Usefulness of GuideLiner Catheter during Percutaneous Coronary Intervention in Difficult to Cross Complex Lesions due to Calcification and Tortuosity

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Abstract: Failure of stent delivery during percutaneous coronary intervention is one of the common causes of procedural failure. The GuideLiner catheter is a novel device with rapid exchange characteristic that ease the device delivery in deep vessel. We are reporting four cases on the usefulness of the GuideLiner catheter during percutaneous coronary intervention to enable stenting in complex, calcified, tortuous or distal lesions.

Keywords: GuideLiner catheter, mother and child catheter, tortuous lesions, left anterior descending artery, right coronary artery, percutaneous coronary intervention.

INTRODUCTION

Despite continued advancement in the techniques and developments in designs of guide catheters, guide wires, balloons and stents, technical troubles during stent delivery are confronted. The rate of failure in delivering stent during percutaneous coronary intervention (PCI) at target vessel ranges from 2.7% to 3.3% [1, 2].

The GuideLiner™ catheter (Vascular Solutions, USA) is a monorail, “mother and child” rapid-exchange guide extension that allows stent delivery by providing additional back-up support and coaxial guide engagement. However, unlike Heartrail II (Terumo, Japan) guiding catheter, entire procedure can be completed using the same guide catheter without increasing the overall length of guiding catheter.

In this case series, we describe our experience with the use of the GuideLiner catheter in facilitating equipment delivery in challenging cases performed transfemorally and also discuss some different uses, complications and remedies of the same.

Case-1

A 72 year old diabetic and hypertensive male, underwent coronary artery bypass grafting (CABG) 10 years back, attended the clinic for severe episodes of angina. The patient was also being treated for cellulitis of right leg for last 10 days which was due to associated peripheral vascular disease which aggravated associated coronary artery disease resulting in ACS. Coronary angiography (CAG) (Figures **1A** & **B**) revealed severe triple vessel disease showing diffuse mild narrowing of distal left anterior descending (LAD) artery with patent left internal mammary artery (LIMA) to LAD, 70% discrete lesion in distal left circumflex (LCX), critical mid right coronary artery (RCA) showing calcified lesion with severe narrowing of mid to distal RCA and its branches which are small caliber vessels unsuitable for redo bypass and closed saphenous vein graft (SVG) to posterior descending artery (PDA). Severe refractory angina during CAG was uncontrolled with intravenous (IV) nitroglycerine (5-10 mcg/min), intracoronary (IC) nitroglycerine (100 mcg) and nicorandil (Nikoran) (2mg repeated twice). Thus, intra-aortic balloon pumping (IABP) support was given after angiography which relieved angina over a period of 1 hour and PCI was planned next day under IABP support.

As the patient had right leg cellulitis (totally occluded right posterior tibial artery), left femoral approach was used for PCI. The RCA was engaged with 7F JR guiding catheter (Cordis Corp., Johnson and Johnson, New Jersey) and lesion was crossed with BMW wire (Abbott Vascular, USA), pre-dilatated with 1.5 mm x 8.0 mm Minitrek balloon (Abbott Vascular, USA). Due to lack of guiding support, buddy wire technique (Figure **1C**) was used to cross the balloon to distal RCA and serial dilatations were carried out using 2.0 mm x 12 mm Minitrek, 2.5 mm x 12 mm Trek (Abbott Vascular, USA), 3.0 mm x 12 mm Voyager NC

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E-ISSN: 2311-052X/14

balloons (Abbott Vascular, USA) for proximal and mid RCA and using 1.5 mm x 8 mm, 2.0 mm x 12 mm Minitrek balloons for distal RCA. We tried to cross the lesion with 3.0 mm x 28 mm Absorb stent (Abbott Vascular, USA), but we failed to cross beyond proximal RCA. Then we engaged RCA with right Amplatz guiding catheter (Boston Scientific Corp., USA) for better support and again lesion was crossed with Voyager NC balloon and Trek balloon. Angiography (post-balloon dilatation) showed mild dissection of proximal RCA with good antegrade flow. Even after many attempts, stent passage was unsuccessful. On the next day, 6Fr GuideLiner (Figure **1D**) was then advanced over BMW wire using balloon anchoring technique and it was passed up to proximal and mid RCA junction. The RCA (proximal to mid) was dilated using 3.0 mm x 12 mm Maverick balloon. Immediately after post-dilatation, the distal portion of the mid RCA lesion was implanted with 3.0 mm x 18 mm Xience V stent (Abbott Vascular, USA), mid and proximal RCA junction was implanted with 3.0 mm x 23 mm Xience V stent overlapping the distal stent. Another 3.5 mm x 18 mm Xience V stent was implanted in proximal RCA to mid RCA, overlapping the previous stent to cover the entire dissection flap. Post stenting dilatations (Figure **1E**) were carried out using 3.5 mm x 18 mm stent balloon at 18 atm (for proximal-mid RCA Junction) and distal RCA and posterolateral ventricular branch (PLVB) was dilated with 1.5 mm x 12 mm Minitrek balloon for 15 to 20 sec each. Post-procedural angiography (Figure **1F**) showed well implanted proximal to distal RCA stents without any residual stenosis/dissection/thrombosis with TIMI-III flow across the distal RCA and its branches. The patient was found asymptomatic at one year follow up.

