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Case Report

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Iatrogenic axillary arteriovenous fistula complicating permanent pacemaker implantation: successful management with a balloon expandable covered stent-A case report

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Abstract

Background: Third-degree atrioventricular block is a Class I indication for permanent pacemaker implantation, and iatrogenic axillary arteriovenous fistula is an extremely rare vascular complication of this procedure with limited clinical reports to date. Case presentation: We present a case of a 57-year-old male with third-degree atrioventricular block who developed an axillary arteriovenous fistula during permanent pacemaker implantation via the left axillary vein approach. The complication was promptly diagnosed by emergency axillary arteriography and successfully occluded with an 8 mm × 37 mm balloon-expandable covered stent; the pre-created left pacemaker pocket was then closed in layers due to the ipsilateral vascular injury. Permanent pacemaker implantation was subsequently completed uneventfully via the contralateral right axillary vein approach with a new pacemaker pocket created on the right side. The patient had an uncomplicated postoperative course and normal pacemaker function at the 1-month follow-up, with no recurrence of symptoms or vascular abnormalities. Conclusions:We review the relevant literature, analyze the pathophysiology, diagnosis, and interventional management of this rare complication, and propose clinical recommendations for its prevention and optimal acute management—including rational pacemaker pocket management after successful vascular fistula occlusion. This case reinforces the efficacy and safety of balloon-expandable covered stents for iatrogenic axillary arteriovenous fistula and highlights the importance of multidisciplinary collaboration, prompt angiographic diagnosis, and deliberate pocket selection in such acute procedural complications.

Keywords

Permanent pacemaker; Iatrogenic axillary arteriovenous fistula; Covered stent; Pacemaker pocket

Case Presentation

A 57-year-old male presented to the emergency department with 2 days of recurrent syncope and one episode of sudden transient amaurosis and syncope (3–4 seconds, spontaneous resolution) without obvious precipitating factors 1 day prior to admission. Initial evaluation at a rural clinic noted a blood pressure of 90/60 mmHg and heart rate of 45 bpm. On the day of admission, the syncopal episodes recurred three times with identical characteristics, and a local hospital ECG demonstrated third-degree atrioventricular block, prompting emergent transfer to our institution for temporary pacemaker implantation via an emergency green channel.

The patient had a 30-year smoking history (40 cigarettes daily) and no family history of genetic disease. On admission physical examination (after temporary pacemaker placement): temperature 36.3℃, pulse 60 bpm, respiratory rate 19 breaths/min, blood pressure 136/83 mmHg; alert and oriented with normal mental status, clear bilateral lung fields; no precordial bulge, apical impulse at the 5th left intercostal space, 1 cm lateral to the midclavicular line (no thrill/pericardial friction rub), no cardiomegaly, normal heart sounds with regular rhythm, and no valvular murmurs; soft, non-tender abdomen with no hepatosplenomegaly or shifting dullness; no lower extremity edema; unremarkable neurological exam.

Laboratory and imaging findings: NT-PROBNP was 1354.0 pg/mL; ECG confirmed third-degree atrioventricular block with ST-segment changes (FIGURE 1); transthoracic echocardiography revealed a left ventricular ejection fraction (LVEF) of 58% with no structural cardiac abnormalities. Admission diagnoses were: (1) Cardiac arrhythmia, third-degree atrioventricular block; (2) Cardiogenic syncope.

Index Procedure

Permanent pacemaker implantation was planned with a left axillary vein approach:

1.The patient was placed supine; the surgical field was routinely disinfected and draped, with local anesthesia administered using 2% lidocaine.

2.Successful left axillary vein puncture was performed, and two guidewires were advanced to the inferior vena cava. A 4 cm oblique incision was made at the superolateral aspect of the left subclavian pectoralis major muscle to create a pacemaker pocket, with gentamicin gauze placed locally for prophylaxis.

3.A 7F peel-away sheath was advanced over the guidewire; the ventricular lead was positioned and screwed into the inferior right ventricular septum, and the atrial lead was placed in the right atrial appendage, with all sensing/pacing parameters within ideal limits.

4.After lead tension adjustment,upon withdrawal of the atrial lead peel-away sheath, brisk bright red arterial bleeding was noted from the puncture site. Local tissue dissection identified a deep bleeding point, and intermittent manual compression was applied for >30 minutes with no hemostasis. Cardiovascular surgery was emergently consulted for suspected axillary artery injury, and emergency angiographic evaluation was planned.

Emergency axillary arteriography was performed via the left brachial artery approach for definitive diagnosis and successful Covered Stent Occlusion of Fistula:

1.Routine disinfection, local anesthesia, and 7F arterial sheath insertion were completed; a contrast catheter was advanced to the left axillary artery over a hydrophilic guidewire.

