Case Report

Rare occurrence of simultaneous coronary artery perforation and intracoronary thrombus formation following angioplasty

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Abstract

Both coronary artery perforation and intracoronary thrombus formation are life-threatening complications of percutaneous coronary interventions, which rarely occur simultaneously during angioplasty. We herein report a case of stent-related, left circumflex artery perforation, and subsequently acute left main artery thrombosis after the leakage was embolized with 7 microcoils. Intracoronary thromboectomy and systemic anticoagulant therapy were carefully used with good results. This case also represents some of our uncertainties regarding the best management of the patient.

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1 Introduction

Coronary artery perforation (CAP) is a rare but dreadful complication during percutaneous coronary intervention (PCI) and associated with significant morbidity and mortality.\textsuperscript{[1−3]} It has been estimated that it complicates approximately 0.43\% of all coronary procedures.\textsuperscript{[4]} The occurrence of intracoronary thrombus during PCI is a well-known complication.\textsuperscript{[5]} Perforation and thrombosis rarely occur simultaneously throughout coronary angioplasty. We describe a case of unexpected Ellis class 3 perforation complicated by acute cardiac tamponade following stenting of mid left circumflex artery (LCX) stenosis. The perforation was successfully sealed by 7 microcoils via microcatheter, thereby avoiding the need for emergent cardiac surgery. However, subtotal occluded thrombus in the left main artery and total occluded in-stent thrombosis unexpectedly occurred, and then aspiration thromboectomy and anticoagulant therapy were used with good results.

2 Case report

A 67 years old male was admitted to the hospital for coronary angiography because of abnormal CT coronary angiogram in a screening test on March 3, 2011 (Figure 1A). His coronary risk factors included well controlled diabetes and current smoking. Echocardiography showed preserved left ventricular systolic function, no chamber enlargement and no valvular heart disease.

Trans-radial coronary angiography (April 13, 2011) showed LCX had a long stenotic lesion up to 80\% at mid portion (Figure 1B). The left main (LM), left anterior descending artery (LAD), and right coronary arteries were practically free of disease. PCI was attempted to mid LCX lesion. Procedure PCI was done with XB 3.5 guiding catheter after being anticoagulated with weight-based heparin. A BMW guidewire was advanced into the distal LCX and another BMW guidewire in the side branch of the LCX. After balloon pre-dilatation, a sirolimus-eluting stent 2.75 × 24 mm (EXCEL, JW Medical System, Weihai, China) was deployed at 12 atm. Shortly after post dilatation was done with stent’s balloon to 11 atm, the patient became hemodynamically compromised and cardiac arrest. Angiography confirmed the presence of Ellis grade 3 coronary perforation at the distal part of the stent with free flow of contrast into the pericardial space (Figure 1C). Emergent echocardiography also confirmed a large pericardial effusion with cardiac tamponade. The effect of heparin was reversed with 30 mg of intravenous Protamine. Nasotracheal intubation and pericardiocentesis were performed to restore hemodynamic stability. The stent’s balloon was reinflated immediately at the site of the perforation to 5 atm (Figure 1D), which was
unsuccessful. Leakage continued after 30 min of balloon inflation, for no suitable cover stents available, the decision was made to place microcoils to close the perforation by a neuron-intervention physician. After 7 Microplex coils (Platinum Detachable Embolization Coils, MicroVention, Aliso Viejo, CA, USA) were placed from the distal LCX to the perforation site via microcatheter, the perforation was embolized with no extravasations of contrast into the pericardial space (Figure 1E). Repeated angiographic pictures showed the presence of subtotal occluded acute thrombus in the left main artery and in-stent macrothrombus in LCX (Figure 1E), aspiration thrombectomy was attempted (Figure 1F), followed by Tirofiban Hydrochloride anticoagulation. Thereafter, the patient remained hemodynamically stable after transferred to the coronary care unit. ECG confirmed the posterior and lateral wall myocardial infarction and the maximum troponin I level was 15.97 ng/mL. A Pigtail drainage catheter was left in the pericardial space for 2 days, and the nasotracheal tube was successfully removed 3 days later. Fondaparinux sodium (ARIXTRA) was injected subcutaneously for 7 days without any event. He was discharged two weeks later and had no effort angina and cardiac dysfunction with more than one year follow-up.

3 Discussion

CAP and intracoronary thrombus formation are undesirable complications during PCI, because it is occasionally life-threatening by causing cardiac tamponade, acute myocardial infarction (AMI), or death. Prompt recognition and treatment is therefore critically important.

