

Probe Endarterectomy on the Beating Heart for Severe Coronary Artery Disease

Erdem Çetin, MD¹ Arda Özyüksel, MD²

¹Department of Cardiovascular Surgery, Medikar Hospital, Karabük; and ²Department of Cardiovascular Surgery, Medipol University, Istanbul, Turkey

ABSTRACT

Although coronary endarterectomy is a challenging procedure, its implementation might be mandatory in some cases with diffuse atherosclerotic coronary artery disease. The traditional techniques such as open, semi-closed, eversion, orificial and extraction endarterectomies have been well defined in vascular surgery, however, due to the small size of the coronary arteries, their implementation is not always possible in surgical cardiac revascularization. In this report, we describe a simple method which combines the open and closed techniques of coronary endarterectomy, in which we use the coronary probes at different sizes in order to extract and release the atheromatous plaques from coronary arteries. This technique facilitates the removal of the plaques with easy handling of the coronary probes.

INTRODUCTION

Diffuse coronary artery disease (CAD) has always been a challenging realm for cardiac surgeons. Coronary endarterectomy (CE) was introduced in 1957 for the treatment of diffusely atherosclerotic CAD [Bailey 1957]. Although different techniques—which involve the open, semi-closed, eversion, orificial, and extraction endarterectomies—have extensively been defined in vascular surgery, their simple and reproducible implementations are not always possible in coronary arterial circulation [Anton 2014]. Most cardiac surgeons prefer an open technique in left anterior descending artery (LAD) lesions and a closed technique in right coronary artery (RCA) lesions.

We aimed to develop a simple and reproducible CE technique in off-pump coronary artery bypass graft surgery (OPCAB) with coronary artery probes at different sizes (1 mm, 1.5 mm, and 2 mm), which are traditionally used in controlling the proximal and distal lumens of the native coronary arteries. Our technique combines the traditional open and closed techniques both in RCA and LAD. The primary aim of the development of this technique is releasing a long atheromatous plaque from within a limited arteriotomy, especially in LAD lesions. The probes provide a smoother transaction

zone from the plaque to the native coronary artery wall, as well as a more precise anatomical plane of dissection due to blunt ends of the probes. We believe that this technique provides less trauma to the arterial wall, especially in RCA lesions in which most of the surgeons rip off the atheromatous plaques with mosquito clamps and external compression.

SURGICAL TECHNIQUE

The coronary endarterectomy using a coronary probe was implemented in 10 cases. The mean age was 60.3 ± 8.9 (8 males, 2 females). The preoperative ejection fraction was $36 \pm 9\%$ in our patient population. We did not encounter any significant valvular pathology in the preoperative transthoracic echocardiography of the patients. Seven of the patients had diabetes mellitus, five of whom were insulin dependent. The left internal thoracic artery (LITA) was

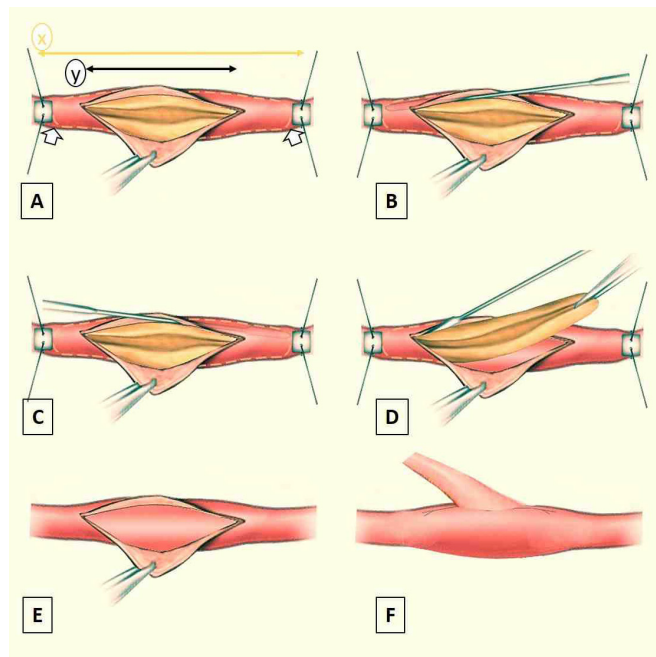


Figure 1. The illustration demonstrates the coronary endarterectomy procedure. The proximal and distal extensions of the atheromatous plaque are indicated with white arrow heads, where the X denotes the length of the plaque and the Y denotes the length of coronary arteriotomy (A). The coronary artery probe is directed to the proximal (B) and distal ends (C) of the plaque. The plaque is released from the lumen (D), the debris is washed out (E), and the graft is anastomosed (F).

