


Complete embolization of a mechanical aortic valve during trail running—a case report with a lucky ending

Havard Dalen ^{1,2,3*}, Torbjørn Graven³, Katrine H. Slagsvold^{2,4},
Lars Erik Krogstad⁴, Lars Mølgaard Saxhaug^{2,3}, Tomas D. Tannvik⁵, Espen Holte^{1,2},
Dag Ole Nordhaug^{2,4}, Øystein Karlsen⁵, Anders Thorstensen^{1,2},
Alexander Wahba^{2,4}, and Anders M. Winnerkvist⁴

¹Clinic of Cardiology, St. Olavs University Hospital, Trondheim, Norway; ²Department of Circulation and Medical Imaging, Faculty of Medicine and Health Sciences, Norwegian University of Science and Technology, Box 8905, 7491 Trondheim, Norway; ³Department of Medicine, Levanger Hospital, Nord-Trøndelag Hospital Trust, Levanger, Norway; ⁴Clinic of Cardiothoracic Surgery, St. Olavs University Hospital, Trondheim, Norway; and ⁵Clinic of Anaesthesia and Intensive Care, St. Olavs University Hospital, Trondheim, Norway

Received 12 November 2021; first decision 3 December 2021; accepted 21 February 2022; online publish-ahead-of-print 2 March 2022

Background

Complete embolization of a prosthetic heart valve is extremely rare and dangerous. This case reports a total embolization of a mechanical aortic valve and contributes to the literature regarding the diagnostic challenges related to infective endocarditis and follow-up after valvular surgery.

Case summary

A 28-year-old male 11.5 years status-post a mechanical aortic valve replacement presented with acute onset of chest pain and dyspnoea while jogging. The patient lost consciousness and went into cardiopulmonary arrest with acute pulmonary oedema and circulatory shock. An echocardiogram revealed an empty aortic annulus, and a chest radiograph showed an embolized valve in the aortic arch. The patient underwent emergent removal of the embolized valve and replacement with a new mechanical aortic valve. The patient survived with minimal sequelae. At a 3-month follow-up, he had resumed work, and the only sequelae were mild left ventricular dysfunction and minor vision loss. Although he experienced no warning signs or symptoms, the most likely aetiology for embolization of the valvular prosthesis was infective endocarditis, which was revealed by re-evaluation of an echocardiogram recorded 1 month before the presentation which demonstrated a subtle motion abnormality of the valve.

Conclusions

We present a case of a late complete embolization of a mechanical aortic valve most likely caused by asymptomatic infective endocarditis. The case illustrates the challenges in follow-up after valvular surgery and highlights the ultimate benefit of a well-functioning pre-hospital to hospital chain.

