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A Case Report: Transcatheter Bicaval Valve Implantation in a CRT-D Patient With Severe Tricuspid Regurgitation and Transient Lead inconsistency

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Case Report

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Abstract

Significant tricuspid regurgitation (TR) correlates with advancing right-sided heart failure, systemic venous congestion, decreased functional ability, and negative outcomes. While surgery is still the primary treatment for certain patients, numerous elderly individuals with various comorbidities are viewed as high risk. Transcatheter bicaval valve implantation (CAVI) through the TricValve system provides an option for patients ineligible for surgery, though existing cardiac implantable electronic devices might hinder valve placement.

We present an 81-year-old male with heart failure with preserved ejection fraction, significant symptomatic TR, and an existing cardiac resynchronization therapy-defibrillator (CRT-D). He showed increased difficulty breathing, swelling in the limbs, and New York Heart Association class IV symptoms even with optimal medical treatment. Due to elevated surgical risk, he received CAVI using the TricValve system. While deploying the superior vena cava valve, minor transient movement of the left ventricular lead in the coronary sinus and a temporary rise in pacing threshold were noted. A prompt fluoroscopic evaluation and device check verified proper lead functionality and maintained biventricular pacing, with no need for lead repositioning or further intervention.

Post-procedure, systemic venous congestion showed improvement, NYHA class decreased from IV to II, the need for diuretics was lower, and no hospitalizations for heart failure took place during the six-month follow-up. This case demonstrates the viability of TricValve implantation in individuals with intricate CRT-D systems and highlights the importance of thorough imaging, ongoing device surveillance, and teamwork across various specialties.

Introduction

Tricuspid regurgitation (TR) is a prevalent valvular condition linked to considerable morbidity and mortality, especially in older individuals with cardiovascular comorbidities. Severe TR can lead to advancing right-sided heart failure, systemic venous congestion, decreased functional ability, repeated hospitalizations, and unfavorable clinical results. While surgical repair or replacement of the tricuspid valve is an established treatment, isolated tricuspid surgery poses significant operative risks, leading many patients to be deemed unsuitable due to factors like advanced age, comorbid conditions, previous cardiac surgeries, or right ventricular dysfunction. As a result, many symptomatic patients persist in undergoing medical treatment aimed primarily at alleviating symptoms instead of addressing the root hemodynamic issues [1, 2].

Transcatheter bicaval valve implantation (CAVI) utilizing the TricValve system has become a less invasive option for high-risk individuals with severe TR. This heterotopic method minimizes systolic venous reflux into the superior and inferior vena cava, leading to a reduction in systemic venous congestion and alleviating symptoms linked to right-sided heart failure. Initial research and registry findings have shown enhancements in functional capabilities, quality of life, and outcomes related to congestion following CAVI implantation [3, 4]. Nevertheless, its application in individuals with cardiac

implantable electronic devices (CIEDs), especially cardiac resynchronization therapy-defibrillator (CRT-D) systems, poses distinct challenges because of possible interactions between transvenous leads and the sites for caval valve deployment. Thorough imaging evaluation, real-time device supervision during procedures, and teamwork between structural heart and electrophysiology groups are crucial to reduce complications in these intricate situations [5].

Although the results of CAVI in patients with severe TR deemed unfit for surgery are promising, experience in patients with intricate cardiac implantable electronic devices (CIEDs), especially CRT-D systems, is still scarce [4, 5]. Having several transvenous leads might elevate the likelihood of device-valve interaction, possibly impacting lead performance when the valve is deployed. We report on an elderly patient with significant symptomatic TR and an existing CRT-D system who had a successful TricValve implantation, with transient left ventricular lead movement and a temporary increase in pacing threshold during deployment of the superior vena cava valve. This case highlights the significance of meticulous anatomical planning, ongoing device oversight, and teamwork across disciplines to enhance safety for patients receiving CAVI with pre-existing cardiac devices.

