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CASE REPORT

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Absorbable Suture Embolization in Distal Coronary Perforation

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ABSTRACT

Coronary artery perforation is a rare but serious complication during percutaneous coronary intervention. Distal or small vessel perforation is usually treated by coil, fat, or microsphere embolization. We describe 5 cases of distal coronary perforation that were managed successfully by a novel technique that uses absorbable sutures. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2022;4:133–136) © 2022 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Coronary artery perforation (CAP) during percutaneous coronary intervention (PCI) is uncommon; however, the frequency increases with complex intervention.[1] The incidence of CAP is estimated to be between 0.1% and 0.7% and is associated with increased morbidity and mortality.[1,2] For large vessel perforation, covered stents and prolonged balloon inflation may be used to seal the perforation. For small vessel CAP, covered stents to block feeding branches, coils, fat embolization, microspheres, or watchful observation after prolonged balloon inflation are all described methods to control distal or small vessel perforation.[3] All these techniques are used to control the source of extravasation, reduce morbidity and mortality, and avoid the need for urgent cardiac surgery.[1-3] Chronic total occlusion (CTO) PCI is associated with increased risk of CAP because of the use of guidewires with greater penetration force.[4,5] In this case series, we used absorbable 3.0 Vicryl sutures to successfully manage distal wire CAP (Table 1).

LEARNING OBJECTIVES

- To describe a novel, readily available, rapid, and inexpensive method in managing distal CAP.
- To learn the importance of step-down strategy in CTO wiring to avoid distal CAP.

TABLE 1 Cases of Distal Perforation Managed Successfully by Absorbable Suture Distal Embolization

Patient #, Age (y), Gender	Coronary Artery	Coronary Guidewire
1, 72, F	PLB of RCA (CTO)	Fielder XT-R
2, 68, M	LCx (CTO)	Gaia first
3, 75, M	PLB of RCA (CTO)	Fielder XT-A
4, 58, M*	PDA of RCA	Runthrough NS
5, 65, M	RCA	Sion

*The CorsairPro microcatheter was used in this patient.

CTO = chronic total occlusion; LCx = left circumflex artery; PDA = posterior descending artery; PLB = posterolateral branch; RCA = right coronary artery.

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ABBREVIATIONS AND ACRONYMS

CAP = coronary artery perforation

CTO = chronic total occlusion

LCx = left circumflex artery

PCI = percutaneous coronary intervention

PLB = posterolateral branch

RCA = right coronary artery

PATIENT 1

A 72-year-old woman with a background history of atrial fibrillation, diabetes, dyslipidemia, and hypertension was admitted with an acute coronary syndrome. Angiography revealed 3-vessel coronary artery disease with CTO of the right coronary artery (RCA). The patient declined coronary artery bypass grafting and elected for percutaneous revascularization.

During PCI to RCA CTO, a 6-F JR4 guide was used with an antegrade wire escalation approach, with the use of Sion Blue, Fielder XT-A, and Gaia Third guidewires through a Caravel microcatheter. Finally, a Fielder XT-R wire was positioned in the posterolateral branch (PLB). Distal perforation in the PLB was noted after RCA stent deployment. The perforation was controlled with 5 pieces of 5- to 6-mm 3.0 absorbable sutures inserted through the microcatheter. The perforation was controlled, with no hemodynamic instability, and minimal pericardial effusion was noted. The patient was in stable condition and was discharged 2 days after the procedure (Videos 1A, 1B, and 1C).

