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Cadaveric Left Main Coronary Artery Ostial Stenting Using Novel Goose-Neck Snare Assisted Aorto-Ostial Stenting Technique

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***Abstract*— *During aorto-ostial stenting, many times we miss the ostium, and other times the stent may protrude into the aorta. The novel technique for the placement of aorto-ostial coronary stent using goose-neck snare gives a fair idea about the location of the coronary ostium at the aorto-ostial location using a 2-dimensional fluoroscopy system and aids in precise placement of the aorto-ostial stent.*

***Keywords*— *Percutaneous coronary intervention, Stenting technique, Coronary artery disease.*

I. INTRODUCTION

Various techniques for precise placement of aorto-ostial stent have been described in literature which includes angiographically assisted placement, aorta free-floating wire technique, Szabo anchor-wire technique, etc. There are special dedicated ostial stents as well as specially designed systems like ostial pro-stent placement system for precise ostial stent deployment. Each technique has its advantages and disadvantages. We have recently developed a technique for placement of aorto-ostial coronary stent using a goose-neck snare. The prototype case using this technique was done for the placement of the stent at the ostium of right coronary artery[1]. Here we are describing the use of the same technique for the placement of the left main coronary artery (LMCA) ostial stent in a cadaveric heart specimen.

II. CADAVERIC STUDY

Steps for the placement of aorto-ostial stent as described in the prototype case report, were followed on the cadaveric heart specimen under fluoroscopy[1].

The usual steps involved in coronary angioplasty are performed. LMCA ostium engaged with JL 3.5 x 6 F guide catheter. A workhorse guidewire crossed through the LMCA to the left anterior descending artery. (Fig 1A)

A goose-neck snare (loop diameter 10 mm) without snare catheter advanced over the coronary guidewire and brought in the left sinus of Valsalva after disengaging the guide catheter. (Fig 1B and 1C)

Then snare was manipulated to oppose it to the wall of the sinus of Valsalva. As the loop is attached perpendicular to the shaft of the snare, once the shaft is pushed against the sinus wall, its loop fairly opposes the wall.

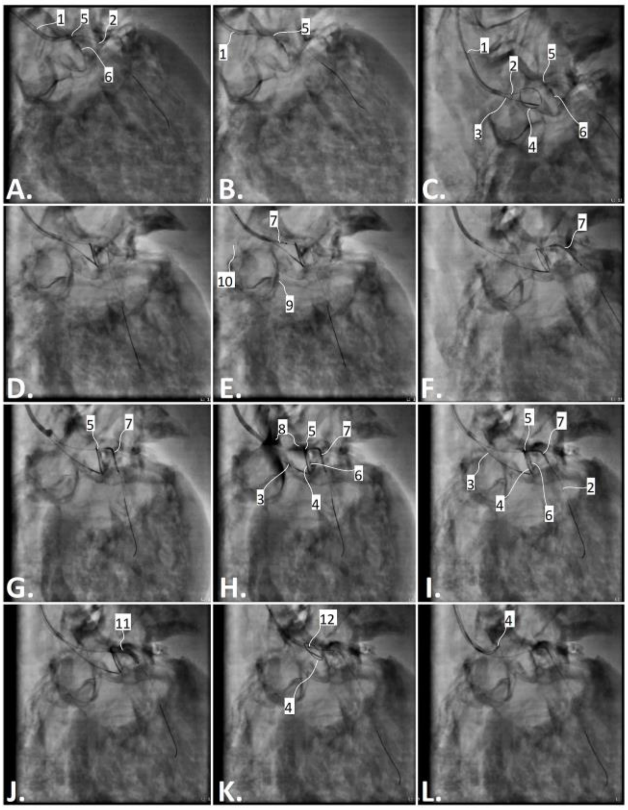

Fig. 1. Cadaveric left main coronary artery ostial stent deployment procedure. A. Guide catheter engaged to LMCA ostium and coronary guidewire parked in the left anterior descending artery (LAD); B. Guide catheter disengaged; C. Goose-neck snare (10 mm) without snare catheter brought in coronary sinus; D. Snare loop opposed to the wall of the sinus of Valsalva and fluoroscopic view adjusted so that fluoroscopic image of the snare loop appears linear; E. Stent advanced towards the coronary artery; F. Stent parked in LAD; G. Stent pulled back towards the LMCA ostium; H. Angiographic shot taken for further confirmation of the location of the LMCA ostium; I. Proximal stent marker kept approximately 1-2 mm proximal to the linear image of snare loop and/or 1-2 mm proximal to the junction of the linear image of the snare loop and the image of the guidewire (which marks the location of the ostium), to cover ostium completely; J. Stent deployment; K. Stent balloon withdrawal; L. Snare withdrawal. Whereas, 1: Guide catheter, 2: Coronary guidewire, 3: Gooseneck snare cable, 4: Gooseneck snare loop, 5: LMCA ostium, 6: Wall of sinus of Valsalva, 7: Stent, 8: Contrast media, 9: Aortic valve cusp, 10: Aorta, 11: Inflated stent balloon for stent deployment, 12: Deflated stent balloon

