

X marks the spot: catheter aspiration using the Inari FlowTrievers device to debulk defibrillator lead vegetations prior to transvenous lead extraction—a case report

James Clark ^{1*}, Abbas Zaidi¹, Peter O'Callaghan¹, Ulrich von Oppell², and Andrew SP Sharp³

¹Department of Cardiology, University Hospital Wales, Cardiff CF14 4XW, UK; ²Department Cardiothoracic Surgery, University Hospital Wales, Cardiff CF14 4XW, UK; and ³Department of Cardiology, University Hospital of Wales and Cardiff University, Cardiff CF14 4XW, UK

Received 10 February 2024; revised 24 June 2024; accepted 5 July 2024; online publish-ahead-of-print 11 July 2024

Background

When cardiac implantable electronic device infection occurs, standard therapy is usually total system extraction. Transvenous lead extraction is preferable to open heart surgical extraction, unless contraindicated because of the presence of very large vegetations on the intravenous leads according to the European Society of Cardiology guidelines. Extraction of transvenous leads with vegetations risks distal embolism resulting in obstruction and/or infection in the pulmonary arteries. Catheter aspiration of vegetations or thrombi has been performed prior to transvenous lead extraction using a partial veno-venous extracorporeal bypass circuit. We report the use of a single-access aspiration system using the Inari FlowTrievers 24 French system to debulk a defibrillator lead before percutaneous extraction.

Case summary

A 79-year-old male presented with fever 18 years after his first implantable cardioverter defibrillator implant and 9 years after his most recent pulse generator change. Two large vegetations were identified on his transvenous defibrillator lead on the atrial aspect, near the tricuspid annulus, which were aspirated using the Inari Medical 24Fr FlowTrievers aspiration catheter. We describe anatomical considerations during the approach and a technique to localize the vegetations based on a combination of fluoroscopy and transoesophageal echocardiogram guidance.

Discussion

This case demonstrates the safe and effective use of the Inari Medical 24Fr FlowTrievers aspiration catheter in debulking a defibrillator lead before transvenous lead extraction. This method uses a single venous puncture and is not dependent on extracorporeal bypass. Apart from reducing complexity, this technique may be advantageous in patients where anticoagulation needs to be minimised.

Keywords

Vegetation • Aspiration • CIED • Defibrillator • Endocarditis • Case report

ESC curriculum

2.2 Echocardiography • 4.11 Endocarditis • 5.10 Implantable cardioverter defibrillators • 5.9 Pacemakers

* Corresponding author. Tel: +44 7528760525, Email: james.clark2@wales.nhs.uk

Handling Editor: Fabian Barbieri

Peer-reviewers: Lorenzo Caratti di Lanzacco; Martin Manninger

Compliance Editor: Marta Peverelli

© The Author(s) 2024. 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 License (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted reuse, distribution, and reproduction in any medium, provided the original work is properly cited.

Learning points

- The Inari Medical 24Fr FlowTrievers system can feasibly be used to aspirate intracardiac vegetations or thrombi without the need for a bypass circuit or prolonged anticoagulation prior to transvenous lead extraction.
- When passing a guidewire from the right femoral vein into the pulmonary circulation, it can be used to interact with and identify the crossing point between the tricuspid annulus and the defibrillator lead, as well as provide a 'safety wire' to allow access to the pulmonary circulation for aspiration should a vegetation embolize during the attempt.