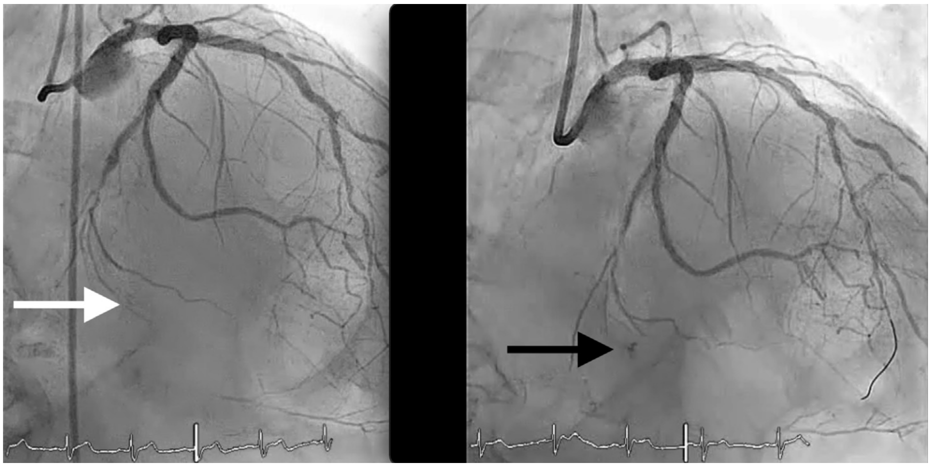
PATIENT 2

A 68-year-old man with a background of stable coronary artery disease, diabetes mellitus, hypertension, and dyslipidemia underwent angiography. The patient had previously undergone PCI to the left anterior descending artery, the left circumflex artery (LCx), and the obtuse marginal branch. After the patient had presented with recurrent angina, an elective coronary angiogram demonstrated a patent left anterior descending artery stent and confirmed subtotal occlusion of the LCx resulting from in-stent restenosis. The patient underwent PCI to LCx by use of a Caravel microcatheter and wire escalation from Runthrough NS wire to Gaia First. After dilatation and the use of a drug-coated balloon to manage the in-stent restenosis, distal LCx perforation was noted. A small pericardial effusion was noted on a bedside echocardiogram; however, the patient remained in hemodynamically stable condition. By use of a microcatheter and Runthrough NS guidewire, 4 pieces of 5- to 6-mm 3.0 absorbable suture were delivered to occlude the distal LCx and control the distal perforation. The patient was admitted to the coronary care unit and discharged after 2 days. An angiogram 1 month later showed partial restoration of flow in the small distal branch (perforation site) (Videos 2A, 2B, and 2C, **Figure 1**).

PATIENT 3

A 75-year-old man was admitted for elective coronary angiogram after investigation for exertional shortness of breath. The patient had a background of diabetes and dyslipidemia. A coronary angiogram revealed subtotal occlusion of the distal RCA, with retrograde filling from the left coronary system. The patient underwent PCI to RCA by use of a 6-F JR 3.5 guide.

FIGURE 1 Patient 2



(Left) perforation site **(black arrow)**. **(Right)** partial restoration of flow 1 month later **(white arrow)**.

FIGURE 2 **Required Equipment**

Scissors, workhorse guidewire, microcatheter, 3.0 Vicryl sutures, guidewire introducer, heparinzed saline, syringe.

The distal RCA lesion was crossed with use of a Caravel microcatheter and Fielder XT-A, with guidewire placed in the PLB. Distal PLB perforation was then noted. The Fielder XT-A guidewire was then exchanged with Runthrough NS guidewire by use of the microcatheter. A total of 6 pieces of 5- to 6-mm 3.0 absorbable suture were delivered through the microcatheter, which then occluded the distal PLB. Echocardiography showed minor pericardial effusion only. The patient was discharged 48 hours later (Videos 3A and 3B).

In terms of cardiac markers, only 1 patient had an increase in creatine kinase (patient 3). Troponin was not assessed routinely for these patients.

