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CASE REPORT

Prosthetic valve endocarditis secondary to *Corynebacterium* following transcatheter aortic valve implantation: a case report

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Background Transcatheter aortic valve implantation (TAVI) has emerged as an alternative for the treatment of severe symptomatic aortic stenosis for patients at high risk for open surgery. Although experience with TAVI is increasing, few cases of post-TAVI endocarditis are reported.

Case summary We present a case of an 87-year-old female patient who presented with fever, unresponsive to empiric antibiotics 3 months after a TAVI procedure for severe aortic valve stenosis. After some delay due to three hospitalizations in primary care hospitals, she was transferred to our general intensive care unit where the diagnosis of endocarditis due to *Corynebacterium* was made. The patient was transferred abroad to a specialized surgical centre of excellence and underwent aortic root and valve replacement with a homograft. After several post-operative complications the patient's condition improved and is presently satisfactory.

Discussion Keeping a high index of suspicion when evaluating patients might lead to a favourable outcome if appropriate and early intervention was implemented. Adherence to policies which address infection control and aseptic techniques when performing TAVI might lead to fewer cases of post-TAVI endocarditis.

Keywords TAVI • Infective endocarditis • *Corynebacterium* • Case report • Homograft • Echocardiography

Learning points

- Post-transcatheter aortic valve implantation (TAVI) endocarditis is being increasingly reported in literature as TAVI becomes more prevalent.
- Transoesophageal echocardiogram is the imaging investigation of choice when post-TAVI endocarditis is suspected.
- *Corynebacterium* endocarditis post-TAVI is rarely reported in the literature.
- Prevention through adherence to aseptic techniques might lead to fewer infection related complications.
- Early identification and appropriate treatment tailored to case might lead to a favourable outcome.

Introduction

Transcatheter aortic valve implantation (TAVI) is a less invasive alternative to surgical replacement of diseased aortic valves first described in 2002.[1] It has gained recognition since and has been adopted as an alternative treatment modality in high-risk patients who seem to be unfit for conventional open heart surgery. With the increase in number of patients treated with TAVI an increment in the number of

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complications have been observed in TAVI recipients including a few case reports of prosthetic valve endocarditis. In one observational single centre study of 509 consecutive patients, an incidence of 2.1% per year was reported,[2] and an incidence of 0.5% was reported in a multicentre study that included 7944 patients.[3]

Infective endocarditis due to *Corynebacterium* has been reported in the literature but very rarely in patients who had undergone a TAVI procedure. In the present article, we report the case of a 87-year-old female who developed infective endocarditis due to *Corynebacterium* 3 months following a TAVI procedure.

Timeline

Time	Events
July 2015	Transcatheter aortic valve implantation (TAVI) was performed in an outside hospital for severe symptomatic aortic stenosis
November 2015	Presented with fever and convulsive seizure and computed tomography (CT) brain showed acute ischaemic stroke
12 January 2016	Transferred to our tertiary hospital intensive care unit (ICU) for further evaluation and management, blood cultures grew *Corynebacterium* and transoesophageal echocardiogram results confirmed suspected diagnosis of post-TAVI infective endocarditis
20 January 2016	Transferred to a specialized cardiac surgery centre in France
25 January 2016	Underwent aortic root and valve replacement with a preserved homograft with re-implantation of coronary ostia (Bentall-like procedure), subsequently blood and vegetations cultures grew *Corynebacterium amycolatum*
15 February 2016	Transferred back from France to our ICU, had a prolonged hospital course with management emphasis on appropriate antibiotic treatment in line with supportive care such as intensive physical therapy and nutrition
21 August 2016	Discharged to ward in stable condition
26 September 2016	Discharged home with specialized home nursing

Case summary

A 87 years old female patient was transferred from another hospital to our tertiary health care centre on 12 January 2016 for further evaluation and management of a recent ischaemic stroke with convulsive seizures and intermittent fever since November 2015. The patient had a background medical history of non-insulin dependent diabetes mellitus, chronic hypertension, coronary artery disease, gastro-oesophageal reflux disease, osteoarthritis with right total knee replacement, cervical spine fixation for degenerative disease, and severe symptomatic aortic stenosis (mean gradient 55 mmHg, aortic valve area 0.85 cm^2) for which TAVI was performed in another centre on July, 2015.