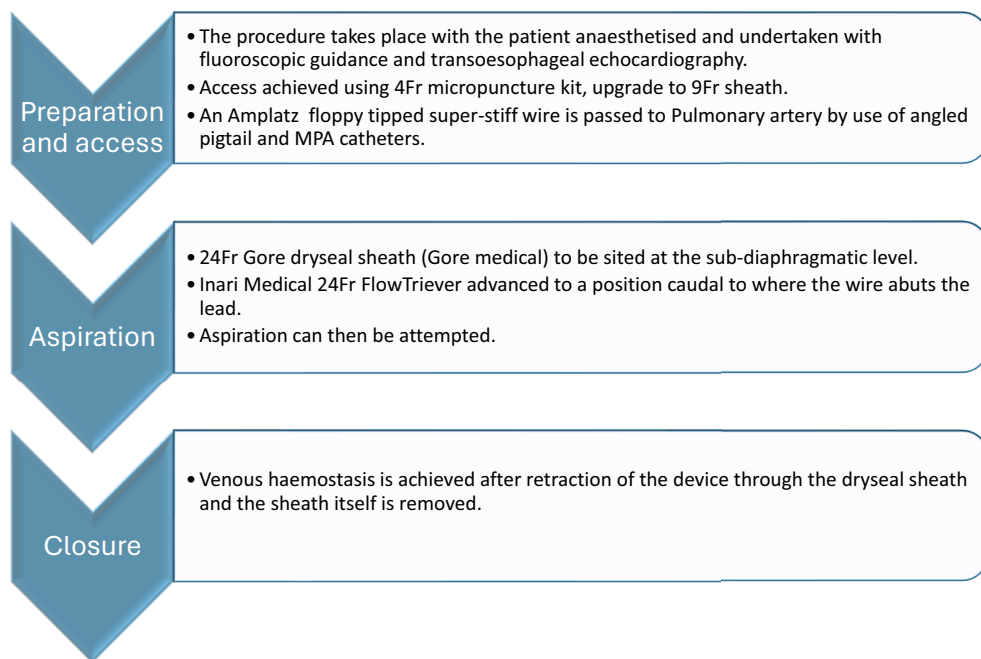
Introduction

Standard therapy for patients with cardiac implantable electronic device infection is usually complete system extraction. Open surgical extraction may be required for those with large vegetations, though this is sometimes not possible due to prohibitive peri-operative risks.¹⁻³ Percutaneous transvenous lead extraction (TLE) is favoured over open surgical extraction unless contraindicated, such as in the case of

need for dual access veno-venous bypass circuit. The Inari Medical 24Fr FlowTrievers aspiration system is indicated for the non-surgical removal of thrombi or emboli in vasculature and has been utilized to debulk tricuspid valve endocarditis in patients after veno-venous extracorporeal membrane oxygenation.⁷

Summary figure

Suggested technique to achieve successful first-time aspiration



very large vegetations, and differing techniques may be required to prevent the potentially fatal complication of distal embolization, which occurs more frequently in patients with larger vegetations.^{3,4} There is growing evidence (expert opinion) supporting prior percutaneous debulking of large vegetations.⁴ Even small masses (<2 cm) have been seen to embolize during TLE, where debulking with catheter aspiration has not been utilised pre-operatively.^{5,6} To our knowledge, this is the first use in the UK of the Inari Medical 24Fr FlowTrievers system to debulk lead vegetations through a single vascular access point, preventing the

Case report

We present a case describing catheter aspiration of two vegetations in a 79-year-old male being treated for endocarditis of his transvenous defibrillator lead.

The patient underwent implantation of a secondary prevention implantable cardioverter defibrillator in 2006 when he presented with collapse in consequence to a sustained monomorphic ventricular tachycardia. He had previously suffered an inferior myocardial

