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CASE REPORT

BEGINNER

CLINICAL CASE

Coronary Artery Perforation, Subepicardial Hematoma, and Cardiac Tamponade After Complex Percutaneous Coronary Intervention

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ABSTRACT

This report presents the case of fissured subepicardial hematoma and cardiac tamponade after coronary artery perforation during a complex percutaneous intervention. Surgical therapy was required to achieve hemostasis because a percutaneous sealing result was insufficient. Prompt recognition and cardiac surgery availability are essential for patient survival in such situations. (**Level of Difficulty: Beginner.**) (J Am Coll Cardiol Case Rep 2021;3:1594–1598)

A 62-year-old man was referred to the authors' center for an elective percutaneous coronary intervention (PCI). The patient presented with Canadian Cardiovascular Society class 3 anginal symptoms, receiving aspirin, 100 mg; clopidogrel, 75 mg; bisoprolol, 2.5 mg; amlodipine, 5 mg; isosorbide dinitrate, 30 mg; and atorvastatin, 40 mg therapy. Clinical examination showed left-sided hemiparesis and no other abnormal findings. Transthoracic echocardiography (TTE) revealed inferior and anterolateral hypokinesia of left ventricle (LV) with an estimated ejection fraction (EF) of 45%, absence of thinned walls or dyskinesia. Severe stenoses in bilateral internal carotid arteries (>70%) were documented by echo doppler. His medical history included inferior ST-segment elevation myocardial infarction (STEMI) and PCI on right coronary artery (RCA), previous stroke, and hypertension. Coronary angiography revealed a good result of PCI on RCA and chronic total occlusion (CTO) of left anterior descending artery (LAD) (**Figures 1A to 1C**). During the retrograde approach for CTO PCI, the wire perforated the posterior descending artery (PDA), creating an iatrogenic channel in the posterolateral LV wall. The trajectory reached the distal left circumflex artery (LCx) territory with stable contrast staining in

LEARNING OBJECTIVES

- To recognize that coronary perforation can evolve into life-threatening cardiac hematomas.
- To suspect cardiac hematoma in cases of pericardial effusion associated with a hypoechoic cardiac mass on echocardiographic examination.
- To be aware that surgical hemostasis may be needed and to ensure that the surgical team is alerted to intervene in an emergency.

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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the lateral LV wall (Figures 2A to 2C). The strategy was changed to the antegrade route. Antegrade wiring was achieved successfully, and 2 drug eluting stents were implanted with a good immediate result (Figure 2D to 2F). At the end of the PCI procedure, the hemodynamics were stable, and the patient was asymptomatic with no evidence of pericardial effusion on TTE. The patient was transferred to the ward in a telemetry bed. A detailed description of the procedure is presented in the Supplemental Appendix and Video 1.

HISTORY OF PRESENTATION

The patient presented signs of hemodynamic collapse with confusion, shortness of breath, tachycardia (120 beats/min), severe hypotension (arterial pressure: 60/40 mm Hg), and decreased peripheral oxygen saturation in pulse oximetry (Spo_2: 92%), 90 minutes after PCI.

DIFFERENTIAL DIAGNOSIS

Causes of hemodynamic collapse after PCI include vagal reaction (5.7%), acute stent thrombosis (0.2%), retroperitoneal hemorrhage (0.3%), malignant arrhythmias (1.5%), pericardial tamponade (0.3%), and cardiac hematomas (1).

INVESTIGATIONS

Bed monitor electrocardiography showed sinus tachycardia, low-voltage QRS complexes, and no ST-segment elevation myocardial infarction. TTE revealed cardiac tamponade by pericardial effusion.

