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Tips and Tricks in Management and Prevention of Coronary Perforation in Acute Coronary Syndrome: Case Illustration and Review

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ABSTRACT

Coronary artery perforation (CAP) represents a rare, but potentially fatal complication during percutaneous coronary intervention (PCI). however, if diagnosed and managed promptly, the consequences were be minimized. We report the case of a coronary perforation(Elis type II) of left anterior descending artery (LAD), due to balloon post-dilatation at the end of revascularization of a non-ST elevation myocardial infarction (NSTEMI). Managed successfully with an immediate blocking balloon, hence hemodynamic stability and non significant pericardial effusion. Through this case, we want to highlights, to interventional cardiologists, some tips and tricks in management and prevention of coronary perforation in acute coronary syndrome.

KEYWORDS: acute coronary syndrome, perforation, blocking balloon, coils, pericardiocentesis.

INTRODUCTION

Coronary perforation is a rare, but life-threatening consequence of percutaneous coronary intervention, requiring rapid and effective intervention. The outcomes of this complication in patient with ACS is similar to those without ACS(5). The reported incidence of CAP is 0.2% to 0.4% in non-complex lesions, 1, 2 to 1.4–4.1% in chronic total occlusions (CTO)(1) ,with a mortality ranging from 7 to 17% (2).

The type of perforation is classified according to the angiographic presentation proposed by Eliss et al(the most widely used for risk stratification and prognosis): type-I: a crater extending outside the lumen; type-II:pericardial or myocardial blush with <1 mm exit hole; type-III: streaming of contrast through a >1 mm exit hole and the cavity spills as a perforation into an anatomic chamber (3). Type III perforation is associated with a high incidence of major adverse events (death, myocardial infarction, tamponade, emergency bypass) and poor prognosis, compared with Eliss type I and II (3,2). Immediate blocking balloon , Call for help (echocardiographer, surgeon and anesthetist),General circulatory support, Pericardiocentesis, autologous reinfusion, covered stent implantation, anticoagulation reversal are the universal management, other specific management can be used for distal coronary perforation like (Autologous blood clots, microcoils, thrombin) (6). In unsuccessful situations, emergency surgery is the salvation procedure (7). Interventional cardiologists must be able to recognize CAP and master the different general and specific techniques of management. Our aim through this case is to give them tips and tricks in management and prevention of coronary perforation.

CASE REPORT

An 49 years old women, with history of diabetes, developed acute chest pain and was brought to our emergency department in the second hour, with a diagnosis of anterior NSTEMI based upon electrocardiogram obtained in the field and a troponin hs measurement of 34ng/ml .she was hemodynamically stable but uncomfortable due to chest pain. Fast Transthoracic echocardiography revealed wall motion abnormalities in the LAD area and moderate systolic dysfunction(EF at 40%) and grade I diastolic dysfunction.

The emergent coronary angiography showed a sub occlusive lesion of the mild LAD with thrombus burden and III TIMI flow(figure1). After administration of a 600 mg loading dose of clopidogrel and an intravenous bolus of 1.400 units of heparin, left main coronary artery was cannulated with a 6-Fr EBU 3.5mm guide catheter and a conventional hydrophilic wire samurai 0.0014mm was advanced. The lesion was stented with a drug-eluting stents (3.0 × 20 mm PROMUS ELITE) deployed at 12 ATM. There was an residual stenoses in the mild of stent in angiographic control, requiring for an aggressive post dilatation with a non-compliant balloon 4 ×9mm (10 atmospheric pressure)in the absence of the 3.5×9mm(Figure 2). A subsequent angiogram revealed contrast extravasation from the vessel leading to the diagnosis of CAP(Elis type II)(figure3). Immediately, we inflated the

balloon of postdilatation , already in the catheter guide, proximal to the site of perforation at 6ATM for 5min. Transthoracic echocardiography was performed, showing a low pericardial effusion without signs of tamponade. Fortunately, the patient did not experience discomfort and had normal blood pressure with a steady heart rate. The anticoagulation reverse was deferred. Repeat injections performed during transient balloon deflation, revealed no extravasation of contrast(Figure4) . We observed the patient in the catheter laboratory for approximately 40 min after the onset of perforation with repetitive echocardiography. Since her symptoms, vital signs and pericardial effusion were stable, The patient was followed up for 2 days in the coronary care unit and was discharged from the hospital 3 days later on dual antiplatelet therapy (DAPT) of aspirin and clopidogrel, in addition to anti-ischaemic medications.