Case Presentation

An 81-year-old man with a background of heart failure with preserved ejection fraction (HFpEF), hypertension, coronary artery disease, and a previously placed cardiac resynchronization therapy-defibrillator (CRT-D) was hospitalized due to worsening dyspnea, peripheral edema, and New York Heart Association (NYHA) class IV symptoms despite receiving optimal medical treatment. The baseline clinical characteristics, relevant medical history, diagnostic findings, and planned intervention are summarized in Table 1.

Table 1
Baseline clinical characteristics and procedural details of the patient.

Parameter	Findings
Age/Sex	81-year-old male
Clinical presentation	Progressive dyspnea, peripheral edema, NYHA class IV symptoms
Medical history	HFpEF, hypertension, coronary artery disease, previous CRT-D implantation
Echocardiographic findings	Severe TR, right atrial and right ventricular enlargement, LVEF 50%
Device status	Stable CRT-D lead position before intervention
Surgical risk assessment	Considered unsuitable for surgical tricuspid valve intervention
Intervention	Transcatheter bicaval valve implantation using TricValve system
Access and device	Femoral venous access, 27-Fr delivery system
Procedural guidance	Fluoroscopy and transesophageal echocardiography

Transthoracic echocardiography showed significant tricuspid regurgitation (TR), enlargement of the right atrium and right ventricle, along with a preserved left ventricular ejection fraction (50%). Pre-procedural computed tomography (CT) validated appropriate caval anatomy for the procedure and stable placement of the CRT-D leads.

Owing to advanced age, various comorbidities, and elevated surgical risk, the patient was deemed inappropriate for surgical tricuspid valve intervention. After a thorough assessment by the multidisciplinary heart team, transcatheter bicaval valve implantation (CAVI) with the TricValve system was scheduled.

The operation was conducted under general anesthesia via femoral venous access utilizing a 27-Fr delivery system with fluoroscopic and transesophageal echocardiographic assistance. Self-expanding valves were effectively placed in the superior vena cava (SVC) and inferior vena cava (IVC). During the deployment of the SVC valve, minor movement of the coronary sinus left ventricular (LV) lead was noted fluoroscopically as shown in Fig. 1, along with a temporary rise in LV pacing threshold.

(A) Baseline fluoroscopic image demonstrating the position of the right atrial, right ventricular, and coronary sinus left ventricular leads.

(B) Deployment of the superior vena cava valve showing the relationship between the valve delivery system and the coronary sinus LV lead, with transient slight lead displacement.

Device interrogation, however, confirmed intact lead function and successful biventricular pacing, and no further intervention was necessary.

Imaging after the procedure verified proper valve placement and stable configuration of the CRT-D leads. Device interrogation showed consistent pacing parameters (RV threshold 0.5 V, LV threshold 1.2 V, and RA threshold 0.5 V at 0.4 ms) while sustaining biventricular pacing at 98% as shown in Fig. 2.

1. Baseline device parameters before implantation.
2. One-month follow-up demonstrating stable pacing parameters
3. Six-month follow-up confirming persistent electrical stability and preserved biventricular pacing.

The patient exhibited swift clinical progress, marked by decreased systemic venous congestion, disappearance of peripheral edema, and advancement from NYHA class IV to class II symptoms within a month. Central venous pressure dropped from 28 mmHg to 10 mmHg after implantation.

At six-month follow-up, the patient remained clinically stable without heart failure-related hospitalization. Follow-up imaging demonstrated sustained valve function and stable CRT-D lead position, while device interrogation confirmed persistent lead stability and preserved biventricular pacing.

The clinical course of the patient, including the initial presentation, diagnostic evaluation, intervention, and follow-up outcomes, is summarized in Table 2.

Table 2
Timeline of clinical events

Time Point	Clinical Finding	Intervention/outcome
Initial presentation	NYHA IV symptoms, severe TR, right-sided chamber enlargement	Heart team evaluation
Pre-procedure	CT confirmed suitable caval anatomy and stable CRT-D leads	TricValve planned
Procedure day	TricValve implantation; transient LV lead displacement during SVC valve deployment	Device interrogation and confirmed preserved function; no intervention required
Early follow-up	Reduced venous congestion and improved symptoms	Stable CRT-D parameters
1 Month	NYHA improvement to II	Reduced diuretic requirement
6 Months	Remained NYHA Class II and No HF hospitalization	Stable valve function and CRT-D performance

Patient Perspective

The patient reported improvement in dyspnea, peripheral edema, and daily functional capacity following the procedure and expressed satisfaction with the treatment outcome.

