

## Echocardiographic Evaluation of the Patient Underwent Endarterectomy to the Chronic Totally Occluded LAD in Short Term

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### Abstract

**Background:** Most cardiac surgeons did not prefer to do CE because it has a higher incidence of surgical morbidities, like postoperative myocardial infarction.

**Aim of Study:** Evaluation of the myocardial muscle performance after an endarterectomy procedure in a totally chronic totally occluded LAD.

**Patients and Methods:** Between September 2018 and September 2021, 29 patients underwent closed endarterectomy with only patch anastomosis to the LAD with LIMA. Started Warfarin and Aspirin immediately after there was no bleeding from the chest drains. Echocardiography assessment of EF after six months of surgery.

**Results:** The preoperative echocardiography was improved to  $50 \pm 6.67$  from  $45 \pm 8.24$  after 6 months of surgery.

**Conclusion:** Endarterectomy is a viable alternative to conventional CABG in CTO LAD patients.

**Key Words:** *Endarterectomy – LAD patch – Chronic total occlusion (CTO).*

### Introduction

**THE** introduction of coronary endarterectomy (CE) was performed since 1950s [1,2].

Most cardiac surgeons did not prefer to do CE because it has a more incidence of surgical morbidities, such as postoperative myocardial infarction, and mortality.

Moreover, coronary artery bypass grafting (CABG) was invented since 1960s and became the golden approach for coronary artery revascularization [3].

But with the innovation of new generation of stents, the indication for percutaneous coronary intervention (PCI) has increased to include multi-

vessel and left main diseases, that were previously indicated for CABG.

Also, with the development of the second-generation DES, the number of CABG has been replaced by PCI, and more complex coronary techniques was done less invasive.

Though this development most of the randomized studies, and the latest European Society of Cardiology/European Association for Cardio-Thoracic Surgery Guidelines on myocardial revascularization, suggesting CABG over PCI specially in highly complex CADs, such as left main or triple-vessel diseases with intermediate or high SYNTAX scores [4].

The definition of complex CADs includes diffuse lesions complicated by severe calcification or narrow segments. Those types of patients are challenging for both coronary interventional cardiologists and the cardiac surgeons.

In conventional surgery, the patient couldn't get a complete revascularization by getting distal anastomosis to the healthy segment of the target coronary artery, and simple anastomosis distal to the diffusely diseased segment of the left anterior descending artery (LAD) cannot achieve complete revascularization of the myocardial territories supplied by the side branches (such as septal perforators and diagonal branches) affected by the diffuse lesions [5].

In these patients, CE can be an useful as a surgical alternative for complete myocardial revascularization.

CE is also effective in this era of the development of new DES generations, in which the complexity of CAD in CABG candidates has been increasing.

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Moreover, also CE can be useful in patients with in-stent restenosis (ISR) that involving side branches in the LAD specially the metal jacketed LAD, in the anter-oseptal region so simple distal anastomosis cannot done considering previously that this LAD is un-graftable because of multiple stents implanted in its distal portion [6].

### Patients and Methods

From 109 patients who underwent CABG, we selected twenty-nine patients that had CTO in the LAD and underwent CE: Closed (traction) endarterectomies between September 2018 and September 2021 at the National Heart Institute, Egypt.

They had diffusely diseased LAD, and the mean patient's age was  $64.76 \pm 11.29$ , twenty-three patients were males representing 79.31 %. The mean number of distal anastomoses was  $2.93 \pm 0.59$  and the mean length of endarterectomy in the LAD was  $11.59 \pm 1.27$ , six patients representing 20.69% underwent stent removal for ISR in the LAD.

The arteriotomy began in the mid-portion of the LAD and extended proximally and distally. The atheromatous core is carefully dissected and then traction from the adventitia with the spatula. The same procedure was carried out when we performed CE with concomitant stent removal. As far as the spatula will go, the endarterectomy has also extended to the side branches, and the distal end of the intima of the side branches is pulled out. (Fig. 1).

