

## Early Clinical Outcomes and Mortality of Coronary Endarterectomy in the Left Anterior Descending Artery: A Single-Center Experience

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### ABSTRACT

**Introduction:** Although coronary endarterectomy is not an ideal procedure, it is the only available option for cardiac surgeons in some patients with diffuse coronary artery disease. Based on the majority of conducted studies, the results of coronary endarterectomy (including survival, graft patency, and recurrence of the symptoms of myocardial ischemia) are less prevalent than standard coronary artery bypass grafting. Generally, the left anterior descending artery (LAD) is the most commonly involved artery in coronary endarterectomy. The aim of this study was evaluate clinical and early results of Endarterectomy of LAD artery.

**Materials and Methods:** In total, 30 cases of coronary endarterectomy of the LAD were studied from January 2015 until January 2016. This is a retrospective study. Endarterectomy procedure was performed in Imamreza hospital of Mashhad university of medical sciences.

**Results:** The mean age of the subjects was  $63 \pm 4.5$  years (range: 45-78 years). As the findings revealed, 18 patients were male (60%), and the mean ejection fraction index was  $43 \pm 5.1$  (range: 15-60). Also, prior history of myocardial infarction was documented in 8 (26%) patients. The mortality rate among patients was estimated at 6.6% (n=2). In total, 12 (40%) and 7 (23%) patients required high-dose inotropic support and intra-aortic balloon pump, respectively. Risk of preoperative myocardial infarction was observed in 5 (16.5%) cases, and 3 (10%) patients required re-exploration due to significant hemorrhage.

**Conclusion:** If coronary endarterectomy of the LAD is performed by experienced cardiac surgeons, favorable outcomes can be obtained.

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### Introduction

Today, despite the advances in coronary artery interventions, many cases of severe and diffuse coronary artery disease are being reported for which coronary artery bypass grafting (CABG) (1-3). In some cases of diffuse coronary artery disease, coronary endarterectomy,

concomitant with CABG, is required (1-3). It should be mentioned that the left anterior descending (LAD) artery is the most commonly involved vessel in CABG (4-7).

Theoretically, poor prognosis and outcomes are highly expected in coronary endarterectomy,

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considering the complexity of this procedure, endothelial injury of coronary arteries, and risk of damage to the septal branch of LAD while removing the plaque from the arteries (6, 8-11).

Although the initial outcomes of coronary endarterectomy are less favorable than CABG alone, in this study, we evaluated the early clinical findings and short-term mortality of 30 patients with diffuse coronary artery disease undergoing coronary endarterectomy of the LAD.

## Materials and Methods

In the present study, 30 patients undergoing coronary endarterectomy of the LAD were assessed from January 2015 to January 2016. All the procedures were performed by one single medical team. This is a retrospective study in Imam reza hospital of Mashhad university of medical sciences. All of revascularization procedure in this study are done with off-pump Technique. After median sternotomy, simultaneously left internal mammary artery (LIMA) graft and saphenous vein graft (SVG) were harvested. The off-pump CABG procedure was performed using a stabilizer. Arteriotomy was performed on the target portion of the LAD. In case graft insertion was not possible due to insufficient lumen diameter, coronary endarterectomy of the LAD was performed.

Afterwards, the atherosclerotic plaque was removed from the proximal and distal portions of the coronary artery through coronary dissection. Plaque excision from the distal part of the artery was more prominent, and the surgeon was required to remove the atherosclerotic plaque from the apex of the heart; afterwards, the LIMA graft was inserted into the LAD.

The majority of patients had multi-vascular (2VD or 3VD) coronary artery disease and one to four extra grafts were used. After graft insertion in the proximal site of aortic conduit, protamine was administered and the sternum was closed. Following these procedures, the patients were transferred to the intensive care unit (ICU).

The recorded variables in this study included low cardiac output syndrome requiring high-dose inotropic support, need for intra-aortic balloon pump (IABP), amount of bleeding, preoperative myocardial infarction (MI) with a rise in creatine phosphokinase (CPK) and cTP levels, ventricular arrhythmia (VA) or ventricular fibrillation (VF), ICU admission, length of hospital stay, hospital mortality, and the three-month mortality rate.