DISCUSSION

Distal CAP is a not uncommon scenario in complex PCI, especially in the case of CTO intervention, reflecting the use of wires with greater penetration force and limitations in coronary angiography in this setting. However, this can also occur in noncomplex PCI as well (patients 4 and 5).[6] One important consideration in CTO-PCI is early guidewire step-down techniques to avoid such complications.[5]

An important method of CAP treatment is to occlude the vessel proximal to the site of perforation. The current methods previously described in the literature include fat, coil, or microsphere embolization.[3] In this case series, we describe a novel technique using absorbable 3.0 sutures to control distal CAP. The method is quick, efficient, can be performed by use of a 6-F guide, and most importantly is a successful method to control CAP. Of note, similar to fat embolism, this suture cannot be seen on fluoroscopy. The theoretical advantage of this absorbable suture is its complete absorption within 58 days.[7] In patient 2, the angiogram 1 month later showed partial restoration of blood flow through the branch occluded with the sutures (**Figure 1,** Video 2C).

The technique requires 3.0 absorbable sutures; the equipment required for this technique includes a (or similar) microcatheter, guidewire introducer, workhorse guidewire, minimum 5-F guide and a pair of scissors. Initially, the procedure requires the suture to be cut into 5- to 6-mm pieces; then, with the wire introducer, a suture piece is inserted into the microcatheter 1 piece at a time after ensuring the microcatheter is in the required position to deliver the suture. Once the suture segment is inserted into the microcatheter, a workhorse guidewire is then inserted into the microcatheter and advanced until visible at the end of the microcatheter. This may be associated with some resistance that requires gentle guidewire torque to facilitate delivery of the suture piece from the microcatheter. The process is repeated to deliver multiple pieces of the suture until the perforation is sealed. In a case of hemodynamic instability and ongoing extravasation, a 2.0-mm balloon can be delivered alongside the Caravel microcatheter to occlude flow.[3] Video 4 and **Figure 2** explain the procedure and the required material.

We have used Caravel, Corsair, Turnpike LP, and FineCross microcatheters to perform this technique.

An important limitation of this technique is the invisibility of the suture material; a previous experiment by mixing it with contrast material did not improve the visibility. However, this procedure has been used successfully on multiple occasions, and it is cheap, is simple, and can be done quickly.

In conclusion, the novel use of absorbable sutures can be used successfully to control distal or small vessel CAP.

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REFERENCES

1. Oliver PG, Daniel AJ, Ankur G, et al. Prevalence and outcomes of coronary artery perforation during percutaneous coronary intervention. *EuroIntervention*. 2017;13:e595–e601.

2. Kinnaird T, Kwok CS, Kontopantelis E, et al. Incidence, determinants, and outcomes of coronary perforation during percutaneous coronary intervention in the United Kingdom between 2006 and 2013: an analysis of 527 121 cases from the British Cardiovascular Intervention Society Database. *Circ Cardiovasc Interv*. 2016;9:e003449.

3. May A, Bhagwandeen R, Collins N. Contemporary management of coronary artery perforation. *Heart Lung Circ*. 2019;28:e121–e125.

4. Azzalini L, Poletti E, Ayoub M, et al. Coronary artery perforation during chronic total occlusion percutaneous coronary intervention: epidemiology, mechanisms, management, and outcomes. *EuroIntervention*. 2019;15:e804–e811.

5. Wu EB, Tsuchikane E, Lo S, et al. Chronic total occlusion wiring: a state-of-the-art guide from the Asia Pacific Chronic Total Occlusion Club. *Heart Lung Circ*. 2019;28:1490–1500.

6. Teis A, Fernandez-Nofrerias E, Rodriguez-Leor O, et al. Coronary artery perforation by intracoronary guide wires: risk factors and clinical outcomes. *Rev Esp Cardiol*. 2010;63:730–734.

7. Munton CG, Phillips CI, Martin B, Bartholomew RS, Capperauld I. Vicryl (polyglactin 910): a new synthetic absorbable suture in ophthalmic surgery. A preliminary study. *Br J Ophthalmol*. 1974;58:941–947.

KEY WORDS absorbable suture, coronary artery perforation

APPENDIX For supplemental videos, please see the online version of this article.