Case-2

A 62 years old male with good left ventricular and right ventricular function was admitted for shortness of breath (SOB), palpitations and left sided chest pain. Electrocardiogram (ECG) revealed atrial fibrillation (AF) with fast ventricular rate which was converted to sinus rhythm with IV Verapamil (10 mg). The mid segment of RCA revealed 60-70% lesion (Figure **2A**) and 80-90% lesion in proximal LAD with tortuosity and aneurysm of the LAD at left marginal (LM) bifurcation site (Figures **2B** & **C**).

The LM was engaged with 6Fr XB 3.0 guiding catheter (Cordis Corp., Jhonson and Jhonson, New Jersey). The lesion was crossed with 0.014" BMW U II wire (Abbott Vascular, USA). Pre-dilatations of the lesion were carried out with 2.0 mm x 15 mm Trek balloon (Abbott Vascular, USA) & 2.5 mm x 20 mm Falcon balloon (Meditronics). However subsequent passage of 3.0 mm x 28 mm BVS (Abbott Vascular, USA) was unfavourable due to tortuous bend. We re-dilated proximal LAD with 3.0 mm x 15 mm NC Trek balloon and again tried to cross BVS and 3.0 mm x 33 mm Xience Prime stent (Abbott Vascular, USA), but failed even with buddy wire technique. So, 6Fr guide-catheter was replaced with 7Fr JL XB 3.0 guide-catheter. The LAD lesion was re-crossed with BMW wire and 6Fr GuideLiner (Figure **2D**) was introduced over the BMW guidewire up to LAD ostium. A 3.0 mm x 33 mm Xience Prime stent (Figure **2E**) was deployed at

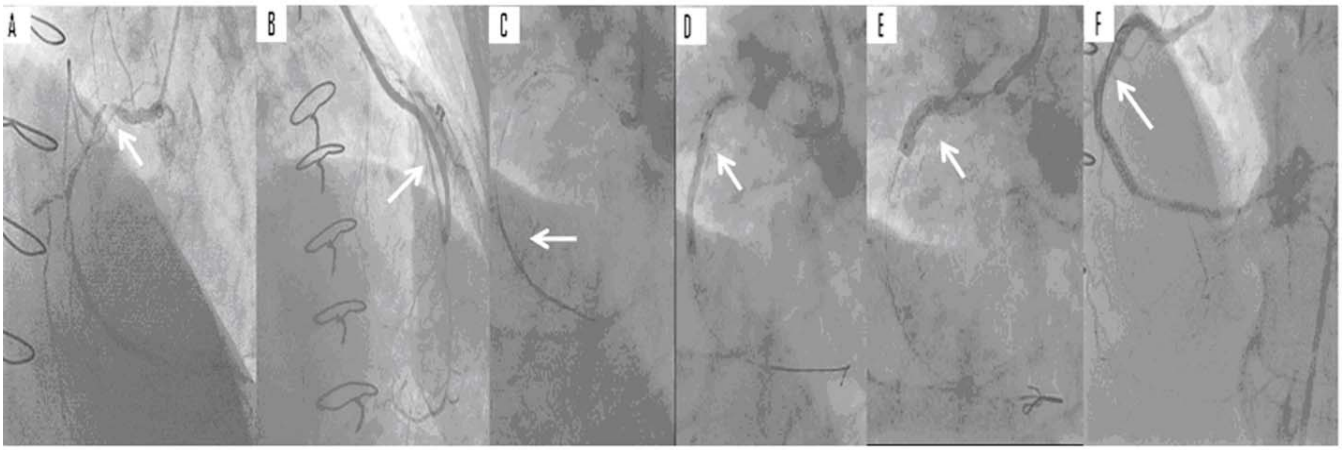

Figure 1: Pre and post porocedural angiographic outcomes of right coronary artery in case 1: (**A**) proximally 99% long segment calcified lesion and diffuse 80-90% lesion in mid segment; (**B**) graft angiography; (**C**) buddy wire technique; (**D**) A GuidelLiner was advanced further using balloon anchoring technique to get good guide catheter support and stent was placed; (**E**) post stenting dilatations were carried out for proximal and mid RCA junction; (**F**) post stenting angio showed well implanted proximal to distal right coronary artery stents with TIMI-III flow.

