

# Coronary Endarterectomy for Diffuse Coronary Artery Disease in A Bangladeshi Population Cohort

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## Abstract:

*Coronary artery bypass grafting (CABG) is a well established treatment modality for coronary artery disease (CAD). However with the trend towards aggressive per cutaneous interventions (PCI) by the cardiologists, more and more patients with poor quality, diffusely diseased coronary arteries are coming for CABG. Quite often these arteries require endarterectomy to ensure revascularisation. Initial experience world wide with coronary endarterectomy was bad enough for many surgeons not advocating it. However recent papers have shown greatly improved results.*

*This was a retrospective study of five hundred consecutive patients undergoing CABG between 19<sup>th</sup> August 2006 and 1<sup>st</sup> of July 2008 at Ibrahim Cardiac Hospital and Research Institute (ICHRI). Pre-operative and Intra-operative variables which could influence outcome were analysed. Of the total patients who had at least one endarterectomy done were labeled as Endarterectomy (EA) group, while patients without endarterectomy were labeled as Control group.*

*Post operative outcome showed results comparable to CABG without endarterectomy can be achieved. We have described our selection criteria and surgical technique. Our protocol did not bring about a statistically significant increase in bypass time, cross clamp time. It also did not change the number of grafts per patient.*

*Our experience shows coronary endarterectomy can be done in order to achieve full revascularisation with very safe and acceptable outcome.*

**Key words:** CABG, Coronary endarterectomy

## Introduction:

The incidence of coronary artery disease is on an increasing trend. The profile of patients coming for Coronary artery bypass grafting (CABG) is also continuously changing to include older patients with associated co morbidities such as diabetes mellitus, hypertension, cigarette smoking, peripheral vascular disease, and others.<sup>1</sup> With the increasing use of non-surgical methods of coronary revascularization like Per Cutaneous Interventions (PCI) stenting or other catheter-based procedures, now patients with severe diffuse coronary disease are being referred for surgery, when the affected vessels are usually not graftable and complete revascularization using conventional CABG may not be feasible. It is well documented that incomplete myocardial revascularization procedure adversely affects the outcome of CABG.<sup>2-7</sup> The option left to surgeons in this group of patients is to place a graft on the diffusely diseased vessel along with endarterectomy (EA) of the vessel. However, many surgeons are reluctant to perform endarterectomy because of the poorer clinical outcome<sup>3,5,8-18,21</sup> as compared to conventional CABG. They are further dissuaded by the technical difficulty and uncertainty

surrounding the procedure. Recently there has been renewed interest in the procedure after the publication of papers stating judicious use of endarterectomy can give appreciable results with good long-term outcome.<sup>19,20</sup> Here we present our experience with Endarterectomy at Ibrahim Cardiac Hospital and Research Institute.

## Materials and Methods:

In this analysis, retrospective data of 500 consecutive CABG cases between 19<sup>th</sup> August 2006 to 1<sup>st</sup> July 2008 were included. Key baseline variables were age, sex, LVEF, and number of coronary vessels involved. Risk factors studied included hypertension, diabetes mellitus, tobacco smoking, dyslipidaemia, preoperative MI, renal impairment, previous CVA, family history of IHD. Perioperative variables considered to have influence on the outcome of endarterectomy were CPB time, X-clamp time and number of grafts required. Outcome was evaluated with the help of postoperative arrhythmia, bleeding, perioperative MI and mortality. Of the total patients who had at least one endarterectomy done were labeled as Endarterectomy (EA) group, while patients without endarterectomy were labeled

as control group. Patients having a concomitant procedure along with the CABG were excluded. All the patients were operated on by a single surgeon. The anaesthesia, perfusion, surgical and postoperative care team also remained the same for each case.

In all cases the following standard protocol was followed. Anaesthesia was induced and maintained using Fentanyl, Etomidate, Thiopentone, Pancuronium and propofol. Heart was approached via median sternotomy. Patients were attached to a Heart-Lung machine (Stockert III) using aortic and bicaval venous cannulation. Patients were cooled down to 28 degree celsius core temperature. Aorta was cross clamped and the heart was arrested with antegrade cold blood cardioplegia and topical cooling. Patients were rewarmed after removal of the cross clamp at the time of constructing the top ends. At the end of the procedure patients were disconnected from the Heart-Lung machine, closed and shifted to the cardiac surgical ICU. Majority of the patients were extubated within three hours.

