

Rotational Ablation as a Bailout Technique

How to facilitate expansion of a severely underexpanded stent.

BY DAVID J. JAMES, MD; S. CHIU WONG, MD; AND ISSAM D. MOUSSA, MD

Stent underexpansion remains an important predictor of stent thrombosis and stent restenosis even in the drug-eluting-stent era.¹ Stent underexpansion can occur as a result of using stents and/or postdilatation balloons that are significantly smaller than the true vessel size or as a result of lesion resistance to dilatation due to severe calcification and/or fibrosis. The most effective method to optimize an underexpanded stent is to post-dilate the stent with a short, noncompliant, appropriately sized balloon at high pressure. When this option is not effective, limited strategies are available to remedy the problem.

This case report presents a clinical scenario that describes how technical decision making resulted in a severely underexpanded stent (which was avoidable), how aggressive stent postdilatation failed to expand the stent, and how rotational ablation (RA) through the freshly implanted stent facilitated subsequent adequate stent expansion.

CASE STUDY

A 57-year-old man with a history of multiple cardiovascular risk factors and known coronary artery disease, status post stent implantation in the mid left

anterior descending (LAD) artery 1 year before presentation. The patient presented with progressive angina and non-ST-elevation myocardial infarction.

Coronary angiography showed nonobstructive ostial left main coronary artery (LMCA) disease and diffuse LAD disease extending from the mid to the distal segment (Figure 1). The left circumflex artery (LCX) and right coronary artery (RCA) were patent, and the left ventricular systolic function was normal. A 7-F vora left 3.5 guiding catheter was used to engage the left coronary system, and intravenous bivalirudin was administered. A 180-cm balance middle weight wire was used to cannulate the LAD. Intravascular ultrasound (IVUS) interrogation of the LMCA and the LAD was performed, but the IVUS catheter could not pass through the distal LAD segment (Figure 2A). IVUS showed nonobstructive disease in the ostial LMCA (minimum lumen area = 7.3 mm²) and severe obstructive disease extending from the mid to distal LAD (Figure 1). Based on these findings, the decision was made to proceed with percutaneous coronary intervention (PCI) to the mid and distal LAD.

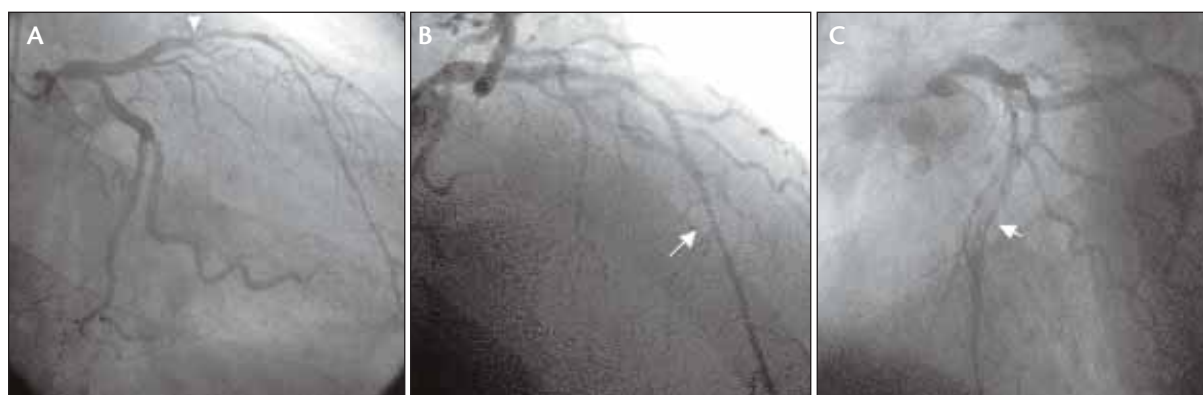


Figure 1. Baseline coronary angiogram. A right anterior oblique (RAO) view: note the proximal end of the diffusely diseased mid LAD (white arrowhead) (A). RAO cranial (B) and LAO cranial (C) views. Note the distal end of the diffusely diseased LAD (white arrows).