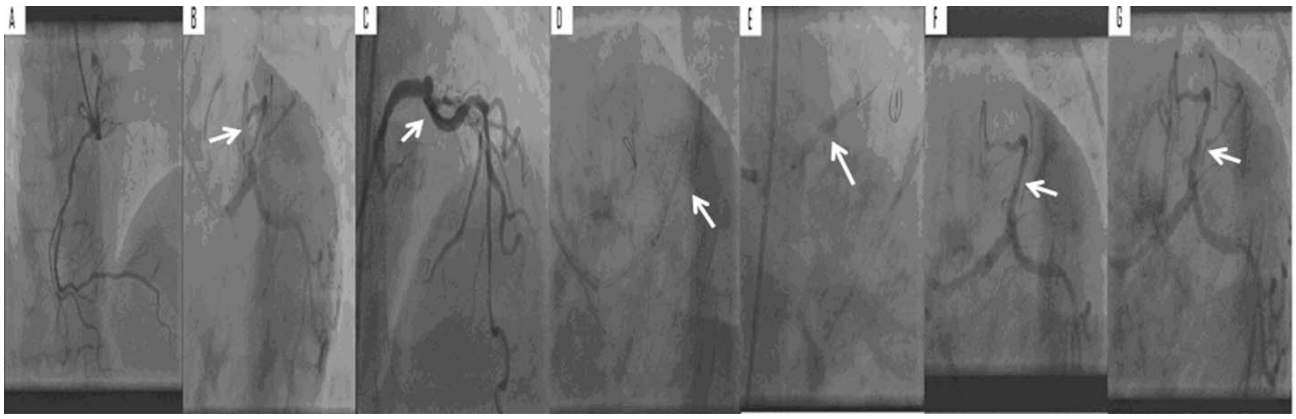

Figure 2: Pre and post porocedural angiographic outcomes of case 2: (**A**) lesion in mid right coronary artery (60-70%); (**B** & **C**) short segment aneurysm of left anterior descending artery (LAD) at the origin with tortuous bend involving long segment lesion of proximal LAD (80-90%); (**D**) advancement of the GuideLiner catheter; (**E**) stenting of proximal LAD; (**F** & **G**) post stenting check angio with TIMI-III flow.

12-14 atms for 20 sec. After serial dialatations with 3.0 mm x 15 mm Leo NC balloon (Biotronik SE & Co., Germany), 3.5 mm x 10 mm NC Trek balloon and 4.0 mm x 10 mm NC Sapphire balloon (Asia Cardiovascular Pdt. Ltd., Hong Kong), good TIMI-III flow was observed (Figure **2F** & **G**).

Dragonfly optical coherence tomography (OCT) imaging catheter (St. Jude medical, USA) (Figure **3**) showed proximal and mid portion of the stent not opposed fully.

Fractional flow reserve (FFR) study (Figure **4**) of RCA was done with intracoronary adenosine administration which revealed FFR value of 0.77.

Case-3

A 65 year old male, with a history of four vessel CABG presented [LIMA to LAD, SVG to diagonal 1, SVG to PDA, SVG to obtuse marginal (OM1)] with recent onset of episodes of classical angina and shortness of breath on effort along with palpitations. Ultrasonography of abdomen revealed renal calculus, prostatomegaly (Grade-II) and hepatomegaly with fatty changes. Coronary angiogram (Figure **5**) revealed triple vessel disease with total occlusion of proximal LAD and OM1, diffusely calcified proximal RCA with 95% calcified lesion of mid RCA and 50% narrowing of proximal SVG graft whereas all other grafts were patent.

The RCA was engaged with 3.5 JR 7Fr guiding catheter through right femoral route and mid RCA was crossed with 0.014" Stabilizer plus and sion blue wire (Asahi Intecc Co. Ltd., Japan) but we failed. Finally, we crossed with Fielder FC guide wire (Abbott Vascular, USA) which was exchanged with microcatheter Corsair (Asahi Intecc Co. Ltd, Japan) (Figure **6A**). We tried to introduce 0.019" Rota Floppy wire (Boston Scientific corp., USA) but passing Rota wire beyond mid RCA through Corsair was difficult, so we tried stride microcatheter but it could not cross beyond mid RCA, which was replaced with another new Corsair microcatheter facilitating the passage of Fielder FC

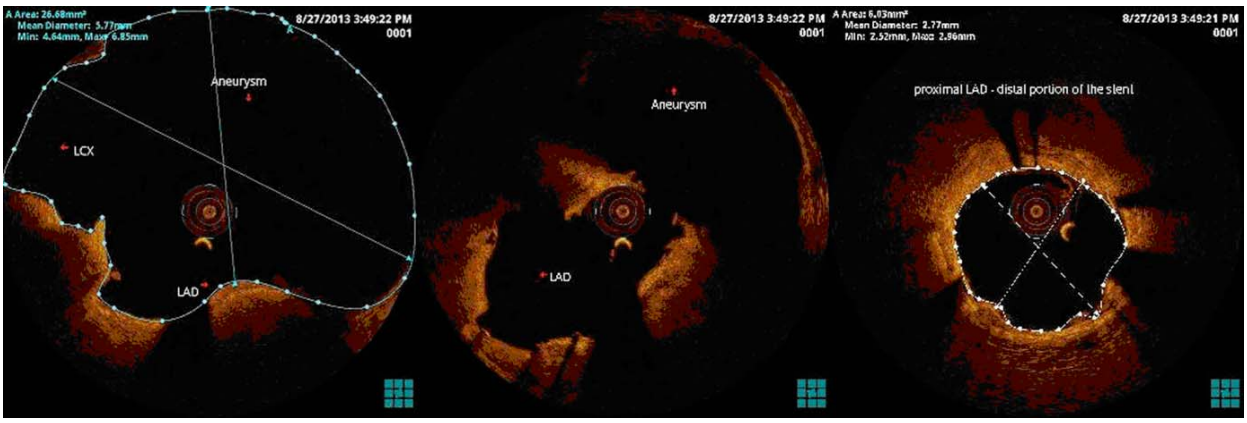

Figure 3: Optical coherence tomography assessment.