The idea of elective endarterectomy was not practiced. Endarterectomy was done only when the vessel quality did not permit the construction of a meaningful graft during surgery. That is when the lumen failed to admit a 1mm metal probe or the lumen was filled with clots, debris that could not be cleared. A very conservative approach was adopted for Left Anterior Descending (LAD) endarterectomy. The viability of the supplying territory was also considered at the time of making a decision. In majority of the cases endarterectomy was achieved using a limited arteriotomy and the “traction” technique.<sup>15,22,23</sup> When the endarterectomy was judged as inadequate additional arteriotomy was made or it was converted to the “open method” of endarterectomy.<sup>15, 24</sup> Left Internal Mammary Artery (LIMA) was anastomosed to the Left Anterior Descending (LAD) artery whenever possible. We do not utilize the LIMA for sequential anastomosis. A reversed vein graft was substituted for the LAD whenever needed. In all case the conduit was directly anastomosed to the endarterectomy site.

### Results:

Of the demographic characteristics age was fairly comparable between the endarterectomy and control groups ( $56.2 \pm 8.0$  vs.  $55.7 \pm 8.8$ ,  $p = 0.703$ ). However, female sex demonstrated their significant presence in the endarterectomy group (36.4%) than that in the control group (14.3%) ( $p < 0.001$ ) as shown in Table I. Over 63% of the endarterectomy group had LVEF  $> 50\%$  (preserved) as opposed to 45.8% of the control group (Fig.-1). All the patients who underwent endarterectomy had experience of prior CVA. Presence of hypertension and history of previous renal failure were also significantly higher in the endarterectomised patients (Table-II) compared to those

who underwent CABG without endarterectomy ( $p = 0.020$  and  $p = 0.024$  respectively).

Family history of ischemic heart diseases was much less in the endarterectomy group than that in the latter group ( $p < 0.001$ ). Perioperative factors (Table-III) that might influence the outcome were all identically distributed in both the groups. Immediate outcome (Table-IV) of endarterectomy did not differ with that of control group except in terms of arrhythmia. Which was considerably higher in the EA group (9%) than that in the control group (2.6%) and this was significant ( $p < 0.001$ ).

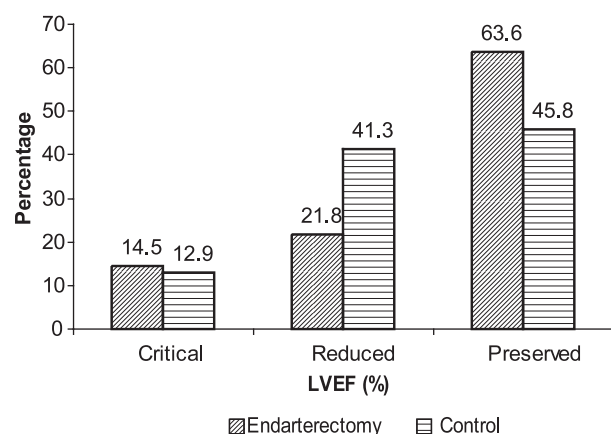
**Table-I**

*Distribution of demographic characteristics between case and control groups*

Demographic characteristics	Group		p-value
	Endarterectomy (n = 55)	Control (n = 496)	
Age			
≤ 50	15(27.3)	146(29.4)	
> 50	40(72.7)	350(70.6)	
Mean ± SD years <sup>#</sup>	56.2 ± 8.0	55.7 ± 8.8	0.703
Sex <sup>¶</sup>			
Male	35(63.6)	425(85.7)	<0.001
Female	20(36.4)	71(14.3)	

<sup>#</sup> Data analysed using Student's t-Test and presented as mean ± SD.

<sup>¶</sup> Data analysed with the help of Chi-square Test ( $c^2$ ) and presented as n (%).