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 (13).IT is a rare but serious complication of percutaneous coronary intervention(8). Several patient-related risk factors, including older age, hypertension, diabetes ,previous coronary artery bypass graft operation, history of congestive heart failure, PCI for NSTEMI or unstable angina, prior clopidogrel use, lower creatinine clearance and female gender, were associated with the development of CAP. Patients with type-III lesions, chronic total occlusions, small ves- sels, calcified lesions, tortuous and angulated vessels and multivessel coronary disease are prone to CAP. Up to 30% of CAP was associated with atheroablative devices (2,5,8,9).

Y. Liu et al suggest that CAP is more likely to occur in patients with NSTE-ACS, which is similar to the findings of a previous study (10). Coronary perforation in this setting may be related to the presence of unstable coronary plaques and the administration of a glycoprotein IIb/IIIa receptor antagonist (9). Aykan et al reported in his study for CAP in acute coronary syndrome that high pressure balloon inflation, oversized balloons, Complex lesion stenting, non-compliant balloons are associated with increased CAP risk (5). Interestingly, the most common mechanism responsible for CAP was post dilation in 39% and guide wire manipulation in 33% (4).

The tendency to postdilate resistant lesions aggressively at higher pressures or with a ballon -to-artery ratio >1.1 is associated with a 2 to 3-fold increase in perforation (11). A large analysis from the British database observed that the use of cutting balloon avoided inadvertent post dilation and was indeed protective against perforation in their patient subset (4). Hydrophilic coated guide wires are associated with increased risk of coronary per- foration due to low coefficient of friction and ease of distal migration (12,23).The first step in management of CAP is an Immediate blocking balloon (1:1 balloon:vessel size), in proximal or at the site of perforation ,inflated at a low pressure (max 8atm) for about 5–10 min . This time will allow the operator to call for help than echocardiographer, surgeon and anesthetist(6). If the patient's hemodynamic is compromised, an aggressive treatment with intravenous fluids, vasopressors, and mechanical circulatory support may be required. The presence of large pericardial effusion in echocardiography with signs of tamponade indicate an emergent pericardiocentesis (14). In case of persisting extravasation in large vessel, despite prolonged balloon inflation, Deployment of a covered stent at the site of perforation can provide definitive treatment of large vessel perforations(6). The use of a single guiding catheter seems fast and efficient, especially if the hemodynamic state is stable and the perforation is small.This technique consists of the rapid positioning of the covered stent immediately after deflation and retrieval of the balloon (14). Alternatively, the "ping pong", also called "dual guide catheter" technique can be used to facilitate PTFE-covered stent delivery in tortuos or calcified vessel, and when hemodynamic is significantly compromise, the polytetrafluoroethylene stent is advancing from a second guide catheter ,via a second vascular access, wile the balloon is deflated and removed in the first catheter (15,14). For distal artery perforation which the vessel caliber is small, embolization with polyvinyl alcohol, collagen foam, intracoronary thrombin, microcoils, subcutaneous fat, or thrombogenic metallic coils into the leaking vessels can be a treatment option (16). The embolization of any occluding materials can be done with a microcatheter over a second wire with the balloon inflated at the same time (block and deliver technique)(17). Covered stents can sometimes be used for distal vessel perforation in order to occlude the origin of a perforated side branch(18). Reversing of anticoagulation is recommended in the continuous extravasation with hemodynamic compromise despite initial effort to achieve hemostasis. Dosage administered (1mg of intravenous protamine per 100 units unfractionated heparin given) to achieve an activated clotting time of <150 s (6, 14). Anticoagulation should not be reversed until all intracoronary equipment is removed, as it may lead to coronary thrombosis(18). Cardiac surgery should be considered if the methods above fails to seal class III perforation and excessive bleeding or haemodynamic instability (6,14,19).Simon et al. believe that 85% of class I cases, 90% of class II cases, and 44% of class III cases may be managed non- surgically(20). Y. Liu et al. found that all patients with class I and class II perforation and 77.3% of the patients with class III perforation were managed successfully using nonsurgical treatment Only 5 patients with class III per- foration died of cardiac shock (mortality, 7.8%)(9). CAP treatment was conservative (including prolonged balloon inflation) in

73.3%. Covered stents, coiling, and fat embolization were used in 24.0%, 0.7%, and 2.0%, respectively(2).