MANAGEMENT

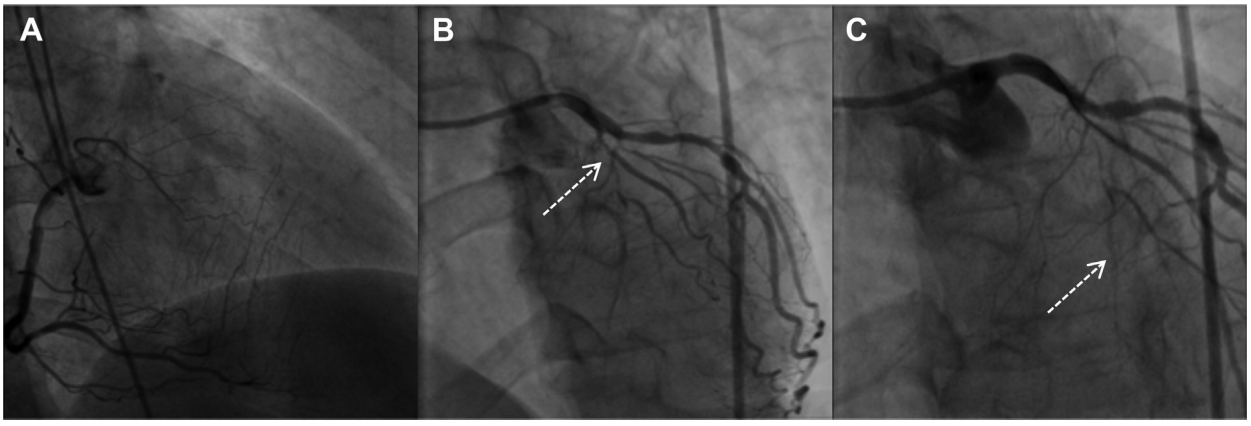
Pericardiocentesis and pericardium to central vein circuit was performed in the ward. Evacuation and reinfusion of 800 ml of blood and isotonic solution stabilized hemodynamics. Re-examination of previous coronary angiography revealed multiple "snowflake-like" contrast staining following the trajectory of an iatrogenic channel from RCA at final shots (Figure 3A). Emergency angiography revealed considerable contrast staining in the lateral wall of the LV (Figure 3D). It was decided to proceed with percutaneous hemostasis. Activated clotting time (ACT) showed 180 s, and 3,000 IU of heparin was administrated. Using standard PCI material and technique, 3 coils were delivered and deployed from RCA (Figures 3B and 3C), and 2 coils and a covered stent were used to seal the fissure of the side branch of obtuse marginal (Figures 3E and 3F) from LCA.

Angiography control showed complete sealing of antegrade and retrograde blood supply to the perforated segment. A detailed description of the procedure is presented in the Supplemental Appendix and Video 2. Still, aspiration of the pericardial space documented active bleeding of 800 to 1,000 ml/h. Diffuse capillary bleeding due to wall hematoma expansion was suspected. A decision to perform surgical hemostasis was taken, and protamine, 2.5 mg, was administered. During transportation to the operating room, the patient presented hemodynamic collapse.

ABBREVIATIONS AND ACRONYMS

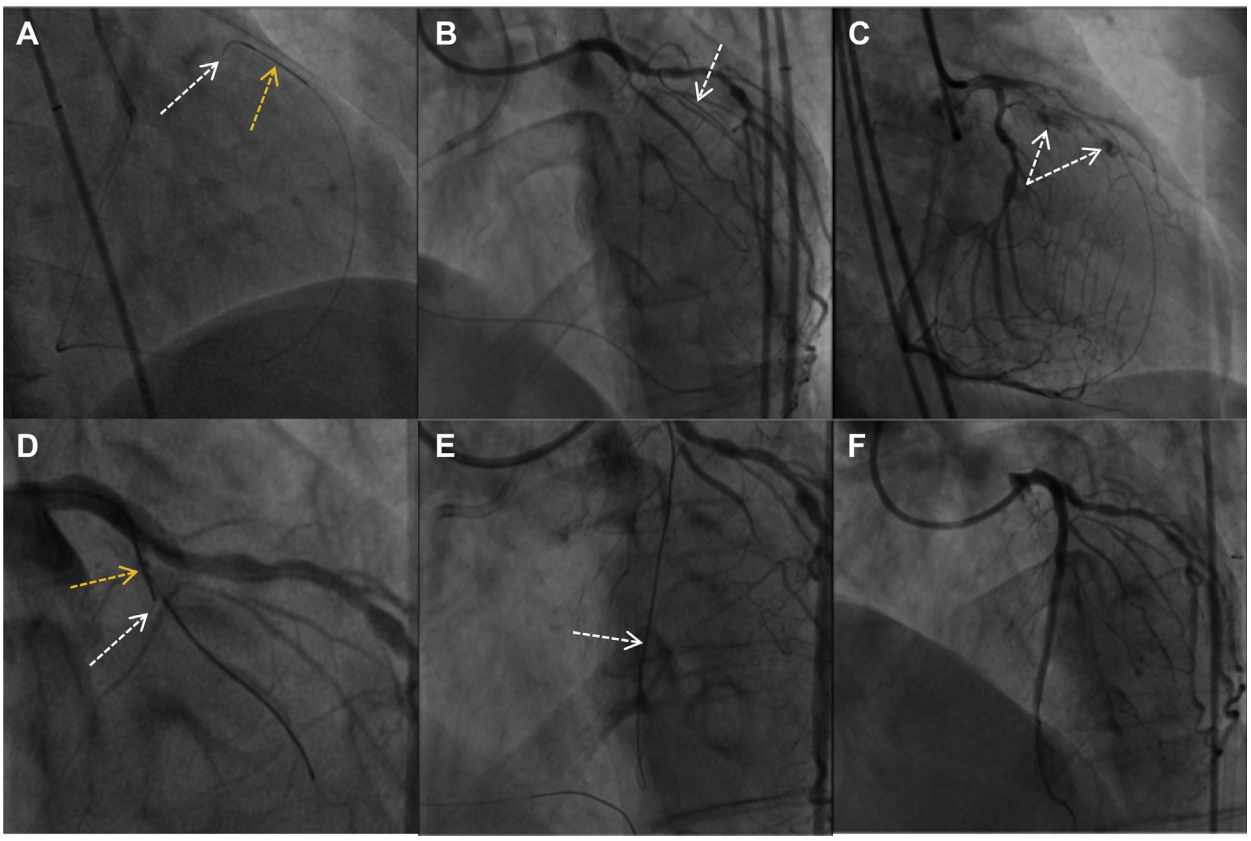
CTO = chronic total occlusion
EF = ejection fraction
LAD = left anterior descending
LV = left ventricle
PCI = percutaneous coronary intervention
RCA = right coronary artery
SEH = sub epicardial hematoma
STEMI = ST-segment elevation myocardial infarction
TEE = transesophageal echocardiography
TTE = transthoracic echocardiography