* Corresponding author. Tel: +47 958 71 716, Email: havard.dalen@ntnu.no

Handling Editor: Poonam Velagapudi

Peer-reviewers: Giulio Russo; Amr Idris

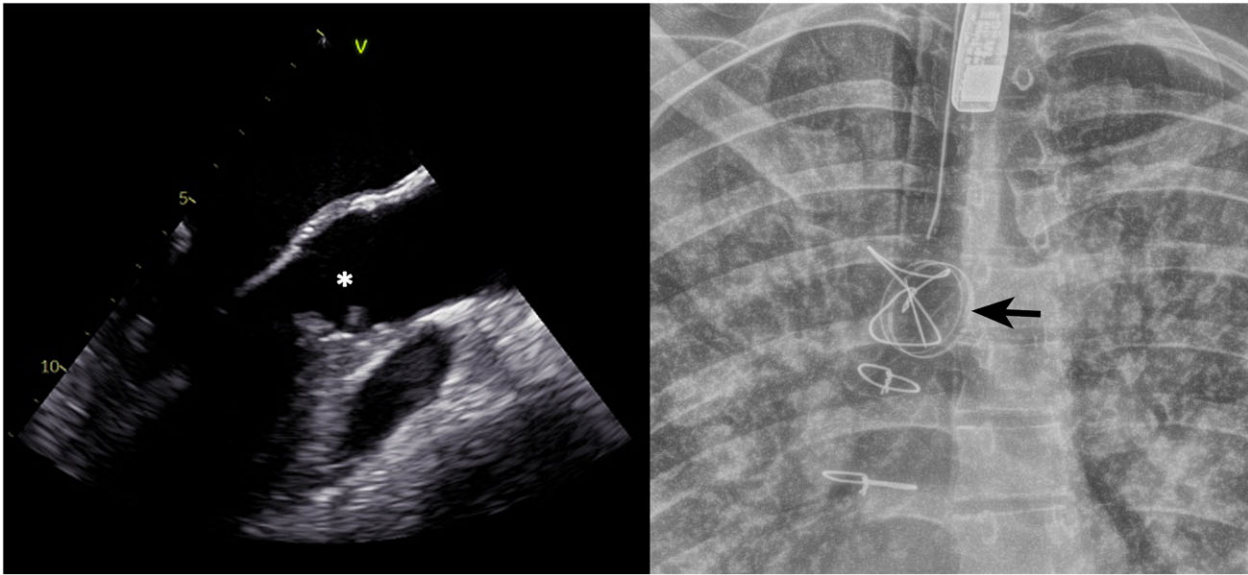
Compliance Editor: Polyvios Demetriades

Supplementary Material Editor: Ameenathul Mazaya Fawzy

© The Author(s) 2022. Published by Oxford University Press on behalf of the European Society of Cardiology.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

Graphical Abstract



Keywords

Case report • Prosthesis dehiscence • Prosthesis embolization • Infective endocarditis • Echocardiography • Surgery • Valve replacement

ESC Curriculum

2.2 Echocardiography • 4.10 Prosthetic valves • 4.11 Endocarditis • 7.3 Critically ill cardiac patient • 7.5 Cardiac surgery

Learning points

- Complete embolization of a surgical prosthetic heart valve is an extremely rare and dangerous condition that may be treated successfully.
- Infective endocarditis may cause valvular dehiscence as well as complete valvular embolization.
- Partial valvular dehiscence may be difficult to diagnose as the symptoms and imaging findings may be absent or difficult to reveal.

Specialties other than cardiology involved

Cardiology, Cardiothoracic surgery, Anaesthesia and intensive care

Introduction

The complete embolization of a prosthetic valve is a dangerous condition, previously only described in a handful of cases.¹⁻⁴ Infective endocarditis may cause partial dehiscence of a valvular prosthesis, but partial dehiscence without paravalvular leakage is exceptionally rare.⁵ Infective endocarditis may present with non-specific symptoms and can be difficult to diagnose, but asymptomatic cases are rare.^{6,7} We present a case with a sudden critical illness caused by complete embolization of a mechanical aortic valve implanted 11.5 years earlier. The most likely cause was asymptomatic infective endocarditis.

Echocardiography 1 month prior to the event was initially interpreted as normal as ventricular and valvular was function without evidence of paravalvular leakage. Re-evaluation of the imaging revealed a subtle abnormal rocking motion of the mechanical aortic valve indicating partial dehiscence.

Timeline

11.5 years prior to event Aortic valve replacement due to congenital aortic stenosis.

1 month prior to event	Last follow-up prior to event. He was healthy and without complaints. Echocardiography judged as normal post-operative state.
Day 0	Acute illness during trail running. Admitted to hospital with circulatory and respiratory collapse. Surgery performed with removal of embolized aortic valve. Start of intensive care treatment.
Day 2	Weaning from extracorporeal membrane oxygenation.
Day 9	Extubation.
Day 16	End of intensive care treatment.
Day 43	End of antibiotic treatment and discharge from hospital.
Day 90	Follow-up. He had resumed work, and only minor sequelae were present.

