Surely you can't B. cereus: *Bacillus cereus* infection resulting in spontaneous pseudoaneurysm of a nonaccessed arteriovenous graft

Thomas McKinley, MD,[a] Kristin Burnham, BS,[b] Marcos Aranda, MD,[a] *and* Todd Simon, DO,[a] *Fort Gordon, GA; and Bethesda, MD*

ABSTRACT

Vascular graft infections are a well-described complication of loop arteriovenous grafts (AVGs) placed for hemodialysis access and are reported to occur in 0.5% to 6.0% of AVGs. The most common microorganisms implicated in these infections are the *Staphylococcus* species. We present a case of a chronically nonaccessed graft rupture caused by an indolent *B. cereus* colonization, which is usually a foodborne contaminant. The finding of this organism as the causal agent in an AVG infection warrants further research into the potential emergence of the *Bacillus* species as a contributing factor in the morbidity and mortality resulting from AVG infection. (J Vasc Surg Cases Innov Tech 2023;9:101333.)

Keywords: Arteriovenous graft; *Bacillus cereus*; Graft rupture; Hemodialysis graft; Pseudoaneurysm

Obtaining and maintaining long-term hemodialysis access is a common situation encountered in nearly all healthcare settings. The placement of prosthetic arteriovenous grafts (AVGs) are frequently used in lieu of creation of arteriovenous fistulas (AVFs) due to the lower risk of primary failure and the ability to perform earlier cannulation. Despite these advantages, AVFs are generally preferred due to their lower complication rate compared with that of AVGs. One of the most notable complications of the AVG is bacterial colonization and infection. This is especially true in immunocompromised populations.[1] Graft infections often present early, with localized signs of infection that can rapidly progress to bacteremia and sepsis. Significantly, these infections can affect, not only the patency of the graft, but also often predispose the graft to rupture. The most common organisms recovered from these infections belong to the *Staphylococcus* species, the members of which compromise ≤86.7% of all graft infections.[2]

Bacillus cereus is a gram-positive rod-shaped bacterium most known as a common cause of food poisoning. The pathogenicity of *B. cereus* is associated with the production of tissue-destructive exoenzymes and biofilms.[3] Serious non-gastrointestinal illnesses caused by *B. cereus* appear to be increasing.[4] Catheter-related *B. cereus* bloodstream infections have been well documented, especially among immunosuppressed patients. There are reports of *B. cereus* as the likely cause of an aortic aneurysm[4]; however, there is a paucity of literature regarding *B. cereus* infections leading to AVG rupture, especially in a nonaccessed graft.

CASE REPORT

A 51-year-old male renal transplant recipient with a 6-year-old AVG placed for hemodialysis due to end-stage renal disease resulting from hypertensive nephrosclerosis presented with painless swelling over his left forearm brachial—brachial loop AVG. The AVG had not been accessed since it was last used 5 years earlier. His donor kidney function remained stable with an immunosuppressive regimen of mycophenolate, tacrolimus, and prednisone. The patient had noted a localized area of swelling with a palpable thrill that presented suddenly when he awoke the day prior. He denied any recent intravenous drug use, trauma, or access of the graft. A radial pulse was easily palpable in the left arm, and there was a palpable thrill across the graft. On physical examination, his blood pressure was 132/77 mm Hg, pulse rate of 70 beats/min, respiration rate of 16 breaths/min, and body temperature of 36.6°C. A duplex ultrasound of the graft revealed the presence of a pseudoaneurysm (Fig 1). A laboratory evaluation revealed a white blood cell count of 5900 cells/μL (reference range, 4000-10,300 cells/μL), with 73.9% segmented neutrophils, hemoglobin of 13.0 mg/dL (reference range, 12.0-16.2 mg/dL), creatinine of 1.6 mg/dL (reference range, 0.3-1.2 mg/dL), and erythrocyte sedimentation rate of 31.0 mm/h (reference range, 0-20.0 mm/h). Attempted salvage of the graft was planned in case his renal function were to decline in the future. We performed white blood cell scintigraphy (WBCS; Fig 2) to rule out graft infection; however, it revealed significant migration to the distal aspect of his graft site concordant with the area of swelling (Fig 3). These findings, in concert with his elevated erythrocyte sedimentation rate, suggested a subclinical graft infection that we suspected could have contributed to his graft pseudoaneurysm formation. The patient provided written informed consent for the report of his case details and imaging studies, with the understanding that all personal identifiable information would be removed before publication.