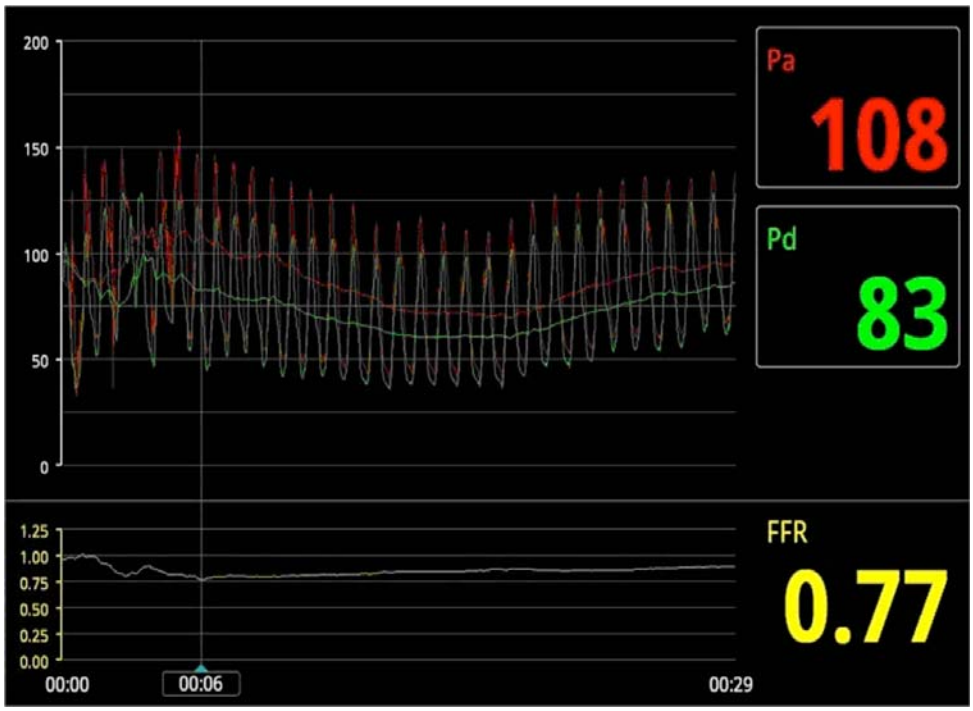

Figure 4: Fractional flow reserve assessment with value of 0.77.

