ESC European Society of Cardiology

European Heart Journal - Case Reports (2022) **6**, 1–6
https://doi.org/10.1093/ehjcr/ytac251

CASE REPORT
Other

Transcatheter tricuspid valve-in-valve implantation for very early bioprosthetic tricuspid stenosis secondary to pacemaker lead entrapment: a case report

Muhammad Hamza Saad Shaukat [1]*, Julia Stys[2], Adam Stys[1], and Tomasz Stys[1]

[1]Sanford Cardiovascular Institute, University of South Dakota, USDSOM, 1301 W 18th Street, Sioux Falls, SD 57105, Sioux Falls, SD, USA; and [2]Sanford School of Medicine, University of South Dakota, Sioux Falls, SD, USA

Received 4 February 2022; first decision 22 March 2022; accepted 22 June 2022; online publish-ahead-of-print 28 June 2022

Background Tricuspid stenosis (native and prosthetic) is rare. Redo-sternotomy for isolated tricuspid replacement is associated with a higher risk. The efficacy and durability of transcatheter valve implantation for severe tricuspid stenosis are unclear.

Case summary Successful tricuspid valve-in-valve implantation (Edwards 26 mm Ultra) was performed to exteriorize a retained, unextractable pacemaker lead causing very early surgical bioprosthetic valve dysfunction in a 66-year-old Caucasian woman. The original indication for surgical replacement was pacemaker lead-related severe tricuspid regurgitation. History of CABG and subsequent surgical replacement rendered the risk of a third sternotomy and open-heart surgery prohibitive.

Conclusion Successful reduction in the severity of bioprosthetic tricuspid stenosis and improvement of right heart failure with transcatheter valve-in-valve implantation was observed. Percutaneous tricuspid valve implantation could be considered an alternative to redo-sternotomy for severe bioprosthetic tricuspid stenosis.

Keywords Tricuspid valve • Bioprosthetic stenosis • Pacemaker • Percutaneous valve-in-valve • Case report

ESC Curriculum 6.7 Right heart dysfunction • 4.10 Prosthetic valves • 4.6 Tricuspid stenosis • 6.1 Symptoms and signs of heart failure

Learning points

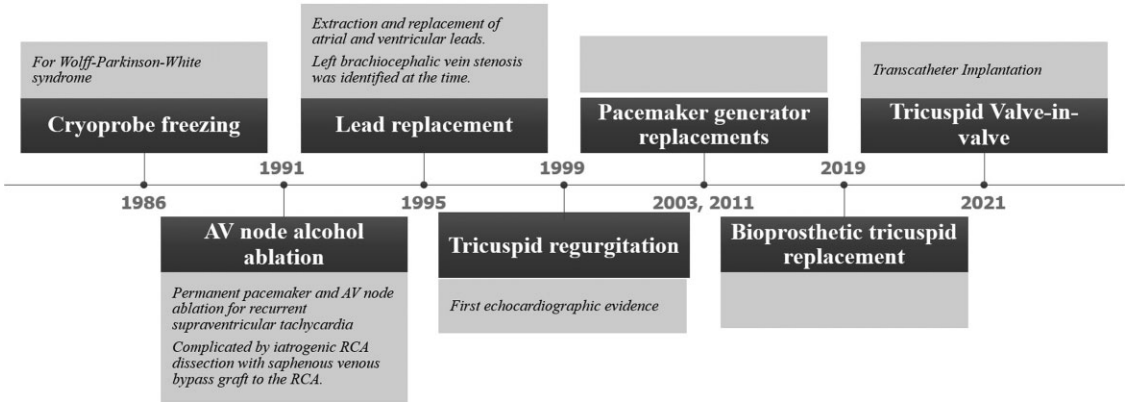
- Atrial pacing lead impingement restricting tricuspid leaflet motion is a rare cause of bioprosthetic tricuspid valve stenosis.
- Redo-sternotomy for isolated tricuspid valve replacement is associated with increased perioperative risk.
- Transcatheter tricuspid valve-in-valve implantation may be explored as an alternative in high-surgical risk patients—especially when, as in the described case, the cause of bioprosthetic valve stenosis could be treated with transcatheter valve implantation (exteriorizing and immobilizing the surgically unresectable atrial lead out of the bioprosthetic tricuspid annulus).

