

Emergent repair of infected aortic aneurysm with contained rupture using a femoral vein neoortoiliac system

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ABSTRACT

Infected aortic aneurysms are rare but are associated with high morbidity and mortality. Management involves surgical resection and debridement of the infected aorta and surrounding tissues, arterial reconstruction or bypass, and flap coverage, followed by long-term antibiotic therapy. Autogenous reconstruction using a neoortoiliac system (NAIS) is a durable form of repair with a decreased risk of reinfection. However, NAIS reconstruction is generally thought to be contraindicated for emergent, but not impending, rupture settings. We present the successful application of NAIS for a contained rupture of an infected infrarenal aneurysm. Use of the NAIS can provide a more durable option for select patients. (*J Vasc Surg Cases Innov Tech* 2021;7:502-5.)

Keywords: Aortic aneurysm; Autogenous graft; Infected; Mycotic; NAIS; Neoortoiliac

“Mycotic” aneurysms are mostly caused by primary bacterial infection of the arterial wall, resulting in adoption of the phrase “infected aneurysm.” They are rare, constituting 1% to 1.8% of aortic aneurysms.¹⁻³ These patients will often have significant comorbidities, contributing to the high morbidity and mortality of $\leq 40\%$.⁴⁻⁷

The reference standard for management involves surgical resection, aggressive debridement of the infected aorta and/or periaortic tissue, concomitant flap or omental coverage of the infected field, and in situ or extra-anatomic arterial reconstruction, followed by long-term antibiotic therapy.^{4,5} Reconstruction can be performed with a cryopreserved allograft,⁸ a polyester or polytetrafluoroethylene graft,⁹ or an autogenous femoral vein, often referred to as the neoortoiliac system (NAIS).¹⁰

The NAIS is more resistant to infection and aneurysmal dilatation but the procedure is often time-consuming and technically demanding. With a mean completion time of 8 hours,¹¹ the NAIS is generally contraindicated for emergent settings,¹² although its use has been advocated for as an early intervention for impending rupture.¹³ However, a two-team approach (femoral

exploration and aortic dissection) can reduce the operative time significantly.¹¹ With robust outcomes, use of the NAIS could benefit select patients with contained rupture of an infected aneurysm.¹⁴

We present the case of a patient with a contained infrarenal infected aortic aneurysm rupture who underwent emergent NAIS. The patient provided written informed consent for the report of his case details and images.

CASE REPORT

A 74-year-old man with type 2 diabetes mellitus had presented to an outside emergency department after experiencing vague abdominal and lower back pain for 1 week. He was hemodynamically stable, with laboratory test results notable for leukocytosis with a white blood cell count of $25 \times 10^9/L$ with a left shift. He had recently traveled to Mexico, where he and his family had experienced dyspepsia and upper gastrointestinal discomfort, without fever, chills, or lower gastrointestinal concerns. Two weeks before, he had developed a sore throat that had resolved with a 2-week course of oral antibiotics. He underwent magnetic resonance imaging for back pain, which showed findings concerning for an aortic aneurysm. A subsequent computed tomography (CT) scan revealed a contained infrarenal aortic aneurysm rupture (Fig 1), concerning for an infectious etiology. He was transferred to our emergency department 3 hours later and vancomycin and piperacillin-tazobactam were started after blood was taken for culturing. Given his hemodynamic stability, otherwise good health, and the need for a durable repair, autogenous NAIS reconstruction was performed 2 hours later to minimize the risk of conduit reinfection postoperatively.

Deep vein imaging with ultrasound was performed by the operating surgeons during the operating room preparation process to confirm the presence of a suitable vein. Using a two-team approach, the abdomen was explored and the right femoral vein was harvested as described by Clagett et al,¹⁰ once the