Discussion

Transcatheter bicaval valve implantation (CAVI) has become a viable treatment option for patients experiencing severe tricuspid regurgitation (TR) who are not candidates for surgery or standard transcatheter tricuspid procedures. In contrast to orthotopic valve therapies, CAVI employs a heterotopic strategy to alleviate systemic venous congestion by blocking systolic reflux into the superior and inferior vena cava, thus enhancing symptoms of severe right-sided heart failure [6, 7]. Early experience with the TricValve system demonstrated procedural feasibility and symptomatic improvement in high-risk TR patients [8]. The TRICUS EURO study further confirmed these benefits, showing high procedural success with improvements in New York Heart Association (NYHA) functional class, quality of life, and congestion-related parameters [9]. In a similar vein, data from the TricBicaval Registry over one year demonstrated ongoing clinical enhancements and reasonable safety results, endorsing the use of CAVI in certain patients facing severe TR and high surgical risk [10]. Nonetheless, information concerning CAVI in individuals with intricate cardiac implantable electronic devices (CIEDs), especially CRT-D systems, is still scarce. This case emphasizes the technical difficulties and possible lead-related concerns linked to CAVI in this difficult population.

Patients with existing cardiac implantable electronic devices (CIEDs) pose distinct difficulties during transcatheter tricuspid procedures, since intracardiac leads can influence procedural strategies and viability. Transvenous pacing and defibrillator leads may lead to tricuspid regurgitation via mechanisms including leaflet impingement, adhesion, entanglement, and prolonged mechanical disruption of valve function [12, 13]. While lead extraction or repositioning might be options for lead-related TR, these approaches come with increased risks, especially for older patients with chronic device systems and various comorbidities [14]. During CAVI, the closeness of current leads to the caval landing zones raises worries about possible lead movement or alterations in electrical performance. In our situation, the deployment of the superior vena cava valve led to temporary displacement of the left ventricular lead in the coronary sinus, causing an increase in pacing threshold; nonetheless, subsequent device interrogation verified stable lead function and maintained biventricular pacing. This emphasizes the need for meticulous imaging before the procedure, ongoing monitoring during the procedure, and prompt evaluation of devices during CAVI in patients with CRT-D systems.

This case highlights various key factors to consider when conducting CAVI in patients who already have CRT-D systems. Thorough pre-procedural imaging is crucial to evaluate caval anatomy, valve landing zones, and the spatial relationship between transvenous leads and intended implantation locations. Multimodal imaging, especially computed tomography (CT), offers comprehensive anatomical evaluations to assist in structural heart interventions by analyzing venous structures, the placement of devices, and possible interactions between inserted devices and cardiovascular components [15, 16]. Throughout implantation, ongoing fluoroscopic observation combined with real-time device assessment allows for the prompt identification of lead displacement or alterations in pacing parameters, which is essential for patients reliant on pacing or cardiac resynchronization therapy [17]. A collaborative strategy that includes structural heart experts, cardiac imaging professionals, and electrophysiologists is essential for enhancing procedural safety and preserving device performance in patients with complex

CIEDs [18]. As the application of transcatheter therapies for severe TR grows, tailored planning that includes lead anatomy and electrophysiology knowledge will become more essential.

This study, being a single-case report, is unable to determine the incidence or lasting effects of lead–device interactions in CRT-D patients during CAVI. Nonetheless, it offers essential procedural insights and underscores the significance of anatomical evaluation, meticulous planning, and teamwork across various disciplines. More extensive studies are required to determine the best strategies and long-term results for this group.

Conclusion

Transcatheter bicaval valve implantation with the TricValve system may be a feasible option for high-risk patients with severe tricuspid regurgitation, including those with pre-existing CRT-D systems. This case highlights the importance of careful imaging assessment, procedural monitoring, and multidisciplinary collaboration to minimize lead-related complications and preserve device function during CAVI.