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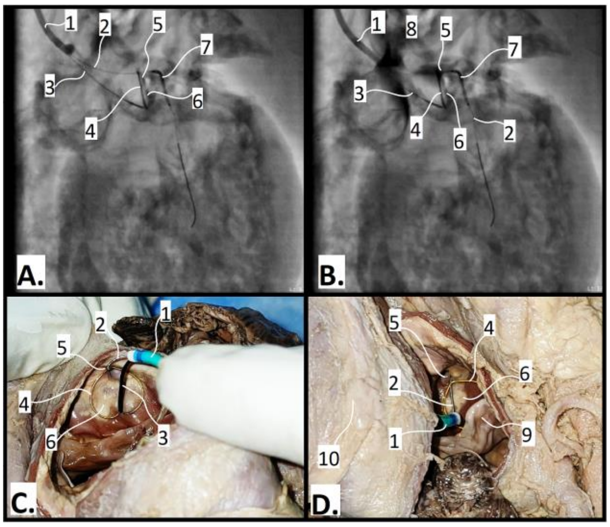

Fig. 2. Fluoroscopic view of the opposition of the snare loop to the wall of sinus of Valsalva and the actual observation of the same over the cadaveric heart. A. Fluoroscopic image showing the linear image of snare loop opposed to the wall of the sinus of Valsalva; B. Fluoroscopic image of an angiographic shot taken for further confirmation of the location of the LMCA ostium; C and D. Actual observation over the cadaveric heart showing snare loop opposed to the wall of the sinus of Valsalva, and the junction of snare loop and coronary guidewire marking the location of the ostium of the LMCA. Whereas, 1: Guide catheter, 2: Coronary guidewire, 3: Gooseneck snare cable, 4: Gooseneck snare loop, 5: LMCA ostium, 6: Wall of sinus of Valsalva, 7: Stent, 8: Contrast media, 9: Aortic valve cusp, 10: Aorta

Fig. 3. Cadaveric image showing the proximal stent edge covering the LMCA ostium without protrusion of the stent in the aorta.

The fluoroscopic view was adjusted in such a way that the image of the loop appeared linear. (Fig 1D) The actual observation of the same over the cadaveric heart was done which showed a snare loop resting over the wall of the sinus of Valsalva. (Fig 2C and D) This linear image of the loop marks the wall of sinus of Valsalva and the point of intersection between this fluoroscopic linear image of the snare loop and the fluoroscopic image of the coronary guidewire corresponds to the LMCA ostium.

The stent system was advanced over the same guidewire. (Fig 1E and 1F) The proximal stent marker was then aligned with the junction of the linear image of the snare loop and the image of guidewire keeping in mind the 'stent-marker relationship' of that specific stent system to cover the LMCA ostium completely without stent protrusion in the aorta. (Fig 1H and 1I) Subsequently, the stent was deployed. (Fig 1J) After stent deployment, the stent balloon followed by a snare was removed. (Fig 1K and 1L) Subsequently, the guidewire and guide catheter both were removed.

Then actual inspection of the cadaveric LMCA ostium was done which showed complete coverage of the ostium. (Fig 3)

III. Discussion

Angiographically assisted stent placement is a conventionally used technique and requires multiple views and a larger volume of contrast media to locate the coronary ostium at aorto-ostial location. As it's solely based on 2-D fluoroscopic views, it is difficult to locate 'actual ostium' and hence quite unreliable.

Dishmon et al[2] reviewed 100 ostial lesions retrospectively and found that the true ostium was missed in 54% of cases, and in 52% of misses, stents were placed too proximally resulting in an inability to coaxially re-engage the vessel in 93% of the cases. Distal miss was found in 48% of cases, resulting in additional stent placement in 38% of cases. When compared to patients without a geographic miss, restenosis and target lesion revascularization (TLR) rates were 3-fold higher in these patients.

Aorta free-floating wire technique is another technique used for placement of aorto-ostial coronary stent in which first guidewire is passed down the coronary and second wire is inserted into the guide and advanced to the tip of the guide. Then guide catheter is disengaged from the ostium and the second wire is advanced into the aorta. This second wire acts as a marker for the coronary ostium. It's the wire-based technique, and hence always associated with wire bias. As the wire does not take a 90-degree bend from the ostium, the actual ostium is located a few millimeters away from the wire curvature from guide to aortic wall.