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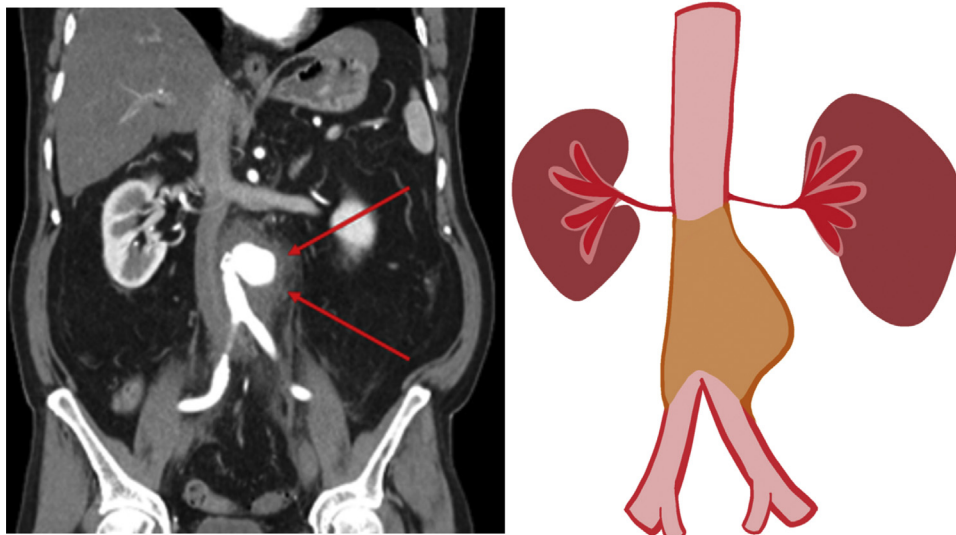


Fig 1. Left, Computed tomography (CT) scan showing infrarenal saccular infected aneurysm with a significant burden of infection (associated stranding highlighted by red arrows). The stranding corresponded to grossly infected tissue at surgery, which was debrided in its entirety, along with the aorta. Right, An illustration of the findings.

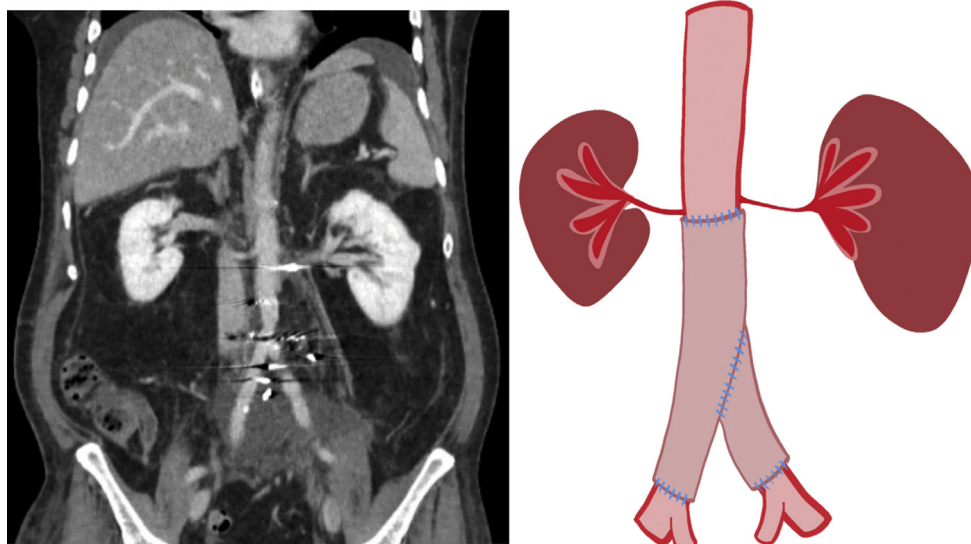


Fig 2. Left, Computed tomography scan showing neo-aortoiliac system (NAIS) segment with associated stranding and surgical clips 2 weeks after repair. Right, Illustration of the NAIS.

length needed was known from the abdominal exploration. Extensive retroperitoneal infection below the renal arteries had spread into the common iliac arteries (Fig 1). Circumferential dissection was begun at the suprarenal aorta in anticipation of the potential for poor local tissue durability. From the gross external evaluation and CT imaging of the aorta without evidence of apparent infection at the renal arteries (ie, the absence of stranding, pseudoaneurysm, intimal disruption), an infrarenal aortic clamp was placed. The aorta and periaortic tissue were widely debrided down to, and including, the common iliac arteries to prevent conduit reinfection. The retroperitoneal tissues

were debrided to the spine without evidence of active discitis or osteomyelitis. The femoral vein graft was sewn end-to-end to the aorta proximally and the right common iliac artery distally. A Y-configuration graft conduit to the distal left common iliac artery was created with the residual vein (Fig 2). An omental flap was created and wrapped around the reconstruction. The thigh wound was copiously irrigated and closed separately to reduce cross-contamination. Biphasic Doppler signals were present in both feet. The completion time was 3 hours, as it was a primary aortic operation, although the inflammation and adhesion of the infected aorta created additional challenges.