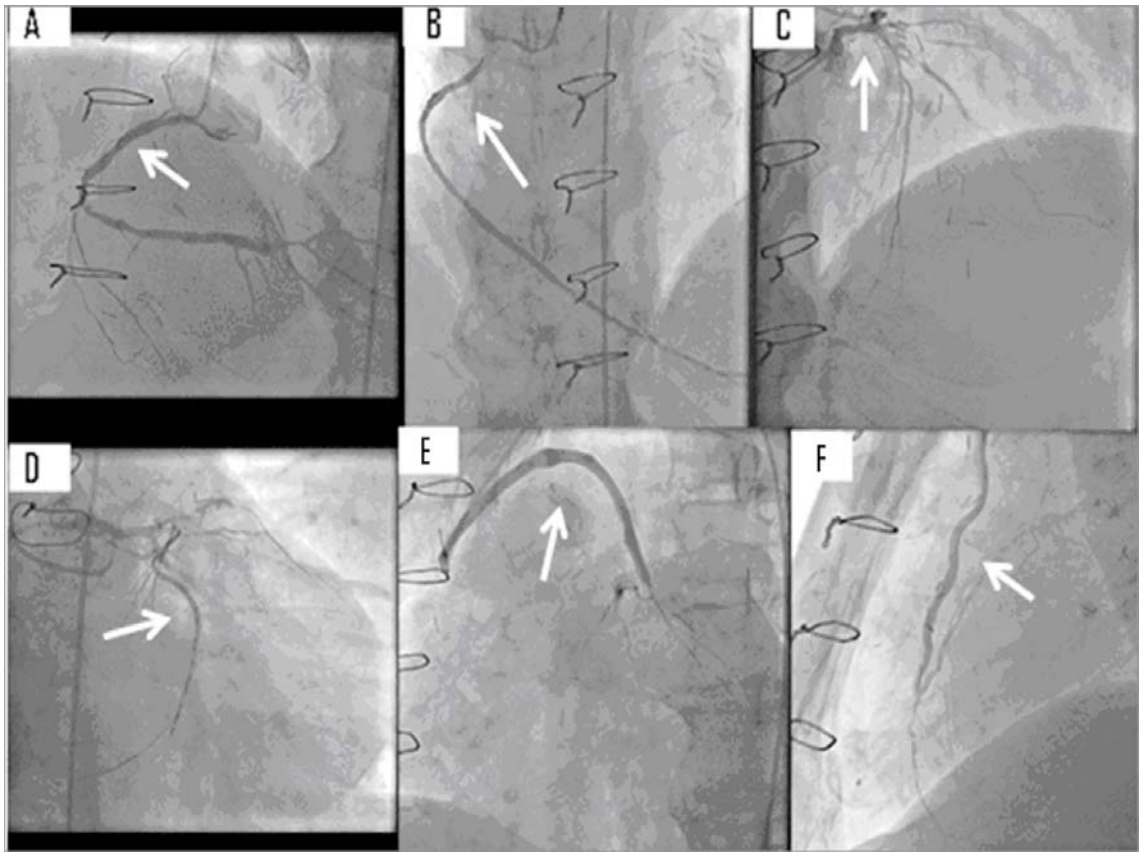

Figure 5: Angiography results of case 3: (**A**) diffusely calcified proximal and mid right coronary artery (RCA) with 95% calcified lesion of mid RCA, small vessel mild disease in postero-lateral ventricular branch (PLVB); (**B**) patent saphenous vein graft (SVG) to posterior descending artery (PDA) with totally occluded PDA proximally; (**C**) normal left marginal coronary artery (LMCA), and proximal total occlusion in left anterior descending artery (LAD); (**D**) non-dominant left circumflex artery and proximal total occlusion in obtuse marginal1; (**E**) patent SVG graft to diagonal, patent SVG graft with 50% narrowing proximally; (**F**) patent left internal mammary artery to LAD.

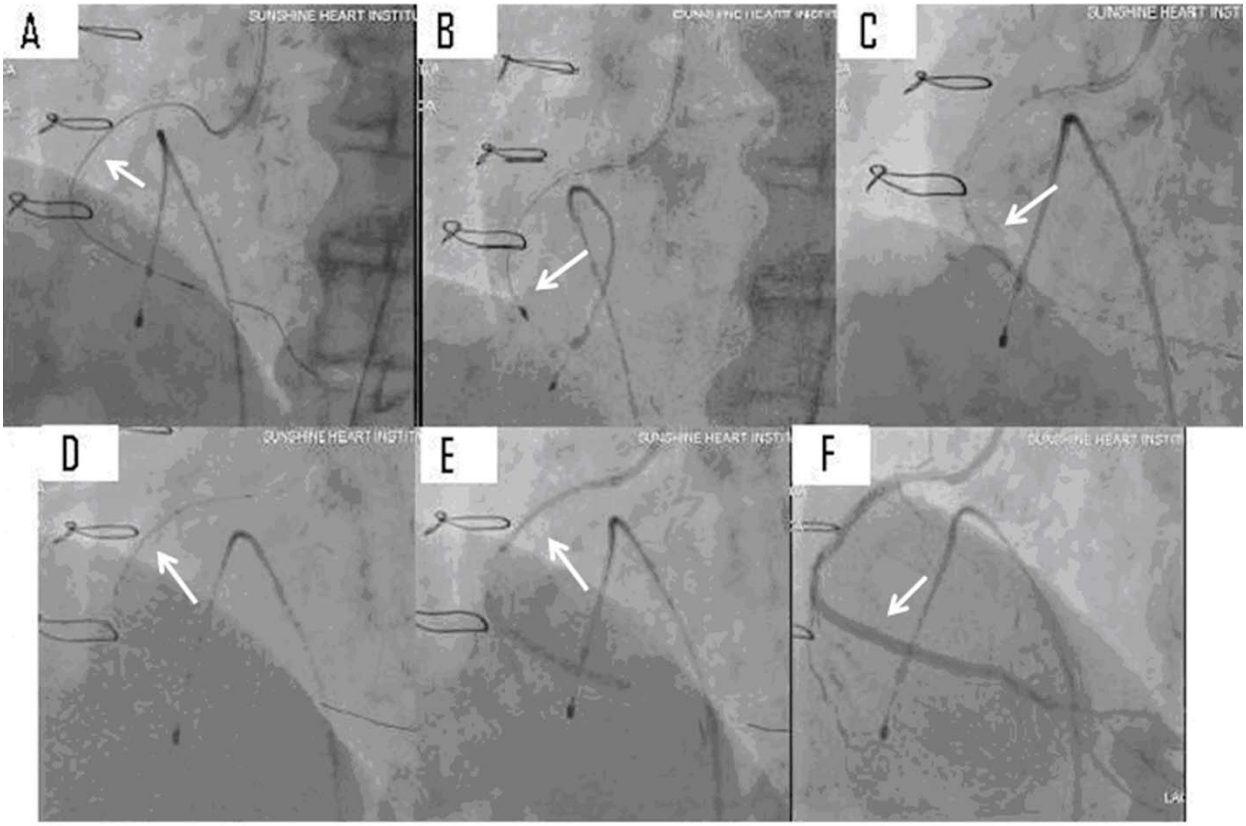

Figure 6: Procedural outcomes of case 3: (**A**) microcatheter was exchanged with guidewire; (**B**) rota-ablation of proximal and mid right coronary artery (RCA) was done; (**C**) predilatations were done in mid RCA; (**D**) resolute integrity stent unable to cross beyond mid RCA; (**E**) advancement of the GuideLiner over BMW Guide wire through 7Fr guide catheter and was extended to mid RCA; (**F**) post stenting final angiogram showed TIMI-III flow.