TECHNIQUES

Two short BMW wires were used to cannulate the first and second diagonal branches. The mid and distal LAD lesion was predilated with a 2.5- X 30-mm

Maverick 2 balloon (Boston Scientific Corporation, Natick, MA) at 12 atm (Figure 2B and C). A 2.5- X 28-mm Cypher RX stent (Cordis Corporation, Warren, NJ) was

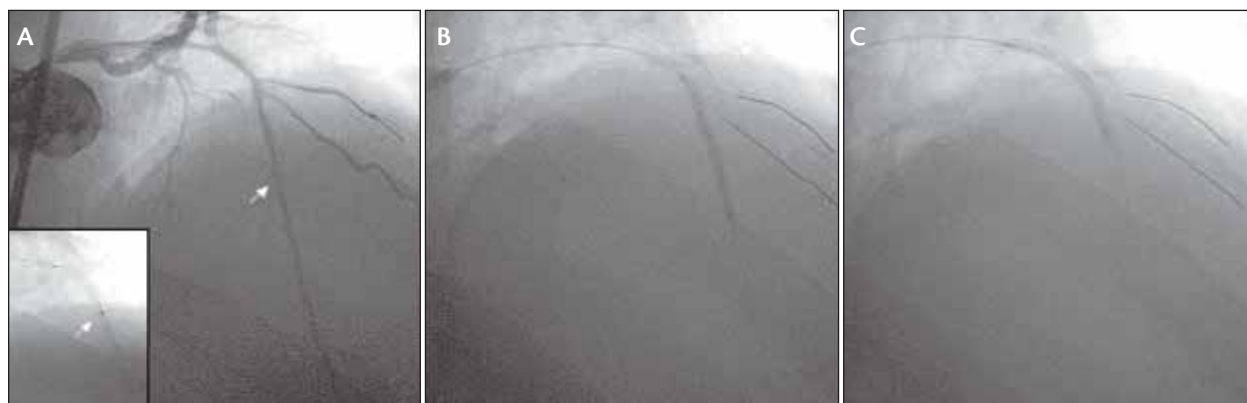


Figure 2. Note the site where the IVUS catheter could not be advanced further (white arrow) (A). Balloon predilatation of the distal (B) and mid (C) LAD lesion.