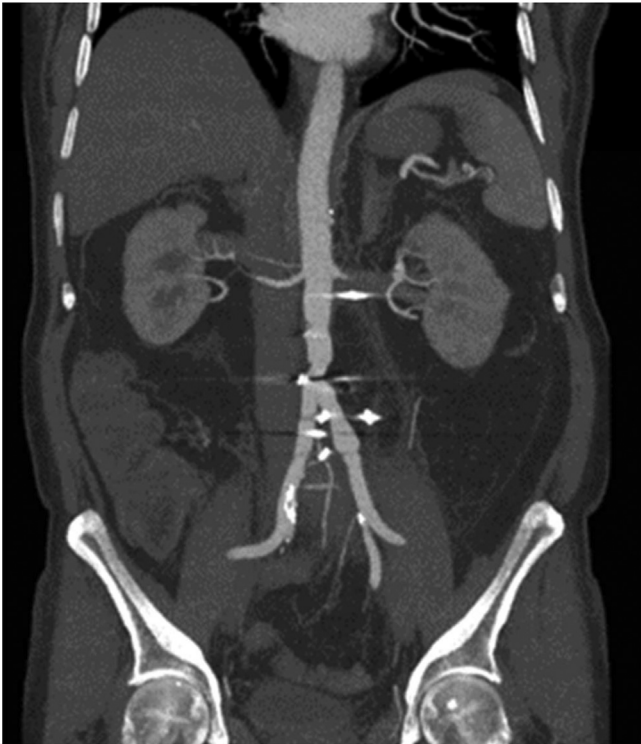


Fig 3. Computed tomography scan showing neo-aortoiliac system (NAIS) segment 2 months after repair.

After one planned abdominal washout and debridement of a small amount of residual infected tissue, the patient was extubated on postoperative day 2. He remained in the intensive care unit for 1 week for close monitoring. His lower extremities were elevated while in bed with a compressive bandage wrapping on the donor leg, which was transitioned to thigh-high compression stockings during the hospital stay and after discharge. The admission and intraoperative blood cultures grew group A *streptococcus*. Repeat blood cultures from postoperative day 3 were negative, and transthoracic echocardiography showed no valvular vegetations. Once speciation had been completed, the antibiotic therapy was narrowed to 6 weeks total of intravenous ceftriaxone alone if the imaging and clinical findings demonstrated no concern for further infection. Given the lack of foreign conduit material, long-term suppressive therapy was not indicated. Repeat imaging studies at 2 weeks showed minimal stranding in the omentum around the aortic reconstruction (Fig 2). Because of prolonged ileus, the patient was discharged home on postoperative day 17 and prescribed fitted thigh-high stockings until the swelling had subsided, 81 mg of aspirin daily, and continued intravenous antibiotics. He followed up with the infectious disease department 1 month later and was transitioned to oral amoxicillin. He followed up with the vascular surgery department 1 month later. He was afebrile with well-healed abdominal and right femoral incisions, intact neurovascular examination findings, and stable imaging findings (Fig 3). Amoxicillin was discontinued. Six months later (8 months postoperatively), a follow-up ultrasound examination showed patent abdominal aorta and iliac arteries with the

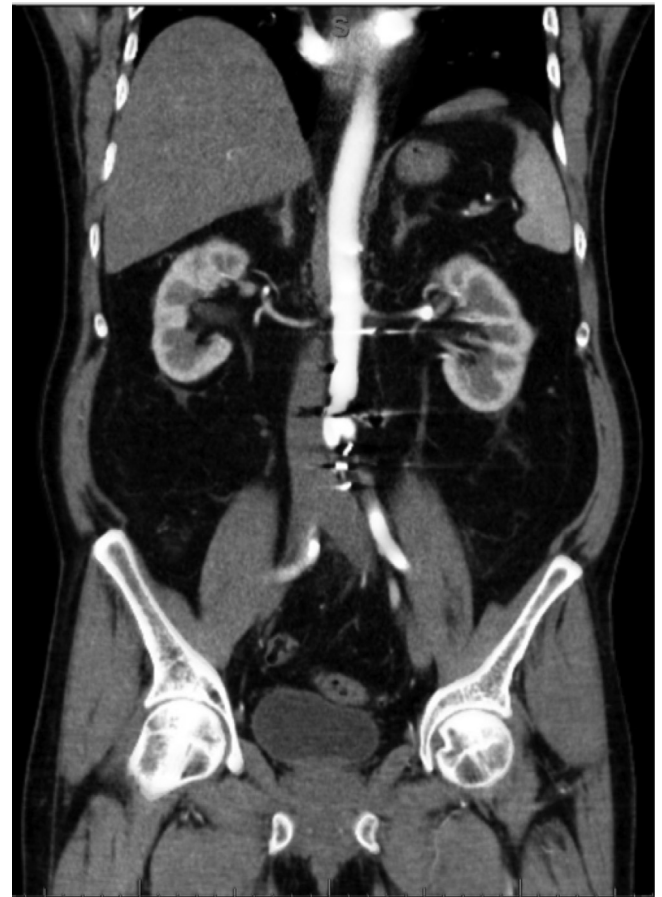


Fig 4. Computed tomography angiogram showing a stable neo-aortoiliac system (NAIS) repair at 14 months post-operatively. Scatter artifact from the surgical clips obscured the distal reconstruction. No stenosis was present on ultrasound.

