CASE REPORT

Embolization of a septal branch perforation using subcutaneous fat during a percutaneous coronary intervention of chronic total occlusion by retrograde approach

Mohsen Mohandes [a,*], Sergio Rojas [a], Jordi Guarinos [a], Judit Rodríguez [a], Francisco Fernández [a], Cristina Moreno [a], Alfredo Bardají [a]

[a] Interventional Cardiology Unit, Cardiology Division, Joan XXIII University Hospital, Tarragona

[a] Spain

We describe a case of septal branch perforation during percutaneous coronary intervention of a right coronary artery chronic total occlusion. The septal branch perforation was treated with administration of autologous fat into the septal branch with significant reduction of extravasation. This treatment was followed by prolonged balloon inflation at the exit point of the septal branch in the donor artery which definitively sealed the perforation.

Keywords: Chronic total occlusion, Retrograde approach, Septal branch perforation

Introduction

Percutaneous coronary intervention (PCI) of a chronic total occlusion (CTO) by retrograde approach consists of crossing collaterals with a guidewire from a donor artery to reach a coronary segment distal to the occlusion. Recently PCI by retrograde access is being extensively used and in dedicated operators is associated with favorably high procedural success (75.3%) and low complication rates (6.8%) [1]. Septal branch perforation is a potential complication when retrograde approach is used for recanalization of a CTO. There are many reports regarding the management of coronary perforation during standard PCI using microcoils [2] and autologous blood perfusion [3]. However, there are not many communications about the use of autologous fat administration for sealing septal branch perforation during CTO-PCI. One feasible strategy to contain the perforation is to administer autologous fat through a micro-catheter and proximal to the extravasation. We

Disclosure: Authors have nothing to disclose with regard to commercial support.

Received 6 October 2015; revised 24 April 2016; accepted 14 May 2016.
Available online 28 May 2016

* Corresponding author at: Interventional Cardiology Unit, Cardiology Division, Joan XXIII University Hospital, Carrer Dr. Mallafrè Guasch 4, 43007 Tarragona, Spain.
E-mail address: mohandesmohsen@hotmail.com (M. Mohandes).

P.O. Box 2925 Riyadh – 11461KSA
Tel: +966 1 2520088 ext 40151
Fax: +966 1 2520718
Email: sha@sha.org.sa
URL: www.sha.org.sa

Peer review under responsibility of King Saud University.
URL: www.ksu.edu.sa
http://dx.doi.org/10.1016/j.jsha.2016.05.003

Production and hosting by Elsevier

report a case of septal perforation during a retrograde approach for recanalization of a CTO in which the combination of subcutaneous fat administration through the septal branch and balloon inflation in a donor artery successfully sealed the perforation.

Case report

We present a case of a 47-year-old man with high blood pressure, dyslipidemia, and smoking as coronary risk factors. He was admitted to our center due to effort angina. Echocardiography showed normal ejection fraction without hypokinetic areas in the left ventricle. A coronary angiogram revealed a total occlusion of the right coronary artery (RCA) in distal segment with collaterals arising from the left anterior descending coronary artery (LAD) through septal branches. The left coronary artery system did not have any significant lesions. The operator tried to perform PCI on RCA in the same procedure but failed to advance the wire through the occluded segment. The patient continued to be symptomatic despite

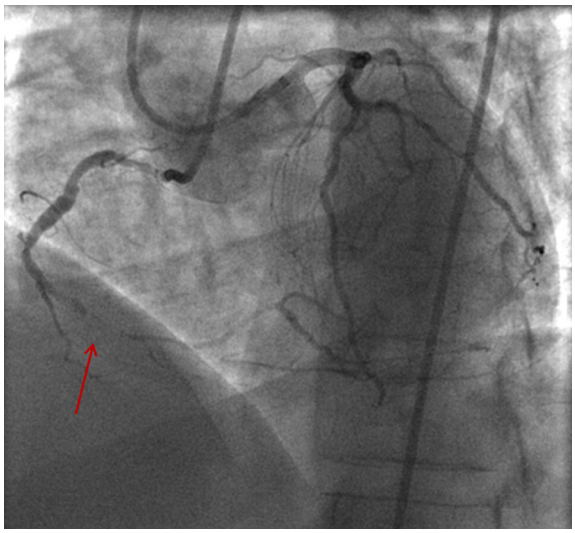

Figure 1. Total occlusion of the RCA in distal segment with microchannel. Contralateral injection from left coronary system showed septal connections filling distal part of RCA. RCA = right coronary artery.