* Corresponding author. Tel: +1 518 368 9572, Fax: +1 605-312-2222, Email: hamzasaad1991@gmail.com, Twitter: @mhss91
Handling Editor: Antonios Karanasos
Peer-reviewers: Adam Hartley and Luigi Biasco
Compliance Editor: Gal Tsaban
Supplementary Material Editor: Nida Ahmed

Introduction

Pacemaker lead-related tricuspid regurgitation is being increasingly recognized.[1] Perioperative risk of surgical tricuspid valve replacement increases with redo-sternotomy.[2] There is limited data on transcatheter tricuspid valve implantation; we describe a case where it was utilized for severe bioprosthetic tricuspid stenosis to circumvent the need for a redo-sternotomy and surgical tricuspid valve replacement.

Timeline



Case summary

History of presentation

A 66-year-old Caucasian woman presented with recurrence of NYHA-4 dyspnoea and bilateral lower extremity oedema on high-dose diuretics (torsemide 40 mg twice daily and metolazone 2.5 mg weekly) 3 months after tricuspid valve surgery. She underwent isolated surgical bioprosthetic tricuspid valve replacement (27 mm Hancock II), extraction of endocardial right atrium (RA)/right ventricle (RV) pacing leads, and pacemaker explanation for long-standing, severe, symptomatic tricuspid regurgitation related to pacemaker leads. Complete surgical endocardial lead extraction was not possible due to fibrosis around the atrial lead and left brachiocephalic vein stenosis. Mid and distal portions of the RA lead were retained proximal to the tricuspid valve. A dual-chamber (RA/left ventricle) epicardial pacemaker was implanted. Post-operative echocardiography showed trivial prosthetic tricuspid regurgitation with a mean diastolic gradient of 5 mmHg.

Past medical history

In 1986, the patient underwent cryoprobe freezing of right and left free lateral accessory bypass pathways (Wolff-Parksinson-White syndrome). In 1991, following pacemaker implantation, AV node alcohol ablation for recurrent supraventricular tachycardia was complicated by iatrogenic right coronary artery (RCA) dissection

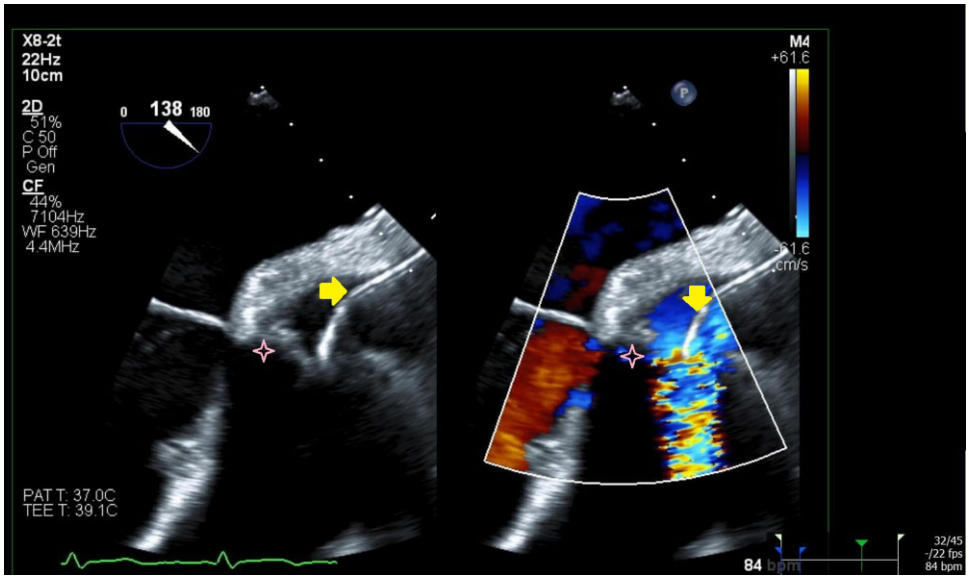


Figure 1 Transoesophageal Echocardiography, non-standard mid-oesophageal view: retained pacemaker lead (yellow arrow) is seen within the bioprosthetic tricuspid orifice. Posterior aspect of tricuspid annulus marked for reference (pink asterisk). Colour Doppler (right panel) suggestive of tricuspid stenosis.

requiring an emergent saphenous vein bypass graft (SVG) to the RCA. AV node ablation was completed surgically.

