CLINICAL VIGNETTE

Mycotic Pseudoaneurysm in an Autogenous Arteriovenous Fistula

Kathleen Yip, MD and Jonathan Balakumar, MD

Case

A 59-year-old male with brittle type 1 diabetes mellitus and end stage renal disease on hemodialysis presented to the emergency department immediately after completion of dialysis due to fever of 101.5F and pain over the fistula for the past two days. He is dialyzed through left upper extremity arteriovenous fistula had blood cultures drawn, and a dose of vancomycin prior to arrival. Initial vitals included a temperature of 98.4F, heart rate 84, blood pressure 122/51, respiratory rate 18, and an oxygen saturation of 100% on room air. Exam revealed an exquisitely tender, glossy, and erythematous fistula with a good bruit and thrill. Laboratory testing, including a complete blood count and basic metabolic panel were unremarkable except for thrombocytopenia at 85K and mild normocytic anemia with a hemoglobin of 12.6. Ultrasound of the fistula revealed a 4.3x4.2cm pseudoaneurysm.

Shortly after returning from ultrasound, the fistula spontaneously ruptured and the patient went into hemorrhagic shock due to profound blood loss, prompting intubation and resuscitation with infusion of blood products, vasoactive medications, and fluids. Hemorrhagic control was ultimately achieved with pressure, hemostatic agents, sutures, and a tourniquet. Vascular surgery was emergently consulted while attaining hemorrhagic control, and the patient was taken to the operating room for a thrombectomy causing acute limb ischemia, as well as AV fistula ligation and brachial artery cutdown. Intra-operatively, it appeared that the fistula wall was grossly infected and easily friable, and blood cultures were later positive for methicillin-sensitive Staphylococcus aureus (MSSA). Due to ongoing and continued ischemia, the patient developed limb necrosis and required amputation. His hospital course was complicated by prolonged ventilator support with need for tracheostomy, aspiration leading to cardiac arrest, labile glycemic control, and phantom limb pain, but ultimately survived to be discharged.

Discussion

End-stage renal disease requiring dialysis affects nearly 500,000 individuals in the United States.[1] Between the two main types of dialysis, approximately 90% are treated with hemodialysis, and the remainder through peritoneal dialysis. Long-term hemodialysis is ideally performed through a surgically created arteriovenous fistula, due to its reliability and lower infection risk compared to other modes of vascular access, such as catheters or prosthetic grafts.[2] Complications related to vascular access are a common cause of hospitalization in hemodialysis patients.[3] We describe two of several possible complications related to arteriovenous fistula vascular access: pseudoaneurysms and infections.

Pseudoaneurysms

The fistula is subjected to repeated cannulations with heparinization three times a week, and bleeding at the puncture site is usually controlled with digital pressure or commercially available hemostatic agents. Repeated needling, especially in the same location along the fistula, increases the risk of pseudoaneurysm formation. Because aneurysms involve all three layers of the arterial wall: intima, media and adventitia, they have a low risk of rupture. Pseudoaneurysms can be thought of as hematomas communicating with the lumen but lacking endothelium and a thick vascular wall. As a result, pseudoaneurysms have a significantly higher risk of rupture. Rapidly increasing size, pain, neurovascular compromise, infection, thinning and degeneration of the overlying skin are associated with increased risk of pseudoaneurysm rupture. Signs of imminent rupture including skin ulceration and scabbing should prompt urgent vascular surgery consultation for emergency ligation of the aneurysm, as rupture of an arteriovenous fistula causes life-threatening hemorrhage due to high flow rates.[3]

Treatment of pseudoaneurysms can be non-invasive or invasive. Some pseudoaneurysms may be carefully observed if the pseudoaneurysm is 2cm or less and repeat duplex ultrasound in one week is stable and the patient remains asymptomatic. Ultrasound-guided compression may also be an option, with direct transducer pressure over the tract connecting the pseudoaneurysm with the vessel lumen which can be repeated several times.[4,5] Ultrasound-guided percutaneous thrombin injections of brachial artery pseudoaneurysms at the site of hemodialysis fistulas have also been used.[6] This technique in treating pseudoaneurysms has a higher success rate when compared to ultrasound-guided compression alone.[5,7]

Open surgical repair is usually the last resort in pseudoaneurysm treatment due to the potential for bleeding, infection, and nerve injury. Anastomotic pseudoaneurysms are most commonly caused by infection and should always be managed via surgical or endovascular revision.[8] Additionally, surgical management is used with signs of imminent rupture, evidence of vascular compromise, or hemodynamic instability.