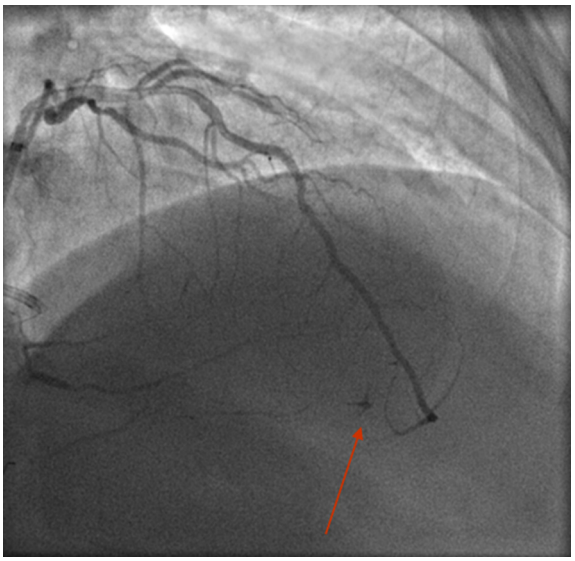

Figure 3. Angiographic control after septal collateral exploration showed septal branch perforation (arrowhead).

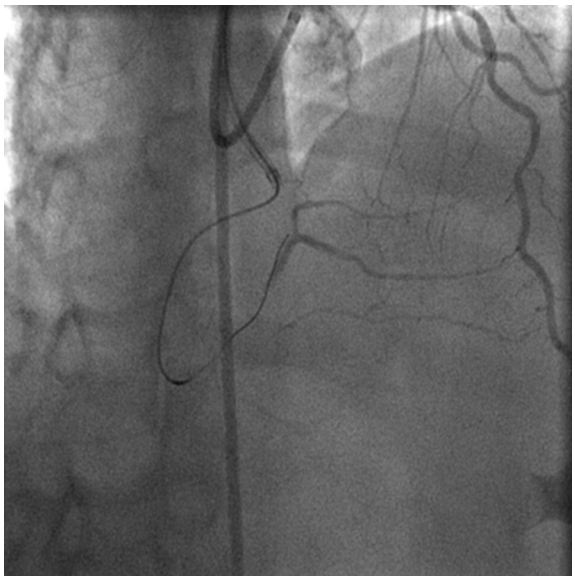

Figure 2. Contralateral injection revealed the position of antegrade wire in subintimal space.

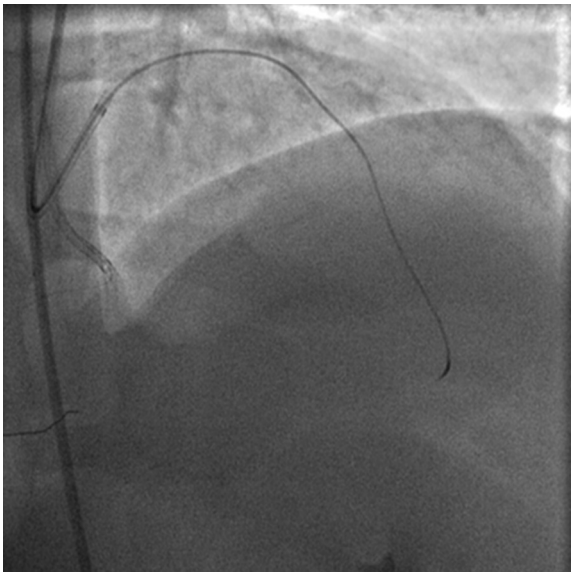

Figure 4. Corsair microcatheter positioned in proximal part of septal collateral.

