

# CORONARY ENDARTERECTOMY: BENEFIT OR DETRIMENT TO MYOCARDIAL REVASCULARIZATION?


*Retrospective experience in 12 cases of diffuse  
coronary artery disease*

## ABSTRACT

Cardiovascular disease is the leading cause of death worldwide. In the same sense, coronary artery bypass graft (CABG) surgery is one of the most frequently performed cardiac surgery procedures worldwide. In clinical practice, myocardial revascularization can be followed by a procedure called endarterectomy to reinforce the sanitation of the vessel with decreased flow and improved irrigation. However, there is sufficient evidence in the medical literature that reports serious adverse events due to the application of endarterectomy, the most feared complication being the perioperative infarction itself, which is why it has fallen into disuse. This work aims to disseminate our experience regarding coronary endarterectomy to be valued as an intervention tool within a complex spectrum like diffuse coronary disease.

**Key words:** Diffuse coronary artery disease, Coronary endarterectomy, Antiplatelet, Antithrombotic, Myocardial infarction.

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## INTRODUCTION

Cardiovascular disease is the leading cause of death worldwide. In 2019, according to the World Health Organization, ischemic heart disease was the leading cause of death, responsible for 16% of all deaths (8.9 million). In second place was stroke, which accounted for 11% of all deaths.

Thus, coronary artery bypass grafting is one of the most frequently performed cardiac surgery procedures worldwide, although it is often insufficient to restore blood flow. In medical practice, myocardial revascularization may be followed by a procedure called coronary endarterectomy (CE), which reinforces the healing of the vessel with diminished flow and improves blood supply. However, sufficient evidence in the medical literature reports serious adverse events from the application of CE, the most feared complication being perioperative infarction, which is why it has fallen into disuse, so much so that the 2021 guidelines for myocardial revascularization proposed by ACC/AHA/SCAI do not mention this procedure.

This work aims to disseminate the experience of our surgical team regarding the application of CE in situations of myocardial revascularization within a complex spectrum, such as diffuse coronary artery disease. The series of cases studied represents 6% of the patients revascularized over four years, with favorable results.

CE is a surgical procedure for removing cholesterol material or plaque from the tunica intima that obstructs the lumen of a vessel. Bailey and collaborators in 1957<sup>(1)</sup> described its application in humans with successful results.

This procedure can be performed open or closed.

Open endarterectomy involves:

- Incising the coronary artery along the stenosis,
- Sectioning the atheroma proximally, and
- Carefully plaque dissection, including the extensions in the coronary side branches.

The vessel is then closed using an autologous saphenous vein or mammary artery patch. On the other hand, a closed endarterectomy is performed through a small arteriotomy over the coronary, followed by gentle traction to remove the atheroma<sup>(2)</sup>.

There are controversies regarding the efficiency of CE based on the aggression to the vascular endothelium due to the "erosion" inherent to the technique, which leads to a higher rate of perioperative events when compared to isolated myocardial revascularization. Thus, CE has been limited to situations of advanced vascular disease. On the other hand, the satisfactory short- and long-term results described after CEA could be attributed to improved surgical techniques, careful perioperative management, and effective antithrombotic therapy after the operation<sup>(3)</sup>.

In this article, we present the experience obtained in 12 cases of coronary endarterectomy in patients with a history of diffuse coronary artery disease.

## METHODOLOGY

A retrospective study from July 2018 to August 2022 of a multidisciplinary group of surgical professionals who performed 193 myocardial revascularizations and, on 12 occasions (6.22%), CE was also performed.

The patients had a history of hypertension (HT), diabetes mellitus (DM), and smoking (SMK)/ex-smoking (EX-SMK). Table 1 summarizes the demographic and clinical characteristics of the patients.

<b>Characteristics</b>	<b>N (12)</b>	<b>Percentage (%)</b>
<i>Gender</i>		
Male	10	83
Mujer	2	17
<i>Age (years)</i>		
40-50	1	8,3
51-60	1	8,3
61-70	6	50
71-80	3	25
81-90	1	8,3
<i>Affected vessels</i>		
Anterior descending	9	74,7
Intermediate	1	8,3
Right	2	17
<i>Extracorporeal circulation</i>		
Yes	10	83
No	2	17
<i>Bypasses (n)</i>		
2	2	16,7
3	9	75
4	1	8,3
<i>Comorbidities</i>		
HT	12	100
DBT	11	91,6
SMK	6	50
EX-SMK	6	50
<i>Perioperative infarction rate</i>		
No	11	91,6
Yes	1	8,4

**TABLE 1.** Summary of the demographic and clinical characteristics of the patients. **Notes:** HT: hypertension; DBT: diabetes mellitus; SMK: smoking; EX-SMK: ex-smoking.

