Section: Cardiovascular and Thoracic Surgery

Original Research Article

CORONARY ENDARTERECTOMY – IS IT WORTH THE RISK? A STUDY ON THE IMMEDIATE AND SHORT-TERM OUTCOMES

K. S. Saravana Krushna Raja[1], Kavitha. N[1], K. Sivasankaran[2], Kirthiga Thiagarajan[2]

[1]*Associate Professor, Department of Cardiovascular and Thoracic Surgery, Kalaignar Centenary Superspeciality Hospital, Guindy, Chennai, India.*
[2]*Assistant Professor, Department of Cardiovascular and Thoracic Surgery, Kalaignar Centenary Superspeciality Hospital, Guindy, Chennai, India.*

Received *: 05/04/2025*
Received in revised form *: 29/05/2025*
Accepted *: 17/06/2025*

Corresponding Author:
Dr. Kirthiga Thiagarajan,
Assistant Professor, Department of Cardiovascular and Thoracic Surgery, Kalaignar Centenary Superspeciality Hospital, Guindy, Chennai, India.
Email: tkirthiga@gmail.com

DOI: 10.70034/ijmedph.2025.3.2

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (3); 7-11

ABSTRACT

Background: Coronary artery disease is one of the leading causes of death globally, with coronary artery bypass grafting remaining the gold standard of treatment, especially in multivessel disease. However, diffuse disease poses an unforeseen difficulty of distal revascularisation by standard Coronary Artery Bypass Grafting (CABG) alone. Coronary endarterectomy as an adjuvant, even if unplanned preoperatively is essential in these cases for adequate revascularisation. In this study, we have compared the technical procedures and outcomes of coronary endarterectomy.

Materials and Methods: In this retrospective observational study, we intend to compare the technique used, the vessel addressed and the outcomes recorded in patients who have undergone CABG with Coronary Endarterectomy at two separate tertiary care speciality hospitals between the period from February 2023 to February 2025, done by a single surgeon.

Results: Data of 57 patients who had undergone CABG with coronary endarterectomy during the study period were analysed and assessed. There was a male preponderance in the study population, with the majority of patients falling in the 50 – 60-year age group. More patients underwent closed endarterectomy with off-pump or on-pump beating heart CABG while open endarterectomy was more common in on-pump arrested heart CABG. RCA was the most commonly endarterectomised vessel in our study.

Conclusion: This study shows that successful coronary endarterectomy with CABG can show a drastic improvement in cardiac function and symptom relief of the patients due to improved perfusion and distal run off as the plaque causing obstruction is completely removed. However adequate postoperative anticoagulation and antiplatelet regimen as well as strict follow-up are necessary to ensure adequate maintenance of vessel patency and prevent reocclusion.

Key Words: Coronary Artery Bypass Grafting, Coronary Endarterectomy, Coronary Artery Disease

INTRODUCTION

Coronary artery disease has now become a common pathology having increasingly detrimental effects on the health of the general population.[1] In patients whose symptoms remain refractory to optimised medical therapy, those with high disease load, failed intervention or complex anatomy making them unsuitable for intervention, coronary artery bypass grafting (CABG) becomes the mainstay and gold standard or treatment.[1,2] However, in patients with diffuse disease or severe calcification, creating and achieving a patent distal anastomosis becomes cumbersome, putting diseased though viable myocardium at a serious ischemic risk.[3] Coronary endarterectomy with CABG facilitates this revascularisation in targets that may otherwise prove ungraftable or as a bailout in an unforeseen severely

calcified artery noted post arteriotomy where it would be impossible for creation of an acceptable and patent distal anastomosis.[3,4]

First described by Bailey and Colleagues in 1957,[5] historically, coronary endarterectomy involved the removal of an atherosclerotic plaque through a small arteriotomy followed by either primary closure of the vessel or a vein patch repair. Effler and colleagues showed that coronary endarterectomy improved patency of distal anastomosis of an occluded coronary artery, however, it sheared off numerous smaller myocardial branches as well as removed the vessel intima and media, resulting in the denuded surface developing a fibrin mural thrombus which rapidly formed organised fibrous tissue that could lead to further occlusion and significant stenosis.[6]

