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CASE REPORT

ADVANCED

CLINICAL CASE

Communicating Coronary and Ventricular Pseudoaneurysms Complicating Coronary Artery Perforation

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ABSTRACT

We present the case of a 75-year-old man who experienced rebleeding after surgical treatment of grade III coronary perforation, resulting in intertwined complications including communicating coronary and ventricular pseudoaneurysms. The percutaneous intervention of sealing the rebleeding site with a covered stent implantation managed this rare pseudoaneurysm successfully. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2022;4:1020–1025)

HISTORY OF PRESENTATION

A 75-year-old man with a history of percutaneous coronary intervention (PCI) was admitted to our hospital because of stable angina. Diagnostic coronary angiography (CAG) revealed a bifurcation lesion in the mid left anterior descending artery (LAD) (**Figure 1A**). He underwent PCI to the LAD on the same day with a 3.5-mm drug-eluting stent implantation. Based on the pre-intravascular ultrasound (IVUS) demonstrating a discrepancy in vessel diameter between the proximal and distal main vessel, we performed the proximal optimization technique using a 4.5-mm noncompliant balloon at 18 atm. Because of misposition of the proximal optimization technique balloon distally resulting in overexpansion of the distal main vessel, an Ellis type 3 coronary perforation (CP) occurred (**Figure 1B,** Video 1). Because hemostasis could not be achieved by the prolonged balloon inflation and covered stents were not available, emergent surgery was performed. In the surgical repair, coronary artery bypass grafting to the LAD was performed using a saphenous vein graft instead of the left internal mammary artery, because left internal mammary artery harvesting was challenging in the current case. The rupture site was successfully treated by a wrapping repair technique with a fibrin sealant patch, which is an adequate salvage procedure to manage the bleeding without suturing the

LEARNING OBJECTIVES

- To understand the importance of achieving a complete hemostasis, especially after Ellis type 3 coronary perforation.
- To understand communicating coronary and ventricular pseudoaneurysms related with intertwined complications following rebleeding after surgical treatment of coronary rupture.
- To understand the treatment of the communicating pseudoaneurysms by sealing the feeding site using a covered stent and its subsequent clinical course.

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coronary artery when the perforation site is difficult to identify and ligate.[1]

Two weeks after the emergent surgery, the follow-up transthoracic echocardiography identified a low-echoic structure in the anterior-middle wall with severe hypokinesis (**Figure 1C**). The diastolic flow signal was detected at the neck between the structure and the left ventricle, suggesting a ventricular pseudoaneurysm (**Figure 1D,** Video 2).

CAG revealed rebleeding from the stented segment and a giant saccular coronary pseudoaneurysm with an associated fistula draining into the left ventricle (**Figures 1E and 1F,** Videos 3 and 4).

PAST MEDICAL HISTORY

The patient had dyslipidemia as a coronary risk factor. A drug-eluting stent had been implanted in the right coronary artery 14 years earlier, and the left circumflex artery had been treated by rotational atherectomy and balloon angioplasty 13 years earlier. He took a direct oral anticoagulant for paroxysmal atrial fibrillation. He previously received left lung resection for lung cancer.

INVESTIGATIONS

On cardiac multislice computed tomography (CT), the huge pseudoaneurysm expanded within the myocardium. The connection to the stented segment was at the extramyocardium level, and the attachment with the left ventricle was at intramyocardium level. The saphenous vein graft was occluded, and the diagonal branch was compressed by the pseudoaneurysm. The myocardial