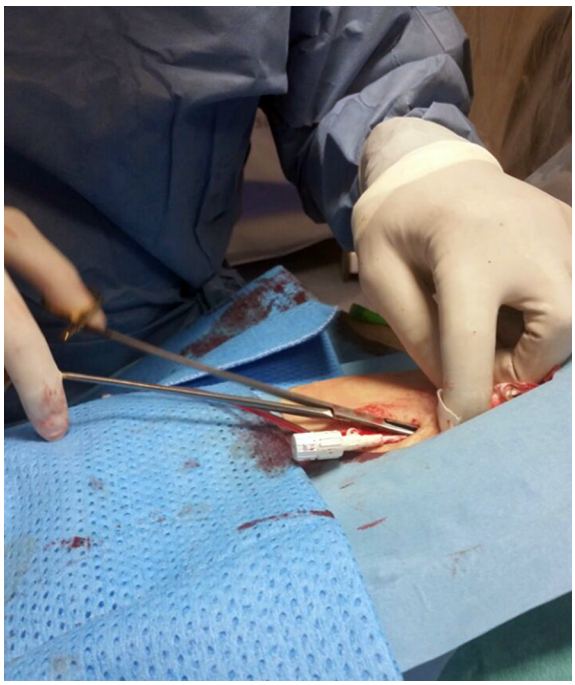

Figure 5. Subcutaneous fat extraction from femoral puncture area.

optimal medical treatment. As there were no signs of necrosis in his electrocardiogram and inferior wall motion was normal according to echocardiographic examination, a dedicated attempt to recanalize the RCA distal segment was planned 3 months later. The category of difficulty in this case according to Japan-Chronic Total Occlusion score was 2. Bilateral injection through the radial and femoral artery was used (Fig. 1) and the wire entered continuously into subintimal space (Fig. 2). Considering the septal branch connections coming from LAD and the operator's experience in retrograde approach we decided to attempt this latter strategy.

We explored septal connections originating from LAD by supraselective injection through a Corsair microcatheter (ASAHI Intecc, Aichi, Japan). We could not advance the wire through the proximal septal branch so, we tried to explore the distal connections. During wire passage through a distal branch, septal perforation was detected (Fig. 3). The wire was left in the proximal part of the septal connection and a Corsair microcatheter was advanced into the branch trying to contain the blood extravasation (Fig. 4). The patient presented with chest pain but he was hemodynamically stable.

As the extravasation did not stop following angiographic injections, we decided to extract a small amount of subcutaneous autologous fat from the femoral puncture area (Fig. 5). The sample was ground into small pieces with a scalpel and mixed with serum in a 2 cc syringe. After that, the serum containing subcutaneous fat was administered into the septal branch through the Corsair microcatheter (Fig. 6). The next angiographic control revealed a considerable reduction of extravasation but not a complete disappearance (Fig. 7). Echocardiographic examination showed

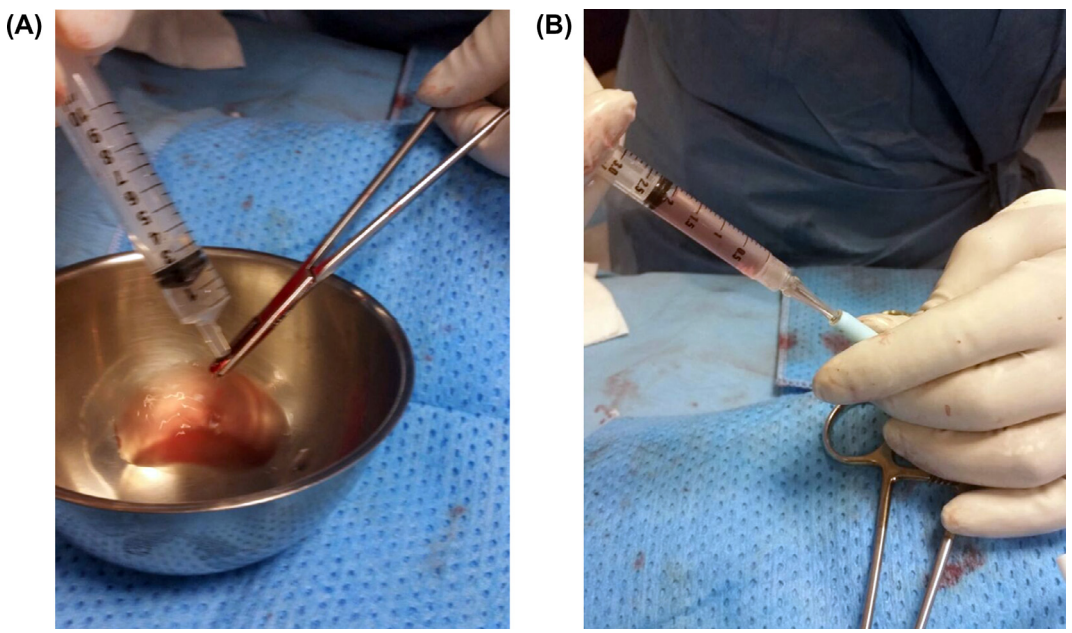

Figure 6. (A) Subcutaneous fat preparation before embolization. (B) Fat administration through Corsair microcatheter.