Though historically there was increased mortality and post procedure myocardial infarction post coronary endarterectomy, causing it to be abandoned as a primary procedure, reducing it as an adjunct,[5] with improvement of the technique, outcomes have improved with early mortality and postoperative myocardial infarction being comparable to isolated CABG.[3]

Coronary endarterectomy may be either closed, where the plaque is accessed through a small arteriotomy and removed from the distal part of the native artery by gentle yet steady traction,[7] however there is high chance of intimal flaps as well as residual obstruction,[8] or the open technique where the native coronary artery is opened longitudinally beyond the plaque, which is then removed under vision, lifting off from the vessel wall,[7] which is then closed using an onlay vein patch, followed by CABG to the vessel.[9] In this study, we aim to compare the techniques of coronary endarterectomy and analyse the outcomes in our institutions.

MATERIALS AND METHODS

The primary objective of this study was to assess the technicalities and differences in the types of coronary endarterectomy, from our institutional experience of cases. The secondary objective was to assess the outcomes of coronary endarterectomy as an adjunct to CABG in patients with diffuse coronary artery disease, with respect to post-operative improvement of cardiac function, documented by a post-operative ECHO.

This study was conducted as a retrospective observational study, with data analysed from two tertiary care superspeciality hospitals in Tamil Nadu, between the period of February 2023 to February 2025. Operative details and presentation of 60 patients from the study period – all consecutive patients who underwent adjunct coronary endarterectomy with CABG – were included in the analysis. Patients were divided based on the type of CABG they underwent as well as the type of endarterectomy they underwent for comparison.

All patients who underwent an isolated first CABG with endarterectomy of any one or more major coronary vessels as elective as well as urgent procedures were included in the study irrespective of patient age or disease burden. Patients who had had a prior CABG or other cardiac surgery planned for a redo sternotomy and proceed, or were planned for an adjunct procedure along with the CABG in the current sitting, including but not limited to concomitant valve replacement, patients taken up for emergency procedure or patients in cardiogenic shock or on inotropes or intra-aortic balloon pump support preoperatively were excluded from the study.

Data Collection

Data on preoperative presentation and plan, coronary angiography (CAG) report and video, preoperative ECHO as well as postoperative ECHO and outcome were collected from the patient hospital case records. The surgical procedure done and the type and vessel endarterectomised were collected from the OR notes. Operator bias was avoided as all cases chosen were operated on by a single surgeon.

RESULTS

There was a male predominance of the study population.

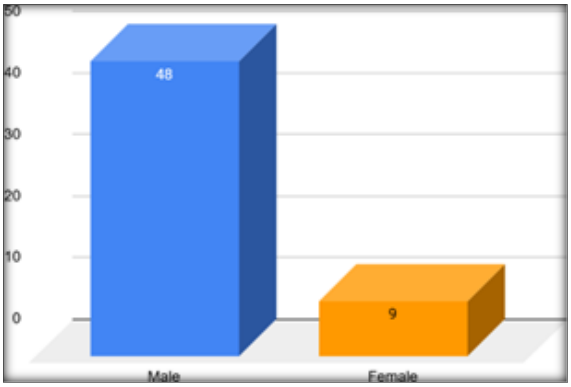

Figure 1: Gender Distribution

Most of the patient population fell in the 50 – 60-year age group, with the average age of the study population being 56 years (Range 45 – 72 years).

