Management of a Balloon Shaft Fracture During Subintimal Retrograde Chronic Total Occlusion Percutaneous Coronary Intervention Due to In-stent Restenosis

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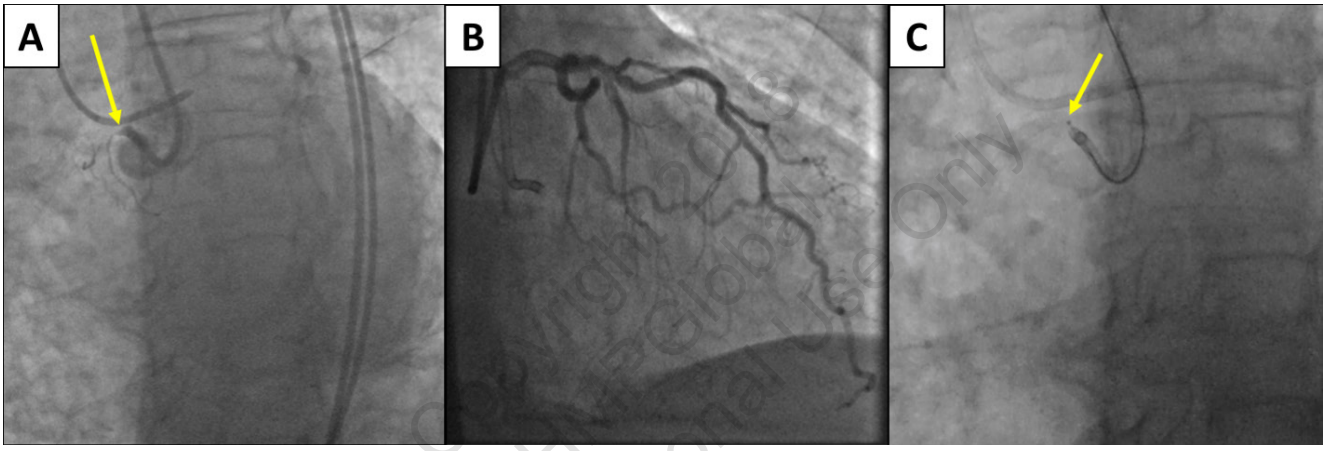

FIGURE 1. (A, B) A 74-year-old man presented with Canadian Cardiovascular Society (CCS) class IV angina with several comorbidities and was referred for PCI of a right coronary artery (RCA) CTO. (B) Seven years prior, he underwent RCA-PCI to treat ST-segment elevation acute myocardial infarction. Five years prior, he presented with non-ST segment elevation acute myocardial infarction and was found to have an occluded RCA stent that could not be recanalized. (C) Given the presence of a well-defined proximal cap and a good re-entry zone, antegrade dissection re-entry with the CrossBoss microcatheter (Boston Scientific) and a Pilot 200 guidewire (Abbott Vascular) was selected as the initial crossing strategy. The wire was switched to a Gaia Second wire, but because of the lack of support (ostial lesion, AL1 guide) the CrossBoss catheter could not be advanced past the proximal cap. The CrossBoss catheter was changed for a Corsair microcatheter (Asahi Intecc), but antegrade crossing failed despite using multiple guidewires (Confianza Pro 12, Hornet 14, Pilot 200, Gaia Second). Retrograde crossing was attempted. A septal collateral was easily crossed with a Sion guidewire using the "surfing" technique. The Corsair catheter did not cross until after dilation of the collateral with a 1.5 x 20 mm balloon.

Chronic total occlusion (CTO) percutaneous coronary intervention (PCI) of in-stent occlusions can be challenging. If crossing through the stent struts fails, an alternative crossing strategy is to cross beneath the stent struts, followed by implantation of new stents, "crushing" the formerly placed stents. We describe such a case of "sub-stent" CTO crossing using the retrograde approach that was complicated by fracture of the shaft of the balloon used for postdilation (Figures 1A-1L). A similar subintimal crossing and crush technique of an in-stent restenotic lesion in the distal coronary artery has been reported by others, with continued patency documented on coronary angiography performed 9 months later. While the long-term outcomes of subintimal stenting require further study, early results appear promising.

Balloon shaft fracture can potentially have serious consequences, such as embolization, urgent surgery, or even death. If the balloon fragment is at least partially within the guide catheter, retrieval is usually done by inflating another balloon inside the guide catheter, "trapping" the fractured shaft segment between the balloon and the guide catheter inner wall, followed by withdrawal of the entire system. However, this maneuver was not possible in our case, as the externalized wire was within the antegrade catheter; hence, the

