

Left internal mammary artery perforation following permanent pacemaker implantation after transcatheter aortic valve replacement: A case series

*Corresponding Author: **Leonardo De Luca, MD**

Email: l.deluca@smatteo.pv.it

Lanzillo G, MD¹; Savastano S, MD¹; Baldi E, MD¹; Tua L, MD¹; Messina G, MD²; Quaretti P, MD³; Aiello ML, MD⁴; Ferlini M, MD¹; De Luca L, MD^{1*}

¹Division of Cardiology, IRCCS Policlinico San Matteo, Pavia, Italy.

²University of Pavia, Italy.

³Division of Interventional Radiology, IRCCS Policlinico San Matteo, Pavia, Italy.

⁴Division of Cardiac Surgery, IRCCS Policlinico San Matteo, Pavia, Italy.

Abstract

The rate of fatal complication after Permanent Pacemaker (PPM) implantation is about 0.1%. Left Internal Mammary Artery (LIMA) perforation following PPM implantation is a rare, anecdotal and potentially life-threatening complication. This complication must be suspected in case of occurrence of acute respiratory distress after PPM, a drop of hemoglobin, and pleural hematic effusion. The best treatment of this condition is still debated but, when technically feasible and in high surgical risk patients, a percutaneous approach can be a valid option. The aims of our cases are: 1) to be able to promptly recognize this potentially life-threatening complication, and 2) to evaluate the efficacy of different percutaneous techniques in the treatment of LIMA perforation. Furthermore, frailty is common in patients undergoing TAVR, making any decision about the optimal balance between thrombotic and bleeding risk more challenging compared to other patients.

Received: Jul 27, 2026

Accepted: Aug 13, 2026

Published Online: Aug 20, 2026

Copyright: © De Luca L (2026). This Article is distributed under the terms of Creative Commons Attribution 4.0 International License.

Cite this article: Lanzillo G, Savastano S, Baldi E, Tua L, De Luca L, et al. Left internal mammary artery perforation following permanent pacemaker implantation after transcatheter aortic valve replacement: A case series. J Clin Med Images Case Rep. 2026; 6(2): 1831.

Case 1

Case presentation

An 85-year-old male with severe Aortic Stenosis (AS) was admitted at our center for a staged Transcatheter Aortic Valve Replacement (TAVR).

Previous medical history included hypertension, permanent atrial fibrillation on anticoagulant therapy, Coronary Artery Bypass Graft (CABG) [Left Internal Mammary Artery (LIMA) to the Left Anterior Descending (LAD) artery and Saphenous Venous Grafts (SVGs) to the Right Coronary Artery (RCA) and Obtuse Marginal (OM) artery] and Percutaneous Transluminal Coronary Intervention (PCI).

Two months before TAVR he underwent a staged coronary angiography disclosing a tight In-Stent Restenosis (ISR) of RCA treated with two Drug-Eluting Stents (DES) implantation and he was discharged on Triple Antithrombotic Therapy (TAT) with aspirin, clopidogrel and warfarin, according to current guidelines of that period (2016) [1].

Procedure

Patient underwent transfemoral TAVR with a Mechanically-Expanding Valve (MEV) - Lotus 27 mm (Boston Scientific, Natick, MA, USA) - that was complicated by a complete Atrio-Ventricular Block (AVB) requiring pacing with the temporary pacemaker previously inserted via right internal jugular vein.

Post-procedural Transesophageal Echocardiography (TEE) confirmed the correct device positioning with normal anterograde gradients excluding Paravalvular Leaks (PVLs) or intravalvular regurgitation.

During the following monitoring in Intensive Care Unit (ICU) the complete AVB persisted with an escape junctional rhythm at 35 bpm; therefore, 48 hours after TAVR, a single-chamber Permanent Pacemaker (PPM) was implanted via left subclavian vein. The procedure was carried out without acute complications and the post-procedural chest x-ray was negative for pneumothorax; only a mild bilateral pleural effusion was found.

Complication

Four days after PPM implantation the patient experienced dyspnea and tachypnea and a concomitant mild reduction of hemoglobin values (from 8.9 to 7.7 g/dL). Lung ultrasounds (US) showed massive left pleural effusion, so an urgent CT scan was performed.

The CT scan confirmed the presence of left pleural effusion ascribable to massive hemothorax with no signs of active bleedings and subtotal collapse of ipsilateral lung. The hemorrhage was also observed in the left part of anterior mediastinum, where an active source of bleeding was observed near to the left subclavian vein (where PPM was positioned) (Figure 1).