Prior to the presentation to our hospital the patient was admitted three times in two different hospitals with the chief complaint of intermittent fever with maximum temperature 39°C, decreased level of consciousness, and dysarthria. During the last admission in December 2015, and prior to transfer to our unit, she was admitted to an intensive care unit (ICU) because of further deterioration in her level of consciousness following recurrent convulsive seizures. The diagnostic workup included a transthoracic echocardiogram (TTE) which was negative for vegetations and para-valvular leak, and a computed tomography (CT) head that revealed evidence of small vessel disease and acute right cerebellar infarction, blood cultures remained negative, nevertheless she received an empiric course of antibiotics after which the fever curve was reduced.

Upon arrival in our unit the patient's clinical examination revealed blood pressure (BP) 105/49 mmHg and sinus tachycardia with a pulse of 108, temperature 38°C, saturation O_2 96% on oxygen 5 L/min via facemask. Cardiac exam revealed no jugular venous distention, no gallops and a soft systolic murmur was heard at the apex not radiating to the neck. The lungs revealed crackles in the dependent regions but were clear anteriorly. The neurological exam revealed a Glasgow coma scale (GCS) 9/15, pseudobulbar signs were observed with inability to swallow and dysarthria. She had bilateral motor weakness predominantly on the right side with right upper extremity Medical Research Council (MRC) score 1/5 and left upper extremity MRC score 3/5, the lower extremities had decreased tone and bilateral extensor plantar reflexes, and no peripheral stigmata of infective endocarditis were observed. The patient's respiratory condition worsened and she had to be intubated for respiratory distress, and worsening hypoxaemia. The chest X-ray showed bilateral lower lobe opacities felt to be secondary to aspiration pneumonia.

Lab results sent on admission 12 January 2016 revealed a normochromic normocytic anaemia with a haemoglobin 10 g/dL (normal range 11.7–14 g/dL), a normal leucocyte count of $5.1 \times 10^3/\mu L$ (normal range 4.1–11.0 $\times$ $10^3/\mu L$), thrombocytopenia with a platelet count $71 \times 10^3/\mu L$ (normal range 150–350 $\times$ $10^3/\mu L$), elevated inflammatory markers with a C-reactive protein (CRP) 104 mg/L (normal range 0–5 mg/L), and low albumin value of 21.1 g/L (normal range 35–55 g/L) but normal liver and renal function tests. Two blood cultures taken from two different sites on 12 January 2016 revealed *Corynebacterium* species.

A TTE was repeated for suspicion of endocarditis and again was negative for vegetations and there was no para-valvular leak around the TAVI prosthesis. The left ventricular function was preserved with a systolic ejection fraction (EF) of 60%. A repeated brain CT scan showed subacute right cerebellar region infarct possibly embolic and bilateral periventricular hypodensities in keeping with small vessel disease.

In view of strong suspicion of infective endocarditis, a transoesophageal echocardiogram (TOE) was carried out on 13 January