Abbreviations

CAVI
Caval valve implantation
CIED
Cardiac implantable electronic device
CRT
Cardiac resynchronization therapy
CRT-D
Cardiac resynchronization therapy-defibrillator
CT
Computed tomography
CVP
Central venous pressure
ECG
Electrocardiogram
HFpEF
Heart failure with preserved ejection fraction
IVC
Inferior vena cava
LV
Left ventricle/left ventricular
LVEF
Left ventricular ejection fraction
NYHA

New York Heart Association
RA
Right atrium/right atrial
RV
Right ventricle/right ventricular
SVC
Superior vena cava
TEE
Transesophageal echocardiography
TR
Tricuspid regurgitation.

Declarations

Ethics approval and consent to participate

Formal ethics committee approval was not required for this single-patient case report in accordance with the institutional policies of Northern Jiangsu People's Hospital Affiliated to Yangzhou University. The patient provided written informed consent for the use of his anonymized clinical information for academic and scientific purposes.

Consent for publication:

Written informed consent was obtained from the patient for publication of his personal and clinical details and all accompanying potentially identifiable clinical images included in this case report. A copy of the written consent is available for review by the Editor-in-Chief of the journal upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

Asad Ullah and Fatima Gul made the principal contributions to the work, including case conception, clinical data collection and interpretation, literature review, figure preparation, manuscript drafting, and revision. Adhikari Krishna, Zhou Jian Wei, Xuechun Shen, and Naresh Bohara assisted with data collection, analysis, and manuscript review. Xu Bing and He Sheng Hu supervised the patient's clinical management and critically revised the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

All data generated or analyzed during the preparation of this case report are included in the published article. Additional de-identified clinical information may be obtained from the corresponding author upon reasonable request, subject to institutional and patient-confidentiality requirements.

References

1. Dreyfus GD, Martin RP, Chan KJ, Dulguerov F, Alexandrescu C. Functional tricuspid regurgitation: a need to revise our understanding. J Am Coll Cardiol. 2015;65(21):2331–6. 10.1016/j.jacc.2015.04.011.
2. Prihadi EA, Delgado V, León MB, Enriquez-Sarano M, Topilsky Y, Bax JJ. Morphologic types of tricuspid regurgitation: characteristics and prognostic implications. JACC Cardiovasc Imaging. 2019;12(3):491–9. 10.1016/j.jcmg.2018.09.027.
3. Taramasso M, Alessandrini H, Latib A, et al. Outcomes after current transcatheter tricuspid valve intervention: mid-term results from the International TriValve Registry. JACC Cardiovasc Interv. 2019;12(2):155–65. 10.1016/j.jcin.2018.10.021.
4. Sorajja P, Whisenant B, Hamid N, et al. Transcatheter Repair for Patients with Tricuspid Regurgitation. N Engl J Med. 2023;388(20):1833–42. 10.1056/NEJMoa2301749.
5. Hahn RT, Makkar R, Zamorano JL, et al. Tricuspid valve disease: current understanding and f future directions in transcatheter therapy. J Am Coll Cardiol. 2021;77(18):2299–317. 10.1016/j.jacc.2021.03.012.
6. Frerker C, Schewel D, Schlüter M, Schmidt T, Wohlmuth P, Kreidel F, et al. First-in-human implantation of the TricValve system for treatment of severe tricuspid regurgitation: procedural feasibility and

early clinical experience. EuroIntervention. 2018;14(2):e190–7.

