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CASE REPORT

ADVANCED

CLINICAL CASE

# Percutaneous Extraction for Misplacement of Pacemaker Leads Within the Coronary Artery and Left Ventricle

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## ABSTRACT

A 75-year-old man, who underwent inadvertent misplacement of pacemaker leads into the left coronary artery and left ventricle through the subclavian artery, was referred to our hospital. We safely performed percutaneous lead extraction in collaboration with surgeons and with the patient under general anesthesia. (**Level of Difficulty: Advanced.**)
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Inadvertent misplacement of a cardiac implantable electronic device (CIED) lead into the left side of the heart is a rare complication, with an incidence of 0.34% (1). Serious consequences, such as thromboembolism, cardiac damage, and vascular complications, can occur. In such cases discovered late after implantation, surgical lead extraction or long-term anticoagulation with warfarin is generally recommended (2). Percutaneous extraction of a malpositioned lead within the left side of the heart, especially from the coronary artery, has rarely been reported (3). We report that percutaneous extraction of malpositioned leads from the left side of the heart by a multidisciplinary approach was effective in a case where surgical removal was undesirable. We used multimodality imaging, such as intravascular ultrasound (IVUS) and optical coherence tomography (OCT).

### LEARNING OBJECTIVE

- To identify and manage malpositioned CIED leads in the arterial system and left ventricle.

## HISTORY OF PRESENTATION

A 75-year-old man with sick sinus syndrome underwent permanent pacemaker implantation using passive fixation leads (tined leads) at another medical institution. The pacemaker pocket became swollen despite needle aspiration several times, and transarterial misplacement of leads was suspected on transthoracic echocardiography (TTE) 2 months after implantation. He was then referred to our hospital, Kagoshima City Hospital, Kagoshima, Japan.

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## PAST MEDICAL HISTORY

Direct factor Xa inhibitor had been prescribed for paroxysmal atrial fibrillation.

## DIFFERENTIAL DIAGNOSIS

We established a diagnosis of inadvertent misplacement of pacemaker tined leads in the arterial system and left ventricle (LV), and this may have been complicated by CIED-related infection.

## INVESTIGATIONS

The patient's physical examination findings on admission were within normal limits, except for being underweight (blood pressure, 135/79 mm Hg; cardiac rhythm, 60 beats/min, regular; body mass index, 18 kg/m$^2$; good appetite). He had a low-grade fever (37.5 °C) without use of antibiotics, and the pacemaker pocket was hot and swollen. Laboratory testing showed that the total white blood cell count (3.5 × 10$^3$/μL) and procalcitonin level (0.02 ng/mL) were within the normal range, with a mildly elevated C-reactive protein level (1.15 mg/dL). One of 2 blood cultures showed methicillin-resistant coagulase-negative staphylococci. A chest radiograph showed that both leads were positioned on the left side of the vertebral body compared with the usual position (**Figure 1**). An electrocardiogram showed a right bundle branch block pattern and precordial transition at lead $V_3$ on ventricular pacing (**Figure 2**). No vegetation was detected on TTE (**Figures 3A and 3B**). Computed tomography (CT) showed that the atrial lead was within the coronary artery and the ventricular lead was within the LV through the subclavian artery (SCA) (**Figures 4A to 4C**). IVUS and OCT, which were performed with coronary angiography before lead extraction, confirmed that the atrial lead was adhered to the intima of the distal portion of the left main coronary artery (LMCA) without thrombus (**Figures 5A to 5D**). Furthermore, these modalities, including CT, showed that both leads were through the proximal portion of the left SCA approximately 3 cm from the aortic arch. This portion was intrathoracic and posterior to the sternoclavicular joint.

## MANAGEMENT

Antibiotic therapy with vancomycin for suspicion of CIED-related infection was started after hospitalization. After discussion with cardiovascular surgeons, percutaneous lead extraction was performed with surgical backup using general anesthesia.

