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Case Report

Fractured and Entrapped Coronary Angioplasty Balloon Successfully Managed with Rotational Atherectomy

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Calcified lesions are associated with higher rates of complications during percutaneous coronary intervention (PCI). Balloon shaft fracture and entrapment is a rare, but potentially severe complication of PCI. The resulting debris might lead to vessel occlusion and/or form a prothrombotic nidus, potentially leading to distal embolization, acute myocardial infarction, ventricular dysrhythmia, and even death. We report a case of balloon fracture and entrapment, in which rotational atherectomy (RA) was essential in modifying the entrapped material, allowing the crossing of an otherwise uncrossable "balloon—lesion complex," subsequently treated with crushing and jailing by stenting, with a good angiographic result and outcome.

Case Presentation

A 78-year-old man, with previous coronary artery bypass graft surgery 12 years prior (left internal mammary artery [LIMA] to left anterior descending artery [LAD]; saphenous venous graft [SVG] to first obtuse marginal branch [OM1]; and SVG to posterior descending artery [PDA] bypass grafts) was admitted for high-risk non-ST-segment-elevation myocardial infarction. Echocardiography demonstrated a left ventricle ejection fraction of 35%. Coronary artery and bypass graft angiography showed the following: left coronary territory perfused by patent LIMA-LAD and SVG-OM1 grafts; SVG-PDA graft occlusion at its origin; mid—right coronary artery (RCA) long, heavily calcified critical stenosis, posterolateral artery (PLA) critical stenosis; and PDA chronic total occlusion.

Although initially managed conservatively, the patient was referred to our centre for RCA and PLA PCI due to recurrent angina. The planned procedure was to perform RA to prepare the mid-RCA lesion for subsequent angioplasty.

The RCA showed a *de novo* thrombosis in myocardial infarction (TIMI)-2 flow and an intermediate ostial lesion (Fig. 1A), with the remaining lesions unchanged. Due to the high risk of no-flow after RA in the context of a TIMI-2 flow status, we decided to not perform RA. First, semicompliant (SC) balloon dilation was performed on the mid-RCA lesion. Then, under the support of a 6F GUIDEZILLA II Guide Extension Catheter (Boston Scientific, Marlborough, MA), the PLA lesion was treated uneventfully with one 3.0 x 40 mm drug-eluting stent (DES; Fig. 1B). Afterward, we proceeded to mid-RCA lesion preparation with multiple predilatation cycles, with SC balloons of increasing caliber (Fig. 1C). While retracting a 4.0 x 15 mm IKAZUCHI ZERO (Kaneka, Cordis, Hialeah, FL) SC balloon into the catheter, resistance was found, immediately followed by documentation of shaft fracture, with distal separation from the proximal end of the balloon, with embolization and entrapment in the mid-RCA lesion (Fig. 1D). Despite this complication, a TIMI-2 flow still was maintained. At the time, we considered multiple techniques to retrieve the embolized material—namely, the *trapping balloon* technique, the *twisting wire* technique, and the *snare* technique (Fig. 1E). The *trapping balloon* technique was not possible due to the shaft's absence (Fig. 1F); and the other 2 techniques could not be performed, because the lesion was uncrossable. At this point, during the attempts to retrieve the entrapped balloon, an iatrogenic RCA ostial dissection occurred and was treated with direct stenting using a 5.0 x 24 mm DES.