In 1995, an atrial lead fracture and intra-operative defect identified in the original ventricular lead prompted extraction and replacement of both leads. Left brachiocephalic vein stenosis was identified at the time.

In 1999, the first echocardiographic evidence of moderate–severe tricuspid regurgitation was recorded.

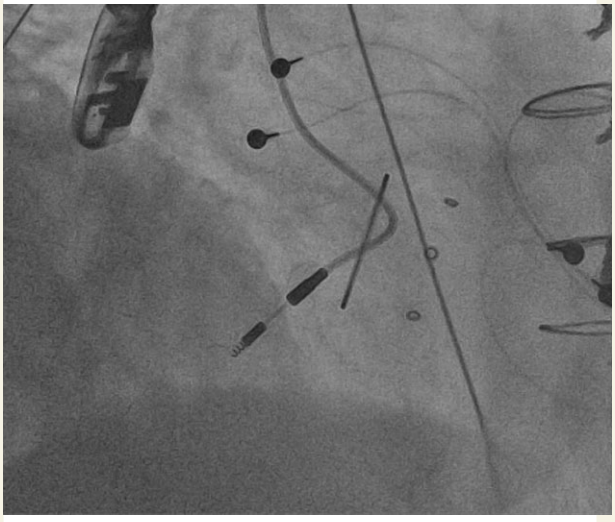


Figure 2 Retained pacemaker lead across bioprosthetic tricuspid annulus on fluoroscopy.

Subsequent generator replacements were performed routinely in 2003 and 2011.

Although echocardiographic evidence of moderate–severe tricuspid regurgitation dated back to 1999, right-sided heart failure remained diuretic-responsive until late 2019, when she was referred for redo-sternotomy and bioprosthetic tricuspid replacement. The chronological sequence of events is summarized in Timeline.

Additional comorbidities include gout and hypertension; there was no known history of atrial fibrillation/flutter or a hypercoagulable state.

Physical examination

The patient appeared fatigued. Lung auscultation was unremarkable. Regular rhythm with a faint (3/6) diastolic murmur on cardiac auscultation was observed and marked jugular venous distension and bilateral lower extremity oedema were noted.

Investigations

Transthoracic echocardiogram showed interval increase in bioprosthetic tricuspid valve gradient (8 mmHg, HR 67 bpm) and mild–moderate right ventricular enlargement.

Right heart catheterization confirmed an elevated RA/RV gradient (16 mmHg) consistent with severe tricuspid stenosis. Mean pulmonary arterial pressure was 30 mmHg (43/20 mmHg, Pulmonary Vascular Resistance 2.8WU) with elevated wedge pressure (20 mmHg). A coronary angiogram showed a patent SVG-RCA graft and native left coronary arteries.

Transoesophageal echocardiography was utilized to assess the aetiology and anatomy of the very early bioprosthetic tricuspid valve failure. The retained right atrial lead was trapped in the tricuspid