FIGURE 1 Baseline Angiography



(A) Good stent result in mid-right coronary artery. **(B)** Lesion of left anterior descending artery mid-segment. **(C)** Distal left anterior descending artery segment.

FIGURE 2 Percutaneous Coronary Intervention for Left Anterior Descending Artery Chronic Total Occlusion



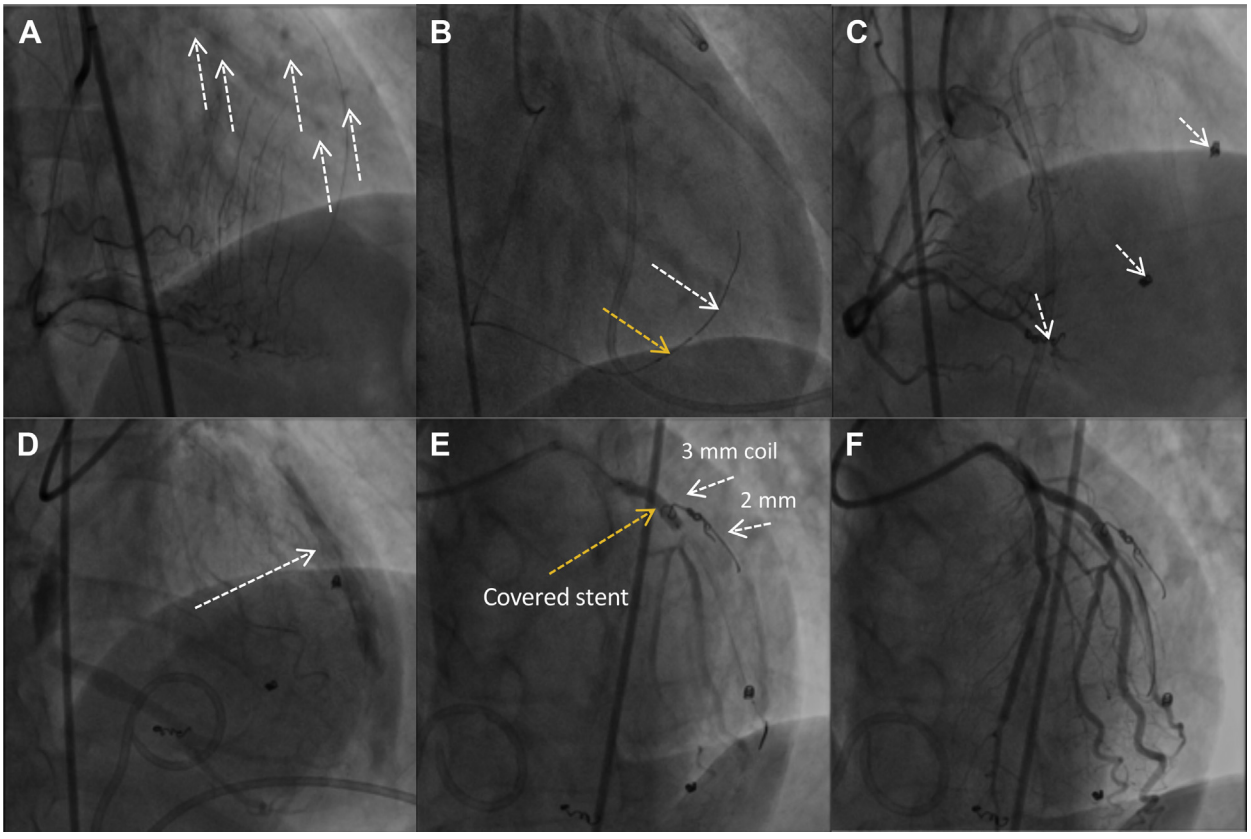
(A) Chronic total occlusion retrograde approach, the guiding wire, and microcatheter are in an iatrogenic channel **(arrows)**. **(B)** Tips of the guiding wire and microcatheter are in the pericardium. **(C)** Coronary perforation **(arrows)**. **(D)** Antegrade approach. Proximal cap perforation with stiff guiding wire **(white arrow)** and microcatheter **(yellow arrow)**. **(E)** Successful antegrade wiring of chronic total occlusion **(arrow)**. **(F)** Final angiography.

