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The Guideliner™ Catheter for Stent Delivery in Difficult Cases: Tips and Tricks

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Introduction: *Stent delivery in complex coronary anatomy with severe calcification and tortuosity is still a common cause of percutaneous coronary interventions (PCI) failure. Recently, a new support rapid exchange catheter, the Guideliner, has been designed specifically for device delivery.*
Methods: *From June 2010 to December 2010, we performed 10 cases using the Guideliner catheter to improve backup support and facilitate stent delivery: 2 emergent PCI for ST elevation myocardial infarction, and 8 stable elective PCI. In 3 cases the operator chose the femoral access, in 2 cases crossover from radial to femoral access was needed, and the other cases were performed radially. In 2 cases PTCA with drug-eluting balloon was performed; in the other cases second-generation drug-eluting stent was implanted.*
Results: *One case, the first one, failed, as stent could not be delivered to the target lesion. The other 9 cases were performed successfully. Three proximal dissections were detected and sealed with stent implantation. In 2 cases, we had stent damage due to the passage of the stent through the Guideliner metal collar. Another stent had to be used.*
Conclusions: *In our experience, the Guideliner catheter is safe to use and helps device delivery in difficult settings. We describe here our experience with the Guideliner catheter for stent delivery and backup support; we discuss its utility and drawbacks in acute and stable clinical settings. Moreover, the aim of this article is to help interventional cardiologists using the device in difficult lesions to avoid potential complications.* (J Interven Cardiol 2011;24:450–461)

Introduction

Over the last decade, numerous advancements in percutaneous coronary interventions (PCI) have been achieved. However, the interventional cardiologist often deals with difficult scenarios, like complex coronary anatomy with severe calcification and tortuosity, where the operator may still be unable to deliver a stent to the target lesion. Several new devices and techniques have been developed to overcome this problem, including more supporting guiding catheters, newer stents with lower profile and better delivery systems, the "buddy" wire to improve guiding catheter coaxiality, or buddy balloon techniques,[1] and the anchor technique, as examples. In particular, for the transradial approach, stent delivery is improved with 5 or 6 French guiding catheter deep-intubation.[2] More recently sheathless catheters have been commercialized, with an outer diameter approximately 1.5 F sizes smaller than the corresponding radial sheathes to overcome the limitations due to radial smaller diameter (6.5 or 7.5 French, Asahi, Intecs, Aichi, Japan). From the methodological point of view in some situations, especially in elderly hypertensive patients, the choice of transradial left despite right approach is associated with higher procedural success.[3] Mamas et al.[4] described the 5F Heartrail II catheter (Terumo, Tokyo, Japan) within a standard 6F guiding catheter (so called ''five-in-six'' system, or "mother and child") which was initially developed for use in chronic total occlusion PCI.[5] Recently a new support catheter, the Guideliner catheter (Vascular Solutions, Minneapolis, MN, USA) has been developed specifically for device

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delivery. The Guideliner catheter consists of a short guiding catheter extension connected to an introducer rod; it is essentially a rapid exchange equivalent of the "five in six" Heartrail II catheter, being potentially easier to use. The device received CE marking in September 2009. First-in-human experience with this device was described by Mamas et al.,[5] the same group then extended its series performing transradial cases for coronary bypass graft interventions.[6] We describe here our initial experience with the Guideliner catheter for stent delivery and backup support, and we discuss its utility and drawbacks in acute and stable clinical settings (Table 1).

Device Details

The Guideliner catheter is a coaxial guide extension with the advantage of rapid exchange. In difficult and challenging interventions, guiding catheters have a tendency to back out of the artery whereas the Guideliner allows guiding catheter extension into the vessel for deep seating. The catheter has been described elsewhere.[7] Briefly, it is composed of a flexible 20-cm soft tipped catheter connected via a metal "collar" with a 115-cm stainless steel shaft to a proximal positioning tab (Fig. 1). It is currently available in three sizes: 5-in-6 (0.056'' internal diameter (ID)), 6-in-7 (0.062''ID) and 7-in-8 (0.071" ID). The extension is 20-cm long (although a maximum intubation of 10 cm is recommended, in order to place the collar in a straighter portion of the catheter) and has silicon coating for lubricity. The extension section is a component built tube, with good flexibility and adequate radial strength; the external layer is made of the same material as a guiding catheter. There is a radio-opaque marker located at 2.66 mm from the tip. Two positioning white markers on the push tube, at 95 cm (single) and 105 cm (double), assist catheter placement through the guide.

At any time, following placement of the mother guide catheter and coronary guidewire in the target vessel, the Guideliner catheter can be advanced over the wire through the hemostatic valve without the need to disconnect the valve from the mother guide. The catheter tip is then advanced beyond the tip of the mother guide into the coronary vessel by pushing on the proximal tab. The interventional procedure is performed in the usual manner through the hemostatic valve.

The Guideliner has two indications for use: deep seating for added back-up guiding catheter support in challenging cases to facilitate device delivery, and coaxial alignment when a difficult coronary ostium takeoff prevents guiding catheter placement. It is contraindicated in vessels with less than 2.5- mm diameter. Herein follows a description of some cases illustrating the advantages and potential drawbacks of this new device. Case 1 was the only failure in our series, the Guideliner catheter being extremely helpful in the other cases; cases 3 and 6 illustrate the advantages of the Guideliner catheter; case 4 is a case of stent damage while being advanced into the Guideliner catheter; and finally, cases 5 and 10 show coronary dissections related to the device.

