

## Ruptured juxtarenal abdominal aortic aneurysm managed with endosuture aneurysm repair

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### ABSTRACT

The use of Heli-FX EndoAnchors (Medtronic CardioVascular, Santa Rosa, CA) with the Endurant II stent graft (Medtronic CardioVascular) has been approved by the Food and Drug Administration for juxtarenal abdominal aortic aneurysms with neck lengths  $\leq 4$  mm. The use of this technique of endosuture aneurysm repair has not been previously described in the setting of rupture. We have presented two cases of successful endosuture aneurysm repair of ruptured juxtarenal AAAs. (*J Vasc Surg Cases Innov Tech* 2022;8:861-4.)

**Keywords:** EndoAnchor; Endosuture aneurysm repair; EVAR; Juxtarenal AAA; Ruptured AAA

In the emergent setting of juxtarenal ruptured abdominal aortic aneurysms (rAAAs), commercially available fenestrated endovascular aneurysm repair (FEVAR) will not be available owing to the inherently long manufacturing times required. The use of physician-modified fenestrated-branched EVAR eliminates this lead time by the use of back table techniques to modify the stent grafts but has been limited to centers participating in clinical trials and physicians trained in modifying endografts. Thus, open repair and chimney-EVAR (ch-EVAR) were often the only feasible options before the description of endosuture aneurysm repair (ESAR).<sup>1</sup> ESAR with the use of Heli-FX EndoAnchors (Medtronic CardioVascular, Santa Rosa, CA) with the Endurant II stent graft (Medtronic CardioVascular) has been approved for juxtarenal AAAs with neck lengths of  $\leq 4$  mm after favorable data from the ANCHOR (aneurysm treatment using the Heli-FX™ EndoAnchor™ system global registry) study.<sup>2</sup> Further analysis of the ANCHOR study demonstrated an overall procedural success rate of 97.1% and a technical success rate of 88.6% for cases with neck lengths  $< 10$  mm and  $> 4$  mm.<sup>3</sup> We have described two cases of a juxtarenal rAAA that

were treated with ESAR. The patients provided written informed consent for the report of their case details and imaging studies.

### CASE REPORT

**Patient 1.** A 69-year-old man with a medical history of diabetes mellitus, obesity, hypertension, coronary artery disease, and chronic kidney disease (CKD) had presented with severe abdominal and back pain, with a systolic blood pressure in the 80s. He had undergone open retroperitoneal AAA repair 12 years prior that had been complicated by inadvertent left renal artery ligation, intraoperative cardiac arrest, and a prolonged recovery. The results of laboratory studies were unremarkable apart from a serum creatinine of 1.35 mg/dL. Computed tomography (CT) revealed a contained juxtarenal rAAA with a proximal neck of 4 mm and degeneration of the previous tube graft, which was noted to be redundant on a prior scan performed 5 years earlier (Fig 1, A and B). Because of his limited functional status, CKD, surgical history, and body habitus, a percutaneous endovascular technique was performed. After obtaining access and an aortogram (Fig 1, C), an Endurant device with a 32-mm main body was deployed below the solitary right renal artery. The iliac limbs were then deployed for the distal seal. Six EndoAnchors were then placed at the level of the neck at the anterior, left lateral, right lateral, and posterior positions. A type Ia endoleak was noted, leading to deployment of a 32-mm proximal aortic cuff with four additional EndoAnchors. The completion aortogram revealed a small type Ia endoleak that was anticipated to resolve (Fig 1, D). The total operating time was 198 minutes, with an estimated blood loss of 200 mL. Because of his severe CKD, ferumoxytol (Feraheme; AMAG Pharmaceuticals, Waltham, MA) magnetic resonance imaging was obtained on postoperative day (POD) 2 and revealed no endoleak. His hospital course was unremarkable, and he was released on POD 3. The 6-month follow-up CT angiogram revealed no endoleak (Fig 1, E). The 1-year follow-up examination was missed owing to worsening of his renal function and his refusal for hemodialysis, leading to death.

