¹ Departamento de Cardiologia
Intervencionista, Hospital São Paulo, Escola
Paulista de Medicina, Universidade Federal
de São Paulo, São Paulo, SP, Brazil.

Conservative type III coronary perforation management: when the basic treatment is life-saving

Conduta conservadora na perfuração coronária tipo III: quando o tratamento básico salva vidas

Marcos Danillo Peixoto Oliveira^{1ID}, Valter Trigueiro^{1ID}, Igor Ramon Batista^{1ID}, Adriano Caixeta^{1ID}

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ABSTRACT – Coronary artery perforation is a rare but potentially lethal complication of percutaneous coronary intervention, mainly due to hemodynamic compromise secondary to cardiac tamponade development. All interventional cardiologists must thus be able to promptly recognize and solve coronary artery perforation. We describe a successfully and conservatively managed type III coronary artery perforation with prolonged balloon inflations, in the absence of covered stents and without compromising the percutaneous coronary intervention result by anticoagulation reversal.

Keywords: Coronary artery perforation; Management; Percutaneous coronary intervention/adverse effects

RESUMO – A perfuração da artéria coronária é uma complicação rara, mas potencialmente letal, da intervenção coronária percutânea, sobretudo pelo comprometimento hemodinâmico secundário ao desenvolvimento de tamponamento cardíaco. Todos os cardiologistas intervencionistas devem ser capazes de reconhecer e resolver prontamente a perfuração da artéria coronária. Descrevemos uma perfuração da artéria coronária tipo III tratada com sucesso e de forma conservadora, com insuflações de balão prolongadas, na ausência de stents recobertos, e sem comprometer o resultado da intervenção coronária percutânea pela reversão da anticoagulação.

Descritores: Perfuração da artéria coronária; Manejo; Intervenção coronária percutânea/efeitos adversos

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Corresponding author:

Adriano Caixeta
Rua Napoleão de Barros, 715 –
Vila Clementino
Zip code: 04024-002 – São Paulo, SP, Brazil
E-mail: acaixeta@me.com

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INTRODUCTION

Iatrogenic coronary artery perforation (CAP) is a rare but potentially life-threatening complication of percutaneous coronary intervention (PCI). The risk of CAP is increased in women, elderly and complex coronary anatomies, and related to oversized balloons or stents, excessive post-dilation, atheroablative devices and hydrophilic guidewires.¹ Therefore, CAP risk is directly proportional to the complexity of the PCI procedure. The lethal potential of CAP stems from the hemodynamic compromise due to ensuing cardiac tamponade.²

Ellis CAP classification is by far the most commonly used. It assesses the angiographic severity and determines the risk of adverse events such as emergent cardiac surgery, myocardial infarction (MI), cardiac tamponade or death.³ Type III is the most severe form of CAP and is associated with the highest mortality rates.⁴

Interventional cardiologists should be able to promptly recognize CAP and know the treatment options available, to diminish the occurrence of complications.

The aim of this study was to describe a successfully and conservatively managed type III CAP, with simple prolonged balloon inflation, in the absence of covered stents and without compromising the final PCI result by anticoagulation reversal. This case report was approved by the Research Ethics Committee (register number: RBR-7nzkxm).

CASE PRESENTATION

A 57-year-old female patient, smoker, presenting with known hypertension, type 2 diabetes and a recent (one month before) right coronary artery primary PCI due to inferior ST-segment elevation MI (STEMI), was referred for staged left anterior descending (LAD) PCI. Left anterior descending was shown to have a long, tight and calcified proximal-mid type C stenosis (Videos 1 and 2). The procedure

was performed with an XB 3.5 6F guiding catheter via right distal transradial access, in the anatomical snuffbox (Figure 1), our standard approach for any routine coronary angiography and/or PCI.⁵⁻⁹ After adequate multiple LAD predilations with a 2.5/30mm non-compliant balloon, two drug-eluting stents (3.5/30 and 4/15mm) were deployed, with minimal overlap, at mid and proximal LAD, respectively. After high-pressure (up to 20atm) post-dilations (overlap segment and proximal stent) with a 4/15mm non-compliant balloon, control angiogram showed an unexpected, large and focal in-stent proximal LAD type III perforation, with frank pericardial drainage (Figure 2 and Video 3).

Video 1. Baseline angiogram: long, tight and calcified proximal-mid type C left anterior descending stenosis - caudal view.

Video 2. Baseline angiogram: long, tight and calcified proximal-mid type C left anterior descending stenosis - cranial view.

Figure 1. Right distal transradial access at the end of the procedure.

Figure 2. In-stent left anterior descending type III perforation (white arrow), with frank pericardial drainage.

Promptly, the same post-dilation 4/15 non-compliant balloon was reinflated (only at 4atm) just proximal to the level of the CAP (Video 4), precluding further antegrade flow. After 20 minutes, a substantial improvement was noted; after additional 20 minutes, an unexpected worsening was showed and finally, after a total of 60 minutes of persistent balloon inflation without anticoagulation reversal, a

final angiogram confirmed the CAP had been completely sealed without any residual active contrast extravasation (Videos 5 and 6). Of note, covered stents were not readily available for use. Just after final balloon deflation, an episode of ventricular fibrillation, secondary to myocardial ischemia due to prolonged LAD occlusion, was promptly reverted, with immediate return of spontaneous circulation

Video 3. In-stent left anterior descending type III perforation, with frank pericardial drainage.