Case 1

An 80-year-old female patient with unstable angina and transient ST segment elevation in inferior leads was admitted to our center. She was on chronic anticoagulation treatment because of chronic atrial fibrillation (INR 1.2). Coronary angiography showed a dominant right coronary artery (RCA) with severe calcification all along the vessel, with a 90% proximal stenosis as the culprit lesion; and a small diameter (1.8 mm) posterior descendent artery (PDA), with a severe proximal stenosis (90%) (Fig. 2). PCI was programmed 7 days after the diagnostic coronary angiography. Oral anticoagulation was discontinued, and femoral access PCI was chosen because of negative bilateral Allen test and small radial pulses. Access for PCI was through right femoral artery. A 6F Judkins Right guiding catheter was chosen. A 0.014'' Balance Middle Weight Universal guidewire (Abbott Vascular, Abbott Laboratories, Abbott Park, IL, USA) was positioned in the distal PDA. Proximal lesion was predilated using a 3.0 × 10 mm Flextome Cutting Balloon (Boston Scientific, Natick, MA, USA). Afterward, different balloons were used to try to dilate the PDA lesion (1.25 × 15 mm Nimbus Pico PTCA balloon catheter, ClearStream Technologies Ltd, Wexford, Ireland; 1.25 × 15 mm Ryujin Plus—RX PTCA Balloon Catheter, Terumo Europe N.V., Leuven, Belgium) but none could cross the lesion, which was tight and hard. The operator then introduced the Guideliner, carefully across the hemostatic valve, deeply down to the acute marginal angle of the RCA, with particular attention to device friction inside the coronary artery. At this point device coaxiality is very important to decrease risk of dissection. Dilation with several small balloons was attempted again, but none of them could cross the lesion. The operator decided to conclude the procedure, as the PDA, a

Table 1. Case Details with Patient's Age, Arterial Access, Guideliner Catheter Indication, Depth of Intubation, Kind of Stent Implanted, and Complications

Case	Age	Access	Vessel	Lesion Type	Indication for GL	Intubation Depth	Stent Deployed	Stent Damage/ Failure	Complication
Case 1	80	R/F	RCA	Severe calcification Type B	Balloon and stent delivery	40 mm	N/A	N/A	Failure
Case 2	75	F	Circ-DPA	Type C	Balloon delivery	60 mm	Drug eluting balloon DIOR	N/A	N/A
Case 3	79	R/F	RCA	Severe tortuosity Type C	Stent delivery	30 mm	2.0 × 25-mm drug eluting balloon DIOR PTCA catheter	N/A	N/A
Case 4	68	F	LMS-Circ	Extreme tortuosity/angulation Type C	Stent delivery	20 mm	2.25 × 14 mm Endeavor Resolute 2.75 × 24 mm Endeavor Resolute 3.5 × 30 mm Endeavor Resolute	2.25 × 18 Endeavor Resolute	N/A
Case 5	80	R	LAD	Extreme tortuosity Type C	Stent delivery	40 mm	2.5 × 23 mm Multi Link 8 2.75 × 18 mm Multi Link 8 3.0 × 28 mm Multi Link 8 3.5 × 13 mm Hexacath Titan 2	2.5 × 5 mm Multi Link 8	Proximal dissection
Case 6	81	R	RCA-CTO	Severe calcification, distal lesion Type C	Balloon and stent delivery	25 mm	2.5 × 30 mm Endeavor Resolute 3 × 30 mm Endeavor Resolute	N/A	N/A
Case 7	52	R	RCA/DP/PL	Long lesion, distal, severe calcification	Balloon and Stent delivery	100 mm	3 × 38 mm Endeavor Resolute		N/A

Continued

Table 1. Continued.

Case	Age	Access	Vessel	Lesion Type	Indication for GL	Intubation depth	Stent Deployed	Stent Damage/ Failure	Complication
				Type C			3.5 × 38 mm Endeavor Resolute		
							2.5 × 14 mm Endeavor Resolute		
							2.25 × 18 mm Endeavor Resolute		
Case 8	60	R	RCA	Very tortuous and calcified	Stent delivery		3.0 × 12 mm Endeavor Resolute	N/A	Proximal dissection
				Type C			3.0 × 15 mm Endeavor Resolute		
							3.0 × 30 mm Endeavor Resolute		
							2.5 × 24 mm Endeavor Resolute		
Case 9	61	F	Circ-OM2	Angulated Circ origin	Stent delivery	20 mm	2.25 × 24 mm Promus Element	N/A	N/A
				Type C			2.5 × 20 mm Promus Element		
Case 10	72	R	Circ CTO	Extreme tortuosity	Stent delivery	30 mm	2.25 × 20 mm Promus Element	N/A	LM-LAD Dissection
				Type C			2.25 × 28 mm Xience Prime		

R = radial; F = femoral; R/F = switch from radial to femoral; GL = guideliner catheter; N/A = not applicable; RCA = right coronary artery; DP = descending posterior artery; PL = posterior-lateral; Circ = circumflex; LMS = left main stem; LAD = left anterior descending artery; lesion type = ACC/AHA classification.

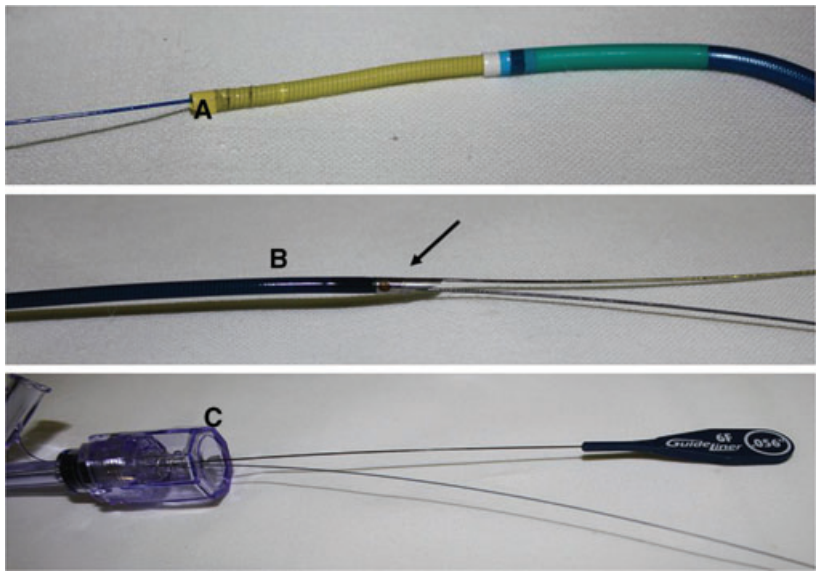

Figure 1. The 5F Guideliner catheter. (A) Guideliner flexible 20-cm distal segment, the guide extension, made of an inner polytetrafluoroethylene liner, a middle stainless steel coil, providing maximum flexibility while retaining radial strength, and an outer polyether block amide (Pebax) polymer extrusion, same material as a guide catheter. (B) The Guideliner metal collar (arrow) connecting the flexible catheter extension with a 115-cm stainless steel shaft to a proximal positioning tab. (C) The proximal end of the Guideliner while used inside the catheter through the hemostatic valve, like a regular balloon.

small diameter vessel, was not suitable to rotablation. The proximal lesion was then treated with a 2.75 × 30-mm drug-eluting Dior PTCA catheter balloon (Eurocor GmbH, Bonn, Germany), avoiding stent placement since the patient was on chronic anticoagulation treatment.