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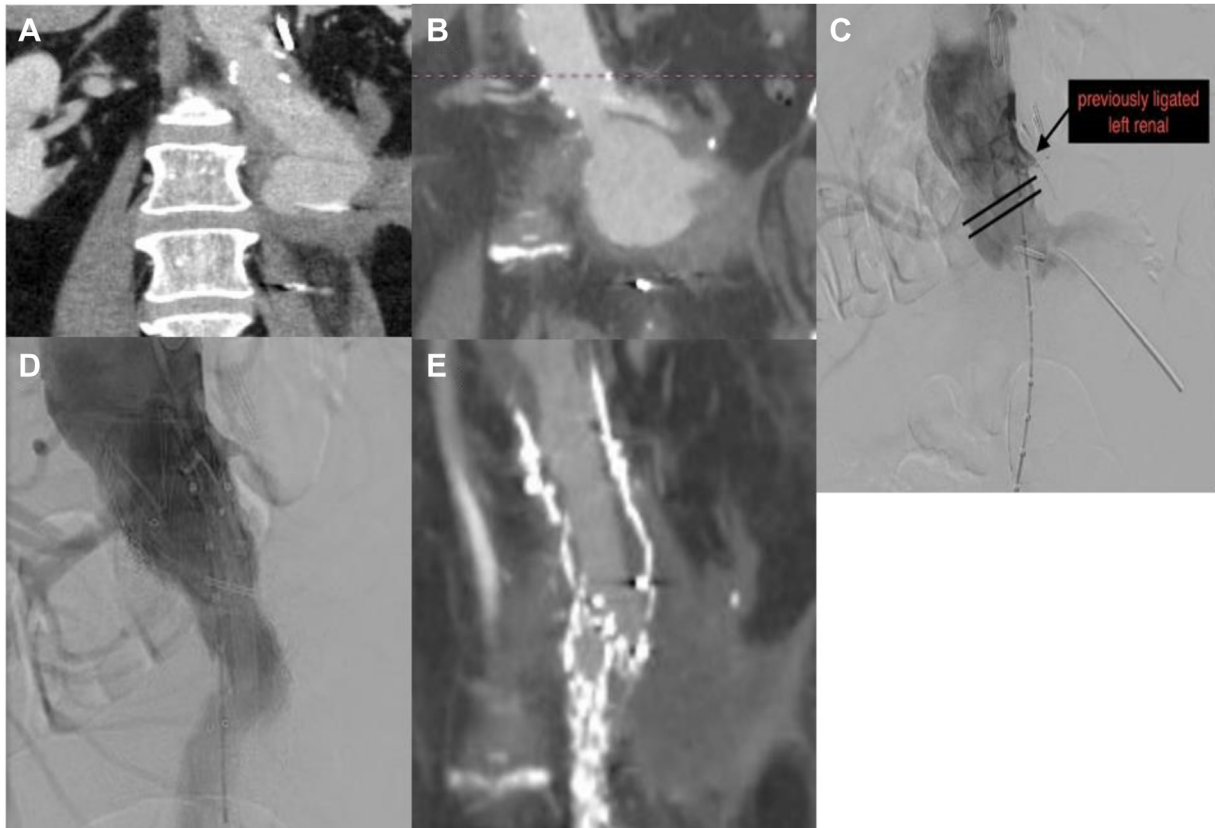
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**Fig 1.** **A,** Computed tomography (CT) scan 5 years before presentation revealing prior open repair with redundant tube graft. **B,** Preoperative CT scan revealing graft degeneration and left posterior ruptured 7.4-cm aneurysm. **C,** Aortogram with marker pigtail before placement of Endurant II aortic stent graft. **D,** Completion aortogram after endosuture aneurysm repair (ESAR) revealing a small type Ia endoleak. **E,** Six-month follow-up CT scan demonstrating resolution of the type Ia endoleak.