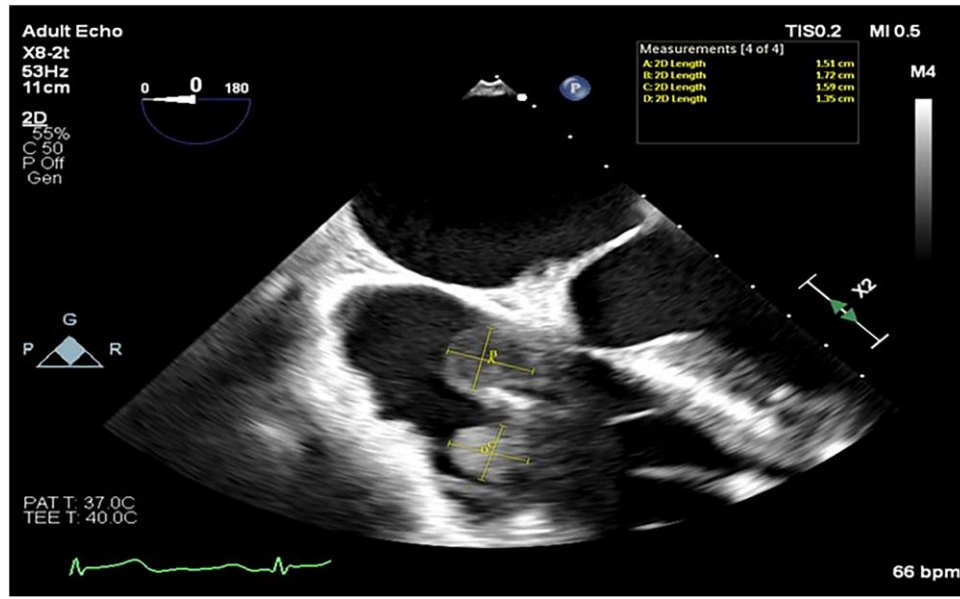


Figure 1 The dimensions of both mobile masses adhered to the defibrillator lead at the level of the tricuspid annulus. (A) 15 mm, (B) 17 mm, (C) 16 mm, and (D) 14 mm.

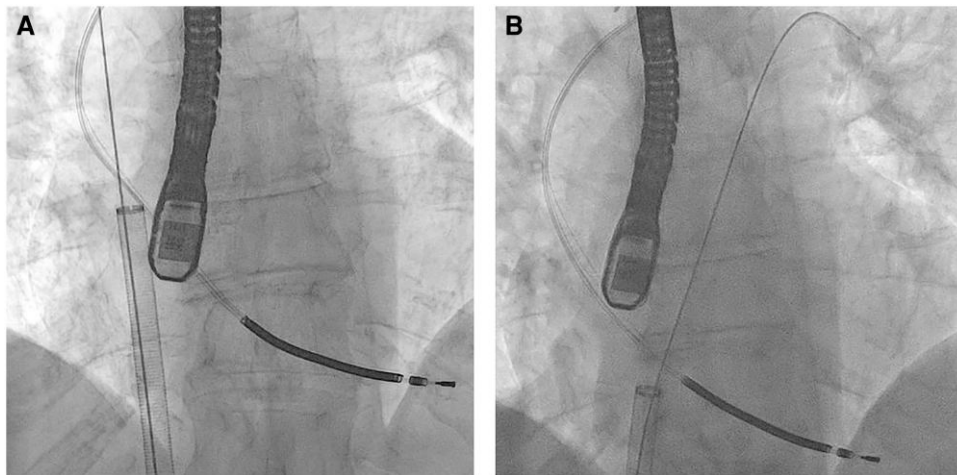


Figure 2 (A) Antero-posterior projection of the aspiration catheter in the first position (mid right atrium). (B) The aspiration catheter in the same view, at the point of successful aspiration where the wire marks the point where the lead crosses the tricuspid annulus.

infarction resulting in moderate left ventricular systolic dysfunction. He underwent a routine generator change in 2015. His routine medications included ramipril 5 mg, bisoprolol 1.25 mg, aspirin 75 mg, and atorvastatin 20 mg.

On the present admission, in 2024, the patient described a 48 h history of fever and complained of pain and swelling at the site of his prepectoral pocket. Fever was recorded at 38.9°C, and the implant site was inflamed and tender.