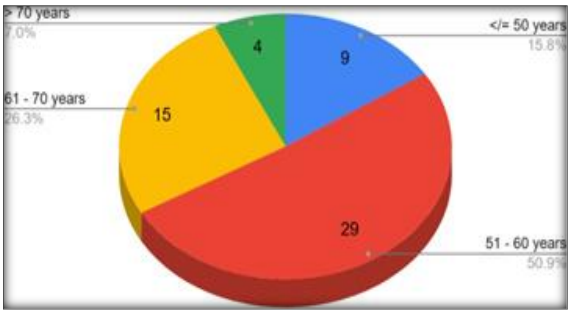

Figure 2: Age Distribution

57 patients had undergone successful coronary endarterectomy with CABG during the study period, 40 patients underwent endarterectomy of a single vessel while the rest had multivessel endarterectomies most commonly of the Left Anterior Descending artery (LAD) and the Right Coronary Artery (RCA).

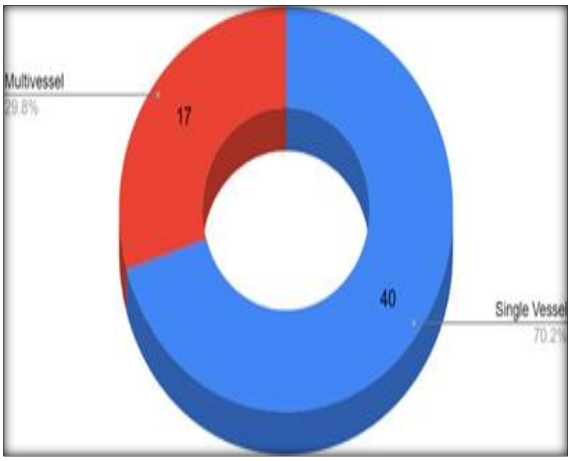

Figure 3: Single Vessel vs Multivessel Endarterectomy

In our study, among single vessel endarterectomies, the most commonly addressed vessel was the RCA followed by the Obtuse Marginal (OM), then the LAD.

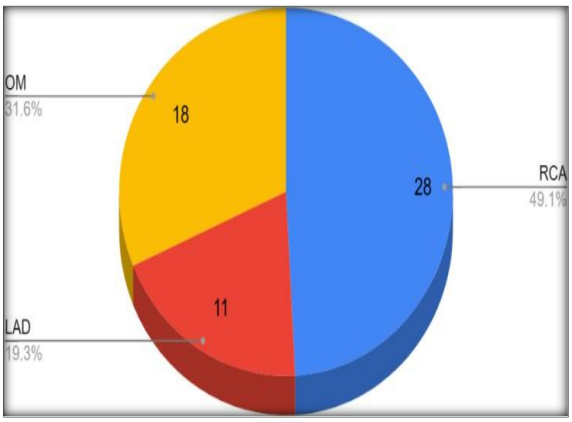

Figure 4: Frequency of Endarterectomy based on Territories

With respect to the type of CABG accompanying the endarterectomy, 26 patients underwent on-pump CABG, the remaining having undergone off-pump CABG. Of the on- pump CABG patients, 15 underwent on-pump beating heart CABG while the rest underwent on-pump arrested heart CABG. Closed endarterectomy was more commonly performed in off- pump and on-pump beating heart CABGs, while open endarterectomy was common in on- pump arrested heart CABG.

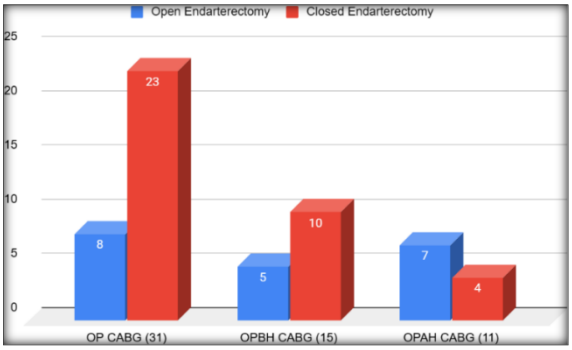

Figure 5: Frequency of Endarterectomy with respect to types of CABG (OP CABG – Off-Pump CABG; OPBH CABG – On- pump Beating Heart CABG; OPAH CABH – On-pump Arrested Heart CABG)

Of the single vessel endarterectomies, closed endarterectomy was more common in the lateral and posterior vessels, while open technique was more common in the anterior territory.

