.7 vs 7.4 days). Follow-up computed tomography scans were available for three of the five OPC patients, which showed resolution of the type II endoleak. The findings from the present study have further demonstrated the safety of OPC for the treatment of type II endoleaks. (J Vasc Surg Cases Innov Tech 2021;7:649-53.)

Keywords: Aneurysm; Endoleak; Endograft preservation; Endograft explant

Endovascular aneurysm repair (EVAR) is a common, less invasive treatment of abdominal aortic aneurysms (AAAs).[1,2] However, the incidence of EVAR-related complications has been increasing.[1] The most common complication is endoleak, with an incidence as high as 30.5% after EVAR.[3] Type II endoleaks, defined as persistent filling of the AAA sac by patent branch arteries, comprise ≤76% of reported endoleaks and are thought to occur in 6% to 30% of all EVAR patients.[1,2,4-6] Historic data on open aortic bypass and popliteal artery aneurysm repair by sac exclusion have described similar mechanisms of persistent sac perfusion via collateral vessels in a small proportion of patients.[7-9]

Type II endoleaks require lifelong surveillance; however, the urgency of treatment and preferred method are debated. The EUROSTAR collaborators (European collaborators on stent-graft techniques for abdominal aortic aneurysm repair) found that many will spontaneously thrombose.[4,10] Other studies have described persistent type II endoleaks that remained unresolved for ≥6 months and resulted in sac expansion.[2,5,6,11,12] In 2002, Hinchliffe et al[13] was the first to report successful sacotomy with ligation of back-feeding vessels, an open partial conversion (OPC) procedure, to treat a persistent type II endoleak and preserve the endograft. Since then, several other investigators have demonstrated similar results using the OPC technique.[1,6,11,12]

Aortic banding can be an adjunct to EVAR. Primary banding corrects unfavorable anatomy before EVAR. Secondary banding secures and stabilizes the endograft in the landing zone after EVAR and has been used most often to treat type Ia endoleaks.[14,15] Because manipulation of the landing zone and treatment of type II endoleaks have continued to be debated, the objective of the present study was to describe our technique of OPC with proximal aortic banding for the treatment of persistent type II endoleaks. We contrasted this technique with endograft explantation to evaluate the potential benefits of OPC with aortic banding.

METHODS

Patient selection. Patients undergoing open repair for type II endoleak after EVAR from 2008 to 2018 at University of Wisconsin Hospital (Madison, Wisc) were identified via billing query and a retrospective review of the medical records after institutional review board approval. Seven patients were identified and categorized according to the conversion technique used: OPC with aortic banding (n = 5) and endograft explantation (n = 2).

Data collection. The patient demographics, comorbidities, previous AAA treatments, and conversion procedure data were recorded. The primary postoperative outcome

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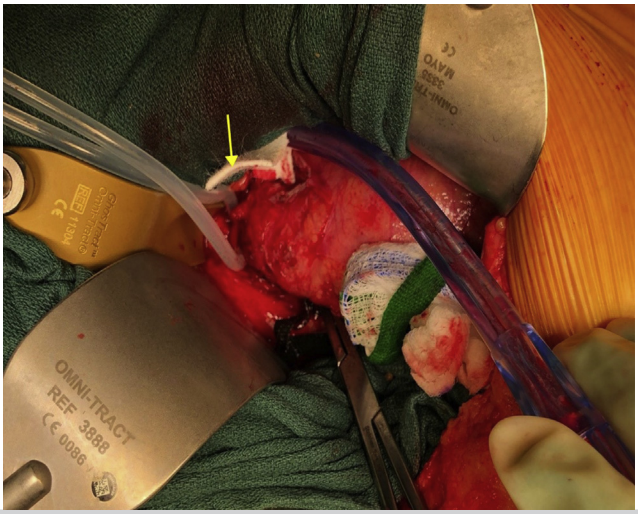

Fig 1. Exposure of the abdominal aorta and encirclement of the aortic neck with a felt strip (*arrow*). The patient's head is to the left of the image.