Case 3

A 79-year-old female patient with Killip I inferior ST elevation myocardial infarction (STEMI) was admitted to our center for primary PCI. Initially the right radial access was attempted, and left radial pulse was absent, but due to severe subclavian artery tortuosity the operator shifted to right femoral access. The coronary angiography showed RCA proximal occlusion (Fig. 3). With a 6F Judkins Right guiding catheter a Balance Middle Weight Universal guidewire (Abbott Vascular, Abbott Laboratories) was placed distally. Manual thrombectomy was attempted with the Pronto thrombectomy catheter (Vascular Solutions) but it could not cross the lesion. A Pronto LP extraction catheter (Vascular Solutions) was then used allowing recanalization of the artery. A long, severely

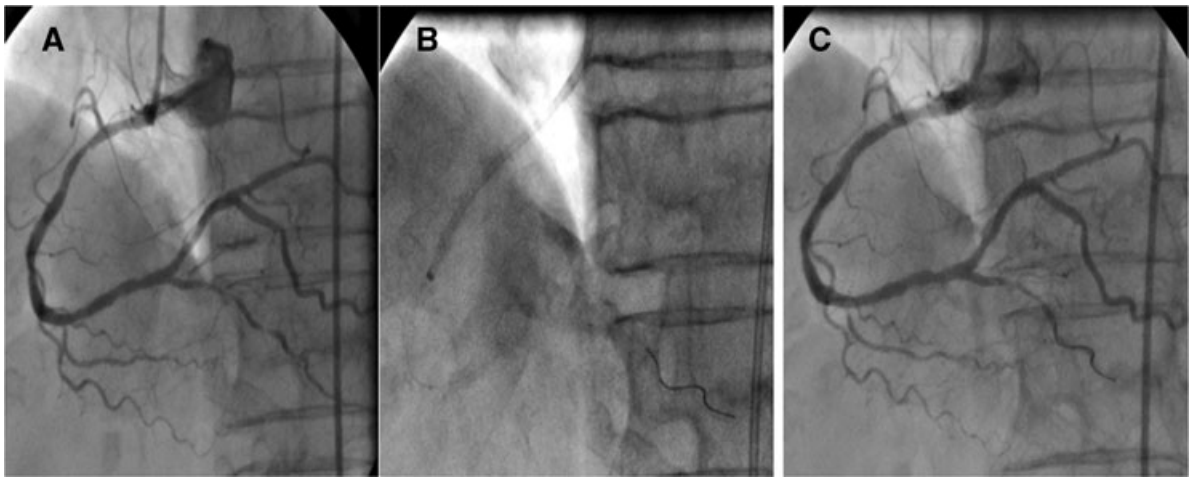

Figure 2. Case 1. (A) Baseline angiography. (B) Guideliner catheter deep intubation. (C) Final result. This case was failed.

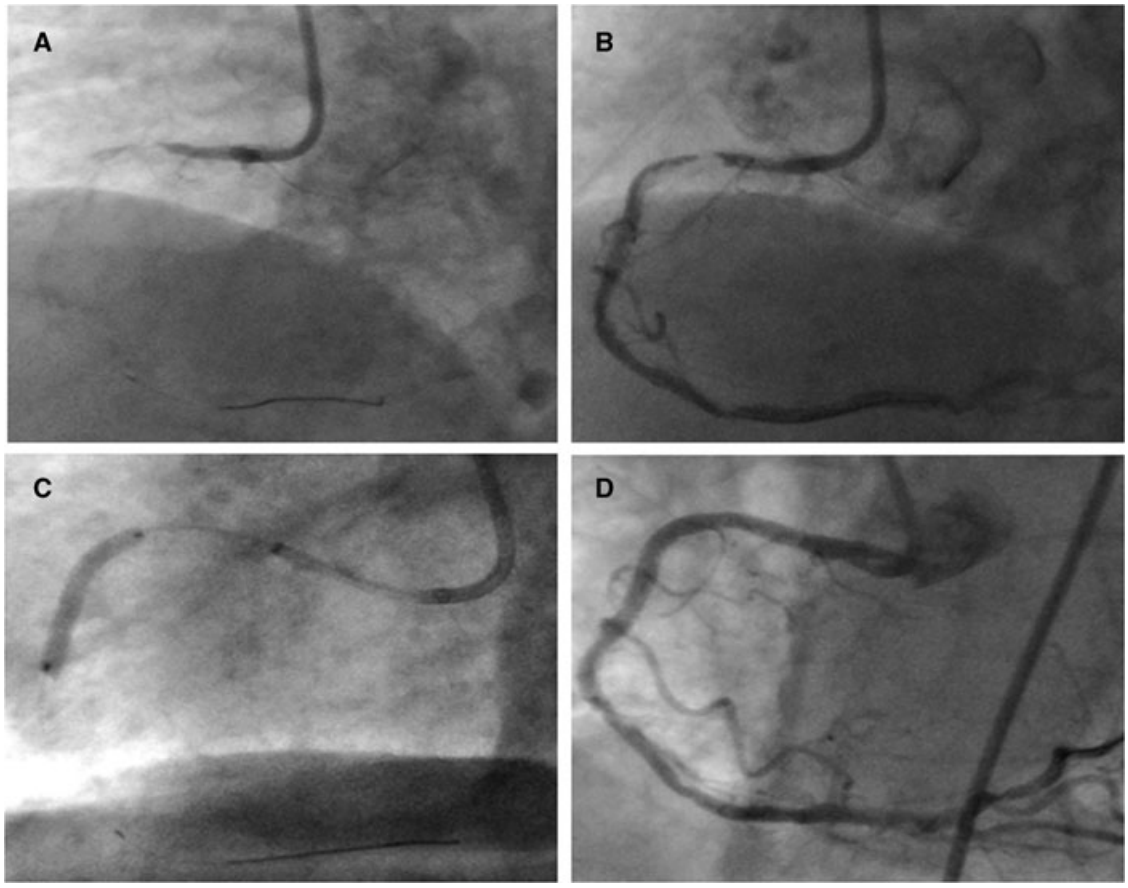

Figure 3. Case 3. (A) RCA baseline angiography. (B) RCA angiography after manual thrombus aspiration; a long, severely calcified and tortuous lesion is visualized. (C) The Guideliner catheter deployed beyond the guide into the RCA and subsequent passage of the stent. (D) final result without complication, TIMI III flow.

