Reverse Movahed Maneuver: Maximal Expiration Maneuver during Saphenous Vein Graft Intervention for Facilitated Balloon and Stent Delivery in Tortuous Vein Grafts – A Novel Technique

Mohammad Reza Movahed, MD, PhD, FACP, FACC, FSCAI, FCCP^{1,2}

¹CareMore Health Care, Tucson, Arizona

²Division of Cardiology, University of Arizona Sarver Heart Center, Tucson, Arizona

Address for correspondence: Mohammad Reza Movahed, MD, PhD, FACP, FACC, FSCAI, FCCP, 7091 E. Speedway Boulevard, Tucson, AZ 85710 (e-mail: rmova@aol.com).

Int J Angiol 2016;25:e66–e69.

Abstract

Keywords

- ▶ percutaneous coronary intervention
- ▶ expiration
- ▶ stent delivery
- ▶ angioplasty
- ▶ stent
- ▶ stenting
- ▶ coronary artery disease
- ▶ PCI
- ▶ saphenous vein graft intervention
- ▶ SVG
- ▶ tortuosity

Percutaneous coronary intervention involving tortuous saphenous vein grafts can be difficult during balloon or stent advancement. There are many available techniques to facilitate stent delivery in tortuous vessel, such as using specialized catheter body wires, use of extra support wires or using extra back up guide catheters. All these techniques have limitations and can be costly and time-consuming. We previously published a maneuver that showed how to facilitate stent delivery in tortuous native coronary arteries by instructing the patient to take a deep breath leading to straightening of the coronary tree, thereby, substantially improving stent deliverability. However, this maneuver will cause worsening of tortuosity in a proximal segment of a vein graft during vein graft interventions as the aorta will be pulled downward during inspiration leading to increasing kink in the vein graft. Hereby, the so called reverse “Movahed Maneuver” during vein graft interventions is described. It is the exact opposite maneuver of deep inspiration previously described for native coronary interventions. By letting the patient perform complete expiration, the body of the intervening saphenous vein graft will be straightened as the aorta and aortic arch will be moved upward in the chest leading to facilitated stent deliverability. This maneuver has been performed successfully in many cases of difficult vein graft interventions due to tortuosity. This maneuver is easy to perform and can save substantial time as well as radiation in many challenging vein graft interventions and has not been described previously.

Coronary tortuosity is a challenge for stent delivery. This challenge is also present during tortuous vein graft intervention. Previously, we described an easy maneuver for facilitated stent delivery in tortuous coronary arteries by instructing the patient to take a deep breath.¹ This would lead to straightening of the coronary tree by displacing the diaphragm more downward and thereby positioning the heart

in a more vertical position. However, this maneuver will have an opposite effect in a tortuous vein graft in the proximal segment. By pulling the aorta and aortic arch downward, it will lead to increasing kink and tortuosity in the vein graft. On the other hand, by instructing the patient to perform complete expiration for few seconds, aorta and aortic arch will be displaced upward leading to the straightening of the proximal

published online
January 14, 2015

Copyright © 2016 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA.
Tel: +1(212) 584-4662.

DOI <http://dx.doi.org/10.1055/s-0034-1395977>.
ISSN 1061-1711.

Fig. 1 Two high-grade lesions are seen in the SVG supplying obtuse marginal branch (AP caudal view). AP, anteroposterior; SVG, saphenous vein graft.

vein graft segment thereby facilitating stent deliverability. This maneuver has been successfully performed in many difficult cases during tortuous saphenous vein graft (SVG) interventions. This maneuver is easy to perform and can save substantial time. Radiation in many challenging tortuous vein graft interventions has not been described previously. In this article, we discuss this successful maneuver in details starting with a case example.

Case Example

The patient was a 61-year-old man with medical history of smoking, hypertension, and coronary disease who was admitted for unstable angina. The patient had a history of three vessel coronary bypass grafting 13 years ago. Coronary angiography revealed high-grade left main lesion with 100% occluded left anterior descending (LAD), circumflex and right coronary arteries. Left internal mammary artery graft to LAD

was patent. SVG to right coronary was 100% occluded. SVG graft to obtuse marginal had two 80% lesions (►Fig. 1). The decision was made to proceed with percutaneous coronary intervention of SVG supplying obtuse marginal branch. We used a 6F JR4 guide and a filter wire (FilterWire EZ Embolic Protection System, Boston Scientific, Marlborough, MA). Before the procedure, the patient received 325 mg of oral aspirin and 600 mg of clopidogrel. He also received weight-adjusted bivalirudin during the procedure. Many attempts to advance a Promus 3.5 × 16 mm stent (Boston Scientific) across the distal lesion were unsuccessful, until the patient was instructed to perform complete expiration maneuver leading to straightening of the SVG and stent delivery across the distal lesion (►Fig. 2). It was successfully deployed at 16 atm. Next proximal lesion was stented using 4.0 × 18 mm Promus stent (Boston Scientific) deployed at 16 atm with excellent final angiographic results after filter wire removal (►Fig. 3). The patient tolerated the procedure well and was discharged the next day.