First, balloon crushing was attempted, but overcoming the "balloon—lesion complex" with balloons larger than 1.5 mm

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Novel Teaching Points

- Complex, tortuous, and heavily calcified lesions raise the risk for device entrapment during PCI, a potentially life-threatening situation.
- Balloon fracture is a rare complication, but it is likely to be underreported.
- In the face of this complication, the recommended first-line strategies[2-4] should be followed, considering the individual case characteristics and the level of operator experience.
- In extreme cases, the lesion can prove to be uncrossable, limiting options for successful rescue strategies.
- As a bailout technique, RA can be effective in partially pulverizing the balloon—lesion complex and allowing lesion crossing, dilation, and jailing by stenting.

was impossible, and immediate recoil occurred when smaller balloons were used (Fig. 2A), with no change in TIMI flow. Given this scenario, we decided to return to our original plan. We advanced an ASAHI Corsair Pro microcatheter (ASAHI Intecc, Aichi, Japan) with extreme difficulty, allowing a guidewire exchange for a RotaWire Drive Floppy (Boston Scientific). We then proceeded with RA using a 1.25 mm burr (Boston Scientific), with successful rotablation after multiple runs at 180.000 revolutions per minute (Fig. 2B; Video 1, view video online). Then, we were able to advance material, and we cracked the "balloon—lesion complex" with a 4.0 mm noncompliant NC Emerge balloon (Boston Scientific), proceeding with 3 consecutive stents (a 4.0 x 40 mm, a 4.5 x 32 mm, and a 5.0 x 15 mm DES), from the previously implanted PLA stent to the previously implanted ostial RCA stent (Fig. 2, C-E). Eventually, a good final angiographic result was achieved (Fig. 2F; Video 2, view video online) with no evidence of distal embolization during or after rotablation. Both the in-hospital and 12-month follow-up assessments were uneventful.

Discussion

As the number of PCI procedures in high-risk and complex settings increases, a parallel increase in complications is expected. The risk of PCI complication by broken and/or entrapped angioplasty material is estimated to be 0.1%, reaching 1.5% in complex procedures, such as chronic total occlusions.[1,2] Overall, disruptions of balloon shafts are rare (possibly underreported) events.[3] All recommended retrieval and fragmentation techniques for the management of this dreadful complication are either based on the need to cross-wire the trapped material or cannot be undertaken in the case of shaft absence.[2,4] Unfortunately, in our case, no shaft remained in the entrapped material, and the lesion proved to be uncrossable. At the time, we did not consider the possibility of releasing the fractured balloon via a subintimal plaque modification technique.

We speculate that the multiple cycles of inflation—deflation of a large-diameter balloon led to it damage, and