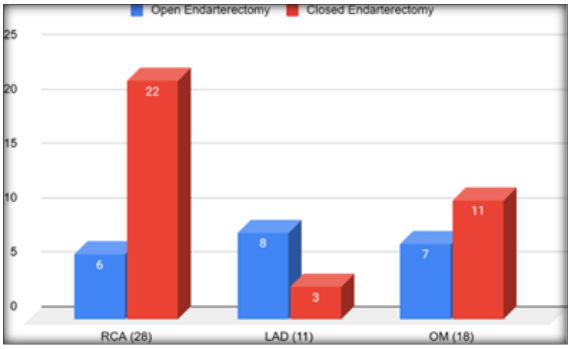

Figure 6: Type of Endarterectomy based on vessel territory

Of the postoperative outcomes, post successful endarterectomy, there was noted a drastic improvement in cardiac function evident by the improved ejection fraction (EF) in the post-operative ECHO by almost 10 to 15%, 1-week post-surgery.

Complications of bleeding and rhythm disturbances in the form of arrythmias and atrial fibrillation were more common with RCA endarterectomy. Open endarterectomy had more bleeding complications than closed endarterectomy, however blood loss with more in off- pump CABG surgery than on-pump CABGs. 2 patients of our study population expired within the 1st 48 hours of surgery, the cause of death being low cardiac output syndrome; one with RCA territory and the other LAD territory endarterectomy, both closed methods.

DISCUSSION

Coronary endarterectomy continues to be a rare adjunct in clinical practice with only 2.89% of CABG patients undergoing concomitant endarterectomy, as evident from data gleaned from the Society of Thoracic Surgeons Adult Cardiac Surgery Database.[3] There exists an increased risk

of operative mortality and perioperative myocardial infarction with the procedure.[3] However postoperative outcome in successful cases were comparable in CABG with coronary endarterectomy of any of the major coronaries. Completeness of endarterectomy in closed technique is possible in off-pump CABG and on-pump beating heart CABG due to the countertraction provided by every systolic contraction of the heart to the controlled gentle traction of the plaque via arteriotomy.[7] Completeness in the closed method can also be ensured using spatula to negotiate and remove plaque from branch vessels, aided by countertraction of each heartbeat. Ensuring complete removal of the plaque is essential before proceeding with CABG as residual plaque or a ruptured or fractured plaque can cause distal obstruction and hasten intraoperative myocardial infarction. This is confirmed in our institute by carefully passing a probe via the arteriotomy along the length of the endarterectomised vessel to ensure and confirm free passage of the probe. Ensuring this is essential to prevent technique failure and maintain good distal run-off and improve post-operative cardiac contraction and function. However, in on-pump arrested CABG, the heart falls flaccid, abolishing any countertraction, hence open method is more successful. Being under direct vision, this method permits complete removal of the plaque, followed by reconstructing the laid open coronary using an onlay vein patch, followed by a CABG.

It is essential to ensure adequate anticoagulation post procedure; the policy in our institute is to use intravenous unfractionated heparin at a dose of 5000IU in the initial postoperative period, while bridging with low dose nicoumalone, followed by discharge with combination therapy with nicoumalone and aspirin for a duration of 6 month, during which we maintain the patient's INR at a range of 1.5 to 2, followed by a switch over to dual antiplatelets after 6 months – to aspirin with clopidogrel. This ensures reduction of the reocclusion rate which might arise out of stripping the intima as well as assuring distal run-off. With improved coronary perfusion, the postoperative ECHO at time of discharge showed a drastic improvement in EF and left ventricular function, compared to the preoperative ECHO in our study population.