calcified and tortuous lesion could then be visualized (Fig. 3B), affecting proximal and mid RCA. With difficulties, due to a low guide catheter support, multiple predilations were performed (2.0 × 6.0 mm Flextome Cutting Balloon; 2.0 × 15 mm and 2.5 × 15 mm Maverick balloon, Boston Scientific). However, no stent could be delivered: 2.5 × 23 mm and 2.5 × 12 mm Multi-Link stents (Abbott Vascular, Abbott Laboratories) could not cross the lesion. The operator used the Guideliner 5F catheter and deployed it 3 cm beyond the guide into the RCA. At this time a small profile short balloon is useful to preserve device coaxiality in the coronary artery: the balloon is advanced before and inside the Guideliner; once the Guideliner is in position deeply seated inside the coronary artery, the balloon is retrieved to advance the desired material. Subsequent passage of the stent was achieved: 2 overlapped 2.5 × 23 mm and 2.5 × 12 mm Multi-Link stents were successfully implanted. Final angiographic control showed good result with TIMI III flow without complications.

Case 4

A 68-year-old male patient was admitted to our center to perform protected left main stem (LM)–left circumflex (LCX) coronary artery PCI due to stable angina. The patient had previous coronary artery bypass graft surgery, but with no graft supply to the LCX territory. Coronary angiography showed a severely tortuous and calcified LCX, with ostial and proximal 50% stenosis, with a take-off angle of 90°, and a second curve proximal to a big trifurcated 1st obtuse marginal

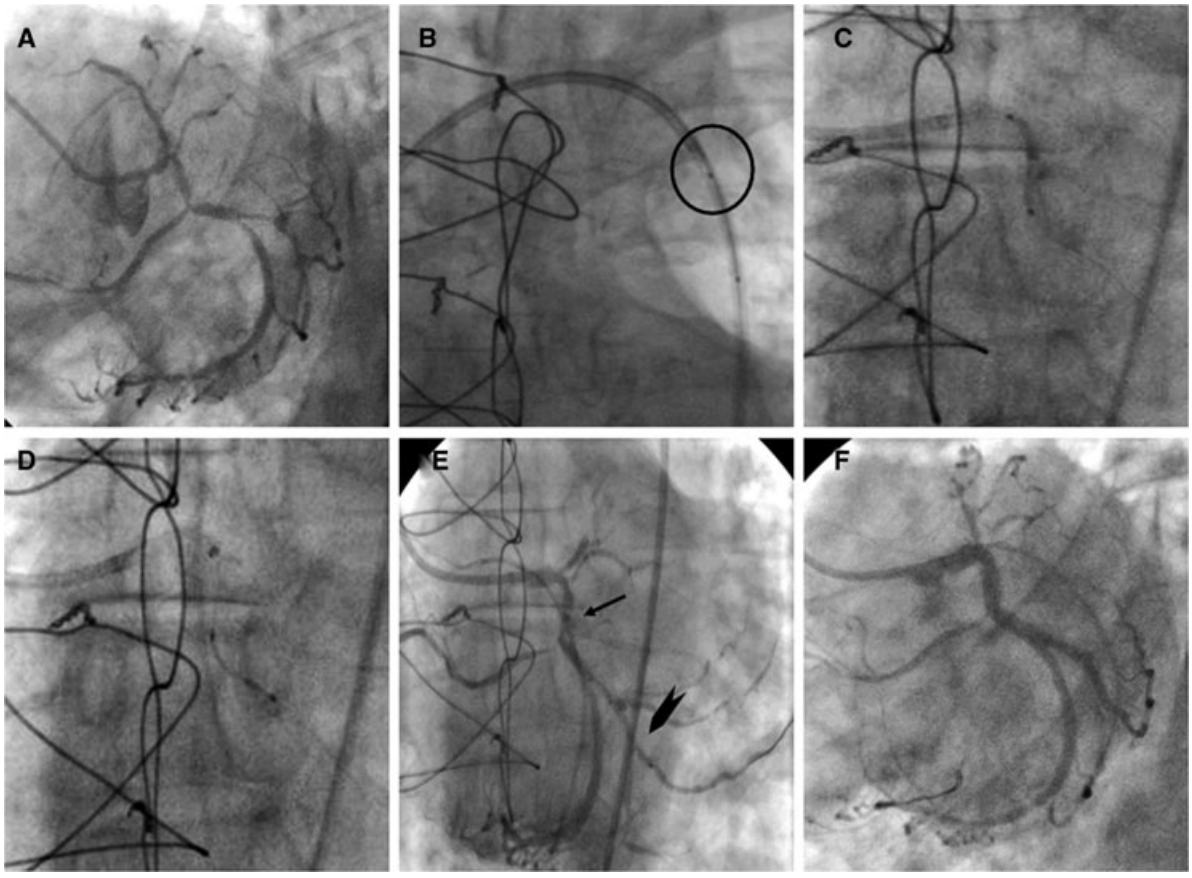

Figure 4. Case 4. (A) Coronary angiography showing a very tortuous and calcified LCX, with proximal 50% stenosis, 90° angle at the origin, and a second curve before the big trifurcated 1st OM brunch. The latter showed a severe proximal stenosis and a second one after the trifurcation. (B) Stent passage was difficult at the metal collar, where the operator felt resistance and pulled the stent back: stent distal struts were deformed and lifted up (C) Guideliner deployed beyond the guide tip while the stent is crossing the first very angulated curve. (D) Guideliner deployed beyond the guide tip, and the stent crossing the 2nd very angulated curve. (E) Guideliner deployed beyond the guide tip and the stent (2.25 × 14-mm Endeavor Resolute) at implantation site. (F) Final result, without complication, TIMI III flow.