7. Estévez-Loureiro R, Sánchez-Recalde A, Amat-Santos IJ, et al. 6-Month Outcomes of the TricValve System in Patients With Tricuspid Regurgitation: The TRICUS EURO Study. JACC Cardiovasc Interv. 2022;15(13):1366–77. 10.1016/j.jcin.2022.04.014.
8. Sánchez-Recalde A, Domínguez-Rodríguez L, Rosseel L, et al. Bicaval TricValve Implantation in Patients With Severe Tricuspid Regurgitation: 1-Year Outcomes From the TricBicaval Registry. JACC Cardiovasc Interv. 2025;18(15):1913–24. 10.1016/j.jcin.2025.06.023.
9. Nickenig G, Weber M, Lurz P, et al. Transcatheter edge-to-edge repair for reduction of tricuspid regurgitation: the TRILUMINATE study. Lancet. 2019;394(10213):2002–11.
10. Sondergaard L, De Backer O, Franzen O, et al. First-in-human transcatheter caval valve implantation for severe tricuspid regurgitation. JACC Cardiovasc Interv; 2018.
11. Praz F, Muraru D, Kreidel F et al. Transcatheter treatment of tricuspid regurgitation: current evidence and future perspectives. Eur Heart J. 2021.
12. Addetia K, Harb SC, Hahn RT, Kapadia S, Lang RM. Cardiac implantable electronic device-related tricuspid regurgitation. JACC Cardiovasc Imaging. 2019;12(4):622–36.
13. Chang JD, Manning WJ, Ebrille E, Zimetbaum PJ. Tricuspid valve dysfunction following pacemaker and cardioverter-defibrillator implantation. J Am Coll Cardiol. 2019;73(18):2331–42.
14. Taramasso M, Pozzoli A, Guidotti A, et al. Transcatheter treatment of tricuspid regurgitation in patients with cardiac implantable electronic devices. JACC Cardiovasc Interv. 2021;14(15):1670–82.
15. Pulerwitz TC, Khalique OK, Leb J, et al. Optimizing cardiac CT for structural heart disease interventions: imaging protocols and procedural planning. J Cardiovasc Comput Tomogr. 2020;14(2):99–110.
16. Hahn RT, Nabauer M, Zamorano JL et al. Imaging assessment of the tricuspid valve and right heart in patients undergoing transcatheter interventions. Eur Heart J Cardiovasc Imaging. 2021.
17. Crossley GH, Poole JE, Rozner MA, et al. The Heart Rhythm Society expert consensus statement on cardiovascular implantable electronic device lead management and extraction. Heart Rhythm. 2017;14(12):e503–51.
18. Taramasso M, van der Bijl P, Alessandrini H, et al. Transcatheter tricuspid valve interventions: patient selection, procedural planning, and future perspectives. Eur Heart J. 2021;42(45):4470–81.

Figures

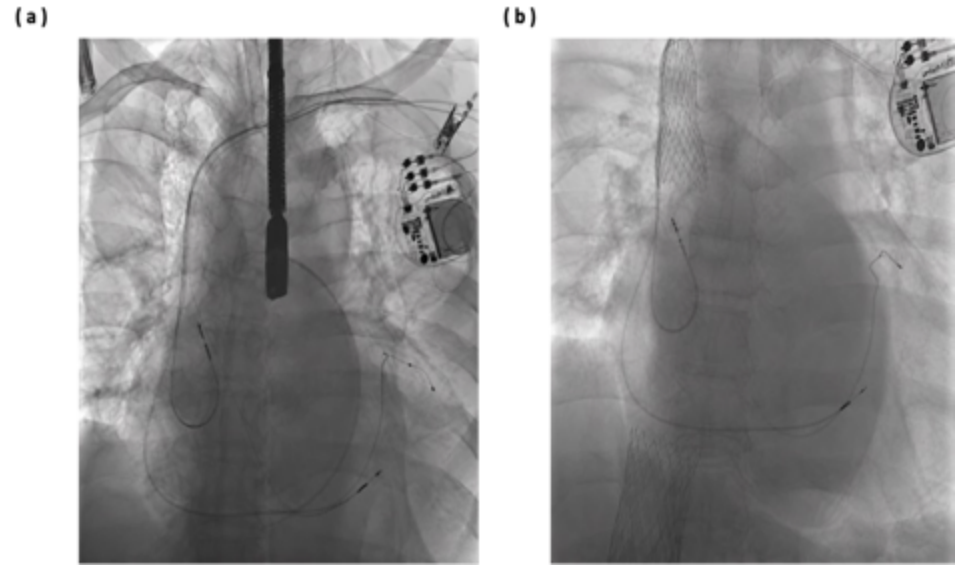


Figure 1

Fluoroscopic images during TricValve implantation in a patient with a pre-existing CRT-D system.