ABBREVIATIONS AND ACRONYMS

CAG = coronary angiography

CP = coronary perforation

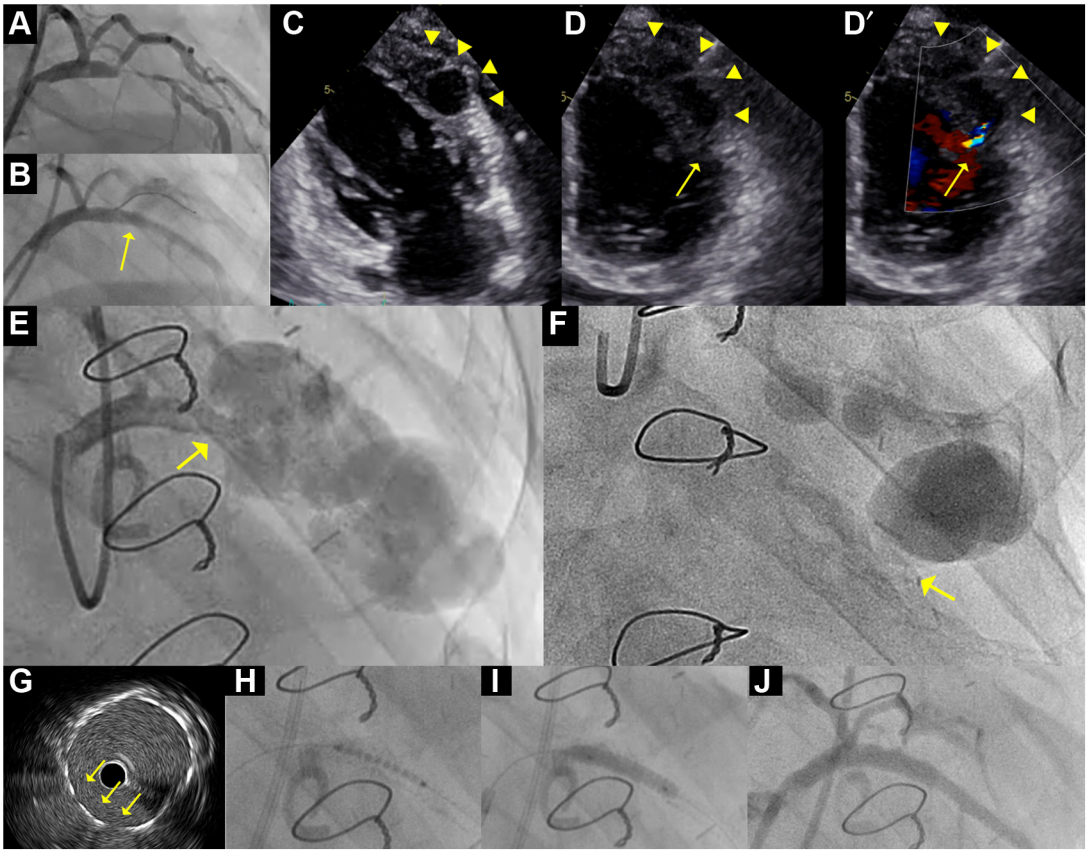
CT = computed tomography

IVUS = intravascular ultrasound

LAD = left anterior descending artery

PCI = percutaneous coronary intervention

FIGURE 1 Interventions and Communicating Pseudoaneurysms



(A) Initial coronary angiography (CAG) demonstrates a bifurcation lesion in the left anterior descending artery. **(B)** Ellis type 3 coronary perforation occurred **(yellow arrow)**. **(C to D′)** Transthoracic echocardiography shows a ventricular pseudoaneurysm **(arrowheads)** with the diastolic flow signal **(arrow)**. **(E to G)** CAG shows the communicating pseudoaneurysms with the rebleeding site on intravascular ultrasound and the fistula draining into the left ventricle **(arrows)**. **(H to J)** CAG shows complete hemostasis after a covered stent implantation.

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perfusion imaging demonstrated a local anterior transmural infarction (**Figure 2C**). The fused single-photon emission computed tomography/CT images documented that this infarcted area corresponded to the diagonal branch (**Figures 2D and 2E**).

MANAGEMENT (INTERVENTIONS)

During a careful follow-up of 30 days, the size of the pseudoaneurysm was not decreased, and the myocardial ischemia of the anterior wall persisted. Therefore, we decided to treat the pseudoaneurysm percutaneously. A covered stent was implanted to seal the entry site of the pseudoaneurysm with confirmation on IVUS (**Figures 1G to 1I**). The final angiogram demonstrated that complete hemostasis was achieved (**Figure 1J,** Video 5).