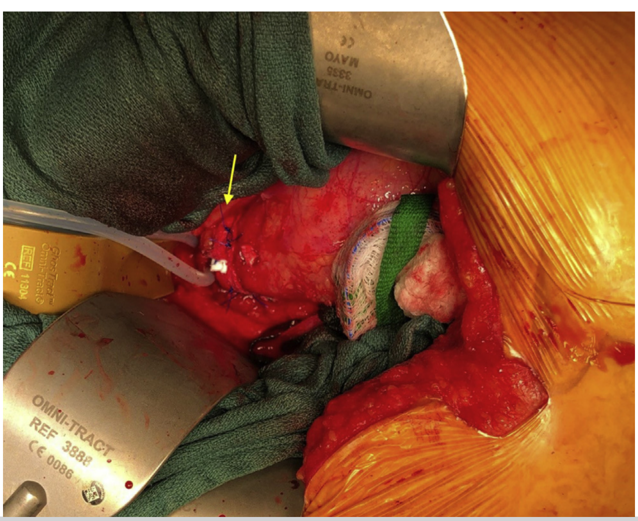

Fig 2. Completed felt banding of the proximal aortic neck (*arrow*).

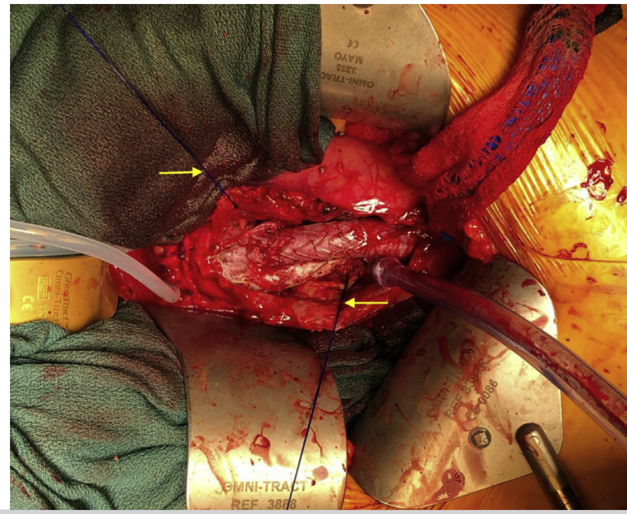

Fig 3. The sac was opened and any back-bleeding vessels were identified and oversewn (*arrows*).

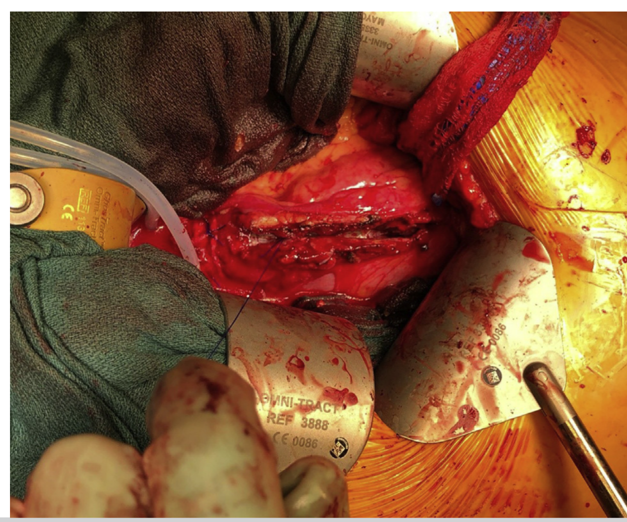

Fig 4. After excision of the redundant aneurysm wall, the sac was closed over the endograft.

was 30-day mortality. The secondary outcomes included prolonged intubation (>48 hours) and acute kidney injury. The necessity for subsequent aortic intervention was the long-term outcome for the present study.