Our patiente had more than one risk factor for perforation, diabetes, clinical presentation of an NSTEMI, aggessive post-dilatation with an oversized non-compliant balloon. Prolonged balloon inflation was successful in sealing the coronary perforation, like 60% of coronary artery perforations during percutaneous treatment in acute coronary syndromes(5). At the time of the angiographic control after post dilatation, the non compliant balloon was in the catheter guide, which explain the rapidity of the management and thus absence of important pericardial effusion and hemodynamic stability, without need of reversal anticoagulation. Through this case we want to emphasize some tips and tricks in management and prevention of coronary perforation in acute coronary syndrome. It is important to recognize clinical, angiographic and technical risk factors to prevent this complication. plaque instability and the use of a glycoprotein IIb/IIIa receptor antagonist increases the risk of perforation in acute coronary syndrome.Balloon and stent oversizing contributed in several cases (21), the use of intravascular imaging, especially in challenging case ,may appropriate the good sizing and potentially reduce the incidence for large vessel perforation. We suggest the trick of keeping the balloon in the guide catheter after post dilation or stent deployment until a comforting angiographic control. If there is an extravasation, an immediate blocking balloon were be in place quickly.

Earlier recognition and treatment of tamponade and hemodynamic instability improved acute survival(2), hence call for help than echocardiographer, surgeon and anesthetist is importante, especially in case of type III CAP. Echocardiography should be repeated during the next 24 hours to rule out late tamponad (2,3). Interventional cardiologists should master the algorithm of CAP management (figure5) and they must be familiar with available general and specific treatment options. Heparin reversal is not systematic and should be avoided until after all equipment is removed from the coronary artery, to minimize the risk for coronary thrombosis, and pericardial coagulum (22). Continuation of anti-platelet agents after the successful management of CAP may be encouraged, especially in case of ACS with their procoagulant status(5).

CONCLUSION

CAP is an infrequent complication but associated with high morbidity and mortality, requiring rapid diagnosis and angiographic classification. immediate blocking balloon may seal most CAP, if it is not efficient, we may attempted for covered stents,coiling and other techniques to reduce pericardial effusion and avoid sergery. Finally, it is worth stressing the importance of caution that must be exercised during dilatation of the coronary lesion either before, during, or after stent implantation while advancing guide wires, especially in patient with more than one risk factor of CAP.

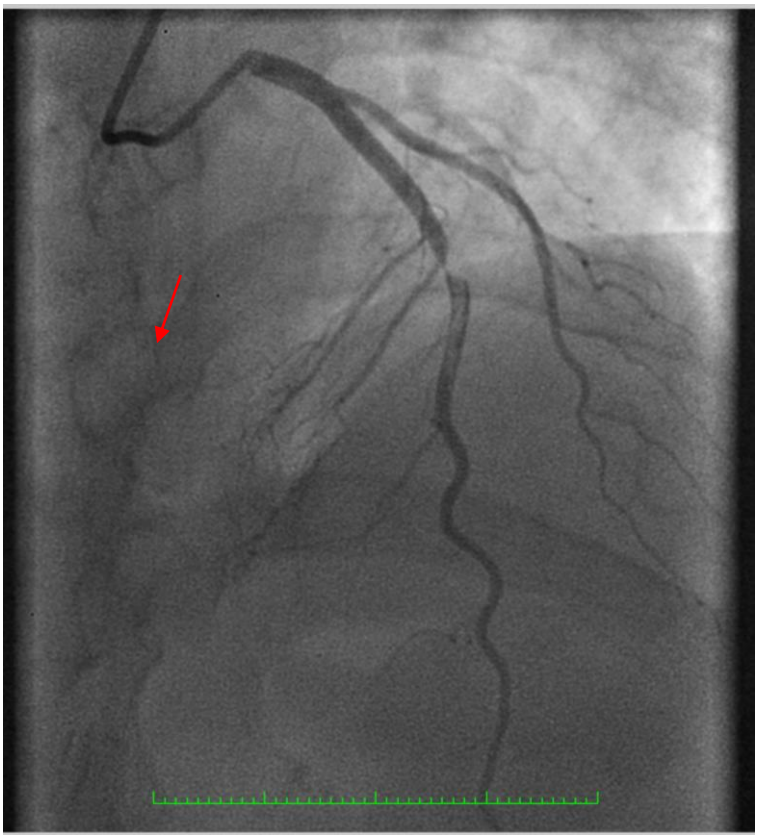


Figure 1: Emergent angiogram taken from cranial projection demonstrating a sub occlusive stenoses in mid-LAD and thrombus burden and III TIMI flow (red arrow).