wire. Fielder wire was exchanged with Rota extra support guide wire without much resistance. However, 1.5 mm Rota burr passage through the ostium was unsuccessful due to calcification. Rota-ablation (Figure **6B**) of ostium, proximal and mid RCA was done at 1, 60,000 revolutions speed using 1.5 mm Rota burr. Unfortunately, the patient developed bradycardia with paced rhythm, hypotension and ST-elevation in inferior leads with chest pain due to slow flow after rota ablation. The patient was agressively treated with IV atropine (6 mg), IV dopamine (7.5 mcg/kg/min) and infusion of dobutamine (5 mcg/kg/min) and noradrenaline (2-5 mcg/min) which improved the blood pressure and heart rate restored back to sinus rhythm. The patient also received diluted IC nicorandil (2 mg), and adenosine (3 mg). After stabilization of haemodynamic status, rota-ablation of mid to distal RCA was done again and tried to cross mid RCA with 1.2 mm x 15 mm Mini trek, but we failed. Serial dilatations (Figure **6C**) were done with 1.0 mm x 10 mm Falcon balloon and 2.5 mm x 15 mm NC Trek balloon. Deploying stent (Figure **6D**) in mid RCA with 3.0 mm x 38 mm Resolute Integrity stent (Medtronic.Inc, United States) was not possible due to difficulty in crossing beyond mid RCA in spite of buddy wire, so 6Fr GuideLiner (Figure **6E**) was introduced over the BMW Guide wire through 7Fr guide catheter. The tip of GuideLiner was introduced almost 5 cm up to the mid RCA, extending from guide catheter tip. The 3.0 mm x 38 mm resolute integrity stent was deployed and post-dilatation was done with 3.0 mm x 12 mm non-compliant Trek balloon inflated at 20 atm. Post-procedural angiogram (Figure **6F**) showed excellent end result with TIMI-III flow and mild narrowing in proximal to the mid RCA stent.

An OCT was done with 3.4Fr C7 Dragonfly imaging catheter which demonstrated well opposed struts without any residual stenosis or dissection.

FFR was done which showed value of 0.94 after stenting (Figure **7**).

Case-4

A 62 years old, alcoholic male, diagnosed with asthma, with a past history of adenoid cystic carcinoma involving right lateral wall of mid trachea admitted for inferior wall ST elevated MI (STEMI) with recent onset

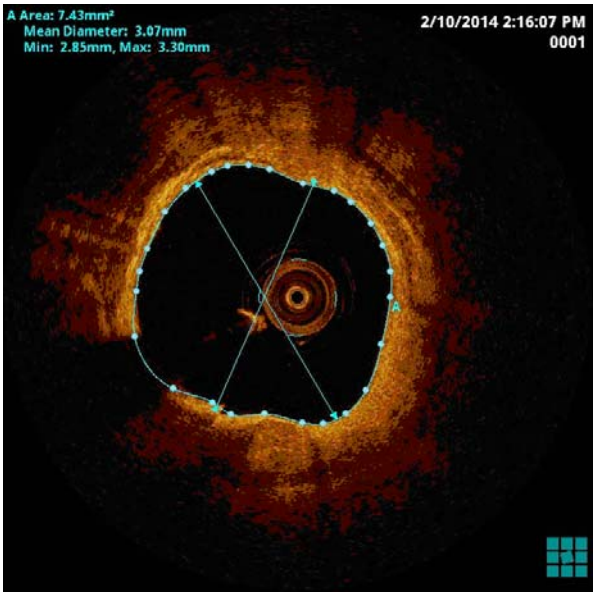

Figure 7: OCT Study.

of angina. Echocardiaography showed regional wall motion abnormalities of inferior wall. Angiography revealed 90% lesion in mid LAD just after bifurcation of LAD and diagonal, with short segment aneurysm of LAD from proximal to the mid LAD lesion (Figure **9A**) and 99% lesion in mid RCA and 80 – 90% lesion in distal RCA. Access was from the right femoral route using JR 3.5 6Fr Guiding catheter. The lesion was crossed with 0.014" Sion blue wire, predilatated with 2.0 mm x 12 mm Mini Trek balloon. The distal RCA was stented with 2.5 mm x 24 mm Endeavor Sprint stent (Medtronic Inc, United States) (DES) at 9 atms for 20 sec. Mid to distal RCA stenting was done with 3.5 mm x 30 mm Resolute Integrity stent at 14 atms for 20 sec, overlapping the distal stent. The left marginal coronary artery (LMCA) was engaged with XB 3.5 7Fr Guiding catheter, crossed with 0.014" Sion blue wire, and predilated with 2.0 mm x 12 mm Mini Trek balloon. However, we tried to cross aneurysmal site with 2.75 mm x 14 mm Resolute Integrity stent (Figure **9B**) and 2.75 mm x 12 mm Xience Xpedition stent (Abbott Vascular, USA), but stent delivery across the lesion was not possible beyond the aneurysm site, hence the GuideLiner was advanced through 7Fr guide catheter, after placing guide liner distal tip just proximal to the aneurysm. A Xience Xpedition 2.75 mm x 12 mm stent (Figures **9C** to **E**) was placed just after the aneurysm covering LAD lesion at 8 to 12 atms for 20 sec, with a good TIMI-III flow (Figure **9F**).