Figure 7: Post Endarterectomy of distal RCA - Plaque removed in toto by controlled gentle traction against countertraction of beating heart via closed Endarterectomy in OP CABG

CONCLUSION

Though historically coronary endarterectomy with CABG has been associated with increased early mortality and myocardial infarction,[4] and though rarely used to approach difficult targets,[3] our study had acceptable early outcomes with respect to improved ejection fraction and left ventricular function in the postoperative ECHO prior to discharge of the patient post-surgery. Early mortality was also comparable between the two types and minimal in our study cohort. Patients with severe disease burden, requiring advanced revascularisation may benefit from coronary endarterectomy as the benefits outweigh the risks of the procedure.[3] The decision to proceed with coronary endarterectomy in our study cohort was pre-planned in the preoperative period based on the appearance of the coronary vessels on the CAG; however, it may benefit as an on-table decision as well, when the arteriotomy done can only be grafted after plaque removal. In conclusion, the decision to proceed with a coronary endarterectomy for a patient rests with the operating surgeon, after weighting risks versus the potential benefits to the patient and carefully selecting the technique most appropriate and suitable for the said patient, making the approach individualised and tailor-made for each patient for best outcomes.

Limitations

Being a retrospective observational study, data was garnered from records and documentation trusting them to be complete. Direct observation of patient outcome was not possible in this study. The small sample size may lead to outcome bias, unless proven otherwise. Need for a long-term follow-up study is essential to assess the long-term benefit and graft patency post coronary endarterectomy to give a picture of the actual benefit in the long- term survival of the patient as opposed to only immediate results compared.

Conflicts of Interest

The authors declare to have no conflict of interest in this subject mater.

REFERENCES

1. Nenna A, Ferrisi C, Salsano A, Lusini M, Santini F, Chello M. Coronary Artery Bypass Grafting in High-Risk Patients: On-Pump Beating-Heart CABG. InCoronary Artery Bypass Surgery-New Insights 2024 May 16. IntechOpen.
2. Jiang Y, Xu L, Liu Y, Deng B, Dong N, Chen S. Beating-heart on-pump coronary artery bypass grafting vs. off-pump coronary artery bypass grafting: a systematic review and meta-analysis. Journal of Thoracic Disease. 2021 Jul;13(7):4185.
3. Kelly JJ, Han JJ, Desai ND, Iyengar A, Acker AM, Grau-Sepulveda M, Zwischenberger BA, Jawitz OK, Hargrove WC, Szeto WY, Williams ML. Coronary endarterectomy: analysis of the Society of Thoracic Surgeons adult cardiac surgery database. The Annals of Thoracic Surgery. 2022 Sep 1;114(3):667-74.
4. Livesay JJ, Cooley DA, Hallman GL, Reul GJ, Ott DA, Duncan JM, Frazier OH. Early and late results of coronary endarterectomy: analysis of 3,369 patients. The Journal of

Thoracic and Cardiovascular Surgery. 1986 Oct 1;92(4):649-60.
5. Bailey CP, May A, Lemmon WM. Survival after coronary endarterectomy in man. Journal of the american medical association. 1957 Jun 8;164(6):641-6.
6. Effler DB, Groves LK, Sones Jr FM, Shirey EK. Endarterectomy in the treatment of coronary artery disease. The Journal of Thoracic and Cardiovascular Surgery. 1964 Jan 1;47(1):98-108.
7. Ghatanatti R, Teli A. Coronary endarterectomy: recent trends. Journal of Clinical and Diagnostic Research: JCDR. 2017 Aug 1;11(8):PE01.
8. Keogh BE, Bidstrup BP, Taylor KM, Sapsford RN. Angioscopic evaluation of intravascular morphology after coronary endarterectomy. The Annals of thoracic surgery. 1991 Oct 1;52(4):766-72.
9. Tiruvoipati R, Loubani M, Peek G. Coronary endarterectomy in the current era. Current opinion in cardiology. 2005 Nov 1;20(6):517-20.