Blood cultures were collected over 7 days, and antimicrobials were initially targeted at likely infective endocarditis (IE) organisms and sequentially altered to cover an ever-broader spectrum after failure to achieve therapeutic response. Transoesophageal echocardiography demonstrated two spherical mobile masses, one 15 mm and the other 17 mm in diameter, adherent to the atrial side of the defibrillator lead just before it crossed the tricuspid valve. [Figure 1](#) demonstrates the relationship between these structures and the dimensions. He was given a



Figure 3 The material aspirated by the Inari Medical FlowTrievers system and recovered from the aspiration container.

presumptive diagnosis of IE when classified against the modified Duke criteria for IE despite initial negative blood culture results.

In the context of a worsening septic picture and after heart team discussion, the patient was offered an elective attempt at vegetation aspiration, with the aim of debulking the leads prior to percutaneous lead extraction.

The case was conducted under general anaesthesia using fluoroscopic imaging and transoesophageal echocardiography. The lead operator, a cardiac physician, used a 4Fr micro puncture kit (Cook Medical) to access the right common femoral vein under ultrasound guidance. A J-wire was passed to allow a 9Fr sheath to be placed. An Amplatz 7 cm floppy tipped super stiff wire (Boston Scientific) was advanced to the superior vena cava allowing a 24Fr Gore DrySeal Sheath (Gore Medical) to be sited at the sub-diaphragmatic level. This then allowed the passage of the Inari Medical 24Fr FlowTrievers to low right atrium (RA).

The first attempt at aspiration was in the mid RA as seen in [Figure 2A](#). This position was chosen as orthogonal transoesophageal echocardiogram and fluoroscopic views implied that the aspiration port was directed towards the vegetation. As per the Inari FlowTrievers aspiration method, 60 mL of blood was aspirated. Analysis of the retrieved sample yielded no macroscopic thrombi or vegetations. The operators elected not to risk returning potentially infected microscopic material despite a blood filtering and return system being available for the Inari system.

It was clear that the Inari device was in the wrong plane; therefore, an angled pigtail was passed to the left pulmonary artery and exchanged for a multipurpose angiographic catheter, allowing passage of a 1 cm floppy tipped Amplatz super stiff wire (Boston Scientific) to the left pulmonary artery. This wire crossed and abutted the defibrillator lead at the tricuspid annulus where the vegetations had been identified. [Figure 2B](#) demonstrates the fluoroscopic view of this. The Inari Medical FlowTrievers device was advanced over the wire to 1

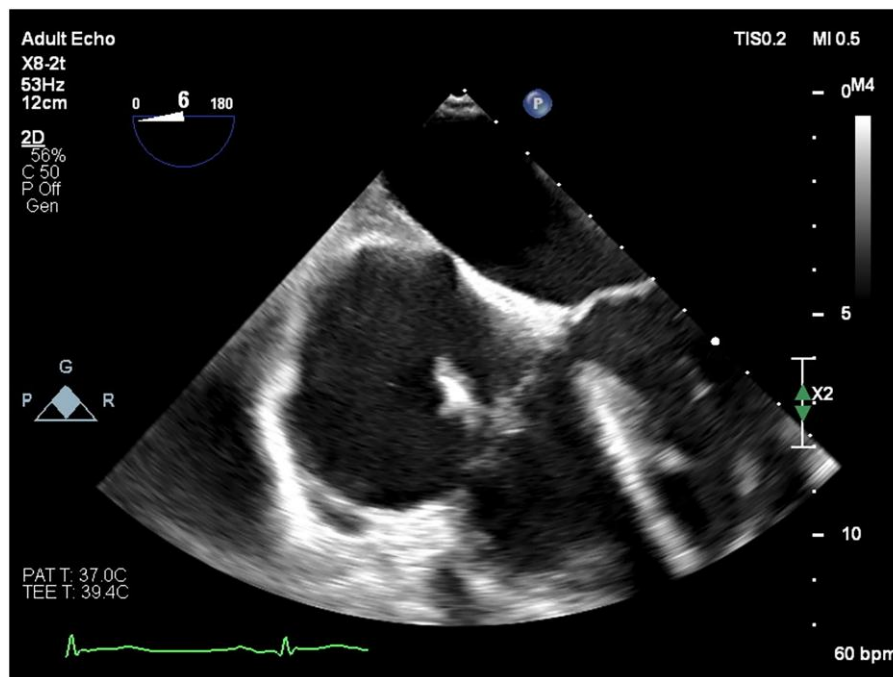


Figure 4 The defibrillator lead has been successfully debulked by removing the two mobile masses.