Several factors have been associated with an increased risk of vessel perforation include complex lesion, severely stenotic and calcified lesion, chronic total occlusion, small and diffuse diseased vessel, high pressure balloon dilatation, use of an oversize device (balloon or stent), stiffer hydrophilic wires or atheroablative devices (directional atherectomy, excimer laser, rotablators, and extraction catheters).[6] Risk factors for this significant complications after PCI also include advanced age, because older patients undergoing coronary angiography and subsequent coronary surgery have more severe underlying cardiac disease, such as triple vessel coronary disease, left main stem stenosis, severe calcification, or left ventricular impairment.[7] The present case of perforation was most likely from over sized stenting and a relative high pressure balloon dilatation.

Angiographically documented perforations were graded
according to the Ellis classification. In brief, perforation class 1 refers to an extra-luminal crater without contrast extravasation; class 2 indicates the presence of pericardial or myocardial blush without contrast jetting; and class 3 involves a frank perforation > 1 mm with contrast jetting.[7] Pooled mortality rates were 0.3%, 0.4%, and 21.2% for patients with Ellis class 1, 2, and 3 CAP, respectively.[4] Serious complication composed of pericardial tamponade 12.2%, cardiogenic shock 9.8% and cardiac arrest 2.4%.[8]

This patient illustrated the most dreadful class 3 perforation with all of the three complications stated above. The treatment for CAP include prolonged balloon inflations, reversal of anticoagulation or antiplatelet therapy, pericardiocentesis, emergency surgery if appropriate, and specific treatment of the vessel perforation or rupture with a bailout device, such as a covered stent,[9] embolization coils,[10] etc. Delivery of covered stents may be attempted as an optional treatment before resorting to emergency surgery, especially for perforation sites located in the proximal or mid portion of the index vessel.[11] However, preparing these stents is technically difficult, time-consuming and the restenosis rates of these devices are known to be high. In this case, the management of the complication was more difficult by the unavailability of a grafted stent. Therefore, another interventional laboratory must be prepared to handle this complication. Embolization of gel foam or thrombogenic metallic (stainless steel/platinum) coils into the leaking vessels is another treatment option when perforation persists.[11] In this case, the perforation is a somewhat distal and in a relative small vessel, thus coil embolization onto the site through an infusion catheter is also a better candidate for this complication. Therefore, every interventional laboratory must be prepared to handle this complication. In this case, we successfully used coil embolization technique to seal the leakage, but sacrificed distal flow which resulted in AMI.

Reversal of anticoagulation with protamine is recommended in the treatment of CAP with frank rupture and hemopericardium. Though protamine administration was reported to be safe and not to predispose to stent thrombosis, the reversal of heparin after a complex PCI remained controversial.[12] In this case, after the protamine administrated and the coils sealed the perforation, unexpected intracoronary and in-stent thrombus formed. Protamine reversal of heparin weakens clot structure and decreases platelet function; therefore, induces platelet aggregation and clotting formation.[13,14] This complication casts doubt on the safety of heparin reversal therapy for CAP. Approaches to avoid excess protamine, or use of alternative heparin antagonists after CAP may be beneficial.

In addition, intracoronary thrombosis during PCI may occur due to thrombi formed within catheterization instruments, or due to guide wires remaining in the arteries for prolonged periods of time. Catheter-induced coronary artery dissection, mechanically induced spasms of coronary arteries, vasovagal,[15] contrast,[16] or drug eluting stent[17] induced anaphylactoid reactions during catheterization can also lead to resultant thrombus in coronaries. Though CT angiogram is a major new tool in the diagnosis of coronary artery disease, whether it should be used as a "screening" test in the general population is still under debate.[18] This patient had not suffered from chest pain and his ECG was normal. Though he was considered at high risk for developing coronary disease (cigarette smoker and diabetes) with a mildly abnormal CT scan, cardiac catheterization is not a good indication for this type of patient and might not gain much benefit from the intervention. Though coronary angiography is useful in establishing or ruling out the presence of coronary stenoses, guidelines suggest that patients with suspected CAD who have severe but stable symptoms and those with certain high-risk features for an adverse outcome should have this invasive examination. Furthermore, whether a given stenosis contributes to reversible myocardial ischemia, myocardial fractional flow reserve (FFR) might better indicate to what degree a patient can be helped by revascularization. In this case, the patient was once suggested not do this invasive procedure, however, he was so worried about the lesion and strongly asked the doctor to proceed, with the dreadful complication in the end. Though perforation seldomly can even be associated with simple stenting, this risk does happen occasionally in the real world, which may require increased attention by both physicians and patients.

In conclusion, we herein described one case of LCX perforation following PCI resulting in cardiac tamponade and cardiac arrest. The leakage was successfully sealed by the deployment of 7 microcoils but resulted in acute intracoronary thrombus formation and AMI. In addition to the availability of covered stents, it is essential to be familiar with various skills necessary for successful management of these complications.

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