Anticoagulation therapy was discontinued and patient was treated with blood transfusions and continuous Positive Airway Pressure (cPAP) therapy.

A thoracentesis was then performed with difficult drainage (due to the presence of clots) of 100 mL of hematic fluid.

CT scan images were reviewed after Maximum Intensity Projection (MIP) iterative reconstruction, identifying the LIMA as the source of the active bleeding at three centimeters from its origin and at 5 mm from left subclavian vein - site of PPM implantation (Figure 2). Although the LIMA served the LAD artery no signs of myocardial ischemia were seen both at ECG (paced) and at echocardiography and no significant rise of troponine was noted. Patient was transferred to the Cath lab, where a bypass angiography - via left radial artery - confirmed the CT scan findings. A covered stent (Papyrus 3 × 20 mm) was successfully implanted with good final result (Figure 3). At the end of the procedure, a left chest drainage was positioned with immediate draining of 1400 mL of hematic fluid.

Calcium heparin was introduced in therapy along with Dual Antiplatelet Therapy (DAPT).

Twelve days after the latter procedure patient's conditions worsened again, with a new drop in hemoglobin values and development of respiratory acidosis. Heparin and aspirin were withdrawn, a new blood transfusion was performed and patient underwent a surgical curettage of pleural cavity, with clinical benefit.

After 45 days of hospitalization, patient was transferred to a rehabilitation center in stable hemodynamic conditions.

Case 2

Case presentation

An 83-year-old female was admitted at our E&A department for angina.

Previous medical history included permanent atrial fibrillation on anticoagulant therapy with Vitamin K Antagonist (VKA), previous mitral valve commissurotomy, and known AS with already planned TAVR.

Procedure

Patient underwent transfemoral TAVR with a Self-Expanding Valve (SEV) – Evolut FX 29 mm (Medtronic Incorporation, Minneapolis, MN, USA).

Post-procedural echocardiography (TEE) confirmed the correct device positioning with normal anterograde gradients and a moderate PVL despite post-dilation during rapid pacing.

During her stay in ICU, 12 hours after the procedure, patient experienced complete AVB requiring pacing with a temporary pacemaker inserted via right femoral vein (Figure 4 – Panel 1).

The complete AVB persisted with an escape junctional rhythm at 40 bpm; therefore, 48 hours after TAVR, a single-chamber PPM was implanted via left subclavian vein.

Complication

During the latter procedure, patient experienced dyspnea and tachypnea with abrupt hypotension. Echocardiography did not show significant pericardial effusion, with a substantial stability of the other findings compared to post-procedural ones. Lung US showed massive left pleural effusion. Patient's condition rapidly deteriorated and endotracheal intubation was required, together with blood transfusions. A thoracentesis was then performed with drainage of 1000 mL of hematic fluid. Considering the hemorrhagic complication and reviewing the catheter course (Figure 4 – panel 2), LIMA angiography was performed via right femoral artery, showing a perforation due to catheter penetration in the artery (Figure 4 – panel 3 & 4). With an internal mammary guiding catheter, a Finecross™ MG Coronary Micro-Guide Catheter (Terumo, Somerset, NJ, USA) was advanced through a hi-torque Balance Middle Weight (BMW) guidewire (Abbott Vascular, Abbott Park, IL, USA), beyond the perforation site. A tip injection confirmed the gaining of the true lumen (Figure 4 – panel 5). Several coils (Stryker Target Helical Ultra detachable coil - Stryker Neurovascular, California, CA, USA) were then deployed to obtain complete hemostasis, with good result (Figure 4 – panel 6).

After 36 days of hospitalization, patient was transferred to a rehabilitation center in stable hemodynamic conditions.

Discussion

The rate of fatal complication after PPM implantation is about 0.1% [2]. LIMA perforation following PPM implantation is a rare, anecdotal [3] and potentially life-threatening complication. Since hemothorax can be a possible complication of venous puncture of both the subclavian vein and the axillary vein, when possible, the cephalic vein approach should be preferred, not only in patients at higher bleeding risk [6]. This complication must be suspected in case of occurrence of acute respiratory distress after PPM, a drop of hemoglobin, and pleural hematic effusion.

