CASE REPORT

Vascular graft infections and role of PET/CT in patients with persistent bacteraemia

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Accepted 20 February 2015

SUMMARY

Prosthetic vascular graft infection although a rare complication of vascular reconstruction surgery; has been associated with significant morbidity and mortality. The author presents two patients with prosthetic aortic graft presenting as fever and methicillin sensitive *Staphylococcus aureus* bacteraemia without any other localising sign of infection. Both patients had a history of postoperative wound infection after their graft placement. Patients remained persistently bacteraemic on appropriate antimicrobial therapy making the clinician suspicious of a vascular graft infection. A [18 F] fluoro-2-deoxy-D glucose positron emission tomography associated to CT scan was used to identify the prosthetic vascular graft infection and since both patients were high-risk surgical candidates, a conservative medical approach was used. They were treated with 6 weeks of nafcillin and rifampin, followed by long-term doxycycline for suppression. This highlights the importance of considering vascular graft infection in patients with recurrent and persistent bacteraemia despite adequate therapy.

BACKGROUND

Prosthetic vascular graft infection although a rare complication of vascular reconstruction surgery; has been associated with significant morbidity and mortality. The estimated incidence of prosthetic vascular graft infection is reported as 0.5–5%,^{1–3} however, the mortality associated with this rare infection is estimated to be greater than 50%.⁴ Early onset infection in such cases usually present as surgical wound infection, however, late infections could present in a more occult manner, with no overt symptoms of the disease. The author describes two cases of prosthetic vascular graft infections which presented as persistent *Staphylococcus aureus* bacteraemia and the infection was diagnosed with the help of positron emission tomography associated to CT (PET/CT) scan.

CASE 1

Case presentation

A 63-year man presented to the emergency centre (EC) with a 4-day history of fever. He started developing fever at home (101°F) associated with chills and fatigue. He denied any other symptoms at this time to help localise an infection.

Medical history was significant in this patient with hypertension and aortic dissection 18 months prior to this presentation requiring an emergent repair with prosthetic graft placement in his descending thoracic aorta at that time. Postoperative

course was complicated with a sternal wound infection and later a loculated pleural effusion in the first month postsurgery, requiring drainage via a chest tube and 4 weeks of intravenous antibiotics.

The patient had done well until 2 months ago, when he presented with fever and found to have methicillin sensitive *S. aureus* (MSSA) bacteraemia without evidence of endocarditis and was treated with 2 weeks of nafcillin. Few days after discontinuing the antibiotics he became febrile and was again found to have MSSA bacteraemia for which at this time he received 4 weeks of nafcillin. Antibiotics were stopped a week prior to this presentation, when he developed fever and now admitted the third time in 2-month duration.

The patient was retired married male living in an urban inner city apartment. He denied illicit drug use ever in his life and denied recent alcohol intake and smoking.

On examination the patient was febrile (T=102.3°F), tachycardic (pulse=108 bpm) with stable blood pressure. On examination, the surgical site appeared well healed, without any external signs of infection. Cardiopulmonary examination was within normal limit without any evidence of murmurs and a full physical examination did not reveal any peripheral signs of infective endocarditis.

Investigations

Initial laboratory examination revealed leucocytosis ($13.6 \times 10^6/L$) with 78% neutrophils and elevated C reactive protein (CRP) (15.3 mg/dL) with normal renal and liver function tests. Two sets of blood cultures were obtained in the first 24 h and growth of *S. aureus* was observed in all the bottles. Antimicrobial susceptibility data later available identified the bacteria as MSSA.

The patient was started on intravenous nafcillin 2 g every 4 h, but remained persistently bacteraemic after 6 days of therapy. A transthoracic and transesophageal echocardiogram did not demonstrate any valvular vegetation or dysfunction. There was no intravascular catheter or prosthesis which could explain his persistent bacteraemia.

Recognising the need to identify a focus of underlying infection and also suspecting an underlying prosthetic vascular graft infection, the patient underwent a [18 F] fluoro-2-deoxy-D-glucose PET associated to CT (18 F-FDG PET/CT). The 18 F-FDG PET/CT identified a circumferential area of increased FDG uptake adjacent to the superior aspect of the aortic graft (maximum standardised uptake value (SUV) value of 6.9), which extended

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To cite: Shahani L. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2014-207678

caudally as a tubular area adjacent to the posterior aspect of the descending aorta; consistent with infection in the distal aortic arch and the descending aorta intravascular graft (figure 1).