From the Department of General Surgery, Dwight D. Eisenhower Army Medical Center, Fort Gordon[a]; and the School of Medicine, Uniformed Services University, Bethesda.[b]

Correspondence: Thomas McKinley, MD, Department of General Surgery, Dwight D. Eisenhower Army Medical Center, 300 E Hospital Rd, Fort Gordon, GA 30905 (e-mail: thomas.r.mckinley6.mil@health.mil).

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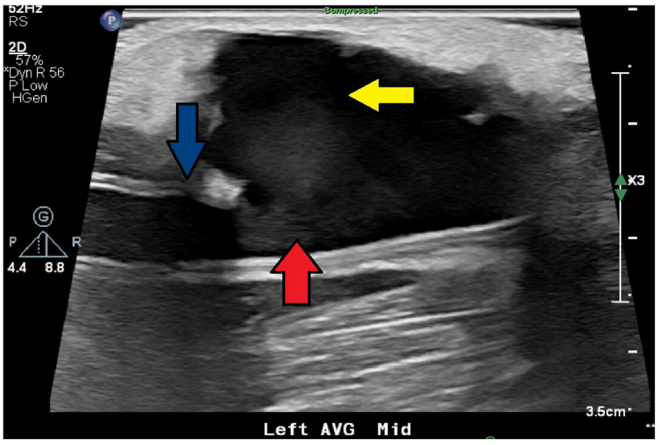

Fig 1. Labeled duplex ultrasound of left upper extremity arteriovenous graft (AVG). *Blue arrow* indicates distal end of intact graft; *red arrow,* ruptured graft segment; and *yellow arrow,* pseudoaneurysm.

Segments of the arterial and venous limbs of the graft were removed, and the pseudoaneurysm segment of the graft was removed without violating the graft. It was noted to be very well incorporated, without any purulence or signs of overt infection. The explanted segments were sent for microbial culture and later returned with significant growth of *B. cereus*. Given the lack of uptake in the proximal portions of the graft on WBCS, the short proximal stumps were oversewn and left in place to avoid a complicated reconstruction. On examination of the graft, an obvious defect was found in the superior wall of the graft (Fig 4). The patient recovered without issues postoperatively and was discharged home on postoperative day 1 without outpatient antibiotics. The patient's preoperative blood cultures returned negative for any growth; however, once the results of his graft culture returned positive for *B. cereus*, he was readmitted for peripherally inserted central catheter placement and 4 weeks of vancomycin therapy in accordance with infectious disease recommendations.