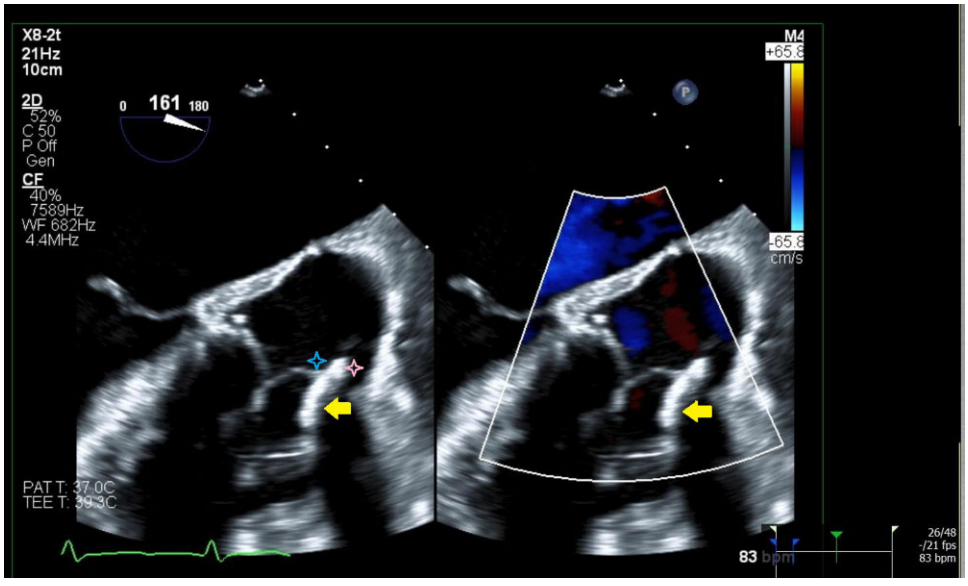


Figure 3 Transoesophageal echocardiography, non-standard, mid-oesophageal view after valve-in-valve implantation: retained pacemaker lead (yellow arrow) is exteriorized out of the tricuspid orifice and is seen between the implanted bioprosthetic tricuspid valve (blue asterisk) and native tricuspid annulus (pink asterisk).

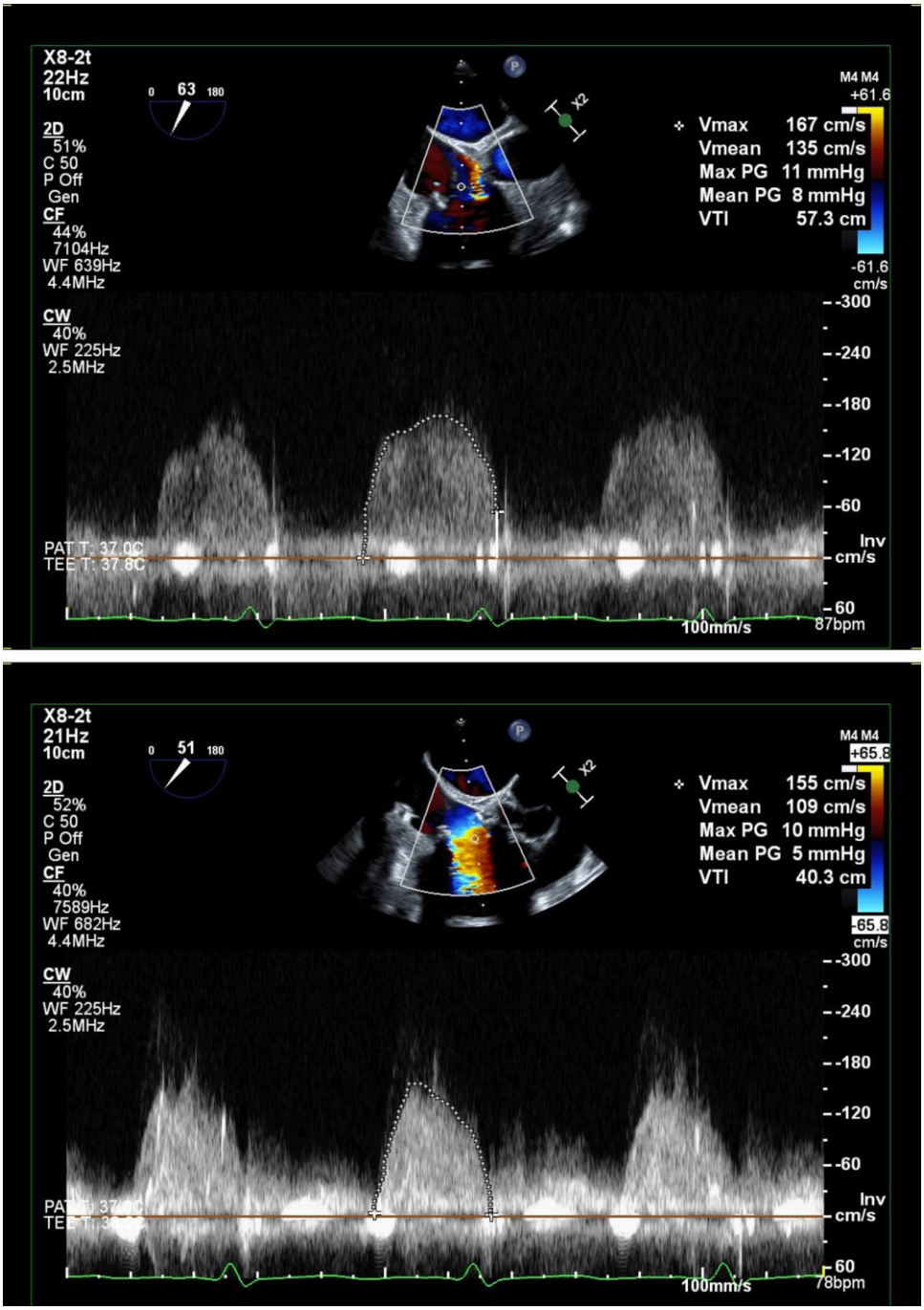


Figure 4 CW Doppler: improvement of tricuspid mean diastolic gradient after transcatheter valve-in-valve implantation. The mean diastolic gradient of 8 mmHg (upper panel) decreased to 5 mmHg (lower panel).