We observed bloody exudate in the pacemaker pocket. After removal of the ventricular lead from the LV without any special device, coronary guidewires through a guide catheter from the left femoral artery were passed through the left coronary artery before removing the atrial lead. On removal of this lead, IVUS and OCT showed the presence of coronary thrombosis and an intimal tear on the LMCA (**Figures 6A to 6D**). We removed both leads from the left SCA and the remaining coronary guidewires within the left coronary artery to prepare for coronary thromboembolism. There was concern about implanting a covered stent in close proximity to an infected pocket. However, despite pressure hemostasis of 8 mm by a dilation balloon catheter for 10 minutes 3 times after removing both leads under fluoroscopic guidance, continuous extravasation of a contrast agent from

### ABBREVIATIONS AND ACRONYMS

**CIED** = cardiac implantable electronic device

**CT** = computed tomography

**IVUS** = intravascular ultrasound

**LMCA** = left main coronary artery

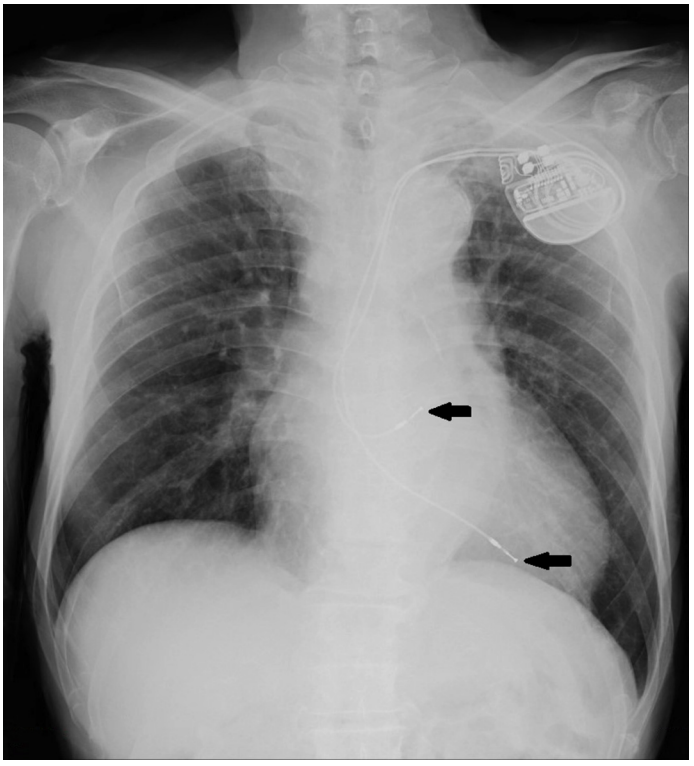
**LV** = left ventricle

**OCT** = optical coherence tomography

**SCA** = subclavian artery

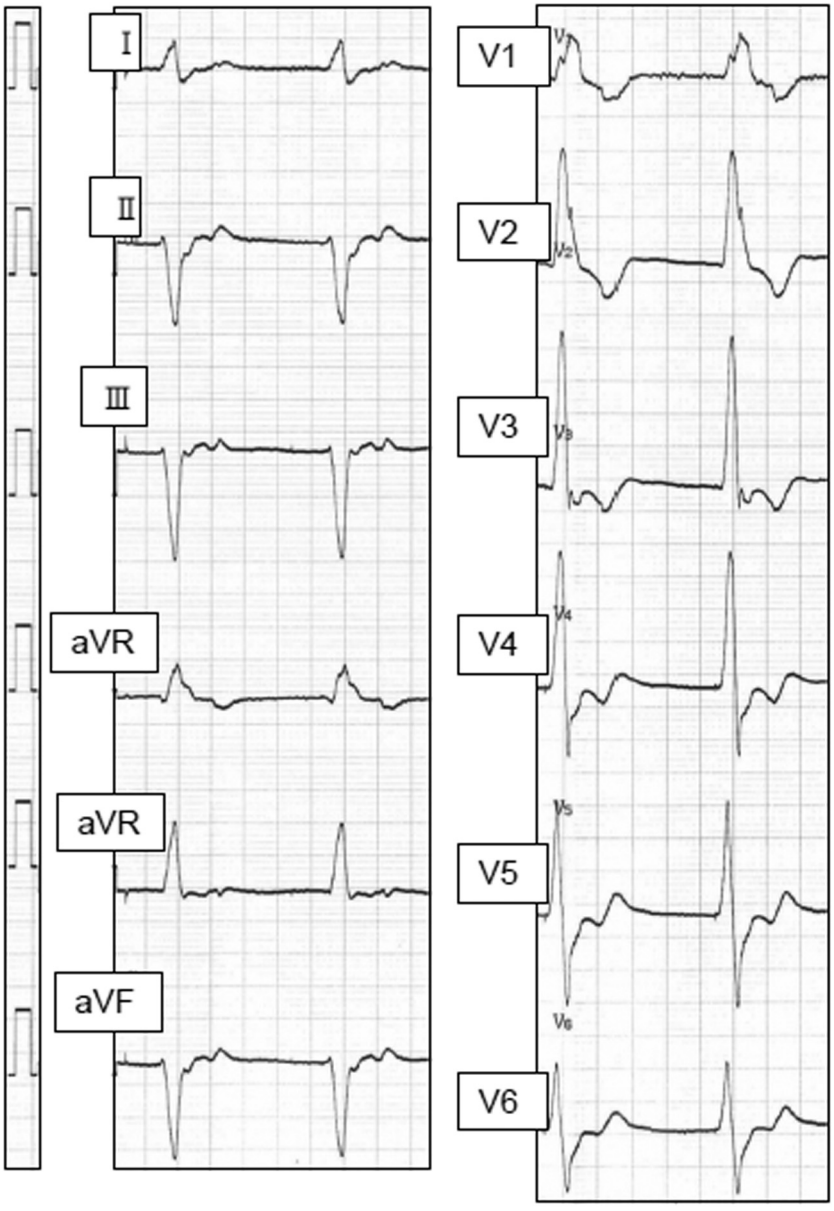
**TTE** = transthoracic echocardiography