DISCUSSION

Ellis type 3 CP is often associated with a coronary laceration by an oversized balloon or stent dilatation, as could be the cause in the current case. Even if percutaneous or surgical interventions can temporarily achieve hemostasis, a rebleeding after treatment often occurs, especially in coronary rupture.[1] Several case reports have suggested late coronary pseudoaneurysm formation following incompletely treated CP.[2,3]

Ventricular pseudoaneurysm, which usually occurs after transmural myocardial infarction, develops in exceptional cases when cardiac rupture is contained by pericardial adhesions. The risk of secondary rupture seems high for large pseudoaneurysms but uncertain for small ones. Surgical direct closure of the defect with sutures or patch closure over an area of viable myocardium has been recommended, and pseudoaneurysm itself can be left unresected.[4]

To our knowledge, this is the first description of communicating coronary and ventricular pseudoaneurysms resulting from the following intertwined complications: rebleeding after the surgical treatment of CP, coronary pseudoaneurysm formation, side branch compression caused by the pseudoaneurysm, local myocardial infarction, limited rupture into the pericardial space, left ventricular pseudoaneurysm formation accompanied by a coronary pseudoaneurysm, and fistulous communication between the 2 pseudoaneurysms (**Central Illustration**). Acquired fistula associated with ventricular pseudoaneurysm after myocardial infarction has been reported previously.[5]

Although postsurgical pericardial adhesions can preclude the accumulation of free pericardial fluid, some case reports described that loculated pericardial effusions related to these adhesions compressed the surrounding structures.[6] In the current case, this mechanism could play a key role in the rare complications: the formation of both pseudoaneurysms, the pseudoaneurysm-induced myocardial infarction, and the fistulous communication between 2 pseudoaneurysms.

Based on the flow direction in the connected pseudoaneurysm from the stented segment to left ventricle, in our strategy, the complete sealing of the entry site by a covered stent could decrease the perfusion pressure in the pseudoaneurysm and facilitate subsequent blood coagulation within it (**Central Illustration**). Several unfavorable possibilities, however, should be considered when performing this intervention: first, the complete removal of the pseudoaneurysm may not be achievable; second, the pseudoaneurysm-induced compression of the branch would not be resolved; and third, long-term patency of covered stents is unclear. When the size regression of the pseudoaneurysm was not observed after the covered stent implantation, we planned the surgical treatment as a second session because the patient was a poor surgical candidate.