Treatment

Recommended definitive treatment of this infected prosthetic vascular graft included reoperative thoracotomy, graft removal and replacement with homograft. Considering the extensive pleural adhesions noted at the time of the initial operation, the proximal location of the graft requiring control of arch vessels and the patient's age; the surgeons associated the surgery with poor perioperative and long-term survival. Considering the need of conservative management the patient was treated with nafcillin along with rifampin for 6 weeks.

Outcome and follow-up

The patient eventually had negative blood cultures and was later transitioned to doxycycline for suppression. The patient has been followed up at our clinic and at 6 months on doxycycline with negative blood cultures, normalised inflammatory markers and no further episodes of fever.

CASE 2

Case presentation

A 59-year-old male presented to the EC with a 2-day history of fever, fatigue and low blood pressure (90/58 mm Hg) when measured at home. He denied any other symptoms at this time to help localise an infection.

The patient's medical history was significant with Marfan's syndrome for repair of an acute ascending aortic dissection 6 years prior to this presentation, repair of descending thoracic aneurysm 3 years ago, followed by dissection of the aortic arch and it requiring complete arch replacement 4 months prior to this presentation. His postoperative course 4 months ago, was complicated by sternal wound infection requiring extensive

debridement followed by plastics flap reconstruction and 6 weeks of intravenous antibiotics.

The patient had done well until a month ago, when he had presented with fever and found to have MSSA bacteraemia without evidence of endocarditis and was treated with 2 weeks of nafcillin. Antibiotics were stopped a week prior to this presentation, when he developed fever and hypotension now admitted for further work up.

The patient was retired married male living in an urban inner city house. He denied illicit drug use ever in his life; however, admitted to social alcohol intake and smoking.

On examination the patient was febrile ($T=103.6^{\circ}\text{F}$), tachycardic (pulse=126 bpm) with low blood pressure (86/48 mm Hg). On examination, the surgical site appeared well healed, without any external signs of infection. Cardiopulmonary examination was within normal limit without any evidence of murmurs and a full physical examination did not reveal any peripheral signs of infective endocarditis.

Investigations

Initial laboratory examination revealed leucocytosis ($11.4 \times 10^6/\text{L}$) with 88% neutrophils and normal renal and liver function tests. Two sets of blood cultures were obtained in the first 24 h and growth of *S. aureus* was observed. Antimicrobial susceptibility data later available identified the bacteria as MSSA.

The patient was admitted to the intensive care unit and aggressive fluid resuscitation was administered to the patient which stabilised his blood pressure. The patient was started on intravenous nafcillin 2 g every 4 h, but remained persistently bacteraemia after 8 days of therapy. A transthoracic and transeophageal echocardiogram did not demonstrate any valvular vegetation or dysfunction. There was no intravascular catheter or prosthesis which could explain his persistent bacteraemia.

Recognising the need to identify a focus of underlying infection and also suspecting an underlying prosthetic vascular graft infection, the patient underwent a (18 F-FDG PET/CT). The 18

Figure 1 Increased [18 F] fluoro-2-deoxy-D-glucose activity consistent with infection in the distal aortic arch and the descending aorta intravascular graft (case 1).

F-FDG PET/CT demonstrated increased FDG activity in the postsurgical ascending aorta from the level immediately superior to the right atrium to the aortic arch which was consistent with infection of the prosthetic aortic graft (figure 2). Further there was moderate FDG uptake in the bisected sternum and in the soft tissue between at the level of the fourth and fifth ribs, along with cortical defects on the right; most consistent with osteomyelitis.

Treatment

Recommended definitive treatment of this infected prosthetic vascular graft and the overlying musculoskeletal infection included removal, debridement, drainage of chest wall and replacement of aortic graft most likely with homograft. The patient was offered surgery at this time; however, the patient refused the surgery due to his age and the number of previously undergone surgeries. Considering the need of conservative management the patient was treated with nafcillin along with rifampin for 6 weeks.