OPC technique. All OPC procedures were performed via a transabdominal approach, although a retroperitoneal approach was also viable. After exposure of the proximal aortic neck, a felt strip was wrapped circumferentially and plicated to constrict the neck, incorporate the graft, and provide additional fixation during sac exploration (Figs 1 and 2). This was performed using two to three 2-0 sutures scattered along the circumference of the aorta, ensuring that the sutures passed through the felt, graft material, and again through the felt. Additional felt banding of the iliac arteries was performed if a tortuous or short landing zone was present or concern existed for displacement. The band circumference was measured precisely to match the original device sizing criteria by obtaining the original device dimensions, and cutting the band with an additional 2 cm to allow for overlap. After opening the sac, mural thrombus or previously placed coils were evacuated. The brisk back-bleeding from the lumbar arteries or other sources of type II endoleak were controlled and ligated from inside the sac (Fig 3). In two patients, this step required proximal clamp placement to control rapid volume loss from hypertrophied collateral vessels. Once

Table I. Individual patient data of aneurysm growth and procedural information

Pt. No.	Procedure type	Sex	Age at repair, years	MTD at EVAR procedure, cm	MTD at repair procedure, cm	OR time, hours	Total aortic clamp time, minutes	In-hospital morbidity	Interventions after original EVAR
1	OPC	M	83	6.7	10.0	4.8	0	AKI	Embolization for type Ib endoleak, 6 coils placed, laparoscopic ligation of IMA, lumbar coil embolization, translumbar glue embolization
2	OPC	M	70	5.4	10.4	5.9	17	None	Placement of Gore contralateral leg excluder endoprosthesis cuff
3	OPC	M	88	7.0	9.3	4.6	0	None	Hypogastric embolization, direct stick embolization of type I endoleak
4	OPC	F	87	4.5	9.0	3.8	8	None	EVAR relining, coil placement, and embolization
5	OPC	M	79	5.6	8.0	4.5	0	None	Embolization of right hypogastric artery
6	Explant	M	87	7.2	7.7	5.15	20	Prolonged intubation	None
7	Explant	M	70	6.5	6.9	6.7	45	None	Coil embolization of posterior lumbar artery for type II endoleak

AKI, Acute kidney injury; *EVAR*, endovascular aneurysm repair; *F*, female; *IMA*, inferior mesenteric artery; *M*, male; *MTD*, mean transverse diameter; *OPC*, open partial conversion; *OR*, operating room; *Pt. No.*, patient number.

the lumbar arteries had been controlled, the sac was trimmed of excess tissue and closed over the endograft with a running 3-0 polypropylene (Prolene; Ethicon, Raritan, NJ) suture (Fig 4).

RESULTS

The average age of all patients was 80.6 years, and most were men (85.7%). Open conversion was performed an average of 5.3 years (range, 2.2-10.7 years) after EVAR. Six of the seven patients had undergone at least one endovascular intervention before conversion (Table I). The mean aneurysm size at conversion was 8.7 cm (range, 6.9-10.4 cm), with a mean increase of 2.6 cm (range, 0.4-5.0 cm) after EVAR. The OPC patients had had a longer time to conversion (6.2 years vs 3.2 years; $P = .12$), a significantly larger increase in sac size (3.5 cm vs 0.3 cm; $P = .008$), and more secondary interventions before conversion ($P = .16$) relative to the explantation patients (Table II).

Aortic cross-clamping was avoided in three of the five OPC procedures, and the remaining two still had a reduced average cross-clamp time compared with explantation (12.5 minutes vs 32.5 minutes). The OPC group also showed a trend toward a decreased total operative time (4.8 hours vs 5.9 hours) and mean hospital stay length (5.7 days vs 7.4 days; Table II).