Case presentation

A 28-year-old man was treated for congenital aortic stenosis and regurgitation with a 25 mm On-X mechanical aortic valve (On-X Life Technologies, TX, USA) 11.5 years ago. The native aortic valve was tricuspid, with valvular asymmetry and a hypoplastic non-coronary cusp. He did not have other congenital abnormalities. He was followed regularly for dilatation of the ascending aorta. He was doing well 1 month prior to the presentation at his most recent follow-up visit. A surveillance echocardiogram seemingly demonstrated a normally functioning mechanical valve, with an ascending aorta measuring 43 mm. No laboratory tests were performed at the time. The patient reported seeing his primary care physician in the preceding 6 months for two small furuncles on his thorax. There were no associated fevers, and both resolved spontaneously without antibiotic therapy.

The patient was jogging on a local trail the day of presentation when he suddenly experienced acute chest pain and dyspnoea. Two bystanders came to his aid. He gave them his name and medical history before losing consciousness. The pre-hospital emergency care service was alarmed immediately, and he was admitted to the local hospital within 38 min. A pre-hospital electrocardiogram showed signs of global ischaemia (Figure 1). Acute aortic dissection was suspected due to the knowledge of a dilated ascending aorta. Upon admission, the patient was in pulmonary arrest with acute pulmonary oedema. His vital signs showed a blood pressure of 60/40 mmHg and a heart rate of 146 b.p.m. He was emergently intubated. Initial arterial blood sample showed pH 7.17, pO₂ 5.3 kPa, pCO₂ 7.2 kPa, and lactate 7.2 mmol/L. Initial blood sample showed elevated haemoglobin (17.5 g/dL), white blood cell count ($14.5 \times 10^9/L$), troponin-I (143 ng/L), d-dimer (1.1 mg/L), and international normalization ratio (2.6), but normal C-reactive protein (CRP) 2 mg/L and renal function. The patient was deemed unstable for computed tomography. Transthoracic and transoesophageal echocardiography were performed; they

showed severely reduced left ventricular function with modest dilatation of the ascending aorta and no signs of dissection. They also demonstrated an empty aortic annulus with the absence of the aortic valve (Figure 2, Videos 1 and 2). Chest radiograph showed widespread patchy shadowing over both pulmonary fields with air bronchograms, and the shadow of the mechanical aortic valve was found in the distal ascending aorta to the aortic arch zone (Figure 2). The patient was anaesthetized with ketamine, intubated, and mechanically ventilated prior to transfer. He received crystalloid fluid resuscitation. He was transferred by the helicopter emergency medical service to the regional university hospital for emergency surgery. Epinephrine infusion was started during transfer. The patient was brought directly to the operating room. The patient experienced circulatory collapse while being prepped for surgery, requiring multiple rounds of manual chest compressions. Cannulas were placed in the right femoral artery [19 French (F)] and vein (23 F), and he was heparinized for total cardiopulmonary bypass. The valve was identified in the aortic arch by manual palpation and intra-operative ultrasound. A retrograde cannula was advanced into the coronary sinus and the heart was stopped at a temperature just above 20°C. A longitudinal incision was made in the distal ascending aorta and the embolized prosthetic valve was removed. No morphological pathology was observed in the valve, and most of the sutures were encapsulated in the tissue surrounding the valvular sewing ring (Figure 3). The aortotomy was extended proximally, and by visual inspection, there were signs of tears and endocarditis between the coronary arteries, but no injury was noted at the fibrous annular position. Due to the defect, a circular pericardial patch was placed in the lower annulus before a St. Jude Medical (Regent 23 mm) mechanical aortic valve was implanted. After unclamping, the heart went into ventricular fibrillation, but this was converted to sinus rhythm. Due to severe oxygen failure, the patient was placed on veno-arterial extracorporeal membrane oxygenation (ECMO). He required reoperation after a few hours due to a diffuse

