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Coronary artery perforation complicated by recurrent cardiac tamponade: a case illustration and review☆,☆☆

Michael DePersis [a,*], Safi U. Khan [a], Edo Kaluski [a], William Lombardi [b]

[a] Guthrie Clinic/Robert Packer Hospital, Sayre, PA 18840
[b] University of Washington, Seattle, WA 98195

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ABSTRACT

Coronary artery perforation during percutaneous intervention is a rare but potentially life threatening complication. The treatment of coronary perforation can be challenging in view of potential life threatening consequences such as cardiac tamponade or myocardial infarction.
Presented is a clinical course of a 69 year-old female who developed cardiac tamponade as a result of presumed wire related perforation of the posterolateral branch of the right coronary artery. Her clinical course was further complicated by recurrent tamponade, atrial fibrillation, stress induced cardiomyopathy, heparin induced thrombocytopenia and cardiogenic pulmonary edema. Based on review of the medical literature a treatment algorithm for wire perforation is suggested.

1. Introduction

With the advancements in medical technology, interventional cardiologists are attempting to treat more complex lesions. Consequently there is an increased incidence of rare, yet potentially life-threatening complication of coronary artery perforation (CAP). We are presenting a clinical course of a 69 year-old female who suffered a life threatening event of cardiac tamponade as a result of CAP during percutaneous intervention (PCI). Keeping her case as a focus, we have provided a brief account of various effective therapeutic strategies.

2. Case

A 69 year-old female with a history of hypertension, hyperlipidemia and severe depression was referred for cardiac catheterization in view of exertional substernal chest pain with minimal exertion despite good medical therapy. She underwent stress echocardiogram which revealed ischemia in the right coronary artery (RCA) distribution. Cardiac catheterization was performed via the right radial artery approach and revealed two-vessel coronary artery disease (CAD): 90% mid-RCA, 80% proximal RCA stenosis (Fig. 1) and 70–80% mid-left anterior descending artery (LAD) stenosis. The therapeutic options were discussed with the patient who preferred PCI to the proximal & mid-RCA. The patient was loaded with Ticagrelor 180 mg and a left coronary bypass (LCB) 6F guide was chosen. Due to significant RCA tortuosity we used Whisper wire which was advanced into the right posterior descending artery (PDA). Pre-dilatation with a Sprinter 3.0 mm × 20 mm (Medtronic, Minneapolis, MN) balloon resulted in excessive nausea and retching resulting in loss of the guide catheter and wire access in the RCA. The Whisper wire was then re-advanced and a Resolute 3.0 mm × 32 mm (Medtronic, Minneapolis, MN) drug eluting stent (DES) was deployed in the proximal RCA. She continued to vomit and retch and the guiding catheter and whisper wire again were disengaged from the RCA. After repositioning the guide, the whisper wire was noted to traverse into a false lumen distal to the stent which created extensive dissection in distal RCA. A second Whisper wire was introduced into the true lumen initially into the proximal right posterolateral ventricular branch (PLV) and later repositioned into the PDA. A 6F Guideliner (Vascular Solutions, Maple Grove, MN) was advanced into the proximal RCA to secure the guiding catheter position. A second DES was deployed in the mid to distal RCA to cover the dissection. Due to slow flow and extensive stenting, and in view of the patient vomiting and inability to absorb the oral Ticagrelor, the patient received double bolus of Integrilin. After the Integrilin bolus a small perforation (Fig. 2) was noted in the distal PLV, therefore no further Integrilin infusion was given.

The patient was monitored for thirty minutes in the catheterization laboratory with no electrocardiographic or symptomatic changes. A transthoracic echocardiogram (TTE) showed no significant pericardial effusion. The patient was then transferred to the coronary care unit in stable condition, but after approximately thirty minutes the patients

Abbreviations: CAP, Coronary artery perforation; CABG, coronary artery bypass grafting; DES, drug eluting stents; LAD, Left anterior descending artery; MI, Myocardial Infarction; PCI, Percutaneous coronary intervention; PDA, posterior descending artery; PLV, posterolateral ventricular; PTFE, poly-tetrafluorethylene; RCA, right coronary artery.

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* Corresponding author at: One Guthrie Square, 5 West Cardiovascular Fellowship, Sayre, PA 18840.
E-mail address: Depersis_michael@guthrie.org (M. DePersis).

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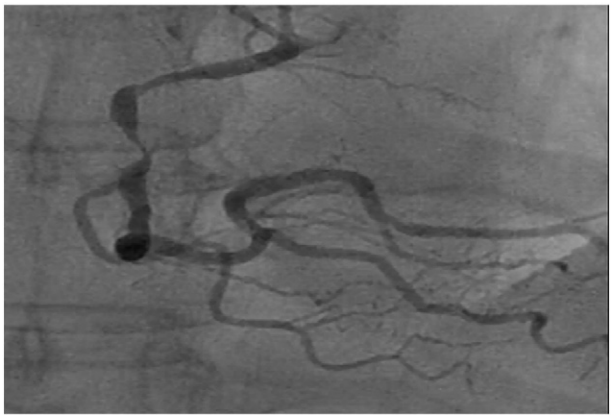

Fig. 1. Baseline coronary angiogram of the right coronary artery: right coronary angiogram revealing 80% proximal and 90% mid-RCA stenosis.

