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Case report

Coronary artery perforation: How to treat it?

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ABSTRACT

Coronary artery perforation fortunately represents a rare complication of coronary catheterization but, if not properly and promptly treated, it is burdened by a high mortality rate. Rates of coronary perforation may be potentially higher when atherectomy devices are used or very complex calcified lesions are treated. Cardiac tamponade constitutes the most severe clinical consequence.

We report the case of an intra-stent coronary perforation at the end of revascularization of a non-ST elevation myocardial infarction (NSTEMI), followed by an immediate impairment of hemodynamic compensation, due to significant pericardial effusion and subsequent cardiac tamponade.

The use of covered stents has revolutionized the management of coronary perforation and this has meant that the use of emergency CABG has decreased over the years with satisfactory immediate and short-term outcomes, reducing the incidence of acute cardiac tamponade and mortality without surgery.

Introduction

Percutaneous coronary intervention (PCI) is today the gold standard for treatment of coronary lesions, however the possible complications deserve proper attention and treatment modality. Coronary perforation represents fortunately a rare complication (incidence among 0.2–0.6%) and it is burdened by a high mortality rate if not properly and promptly treated [1,2].

We report the case of an intra-stent coronary perforation at the end of revascularization of a non-ST elevation myocardial infarction (NSTEMI), followed by immediate impairment of hemodynamic compensation due to significant pericardial effusion and subsequent cardiac tamponade.

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Case report

We present the case of a 67-year-old Caucasian man with arterial hypertension, and also a former smoker, who in 2008 was admitted to our department for lateral NSTEMI. A coronary angiography was performed in our catheterization laboratory with the evidence of critical stenosis (70–90%) of the distal left anterior descending (LAD) coronary artery, which also appeared dilated with a sequence of moderate stenosis at the middle segment. An occlusion of the distal left circumflex artery (LCX) was also present rehabilitated by collateral homocoronaric circulation and moderate stenosis of the right coronary artery (RCA).

After an ineffective attempt at revascularization of the distal LCX, the patient was discharged after medical therapy optimization (aspirin, beta-blocker, ACE inhibitor, statin, ranitidine).

Due to the persistent unstable angina, a myocardial scintigraphy was performed in January 2013 which showed moderate/severe inducible ischemia with low workload involving the inferolateral myocardial wall. The patient refused a further coronary angiography.

In November 2013 he was referred to our emergency room because of the onset of localized pain in the left shoulder. A diagnosis of NSTEMI was made (ST segment depression in the anterior side extended max 3 mm in V3-5, ST segment elevation max 1 mm in aVR) (Fig. 1) and he was transferred to our cardiology care unit (CCU).

At admission Troponin I was 0.035 ng/ml (normal value <0.012 ng/ml), eGFR (MDRD) 65.4 ml/min/1.73 mq, Killip class 1 and high GRACE risk score (153).

The patient was treated with acetylsalicylic acid (300 mg orally) and subcutaneous enoxaparin (6000 IU); an urgent coronary angiography with right femoral artery access was performed showing extremely calcified coronary vessels, and critical stenosis of middle LAD with occluded apical segment rehabilitated by collateral homocoronaric circulation (Fig. 2, panels A and B). Distal LCX and obtuse marginal (OMB) were occluded and rehabilitated by homocoronaric collateral circulation (Fig. 2, panel C), a RCA with critical stenosis along its posterolateral and posterior interventricular branches of small caliber (Fig. 2, panel D).

So we decided to administer prasugrel 60 mg orally and to perform PCI on middle LAD beyond the critical and extremely calcified stenosis with the guide wire BMW ABBOTT (a second ABBOTT BMW guide wire placed on diagonal branch) and with implantation of a bare metal stent (BMS) MULTI-LINK ABBOTT 5 mm × 18 mm (issued to 16 atm, estimated stent diameter 5.33 mm).