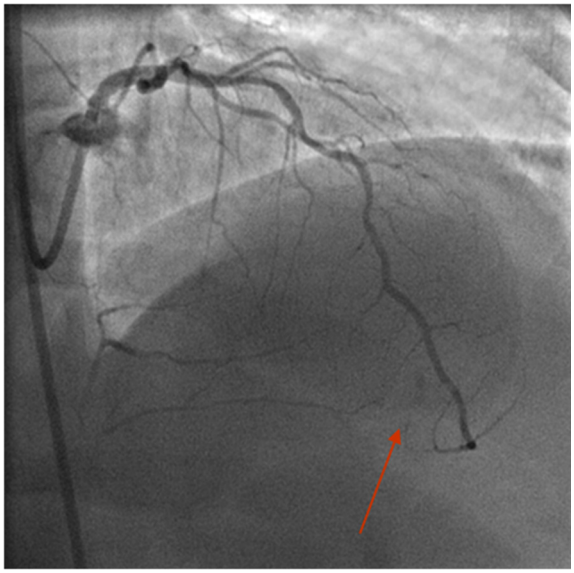

Figure 7. Mild residual extravasation after fat administration.

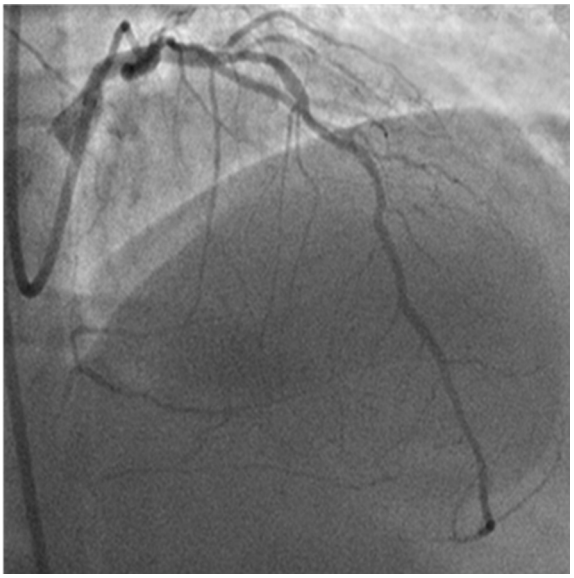

Figure 9. Complete disappearance of extravasation after balloon inflation.

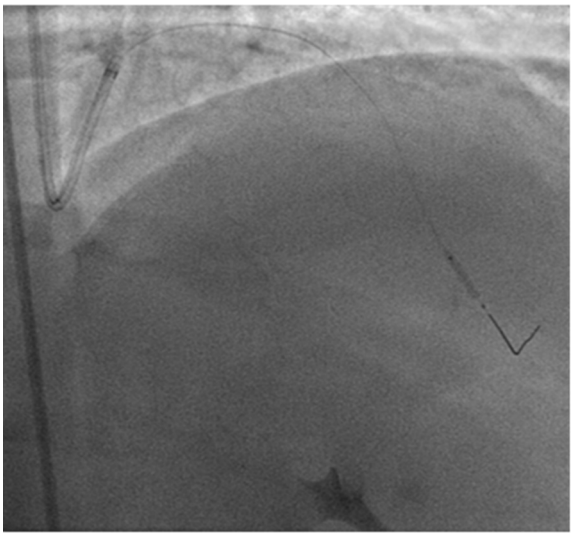

Figure 8. Balloon inflation in LAD distal segment at exit point of septal branch. LAD = left anterior descending coronary artery.