**FIGURE 1 Chest Radiograph on Admission**



The anteroposterior view in the supine position is shown. Both leads **(arrows)** are positioned on the left side of the vertebral body compared with the usual position.

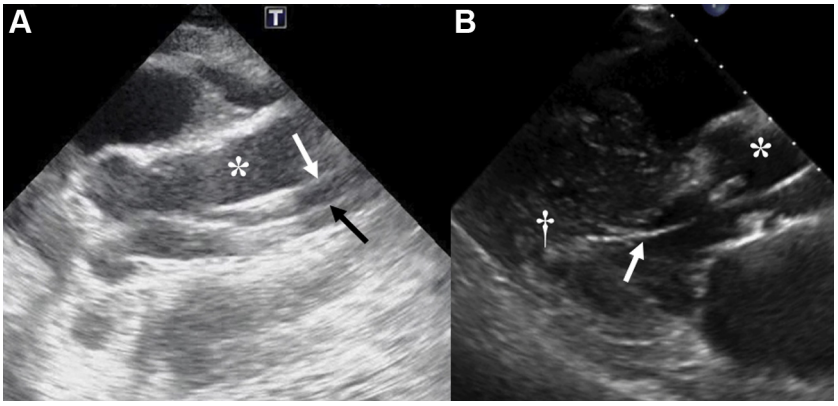
**FIGURE 2 Electrocardiogram on Admission**




An electrocardiogram shows pacing failure in the "atrial" lead and only the ventricular pacing status. A right bundle branch block pattern was observed, which raised the suspicion of left ventricular pacing.