Infections

In a five-year study examining vascular access in long-term hemodialysis patients, infections that required excision occurred in 0.5% of fistulas with incidence of 4 per 1000 person-years) and 5.0% of grafts, with an incidence of 40 per 1000 person-years. Initiation with a catheter and subsequent conversion to a fistula or graft conferred a 2.3-fold increase in severe infection.[9] Organisms isolated from all types of AV access infections, are most commonly Staphylococcus *spp*, but may be polymicrobial and include gram-negative bacteria.[8] Empiric antibiotic coverage for gram positive organisms should be given with some advising coverage for gram negative facultative and anaerobic coverage due to polymicrobial infections, especially associated with intravenous drug use.[10]

Surgical incisions for revisions and recently implanted prosthetic grafts may require weeks to heal and become integrated into the surrounding native tissue, and as such may develop perigraft fluid collections or seromas that could mimic an infection. Serial duplex ultrasonography may be useful to monitor for the resolution of non-infectious fluid. Clinical findings may also be helpful. Positive blood cultures, leukocytosis, and fever, as well as physical exam findings suggestive of cellulitis or abscess may also suggest AV access infection.[8]

Treatment for AV access infections is usually surgical, but depends on several factors such as the extent of infection, bacterial etiology, and functional status of the AV access presenting symptoms and type of AV access conduit, (autogenous or prosthetic). With autogenous AV access infections may respond to antibiotics, but if associated with bleeding and proximity to the anastomosis, ligation may be required. Management of the prosthetic AV access can include total, subtotal, segmental AV access excision or rarely complete AV access preservation, depending on the extent of the infection. These rarely resolve with antibiotics alone.[8]

Conclusion

We described an uncommon case of a ruptured mycotic pseudoaneurysm of a native upper extremity arteriovenous fistula. Prompt recognition, especially for rapidly enlarging or symptomatic pseudoaneurysms, and urgent vascular surgical consultation are crucial to patient management and outcomes.

REFERENCES

1. **Johansen KL, Chertow GM, Foley RN, Gilbertson DT, Herzog CA, Ishani A, Israni AK, Ku E, Kurella Tamura M, Li S, Li S, Liu J, Obrador GT, O'Hare AM, Peng Y, Powe NR, Roetker NS, St Peter WL, Abbott KC, Chan KE, Schulman IH, Snyder J, Solid C, Weinhandl ED, Winkelmayer WC, Wetmore JB**. US Renal Data System 2020 Annual Data Report: Epidemiology of Kidney Disease in the United States. *Am J Kidney Dis.* 2021 Apr;77(4 Suppl 1):A7-A8. doi: 10.1053/j.ajkd.2021.01.002. PMID: 33752804; PMCID: PMC8148988.
2. **Stevenson KB, Hannah EL, Lowder CA, Adcox MJ, Davidson RL, Mallea MC, Narasimhan N, Wagnild JP**. Epidemiology of hemodialysis vascular access infections from longitudinal infection surveillance data: predicting the impact of NKF-DOQI clinical practice guidelines for vascular access. *Am J Kidney Dis*. 2002 Mar;39(3):549-55. doi: 10.1053/ajkd.2002.31405. PMID: 11877574.
3. **Mudoni A, Cornacchiari M, Gallieni M, Guastoni C, McGrogan D, Logias F, Ferramosca E, Mereghetti M, Inston N**. Aneurysms and pseudoaneurysms in dialysis access. *Clin Kidney J*. 2015 Aug;8(4):363-7. doi: 10.1093/ckj/sfv042. Epub 2015 Jun 10. PMID: 26251700; PMCID: PMC4515897.
4. **Witz M, Werner M, Bernheim J, Shnaker A, Lehmann J, Korzets Z**. Ultrasound-guided compression repair of pseudoaneurysms complicating a forearm dialysis arteriovenous fistula. *Nephrol Dial Transplant*. 2000 Sep;15(9):1453-4. doi: 10.1093/ndt/15.9.1453. PMID: 10978408.
5. **Saad NE, Saad WE, Davies MG, Waldman DL, Fultz PJ, Rubens DJ.** Pseudoaneurysms and the role of minimally invasive techniques in their management. *Radiographics*. 2005 Oct;25 Suppl 1:S173-89. doi: 10.1148/rg.25si055503. PMID: 16227490.
6. **Clark TW, Abraham RJ**. Thrombin injection for treatment of brachial artery pseudoaneurysm at the site of a hemodialysis fistula: report of two patients. *Cardiovasc Intervent Radiol.* 2000 Sep-Oct;23(5):396-400. doi: 10.1007/s002700010091. PMID: 11060373.
7. **Shah KJ, Halaharvi DR, Franz RW, Jenkins Ii J**. Treatment of Iatrogenic Pseudoaneurysms Using Ultrasound-Guided Thrombin Injection over a 5-Year Period. *Int J Angiol*. 2011 Dec;20(4):235-42. doi: 10.1055/s-0031-1295521. PMID: 23204825; PMCID: PMC3331643.
8. **Padberg FT Jr, Calligaro KD, Sidawy AN**. Complications of arteriovenous hemodialysis access: recognition and management. *J Vasc Surg*. 2008 Nov;48(5 Suppl):55S-80S. doi: 10.1016/j.jvs.2008.08.067. PMID: 19000594.
9. **Arhuidese IJ, Orandi BJ, Nejim B, Malas M**. Utilization, patency, and complications associated with vascular access for hemodialysis in the United States. *J Vasc Surg*. 2018 Oct;68(4):1166-1174. doi: 10.1016/j.jvs.2018.01.049. PMID: 30244924.
10. **Jayaraman S, Richardson D, Conrad M, Eichler C, Schecter W**. Mycotic pseudoaneurysms due to injection drug use: a ten-year experience. *Ann Vasc Surg*. 2012 Aug;26(6):819-24. doi: 10.1016/j.avsg.2011.11.031. Epub 2012 Apr 24. PMID: 22534261.