Patients with a history of diffuse coronary artery disease who had not received any previous revascularization procedure were included in this study (inclusion criteria). Patients with a history of diffuse coronary artery disease who had undergone a previous procedure to revascularize their coronary tree were excluded.

The procedure was always performed on a single main

vessel; on nine occasions on the anterior descending coronary artery (AD) with subsequent anastomosis of an arterial graft (left internal mammary artery), on two occasions on the right coronary artery (RCA) and, only once, on an intermediate branch, performing anastomosis of a venous graft to form a coronary artery bypass graft. In all cases of endarterectomy, the closed technique was chosen (*Figures 1A, 1B and 2*).

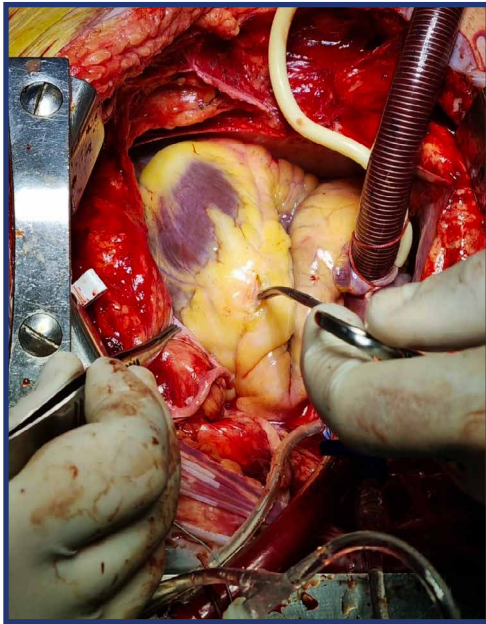


FIGURE 1A. Coronary opening.

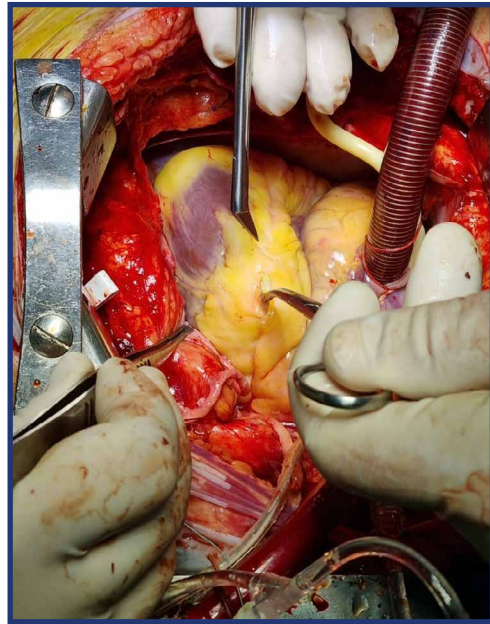


FIGURE 1B. Atheromatous core clamping



FIGURE 2. Complete distal removal of the atheromatous core over the anterior descending artery

In 10 cases, it was performed under extracorporeal circulation (ECC) plus cardiac arrest. In 2 cases, it was performed without extracorporeal circulation pump support, and in these cases, the endarterectomized vessel was the DA artery. In 9 cases, 3 bridges were performed, in 2 cases, 2 bridges were performed, and in 1 case, 4 bridges were performed. All the procedures performed were planned.

One case developed perioperative infarction within 24 hours after myocardial revascularization, evidenced by ST-segment elevation from V1 to V5 and positive qualitative troponins with subclinical signs. Antithrombotic therapy was not installed in this case because it was considered a risk factor. In the remaining 11 cases, no electrocardiogram recordings of myocardial infarction were obtained during hospitalization.

The pharmacological strategy used to maintain vessel patency was always the same. Initiation 24 hours after the procedure, using an antiplatelet agent (acetylsalicylic acid 100 mg/day) and a subcutaneous dose of low molecular weight heparin (enoxaparin) in an anticoagulant dose every 12 hours. After discharge from the hospital, oral medication (acenocoumarol) was continued for 3-6 months with hematological controls.

Postoperative controls were performed at 7 and 14 days with electrocardiography. The shortest in-hospital stay was 4 days, and the longest was 7 days.

## DISCUSSION

The increase in life expectancy of the population added to the characteristics of modern life (such as a sedentary lifestyle and intake of a diet rich in high-calorie ultra-processed products). The higher incidence of chronic diseases (such as diabetes mellitus, hypertension, or inflammatory diseases) means that medical teams must be trained to respond to more significant challenges. The vascular system in this type of patient is modified by the deposit of atheromatous material obstructing the lumen. In diabetic patients, it is common to find multiple deposits at short distances within a vessel, resembling a "string of pearls". Functional and complete revascularization in these cases involves more than a bypass performance; therefore, we consider the complementary application of CE.