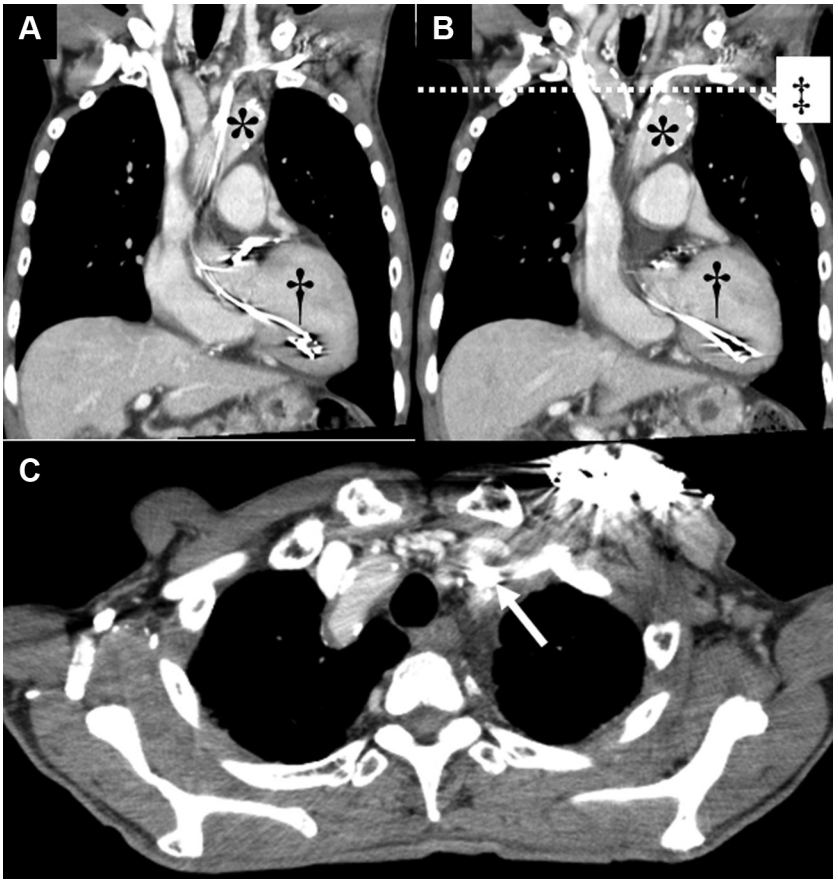
the left SCA was observed on angiography (**Figures 7A to 7C,** Video 1). A polytetrafluoroethylene-covered, self-expanding stent (10 × 50 mm) was deployed through a long sheath from the right femoral artery to repair the subclavian arteriotomy. We observed neither bleeding from the inserted portion of the leads nor extravasation on angiography (**Figures 7A to 7C,** Video 2). Finally, a sirolimus-eluting stent (3.5 × 18 mm) was deployed for the intimal tear of the LMCA to the left anterior descending artery and was post-dilated with a 4.5 × 8 mm balloon for the LMCA. There was no vegetation or thrombosis on removed leads. No bacilli were detected in any culture of exudate from the pacemaker pocket. Antibiotic therapy with vancomycin was continued for 2 weeks after the

**FIGURE 3** **Transthoracic Echocardiography Images on Admission**



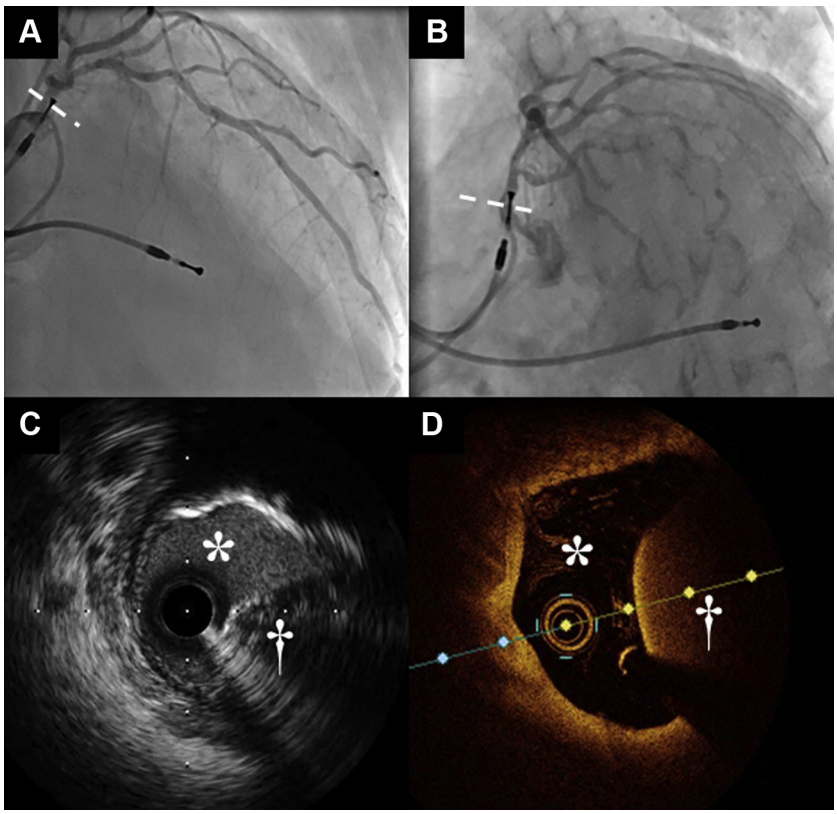

Two different sections **(A, B)** of transthoracic echocardiography shows dual chamber leads in the ascending aorta **(asterisks),** one of which **(white arrows)** was inserted into the left ventricle **(dagger)**. The position of another lead **(black arrow)** was not in the left ventricle.