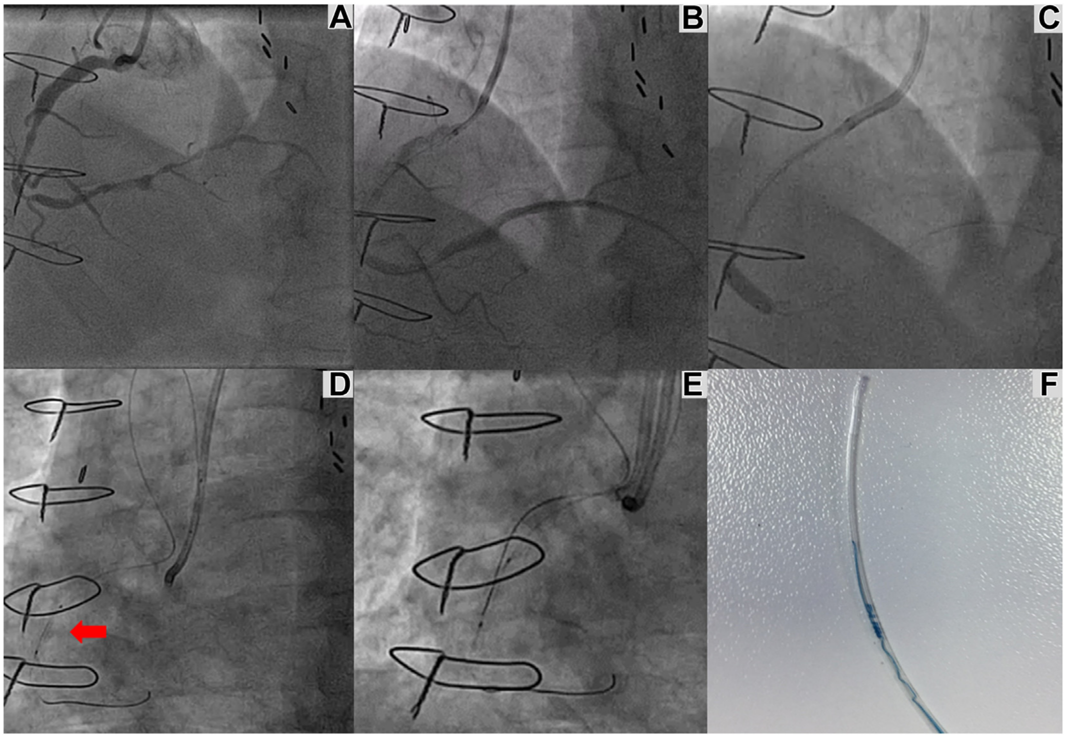

Figure 1. Percutaneous coronary intervention of the right coronary artery (RCA) and the posterolateral arteries. (**A**) A *de novo* RCA ostial intermediate lesion and thrombosis in myocardial infarction (TIMI)-2 flow. (**B**) Final result after posterolateral artery percutaneous coronary intervention. (**C**) Mid-RCA lesion predilatation (4.0-mm semicompliant [SC] balloons). (**D**) Fractured balloon embolization and lodgment in a mid-RCA lesion (**red arrow**). (**E**) Failed attempt to advance a snare or another wire through the balloon—lesion complex. (**F**) The fractured balloon shaft.