was noted to have profound hypotension and new ischemic ECG changes (Fig. 3) and thus was brought emergently back to the catheterization laboratory. During transthoracic echo revealing cardiac tamponade (Fig. 4) pericardiocentesis was performed emergently and 400 mL of blood was removed from the pericardial space and a 6F pericardial drain was left on negative pressure. Repeat coronary angiography was performed in view of significant ST-elevations in the inferior leads. The RCA and the recently placed stents were noted to be widely patent but the PLV perforation was noted to have more significant flow (Fig. 5). The left coronary system was not feeding the perforation. Less than one hour after pericardiocentesis, the patient developed hypotension and was noted to have a moderate pericardial effusion with repeat tamponade physiology despite pericardial drainage (Fig. 6). This was initially managed with fluids and inotropes, but ultimately she was brought back to the catheterization laboratory a few hours later with drain retraction approximately 5 cm and 350 mL of blood was again drained. At this time, the PLV perforation was sealed with a 2-mm coil via a Renegade (Boston Scientific, San Jose, CA) catheter with good angiographic result and resolution of perforation (Fig. 7). Despite no further bleeding, she continued to have tamponade physiology on echocardiography with minimal anterior pericardial fluid (Figs. 8, 9). Initially attempts were made at repositioning the drain, as well as exchange of the drain, but this did not resolve her hemodynamic problem. Eventually the patient was referred for pericardial window and underwent window placement with resolution of her tamponade physiology. Her post-procedural course was complicated by atrial fibrillation, acute heart failure with reduced left ventricular function to 30% and new ischemic ECG changes (repeat coronary angiography showed no change in coronary anatomy) probably related to stress induced cardiomyopathy. She also developed heparin induced thrombocytopenia with platelet drop from 350,000 to 45,000, without thrombotic complications. She ultimately was managed expectantly and was discharged from the hospital in stable condition after 12 days.

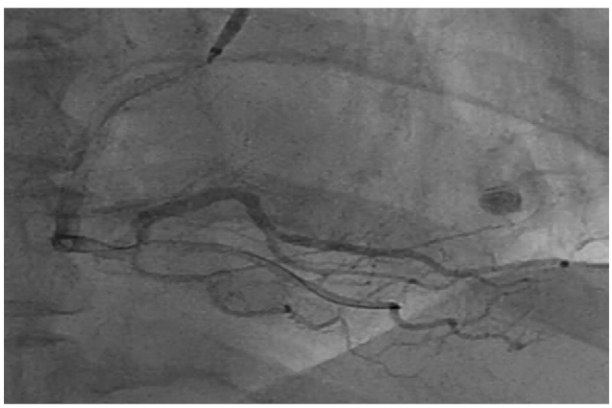

Fig. 2. Coronary perforation noticed after right coronary stenting: small perforation of the posterolateral ventricular branch of the RCA.

3. Discussion

CAP is defined as an anatomical breach in the wall of a coronary vessel due to penetration of the 3 layers of the vessel wall resulting in extravasation of blood or dye, either into pericardium, myocardium or adjacent cardiac chamber or vein. The incidence ranges from 0.19% to 0.59% [1]. There are various classification schemes reported for CAP but so far there is no prospective data validating the clinical relevance of these classifications through a core laboratory analysis [2]. However Ellis classification is the most frequently quoted for risk stratification and prognostication of CAP [3]. With the introduction of hydrophilic wires and engagement in PCI of chronic total occlusions, wire induced CAP was recognized as a distinct entity mandating special treatment strategies.

The presented case sets the stage to review the management of wire related perforation. The treatment strategies are discussed based on the presence of pericardial effusion and patient's hemodynamic state, the location of the perforation and adjunctive pharmacotherapy. The use utilization of adjunctive imaging modalities for management of this condition is also discussed.

4. Guidewire related perforation

Guidewire related perforations are most frequently encountered as result of accidental migration of the wire deep into the coronary microvasculature or use of aggressive wires that penetrate the adventitia. Distal guidewire perforations may be initially, as in our case, unrecognized especially in cases involving obese patients and with suboptimal imaging. This case emphasizes evaluation for excellent angiographic result after percutaneous intervention and confirmation with angiography after the performed procedure. Of note, the final angiogram should be performed with no wires in the coronary bed as to limit the chance of transient sealing, wire artifact or masking of a perforation.

Wire related perforations are generally considered to be more prevalent with the use of hydrophilic coated guidewires [4,5] and specialty wires with high penetrating power, especially for the treatment of complex coronary lesions or chronic total occlusions [6]. Use of these types of guidewires should be minimized and not used, if possible, for stent implantation as these increased the risk of wire perforation 6-fold. This is due to their low coefficient of friction and ease of distal migration [7].

5. Management strategies

The management strategies range from observation to prompt intervention depending on the following aspects: severity of the perforation, presence of pericardial effusion, hemodynamic status of the patient, location of perforation, operator's skills, equipment availability and interventional practices applied in centers [2].

Any large scale perforation with massive pericardial extravasation or myocardial staining requires balloon occlusion of the CAP vessel, reversal of anticoagulation and if indicated pericardiocentesis and sealing the perforation with a covered stent. Wire perforations are frequently subtle low grade perforations that frequently do not manifest themselves at all or have delayed clinical manifestations. Although the majority of cases may be subtle, small diameter balloon inflation may be considered when initially recognized. This would allow for immediate control of the perforation, obtaining transthoracic echocardiography to assess for fluid and allow for further patient monitoring and evaluation. During balloon inflation the patient may be evaluated for tolerance of occlusion if this becomes a necessary procedure.

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