(1st OM) branch. The latter showed a severe proximal stenosis and a second one after the trifurcation (Fig. 4). Through the right femoral artery with a 6F Extra Back-up 4.0 Launcher guiding catheter we advanced an extra-support hydrophilic Whisper guidewire (Abbott Vascular, Abbott Laboratories) into the distal 1st OM and a Balance Heavy Weight guide wire (Abbott Vascular, Abbott Laboratories) into the LAD to protect it and optimize support. Predilations with 3.0 × 6.0 and 3.5 × 6.0 mm Flextome Cutting Balloon (Boston Scientific) were performed in proximal LCX. A 2.25 × 18 mm Endeavor Resolute drug-eluting stent (Medtronic Cardiovascular) could not cross the curve at proximal LCX. The operator introduced a Guideliner catheter after retrieving LAD and distal LCX guidewires to make room inside the guiding catheter. When inserting the stent through the Guideliner catheter, difficulties were encountered at the collar level, where the stent could not be advanced. The operator pulled it back and checked it for damage: stent distal struts were deformed and lifted up (Fig. 5). A new 2.25 × 14 mm Endeavor Resolute drug eluting stent (Medtronic Cardiovascular) could then be cautiously advanced after slight withdrawal of the Guideliner, so as to place the collar in a straighter portion of the catheter, and then successfully implanted.The final angiogram showed a good result, TIMI III flow, without complications.

Figure 5. A damaged stent (2.25 × 18-mm Endeavor Resolute drug-eluting stent, Medtronic Cardiovascular). Difficulties were encountered at the collar level where the stent could not be advanced. We pulled it back and checked it for damage: stent distal struts were deformed and lifted up.

Case 5

An 80-year-old female was admitted to our center for primary PCI with a Killip II anterior STEMI. The coronary angiography showed thrombotic occlusion of the mid LAD, with a tortuous and calcified proximal segment. The operator chose the right radial artery access and a 6F extra-back-up 4.0 Launcher guiding catheter. An hydrophilic Whisper guidewire (Abbott Vascular, Abbott Laboratories) was deployed distally in the artery and thrombectomy was performed using a Pronto® LP extraction catheter (Vascular Solutions). A severely angulated lesion was then detected (Fig. 6). Multiple predilations were performed with a 2.5 × 6 mm Flextome Cutting Balloon (Boston Scientific) and type B dissection of mid LAD was visualized, with TIMI III flow. The operator tried to pass a 2.5 × 15 mm Multi-Link bare metal stent (Abbott Vascular, Abbott Laboratories) but it could not cross the proximal curve, so a Guideliner catheter was used. The device was advanced through the proximal tortuous segment allowing a deep seating into proximal LAD, which added back-up support. The same 2.5 × 15-mm Multi-Link stent was advanced through the Guideliner and it could not proceed further because of the next mid segment curve. It was impossible to pull the stent back into the tip of the Guideliner, so all the system (Guideliner catheter and stent together) had to be retrieved; the stent distal struts were lifted up and deformed, while Guideliner tip appeared in good condition. We cut the stent delivery system to recover the Guideliner. A deeper seating was then reached with the same Guideliner catheter, crossing the second curve as well, and a new 2.5 × 23-mm Multi-Link stent was implanted followed by a proximal and overlapped 2.75 × 18-mm Multi-Link stent. Hence a proximal LAD type B dissection was detected, which was suspected to be caused while advancing the Guideliner. Two new 3 × 28 and 3.5 × 13-mm stents were implanted in proximal LAD to seal the all dissected segment.

Case 6

An 80-year-old male patient with known coronary artery disease was admitted to our center because of effort angina. Coronary angiography showed chronic total occlusion (CTO) of RCA (Fig. 7) with severe calcification, and PCI was programmed with rotational atherectomy. Right femoral artery access was chosen with a 6F extra back up right coronary artery guiding catheter (Cordis, Johnson & Johnson Corporation). The operator crossed the occlusion with a Fielder XT guidewire (Abbott Vascular, Abbott Laboratories) and predilated with a 1.2 × 15 mm Ryujin balloon (Terumo Corp., Tokyo, Japan) without successful recanalization. A 2.6 Tornus catheter (Abbott Vascular Devices, Redwood City, CA) was then advanced to the distal segment and TIMI III flow was achieved, allowing visualization of diffuse and severe disease all along proximal and mid-RCA. Rotational atherectomy was then performed with a 1.25 burr (Rotablator Rotational Atherectomy System, Boston Scientific, Natick, MA, USA). The operator tried to dilate with a 2.0 × 6.0 mm Flextome Cutting Balloon (Boston Scientific) which could not reach the most distal part of the lesion. Hence a Guideliner catheter was used, which allowed distal cutting balloon dilatation followed by implantation of 2.5 × 30 mm and 3.0 × 30 mm Endeavor Resolute drug-eluting stents (Medtronic Cardiovascular). After stent implantation, the Guideliner was again advanced into the stents to allow for stent redilatation with a noncompliant balloon. Final angiography showed a good result without complications (Fig. 7F).