It is of fundamental importance to understand that the procedure involves mechanical damage to the vascular surface, with alteration of the integrity of the endothelium and its functions, which could include the possibility of embolization of detached atheromatous material <sup>(2)</sup> and thus an increased tendency to de novo thrombogenesis.

Several studies, including two meta-analyses evaluating more than 50,000 patients, have compared clinical outcomes after CE and coronary artery bypass grafting (CABG) interventions (CE + CABG vs. CABG alone). The results show that CE + CABG had significantly higher 30-day mortality and perioperative and postoperative heart failure mortality rates. However, long-term survival was comparable between the two types of interventions, <sup>(2)</sup> which came to support the selective use of CE + CABG in diffuse coronary artery disease where the distal vessel is unsuitable for CABG alone. Another published study reported that the CE + CABG procedure had a higher incidence of mortality and, in addition, postoperative renal failure <sup>(2)</sup>.

Many of these studies use antiplatelet and/or anticoagulant therapies during the postoperative period after the intervention; however, there is no unified criterion for using antiplatelet or anti-inflammatory therapy <sup>(4)</sup>. Published pharmacological therapy is mainly based on acetylsalicylic acid, clopidogrel, and unfractionated heparin <sup>(5,6)</sup>. Some authors evaluated intraoperative or perioperative myocardial infarction by persistent electrocardiographic changes compatible with myocardial infarction, such as new Q waves, loss of R wave progression, or new atrioventricular conduction defects associated with elevated cardiac enzymes <sup>(2)</sup>. In our experience, one case of myocardial infarction was reported within 24 hours post-intervention, the reason for which could be found in the non-application of antithrombotic therapy due to the risk of hemorrhage due to the patient's baseline condition.

In this study, 6.22% of patients required CE + CABG to achieve complete myocardial revascularization. Within this group, all patients had diabetes mellitus, HT, and had been or were nicotine smokers (TB-EXTBQ), all factors that predispose to coronary artery disease and condition to high morbi-mortality rates. In patients with diffuse coronary artery disease, CE can be considered a good complement to achieving complete revascularization. From our point of view and experience, we believe that case selection for the performance of the procedure, careful planning and technical management employed during the removal of the atheroma core, and the implementation of antiplatelet and anticoagulant drug therapy are of vital importance for success in the postoperative period.

## CONCLUSION

The selected group of patients met standard criteria for applying the CE procedure (such as advanced

coronary artery disease with hypertension) and conditions complicating heart disease (such as diabetes and hyperlipidemia). Then we performed CE + CABG surgery to favor tissue revascularization and to make it last longer. Only one case of myocardial infarction was reported; no strokes or death following the procedure were reported.

#### Declarations

The authors declare no conflict of interest.

#### LIMITATIONS OF THE STUDY

No analysis of graft patency was performed, and no tests were performed to evaluate cardiovascular functionality after a year of the study. The N of the study is low.

#### REFERENCES

1. Bailey C, May A, Lemmon W. Survival after coronary endarterectomy in man. *J Am Med Assoc.* 1957 Jun 8;164(6):641-6.
2. Soylu E, Harling L, Ashrafian H, Casula R, Kokotsakis J, Athanasiou T. Adjunct coronary endarterectomy increases myocardial infarction and early mortality after coronary artery bypass grafting: a meta-analysis. *Interact Cardiovasc Thorac Surg.* 2014 Sep;19(3):462-73.
3. Tiemuerniyazi X, Yan H, Song Y, Nan Y, Xu F, Feng W. Mid-term outcomes of coronary endarterectomy combined with coronary artery bypass grafting. *Interact Cardiovasc Thorac Surg.* 2021 Jan 22;32(2):188-195.
4. LaPar D, Anvari F, Irvine J, Kern J, Swenson B, Kron I et al. The impact o coronary artery endarterectomy on outcomes during coronary artery bypass grafting. *J Card Surg.* 2011 May;26(3):247-53.
5. Tiruvoipati R, Loubani M, Lencioni M, Ghosh S, Jones P, Patel R. Coronary endarterectomy: impact on morbidity and mortality when combined with coronary artery bypass surgery. *Ann Thorac Surg.* 2005 Jun;79(6):1999-2003.
6. Ghatanatti R, Teli A. Coronary Endarterectomy: Recent Trends. *J Clin Diagn Res.* 2017 Aug;11(8):PE01-PE04.