Cardiopulmonary resuscitation measures were maintained until the exploration through median sternotomy. A large amount of blood with thrombus was evacuated from the pericardium. The pericardial drainage resulted thrombosed, most probably due to protamine administration. Transesophageal echocardiography (TEE), performed after patient intubation, revealed a large subepicardial hematoma (SEH) in the anterior and lateral LV wall (Figure 4A). The surgery was performed on the beating heart. The heart was verticalized through several pericardial stitches. A large hematoma, 7×4-cm in the anterior and lateral LV walls with expansion toward the LAD, avulsed capillary vessels providing active bleeding through a tear to the epicardium, and a blood pocket with a tear near the apex were found (Figure 4B). Closure of the blood pocket using a 3.0-polypropylene suture leaning on 2 strips of polyethylene terephthalate (Dacron) was performed. Two hemostatic stitches with polytetrafluoroethylene (Teflon) were placed proximally, passing below the LAD to contain the blood leakage from the tear. The fibrin sealant patch (TachoSil, Baxter) with the adjunct of human fibrin glue (Tissucol, Baxter) was also used to achieve hemostasis. TEE was maintained throughout the surgery to monitor for regional LV contraction during application of hemostatic sutures and in the early postoperative period for SEH evolution as the dual-antiplatelet therapy was continued. The postoperative course was complicated by left-sided hemiplegia, probably due to episodes of low cardiac output. The patient was discharged after 14 days.

FOLLOW-UP

At 1 month follow-up, the patient returned to his prior neurological status. Lateral wall hypokinesia with LV ejection fraction (EF) 40% was found at TTE. Right

FIGURE 3 Percutaneous Hemostasis Intervention



(A) Coronary angiography from RCA showing "snowflakes" like contrast deposition following the trajectory of iatrogenic channel **(arrows)**. **(B)** Percutaneous coil embolization of iatrogenic channel **(arrows)**. **(C)** Angiography after coil embolization of iatrogenic channel showing complete sealing (**arrows** show deployed coil positions). **(D)** Coronary angiography from LCA showing large perivascular contrast staining of the lateral wall of LV **(arrow)**. **(E)** Coil embolization **(white arrows)** and covered stent **(yellow arrow)** implantation of a side branch of OM. **(F)** Angiography after OM coil embolization and covered stent implantation showing complete sealing. LCA = left coronary artery; OM = obtuse marginal; RCA = right coronary artery.