DISCUSSION

The main findings of this study are that, the use of GuideLiner catheter helps in (a) facilitating the delivery of equipment in challenging lesions and (b) enabling engagement of difficult to engage vessels.There are various techniques [3] for delivering equipments in the challenging lesions, like the use of guide catheter [4], the angioplasty wire (such as use of more supportive wires or use of one or more buddy wires [5], the lesion (such as lesion modification with laser [6], rotational atherectomy [7], balloon angioplasty [8], the stent (use

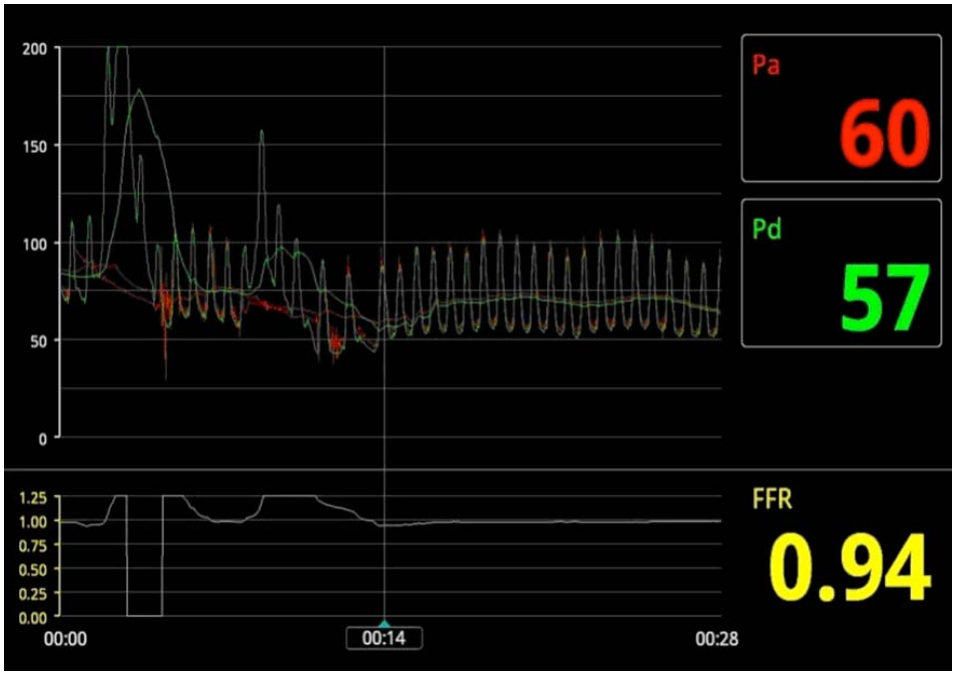

Figure 8: FFR assessment with a value of 0.94.