(A) Baseline fluoroscopic image demonstrating the position of the right atrial, right ventricular, and coronary sinus left ventricular leads.

(B) Deployment of the superior vena cava valve showing the relationship between the valve delivery system and the coronary sinus LV lead, with transient slight lead displacement.

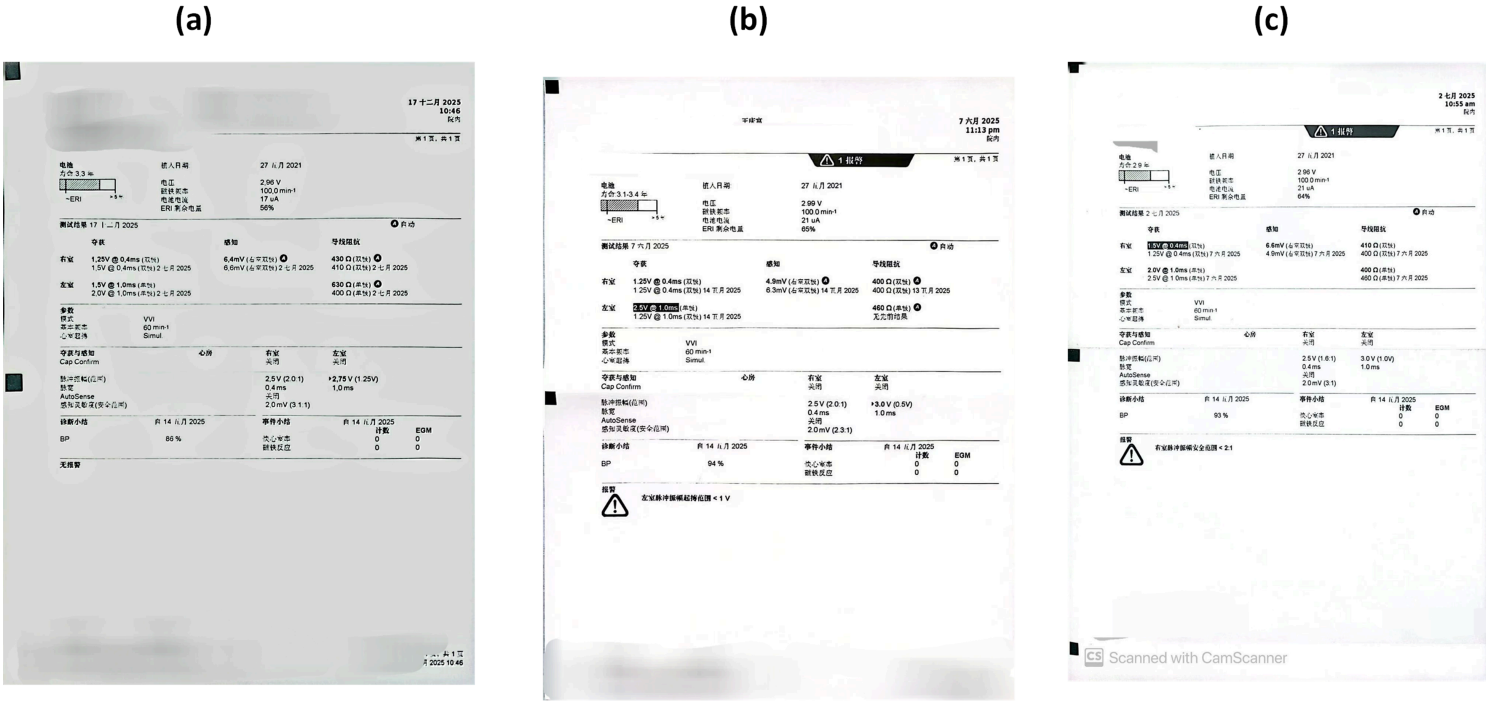


Figure 2

Serial CRT-D device interrogation following TricValve implantation.

(A) Baseline device parameters before implantation.

(B) One-month follow-up demonstrating stable pacing parameters

(C) Six-month follow-up confirming persistent electrical stability and preserved biventricular pacing.

Supplementary Files

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