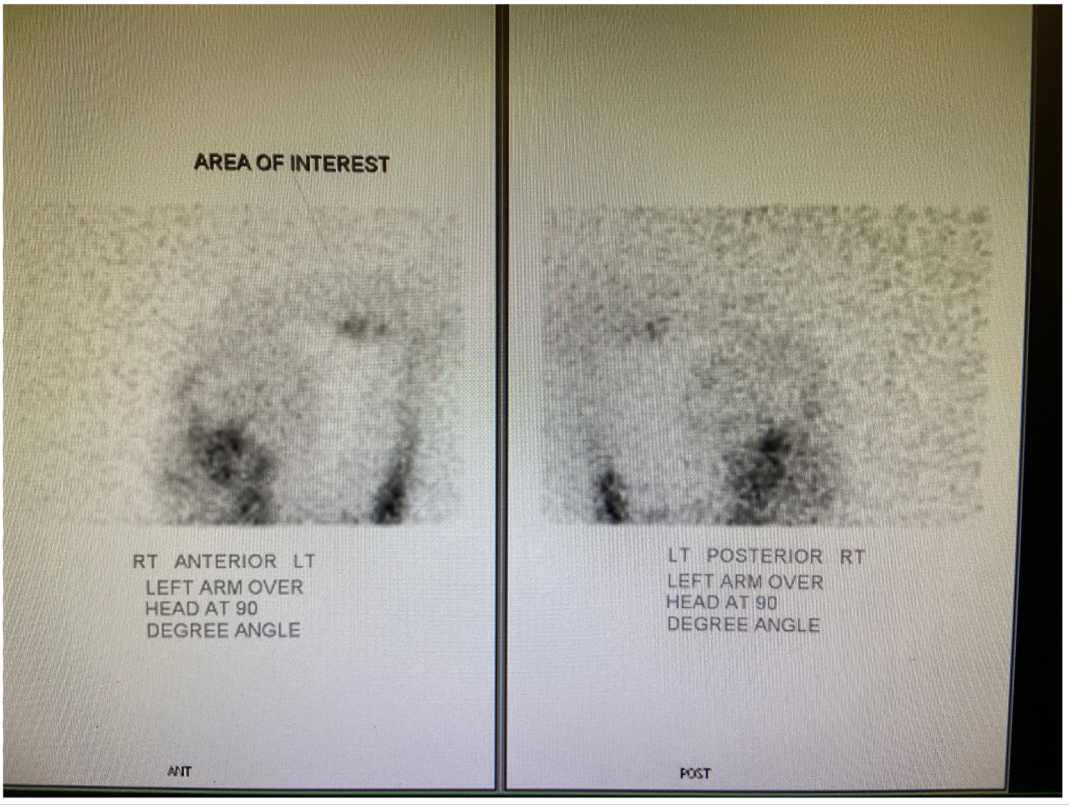

Fig 2. White blood cell scintigraphy (WBCS) scan with localization at the graft site. *ANT,* anterior; *LT,* left; *POST,* posterior; *RT,* right.

INTERVENTION AND POSTOPERATIVE COURSE

A transverse incision was made in the antecubital fossa and dissection carried down circumferentially around the brachial artery and brachial vein anastomoses. Proximal and distal control of the graft was obtained with straight edge clamps, and the graft was sharply divided. The anastomotic cuffs were closed in two layers.

DISCUSSION

We report an unusual case of colonization of a nonaccessed AVG with *B. cereus* with a subsequent atraumatic contained graft pseudoaneurysm. Delayed vascular graft

Fig 3. Preoperative photograph of left upper extremity showing a clearly demarcated area of swelling corresponding to the pseudoaneurysm.

Fig 4. Photograph of the ruptured arteriovenous graft (AVG) after explantation.

infections (>2 months postoperatively) can be difficult to diagnose due to nonspecific clinical features and well-appearing patients.[5] The lack of systemic indicators of infection (ie, fever, leukocytosis, C-reactive protein, erythrocyte sedimentation rate) is unusual but not necessarily a reliable negative prognosticator for graft infection in chronically immunosuppressed patients.[5] The literature on excision and ligation of AVGs and AVFs is extensive and largely supports our decision to excise the ruptured graft segment, leaving the residual graft cuffs in place. For patients presenting with overt sepsis, aortoenteric fistula formation, or anastomotic disruption, complete graft excision with patching is indicated. However, in our patient, who presented with a stable spontaneous pseudoaneurysm, we believed that excision of the ruptured segment with oversewing of the cuffs was appropriate and associated with a lower surgical risk.[6,7] The decision of ligation vs preservation of an AVF or AVG in stable renal transplant recipients involves complex medical decision making. The existing literature favors preservation of the AVG or AVF in renal transplant recipients, given the likelihood of a future hemodialysis requirement and the inherent surgical risk. Although significant risk factors are associated with persistent patent AVGs and AVFs, such as high-output heart failure and graft infection, the overall patient and graft survival have not been found to be affected by the presence of persistent AVGs or AVFs.[8] WBCS, also known as an indium scan or tagged WBC study, is a valuable tool in the armament for diagnosing indolent graft infections. WBCS is recommended by the American Heart Association in their 2016 Scientific Statement on Vascular Graft Infections and the European Society for Vascular Surgery in their 2020 algorithm for suspected vascular graft/endograft infections

for patients with clinical suspicion of vascular graft infection but indeterminate imaging findings.[5,9] In our patient, WBCS was helpful for both surgical planning and diagnostic clarity.

CONCLUSIONS

The overwhelming causative organism for vascular graft infection is *Staphylococcal* species. Although *B. cereus* is known for its gastrointestinal and ocular manifestations, its role in life-threatening and systemic infections has been understudied.[3] *B. cereus* is a seasonal, widely distributed, environmental bacteria known in environmental literature to be capable of degrading polyethylene plastics.[10] Studies focusing on *B. cereus* role in bloodstream infections note a markedly increased isolation of the microbe in summer seasons.[11] It produces biofilms and numerous toxins increasingly recognized as capable of causing severe consequences and disease. *B. cereus* infections should be taken seriously, particularly in immunocompromised patients with indwelling catheters or prosthetic grafts.

DISCLOSURES

None.

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