**Fig.-1:** Comparison of LVEF between endarterectomy and control groups

**Table-II**  
*Distribution of risk factors between the groups*

Risk factors	Group		P-value
	Endarterectomy (n=55)	Control (n=496)	
Prior CVA	55(100.0)	1(0.2)	<0.001
Perioperative MI	0(0.0)	0(0.0)	—
Previous renal impairment	12(21.8)	56(11.3)	0.024
Diabetes mellitus	36(65.5)	292(58.9)	0.345
Hypertension	49(89.1)	372(75.0)	0.020
Smoking	26(47.3)	241(48.8)	0.831
Dyslipidaemia	36(65.5)	292(58.9)	0.345
Family history IHD	3(5.5)	138(27.8)	<0.001
Hypothyroidism	1(1.8)	2(0.4)	0.176

**Table-III**  
*Perioperative factors influencing outcome of endarterectomy*

Perioperative factors	Group		P-value
	Endarterectomy (n=55)	Control (n=496)	
CPB time (minutes)	110.9±44.8	97.1±96.9	0.299
X-clamp time (minutes)	66.9±21.4	60.3±17.4	0.650
Number of grafts required	3±1	3±1	0.861

# Data analysed using Student's t-Test and presented as mean ± SD.

**Table-IV**  
*Immediate outcome of endarterectomy*

Outcome variables	Group		P-value
	Endarterectomy (n=55)	Control (n=496)	
Postoperative arrhythmia <sup>#</sup>	5(9.0)	13(2.6)	<0.001
Postoperative bleeding <sup>#</sup>	1(1.8)	7(1.4)	0.647
Perioperative MI <sup>¶</sup>	2(3.6)	10(2.0)	0.161
Perioperative mortality <sup>¶</sup>	1(1.8)	6(1.2)	0.529

# Data analysed using Chi-square ( $\chi^2$ ) Test and were presented as mean

## Discussion

The technique of coronary artery endarterectomy was developed by Bailey and colleagues<sup>6</sup> in the early days of CABG.<sup>3</sup> However the technique did not get popular because of the technical difficulties involved in the process of endarterectomy and the higher incidence of adverse

clinical events.<sup>3,5,8-18</sup> But there has been a change in attitude mainly brought about the referral of patients with severe diffuse coronary artery disease. These patients are not deemed to be suitable for PCI and only options left for them are endarterectomy.

The present study revealed that females are more likely to have diffuse coronary artery disease than their male counterpart requiring an endarterectomy. Previous CVA, hypertension and renal impairment were significantly common in the endarterectomy group than those in the control group suggesting these factors might be associated with diffuse coronary artery disease. Diabetes, dyslipidaemia and smoking were not found to carry extra risk for diffuse coronary artery disease in our Experience. Although other investigators have found them as risk factors. In our series the immediate outcome of endarterectomy is encouraging. Postoperative bleeding, MI and mortality were all negligible and did not differ from the control group. Only arrhythmia was significantly higher in the endarterectomy patients which were managed medically. All this justifies performing endarterectomy is better than doing an incomplete revascularisation.

Despite increased risks involved a better outcome is being increasingly reported by judicious selection of target vessel for performing endarterectomy. There is no uniformity in the frequency of coronary endarterectomy.<sup>26</sup> Some centers do not entertain the procedure at all. Others who have adopted the procedure report an incidence between 3.7% and 42%.<sup>8,26</sup> The reported incidence of mortality after EA ranges between 3.2% and 10% and that of myocardial infarction (MI) is between 4% and 15%.<sup>3,5,8-18</sup>

Newer studies report outcomes very similar to CABG without EA. This has been possible by a combination of careful patient selection, improved anaesthesia, myocardial protection, sophisticated surgical technique and better postoperative management. There are studies showing increased operative risk for LAD endarterectomy<sup>7,16</sup> as compared to the Right Coronary Artery (RCA). A number of studies<sup>16,18,25</sup> have shown improved outcome when the LIMA is used to reconstruct the endarterectomised vessel.

Our study shows a mortality of 1.8% for endarterectomy during coronary artery bypass. This is well within the worldwide standard and justifies against not doing the procedure. Our selection criteria further shows the procedure can be done with a bypass time and cross-clamp time statistically not significantly different from a straightforward coronary bypass. In our study female sex and a history of previous CVA was statistically significant

enough to warn off the surgeon of bad quality vessels with a potential need for endarterectomy during surgery.

The study concludes that patients with diffuse coronary artery disease are high risk candidates for revascularization. However with careful selection of patients, well-judged and a well executed surgical technique, followed by close postoperative care very good results can be obtained.

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