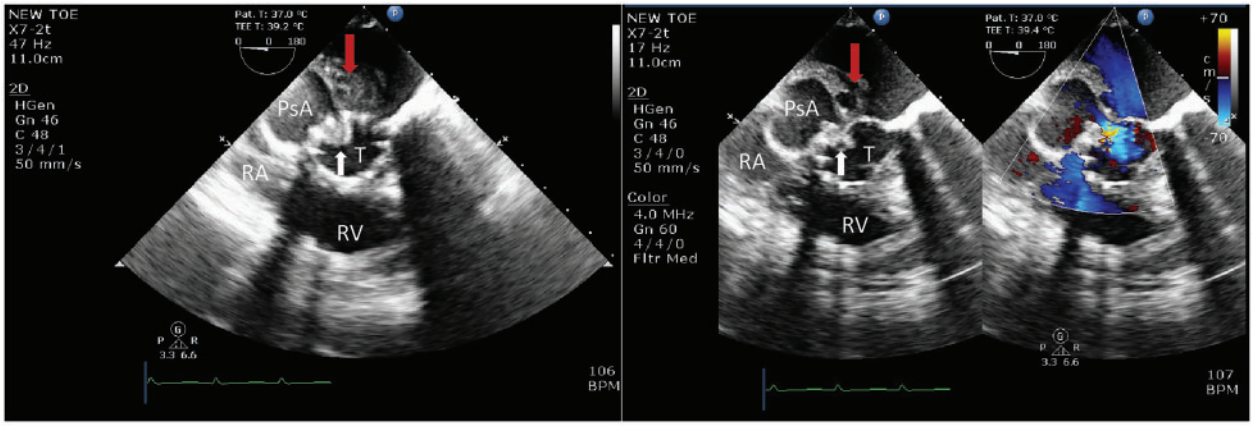

Figure 1 Transoesophageal echocardiogram mid-oesophageal modified views, probe angle 0°. Long axis and colour Doppler views showing a large mobile vegetation attached to TAVI (T) struts at white arrow cursor, the aortic root pseudoaneurysm (PsA) arising from the medial aspect of the transcatheter aortic valve implantation, and an area of increased echogenicity suggestive of aortic root abscess pointed at with red arrow. The right atrium (RA) and right ventricle (RV) are apparent.

2016 and showed a large mobile vegetation measuring 1.3 × 0.6 cm attached to transcatheter prosthetic valve struts, and an abnormality of the aortic root resembling a mass extending from the aortic root to the left atrium that was thought to be a pseudoaneurysm arising from the medial aspect of the prosthetic valve. There was an area of increased echogenicity with small loculations surrounding the pseudoaneurysm suggestive of aortic root abscess (*Figure 1*). A CT angiography was done the following day and revealed the presence of a posterior aortic root pseudoaneurysm 2.5 × 2.0 cm with surrounding tissue oedema suggestive but not confirmatory for the presence of a collection and highlighting the possibility of an infectious aetiology (*Figure 2*).

The patient was seen and her case was discussed by a multidisciplinary team including specialists of infectious diseases, cardiology, neurology and cardiac surgery and infective endocarditis was felt to be the most likely diagnosis. Applying the modified Duke criteria, the patient had one of the major criteria: a positive echocardiogram revealing a mobile vegetation and at least three minor criteria: fever 38°C, a positive blood culture, and a predisposing cardiac device.[4] The diagnosis was prosthetic valve endocarditis complicated with aortic root pseudoaneurysm and possible concomitant abscess and coexisting hospital acquired pneumonia. She was started on meropenem/levofloxacin and vancomycin on admission with a partial response in CRP decreasing to 44 mg/L by the 6th day however the patient remained febrile. Given the findings of aortic root pseudoaneurysm and surrounding infection unresponsive to antibiotics and history of thrombo-embolic event (cerebro-vascular accident (CVA)) it was felt at this point the patient needed surgical treatment (TAVI explantation and aortic valve replacement and possible aortic root repair). Given the high risk nature of the procedure the family and the cardiac surgeon opted for the procedure to be performed in a centre of excellence abroad.

The patient subsequently was transferred to France on 20 January 2016 (Department of Cardiac Surgery, Pr. JP Couetil, Hôpital Henri Mondor, Creteil, France). The repeat blood cultures there confirmed the presence of *Corynebacterium amycolatum*, sensitive to Vancomycin, Rifampin, and Imipenem.

After evaluation of the patient in France several findings favoured complete replacement of the aortic root with a homograft. Most important amongst these findings was the presence of severe endocarditis complicated by a posterior aortic root abscess/pseudoaneurysm with high risk of recurrence unless the aortic root abscess is completely removed and the fact that perforation of the aortic wall due to impingement of the prosthetic valve was suspected preoperatively. Other factors favouring the aortic root replacement were the presence of aortic root calcifications associated with the patient's advanced age and the availability of a human homograft.

The above findings suspected were confirmed intraoperatively namely the presence of endocarditis complicated by an aortic pseudoaneurysm and surrounding abscess. The patient underwent an aortic root and valve replacement with a preserved homograft with reimplantation of coronary ostia (Bentall-like procedure) on the 25 January 2016. The culture of the vegetations confirmed the presence of *Corynebacterium* species again.

The post-operative course was complicated by chylothorax and septic shock due to a ventilator associated pneumonia, requiring prolonged mechanical ventilation and subsequent percutaneous tracheostomy. The patient received appropriate treatment with several antibiotics under ID supervision in France and improved. She was continued on Daptomycin and Rifampin planned for 6 weeks after the aortic root replacement covering the *C. amycolatum* endocarditis.