Outcome and follow-up

The patient eventually had negative blood cultures and was later transitioned to doxycycline for suppression. The patient has been followed up at our clinic and at 6 months on doxycycline with negative blood cultures, normalised inflammatory markers and no further episodes of fever.

DISCUSSION

The author describes two cases presenting similarly with recurrent and persistent *S. aureus* bacteraemia without any symptoms suggestive of an aortic graft infection; however, the infection

was diagnosed with the help of 18 F-FDG PET/CT scan. Both these infection occurred in patients who had developed post-operative wound infection, further highlighting the role of bacterial seeding from an adjacent source of infection. Most cases of graft infection occur at the time of graft implantation; however, other contributing factors include graft revisions, surgical wound infections, emergent initial surgery and post-operative bacteraemia.^{1 2}

The common organisms associated with prosthetic vascular graft infection include *S. aureus*, *Staphylococcus epidermidis* and Gram-negative enteric organisms.⁵ A review of 205 prosthetic vascular graft infections described *S. aureus* as the cause in 43%, *Escherichia coli* in 17%, *S. epidermidis* in 14%, *Pseudomonas* spp in 10%, *Proteus* in 8%, and *Klebsiella* in 4% of the cases.⁶ This is particularly important in cases where empiric antibiotics therapy needs to be initiated prior to availability of culture results.

Aortic graft infections could present with obvious signs such as cellulitis or abscess formation in the surgical area with a possible communication to the vascular graft. However, at times, the patient may have a subtle presentation, as in our cases where they present with isolated fever and bacteraemia. Persistent bacteraemia on appropriate antimicrobial therapy and recurrence despite adequate therapy or isolation of the nidus of infection should make the clinician suspicious of a vascular graft infection. Using inflammatory markers such as presence of leucocytosis, and elevated erythrocyte sedimentation rate and CRP should aid in diagnosis and follow-up of such cases.

Imaging techniques used to diagnose prosthetic graft infection include ultrasound, CT scanning, MRI and newer techniques such as 18 F-FDG PET/CT scan as used in our patients. A large

Figure 2 Increased [18 F] fluoro-2-deoxy-D-glucose activity consistent with infection of the prosthetic graft of the ascending aorta (case 2).

case series of 76 patients with suspected vascular graft infection, subjective focal uptake was linked to very high positive predictive value (93%) for vascular graft infections.⁷ Similarly Keidar *et al*⁸ in a study of 39 patients with suspected graft infections demonstrated PET/CT to have a sensitivity of 93%, specificity of 91%, positive predictive value of 88% and negative predictive value of 96% for the diagnosis of vascular graft infection. The fusion of 18 F-FDG-PET and CT scans acquired together enables precise localisation of abnormal 18 F-FDG uptake, providing higher diagnostic rates compared to other modalities in case of low-grade vascular graft infections and making it a promising diagnostic modality in such cases.⁹ Further Spacek and colleagues¹⁰ have demonstrated that measuring metabolic activity in the vasculature using 18 F-FDG-PET scan is a suitable marker for monitoring the disease activity and the therapeutic success rate as a part of long-term patient monitoring.

Resection of the infected graft, followed by either extra-anatomic bypass or in-line replacement, has been since long been considered the mainstay of therapy for prosthetic vascular graft infections. However, with older patient and with higher comorbidities, the above modality has been associated with 25–35% mortality.^{11 12} Further location of the graft such as ascending aorta, arch of the aorta and descending thoracic aorta has also been considered difficult for resection and these patients have been treated conservatively.¹³ In a previous series of five patients with aortic graft infection being treated conservatively with long-term antibiotics, all patients were reported to be alive and without complications with a median survival of 32 months and a maximum of 6 years.¹⁴ Although the results of conservative management of these complicated cases are encouraging the data reported is small and the follow-up has been limited. Use of culture specific parenteral antibiotics for duration of 4–

6 weeks, followed by continuation of oral antibiotics for a period of 3–6 months or even lifelong has been considered in many cases.^{15 16} Use of rifampin deserves special mention, because of its role in treating biofilm associated infection, such as *S. aureus* prosthetic vascular graft infections and preferential concentration in leucocytes leading to better drug delivery to the site of infection. Use of endovascular approach and implantation of stent grafts along with antibiotics has been shown to be beneficial for patients not suitable for conventional open surgery.¹⁷ This approach could also be used in a situation of impending rupture as a ‘bridge to surgery’.¹⁷

The author reports two cases presenting with recurrent and persistent *S. aureus* bacteraemia without any symptoms suggestive of an aortic graft infection; however, the infection was diagnosed with the help of 18 F-FDG PET/CT scan. Further because of the high mortality risk associated with the surgical repair; both these cases were treated conservatively. Follow-up data for conservative management is limited, however, preliminary results are promising for these complicated cases.