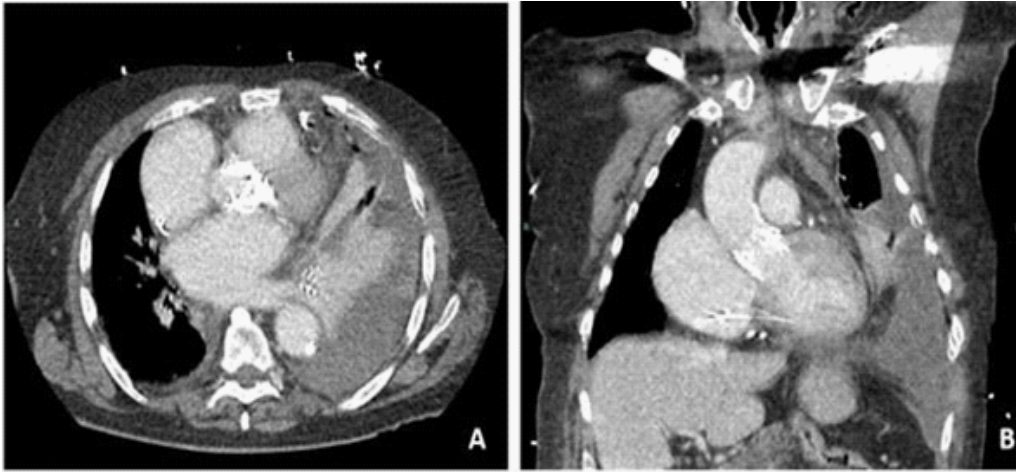


Figure 1: CT scan shown the presence of left pleural effusion and subtotal collapse of ipsilateral lung. The hemorrhage is also observed in the left part of anterior mediastinum (**Panel A:** axial plane; **Panel B:** coronal plane).

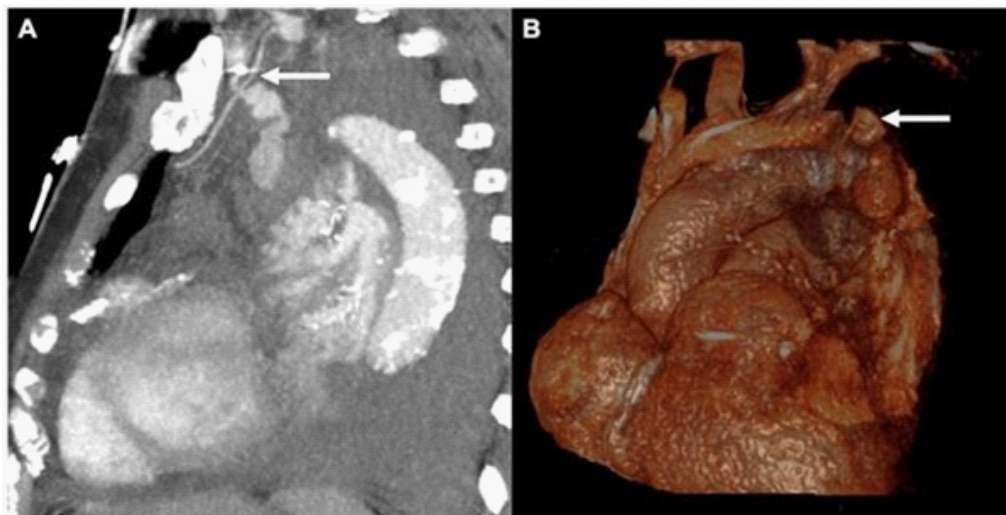


Figure 2: **Panel A:** Maximum Intensity Projection (MIP) reconstruction shown active bleeding source from left internal mammary artery (white arrow), near (5 mm) to left subclavian vein. **Panel B:** 3D reconstruction showing left internal mammary artery perforation (white arrow).