The wire floats freely and imparts fluoroscopic image as a single line and so different fluoroscopic views may show variable relationship between the wire and the stent.

In 2005, Szabo reported a method for optimal coverage of the ostium using two guidewires[3]. One guidewire is placed in the main branch and another one in the side branch or in the aorta if an aorto-ostial lesion is being treated. Then the stent is loaded over the guidewire which is placed in the main branch. Stent is prepared outside the patient by low-pressure inflation of the delivery balloon to raise the proximal cell of the stent. The majority of the stent remains on the balloon and only the proximal cell is lifted from the *delivery* balloon. When the proximal cells of the stent are seen to have lifted, the balloon is immediately deflated, leaving the proximal strut free. The proximal end of the guidewire positioned in the aorta or in the opposing branch is passed through this lifted stent strut and

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the stent is re-crimped on the delivery balloon. Then the stent is advanced over the guidewires. As the side branch wire is crossing through the proximal cell of the stent, the proximal cell of the stent will not go beyond the ostium of the main branch and ostial stent placement can be done with fair accuracy.

A small-scale study by *Vaquerizo B et al*[4] in 26 patients who underwent the Szabo technique, angiographic success was achieved in 88.5% cases. One case had stent dislodgement. Follow-up intravascular ultrasound (IVUS) examination done on four patients showed significant stent protrusion in one case. The study concluded that the Szabo technique is not a predictable and precise method for ostial stent implantation. Micro-computed tomography (CT) examination has revealed asymmetric deformation of the stent leading to strut protrusion into the side branch. In bench testing, the cell of the stent wired by the anchor side-branch guidewire underwent significant deformation at the level of the ostium and in the carina side of the vessel. Such a deformation can led to non-uniform drug distribution.

Valdesuso R et al[5] in their study, successfully implanted ostial stent using Szabo technique in 268 cases out of 283 attempted, using two different approaches for crossing the proximal stent strut i.e., inflating stent balloon to lift up its proximal crown (Type I) and by bending the stent (looking for "fish flake effect") attempting to separate its proximal cell from balloon (Type II). Causes for failure of stent delivery were puncture of stent balloon in 3 (13%) (all in Type II), stent dislodgment in 7 (30%) (6 in Type I); stent non eligible due to deformation by any type in 5 (22%) cases; and others causes were guide wire twisting, failure of reaching the lesion etc. in 8 (33%) cases.

In in-vitro models and in cases it has been shown that the anchor-wire may wrap around the stent and could potentially impede the advancement of the stent and cause stent dislodgement[6]. The stiff part of wire obeys its fundamental properties and causes wire bias as the curve starts more proximally than actual ostium of the vessel.

Szabo technique needs fiddling with inbuilt stent system which many operators do not prefer.

The Ostial-Pro (Merit Medical) is a nitinol device with expanded gold-plated feet devised for precise placement of aorto-ostial stent[7]. It is advanced into the Toughy-Borst adapter using the supplied introducer to the primary curve in the guide catheter. The introducer is removed, and a 0.014″ coronary wire is advanced distal to the lesion. The stent is placed on the 0.014″wire and advanced distal to the lesion by 1-3 cm. The guide is then disengaged from the ostium and position is confirmed with a contrast test. Holding the stent and the wire, Ostial Pro is advanced until the gold feet are out of the distal end of the guide and pop open. Only the feet of the Ostial Pro should be out of the guide. Then the guide catheter is advanced until the expanded feet of the Ostial Pro begin to flatten against the aortic wall. Holding the Ostial Pro, stent is withdrawn until the 'proximal marker band' is just distal to the guide. It should be confirmed with the contrast injection that the proximal stent is just distal to the gold feet and subsequent stent deployment should be done.

Fischell and colleagues[8] used Ostial Pro stent placement system with high success rate in 30 patients for aorto-ostial stent placement.

Comparison of novel technique with other techniques: Present technique doesn't involve complex steps as in the Szabo technique and needs minimal dye compared to the conventional angiographic technique. A snare loop is a circular structure and when it is resting on the wall of sinus of Valsalva, orthogonal fluoroscopic views to the snare loop give a fair idea about the 3-dimensional structure and location of the ostium of the coronary arising from aorta, with a 2-dimensional fluoroscopic image. As the loop forms 90-degree angle with the shaft, once the loop rests over the sinus wall it avoids the 'wire-bias phenomenon' which happens in other techniques like the aorta free-floating wire technique and Szabo technique[1].

IV. CONCLUSION

Novel snare-assisted technique for aorto-ostial stent placement appears simple and effective. Imaging guided studies will help to prove the reliability of this technique in real-time scenarios.

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