No 30-day mortality was reported in either cohort. The in-hospital morbidity was 40%, with one report of acute kidney injury in the OPC group and one report of prolonged intubation in the explantation group. The mean length of follow-up was 1.3 years after conversion. Follow-up computed tomography scans were available for three of the five OPC patients, which showed resolution of the type II endoleak. No additional aortic

Table II. Characterization of *OPC* and endograft explantation

Characteristic	OPC (n = 5)	Explantation (n = 2)
Age, years	81.4	78.5
Male sex	80 (4)	100 (2)
BMI, kg/m^2	28.3	24.5
Comorbidity		
AFIB	20 (1)	0 (0)
CAD	60 (3)	0 (0)
CHF	40 (2)	0 (0)
CKD	20 (1)	50 (1)
CRF	0 (0)	50 (1)
Type 2 DM	40 (2)	0 (0)
DVT	40 (2)	0 (0)
HLD	40 (2)	0 (0)
HTN	60 (3)	50 (1)
PVD	20 (1)	0 (0)
Smoking status		
Never	40 (2)	50 (1)
Former	60 (3)	0 (0)
Current	0 (0)	50 (1)
Surgical history		
Interval since EVAR, years	6.2	3.2
Average No. of secondary interventions	2.4	1
Average MTD growth from EVAR to open repair, cm	3.5[a]	0.3
Average MTD at open repair, cm	9.3[a]	7.1
Average ASA class	3.4	3
Surgical outcomes		
OR time, hours	4.8	5.9
Length of hospital stay, days	5.7	7.4
30-Day mortality	0 (0)	0 (0)
In-hospital morbidity	20 (1)	50 (1)
Subsequent interventions	0 (0)	0 (0)

ASA, American Society of Anesthesiologists; *AFIB,* atrial fibrillation; *BMI,* body mass index; *CAD,* coronary artery disease; *CHF,* congestive heart failure; *CKD,* chronic kidney disease; *CRF,* chronic renal failure; *DM,* diabetes mellitus; *DVT,* deep vein thrombosis; *EVAR,* endovascular aneurysm repair; *HLD,* hyperlipidemia; *HTN,* hypertension; *MTD,* mean transverse diameter; *OPC,* open partial conversion; *OR,* operating room; *PVD,* peripheral vascular disease.
Data presented as percentage (number), unless noted otherwise.
[a]$P < .05$.

interventions were reported after the OPC procedures during the data collection period.

DISCUSSION

The long-term durability of EVAR remains a weakness of the procedure. Type II endoleaks causing sac expansion have created a conundrum for physicians. Although substantial data on the risk of rupture in these situations are lacking, several studies have reported that rupture is possible.[5,6,8,11,16] Although most type II endoleaks will have a clear etiology, a subset of endoleaks will not resolve despite repeated interventions. Some of these patients will become fatigued by the reinterventions or carry emotional concern about sac growth. We used the OPC technique as an alternative treatment with a more definitive outcome. In our data, the use of OPC resolved type II endoleaks with a significantly decreased aortic cross-clamp time relative to explantation. The OPC group also showed a trend toward a decreased operative time and length of hospital stay, although the differences did not reach statistical significance. Together, these findings suggest that OPC with aortic banding could be performed in patients who would otherwise be considered at high risk for an endograft explant procedure to treat persistent type II endoleaks.

The banding technique used during the OPC procedure also has many benefits. Oversewing the felt pledget in place and fixing it by suture to the graft will stabilize the proximal landing zone and prevent further complications, such as device migration or type Ia endoleaks.[1,14,15] Precise placement of the band is necessary to avoid aortic stenosis, and surgeons must also consider the thrombus present in the aneurysm sac to prevent its displacement into the renal arteries.[13]

The limitations of our study included the small sample size and unequally sized groups. Because the explantation group had decreased sac growth and a shorter time to conversion, they might have represented an entirely different population. Selection bias could also have influenced which patients were selected for OPC and included in the present study. Future studies could investigate a larger cohort to increase the confidence of this procedure and better identify which patients might benefit from OPC with aortic banding. Despite these limitations, our study has provided additional evidence regarding the success of OPC with aortic banding for the treatment of persistent type II endoleaks.

CONCLUSIONS

The results from the present study have demonstrated the safety of OPC with endograft preservation and aortic banding for the treatment of type II endoleaks. This procedure is an important option to consider when planning intervention for high-risk patients with a persistent type II endoleak causing sac expansion.

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