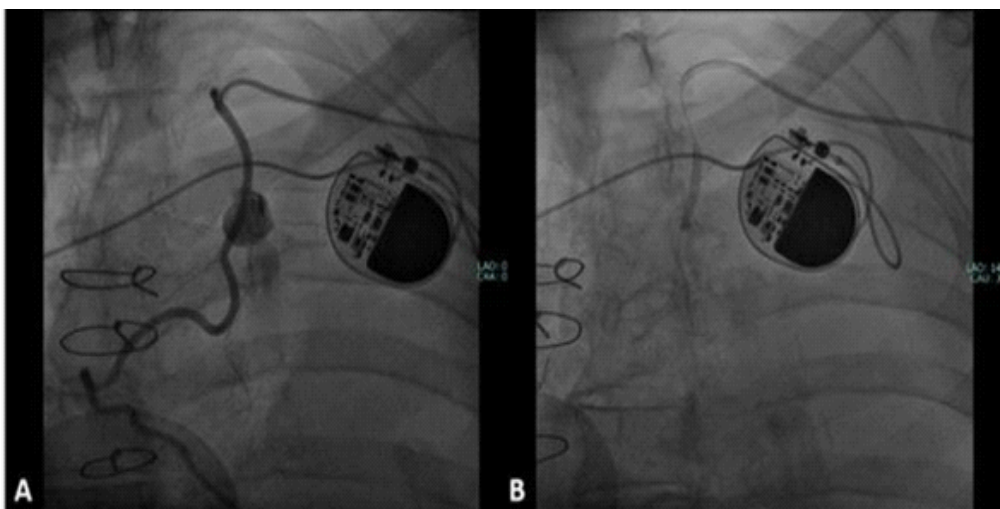


Figure 3: **Panel A:** Angiographic view of left internal mammary artery perforation; **Panel B:** subsequent covered stent implantation.



Figure 1: Panel 4.1 shows temporary pacemaker insertion via right femoral vein. After hemorrhagic complication, catheter course revision (Panel 4.2) induced Left Internal Mammary Artery (LIMA) angiography, showing a perforation due to catheter penetration in the artery (Panel 4.3 and 4.4). After tip injection to confirm the gaining of the true lumen (Panel 4.5), several coils were deployed to obtain complete hemostasis (Panel 4.6).

The best treatment of this condition is still debated but, when technically feasible and in high surgical risk patients, a percutaneous approach can be a valid option.

Our cases highlighted some of the main aspects to consider in the treatment of this complication:

1. In the first case described, we cannot exclude that TAT favored blood effusion after the incidental puncture of LIMA, even if warfarin was withdrawn before TAVR and enoxaparin was administered 12 hours before PPM implantation. Among the different antithrombotic regimens, TAT has been associated with the higher risk of fatal and non-fatal bleeding in patients with AF requiring PCI [5].

2. In the choice of best treatment, it is mandatory to evaluate if LIMA is grafted or not: in the second case, complete embolization of the vessel would have not had any ischemic consequence, being a non-grafted artery.

3. However, in the latter case, a covered stent would have not been a valid option in any case, because of the presence of PPM lead in arterial lumen: in case of embolization failure, a second option could have been left subclavian artery stenting, to completely exclude collateral perfusion.

Furthermore, frailty is common in patients undergoing TAVR, making any decision about the optimal balance between thrombotic and bleeding risk more challenging compared to other patients.

Conclusion

LIMA perforation following PPM implantation is a rare but potentially life-threatening complication. A prompt identification of this condition is mandatory to avoid a negative outcome. Different transcatheter techniques can be used to avoid invasive solutions, especially in older and high-surgical risk patients.

References

1. Gooley RP, Talman AH, Cameron JD, Lockwood SM, Meredith IT. Comparison of Self-Expanding and Mechanically Expanded Transcatheter Aortic Valve Prostheses. *JACC Cardiovasc Interv.* 2015.
2. Schulz N, Püschel K, Turk EE. Fatal complications of pacemaker and implantable cardioverter-defibrillator implantation: medical malpractice? *Interactive CardioVascular and Thoracic Surgery.* 2009.
3. Santagostino Baldi G, Trabattoni D, Teruzzi G, Mancini E, Montorsi P. Iatrogenic Left Internal Mammary Artery Perforation Treated With a Covered Stent Via Transradial Approach. *JACC: Case Reports.* 2019.
4. Kandzari DE, Birkemeyer R. PK Papyrus Covered Stent: Device Description and Early Experience for the Treatment of Coronary Artery Perforations. *Catheter Cardiovasc Interv.* 2019.
5. Lamberts M, Bjerring Olesen J, Ruwald M, Hansen C, Karasoy D, et al. Bleeding after initiation of multiple antithrombotic drugs, including triple therapy, in atrial fibrillation patients following myocardial infarction and coronary intervention: a nationwide cohort study. *Circulation.* 2012; 126: 1185-93.

6. Glikson M, Cosedis Nielsen J, Kronborg MB, Michowitz Y, Auricchio A, et al. ESC Scientific Document Group. 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy: Developed by the Task Force on cardiac pacing and cardiac resynchronization therapy of the European Society of Cardiology (ESC) With the special contribution of the European Heart Rhythm Association (EHRA). *European Heart Journal*. 2021; 42: 3427–3520.