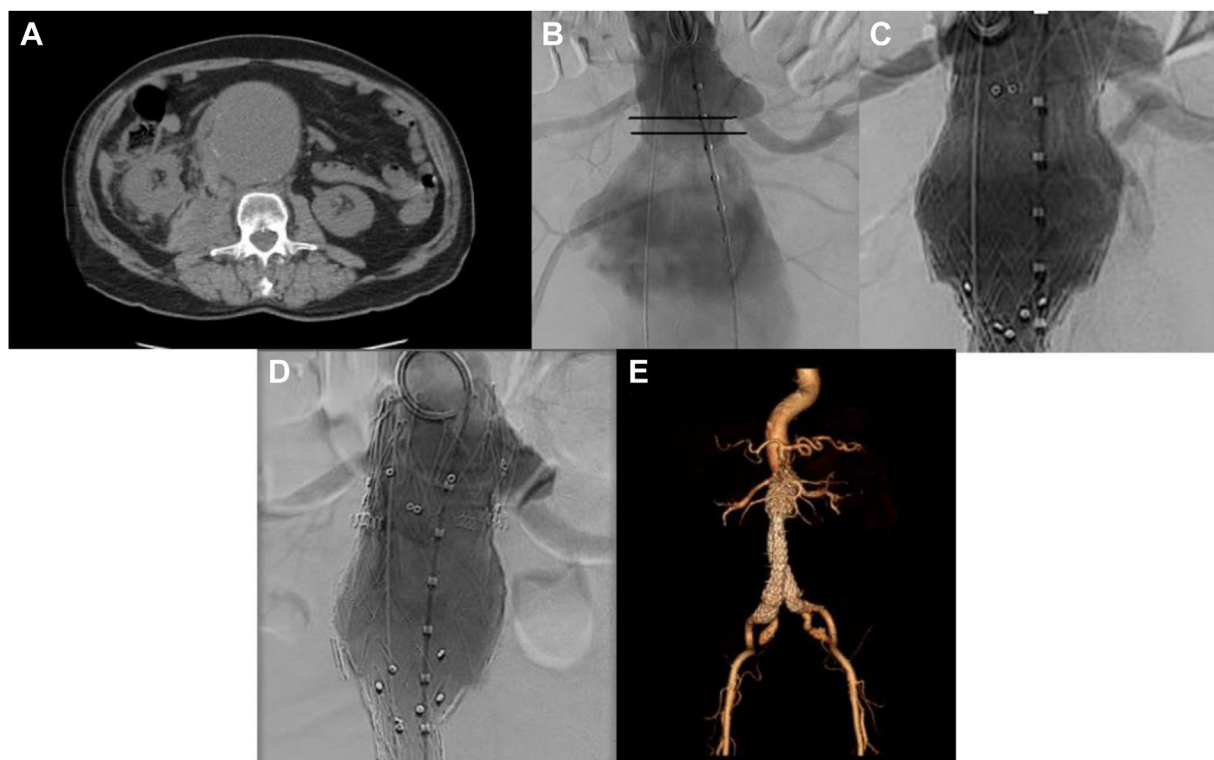
**Patient 2.** A 78-year-old man with a medical history of hypertension, tobacco abuse, and hypothyroidism had presented with lower abdominal and flank pain with a systolic blood pressure in the 70s. CT revealed a 10-cm contained juxtarenal rAAA with concurrent 20-mm left and 25-mm right common iliac artery aneurysms (Fig 2, A). A percutaneous endovascular technique was again preferred owing to his age, limited functional status and the presence of a rupture. After an aortogram, an Endurant device with a 36-mm main body was deployed below the lowest renal artery (Fig 2, B). Next, a 28-mm bell-bottom device was deployed in the right common iliac artery, which was aneurysmal near the bifurcation. Deployment of the main body device was completed and followed by deployment of the 24-mm device for the left common iliac artery seal with balloon angioplasty. Subsequently, a type Ia endoleak was noted (Fig 2, C). A proximal aortic extension and a 36-mm cuff were placed, without resolution of the endoleak. An EndoAnchor device was then used to deploy six anchors at the 3:00-, 9:00-, 10:00-, 4:00-, 7:00-, and 2:00-o'clock positions. The completion aortogram revealed no evidence of an endoleak (Fig 2, D). The total operation time was 141 minutes, with an estimated blood loss of 100 mL. His hospitalization stay was unremarkable, and he was discharged on POD 2. The 1-month follow-up CT