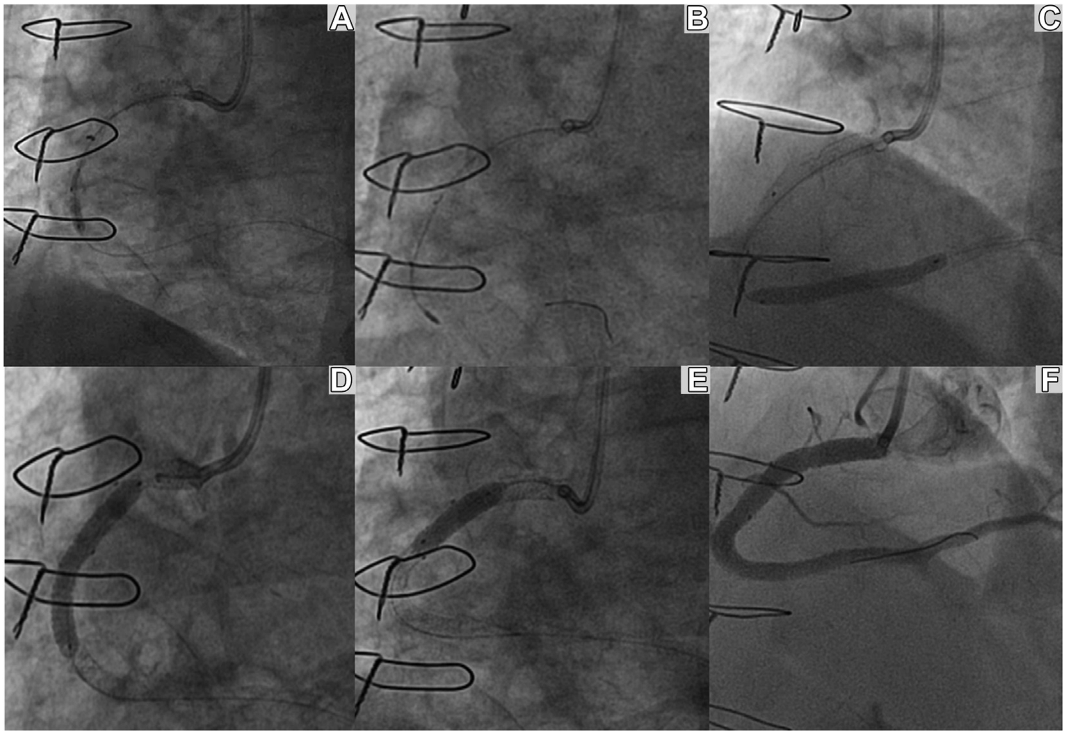

Figure 2. Crush attempts of the fractured balloon, and rotational atherectomy of the "balloon–lesion complex." (**A**) Impossibility of overcoming the "balloon–lesion complex" with a balloon > 1.5 mm in diameter, with immediate recoil after inflation of the 1.5-mm balloon. Note that the ostial and/or proximal right coronary artery (RCA) was already stented, due to ostial dissection. (**B**) Shown is a 1.25-mm burr advancing through the mid-RCA lesion. (**C**–**E**) Consecutive implantation of 3 stents. (**F**) Final result of posterolateral and RCA percutaneous coronary intervention.

probably to suboptimal deflation, making it prone to fracture during its retraction.

Tortuosity, angulation, and lesion calcification are risk factors for device entrapment during PCI.[1] All these factors were considered in the original planning of the procedure — preparing the lesion with RA. However, common complications of RA include coronary artery spasm, coronary artery dissection, rotational head incarceration, the slow-flow and/or no-reflow phenomenon, and perforation.[5,6] Indeed, RCA slow-flow status is a major predictor of no-flow status after RA, which was the main reason for our initial intraprocedural strategy change.

We here present an approach consisting of atherectomy-based modification of the fractured and/or embolized fragment, consistent with a previous report by Balasubramaniam et al.[7] In this case, due to the large dimensions of the entrapped balloon, we did not attempt a complete pulverization of the embolized fragment with RA, but rather we performed just enough of a modification to cross it and proceed with crushing and jailing with stenting. Also, due to persistent entrapment after RA, balloon extraction by snaring was not attempted, due to the low probability of success and the added risk of dissection. Given the unpredictability of both the sizes of the pulverized fragments and their final location after RA, this technique must be considered as a bailout option only, until additional reports further define its merits and risks.

Ethics Statement

The research reported has adhered to the relevant ethical guidelines.

Patient Consent

The authors confirm that a patient consent form has been obtained for this article.

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Disclosures

The authors have no conflicts of interest to disclose.

References

1. Iturbe JM, Abdel-Karim AR, Papayannis A, et al. Frequency, treatment, and consequences of device loss and entrapment in contemporary percutaneous coronary interventions. J Invasive Cardiol 2012;24:215-21.

2. Gasparini G-L, Sanz-Sanchez J, Regazzoli D, et al. Device entrapment during percutaneous coronary intervention of chronic total occlusions: incidence and management strategies. EuroIntervention 2021;17:212-9.

3. Chang W-T, Chen J-Y, Li Y-H, Tsai L-M, Lee C-H. A two-case series of entrapment of a ruptured balloon in the coronary artery: avoidable

complications and nonsurgical management. J Formos Med Assoc 2015;114:1135-9.

4. Sanz-Sánchez J, Mashayekhi K, Agostoni P, et al. Device entrapment during percutaneous coronary intervention. Catheter Cardiovasc Interv 2022;99:1766-77.

5. Tomey MI, Kini AS, Sharma SK. Current status of rotational atherectomy. JACC Cardiovasc Interv 2014;7:345-53.

6. Barbato E, Carrié D, Dardas P, et al. European expert consensus on rotational atherectomy. EuroIntervention 2015;11:30-6.

7. Balasubramaniam K, Elbarouni B, Kass M, Minhas K, Ravandi A. Rotational atherectomy in the management of ruptured and entrapped coronary angioplasty balloon. Cardiovasc Revasc Med 2021;28S:140-3.

Supplementary Material

To access the supplementary material accompanying this article, visit *CJC Open* at https://www.cjcopen.ca/ and at https://doi.org/10.1016/j.cjco.2024.08.001.