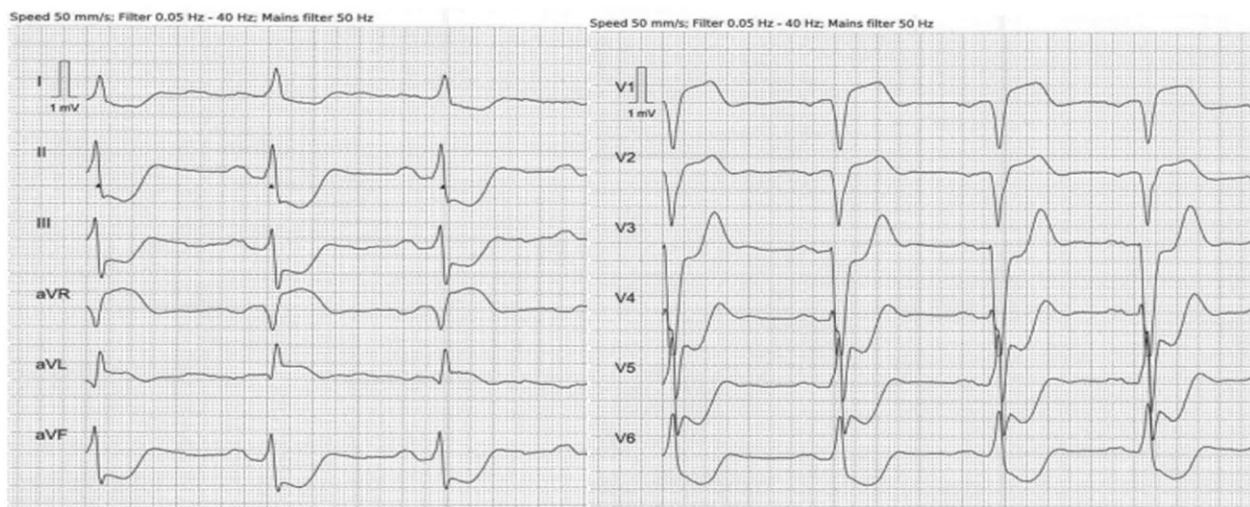


Figure 1 Pre-hospital electrocardiogram. Pre-hospital electrocardiogram recorded in the ambulance. There are signs of global ischaemia with ST-elevation in leads aVL, aVR, and V1–V2, as well as deep ST-depressions in the other leads.