At the end of first BMS implantation, we observed an aspect of minus in the stenosis downstream to the distal edge (plaque shift, stenosis accentuation?), so we proceeded to implantation of an overlapping BMS MULTI-LINK ABBOTT 4.5 mm × 18 mm (issued to 14 atm, diameter reached 4.8 mm) and post-expending the point of overlap with the balloon of the second stent. Angiography performed after implantation of these two overlapping BMS showed the presence of intra-stent coronaric perforation type III [1] with hemorrhage (Fig. 3, panels A and B) and progressive and rapid reduction in blood pressure and bradycardia. Due to rapid hemodynamic destabilization, after the placement of an intra-aortic balloon pump (IABP), a covered stent GRAFTMASTER (Jostent Graftmaster, Abbott Vascular) 4.5 mm × 16 mm (inflated up to cover the perforation) was placed (Fig. 4) but the angiographic acquisitions in the course of the placement of the covered stent and at the end of the placement revealed multiple perforations (difficult to assess precisely because of severe hypotension, systolic blood pressure 60 mmHg) with slow flow in the middle-distal segment of LAD (Fig. 5). For this reason we proceeded to the positioning of an overlapping covered stent GRAFTMASTER 4.5 mm × 19 mm. A subsequent

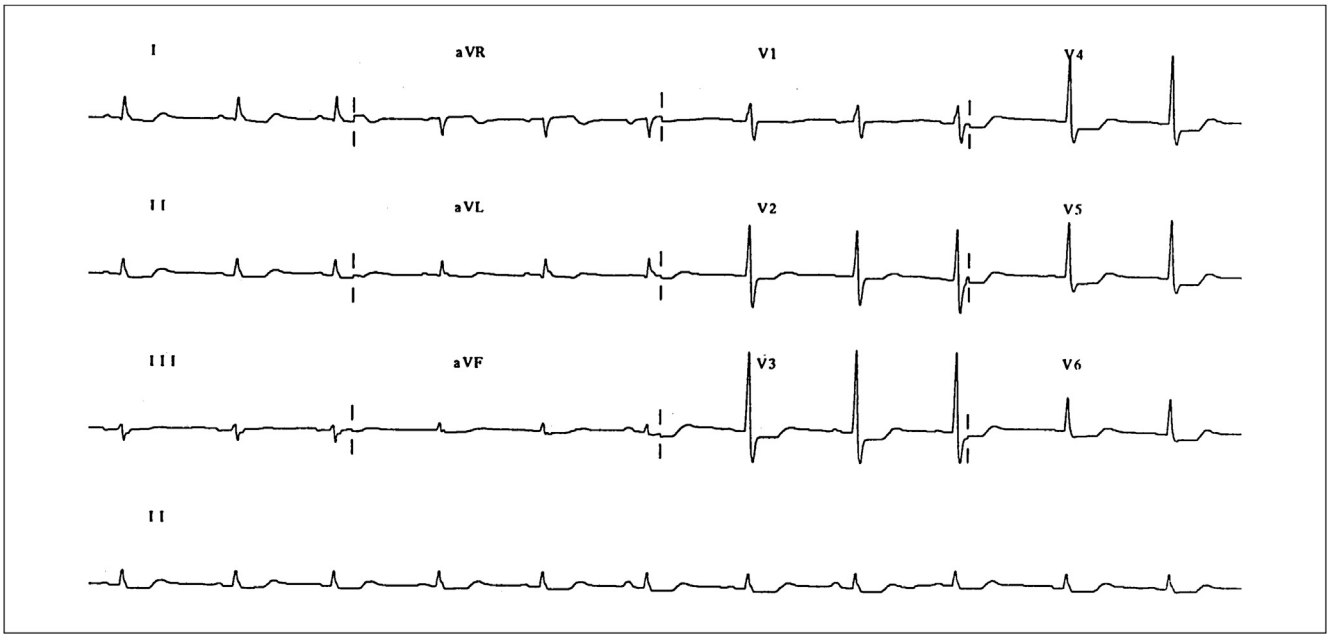

Fig. 1 – ECG at the admission.