orifice, causing restricted leaflet motion (*Figure 1*, see Supplementary material online, *Videos 1, 2, and 4*).

Management

In view of NYHA-4 symptoms despite adherence to outpatient high-dose diuretics, the local cardiothoracic surgery and interventional cardiology teams determined a transcatheter approach to be beneficial in improving this relatively young patient's quality of life. Fluoroscopy confirmed the retained RA lead extending through the bioprosthetic tricuspid orifice (*Figure 2*). Due to known fibrosis around the atrial lead and the risk of underlying tissue damage from manipulation, no percutaneous attempt was made to displace the lead out of the tricuspid orifice. Edwards 26 mm Ultra valve-in-valve implantation via right femoral vein successfully

exteriorized the retained pacemaker lead from the tricuspid valve orifice (*Figure 3*, see Supplementary material online, *Videos 3 and 5*) with no residual tricuspid regurgitation. The mean tricuspid diastolic gradient improved from 8 to 5 mmHg (*Figure 4*).

Discussion

Bioprosthetic tricuspid stenosis is rare because tricuspid valve replacement is infrequently performed compared with left-sided valves. Clear guidelines for management are not available.[3]

Isolated surgical tricuspid valve replacement is uncommon partly due to high inpatient mortality (10.9%) and morbidity (20% of patients were discharged due to skilled nursing facilities) despite being performed in a largely non-elderly population with a mean age of 62 years.[4] Non-structural causes of bioprosthetic tricuspid valve dysfunction are similar to those for left-sided valves (pannus formation, thrombus, infection, and native valve attachment). Prosthetic tricuspid valve dysfunction, when present, becomes clinically evident after or toward the end of the first decade after replacement.[5–7] Additionally, re-operation rates for bioprosthetic tricuspid valve replacement have been reported to be as high as 37.3%.[5]

The described case is a series of unusual events spanning three decades, leading to severe tricuspid stenosis due to very early failure of the surgical bioprosthetic tricuspid valve. The already high perioperative risk of a redo-surgical replacement was rendered unequivocally prohibitive by the single-vessel CABG done 30 years ago for iatrogenic RCA dissection.

Evidence of transcatheter valve-in-valve implantation for bioprosthetic tricuspid stenosis is limited to case reports. Edwards SAPIEN valve-in-valve implantation has been utilized for degenerative bioprosthetic tricuspid stenosis in patients for whom the original indication for tricuspid valve replacement was rheumatic heart disease,[8,9] or infective endocarditis.[10,11] Similar to percutaneous balloon valvuloplasty for bioprosthetic tricuspid stenosis,[12] transcatheter valve-in-valve implantation was an inferior therapeutic alternative acceptable only because it avoided the high-surgical risk associated with redo-surgical tricuspid valve replacement.

During surgical tricuspid valve replacement in the described case, RA lead extraction was unsuccessful due to brachiocephalic vein stenosis and fibrosis around the leads. The retained lead was above and not within the tricuspid annulus at that time. Even if the risk of a redo-sternotomy was not prohibitive, the likelihood of successfully extracting the retained lead on redo-surgical replacement was low. This observation raises the question of whether, in this specific situation, a percutaneous valve-in-valve implantation that treats bioprosthetic tricuspid stenosis by 'exteriorizing' the retained pacemaker lead out of the tricuspid orifice is non-inferior to surgery. It must be noted that surgery remains the gold standard for native and bioprosthetic tricuspid stenosis. Treatment options for transcatheter valve-in-valve dysfunction, in this case, would include balloon valvuloplasty or high-risk surgery.

Follow-up

On a 6-week follow-up, the patient reported improvement in exertional tolerance (NYHA-2) and lower extremity oedema. However, she continues to require torsemide 40 mg daily and metolazone 2.5 mg weekly.