Case 10

A 72-year-old female patient was admitted to our center with stable angina functional class II and a positive stress test with lateral ischemia. The angiogram

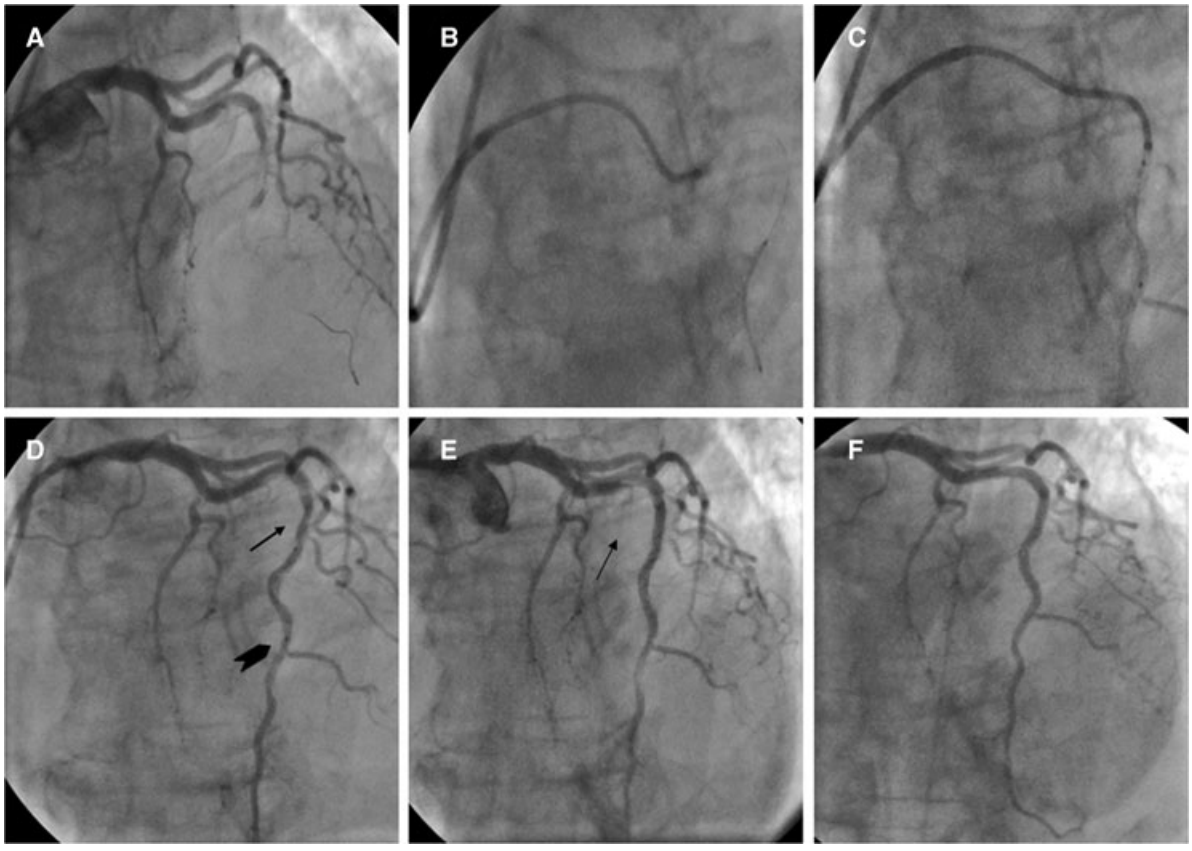

Figure 6. Case 5. (A) Coronary angiography showed a thrombotic occlusion of the mid LAD, with a very tortuous and calcified proximal segment. (B) Guideliner deployed beyond the guide tip and the 2.5 × 23-mm Multi-Link stent distally to the lesion across the proximal severe tortuosity. (C) Angiography showing Guideliner catheter deeply seated and stent position in mid LAD (arrowhead). (D) Stent deployment in mid LAD thanks to Guideliner deep seating, crossing the severe tortuosity. (E) LAD proximal segment type B dissection was detected and a third 3 × 28 and 3.5 × 13-mm stent was implanted to seal the all dissected segment. (F) Final result.

showed a 30% stenosis of proximal LAD, and a chronic total occlusion of proximal left circumflex in bifurcation with the 2nd OM branch, with severe tortuosity (Fig. 8). PCI was performed from the right radial artery with a 6F extra-backup 4.0 Launcher guiding catheter (Cordis, Johnson & Johnson Corporation). The occlusion was crossed with an Asahi Fielder XT coronary guidewire (Abbott Vascular, Abbott Laboratories). This guidewire was then exchanged to a 0.014'' Balance Middle Weight Universal guidewire (Abbot Vascular, Abbott Laboratories) which was positioned distally in the 2nd OM. A hydrophilic Whisper guidewire (Abbot Vascular, Abbott Laboratories), was introduced distally into the LCX and proximal LCX dilated with a 2.0 × 15 Trek balloon catheter (Abbott Vascular, Abbott Laboratories). As a 2.25 × 20 mm Promus Element drug eluting stent (Boston Scientific) did not cross the proximal LCX, a Guideliner catheter was used to advance it through the proximal LCX- 2nd OM severe tortuosity. We implanted 2.25 × 20 mm Promus Element drug eluting stent (Boston Scientific) and an overlapped 2.25 × 28 mm Xience Prime drug eluting stent (Abbott Vascular, Abbott Laboratories). During stent placement and implantation, LM and proximal to mid LAD type B dissection was detected (Fig. 8D). The Guideliner was occlusive, and this dissection was possibly due to the direct injection in the diseased proximal LCX. We implanted 2.75 × 33 mm and 3.5 × 18 mm Xience Prime drug eluting stents (Abbot Vascular, Abbott Laboratories) to heal the dissected segment, from mid-LAD up to the ostium of LM. The final angiogram showed a good result with TIMI III flow and no residual dissection.