cm caudal to this crossing point. Aspiration at this point instantly removed both prominent vegetations from the defibrillator lead. Transoesophageal imaging could no longer detect any intracardiac masses.

Multiple masses were then recovered from the aspiration syringe as seen in [Figure 3](#). [Figure 4](#) demonstrates the defibrillator lead with both mobile masses no longer in evidence.

After retraction and removal of the Inari Medical 24Fr FlowTrievee, the venous access site was closed with a single Perclose ProGlide (Abbott) suture and manual pressure. The patient went on to have an uncomplicated percutaneous TLE using a rotational cutting device as well as excising the infected device pocket by our centre's cardiothoracic team. Staphylococci epidermis was later identified by 16 s ribosomal ribonucleic acid sequencing of the vegetation material and the excised pocket material.

The patient has undergone reimplantation of a new device on the contralateral side 3 months after TLE.

Discussion

This case supports the use of Inari Medical® 24Fr FlowTrievee system in the debulking of transvenous defibrillator leads as a preparatory step towards percutaneous TLE in a population who may otherwise require open heart surgery. Previous methods of catheter aspiration have been described, but these have historically required the need for double puncture and partial extracorporeal bypass circuits, a complexity not required by the currently described technique.

In patients with cardiac implantable electronic device endocarditis, concomitant infection of the tricuspid valve and pacing lead occurred in 63% of cases in one epidemiological report.⁸

The siting of a 1 cm floppy Amplatz super stiff wire in the left pulmonary artery was the key to the efficient and safe aspiration of vegetations, ensuring that the aspiration port was directed towards the pacing lead at the point it crossed the tricuspid valve and ensuring rapid access to the pulmonary circulation should accidental distal embolization of material occurs.

Prior use of the AngioVac system (AngioDynamics, Latham, NY) using partial extracorporeal bypass for this purpose has been well described.^{9–11} An analysis of 232 patients found this to be both safe and efficacious.¹² The Indigo Thrombectomy system (Penumbra, Inc., Alameda, CA) has also been utilized successfully.^{13,14}

The use of the Inari Medical® 24Fr FlowTrievee system holds the potential advantage in selected patients of a more efficient, single-access procedure, with reduced volumes of systemic anticoagulation required. In our procedure, a single dose of heparin at 70 units per kilogramme body weight was administered. The 24 French aspect of the device allows for aspiration of larger intracardiac masses than the Penumbra Indigo system that is currently available in Europe, though the 16Fr Lightning Flash computer-assisted continuous aspiration system, currently available in the USA, may also prove suitable when available internationally.^{12–14}

Current European Society of Cardiology guidelines stipulate that after signs, symptoms, and microbiological evidence of infection are absent for 72 h, or 2 weeks if vegetations or fibrous remnants, reimplantation can proceed at a site distant to the previous generator.⁴

The Inari Medical 24Fr FlowTrievee device is a single puncture transvenous aspiration system which can be used to debulk pacing leads before percutaneous TLE without extracorporeal bypass circuits. The use of a floppy tipped stiff wire advanced into the pulmonary vasculature allows easy fluoroscopic identification of where the pacing lead crosses the tricuspid annulus and ensures the aspiration device can be advanced should embolization occurs.

Lead author biography



James Clark is a cardiology specialist registrar working in South Wales. He is training in heart rhythm.

Consent: The authors confirm that informed written consent was obtained for the submission and publication of this case report, including the accompanying text and figures as per COPE guidelines.