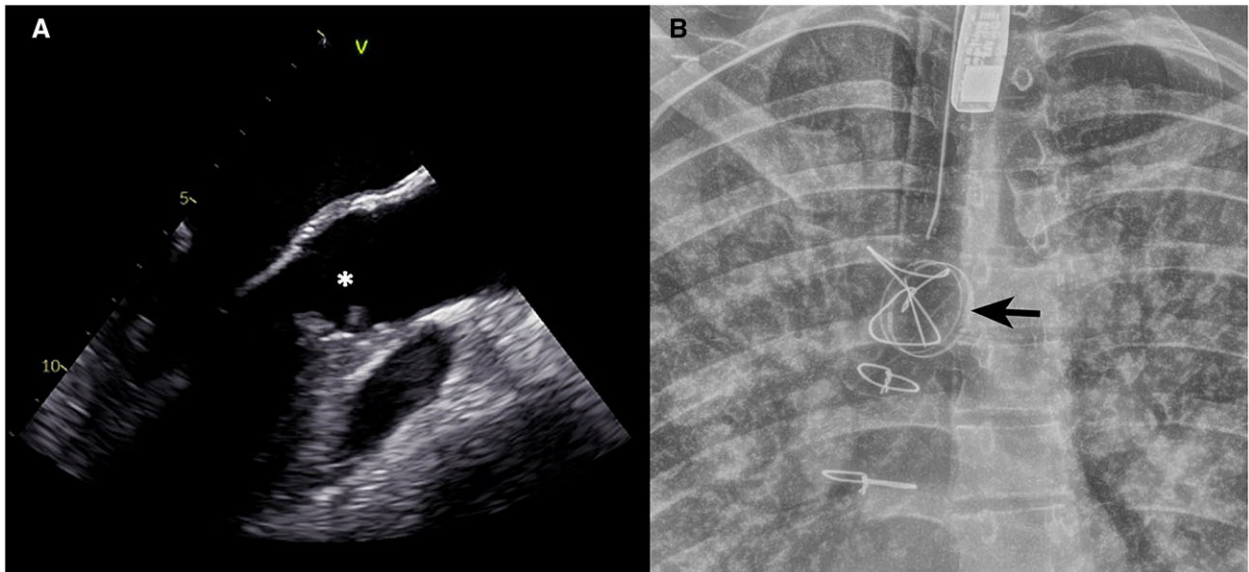


Figure 2 Transoesophageal echocardiography and chest radiograph. Imaging performed at admission to the local hospital. (A) Transoesophageal echocardiogram showing an empty aortic annulus (*). (B) Chest radiograph showing the mechanical prosthetic valve in the proximal aortic arch (arrow).



Video 1 Transoesophageal echocardiography. Transoesophageal echocardiogram showing the empty aortic annulus.



Video 2 Transoesophageal echocardiography. Colour-coded transoesophageal echocardiogram showing the empty aortic annulus.

haemorrhage. Weaning from ECMO was postponed due to significant cardiac dysfunction, with hypokinesia of the right ventricle and in the septal, anterior, and inferior left ventricular wall. Post-operative ejection fraction (EF) was 25–30%. Extracorporeal membrane oxygenation was successfully weaned on a post-operative Day 2. The patient's blood cultures were negative, but tissue cultures and cultures of the explanted valve grew *Streptococcus mitis* and *Cutibacterium acnes*, so treatment for infective endocarditis was continued. Both microbes were penicillin-sensitive (minimum inhibitory concentration 0.25 and 0.016, respectively). The patient was successfully

extubated on post-operative Day 9 and monitored in the intensive care unit until Day 16. His hospital course was notable for heart failure, paroxysmal atrial fibrillation, pericardial, and pleural effusions, as well as ascites. He required multiple cardioversions and pleural drainages.

After extubation, the patient complained of diplopia and partial right-sided vision loss. Initially, he had some weakness and abnormal movement of the upper extremities. Magnetic resonance imaging (MRI) of the brain revealed several small ischaemic lesions in bilateral