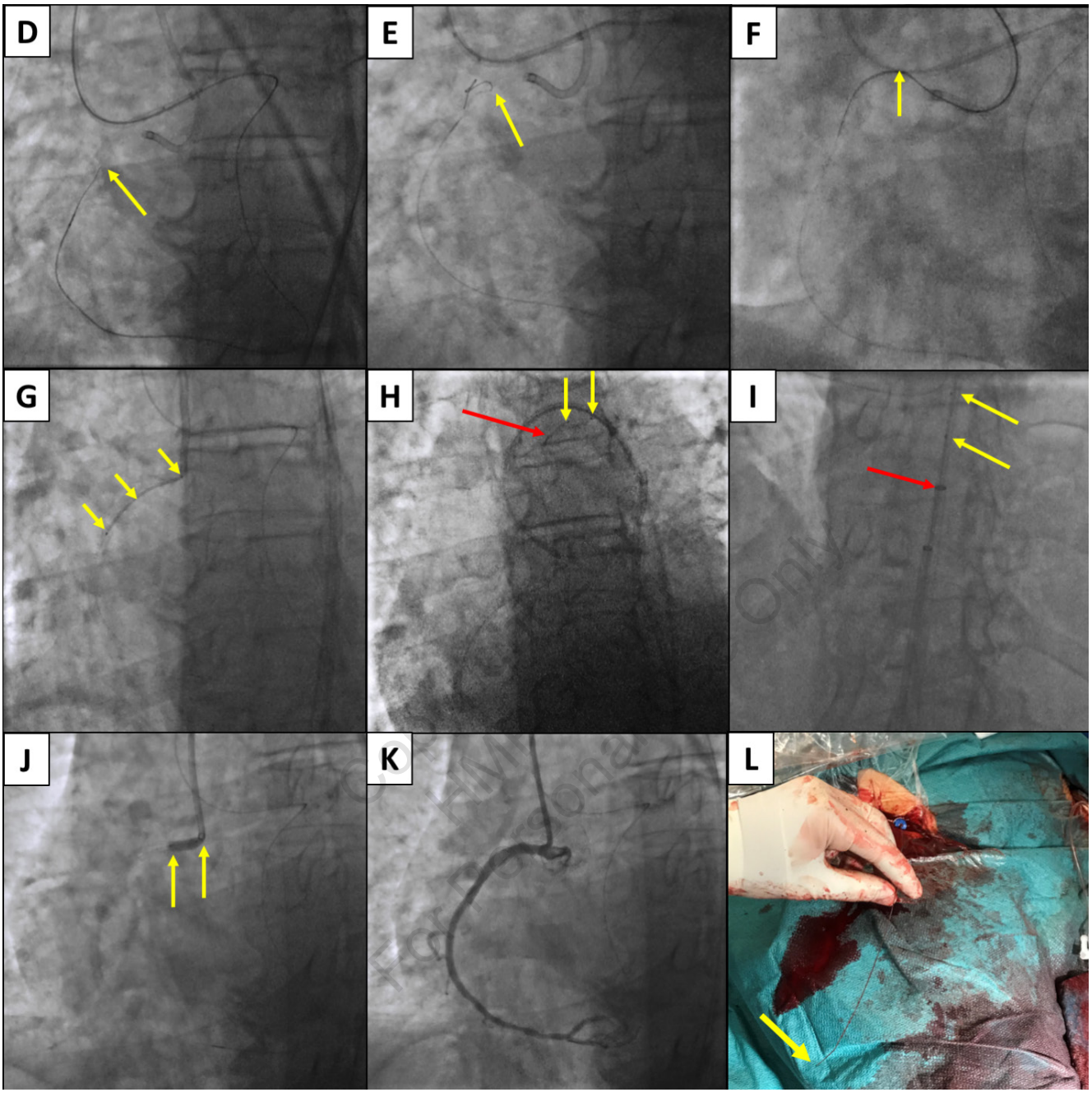

FIGURE 1. *(continued)* (D) The distal end of the stent could not be crossed despite using multiple guidewires (Pilot 200, Gaia Second, Hornet 14, Confianza Pro 12, Miracle 12). (E) A knuckle was formed using a Pilot 200 guidewire and was advanced in the sub-stent space. (F) Antegrade crossing was very challenging, but sub-stent crossing was achieved using a Hornet 14 guidewire. (G) Antegrade advancement of several balloons (2.5 x 12 mm, 1.2 x 12 mm) failed, but a Threader 1.2 x 12 mm microcatheter (Boston Scientific) crossed the proximal cap. Using the reverse controlled antegrade and retrograde tracking and dissection technique, the retrograde guidewire entered the antegrade guide catheter. Following advancement of the Corsair microcatheter, an RG3 wire (Asahi Intecc) was externalized. After predilation with 2 x 15 mm and 3 x 20 mm balloons, a 3 x 38 mm drug-eluting stent (DES) was deployed distally and 3.5 x 38 mm DES, proximally "crushing" the old stent. (H, I) Based on the angiography after stent deployment, a 3.0 x 20 mm balloon was inserted for postdilation, but the shaft of the balloon broke, leaving an approximately 60 cm-long segment of the balloon catheter inside the guide catheter on the externalized guidewire. After failed attempts to snare the entrapped balloon catheter fragment, a decision was made to retract the antegrade guide catheter, which enabled retrieval of the fractured balloon shaft. (J) The ostium of the RCA was stented with a 3.5 x 12 mm DES and postdilated with 3.0 x 20 mm and 3.5 x 20 mm non-compliant balloons. (K) Final angiography revealed TIMI 3 flow with well-expanded stents. (L) The broken balloon catheter segment (yellow arrow represents the fracture point).

antegrade catheter could not be withdrawn with a balloon inflated within its shaft. After measuring the balloon fragment length, it became apparent that it was long enough to be retrieved by withdrawing the antegrade guide catheter (without inflating a balloon inside its shaft), as was successfully done. In summary, subintimal crossing and crushing of an occluded previously deployed stent can allow successful crossing of in-stent CTOs when other strategies fail. Balloon shaft fracture can be challenging to treat in the setting of retrograde CTO-PCI with guidewire externalization; withdrawal of the guide catheter without simultateous balloon inflation within its shaft may allow successful removal of the balloon shaft fragment if the latter is long enough.

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