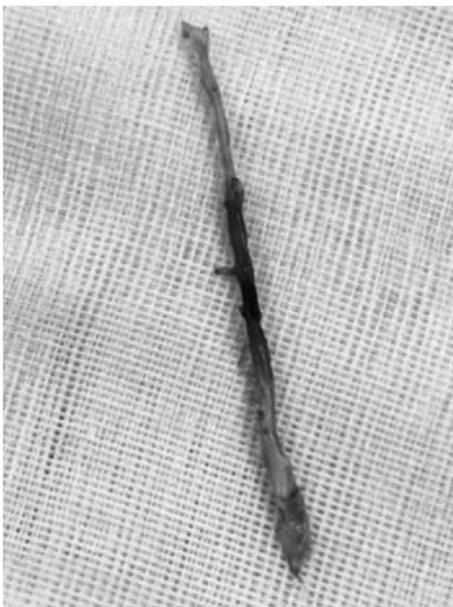


Fig. (1): The endarterectomy continues to the side branches.

The proximal core of the atheroma is divided and cutted to avoid competitive flow through the native vessel. The distal end of the atheromatous core is sharply divided till we reach an intact intima, then cleaning the surface with saline solution. (Fig. 2).

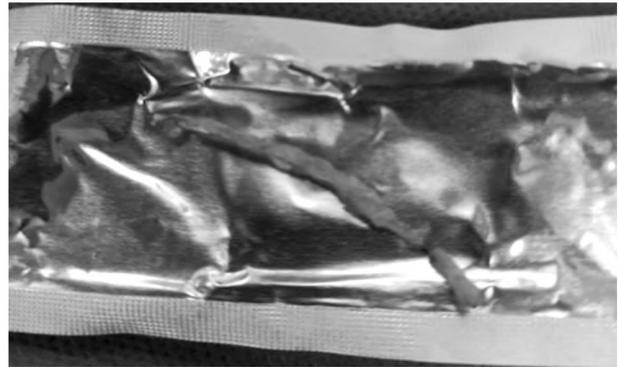


Fig. (2): The distal end of the atheromatous core is sharply divided.

In 50% of patients, we use skeletonized LITA, the length of the LAD arteriotomy matching the anastomosed to the LAD with several 7-0 polypropylene sutures in onlay-patch fashion. After completion of the anastomosis, we then measuring the flow by flowmeter to evaluate the graft patency.

Acute thrombosis in the reconstructed LAD is one of the most serious problem after CE because of the lack of endothelium in the endarterectomy portion that exposes the subendothelial tissue to the bloodstream, thereby triggering the coagulation cascade.

So, strict anticoagulation is crucial to prevent thrombosis in endarterectomy vessels. Our protocol for anticoagulation is as follows:

- Heparin infusion according to the activated clotting time (ACT) is maintained for 450 to 500 seconds during surgery with systemic or applying low-molecular-weight heparin (5000 units/day) after chest tube output has settled and continued until warfarin is effective.
- Low-dose Aspirin (100mg/day), Clopidogrel (75mg/day), and Warfarin (titrated to a target international normalized ratio of 2.0-2.5) are started after the initiation of oral intake.

#### Statistical analysis methods:

Values were presented as numbers and proportions for qualitative variables or means and standard deviation for quantitative variables. Quantitative variables were checked for normality by the Sha-

piro-Wilk test. Within-group, comparison between pre- and post-operative data was compared using paired *t*-test.

All tests were bilateral and a *p*-value of 5% is the limit of statistical significance. Analysis was performed by statistical package software IBM-SPSS version 24.

### Results

The mean number of grafts is  $2.93 \pm 0.59$ . The mean extracorporeal circulation time was  $89.86 \pm 18.11$  and the aortic cross-clamp mean time was  $68.34 \pm 17.30$ .

The length of the endarterectomy was  $11.59 \pm 1.27$  (Fig. 3).



Fig. (3): The length of complete endarterectomy by closed (traction) technique for a patient with CTO in the LAD exceeding 13cm.

Removed plaque and stent were done in six patients representing 20.69%.