Received December 12, 2014; accepted January 6, 2015.

Correspondence: Arda Özyüksel, Medipol University Department of Cardiovascular Surgery, Medipol Mega Hospital, TEM Goztepe Cikisi No: 1, 34214, Bağcılar, Istanbul, Turkey; +90-212-4607777; fax: +90-212-4607070 (e-mail: ozyukselarda@yahoo.com).

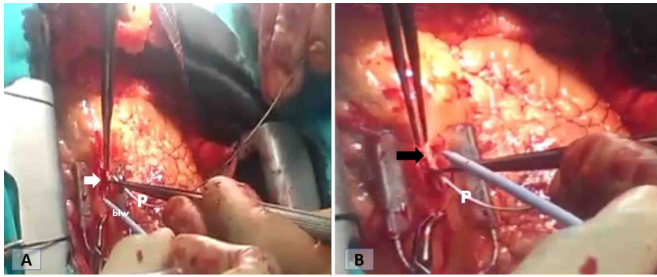


Figure 2. Intraoperative view of the procedure. The coronary artery probe is directed to the distal segment of the LAD (white arrow) (A) and the atheromatous plaque (black arrow) is removed from the lumen (B). P indicates probe; blw, carbon monoxide blower.

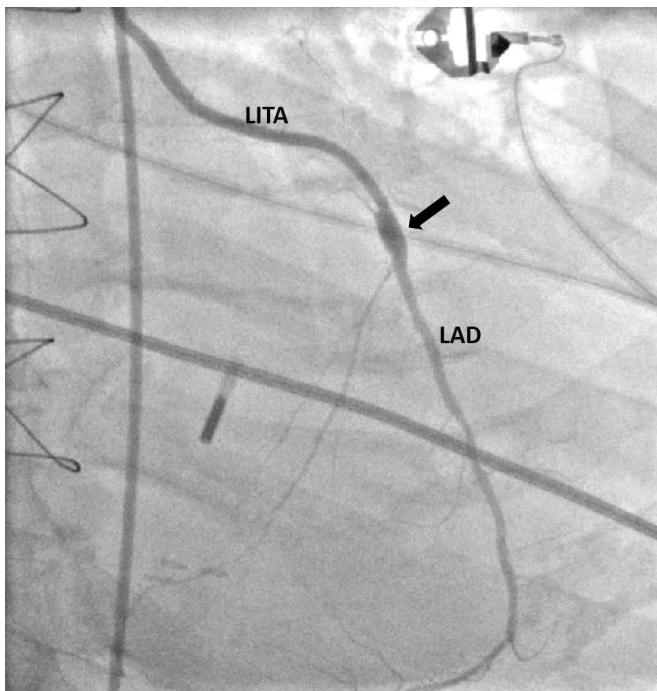


Figure 3. Coronary angiography that is performed after the off-pump coronary endarterectomy procedure revealing the adequate lumen size (black arrow) in LITA-LAD anastomosis. LITA indicates left internal thoracic artery; LAD, left anterior descending artery.

anastomosed to the LAD in all cases and all of the patients had at least one saphenous vein graft. The average saphenous vein graft number was 1.8 ± 0.7 . We did not use any arterial conduits.