Competing interests None.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- Valentine RJ. Diagnosis and management of aortic graft infection. *Semin Vasc Surg* 2001;14:292–301.
- Bunt TJ. Synthetic vascular graft infections. *Surgery* 1983;93:733–46.
- Bandyk DF. Surgical management of vascular graft infections. *Perspect Vasc Surg* 1995;1:1–13.
- Reilly LM. Aortic graft infection: evolution in management. *Cardiovasc Surg* 2002;10:372–7.
- Calligaro KD, Veith FJ, Valladares JA, *et al*. Prosthetic patch remnants to treat infected arterial grafts. *J Vasc Surg* 2000;31:245–52.
- Calligaro KD, Veith FJ, Swartz ML, *et al*. Are gram negative bacteria a contraindication to selective preservation of infected prosthetic arterial grafts? *J Vasc Surg* 1992;16:337–46.
- Spacek M, Belohlavek O, Votrubova J, *et al*. Diagnostics of “non-acute” vascular prosthesis infection using 18F-FDG PET/CT: our experience with 96 prostheses. *Eur J Nucl Med Mol Imaging* 2009;36:850–8.
- Keidar Z, Engel A, Hoffman A, *et al*. Prosthetic vascular graft infection: the role of 18F-FDG PET/CT. *J Nucl Med* 2007;48:1230–6.
- Bruggink JL, Slart RH, Pol JA, *et al*. Current role of imaging in diagnosing aortic graft infections. *Semin Vasc Surg* 2011;24:182–90.
- Sedivy P, Spacek M, El Samman K, *et al*. Endovascular treatment of infected aortic aneurysms. *Eur J Vasc Endovasc Surg* 2012;44:385–94.
- Wilson SE. New alternatives in the management of the infected vascular prosthesis. *Surg Infect* 2001;2:175–7.
- Chiesa R, Astore D, Frigerio S, *et al*. Vascular prosthetic graft infection. *Acta Chir Belg* 2002;102:238–47.
- Kaneda T, Iemura J, Oka H, *et al*. Treatment of deep infection following thoracic aorta graft replacement without graft removal. *Ann Vasc Surg* 2001;15:430–4.
- Roy D, Grove DI. Efficacy of long-term antibiotic suppressive therapy in proven or suspected infected abdominal aortic grafts. *J Infect* 2000;40:184–7.
- Ohta T, Hosaka M, Ishibashi H, *et al*. Treatment for aortic graft infection. *Surg Today* 2001;31:18–26.
- Lawrence PF. Management of infected aortic grafts. *Surg Clin North Am* 1995;75:783–97.
- Spacek M, Stadler P, Belohlavek O, *et al*. Contribution to FDG-PET/CT diagnostics and post-operative monitoring of patients with mycotic aneurysm of the thoracic aorta. *Acta Chir Belg* 2010;110:106e8.

Learning points

- ▶ Prosthetic vascular graft infection although a rare complication of vascular reconstruction surgery; has been associated with significant morbidity and mortality.
- ▶ Graft revisions, surgical wound infections, emergent initial surgery and postoperative bacteraemia are contributing factors for prosthetic vascular graft infection.
- ▶ The fusion of [18 F] fluoro-2-deoxy-D-glucose positron emission tomography associated to CT (18 F-FDG-PET) and CT scans acquired together enables precise localisation of abnormal 18 F-FDG uptake, providing higher diagnostic rates compared to other modalities in case of low-grade vascular graft infections.
- ▶ Persistent bacteraemia on appropriate antimicrobial therapy and recurrence despite adequate therapy or isolation of the nidus of infection should make the clinician suspicious of a vascular graft infection.

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