Intra-aortic balloon pump (IABP) was placed during surgery in seven patients representing 24.14%.

There were two (6.89%) mediastinal re-exploration due to a high volume of drainage (1300ml).

All patients operated on had an echocardiographic evaluation more than six months postoperatively.

We had five patients representing 17.24% who had a significant increase in the creatine kinase-

MB level Postoperatively with an average of  $53.8 \pm 22.53$  IU/L.

Coronary angiography was performed on five patients while CT Angio was done on one patient.

A total of 4 (13.79%) had an occlusion of the LAD.

Postoperative bleeding occurred in two patients representing 6.89% while hemorrhagic stroke happened in only one patient, so Warfarin was stopped.

Two of our patients were not compliant with the medication and one was ignored to follow up with INR and did not reach the target, the last patient of the four developed a hemorrhagic stroke so only a superficial sternal wound infection was seen in one patient representing 3.45%.

No operative or post-operative mortality was seen.

The preoperative echocardiography was improved compared to the postoperative echocardiography  $50 \pm 6.67$  from  $45 \pm 8.24$ .

### Discussion

Though our technique is closed CE, it is equivalent to the same average length of endarterectomy  $11.59 \pm 1.27$ . As in our study, the length of endarterectomy was thorough as the closed endarterectomy requires only limited arteriotomy, we used it because it is simpler, though some theories considered it incomplete, and they considered remnant atherosclerotic plaques and shearing-off of the plaques in the side branches called “snow-plow effect”.

Some literature considers open endarterectomy facilitates the complete removal of the atherosclerotic lesion under direct vision, but from our point of view, it is a technically demanding and time-consuming procedure [7].

We are using onlay patch LIMA to LAD, several procedures have been reported as reconstruction methods for endarterectomies coronary arteries, using onlay patch with LITA is superior to saphenous vein patching [8].

We perform our technique on CPB as the CE is complex and time-consuming. Surgeons may be reluctant to perform CE with an off-pump procedure. This is consistent with Shapira and colleagues [9].

Open endarterectomy via a long arteriotomy is a time-consuming procedure, and CE with off-

pump CABG avoids longer cardiopulmonary bypass and cross-clamp times. We usually perform CABG with concomitant CE using the CPB [6].

The number of patients who had an increase in the CK MB was five patients representing 17.24% with mean of  $53.8 \pm 22.53$ .

The mean ICU  $63.66 \pm 9.92$  stay is consistent with Kardiochir Torakochirurgia et al., Occluded LAD was 4 (13.79%) and consistent with Kardiochir Torakochirurgia and co-workers. (Fig. 4).

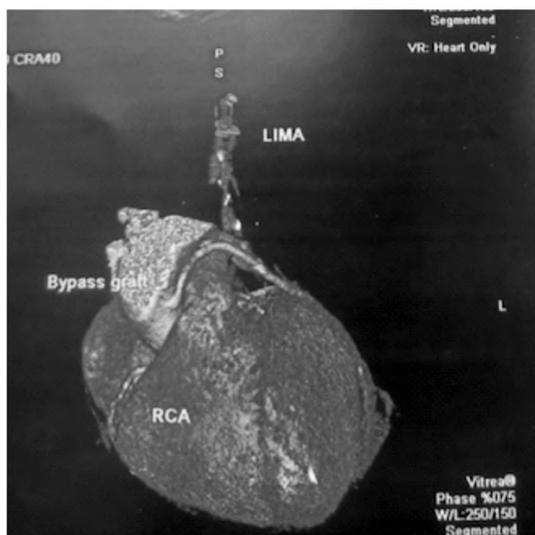


Fig. (4): CT coronary angiography showing totally occluded LIMA due to noncompliant patient with anticoagulation.

In the literature, some cases had only one option and should do LAD endarterectomy combined with LIMA grafting to achieve completeness of revascularization. Published analyses with larger numbers of patients confirm our observation and indicate the efficiency of this method in this group.