**FIGURE 4** **Computed Tomography Images on Admission**




**(A and B)** Transarterial misplacement of dual chamber leads. Both leads were inserted into the left subclavian artery just above the aortic arch **(asterisks)**. The ventricular lead was detained in the left ventricle **(daggers). (C)** The horizontal section **(double dagger in B)** shows both leads through the subclavian artery **(arrow)**.

**FIGURE 5 Angiographic, Intravascular Ultrasound, and Optical Coherence Tomography Images Before Lead Extraction**




Contrast images of the left coronary artery in the **(A)** right anterior oblique cranial view and **(B)** left anterior oblique caudal view. **(C)** Cross-sectional intravascular ultrasound and **(D)** optical coherence tomography images of the left main coronary artery lumen **(asterisks)** with the atrial lead **(daggers)**.

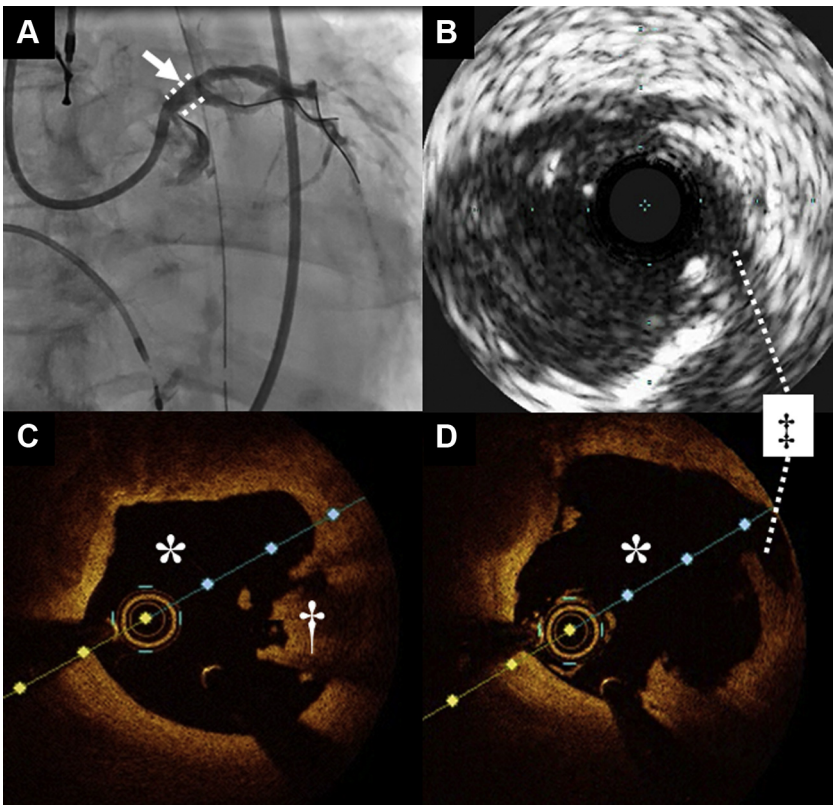
procedure. The patient's fever decreased without swelling of the pacemaker pocket. He was discharged after undergoing implantation of a leadless pacemaker.

## DISCUSSION

To the best of our knowledge, the situation in which pacemaker leads were misplaced within not only the LV, but also the coronary artery, has rarely been reported (3). Although no thromboembolic events have been reported in patients who have anticoagulant therapy only with warfarin for lead misplacement into the LV (4,5), we decided to perform percutaneous extraction by a multidisciplinary approach in our patient. This decision was made for the following reasons. First, lead extraction is recommended for patients with persistent bacteremia, even without another identifiable source of infection (6,7). Second, we were concerned about the possibility of future complications, such as coronary thromboembolism. Third, in surgical lead extraction, hemostasis for bleeding from the SCA may be necessary. Clavicle transection in addition to mediastinotomy could have been too extensive for the patient's age. Additionally, postsurgical severe infection, such as mediastinitis, could have developed from the suspected pacemaker pocket infection.