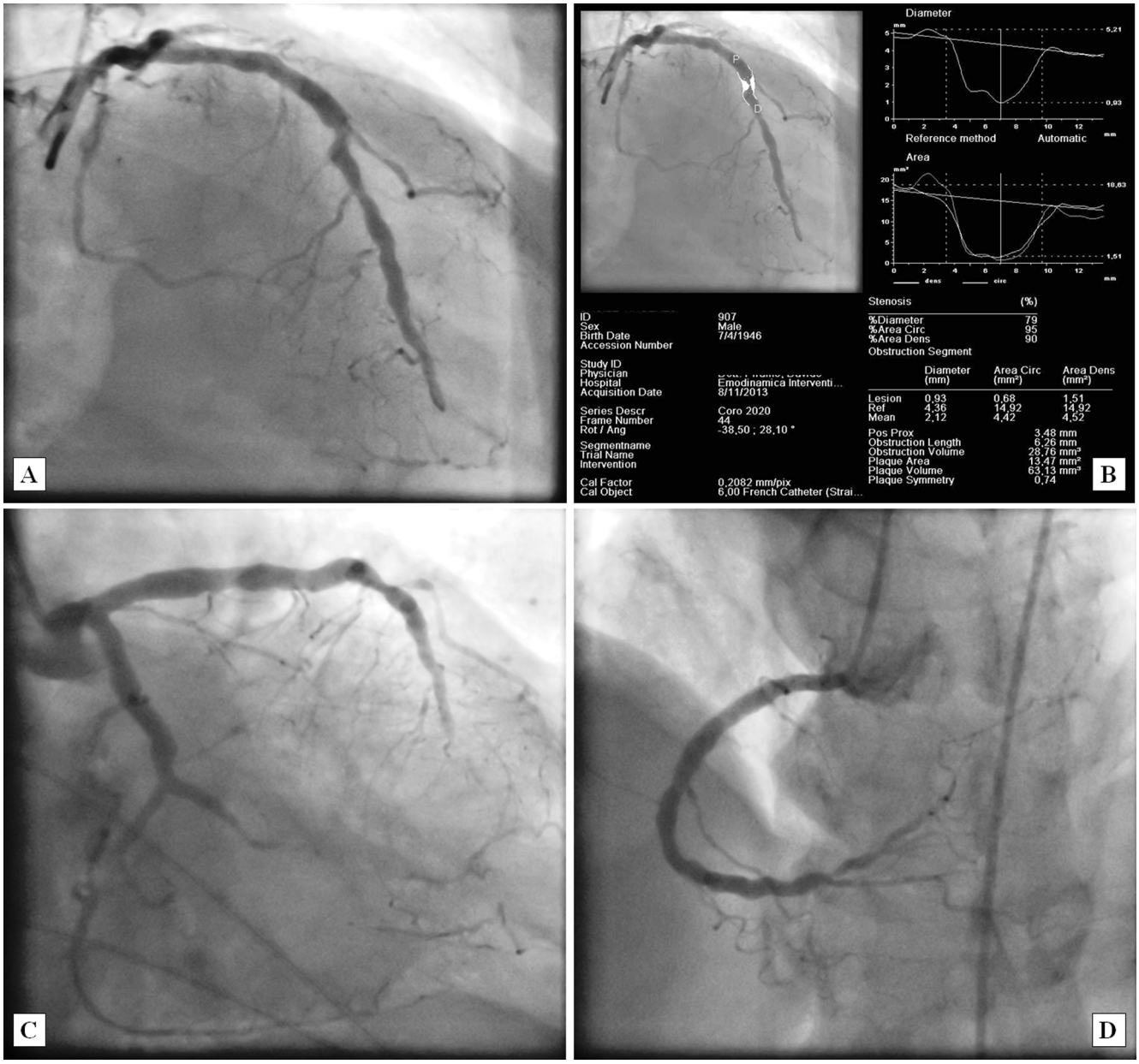

Fig. 2 – Panels A and B: Coronary angiography showing extremely calcified coronary vessels, critical stenosis of middle LAD with occluded apical segment rehabilitated by collateral homocoronaric circulation. Panel C: Distal left circumflex artery and obtuse marginal occluded and rehabilitated by homocoronaric collateral circulation. Paned D: Right coronary artery with critical stenosis along its posterolateral and posterior interventricular branches of small caliber.

angiogram has showed an adequate control of the perforated segments of the LAD (Fig. 6).