angiogram (Fig 2, E) was negative for an endoleak, and he remained alive after 3 years. Further imaging studies were not available owing to the poor functional status of the patient.

## DISCUSSION

EVAR has been preferred over open repair for rAAAs, whenever feasible, owing to its lower perioperative morbidity and mortality.<sup>4</sup> Techniques such as FEVAR and ch-EVAR were the only valid methods of endovascular treatment of juxtarenal AAAs before ESAR. However, studies have shown comparable outcomes with each technique, with 1-year endoleak rates of 1.9%, <2%, and 0% to 6.3% for ESAR, FEVAR, and ch-EVAR, respectively. The 30-day mortality rate after short-neck ESAR was 5.7%, similar to that with FEVAR and ch-EVAR.<sup>3</sup>

ESAR has not been well described in the setting of juxtarenal rAAAs. One of the advantages of ESAR is the shorter procedure time resulting from the lack of a need for renal cannulation. The ANCHOR study reported that the total fluoroscopy time to complete ESAR averaged 35.3 minutes, with a mean length of time to implantation of 148 minutes.<sup>3</sup> They also reported that deployment of endosutures added 17 minutes to the



**Fig 2.** **A**, Outside computed tomography (CT) scan revealing a 10-cm aneurysm with a rupture on the right posterior aspect. **B**, Aortogram before endovascular aneurysm repair (EVAR). **C**, Aortogram after placement of Endurant II aortic stent graft with a type Ia endoleak. **D**, Completion aortogram after endosuture aneurysm repair (ESAR) with resolution of the type Ia endoleak. **E**, Reconstruction of 1-month postoperative CT scan.

procedure.<sup>3</sup> Li et al<sup>5</sup> completed a meta-analysis and found a total procedure time of 261 minutes and 178 minutes for FEVAR and ch-EVAR, respectively. This decreased operative time can be crucial in situations of ruptured AAAs when patients are unstable and might not survive a complex procedure.

The other benefit of ESAR compared with FEVAR is the off-the-shelf capability of both Endurant and EndoAnchor devices. The 3- to 6-week lead time required for the graft to be fit to the patient's anatomy has made FEVAR unusable in emergent situations. Trials of off-the-shelf fenestrated stent grafts, such as the p-Branch (Cook Medical Inc, Bloomington, IN) and Ventana (Endologix, Irvine, CA) designs, for juxtarenal and pararenal AAAs were conducted and revealed a lack of reliability, with 40% of cases not meeting the anatomic criteria for endovascular repair.<sup>6</sup> Additionally, physician-modified endograft techniques will often only be performed at aortic centers of excellence.

The placement of proximal aortic cuffs in our two patients was chosen to use every millimeter of the proximal neck seal. We recommend placement of the proximal extension cuff before EndoAnchor deployment. Placing the EndoAnchor before the aortic cuff can result in screws protruding into the lumen and affecting the seal that can be achieved with the cuff. This was an error

of ours with our first patient, which might have contributed to the small type Ia endoleak found on the completion angiogram, although it had resolved on subsequent follow-up imaging studies.

## CONCLUSIONS

Juxtarenal rAAAs traditionally cannot be treated with off the shelf stent grafts owing to the unacceptable rates of device failure at the neck. Our successful short-term experience with ESAR in these two patients suggests that this can be a viable alternative to open repair in these gravely ill patients. ESAR is an approved, readily available technology that is intuitively easy to use in this setting. Further assessment of the short- and long-term outcomes with a registry is suggested.

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