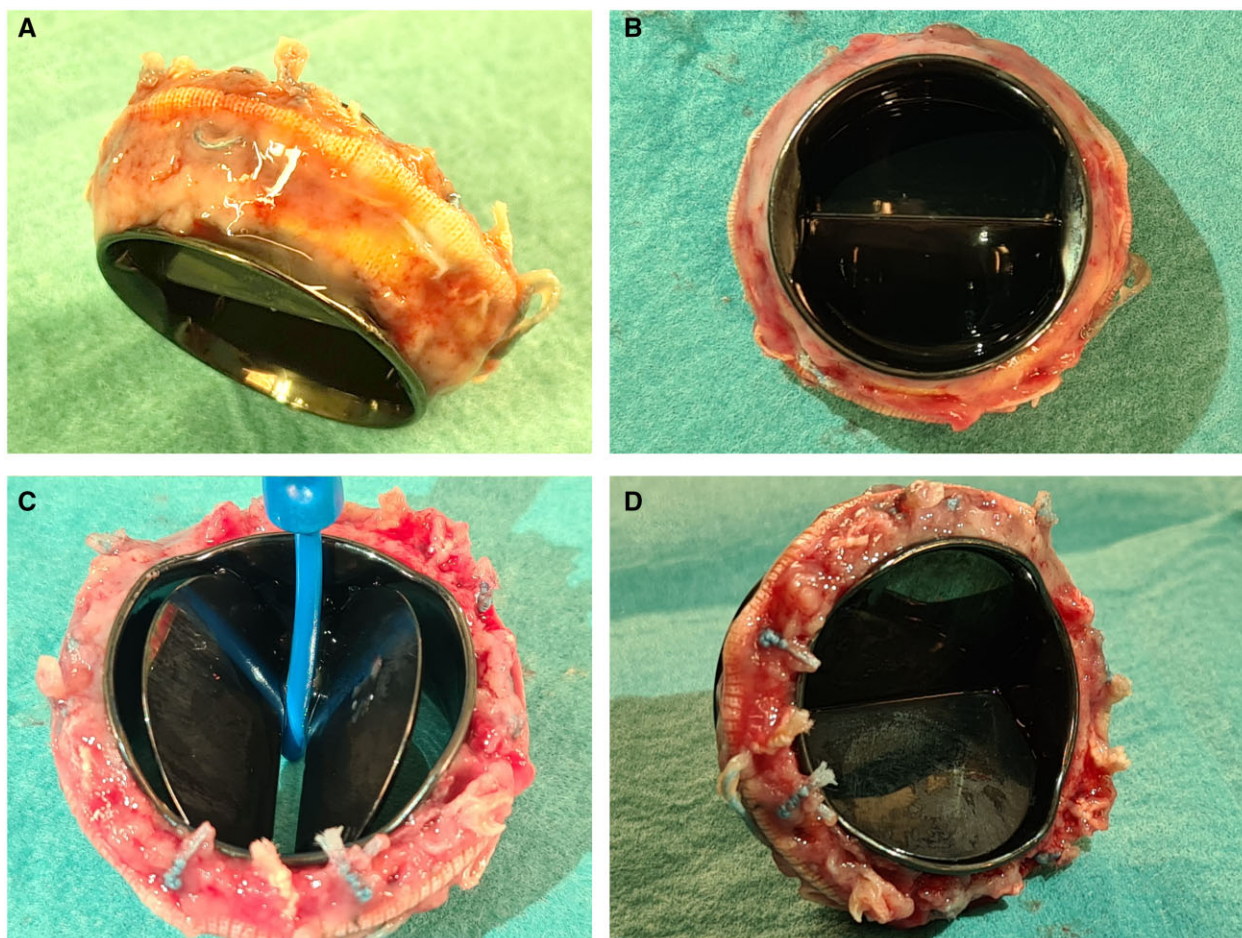


Figure 3 The embolized prosthetic aortic valve. Post-operative images (A–D) of the embolized valve after removal. All sutures were in place, and the valvular function was normal.

cerebral and cerebellar hemispheres, and one moderately ischaemic area in the left hemisphere (Figure 4). He was treated with 2 weeks of gentamicin and 6 weeks of penicillin. The patient was moved to the cardiac step-down ward on hospital Day 16. His condition improved rapidly thereafter, and he was discharged on hospital Day 43 without residual musculoskeletal deficits, minor right-sided vision loss, and improved left ventricular function with residual anteroseptal hypokinesia and an EF of 40%. He received regular physical therapy on the ward and attended a cardiac rehabilitation program after discharge.

Discussion

We present a very rare case of a young male with total embolization of a well-functioning mechanical aortic valve to the aortic arch 11.5 years after aortic valve replacement. He underwent emergent cardiac surgery and survived with minimal sequelae. At 3 months follow-up, he resumed his work as an engineer, with persistent mild left ventricular dysfunction and right-sided vision loss.

Several findings of this case presentation are important to physicians treating patients with prosthetic heart valves. Complete embolization of a surgical valvular prosthesis has only been described in a handful of cases previously, and it is an extremely rare and dangerous condition.^{1–4} In our case, the most likely reason was infective endocarditis. Furthermore, the patient was asymptomatic until experiencing acute onset of symptoms during exercise. Surveillance echocardiography one month prior was interpreted as normal, but careful re-evaluation of the examination showed a minor rocking-motion abnormality of the mechanical valve indicating partial dehiscence (Video 3 and Supplementary material online, Video S1). The diagnosis was elusive due to the absence of a paravalvular leakage or clinical symptoms. Partial valvular dehiscence without paravalvular leakage is a rare finding.⁵

Secondly, the asymptomatic course of infective endocarditis is important. Infective endocarditis may present with non-specific symptoms and therefore can be difficult to diagnose.⁶ Asymptomatic infective endocarditis is a rare finding.⁷ This case illustrates some important clinical features. Upon admission to