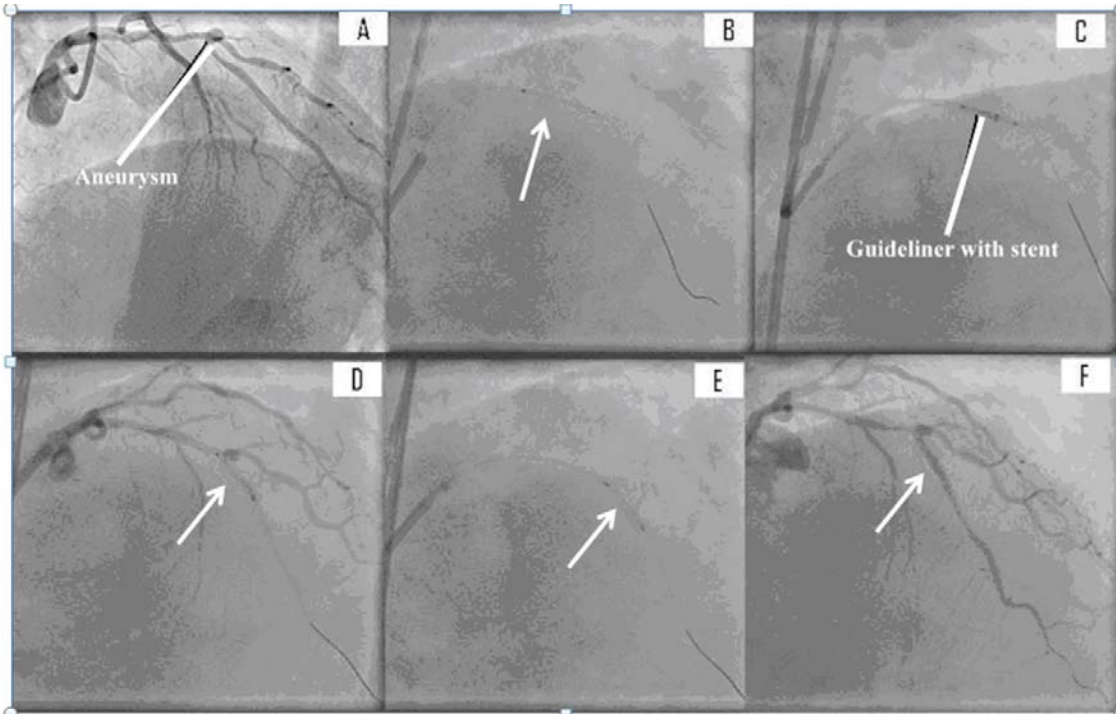

Figure 9: Pre and post angiographic outcomes of case 4: (**A**) lesion in mid left anterior descending artery (LAD) (90%) and diagonal bifurcation with short segment aneurysm of LAD proximal to the mid LAD lesion; (**B**) stent could not crossed beyond the aneurysm without GuideLiner; (**C**) stent crossed beyond aneurysm with the GuideLiner support; (**D**) stent placement; (**E**) stent deployment; (**F**) good TIMI-III flow.

of shorter or more deliverable stents), or by using guide anchoring [9].

Delivery of balloons and stent was successfully achieved in all 4 cases. It was easy to use and deliver stents across difficult to cross the lesions without any major procedural complications. This has been achieved using the GuideLiner catheter by both increasing the back up support and crossing proximal points of obstruction.

A first case of post CABG PCI was observed having closed SVG graft to PDA. Buddy wire technique was used in delivering stent, but was unsuccessful in spite of multiple balloon dilatations. During intervening, mild dissection of proximal RCA was observed. Finally, the GuideLiner was advanced using anchoring technique to distal RCA facilitating stent delivery. This was followed by stenting of proximal and mid RCA segments with two more stents, showing good angiographic result. Anchor balloon techniques using a conventional guide catheter [10] and the GuideLiner catheter have been used to facilitate stent delivery as well as wire and balloon passage in chronic total occlusive (CTO) lesions [11].

A patient in second case had 90% lesion in proximal LAD with tortuosity and aneurysm at the origin. Crossing the stent through the tortuous lesion was difficult which was simplified using the GuideLiner. Treating tortuous and calcified disease, failure in delivering a stent to target lesion remains one of the major causes of procedural failure. Rao *et al*. reported a successful case of inserting GuideLiner in tortuous vessel [12].

In third case, the patient with triple vessel disease had diffusively calcified RCA. It was difficult to cross the equipments beyond mid RCA due to calcification. Various techniques like rota-ablation, micro catheterization were used but it did not work out. As such deploying stent in the mid RCA was impossible, which was made possible using the GuideLiner, which was even reported by Pershad *et al*. [13].

In fourth case, the patient with 90% lesion in mid LAD just after LAD and diagonal bifurcation with short segment aneurysm in proximal to mid LAD lesion and another lesion in mid to distal RCA. While stenting LAD, passage of stent was difficult due to an aneurysm proximally. Use of the GuideLiner enabled the deployment of stent with good TIMI-III flow.

Conventional stenting is performed from distal to proximal vessel in most cases, mainly due to the potential difficulty of crossing a deployed stent in the

proximal portion in the setting of vessel tortuousity. However, use of the GuideLiner catheter overcomes this restriction because of the ease with which the GuideLiner catheter will pass through even very tortuous stented segments (in some cases aided by a distal balloon anchor [11].

The advantages of the GuideLiner included not needing to remove and reconnect the Y connector, less risk of air embolism, easier control of the mother catheter, more selective contrast injection [14], easier advancement and removal, and ability to advance a stent further beyond the catheter tip [11, 15].

COMPLICATIONS AND REMEDIES

Intubation of the GuideLiner bears the risk of causing a dissection in a proximal coronary artery and should be performed carefully. While advancing the device if resistance is encountered, the GL can be retrieved into the mother guide and then re-advanced over a balloon catheter (to improve alignment) into the target vessel [16]. The risk can be decreased by using buddy wire technique or by using guide catheter extension. After advancing the GuideLiner into the vessel, the operator should check the coronary pressure waves and verify the presence of adequate, preserved antegrade coronary flow. There are chances of pressure dampening using GuideLiner catheter and if dampening occurs, ensure that adequate antegrade flow is preserved and no injury has occured before proceeding with the intervention. A case study by Michael Luna *et al.*, reported a pressure dampening in 12 patients (out of 21 patients) [17]. Since use of the GuideLiner reduces the size of working lumen, there is an increased risk of air embolism, which can be diminished by slow advancement and withdrawal of the equipment; time should then be taken to carefully vent the system. A limitation of the device is the metallic collar located at an entrance of the extension tube. In case of resistance, the location of the stent in relation to the metallic collar of the GuideLiner should be checked and the stent should be inspected for damage. Stent damage has been reported in many cases [18]. If the collar is located at a bend in the catheter, the GuideLiner should be retrieved gently into a straight section of the mother guide in order to allow more coaxial alignment of the collar [16].

CONCLUSION

GuideLiner catheter is a simple and easy to use device which provides an increased back up support and facilitates stent delivery in tortuous or complex, heavily calcifed lesions and also in distal lesions. No procedural complications were observed with good success rate of the GuideLiner.

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Received on 09-02-2014 Accepted on 07-04-2014 Published on 30-11-2014

DOI: http://dx.doi.org/10.12970/2311-052X.2014.02.03.1