## Results

The mean age of the patients was 63±4.5 years (range: 45-78 years). In total, 18 patients were male (60%), and the mean ejection fraction index was 43%±5.1 (range: 15-60). Also, prior

**Table 1.** Results of endarterectomy patients

Need for high-dose inotropic support	12 (40%)
Intra-aortic balloon pump (IABP)	7 (23%)
Hemorrhage	700 cc(250-1600)
Need for re-exploration	3 (10%)
Preoperative myocardial infarction (MI)	5 (16.5%)
Ventricular arrhythmia (VA) or ventricular fibrillation (VF)	4 (12.5%)
ICU stay	7.5 (4-16)
Length of hospital stay	14 (9-24)
Mortality	2 (6.6%)

history of myocardial infarction was documented in 8 patients (26%) (Table 1).

Among 30 patients for whom coronary endarterectomy of the LAD was performed, two cases died from heart failure and low cardiac output syndrome despite high-dose inotropic support and IABP insertion. These two patients were 72- and 65-year-old men with 3VD coronary artery disease and recent MI. The patients succumbed to their disease within 24 and 48 hours after the procedure in the ICU, respectively.

On the other hand, 28 patients were successfully discharged from the hospital and were in good condition based on the three-month follow-up. In 12 patients, high-dose inotropic support (epinephrine and norepinephrine) was required within the first 48 hours after surgery, while IABP support was essential in seven patients. Postoperative bleeding varied from 250 to 1600 cc in the first 24 hours after surgery.

In three patients, re-exploration in the operating room was essential for hemorrhage management. Preoperative MI with increased cardiac enzyme levels was recorded in five patients, which was overcome without requiring any further interventions. Additionally, VT and VF were reported in seven patients. The mean length of ICU stay was 7.5 day (range: 4-16 days), and the mean length of hospital stay was 14 days (range: 9-24 days)

## Discussion

Coronary endarterectomy, concomitant with CABG, has been performed for more than 45 years. Today, the majority of patients, who are candidates for coronary revascularization, are in the late stage of the disease with severe diffuse atherosclerotic plaques (1-3).

In some cases, coronary interventions using balloon angioplasty, with or without stenting, are performed at the time of CABG (5). In some cases,

the surgeon may face diffuse coronary artery disease with heavy calcification (6, 7). Under these circumstances, the surgeon may be unable to find a suitable site in the coronary artery for the insertion of conduit. In case there is insufficient coronary lumen despite distal extension by arteriotomy, coronary endarterectomy is performed (13).

Theoretically, simultaneous use of CABG and surgical removal of atherosclerotic plaques in coronary artery disease is expected to result in complete revascularization with favorable clinical outcomes, unlike CABG alone. However, in practice, as reported by many scholars, coronary endarterectomy has poor outcomes with no long-term survival, resulting in the rapid recurrence of patient symptoms and MI (11-14).

In order to achieve favorable long-term results in coronary endarterectomy, expert and experienced cardiac surgeons should perform this complex procedure. During endarterectomy, it is necessary to completely extract the calcified plaque from the coronary artery, especially in the distal portion of vessels with large branches, since the intimal cord can break at the ostium of septal and diagonal branches, resulting in poor revascularization of the distal segment. Therefore, incisions should be made close to large branches, and intimal extraction should be performed along the path of branches to achieve complete revascularization (12-16).

Several studies have reported poor results and high mortality rate (30 days) of coronary endarterectomy (12-14). Although coronary endarterectomy has been practiced for about 40 years, many authors believe that the results are poor in terms of different parameters within 30 days after the procedure. In this regard, various large-scaled meta-analyses have been performed.

Poor outcomes of coronary endarterectomy may be attributed to endothelium damage during the procedure. In fact, damaged endothelium can lead to endothelial dysfunction, platelet aggregation, inflammatory reactions, and finally thrombosis in blood vessels (10-13). Overall, LAD, followed by the right coronary artery, requires endarterectomy more than other major coronary arteries (4, 5).

Cardiac surgeons usually avoid coronary endarterectomy considering the less favorable outcomes in comparison with CABG alone. Based on various studies, after coronary endarterectomy, risk of graft failure, preoperative MI, low cardiac output syndrome, and recurrent angina, as well as the need for further coronary interventions and redo CABG, is increased (10-14).

Owing to the mentioned shortcomings, cardiac surgeons do not favor coronary endarterectomy. However, recently, surgeons' experience of this procedure has increased and

better surgical techniques are available to successfully perform coronary endarterectomy and remove atherosclerotic plaques from the proximal and distal portions of coronary arteries.

## Conclusion

In this study, although we could not evaluate the long-term outcomes and survival of patients, the findings revealed promising short-term clinical outcomes and 30-day mortality. The present findings were comparable with previous research. Overall, in cases for which cardiac surgeons have no options, coronary endarterectomy of the LAD could result in favorable outcomes and low mortality rates.

## Conflict of Interest

The authors declare no conflicts of interest.

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