Meanwhile, because of cardiac tamponade confirmed by echocardiography (38 mm pericardial effusion with collapse of the right cavities), pericardiocentesis was performed (subxiphoid approach) with aspiration of 350 ml of blood and rapid improvement in hemodynamic balance (normalization of pressure and cardiac frequency). The IABP and the pericardial drainage were removed when the patient was stabilized (after 24 h, without further bleeding).

The series of ECG performed until discharge showed resolution of ST-segment depression; there was also a normalization of myocardial necrosis indices (Fig. 7). Echocardiography monitoring (post-pericardiocentesis) showed a normal size and contractility of left ventricle, and also ejection fraction at 50%, with no residual pericardial effusion.

The patient was discharged after five days of the procedure in dual antiplatelet therapy (prasugrel and acetylsalicylic acid) and at a follow-up performed after one month, he was in good clinical condition.

Fig. 3 – Panels A and B: Angiographic acquisitions performed after implantation of two overlapping BMS showing the presence of intra-stent coronaric perforation type III with hemorrhage.

Discussion

Coronary perforation is a potentially lethal although rare complication of PCI and its rates may be potentially higher when atherectomy devices are used or if very complex calcified lesion is treated [3].

The sudden accumulation of blood in the pericardial space may lead to cardiac tamponade with resulting cardiogenic shock and high mortality rate. Closure of the perforated

Fig. 4 – Angiographic acquisition performed after implantation of the first covered stent GRAFTMASTER (Jostent Graftmaster, Abbott Vascular) 4.5 mm × 16 mm (inflated up to cover the perforation).

Fig. 5 – Angiographic acquisition after positioning of the first covered stent that shows multiple perforations with slow flow in the middle-distal segment of LAD.

Fig. 6 – Angiographic acquisition after positioning of an overlapping covered stent GRAFTMASTER 4.5 mm × 19 mm showing an adequate control of the perforated segments of the LAD.

segment must therefore be immediate to limit the chain of events that could be fatal for the patient [4].

According to the Ellis classification, coronary perforations are classified as types I (extraluminal crater), II (myocardial or pericardial blushing), and III (contrast streaming or cavity spilling). Our case report appears to be a case of type III coronary artery perforation [1].

The management options of this complication should include: discontinuing glycoprotein IIb/IIIa inhibitors, heparin substitution with administration of protamine, prolonged balloon inflation across the dissection in the coronary vessel, coil embolization, placement of covered stents and surgical repair [5] (Fig. 8).

Prolonged balloon inflation, although is a therapeutic choice, may result in intra-coronary thrombosis, myocardial infarction and death [6].

Several devices have been introduced to repair the coronary perforations and the one we used is the GraftMaster stent [6,7], a device indicated for use in the treatment of free perforations. This covered stent, constructed using a sandwich technique, consists of a biocompatible and expandable polytetrafluoroethylene layer sandwiched in between two coaxial stainless steel stents, which are then pre-mounted on a balloon catheter delivery system.

Although in a type III coronary perforation with hemodynamic compromise the CABG emergency intervention may be indicated, due to the elevated risk of this complication and to the speed of its evolution [8], the time needed to prepare the operating room might be too long.

In this case, the placing of a graftmaster stent has allowed us to keep the patient alive thanks to a rapid correction of the hemorrhage, giving us the time to perform pericardiocentesis and to solve the cardiac tamponade with an immediate recovery, an efficient ventricular contractility and a good hemodynamic compensation. The IABP placement was also possible despite the presence of abdominal aorta aneurysm (AAA) under the kidney.

So, although CABG is an excellent treatment in type III Ellis perforation, the use of covered stents represented an alternative and quicker treatment. Experience about the use of covered stents may provide an option to save valuable time for this serious complication [9], therefore (as reported by