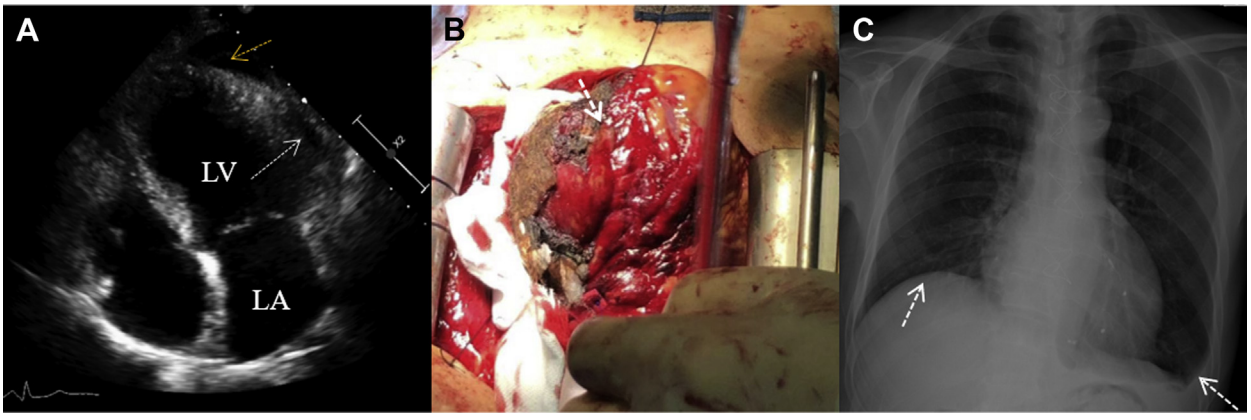
hemidiaphragm elevation, probably secondary to phrenic nerve injury, was found by radiographic examination (Figure 4C).

DISCUSSION

This paper reports the case of coronary perforation leading to LV fissured SEH and cardiac tamponade. Coronary perforation and tamponade are uncommon complications of PCI (during CTO and PCI: 2.9% and 0.3%, respectively), and subsequent cardiac hematoma is even more rare (1). Cardiac hematomas are considered incomplete cardiac ruptures with a high fatality rate, mainly occurring after myocardial infarction, chest traumas, cardiac surgery, or PCI procedures (2-5).

This report highlights the difficulty in diagnosing and managing the cardiac wall hematoma when accompanied by large pericardial effusion. A seemingly benign lesion evolved in a subepicardial hematoma. Immediate sealing before the self-propagating process initiation, regardless of the stable image of staining, could prevent the complication. Diffuse bleeding persisted after successful but delayed percutaneous sealing. Coronary perforation caused the initial lesion to expand by a self-propagating mechanism: hematoma damaged the capillary vessels that fueled its expansion (4), as demonstrated by the macroscopic examination during surgery. Blood drainage and reinfusion were life-saving, but large reinfusions led to a systemic inflammatory response with deleterious consequences. Urgently performed TTE missed the SEH, and the importance of TEE was unquestionable, yet performing it in an awake patient could add to the already existing respiratory distress. The

FIGURE 4 Findings During Surgical Hemostasis and Follow-Up



(A) Echocardiography during emergency cardiac surgery revealing large subepicardial hematoma **(arrow)**. **(B)** Macroscopic examination revealing large hematoma in the anterior and lateral LV wall **(arrow)**. **(C)** One-month follow-up radiographic examination shows blunting of the left costophrenic angle and right hemidiaphragm elevation, probably secondary to phrenic nerve injury **(arrows)**.

hemodynamic status was compromised by hypovolemia and loss of cardiac output due to damaged muscle and tamponade (3-5). Mechanical support could be helpful to stabilize hemodynamics at the expense of additional anticoagulation regimens that are harmful in a patient with hemorrhagic complications (2,5). Administration of prothrombin at the end of percutaneous sealing resulted in drainage thrombosis and second cardiac tamponade. Surgical hemostasis had to be performed under active dual-antiplatelet therapy that had to be maintained due to implanted drug eluting stents and covered stents. Due to the self-propagating mechanism of SEH, the percutaneous methods, even if successful in sealing the initial source of hemorrhage, are destined to fail in this scenario. It emphasizes the need for prompt diagnosis, nevertheless of clinical emergency and obvious image of significant pericardial effusion.

CONCLUSIONS

Even "benign" coronary perforations have unpredictable courses. In the case of cardiac tamponade after PCI procedure, the LV SEH should be suspected as the cause. When it is confirmed and the attempts of percutaneous sealing fail, emergency referral to the cardiothoracic surgeon after the pericardiocentesis is crucial for the patient survival.

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KEY WORDS cardiac surgery, cardiac tamponade, coronary artery perforation, percutaneous coronary intervention, pericardiocentesis, subepicardial hematoma

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