2.Angiography demonstrated local contrast medium extravasation from the left axillary artery and concurrent opacification of the left axillary vein (FIGURE 2), confirming the diagnosis of iatrogenic left axillary arteriovenous fistula.

Following written informed consent from the patient’s family, balloon-expandable covered stent implantation was performed for urgent fistula occlusion:

1.The 7F arterial sheath was exchanged for a 7F long sheath; an 8 mm × 37 mm balloon-expandable covered stent was advanced over a stiff hydrophilic guidewire to the fistula site (FIGURE 3) and accurately positioned and deployed (FIGURE 4).

2.Post-deployment angiography confirmed complete resolution of contrast extravasation and no residual fistula flow (FIGURE 5), indicating successful occlusion of the left axillary arteriovenous fistula. The brachial artery sheath was removed, and pressure bandaging was applied to the puncture site.

3.Pacemaker pocket management after successful fistula occlusion: the pre-created left pacemaker pocket was closed in layers with absorbable sutures immediately after successful interventional occlusion of the fistula, with sterile dressing applied for fixation.

Completion of Permanent Pacemaker Implantation via Right Axillary Vein Approach:

1.The right axillary surgical field was disinfected and draped; local anesthesia was administered with 2% lidocaine, and successful puncture of the right axillary vein was performed. Two guidewires were advanced to the inferior vena cava.

2.A 4 cm oblique incision was made at the superolateral aspect of the right subclavian pectoralis major muscle to create a new pacemaker pocket, with gentamicin gauze placed locally for antimicrobial prophylaxis.

3.A 7F peel-away sheath was advanced over the guidewire; the ventricular lead was repositioned and screwed into the inferior right ventricular septum, and the atrial lead was placed in the right atrial appendage, with all sensing and pacing parameters verified to be within ideal limits (FIGURE 6).

4.Lead tension adjustment and functional testing (repeated coughing and deep breathing) confirmed stable pacemaker function with no lead displacement or parameter abnormality. Leads were secured with non-absorbable sutures, connected to the pacemaker device, and the device was placed into the newly created right pacemaker pocket.

5.The right incision was closed in layers with absorbable sutures and covered with a sterile dressing for fixation.

Postoperative Management and Follow-Up:

Perioperative prophylactic antibiotics were administered for 48 hours. The right pacemaker pocket incision was compressed with a sandbag for 6 hours, and upper body immobilization was maintained for 24 hours postoperatively. The closed left axillary incision was regularly dressed and monitored, the patient achieved uneventful wound healing of both left and right incisions and was discharged on schedule.At the 1-month follow-up: No recurrence of syncope,limb numbness, or swelling was reported; bilateral upper extremity blood pressure was symmetric (132/80 mmHg on the right, 130/79 mmHg on the left); motor and sensory function of the left upper extremity was normal;Pacemaker interrogation demonstrated normal pacing and sensing function. Angiographic re-evaluation was not performed as the patient had no clinical evidence of fistula recurrence, and long-term clinical follow-up was scheduled.

Discussion

The increased use of interventional therapy in recent years has led to an increased frequency of their associated complications[1]. There are reports of subclavian or axillary artery injury during pacemaker implantation via subclavian or axillary vein puncture[2]. The axillary vein is located anteromedial to the axillary artery, and the arteriovenous overlap is obvious in the second segment of the axillary artery (deep to the pectoralis minor muscle), which is the area most prone to concurrent injury and arteriovenous fistula formation during surgery and puncture[3].In our case, the iatrogenic fistula was attributed to a laterally deviated left axillary vein puncture that traversed the adjacent axillary artery, creating a direct arteriovenous communication; the 7F peel-away sheath further exacerbated the vascular wall damage, leading to brisk arterial bleeding that was unresponsive to manual compression.

Current the treatment methods for iatrogenic arteriovenous fistula mainly include conservative treatment and surgical treatment. The former refers to continuous low-pressure compression of the arteriovenous communication site, while the latter includes covered stent implantation to cover the fistula or open surgical ligation of the fistula[4]. A 7F peel-away sheath had been

placed after successful puncture in this patient, and continuous compression was ineffective,Surgical ligation required local incision under anesthesia and was time-consuming, so interventional occlusion with minimal trauma and high speed was selected. Recently, covered stents have been increasingly widely used in clinical practice[5], especially for aortic dissection, arteriovenous fistula, etc[6-7].Relevant studies have shown that the technical success rate of covered stent implantation for the treatment of iatrogenic vascular injury is 97.6%, with a high 12-month patency rate and no obvious surgery-related complications during long-term follow-up[8]. The results of this case further verify the reliability of this scheme.