Video 5. Final angiogram: sealed coronary artery perforation without any residual active contrast extravasation. Caudal view.

Video 4. Prolonged balloon inflation just proximal to the level of the coronary artery perforation, precluding further antegrade flow.

Video 6. Final angiogram: sealed coronary artery perforation with no residual active contrast extravasation. Cranial view.

and no neurological, hemodynamic or ventilatory damage. Immediate transthoracic echocardiogram (TTE) showed a diffuse and mild pericardial effusion (9mm), without any signs of hemodynamic compromise. The same was noted during the subsequent two days, at the intensive cardiac care unit, with frequent and repeated TTE evaluations, to monitor the extension of the pericardial effusion, which remained stable. At hospital discharge, on the fourth post-PCI day, the diffuse pericardial effusion was limited to 7mm. At one-week follow-up medical appointment, she was completely stable and asymptomatic, with normal ECG and physical examination.

DISCUSSION

Coronary artery perforation is associated with high morbidity and mortality. Hemodynamic status, CAP location, individual coronary anatomy, the amount of myocardium at risk, and patient's ability to undergo cardiac surgery should determine the treatment strategy.^{2,4}

Lemmert et al. described their 11-year experience about clinical characteristics and management of CAP.² Out of 21,212 PCI procedures, CAP was identified in 150 (0.71%). Mean age of patients was 66±11 years, and 62.7% were male. The most common lesion type was B2/C (94.6%); in that, 31.3% were chronic total occlusions. The CAP variants were Ellis type I in 2.9%, type II in 40.4%, type III in 54.8%, and type III cavity spilling in 1.9%. As in the present case, CAP management 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% of cases, respectively. Pericardiocentesis due to cardiac tamponade was required for 72 patients (48.0%), of which 28 cardiac tamponade were initially unrecognized. Twelve patients (12.7%) required emergency cardiac surgery to alleviate cardiac tamponade. All-cause mortality rates were 8.0% (in-hospital), 10.7% (at 30 days) and 17.8% (at 1 year).

Al-Lamee et al. reported incidence, predictors, treatment, and long-term outcomes of 56 (0.2%) out of all 24,465 patients with specific type III CAP as a complication of PCI. Most lesions were complex – 44.6% of type B2, 51.8% of type C and 28.6% of chronic total occlusions. The device causing CAP was balloon in 50%, guidewire in 17.9%, rotator in 3.6% and directional atherectomy in 3.6%. Immediate treatment and success rates were, respectively: prolonged balloon inflation 58.9% and 54.5%; covered stent 46.4% and 84.6%; surgical repair 16.0% and 44.4%; and coil embolization 1.8% and 100%. Multiple methods were required in 39.3%. During the procedure, 19.6% required cardiopulmonary resuscitation and 3.6% died. In-hospital major adverse cardiac events rate was 55.4%.⁴

In the present case, the in-stent LAD CAP was probably consequent to lesion characteristics associated to post-dilation balloon oversizing. Prolonged proximal balloon

inflation (1:1 balloon:vessel ratio) allows the operator to gain time, and multiple sessions may be required, like in the present case. Most Ellis types I and II CAP can be treated with this minimal, relatively conservative approach, especially more distal CAP caused by guidewire exits. Rapidly increasing pericardial effusion and frank cardiac tamponade justify early pericardial drainage.²⁻⁴

Covered stents have an important role as bailout treatment of CAP, especially when located in the proximal vessel segments, generally caused by oversized or aggressive use of balloons or devices. The main objective of a covered stent is to seal the perforation with a layer impermeable to blood.²⁻⁴

Systematic echocardiographic monitoring is recommended in order to screen for pericardial effusion and fast pericardiocentesis in case of cardiac tamponade. Echocardiography should be repeated during the next 24 hours to rule out late tamponade, as described, for example, by Ellis et al. and Lemmert et al. In their cohort, there was need for pericardiocentesis in 32.9% of patients after an initial conservative approach, and in 52.8% after placement of a covered stent. When further actions are required, CAP location and severity play decisive roles. In general, proximal CAP requires covered stents or surgical repair, and distal CAP, caused by guidewire exits, can be treated with embolization therapies including coils, microspheres, thrombin, and autologous fat or blood.^{2,3}

In conclusion, type III CAP is an unusual but dreaded PCI complication which can be conservatively managed with simple prolonged balloon inflation, not compromising the final PCI result by anticoagulation reversal, especially when covered stents are not readily available.

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CONFLICTS OF INTEREST

The authors declare there are no conflicts of interest.

CONTRIBUTION OF AUTHORS

Conception and design of the study: MDPO and AC; data collection: MDPO, VT and IRB; data interpretation: MDPO, VT, IRB and AC; text writing: MDPO and AC; approval of the final version to be published: MDPO, VT, IRB and AC.

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