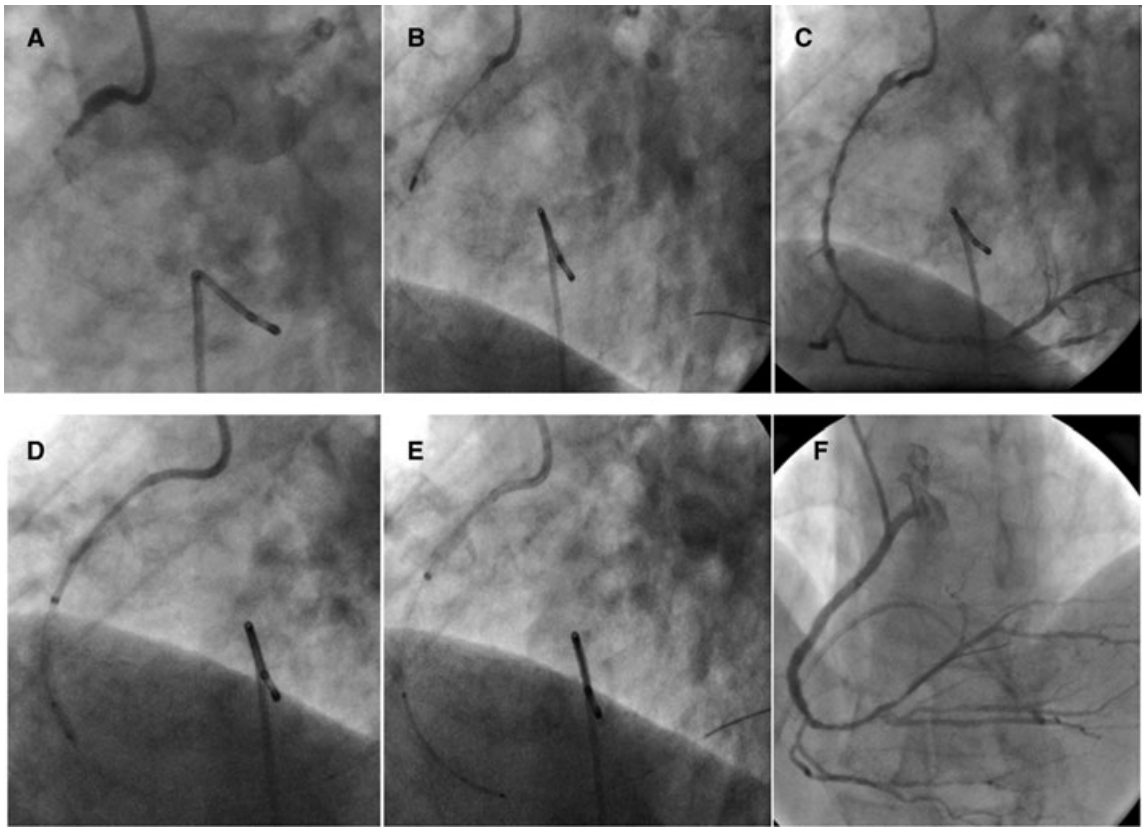

Figure 7. Case 6. (A) Baseline angiography showing RCA chronic total occlusion. (B) Rotational atherectomy with a 1.25 burr (Rotablator Rotational Atherectomy System, Boston Scientific, Natick, MA, USA). (C) Postrotational atherectomy angiography showing a severely calcified long lesion. (D) Deep intubation of the Guideliner allowing distal balloon dilation. (E) Deep intubation of the Guideliner and distal stent implantation (2.5 × 30 mm and 3.0 × 30 mm Endeavor Resolute drug eluting stent, Medtronic Cardiovascular). (F) Final result. TIMI III flow.

Discussion

Coronary artery tortuosity is associated with increased technical difficulty, increased use of contrast and fluoroscopy, and reduced PCI success rates. Vessel calcification is an additional anatomical factor associated with procedural failure and complications.[8,9] The combination of coronary tortuosity and calcification could impede stent delivery and significantly increase the risk for stent loss or stent damage. Several strategies to increase PCI success in difficult scenarios have been described. Good guiding catheter support is crucial for both wiring and equipment delivery. The rapid exchange Guideliner catheter has been designed as a guiding catheter extension to ease stent delivery when guiding catheter support is poor. Mamas et al.[6] described their experience in a series of 13 challenging cases treated with the Guideliner catheter. They concluded that the catheter can cross points of proximal obstruction where a stent gets stuck due to the greater flexibility and smoother surface of the catheter than the stent. Therefore, it increases backup support in the setting of difficult disease. Moreover, these cases were performed transradially, when an extra-backup is needed, especially facing complex anatomy, demonstrating safety and feasibility of the use of this catheter extension in this setting. Furthermore, the same group extended the series successfully performing transradial coronary bypass graft PCI with guide catheter extensions.[7,10] Our purpose with this case review is to expand the description of how to use this device and warn of some complications that may be associated. We performed 10 cases with the Guideliner catheter: 9 successful cases and 1 failure, 2 primary PCIs and 2 CTOs. In 3 cases we had a proximal dissection as a complication and, in 2 cases, stent damage. In our experience,