Conclusion

Based on this case and a comprehensive review of the relevant literature, we propose four recommendations to reduce the incidence of iatrogenic vascular complications such as axillary arteriovenous fistula, and optimize acute management—including a clear algorithm for pacemaker pocket management after successful vascular fistula occlusion:

1.Preoperative prevention: Individualize the puncture approach based on the patient's vascular anatomical characteristics.Perform pre-procedural ultrasound vascular mapping to identify high-risk anatomical zones and to avoid blind needle insertion.

2.Intraoperative prompt recognition and diagnosis: Closely monitor the surgical field for abnormal bleeding during the procedure; immediate procedural cessation is mandatory for brisk bright red arterial bleeding. If arteriovenous fistula is suspected, emergent angiography is the gold standard for definitive diagnosis, and multidisciplinary collaboration (cardiovascular surgery, interventional radiology) should be initiated immediately to avoid delayed intervention.

3.Minimally invasive interventional therapy as first-line for fistula occlusion: For acute iatrogenic axillary arteriovenous fistula with active bleeding, balloon-expandable covered stent implantation should be the first-line intervention.

4.Pacemaker pocket closure at the injured site after successful fistula occlusion: Following successful endovascular occlusion of an iatrogenic axillary arteriovenous fistula, immediate layered closure of the pre-created ipsilateral pacemaker pocket is recommended to eliminate the risk of late hematoma, infection, and vascular re-injury. Permanent pacemaker implantation should then be completed via the contralateral axillary approach with a new pacemaker pocket created on the uninjured side, a strategy that is safe, feasible.

In conclusion, axillary arteriovenous fistula complicating permanent pacemaker implantation is a rare and acute complication, but due to the few reports of such cases, more clinical cases need to be accumulated in the follow-up to optimize the diagnosis and treatment process.

Abbreviations

bpm: beats per minute

ECG: Electrocardiography

NT-PROBNP: N-Terminal PRO-B-type Natriuretic Peptide

LVEF: Left ventricular ejection fraction

CS: Covered stent

Declarations

Acknowledgements: Not applicable.

Author contributions: JP contributed to study design, data collection, and manuscript drafting. ZS performed the surgical procedures. DN contributed to data collection and clinical case management. DW performed data sorting and statistical analysis. LX conducted the literature review. HZ supervised the study, critically revised the manuscript, and gave final approval for submission.

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Data availability: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate:It was not required for this case report according to our institutional guidelines.

Consent for publication: Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests: The authors declare that they have no competing interests

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Figure Legends

Figure 1: Electrocardiogram demonstrating third-degree atrioventricular block (sensitivity:10mm/mV; filter:45Hz; paper speed:25mm/s).

Figure 2: Left axillary arteriography showing contrast medium extravasation from the left axillary artery and opacification of the left axillary vein and surrounding soft tissues (arrow), confirming the diagnosis of iatrogenic left axillary arteriovenous fistula (scale:50 mm).

Figure 3: Fluoroscopic image showing advancement of an 8 mm × 37 mm balloon-expandable covered stent over a stiff hydrophilic guidewire to the site of the left axillary arteriovenous fistula.

Figure 4: Fluoroscopic image confirming accurate positioning and deployment of the balloon-expandable covered stent at the left axillary fistula site (arrow) (scale:50 mm).

Figure 5: Post-deployment left axillary arteriography demonstrating no residual contrast medium extravasation or axillary vein opacification, confirming complete and successful occlusion of the left axillary arteriovenous fistula (scale:50 mm).

Figure 6: Fluoroscopic image showing successful permanent dual-chamber pacemaker implantation via the right axillary vein approach, with the atrial lead in the right atrial appendage and ventricular lead in the inferior right ventricular septum, and the device placed in a newly created right pacemaker pocket (the left pacemaker pocket was closed after successful fistula occlusion).