On 15 February 2016, the patient was transferred back from France to our ICU on mechanical ventilation. On arrival an important drop from her baseline GCS 9-10/15 to a GCS of 6/15 E: 4, M: 1 V: 1 was noted. An extensive workup done to establish the cause of this drop included a lumbar puncture which was normal except for slight elevation in protein, a magnetic resonance imaging (MRI) head which confirmed the previous CT head findings, cervical MRI which showed degenerative disease with no cord compression, an electroencephalogram (EEG) which revealed no seizures and a nerve conduction/

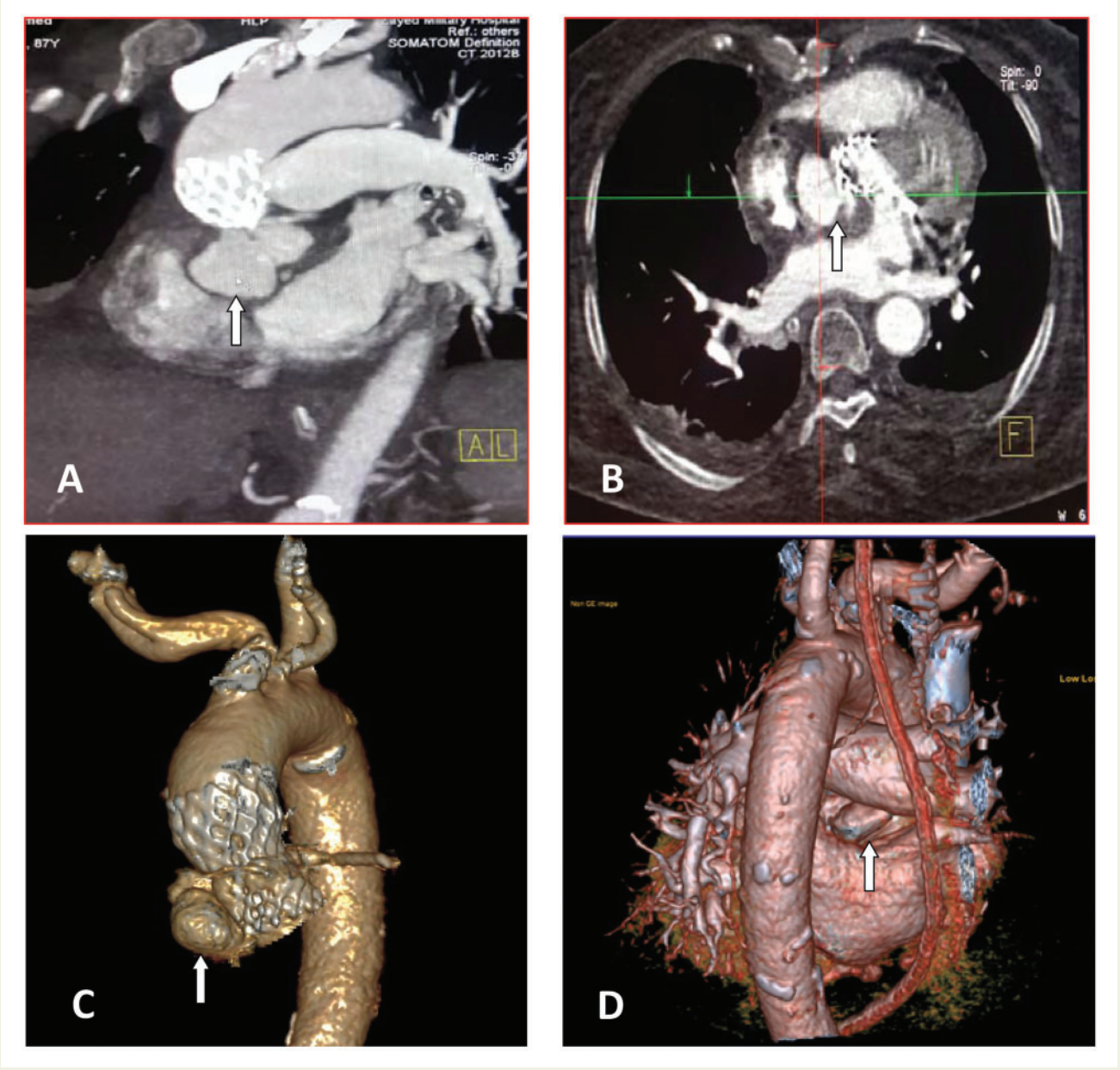

Figure 2 (*A*) Coronal (*B*) transverse and (*C* and *D*) 3D reconstruction images of computed tomography (CT) angiography showing a posterior aortic root pseudoaneurysm 2.5 × 2.0 cm pointed at with white arrow.