Early identification and prevention of misplacement of pacemaker leads are important. Misplacement of pacemaker leads into the left side of the heart in this case could have had the potential to be noticed during or just after the procedure. The following points were helpful for identifying misplaced pacemaker leads in our case. First, a chest radiograph obtained during or after the procedure is useful. Both leads in our case were positioned on the left side of the vertebral body compared with the

**FIGURE 6** Angiographic, Intravascular Ultrasound, and Optical Coherence Tomography Images Just After Removing the Atrial Lead




**(A)** The frontal caudal view on coronary angiography shows a filling defect **(arrow)** in the left main coronary artery. **(B to D)** Intravascular ultrasound and optical coherence tomography show **(B and D)** an intimal tear **(double dagger)** in the proximal part and **(C)** thrombi **(dagger)** in the distal part of the left main coronary artery **(asterisks)**.

usual position. Second, a 12-lead electrocardiogram showed a right bundle branch block pattern, which raised the suspicion of LV pacing. There was also failure of atrial sensing and pacing during the procedure.

Finally, the most unique aspect of this case was the location of the atrial lead in the LMCA. The use of intravascular imaging was helpful in this case. If intravascular imaging at post-lead removal had shown minimal disruption, we possibly could have been able to conservatively treat our patient with antithrombotic agents, rather than stenting.

The safety of our procedure remains unclear regarding the risk of cardiac damage and embolization. However, the findings in this case may encourage clinicians to perform percutaneous lead extraction within the left side of the heart.

## FOLLOW-UP

Follow-up was uneventful.

## CONCLUSIONS

Percutaneous lead extraction by a multidisciplinary approach was effective in our patient whose pacemaker leads were misplaced into the left side of the heart, especially the coronary artery.

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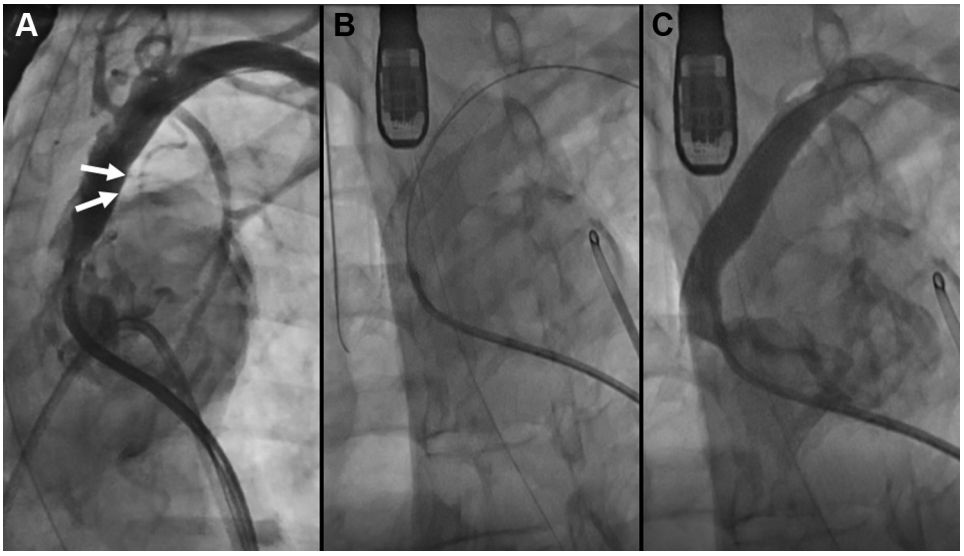
**FIGURE 7 Angiographic Images in Subclavian Arteriotomy**




**(A)** Angiography shows continuous extravasation from the subclavian artery **(arrows). (B)** After deploying the covered stent, **(C)** no extravasation can be seen on angiography.

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**KEY WORDS** cardiac pacemaker, complication, percutaneous coronary intervention

**APPENDIX** For supplemental videos, please see the online version of this paper.