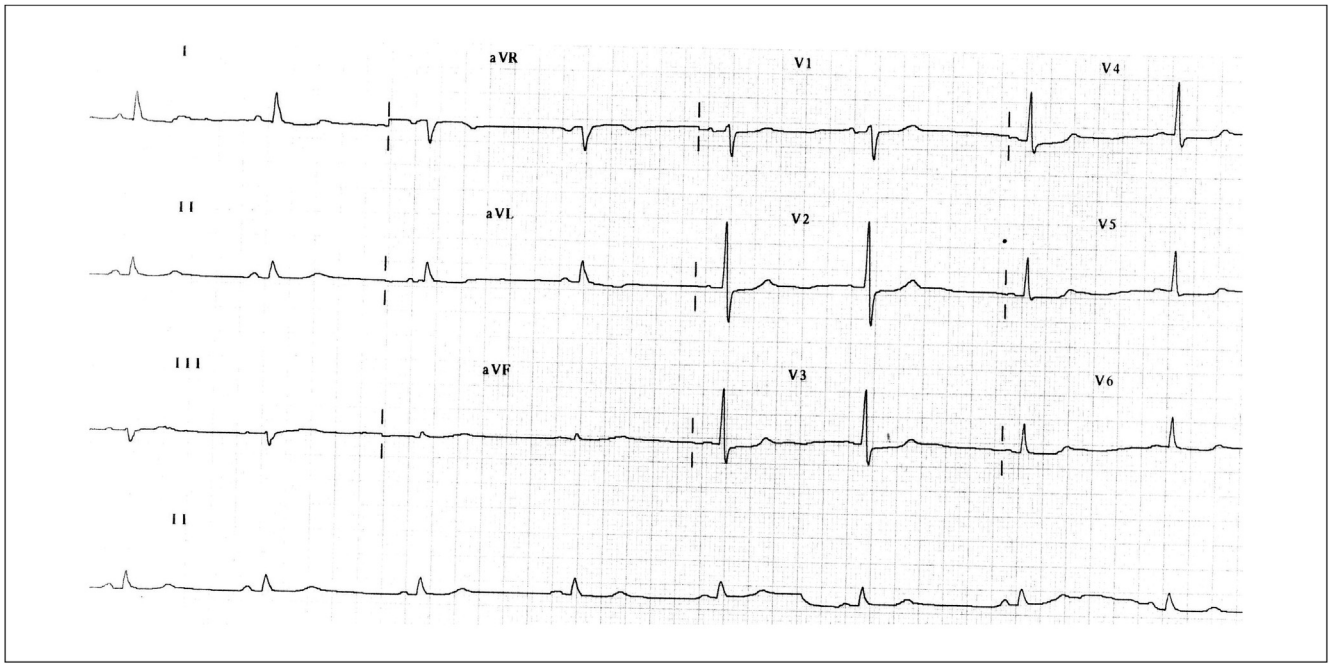

Fig. 7 – ECG performed before discharge showing resolution of ST-segment depression.