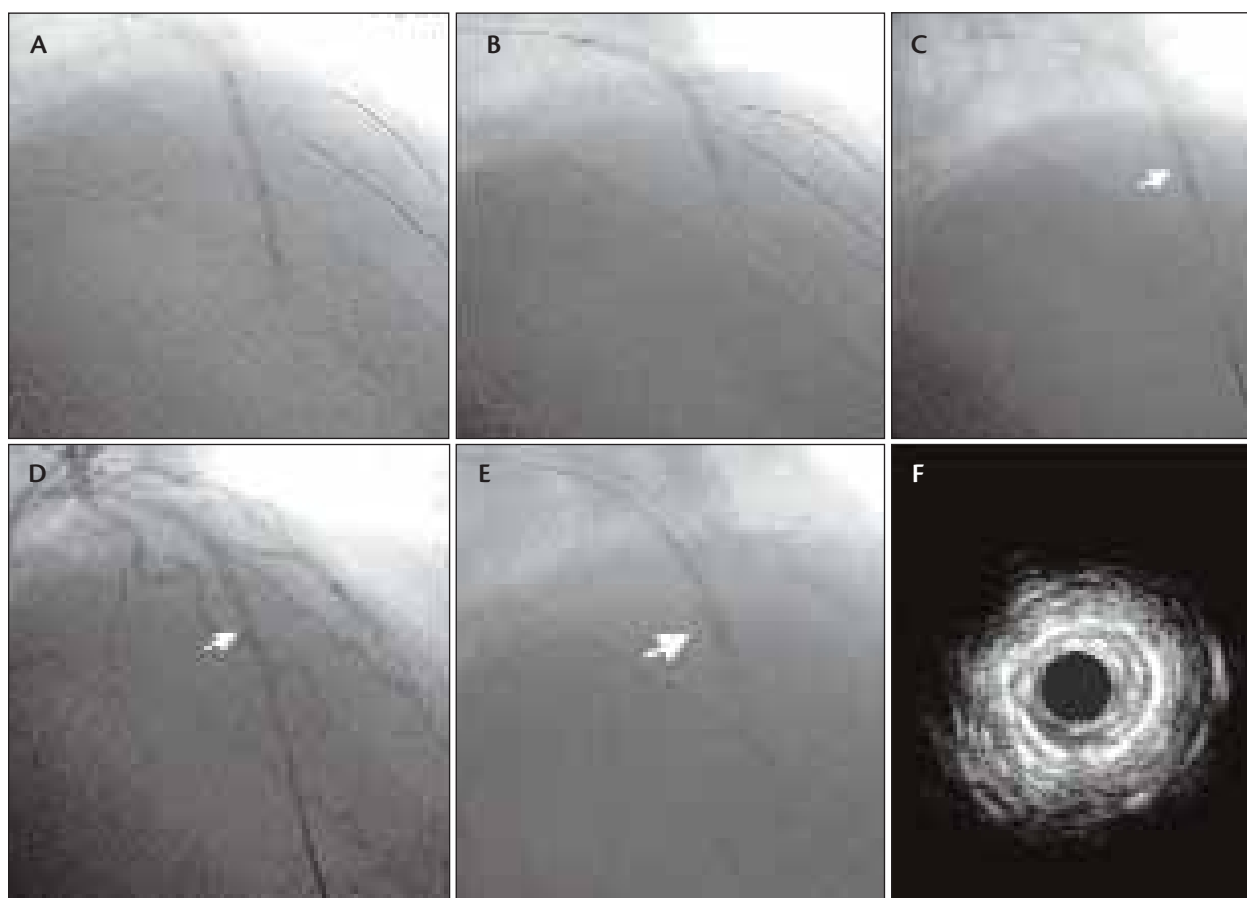


Figure 3. Deployment of a 2.5- X 28-mm (A) and a 3- X 33-mm (B) Cypher stent in the distal LAD. Distal LAD stent postdilatation with a 3- X 8-mm balloon up to 28 atm (C) (note the residual indentation on the balloon [white arrow]). Also note the residual stenosis after stent postdilatation (white arrow) (D) and the site where the IVUS catheter could not be advanced further (E) with the corresponding IVUS image (F).



Figure 4. RA with a 1.75-mm burr (A), coronary angiogram after RA (B), and stent postdilatation with a 3- X 15-mm balloon at 12 atm (C).

then implanted at the distal LAD (Figure 3A), and a 3- X 33-mm Cypher RX stent was deployed at the mid LAD, jailing the wires in the diagonal branches (Figure 3B). The jailed wires were removed, the branches were rewired, and kissing balloon inflation was performed with the mid LAD stent, which produced a good angiographic result. The distal LAD stent appeared to be underexpanded, so it was postdilated with a 2.5- X 8-mm Quantum Maverick RX balloon (Boston Scientific Corporation) up to 28 atm without overcoming resistance. This was followed by postdilatation with a 3- X 8-mm Quantum Maverick RX balloon that was also inflated up to 28 atm without successful stent expansion (Figure 3C and D). IVUS interrogation of the site was attempted, but the IVUS catheter did not cross due to a severely underexpanded stent (Figure 3E and F).

TREATMENT OPTIONS AND ACTION PLAN

At this point, we were faced with a severely underexpanded stent in the distal LAD segment. There were three options available: (1) abort the procedure with a suboptimal result, (2) refer the patient to coronary artery bypass surgery, or (3) consider unorthodox techniques to facilitate stent expansion. Colombo and colleagues reported the successful use of excimer laser in a similar case scenario to facilitate stent expansion.² We chose to use RA inside the freshly deployed stent to ameliorate the extent of resistance to balloon dilatation. RA was first performed using a 1.5-mm Rotablator burr (Boston Scientific Corporation), but the burr did not pass through the

underexpanded stent. We then tried to pass through with a 1.75-mm Rotablator burr, which successfully crossed through the stent (Figure 4A and B). The stent was subsequently postdilated with a 3- X 15-mm Quantum Maverick RX balloon at 12 atm with good stent expansion (Figure 4C). Final angiography demonstrated full stent expansion with TIMI 3 flow (Figure 5). Repeat coronary angiography at 5-month follow-up showed patent mid and distal LAD stents (Figure 6).