(a) **(b)** **(c)**

Figure 2: Angiograms showing stent deployment(a) and residual stenoses in stent (b) ,requiring post dilatation (c).

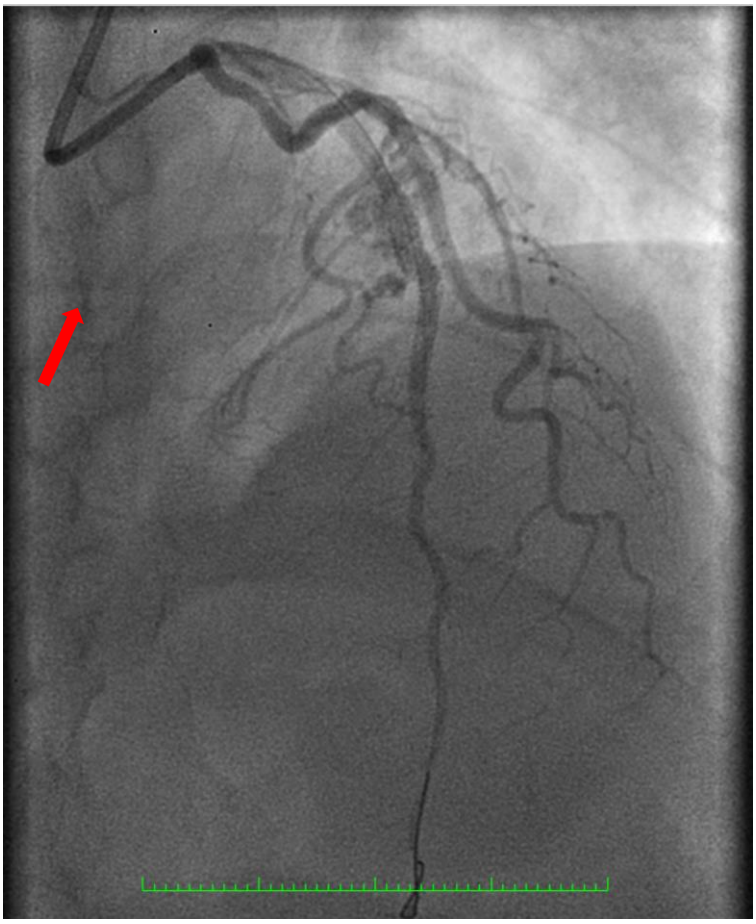
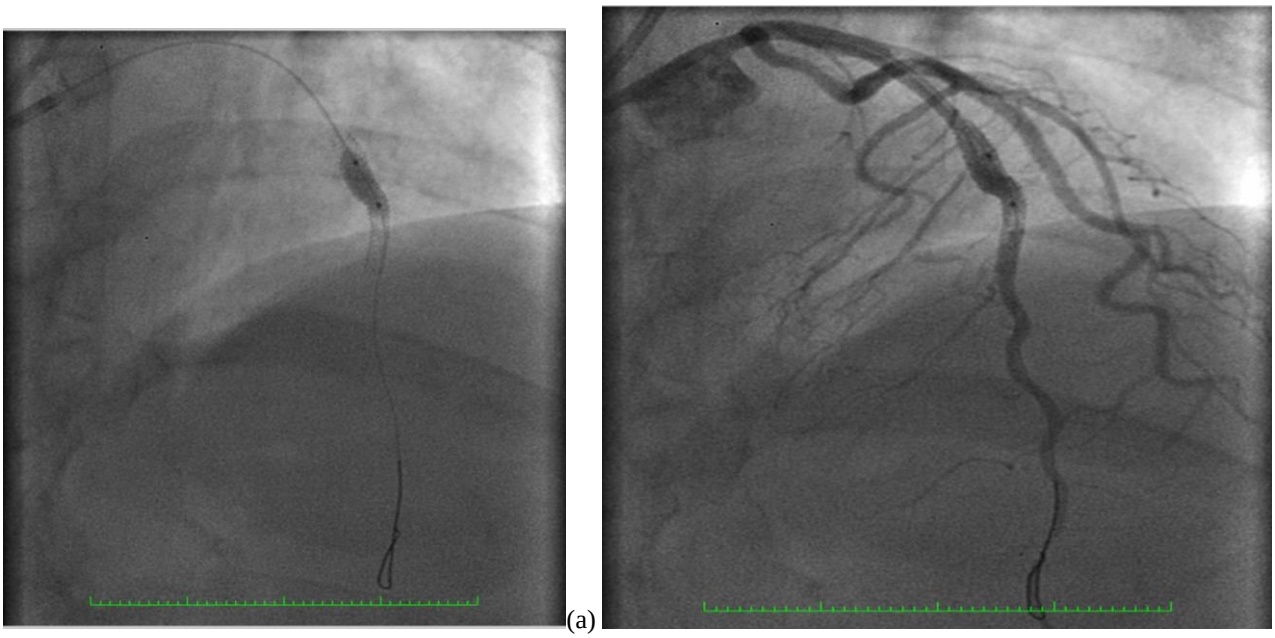