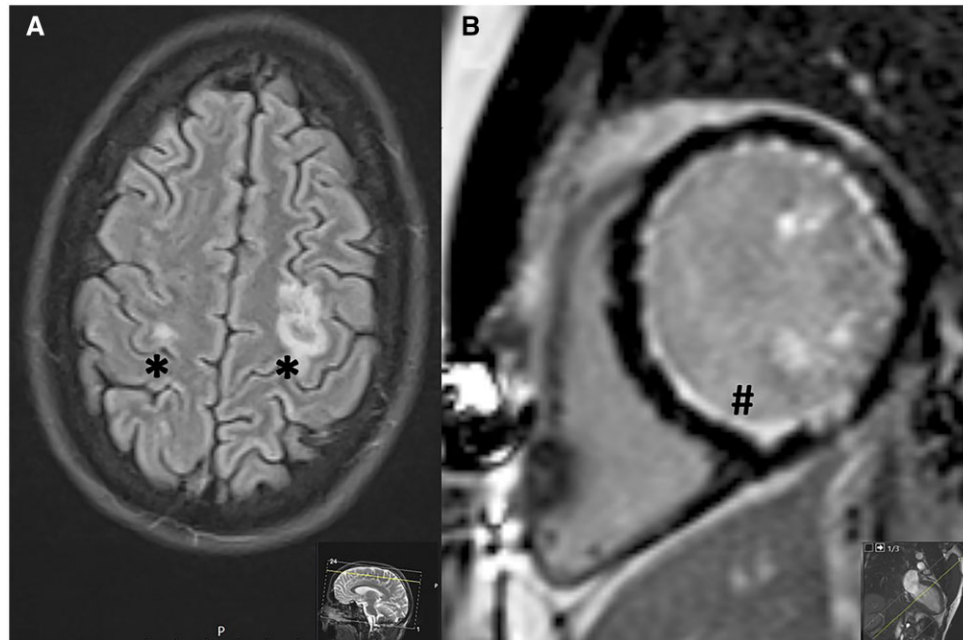
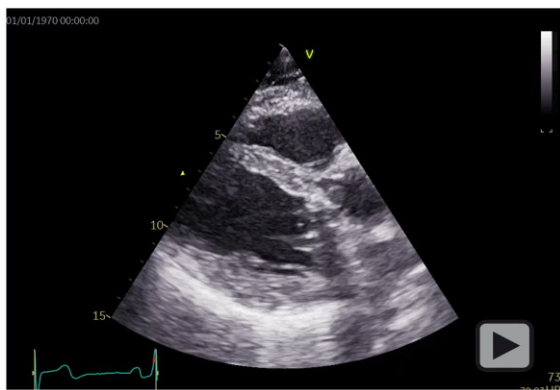


Figure 4 Magnetic resonance imaging of the brain and heart. Post-operative magnetic resonance images of the brain (A) and the heart (B). There were small ischaemic lesions in the cerebral hemispheres, and one moderate ischaemic area in the left hemisphere (*). In (B), the circular shaped (global) sub-endocardial late gadolinium enhancement is shown (#).



Video 3 Transthoracic echocardiography at the last follow-up visit prior to the event. Parasternal long-axis view showing mechanical aortic valve with a subtle rocking motion. The echocardiogram was recorded at the follow-up visit 1 month prior to the event.

the hospital, CRP was normal (2 mg/L) and white blood cell count was $14.5 \times 10^9/L$. This is consistent with previous studies which suggest that a low CRP does not exclude infective endocarditis.⁸ Cultures positive for *C. acnes* are likely related to the history of truncal furuncles. *Cutibacterium acnes* is a common microbe in acne and may have a predilection for prosthetic valves.⁹

However, the importance of this finding should not be overestimated, as it is a rare finding in endocarditis.⁹