DISCUSSION

To our knowledge, this is the first published report of using RA in a freshly implanted underexpanded stent to facilitate its expansion. Severely calcified and/or fibrotic lesions remain an enduring challenge to PCI, particularly in relation to stent delivery and/or full expansion. Needless to say, it is always better to avoid implanting a stent in a lesion that is not well prepared than to deal with an underexpanded stent after the fact. Stent underexpansion is almost always avoidable if

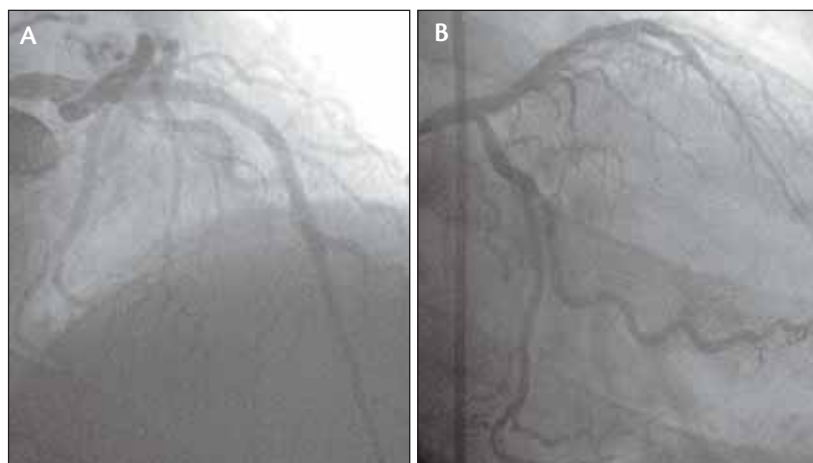


Figure 5. Final coronary angiogram. RAO cranial view (A) and RAO caudal view (B).



Figure 6. Coronary angiogram at 5-month follow-up.

lesion preparation is performed meticulously.³ In this case, RA should have been performed after the IVUS catheter failed to pass through the lesion. Instead, we proceeded with predilatation using a 2.5-mm compliant balloon. Although we did not observe severe underexpansion of the balloon, it is likely that a different view would have shown this. Another technical step that should have been done was reintroducing the IVUS catheter after predilatation to confirm whether lesion compliance had been altered. The inability to pass the IVUS catheter across the lesion would have reinforced the need for better lesion preparation.

As for the issue of how to deal with a freshly deployed but severely underexpanded stent, few options are available. The first option is to use a short, noncompliant, appropriately sized balloon at high inflation pressure. This option is effective in many but not all patients, and it carries the risk of vessel perforation if the balloon size and/or pressure is excessive. In this case, we initially used a very aggressive balloon-sizing and pressure strategy (3-mm, short, noncompliant balloon at 28 atm) that failed to ensure proper stent expansion. In similar case scenarios, few investigators reported the successful use of excimer laser to alter stent/plaque mechanical resistance.^{2,4} In our case, we chose to use RA to ameliorate the mechanical resistance imposed by stent struts to facilitate subsequent stent expansion by a balloon, which was successful.

Although we did not observe any complication with this procedure, several potential problems can be associated with this approach such as burr entrapment, excessive stent damage, and particle embolization. Therefore, this technique should only be used as a last resort after all traditional means to expand the stent have failed.

CONCLUSION

Refractory stent underexpansion is infrequent but can potentially be associated with serious sequelae. Stent underexpansion is almost always avoidable if proper lesion preparation is performed. RA is underutilized in contemporary PCI, and more consideration should be given to its use when undilatable lesions are suspected. RA can also be used as a last resort to change stent/plaque compliance in refractory stent underexpansion. However, this technique should be used with extreme caution and with the recognition of the potential complications that may occur as a result. ■

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