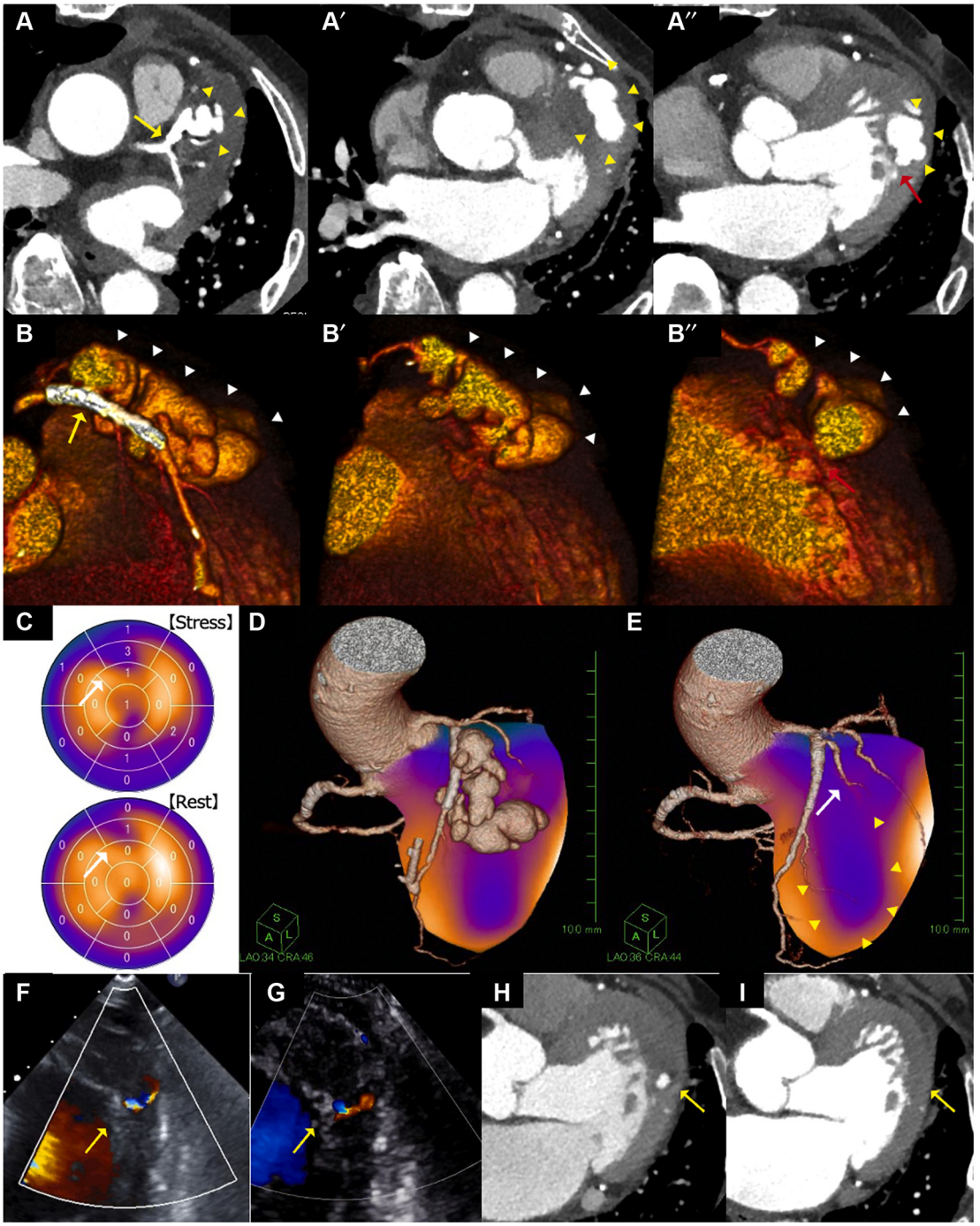
FOLLOW-UP

Three and 10 days after the covered stent implantation, transthoracic echocardiography demonstrated the recovery of the anterior wall asynergy and the size regression of the pseudoaneurysm with the remaining systolic flow signal (**Figures 2F and 2G,** Video 6). The serial CT at 2 and 20 weeks showed nearly complete resolution of the pseudoaneurysm (**Figures 2H and 2I**). After 2 years, the patient was still symptom free, and the CAG demonstrated patency of the covered stent (Video 7).

CONCLUSIONS

The rebleeding after the treatment of coronary rupture caused several intertwined complications, especially in a patient with a history of cardiac surgery. The implantation of a covered stent to seal the rebleeding site by PCI could be one of the effective managements for communicating coronary and ventricular pseudoaneurysms in poor surgical candidates.

FIGURE 2 Communicating Pseudoaneurysms and Follow-Up Images



(A to B″) Computed tomography (CT) and 3-dimensional images show the communicating pseudoaneurysms **(arrowheads)** connected with the left anterior descending artery **(yellow arrows)** and attached to left ventricle **(red arrows)**. **(C to E)** Single-photon emission computed tomography (SPECT) shows an anterior perfusion defect **(white arrow)**, which **(yellow arrowheads)** is corresponding to the pseudoaneurysm-induced diagonal occlusion **(white arrow)** on fused SPECT/CT images. **(F to H)** Transthoracic echocardiography 3 and 10 days after the covered stent implantation and CT 2 weeks later, respectively, show the remaining ventricular pseudoaneurysm with systolic flow signal **(arrows)**. **(I)** CT 20 weeks later shows the disappearance of the pseudoaneurysm **(arrow)**.