Thirdly, the minimal sequelae of the patient are clinically interesting. The pre-hospital emergency services allowed for the expeditious transfer of the patient to the operating room with minimal time loss. Due to his critical condition, 2.5 h were needed to prepare and successfully transfer the patient to the operating room from alarm to arrival. Consequently, he suffered a short pulmonary failure upon admission to the local hospital and a circulatory collapse shortly after arriving to the operating room. It is unclear whether the embolized valve played a role in maintaining cerebral circulation. Due to visibility issues, it was not possible to identify the prosthetic valve by either transthoracic or transoesophageal echocardiography. Echocardiography at 3-month follow-up demonstrated mild left ventricular dysfunction with an EF of 45–50% and modest left ventricular dilation. To better evaluate the myocardium, we performed a cardiac MRI 5.5 months after the acute event, and this revealed global sub-endocardial late gadolinium enhancement indicating sub-endocardial fibrous replacement (Figure 4).

In summary, this case report presents the successful treatment of a young male with complete embolization of a mechanical aortic valve 11.5 years after surgery probably due to unrecognized infective endocarditis caused by low-virulent microbes. The case also highlights the ultimate benefit of a well-functioning pre-hospital to hospital chain and highlights important clinical challenges of detecting and diagnosing infective endocarditis after valvular surgery.

Lead author biography



Havard Dalen is a consultant in cardiology at St. Olavs University hospital in Trondheim, Norway. His main clinical interest is valvular heart disease. He has an active research interest in cardiology in general, and echocardiography in special.

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 images and associated text has been obtained from the patient in line with COPE guidance.

Acknowledgements

We acknowledge the important contribution from the health care personnel involved in treatment of the patient in the pre-hospital setting, at Levanger Hospital, and at St. Olavs University hospital.

Conflict of interest: none declared.

Funding: This work was not funded beyond ordinary salaries to the authors from St. Olavs University hospital (Trondheim, Norway), Levanger Hospital (Levanger, Norway), and Norwegian University of Science and Technology (Trondheim, Norway).

References

1. Stoneburner JM, Tucker BL, Hurvitz RJ. Survival after embolization of a complete prosthetic aortic valve to the aortic arch. *Ann Thorac Surg* 1990;**49**: 140–142.
2. Horstkotte D, Körfer R. Prosthesis endocarditis with embolization of a Smeloff-Cutter aortic valve prosthesis. Diagnosis, surgical management, clinical and hemodynamic course to 3 years' postoperative follow-up. *Z Kardiol* 1983;**72**: 476–480.
3. Villani M, Leotta E, Cesarani F, Isolato G. Embolization of a complete prosthetic aortic valve to the abdominal aorta. Long-term survival after surgery. *Tex Heart Inst J* 1996;**23**:236–237.
4. Bedeir K, Robichaux RP Jr, Gleason TG. Surgical whole valve embolization 15 years after implantation. *Eur Heart J* 2021;ehab859. doi: 10.1093/eurheartj/ehab859.
5. Buggey J, Hoit BD. A case of prosthetic aortic valve dehiscence due to infective endocarditis without paravalvular regurgitation. *Echocardiography* 2019;**36**: 1409–1412.
6. Habib G, Lancellotti P, Antunes MJ, Bongiorni MG, Casalta J-P, Del Zotti F, et al.; ESC Scientific Document Group. 2015 ESC Guidelines for the management of infective endocarditis: the Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC). Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM). *Eur Heart J* 2015;**36**:3075–3128.
7. Shapira N, Merin O, Rosenmann E, Dzigivker I, Bitran D, Yinnon AM et al. Latent infective endocarditis: epidemiology and clinical characteristics of patients with unsuspected endocarditis detected after elective valve replacement. *Ann Thorac Surg* 2004;**78**:1623–1629.
8. Ribeyrolles S, Ternacle J, San S, Lepeule R, Moussafeur A, Faivre L et al. Infective endocarditis without biological inflammatory syndrome: description of a particular entity. *Arch Cardiovasc Dis* 2019;**112**:381–389.
9. van Valen R, de Lind van Wijngaarden RA, Verkaik NJ, Moxhles MM, Bogers AJ. Prosthetic valve endocarditis due to *Propionibacterium acnes*. *Interact Cardiovasc Thorac Surg* 2016;**23**:150–155.