FIGURE 1

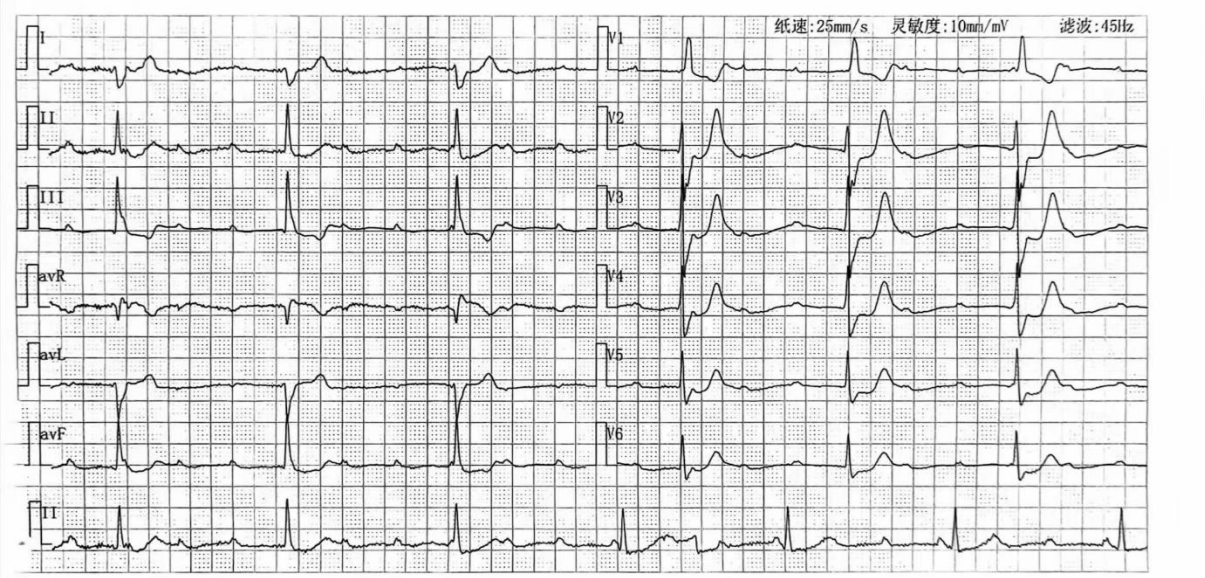

纸速:25mm/s
灵敏度:10mm/mV
滤波:45Hz
I
II
III
avR
avL
avF
II
V1
V2
V3
V4
V5
V6

FIGURE 2

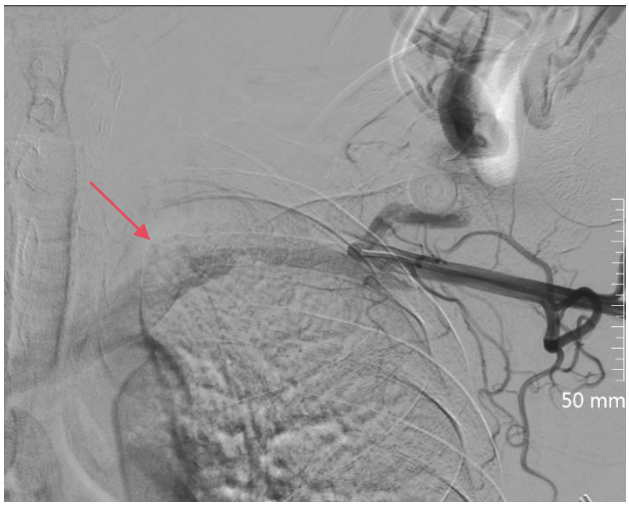


FIGURE 3



FIGURE 4

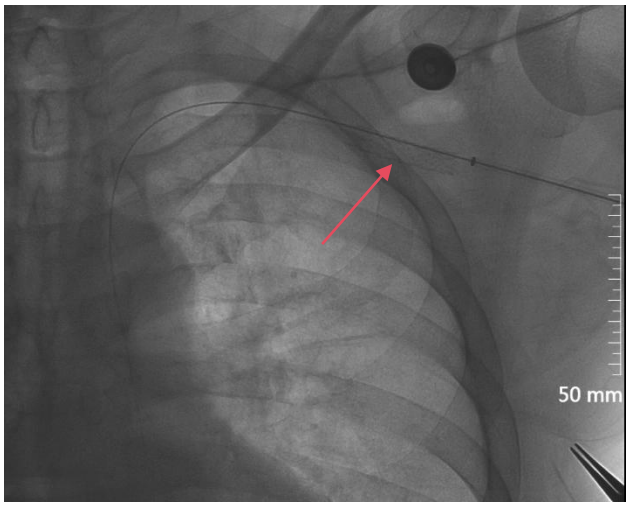


FIGURE 5

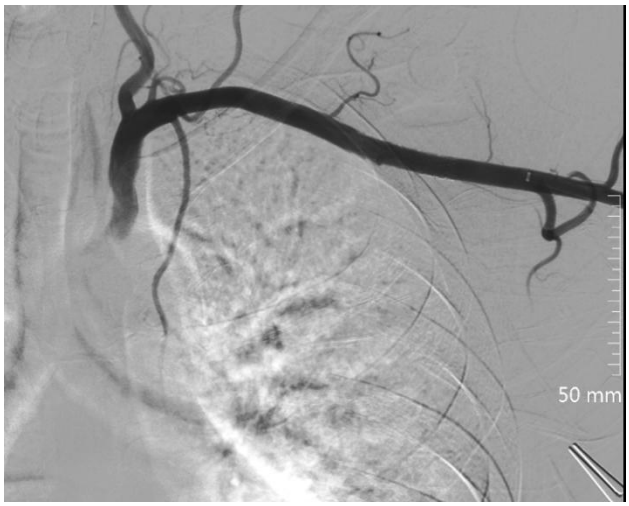


FIGURE 6