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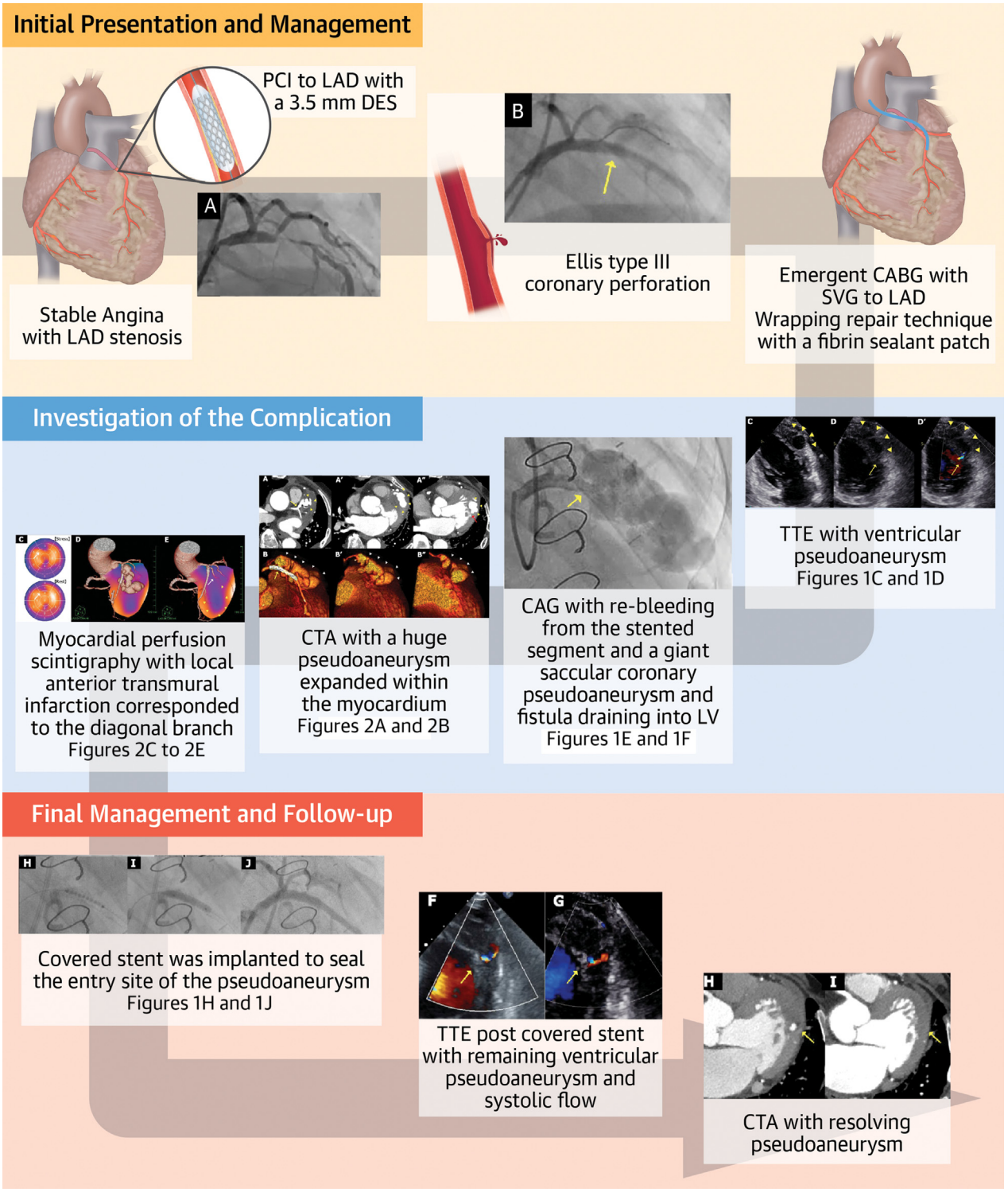
CENTRAL ILLUSTRATION **Mechanism and Management of Communicating Pseudoaneurysms**



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(Top panel) An Ellis type III coronary perforation was occurred during the percutaneous coronary intervention (PCI) of a true bifurcation lesion in left anterior descending (LAD) with a drug-eluting stent (DES) implantation due to stable angina, which was treated by an emergent surgery. **(Middle panel)** The formation of a huge pseudoaneurysm resulting from the intertwined complications: coronary pseudoaneurysm formation after rebleeding of perforation, local myocardial infarction due to pseudoaneurysm-induced compression of the side-branch, left ventricular (LV) pseudoaneurysm formation complicating ventricular rupture, and fistulous communication between 2 pseudoaneurysms. **(Bottom panel)** The communicating pseudoaneurysms were managed by sealing the entry site with a covered stent implantation percutaneously, resulting in their complete disappearance successfully. CABG = coronary artery bypass graft; CAG = coronary angiography; CTA = computed tomography angiogram; SVG = saphenous vein graft; TTE = transthoracic echocardiogram.

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KEY WORDS coronary perforation, coronary pseudoaneurysm, coronary rupture, covered stent, left ventricular pseudoaneurysm, ventricular pseudoaneurysm

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