Conflict of interest: None declared.

Funding: None declared.

Data availability

The data underlying this article are available in the article and in its online supplementary material.

References

- Greenspon AJ, Le KY, Prutkin JM, Sohail MR, Vikram HR, Baddour LM, et al. Influence of vegetation size on the clinical presentation and outcome of lead-associated endocarditis: results from the MEDIC registry. *JACC Cardiovasc Imaging* 2014;**7**:541–549.
- Kusumoto FM, Schoenfeld MH, Wilkoff BL, Berul CI, Birgersdotter-Green UM, Carrillo R, et al. 2017 HRS expert consensus statement on cardiovascular implantable electronic device lead management and extraction. *Heart Rhythm* 2017;**14**:e503–e551.
- Mohanane D, Mohadjer A, Pettersson G, Navia J, Gordon S, Shrestha N, et al. Association of vegetation size with embolic risk in patients with infective endocarditis. *JAMA Intern Med* 2018;**178**:502–510.
- Delgado V, Ajmone Marsan N, De Waha S, Bonaros N, Brida M, Burri H, et al. 2023 ESC guidelines for the management of endocarditis. *Eur Heart J* 2023;**44**:3948–4042.
- Klug D, Lacroix D, Savoye C, Goullard L, Grandmougin D, Hennequin JL, et al. Systemic infection related to endocarditis on pacemaker leads: clinical presentation and management. *Circulation* 1997;**95**:2098–2107.
- Grammes JA, Schulze CM, Al-Bataineh M, Yesenosky GA, Saari CS, Vrabel MJ, et al. Percutaneous pacemaker and implantable cardioverter-defibrillator lead extraction in 100 patients with intracardiac vegetations defined by transoesophageal echocardiogram. *J Am Coll Cardiol* 2010;**55**:886–894.
- Morton K, Heindl B, Mcelwee SK, Litovsky S, Ahmed MI, Clarkson S. Percutaneous debulking of tricuspid valve endocarditis in severe COVID-19 pneumonia after prolonged venovenous extracorporeal membrane oxygenation with right-ventricular support: a case series. *Eur Heart J Case Rep* 2023;**7**:ytac409.
- Duval X, Selson-Suty C, Alla F, Salvador-Mazenq M, Bernard Y, Weber M, et al. Endocarditis in patients with a permanent pacemaker: a 1-year epidemiological survey on infective endocarditis due to valvular and/or pacemaker infection. *Clin Infect Dis* 2004;**39**:68–74.
- Patel N, Azemi T, Zaeem F, Underhill D, Gallagher R, Hagberg R, et al. Vacuum assisted vegetation extraction for the management of large lead vegetations. *J Card Surg* 2013;**28**:321–324.
- Issa ZF, Goswami NJ. Simultaneous lead extraction and vacuum-assisted vegetation removal. *HeartRhythm Case Rep* 2016;**2**:17–19.
- Starck CT, Schaerf RHM, Breitenstein A, Najibi S, Conrad J, Berendt J, et al. Transcatheter aspiration of large pacemaker and implantable cardioverter-defibrillator lead vegetations facilitating safe transvenous lead extraction. *Eurpace* 2020;**22**:133–138.
- Gill GS, Chakrala T, Kanmanthareddy A, Alla VM. Transcatheter vacuum aspiration of valvular and lead related infective endocarditis. *Cardiovasc Revasc Med* 2023;**57**:8–15.
- Misra SK, Madjarov J, Coons T, Mehta R. B-AB02-01 use of the Penumbra aspiration system for debulking of large vegetations prior to transvenous lead extraction. *Heart Rhythm* 2021;**18**:S2–S3.
- Krishnan B, Lässig J, Narashiman C, Simonson J, Shultz J. Use of vacuum-assisted aspiration for removal of vegetations during transvenous lead extraction. *HeartRhythm Case Rep* 2021;**7**:170–173.