Lead author biography

Cardiology Fellow at University of South Dakota Sanford School of Medicine.

Supplementary material

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

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

Consent: Written consent was obtained from the patient in line with COPE guidelines for the submission and possible publication of this manuscript.

Conflict of interest: No industry relationships or competing interests to disclose.

Funding: None declared.

References

1. Al-Bawardy R, Krishnaswamy A, Bhargava M, Dunn J, Wazni O, Murat Tuzcu E, Stewart W, Kapadia SR. Tricuspid regurgitation in patients with pacemakers and implantable cardiac defibrillators: a comprehensive review. *Clin Cardiol* 2013;**36**:249–254. doi:10.1002/clc.22104
2. Jeganathan R, Armstrong S, Al-Alao B, David T. The risk and outcomes of reoperative tricuspid valve surgery. *Ann Thorac Surg* 2013;**95**:119–124. doi:10.1016/j.athoracsur.2012.08.058
3. Otto CM, Nishimura RA, Bonow RO, Carabello BA, Erwin JP 3rd, Gentile F, Krieger EV, Mack M, McLeod C, O'Gara PT, Rigolin VH, Sundt TM 3rd, Thompson A, Toly C. 2020 ACC/AHA guideline for the management of patients with valvular heart disease. *J Am Coll Cardiol* 2021;**77**:e25–e197. doi:10.1016/j.jacc.2020.11.018
4. Zack CJ, Fender EA, Chandrashekar P, Reddy YNV, Bennett CE, Stulak JM, Miller VM, Nishimura RA. National trends and outcomes in isolated tricuspid valve surgery. *J Am Coll Cardiol* 2017;**70**:2953–2960. doi:10.1016/j.jacc.2017.10.039
5. Nakano K, Ishibashi-Ueda H, Kobayashi J, Sasako Y, Yagihara T. Tricuspid valve replacement with bioprostheses: long-term results and causes of valve dysfunction. *Ann Thorac Surg* 2001;**71**:105–109. doi:10.1016/S0003-4975(00)02149-4
6. Nakano K, Eishi K, Kosakai Y, Isobe F, Sasako Y, Nagata S, Ueda H, Kito Y, Kawashima Y. Ten-year experience with the Carpentier-Edwards pericardial xenograft in the tricuspid position. *J Thorac Cardiovasc Surg* 1996;**111**:605–612. doi:10.1016/S0022-5223(96)70312-4
7. Hirata K, Tengan T, Wake M, Takahashi T, Ishimine T, Yasumoto H, Nakasu A, Mototake H. Bioprosthetic tricuspid valve stenosis: a case series. *Eur Heart J Case Rep* 2019;**3**:ytz110.
8. Trombara F, Bergonti M, Toscano O, Dalla Cia A, Assanelli EM, Polvani G, Bartorelli AL. Bloody tricuspid stenosis: case report of an uncommon cause of haemoptysis. *Eur Heart J Case Rep* 2021;**5**:ytaa537. doi:10.1093/ehjcr/ytaa537

9. Lilly SM, Rome J, Anwaruddin S, Shreenivas S, Desai N, Silvestry FE, Herrmann HC, Fassa A, Himbert D, Brochet E, Labbé JP, Depoix JP, Hvass U, Vahanian A, Holoshitz N, Kenny D, Hijazi ZM. How should I treat prosthetic tricuspid stenosis in an extreme surgical risk patient? *EuroIntervention* 2013;**9**:407–409. doi:10.4244/EIJV9I3A64
10. Parikh PB, Pyo R, Stergiopoulos K, Katz J, Fan R, Izrailtyan I, Bilfinger T. Transcatheter tricuspid valve-in-valve replacement via right internal jugular vein access in a 39-year-old woman. *J Invasive Cardiol* 2019;**31**:E304–E305.
11. Zoltowska DM, Maaliki N, Al-Turk B, Maldonado AMP, Sattiraju S. A valve-in-valve approach to manage severe bioprosthetic tricuspid valve stenosis. *J Geriatr Cardiol* 2021;**18**:400–402. doi: 10.11909/j.issn.1671-5411.2021.05.002
12. Rana G, Malhotra R, Sharma A, Kakouros N. Percutaneous valvuloplasty for bioprosthetic tricuspid valve stenosis. *Tex Heart Inst J* 2017;**44**:43–49. doi:10.14503/THIJ-15-5408