largest abdominal aortic diameter at 1.77×1.96 cm within the mid-segment. Six months later (14 months postoperatively), repeat CT angiography showed a normal graft without an aneurysm, dissection, or stenosis (Fig 4). He was scheduled to follow-up annually thereafter with duplex ultrasound and ankle brachial index measurements.

DISCUSSION

Management of infected aortic aneurysms remains challenging, with high morbidity and mortality.^{4-7,11-20} The presence of sepsis and/or periaortic infection result in added complexity, requiring an early diagnosis, aggressive surgical debridement, and prolonged postoperative antibiotic therapy. Fillmore and Valentine¹⁵ studied the single-institution outcomes of 10 patients with infected aneurysms during a 6-year period. Of the 10 patients, 4 had died of sepsis, and 6 had survived to discharge after a mean hospitalization of 23 days followed by extensive rehabilitation.¹⁵ Dubois et al¹² studied 44 patients with infected aneurysms involving the abdominal aorta treated at a single institution.

In-hospital mortality was 22.7%, and 30-day mortality was 18.2%.¹² The patients had died of in situ graft rupture, fulminant progression of previously known cancer, respiratory failure, and sepsis. One third of the patients who had presented with ruptured (free and/or contained) infected aneurysms had died in the perioperative period compared with 13% of the patients who had presented with an intact aneurysm.¹²

Open (in situ and extra-anatomic) and endovascular surgical techniques have been described for infected aortic aneurysm repair. In situ reconstruction has typically used synthetic conduits, namely a cryopreserved allograft, with 1-, 2-, and 5-year survival rates of 84%, 76%, and 64%.¹⁶ Deep vein in situ replacement for complex aortic problems has been associated with low rates of reinfection and occlusion.^{10,17} Extra-anatomic bypass has been associated with higher complication rates and should only be considered for patients unsuitable for in situ revascularization.¹⁸

Semba et al¹⁹ first reported endovascular stent-graft use in 1998 for three patients with infected aneurysms. Endovascular aneurysm repair can be a life-saving bridge treatment,²¹ and can be used to successfully treat a bleeding aortoenteric fistula and infected abdominal aortic aneurysm.²² Although less invasive, endovascular graft placement risks reinfection, a devastating complication in >5% of endovascular aortic repairs, a rate that could be higher owing to publication bias.^{23,24} Endografts can complicate reconstruction, and explantation is high risk with low (51%) 5-year survival.²³ Thus, more durable options should be considered for healthier patients.

CONCLUSIONS

The findings from our case report have demonstrated that the NAIS can be used in emergent situations for stable patients who can physiologically tolerate the operation. A two-team approach can decrease the operative and, thus, ischemic and anesthetic time. Given the lower reinfection rate, this procedure should be considered for otherwise reasonably healthy patients.