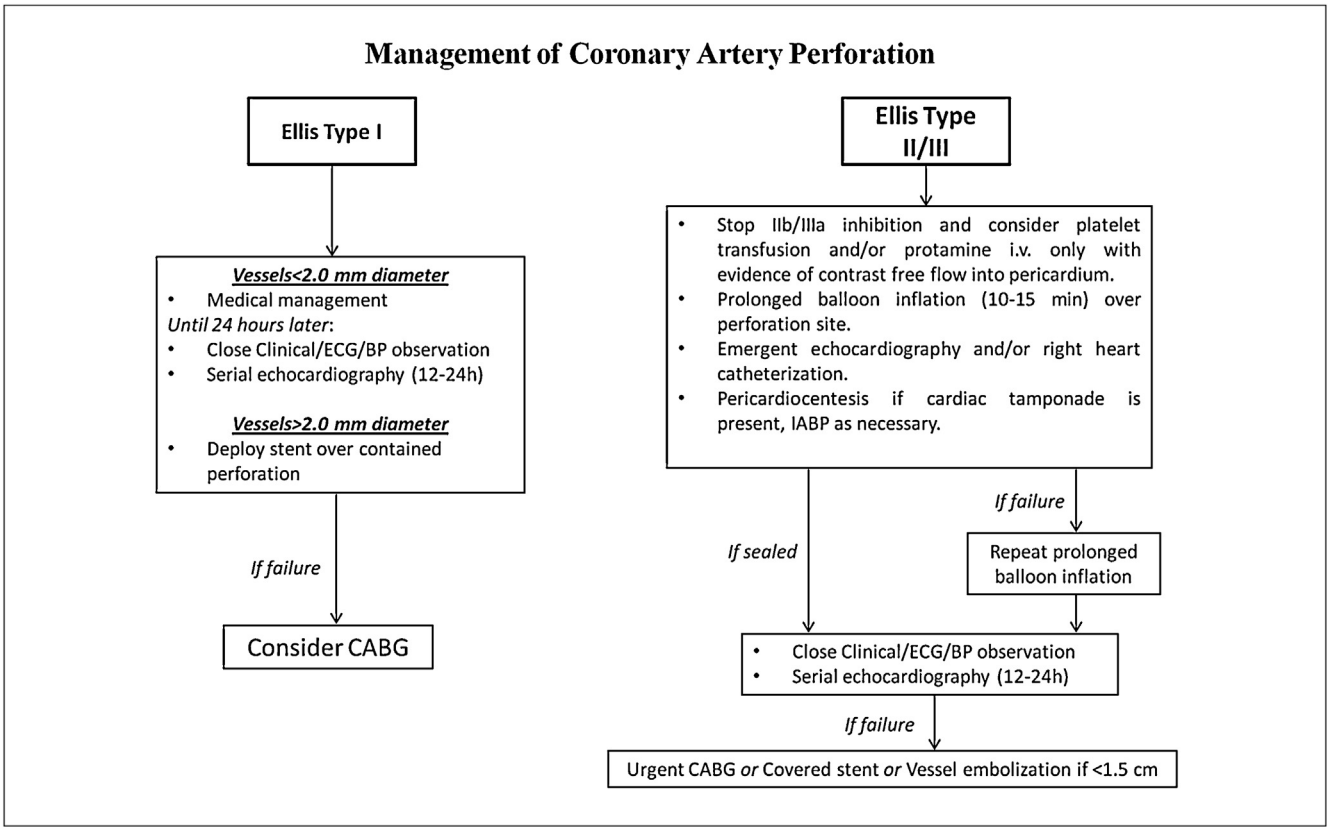

Fig. 8 – Management of coronary artery perforation.

Gunning and others in a retrospective study) CABG could be used as an alternative treatment when coated stent and the pericardial drainage had not corrected the initial hemodynamic compromise [3].

As regard to long-term complications, especially in type III coronaric perforation, a high incidence rate of these complications has been shown; Rasha et al., in a retrospective study of 24,465 patients undergoing percutaneous coronary intervention, have reported in 56 patients with type III coronary perforation a mortality rate of 3.6% [10].

Therefore our case report offers the following different points of reflection: faced with an acute and life-threatening type III coronary perforation, what to do? Listed therapeutic options are: prolonged balloon inflation, coated stent implantation, CABG surgical repair and embolization [11,12].

However there are various points to consider; first of all the type of injury that we have to face. Although appropriate management would appear to include the immediate placement of a perfusion balloon (if longer period available, balloon should be placed rapidly) to minimize myocardial ischemia (since some perforations can be ''sealed'') [1], a highly calcified coronary segment often does not allow to recross the lesion and the perforated segment of the stent with the balloon (used and frayed) and to make a prolonged balloon inflation; so in this case we had to discard this hypothesis and we place a covered stent (it was easy by the high caliber of the LAD).

We dropped the surgical option because of severe hemodynamic instability of the patient and because there was no enough time (even if there is, due to the low pressure it was difficult to have an adequate visualization of the involved segment to understand if the extravasation of blood had stopped after covering the overlapping implantation stent).

Resolving the coronary perforation, pericardiocentesis helped to restore the hemodynamic stability and ventricular contractility.

According to the literature regarding the type III Ellis perforations, we have not stopped dual antiplatelet therapy once the perforation was resolved [1].

Conclusions

We have described the case of a coronary stenosis perforation in a subject with acute coronary syndrome; a potentially fatal complication which in our case was successfully treated with the use of two covered stents without having to resort to surgery by CABG. The use of covered stents has meant that the use of emergency CABG has decreased over the years [13].

The use of covered stents for the endovascular repair of coronary iatrogenic injuries shows a high technical success, may be a valid alternative to surgery and can achieve favorable long-term results [14].

Conflict of interest

No conflict of interest.

Ethical statement

Authors state that the research was conducted according to ethical standards.

Informed consent

The authors declare that an informed consent was regularly obtained.

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The first two authors have equally contributed to this work.

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