We had no perioperative mortality some data revealing to perioperative mortality among patients who underwent a combined CABG + CE procedure are quite different among hospital units. Most results are estimated between 2 and 8% [5-10].

This may be due to different types of patient and neomerous research methodology. Byrne and co-authors analyzed 196 patients; the mortality was 3%. Three percent of patients suffered from myocardial infarction within the LAD-dependent myocardial area. At one-year follow-up, 90% of patients were angina-free [11].

We had five patients representing 17.24% who had a significant increase in the creatine kinase-MB level Postoperatively with an average of  $53.8 \pm 22.53$  IU/L.

Varability of data that estimate the frequency of early perioperative MI is variable between 1 and 19%, depending on the cardiac surgery unit [5,12].

As studies show that MI is more frequent in patients after CABG + CE more than conventional CABG. Despite this fact, Damien et al., reported that in only few patients 27.8% did it relate to area depending on the vessel that underwent CE [10].

The advanced stage of coronary artery disease may play a rule in development of MI in those kind of patients and not only an effect of the endarterectomy procedure itself.

We had only single vessel (LAD) endarterectomy in many studies patients who have had more than single-vessel endarterectomy had a higher possibility of infarction [12,13].

We had strict control of the anticoagulation process, heparin infusion immediately after no bleeding from chest drains, then warfarin with target INR (2-2.5) for 6 months the dual antiplatelet therapy for 1 year as there are no clear guidelines recommending pharmacotherapy in patients who had CABG + CE. most of studies used dual antiplatelet or anticoagulation. The lack of a single infarction in our cardiac surgery unit allows us to be optimistic about our protocol.

Though we had satisfactory results in the myocardial performance as described in the results Minale et al., mentioned some fall of EF and contraction disorder in 17.7% of patients with a trend to arise within the anterior wall. The same study reported EF improvement in 16.5% of cases [14].

Some patients had an LAD endarterectomy decreased anterior wall contraction in about 34% of patients. It appeared to be most significant in cases without previous dysfunction [15].

In conclusion, although technically demanding and unfamiliar to many cardiac surgeons, we should reconsider endarterectomy as an alternative solution to CTO patients and should be indicated in some cases. Strict anti-coagulation is crucial for preservation of the artery that had no intima and preventing the coagulation cascade.

The procedure is not an alternative to CABG, and it is only a therapeutic option in a specific type of patients despite its risk. The patient selection to take the correct decision and great caution when performing CE is essential in achieving good results more number of patients is required, as well as guideline preparation for post-operative care.

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## تقييم كفاءة عضلة القلب للمرضى الخاضعين لاستئصال الانسداد المتكلس المزمن من الشريان التاجى الايسر النازل وتقييم عضلة على المدى القصير

معظم جراحى القلب يترددون فى هذا الاجراء لأنه يحتوى على نسبة أعلى من الخطورة الجراحية، مثل احتشاء عضلة القلب وكذلك الوفيات.

الهدف من الدراسة : لتقييم أداء عضلة القلب بعد إجراء استئصال الانسداد المتكلس المزمن من الشريان التاجى الايسر النازل.

بين سبتمبر ٢٠١٨ وسبتمبر ٢٠٢١، خضع ٢٩ مريضاً لاستئصال هذا الجزء من الشريان مع عمل وصلة شريانية من الشريان الصدرى وترقيع الشريان بالكامل ومتابعة الحالة المرضية بتخطيط القلب بالإضافة إلى الانزيمات.

واستخدام الأسبرين مباشرة بعد عدم التأكد من عدم حدوث نزيف من الأنابيب الصدرية، ثم التقييم عن طريق الموجات الصوتية على القلب بعد ٦ أشهر من إجراء الجراحة.

النتائج : تم تحسين تخطيط صدى القلب قبل الجراحة إلى  $50 \pm 6.67$  من  $45 \pm 8.24$  بعد ٦ أشهر من الجراحة.

مما يستنتج بأن استئصال وازالة التكلس من الشرايين هو بديل جيد لعملية ترقيع الشريان التاجى فى ما يعرف بمريض CTO-LAD.