Discussion

In this report, a complete expiration maneuver for easier balloon or stent advancement in a tortuous vein graft is described to be due to the straightening effect of expiration when the aorta and aortic arch are moved upward. In many cases, tortuosity of a vein graft may not be obvious or does not seem to be extreme by looking at the two-dimensional cine images obtained during angiography. However, very difficult balloon or stent deliverability is the first clue to high-grade tortuosity. This is the reason that in some of our cases tortuosity is not obvious by just looking at the angiographic images. This effect can be best seen in right anterior oblique (RAO) views of the left-sided vein grafts. ►Fig. 4 demonstrates another case example of a patient with a high-grade SVG graft lesion supplying obtuse marginal branch in RAO view. After initial balloon angioplasty, we had great difficulty in advancing the stent until the patient performed complete expiration thus leading to stent delivery. ►Fig. 5 shows final

Fig. 2 Left: Vein graft seen in expiration with arrow showing upward heart position and straightening of the vein graft in expiration. Right: Vein graft seen in inspiration with arrow showing downward heart position and more kinking of the vein graft during inspiration. Other arrows are showing the effect of breathing on the diaphragm during inspiration and expiration.

Fig. 3 Final angiographic results.

Fig. 4 High grade in-stent restenosis can be seen in the proximal SVG supplying obtuse marginal branch seen in RAO position. RAO, right anterior oblique; SVG, saphenous vein graft.

Fig. 6 Schematic description of the reverse Movahed maneuver: Aorta and aortic arch (where vein graft ostia are attached) will move upward during expiration (straight line) leading to straightening of the vein graft with opposite effect of downward motion of the aorta during inspiration (dashed line) that lead to increasing kinking and tortuosity of a vein graft.

angiographic results in deep inspiration in comparison to complete expiration. The arrows show the effect of respiration on the proximal SVG tortuosity. As seen in the figure, the ostum of the SVG is displaced more upward during expiration leading to a reduction in the vein graft tortuosity. **Fig. 6** demonstrates schematic description of this maneuver in detail. Aorta and aortic arch (where vein graft ostia are attached) will move upward during expiration leading to straightening of the vein graft. This maneuver is opposite of the initially described maneuver by Movahed et al¹ which showed that deep inspiration will lead to facilitated stent delivery in the native coronaries due to displacement of the diaphragm in a downward position during deep inspiration thus straightening native coronaries. In this case, maneuver would increase tortuosity in the vein grafts due to increased

Fig. 5 Left: Vein graft seen during deep inspiration with arrow showing downward position of the vein graft ostium and diaphragm leading to more kinking of the proximal vein graft segment. Right: Vein graft seen in complete expiration with arrow showing upward position of the vein graft ostium leading to more straightening of the proximal vein graft segment. Other arrows are showing the effect of breathing on the diaphragm during inspiration and expiration.

Fig. 7 Arrows are showing the effect of respiration in this vein graft on the proximal tortuosity segment. Upward motion of the aorta during expiration (left) reduces proximal tortuosity in comparison to inspiration (right).

kinking that occurs when aorta and aortic arch move downward with diaphragm during inspiration. Therefore, reverse Movahed maneuver should be performed during vein graft interventions in tortuous vein grafts with difficulty in advancing stent by performing complete expiration maneuver that will lead to straightening of the vein graft with improvement in the stent deliverability. ►**Fig. 7** is showing angiogram in a vein graft with marked proximal tortuosity. The effect of respiration can be seen as it was described in ►**Fig. 6**. In the left, a marked proximal tortuosity of the vein graft during inspiration improved at the end expiratory cycle. Respiratory maneuvers for better coronary artery engagement during cardiac catheterization have been described previously but not for stent and balloon delivery in tortuous vein grafts. For example, Di Mario and Sutaria² describe the utility of a deep inspiratory holding for easier engagement of an ostial right coronary artery during coronary angiography. Laramee and Hartzler³ have demonstrated the position of SVG stenosis during different phases of respiratory cycle. Respiration-induced catheter position can cause deep seeding of a catheter that can lead to dissection.⁴ The reverse Movahed maneuver can save substantial time, cost, and radiation in many cases of difficult stent delivery in tortuous vein graft intervention. This can be initially tried before complex techniques are utilized, as it is easy to perform in a cooperative patient. Clearly, this technique requires an adequate expiratory effort from the patient and would not be feasible in those unable to provide such an effort. Usually before complete expiration, the patient

needs to take a deep breath to have respiratory reserve while holding breath at the end expiratory cycle. It is important to perform a very slow gradual inspiration before final expiratory maneuver to prevent severe vein graft kinking that can lead to the loss of guide catheter and coronary wires during this phase due to downward movement of the aorta and aortic arch.

Conflict of Interest

None.

Acknowledgments

The author would like to thank Mrs. Billie H. Mass and Mrs. Michelle Bureau Claire for editing this manuscript.

References

- 1 Attaran RR, Butman S, Movahed MR. Going around the bend: deep inspiration facilitates difficult stent delivery in the native coronary arteries. *Tex Heart Inst J* 2011;38(3):270–274
- 2 Di Mario C, Sutaria N. Coronary angiography in the angioplasty era: projections with a meaning. *Heart* 2005;91(7):968–976
- 3 Laramee LA, Hartzler GO. Effect of respiration on angiographic assessment of saphenous vein graft stenoses. *Cathet Cardiovasc Diagn* 1989;17(4):243–245
- 4 Biel SI, Krone RJ. Left coronary artery dissection with an amplatz-shaped catheter. The role of vigorous inspiration during contrast injection. *Chest* 1984;86(4):640–641