REFERENCES

1. Corso JE, Kasirajan K, Milner R. Endovascular management of ruptured, mycotic abdominal aortic aneurysm. *Am Surg* 2005;71:515-7.
2. Svensson LG, Crawford ES. Aortic dissection and aortic aneurysm surgery: clinical observations, experimental investigations, and statistical analyses. Part I. *Curr Probl Surg* 1992;29:817-911.
3. Osler W. The Gulstonian lectures, on malignant endocarditis. *BMJ* 1885;1:522.
4. Muller BT, Wegener OR, Grabitz K, Pillny M, Thomas L, Sandmann W. Mycotic aneurysms of the thoracic and abdominal aorta and iliac arteries: experience with anatomic and extraanatomic repair in 33 cases. *J Vasc Surg* 2001;33:106-13.
5. Luo CY, Ko WC, Kan CD, Lin PY, Yang YJ. In situ reconstruction of septic aortic pseudoaneurysm due to *Salmonella* or *Streptococcus* microbial aortitis: long-term follow-up. *J Vasc Surg* 2003;38:975-82.
6. Moneta GL, Taylor LM Jr, Yeager RA, Edwards JM, Nicoloff AD, McConnell DB, et al. Surgical treatment of infected aortic aneurysm. *Am J Surg* 1998;175:396-9.
7. Kyriakides C, Kan Y, Kerle M, Cheshire NJ, Mansfield AO, Wolfe JH. 11-Year experience with anatomical and extra-anatomical repair of mycotic aortic aneurysms. *Eur J Vasc Endovasc Surg* 2004;27:585-9.
8. Harlander-Locke MP, Harmon LK, Lawrence PF, Oderich GS, McCready RA, Morasch MD, et al. Vascular Low-Frequency Disease Consortium. The use of cryopreserved aortoiliac allograft for aortic reconstruction in the United States. *J Vasc Surg* 2014;59:669-74.
9. Semba CP, Sakai T, Kato N, Razavi MK, Kee ST, Slonim SM, et al. Abdominal aortic aneurysm repair using an aortoiliac stent-graft combined with femoral-femoral bypass. *Techn Vasc Interv Radiol* 1998;1:32-6.
10. Clagett GP, Valentine RJ, Hagino RT. Autogenous aortoiliac/femoral reconstruction from superficial-popliteal veins: feasibility and durability. *J Vasc Surg* 1997;25:255-66.
11. Ali AT, Modrall C, Hocking J, Valentine RJ, Spencer H, Eidt JF, et al. Long-term results of the treatment of aortic graft infection by in situ replacement with femoral popliteal vein grafts. *J Vasc Surg* 2009;50:30-9.
12. Dubois M, Daenens K, Houthoofd S, Peetermans WE, Fourneau I. Treatment of mycotic aneurysms with involvement of the abdominal aorta: single-centre experience in 44 consecutive cases. *Eur J Vasc Endovasc Surg* 2010;40:450-6.
13. Sharma A, Pawar P, Raju R, Ayappan MK, Mathur K. Neo aortoiliac system repair of *Burkholderia cepacia* infected mycotic aneurysm with impending rupture. *Indian J Vasc Endovasc Surg* 2018;5:129.
14. Dorweiler B, Neufang A, Chaban R, Reinstadler J, Duenschede F, Vahl CF. Use and durability of femoral vein for autologous reconstruction with infection of the aortoiliac axis. *J Vasc Surg* 2014;59:675-83.
15. Fillmore AJ, Valentine RJ. Surgical mortality in patients with infected aortic aneurysms. *J Am Coll Surg* 2003;196:435-41.
16. Corvera JS, Blitzer D, Copeland H, Murphy D, Hess PJ Jr, Pillai ST, et al. Repair of thoracic and thoracoabdominal mycotic aneurysms and infected aortic grafts using allograft. *Ann Thorac Surg* 2018;106:1129-35.
17. Nevelsteen A, Lacroix H, Suy R. Autogenous reconstruction with the lower extremity deep veins: an alternative treatment of prosthetic infection after reconstructive surgery for aortoiliac disease. *J Vasc Surg* 1995;22:129-34.
18. Lee CH, Hsieh HC, Ko PJ, Li HJ, Kao TC, Yu SY. In situ versus extra-anatomic reconstruction for primary infected infrarenal abdominal aortic aneurysms. *J Vasc Surg* 2011;54:64-70.
19. Semba CP, Sakai T, Slonim SM, Razavi MK, Kee ST, Jorgensen MJ, et al. Mycotic aneurysms of the thoracic aorta: repair with use of endovascular stent-grafts. *J Vasc Interv Radiol* 1998;9:33-40.
20. Kan CD, Lee HL, Yang YJ. Outcome after endovascular stent graft treatment for mycotic aortic aneurysm: a systematic review. *J Vasc Surg* 2007;46:906-12.
21. Lee KH, Won JY, Lee DY, Choi D, Shim WH, Chang BC, et al. Stent-graft treatment of infected aortic and arterial aneurysms. *J Endovasc Ther* 2006;13:338-45.
22. Escobar GA, Eliason JL, Hurie J, Arya S, Rectenwald JE, Coleman DM. Rifampin soaking Dacron-based endografts for implantation in infected aortic aneurysms—new application of a time-tested principle. *Ann Vasc Surg* 2014;28:744-8.
23. Laser A, Baker N, Rectenwald J, Eliason JL, Criado-Pallares E, Upchurch GR Jr. Graft infection after endovascular abdominal aortic aneurysm repair. *J Vasc Surg* 2011;54:58-63.
24. Heyer KS, Modi P, Morasch MD, Matsumura JS, Kibbe MR, Pearce WH, et al. Secondary infections of thoracic and abdominal aortic endografts. *J Vasc Interv Radiol* 2009;20:173-9.