electromyography study showed evidence of axonal neuropathy and muscle weakness suggestive of critical illness polyneuropathy and myopathy. The Neurology team was consulted and felt the intermittent changes in level of consciousness could be explained by probable recurrent CVAs or sepsis. Her level of consciousness subsequently improved.

The patient was initially on Rifampin 600 mg per feeding tube daily daily and daptomycin 600 mg iv daily after returning from France but was shifted to meropenem 1 gm iv every 8 h and daptomycin continued after she developed a drug rash and elevated liver enzymes possibly related to Rifampin and for coverage of episodes of ventilator associated pneumonia, a catheter-related infection and a urinary tract infection. She completed 6 weeks appropriate treatment under Infectious Diseases team supervision. In an attempt to optimize nutrition and avoid aspiration, the patient underwent percutaneous endoscopic gastrostomy.

Following optimized nutrition, aggressive physiotherapy and infection control the patient improved and was able to be weaned off mechanical ventilation with the tracheostomy still *in situ* and to sit in a chair, as well as tolerate pureed diet after a favourable swallowing assessment. A follow-up transthoracic echo revealed mild aortic regurgitation and preserved EF and the inflammatory markers had returned to normal (CRP 4.64 mg/L), and thus the patient was discharged home.

Eighteen months following discharge the patient is still at home, aided by a home health nurse and is afebrile, able to follow simple commands and statements and interact with her family members.

Discussion

Healthcare Professionals should be aware of the potential complications associated with TAVI including the particularly serious complication of infective endocarditis as in the present reported case. A high index of suspicion may lead to early recognition and management and possibly a favourable outcome. Our patient although presenting with unexplained fever and non-specific symptoms was indeed treated by empiric antibiotics therapy after having undergone only a TTE and not a more sensitive TOE that might have demonstrated the lesions and altered the management sooner.

As mentioned in the introduction few cases of post-TAVI prosthetic valve endocarditis are reported in the literature and to the best of our knowledge the present case is the first to be observed and reported from UAE, and the second case reported to be secondary to *Corynebacterium* species.[5] Hence, it is important to report such cases as TAVI procedures are becoming more common and a growing body of evidence is emerging on the potential complications including endocarditis.

The gold standard for treatment of aortic valve disease remains surgical valve replacement; however, the introduction of TAVI has offered an alternative for those patients at high surgical risk. Transcatheter aortic valve implantation procedures are usually performed in catheterization labs by interventional cardiologists with the cardiac surgery team available if the need arises. Recently the introduction of the hybrid operating room, a combination of a cardiac catheterization lab and operating theatre, has offered the ideal setup for such combined procedures. Hence the recent trend has been to perform TAVI procedures in a hybrid room, where the traditional diagnostic functions of the catheterization lab are combined with the surgical functions of an operating room. However, at present, many hospitals that perform TAVI procedures do not have a hybrid lab, and therefore, TAVI procedures are often performed in the catheterization lab where airflow and sterilization guides might not be as strict and respected as in surgical operating rooms. One study showed a low incidence of infection when TAVI is performed in catheterization lab, but the study was underpowered and observational and utilized strict infection control measures and antibiotic prophylaxis.[6] Therefore, further studies highlighting whether tighter aseptic techniques respected in operating rooms, which may be superior or more binding than the ones observed in catheterization labs, play a role in the rate of infection and whether strengthening those rules results in a risk reduction of infectious complications.

In addition, to further implementing strict procedural aseptic techniques, the use of appropriate antibiotics prophylaxis tailored to patients at higher risk may lower the risk of prosthetic endocarditis and has become standard practice in TAVI centres.[7,8] In a recent multicentre study, orotracheal intubation and the use of self-expandable CoreValve system were reported to be risk factors for post-TAVI Infective endocarditis ($P = 0.004$, $P = 0.007$), respectively.[3]

The optimal management of patients with post-TAVI endocarditis still needs to be evaluated in clinical trials with adequate patient numbers. Till then reporting individual experiences can lead to a larger body of evidence enabling the medical community to establish a structured and evidence-based approach for diagnosing and treating in addition to preventing infective complications following TAVI.