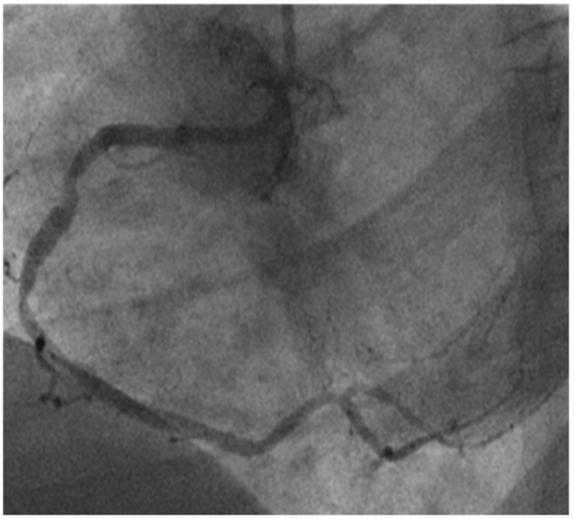

Figure 10. Final result after the second dedicated attempt using antegrade approach.

mild pericardial effusion but the patient continued to be hemodynamically stable.

Heparin was then reversed with protamine and the wire was advanced distally into LAD and a 2 × 15-mm balloon was inflated at the exit point of the septal branch for a duration of 5 minutes (Fig. 8). After this maneuver, the residual image of perforation completely disappeared (Fig. 9). The patient did not present any remarkable event during hospitalization. A second dedicated attempt was planned 1 month later and CTO was successfully recanalized with antegrade approach (Fig. 10).

Discussion

The main feature of this case report is the feasibility of autologous fat administration through a microcatheter in order to contain a septal branch perforation during a CTO-PCI by retrograde approach.

A CTO lesion can be approached in both antegrade and retrograde manner. The retrograde access has significantly increased the procedural success rates in CTO-PCI [4,5].

CTO distal cap can be reached either by epicardial collaterals or septal branches. Perforation of collaterals during a retrograde CTO-PCI is a

feared complication, especially when epicardial collaterals are used, as it can lead to rapid tamponade and hemodynamic collapse [6]. Thus, this latter complication requires an immediate treatment to seal the extravasation. Septal branch perforation rarely leads to cardiac tamponade but it could cause other complications such as septal infarction [7], ventricular septal defect [8], and obstruction of the ventricular cavity with subsequent cardiogenic shock. Rathore et al. [4], in a series of 157 patients undergoing retrograde CTO recanalization, reported a total rate of 3.8% of septal perforation.

Morisawa et al. [9] described a case of septal branch perforation during a RCA-CTO-PCI which was managed with two-coil embolization delivered proximal to the perforation site. They administered an additional autologous clot due to the persistence of extravasation. This technique achieved complete resolution of the extravasation.

In our case, the septal branch perforation occurred during the distal connections exploration with a guidewire when it accidentally entered into a thin collateral without a clear communication with RCA. This is type-CC0 septal collateral consisting of no continuous connection between donor and recipient artery according to Werner [10] classification. Rathore et al. [4] found that CC0 septal branch and nonvisibility of the connection with recipient vessel to be significant predictors of procedural failure in retrograde approach.

It is worth making several comments about the management of a septal perforation. Firstly, there is no clear consensus about when a septal perforation should be embolized. Some perforations can be conservatively managed especially when they have been caused by a guidewire. Secondly, it is reasonable to think that when a septal perforation does not have any leakage to a cavity, it could be encapsulated within the septum and a continuous extravasation may cause hemodynamic collapse despite the absence of pericardial effusion. In this situation the perforation needs prompt treatment with embolization and autologous fat is a safe, fast and available option to seal the extravasation. Thirdly, when a perforation is detected a bilateral angiographic control is needed because it is not uncommon that the perforation is fed from both sides. In these cases the embolization should be performed both from donor and recipient vessel. Fourthly, we must be very cautious with heparin reversal because it may potentially cause coronary artery thrombosis which could be catastrophic in cases of donor artery. Finally, the embolization should be gently done proximal and/or distal to but not at the perforation site in order to prevent increasing the size of the perforation [9].

Regarding epicardial perforation, an embolization strategy should be set up as soon as possible. The use of detachable-coil embolization is an adequate technique which can control this life threatening complication [11]. Besides, microspheres with its original use in other fields like intracranial vascular malformations [12] can potentially be utilized to seal small coronary perforations. In fact, detachable coils in different sizes, microspheres, along with cover stents should mandatorily be available in all catheterization laboratories with a dedicated CTO-PCI program and the operator should be familiar with their utilization.