Figure 3: Angiogram showing coronary perforation Elis type II(red arrow).



(a) (b)

Figure 4: Angiograms showing prolonged inflation balloon (a) and sealing of CAP after 5min later (b).

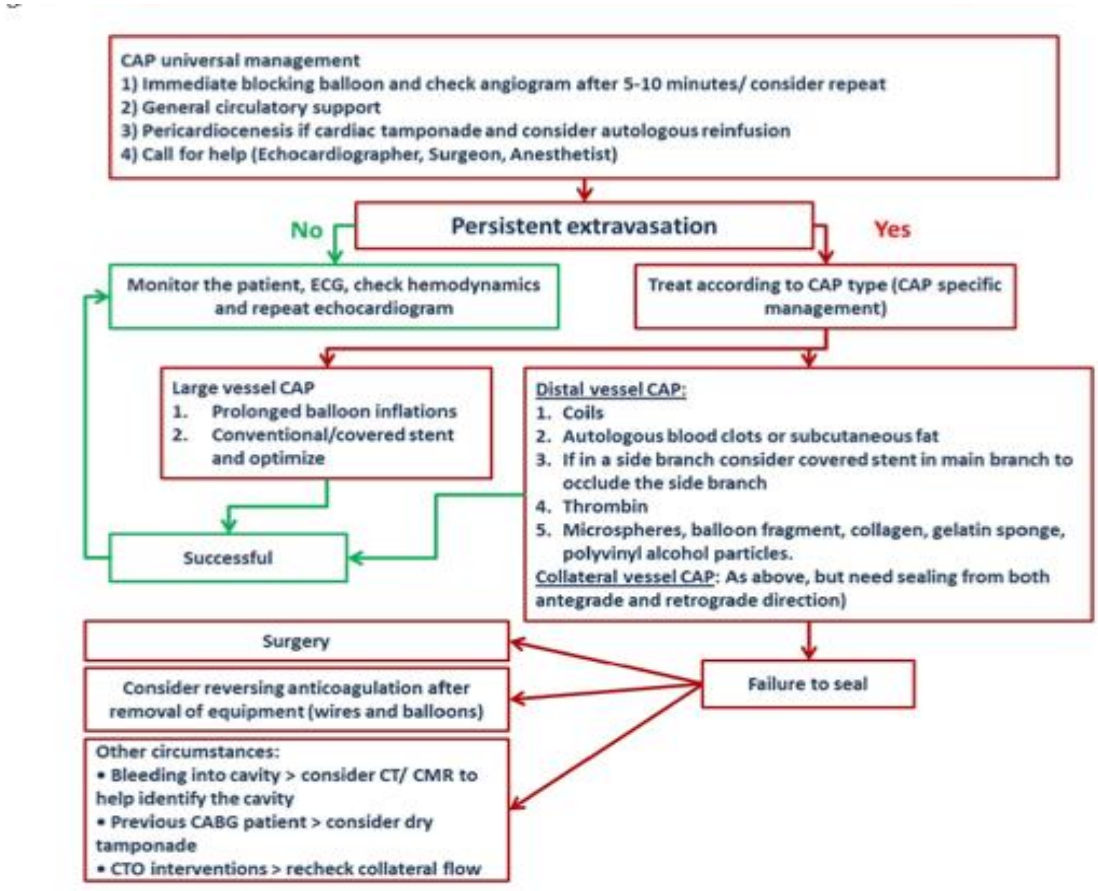


Figure 5: Universal and type-specific coronary artery perforation management algorithm (6).

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