In this regard, TOE has been found more sensitive in detecting vegetations than TTE particularly in patient with poor acoustic windows and aortic root complications.[9] The pathophysiology of prosthetic valve endocarditis differs from that of native valve endocarditis in that it is characterized by a lower incidence of vegetations and higher incidence of perivalvular abscesses. These characteristics favour TOE in detecting prosthetic valve endocarditis because of its higher sensitivity and specificity for the detection of vegetations, abscesses, and perivalvular lesions.[9] Given the added sensitivity of TOE, it should be preferred in cases with high suspicion of endocarditis particularly those patients with prior valve surgery or prosthesis placement like TAVI. Despite the added value of TOE its sensitivity in prosthetic valve endocarditis remains lower than in native valve endocarditis probably because of the presence of intracardiac material which may hinder the identification of vegetations and abscesses. Indeed, in a study of 31 patients Lengyel and co-workers have demonstrated that TOE was able to detect evidence of prosthetic valve endocarditis after TAVI in 50% of cases.[10] Also in a recent review of 180 consecutive patients to assess safety and efficacy of TAVI, Puls *et al.*[11] reported difficulty in making the correct diagnosis by TOE due to shadowing and reflection by the prosthesis and due to the absence of solid echocardiographic criteria for the diagnosis of endocarditis post-TAVI and hence they concluded that verifying the diagnosis of infective endocarditis by TOE was challenging in this context and may delay therapy.

Another point of interrogation may concern the proper treatment of those infective endocarditis following TAVI. In the same series by Puls *et al.*,[11] 4 out of 15 patients with post-TAVI endocarditis died; 3 of the 4 patients who died had a strong indication for surgical therapy (abscesses, pseudoaneurysm); nevertheless open heart surgery was not done because of the patients' high risk status.[11] In a recent case report and literature review on the management of infective endocarditis following TAVI, Loh *et al.* reviewed five cases all of which had local pathology where surgery would be recommended. Out of the five cases, three patients underwent surgery and survived while the two managed conservatively did not. It appeared that surgery had a reduced mortality rate and more favourable outcomes as compared to medical treatment for post-TAVI endocarditis especially when local pathology existed.[12] These findings confirm our choice in surgical management of our patient who survived the homograft replacement.

Homograft aortic root replacement in native or prosthetic active infective endocarditis has been reported in the literature and may be the surgical treatment of choice for active endocarditis with aortic root abscess. This surgery for prosthetic valve endocarditis remains highly risky and results in higher rates of post-operative mortality and morbidity than in native valve endocarditis.[13] Our case is the first to report a homograft replacement post-endocarditis in TAVI, a procedure usually indicated and performed in patients already deemed too risky to undergo initial conventional aortic valve replacement and hence referred to the less invasive option. This somewhat paradoxical situation where, with the intention of avoiding surgery in a high-risk patient, a minimally invasive procedure performed inadvertently results in complications that warrant eventual surgery, highlights the

need for better patient selection for TAVI. Better criteria for patient selection in TAVI are required to reduce the complications requiring high risk open heart surgery like post-TAVI endocarditis and to further establish reliable criteria for surgical vs. medical management of post-TAVI endocarditis.

In our patient, the presence of the aortic root abscess and the impingement of the implant into the aortic root wall and possible perforation as well as the high risk for recurrence of infection and the availability of the homograft prompted the choice of surgery with a preserved aortic root homograft.

Conclusion

We report a case of prosthetic valve endocarditis secondary to a very rare organism *C. amycolatum* following TAVI. It is also the first to report the use of a preserved homograft for this particular case of post-TAVI endocarditis with aortic root abscess and pseudoaneurysm. It certainly highlights the need for better patient selection criteria as well as emphasizes early recognition of TAVI complications and appropriate management. Whether tighter aseptic techniques play a role in preventing the infectious complications in TAVI remains to be seen.

Supplementary material

Supplementary material is available at *European Heart Journal - Case Reports* online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The authors confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: none declared.

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