CTO-PCI requires not only particular training but also the operator should know how to manage and properly solve all eventual complications which could be life threatening in some situations.

In the case presented here, we decided to embolize the septal branch perforation from a donor artery with a gentle administration of autologous fat through a microcatheter because in the following angiographic controls the extravasation image persisted. After this maneuver a considerable reduction of extravasation was observed. We did not embolize fat from the recipient artery because there was not any blood flow from this vessel to the perforation site. Balloon inflation in a donor artery at the site of septal exit helped to completely seal the perforation. We used protamine in order to neutralize heparin in the last 5 minutes of the procedure, although we recognize that this decision is controversial and probably could have been avoided due to its potential risk of coronary thrombosis.

Injection of autologous fat in septal branch perforation could be a safe and effective method to control extravasation, especially when the perforation is big or fails to disappear. In our case, this treatment was followed by balloon inflation at the exit point of the septal branch to completely seal the perforation. CTO operators should get used to the fat embolization technique because of its effectivity and availability when PCI by retrograde approach is performed.

References

[1] Galassi AR, Sianos G, Werner GS, Escaned J, Tomasello SD, Boukhris M, et al.. Euro CTO Club. In-hospital outcomes of percutaneous coronary intervention in patients with chronic total occlusion: insights from the ERCTO (European Registry of Chronic Total Occlusion) registry. J Am Coll Cardiol 2015;65:2388–400.

[2] Gaxiola E, Browne KF. Coronary artery perforation repair using microcoil embolization. Cathet Cardiovasc Diagn 1998;43:474–6.
[3] Komatsu I, Hirano K, Takimura H, Araki M, Yamawaki M, Nakano M, et al.. A case of coronary artery perforation with successful hemostasis using over-the-wire balloon and autologous blood perfusion. Cardiovasc Interv Ther 2013;28:197–201.
[4] Rathore S, Katoh O, Matsuo H, Terashima M, Tanaka N, Kinoshita Y, et al.. Retrograde percutaneous recanalization of chronic total occlusion of the coronary arteries: procedural outcomes and predictors of success in contemporary practice. Circ Cardiovasc Interv 2009;2:124–32.
[5] Brilakis ES, Grantham JA, Thompson CA, DeMartini TJ, Prasad A, Sandhu GS, et al.. The retrograde approach to coronary artery chronic total occlusions: a practical approach. Catheter Cardiovasc Interv 2012;79:3–19.
[6] Brilakis ES, Karmpaliotis D, Patel V, Benergee S. Complications of chronic total occlusion angioplasty. Interv Cardiol Clin 2012;1:373–89.
[7] Lin TH, Wu DK, Su HM, Chu CS, Voon WC, Lai WT, et al.. Septum hematoma: a complication of retrograde wiring in chronic total occlusion. Int J Cardiol 2006;113:e64–6.
[8] Fairley SL, Donnelly PM, Hanratty CG, Walsh SJ. Images in cardiovascular medicine. Interventricular septal hematoma and ventricular septal defect after retrograde intervention for a chronic total occlusion of a left anterior descending coronary artery. Circulation 2010;122:e518–21.
[9] Morisawa D, Okamura A, Date M, Nagai H, Iwakura K, Fujii K. Treatment of collateral channel perforation during percutaneous coronary intervention for chronic total occlusion with retrograde approach. Cardiovasc Interv Ther 2014;29:86–92.
[10] Werner GS, Ferrari M, Heinke S, Kuethe F, Surber R, Richartz BM, et al.. Angiographic assessment of collateral connections in comparison with invasively determined collateral function in chronic coronary occlusions. Circulation 2003;107:1972–7.
[11] Boukhris M, Tomasello SD, Azzarelli S, Elhadj ZI, Marzà F, Galassi AR. Coronary perforation with tamponade successfully managed by retrograde and antegrade coil embolization. J Saudi Heart Assoc 2015;27:216–21.
[12] Jankowitz BT, Vora N, Jovin T, Horowitz M. Treatment of pediatric intracranial vascular malformations using Onyx-18. J Neurosurg Pediatr 2008;2:171–6.