The target vessel segment was occluded either between bulldog clamps or a full thickness 7/0 polypropylene suture with a pledge that squeezes the lumen from the outer side. For the occlusive or near-occlusive lesions in the RCA, the coronary arteriotomy was performed at a length of 2-3 centimeters. Afterwards, a 1 or 1.5 mm coronary probe was gently advanced towards the proximal and distal end of the lesion. A simple blower that mixes carbon dioxide and warm saline was also used to lubricate the lumen and provide easier extraction of the atherosclerotic plaque. At

the proper length, a gentle circumferential movement of the probe mobilized the most distal parts of the plaque. Then a simple external compression with a gauze ball handled by a mosquito clamp mobilized the plaque completely. The plaque and atherosclerotic debris remnants were washed with saline and the saphenous vein graft was anastomosed to the target RCA segment in an end-to-side fashion (Figure 1). When the occlusive plaque was located at the bifurcation of RCA to posterior descending artery and posterolateral branches, this technique was extremely useful, since a smaller sized (1 mm) probe was advanced through the RCA to its branches without cracking the plaques with compression from outside or pulling from the RCA. The same technique was implemented in lesions involving the circumflex coronary artery and its branches.

In occlusive or near-occlusive lesions involving the LAD, the arteriotomy was performed in a length of 3-4 centimeters. The atherosclerotic plaques were gently mobilized with the aid of 1 and 1.5 mm coronary probes and the attachments to the lumen were released in all the inner circumference of the vessel wall (Figure 2). When the plaque was extending into septal or diagonal branches, this technique provided 360-degree mobilization in the lumen of the effected branch with minimization of plaque disruption and distal embolization. The LITA graft was anastomosed to the LAD segment in this limited length of arteriotomy. 8/0 polypropylene sutures were used for the anastomosis of LITA-LAD. Figure 3 demonstrates the postoperative angiography of the LITA-LAD anastomosis.

The postoperative course was uneventful in all of the patients. Intra-aortic balloon counter pulsation was needed in one patient with a preoperative ejection fraction of 25%. Dobutamine was the preferred agent in patients who needed temporary inotropic support. The mean extubation time and mean ICU stay were 5.6 ± 1.6 and 24.1 ± 12.5 hours, respectively. Postoperative atrial fibrillation was encountered in two patients and managed with amiodarone treatment. All of the patients received subcutaneous low molecular weight heparin treatment at the first postoperative night until the prothrombin time was maintained over 2 with oral warfarin, which was initiated the day after surgery. Oral acetylsalicylic acid was administered to all of the patients with a dosage of 100 mg/day. We did not encounter any mortality in a mean follow-up period of 7 ± 3.5 months.

DISCUSSION

Off-pump CE is a comparable treatment modality in high-risk patients with diffuse CAD [Naseri 2003]. The traditional endarterectomy tools that are utilized in endarterectomy procedures in larger vessels, such as moll ring cutters, spatulas, and needle reentry systems are not practically applicable due to size mismatch in coronary arteries. Therefore, more creative approaches have been necessary in order to create a graftable lumen in the target coronary artery. When the right coronary arterial circulation is concerned, the closed technique usually involves traction and crimping of the atherosclerotic plaque with external compression in order to release

it from the lumen. The dissectors and elevators are not always satisfactory in terms of determining the anatomical plane of dissection as well as the terminal points of plaque extension. When the plaques in LAD are considered, a long arteriotomy is usually preferred with a patch plasty like anastomosis of the LITA on a long arteriotomy [Schmitto 2010].

Conclusion

In this technique, we aimed to implement a simple method for the development of the dissection plane during atheromatous plaque removal from coronary arteries. The coronary artery probes are directed easily in the lumen of coronary arteries with their malleable handles. We believe that these probes are useful in extracting firm and adherent plaques from the coronary arteries while also minimizing the traction

and ripping of procedures that may further damage the integrity of the coronary artery intima.

REFERENCES

- Anton NS, Neville RF. 2014. Technique: Open Surgical. In: Cronenwett JL, Johnston KW, eds. Rutherford's Vascular Surgery. 8th Edition. Philadelphia, PA; Elsevier Saunders; 1292-4.
- Bailey CP, May A, Lemmon VM. 1957. Survival after coronary endarterectomy in man. *J Am Med Assoc* 164:641-6.
- Naseri E, Sevinç M, Erk MK. 2003. Comparison of off-pump and conventional coronary endarterectomy. *Heart Surg Forum* 6:216-9.
- Schmitto JD, Kolat P, Ortmann P, et al. 2010. CABG surgery with long coronary endarterectomy of the LAD. *Ann Thorac Cardiovasc Surg* 16:445-7.