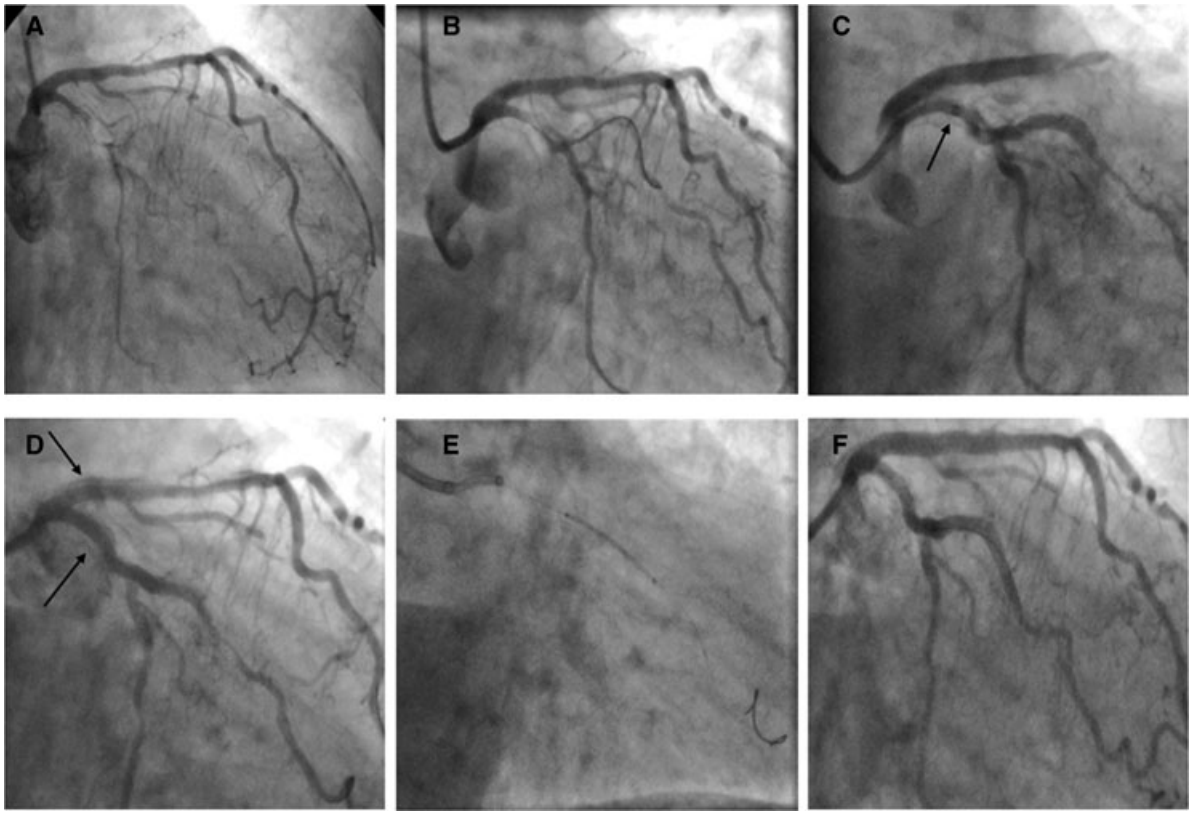

Figure 8. Case 10. (A) Baseline angiography showing 30% stenosis of proximal LAD, chronic total occlusion of proximal circumflex in bifurcation with the 2nd OM with severe tortuosity. (B) Asahi Fielder XT coronary guidewire (Abbott Vascular, Abbott Laboratories, Abbott Park, IL, USA) inside the 2nd OM showing its severe tortuosity. (C) Guideliner catheter introduced into the diseased segment (arrow), then contrast has been injected selectively into the proximal LCX, straight to the plaque in the disease segment. and retrograde dissection was detected, involving LAD and LM (arrow). (D) After selective intracoronary injection retrograde dissection was detected, involving proximal LCX, proximal LAD and LM (arrows). (E) Guideliner intubation and stent implantation across the severely tortuous segment. (F) Final result, the dissection is sealed. TIMI III flow.

the Guideliner catheter increased back-up support and allowed to cross proximal points of obstruction where no stent could pass and helped crossing tortuous segments. These cases could not have been completed successfully if the Guideliner catheter would not have been used, as other techniques (buddy wire, anchoring, incremental dilatations) failed. In every case the Guideliner was easy to deploy and retrieve, like a conventional balloon.

Typically, stenting is performed from distal to proximal because of potential difficulty of crossing a deployed stent in the setting of vessel tortuosity. As reported by Mamas et al.,[5] in some cases proximal segments are stented first; once proximal disease is treated, deep intubation of the device is safe and allows stenting of distal lesions. Use of the Guideliner catheter overcomes this restriction: the device easily passes through even very tortuous stented segments. This strategy was used in our 6th case, to allow for stent redilatation. Our first case was a failure. In the attempt to treat a proximal PDA with a 6F Judkins Right guiding catheter, we could advance the Guideliner over the wire into the acute margin of the right coronary artery, but support was not enough to cross the lesion with a balloon. A deeper intubation could have been achieved if we had advanced and dilated a balloon distally, using it as an anchor to further advance the Guideliner. We had 2 cases of proximal dissection (as exemplified in case 5 and 10) after Guideliner deep seating. In particular in case 5 a retrograde large type D dissection involving the mid-proximal segment of LAD was visualized once the operator retrieved the Guideliner. This complication, which can add considerable risk to the procedure, was probably caused during the

device advancement directly over the wire. In our first case, the device was advanced alone over a wire into the distal vessel. In later cases, we always advanced a balloon before, which made the Guideliner passage more coaxial, decreasing dissection risk. Besides, this balloon can be inflated distally, creating an anchor that helps advancing the Guideliner catheter. This strategy has avoided new cases of dissection. In case 10, a large retrograde type C dissection involving left main stem and LAD proximal segment originated at the tip of the Guideliner while injecting; the device was occlusive in a diseased segment, and then the dissection extended backward into the left main. Again a severe complication added important risk to the procedure. Extreme caution has to be exerted when injecting in these kinds of risky situations; the injection must be avoided unless strictly necessary and, if needed, should be gentle. Using the Guideliner, few but important tips have to be known: a useful tool can be dangerous, as it often happens during interventional procedures.

One limitation Mamas et al. described[6] is a small risk that large/bulky stents can get damaged entering the collar; they recommend the use of low profile stents with this system, avoiding >4-mm diameter stents. We report 2 cases of stent damage: In case 4 the operator felt resistance crossing the device steel collar with the stent (2.25×18 Endeavor Resolute, Medtronic Cardiovascular) and retrieved it. In case 5, stent damage probably was due to the severe tortuosity and calcification of the mid-LAD segment. Problems at the collar level have been described by other operators as well.[6] In case of resistance while inserting a stent through the Guideliner catheter, the location of the device in relation to the metal collar should be checked and the stent checked for damage. In our experience, even a low profile stent with 2.25-mm diameter got damaged. Instead, coaxiality is probably more important, as the stent may get stuck at the metallic collar if it coincides to be in a bend of the catheter. In this case, gentle retrieval of the Guideliner so as to place the collar in a more straight segment of the guide helps getting the stent into the catheter extension.

Conclusions

The Guideliner catheter is helpful in performing complex procedures. Benefits include deep intubation to cross proximal calcification and tortuosity with better support, allowing distal stent delivery. The device only reduces the lumen of the guide by approximately 1 French; rapid exchange makes it easy to use, and it can be deployed through the hemostatic valve. The Guideliner can be used safely either for transradial or transfemoral procedures, primary or elective PCI and CTO PCI. We safely used it after rotational atherectomy and thrombus aspiration. Downsides include the important risk of proximal dissections during catheter advancement and injection. These complications add high risk to the procedure, and few tips and tricks are paramount not to make its use dangerous. A second downside is a small but real risk of stent damage because of the collar shape, which can be experienced even with second-generation low profile stents. Future catheter design modifications are needed. Our experience confirms the device usefulness in difficult scenarios; moreover, we give some tips about its technique of use in order to decrease complications.

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