

Study of Surgical Management of diffusely diseased coronary arteries in Rural Maharashtra Population

By

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Abstract

Background: Diffuse coronary Artery disease (CAD) is a surgical challenge because coronary artery bypass graft (CABG) in diffuse CAD may result into incomplete revascularisation and high chances of early graft occlusion due to poor distal flow may lead to perioperative morbidity and mortality.

Method: 480 (four hundred Eighty) patients underwent long segment coronary anatomises for diffuse CAD with either left internal thoracic artery (LITA) or saphenous vein conduits. In 180 (37.5%) patients the anastomosis length was more than 4 cm 240 (50%) patients were operated off-pump and rest were operated on cardio pulmonary bypass. Mortality was 2% due to cerebro-vascular accident.

Results: Post-surgical patients were compared with medicine managed diffused CAD patients and significant p value ($p < 0.001$) was observed.

Conclusion: Diffused CAD patients treated surgically had better results as compared to medically managed morbidity and mortality.

Keywords: Diffuse CAD, angiography, anastomosis, CABG

Introduction

Diffuse coronary artery disease (CAD) is generally considered in the presence of a narrowing ($\geq 70\%$) of coronary artery, ≥ 20 mm or in the presence of multiples stenosis encompassing the whole length of coronary artery ⁽¹⁾. Nevertheless, diffuse CAD can lead to severe myocardial ischemia and there by angina, myocardial infarction (MI) and every heart failure especially when the left descending artery (LAD) is exclusively involved ⁽²⁾. The prognosis of diffuse CAD after stenting or CABG (coronary artery bypass grafting) is unknown. Most of the patients with diabetes hyperlipidemia, chronic renal insufficiency, connective tissue disease, heart transplantation and multistended coronary arteries have diffused atherosclerotic lesions in the coronary territory. All of these diseases affect and accelerate coronary atherosclerosis. Management diffuse CAD is a surgical challenge. Routine CABG surgery in diffuse CAD may result in incomplete revascularisation and there is chance of early graft occlusion due to poor distal flow. This may lead to high chance of perioperative morbidity and mortality. In

addition if the anastomosis compromises the native coronary flow, patient may develop acute myocardial ischemia, if the occlusion of graft occurs in the course of time. Such types of diffuse CAD are mostly considered inoperable and were being continued on medical management until the introduction of reconstructive procedures. These reconstructive procedures include saphenous vein on lay patch followed by LITA grafting or direct anastomosis of LITA to the long segment arteriotomy of AD with or without endarterectomy⁽³⁾⁽⁴⁾.

Surgical techniques included long segment coronary anastomosis LITA, LAD, and PDA operated off-pump, cardio-pulmonary bypass.

Material and Methods

480 (four hundred and eight) patients admitted at cardiac unit of MGM Medical College and hospital Aurangabad-431005 Maharashtra were studied.

Inclusive Criteria: Anaesthetically fit and willing to undergo surgery.

Exclusion Criteria: Anaesthetically unfit, patient's already undergone cardiac surgery, abnormal platelet count, and abnormal coagulation time patients were excluded from study.

Method: The pre-operative clinical conditions of the patients in terms of ejection fraction (EF), SYNTAX score, co-morbidities (HTN, type-II DM, dyslipidemia and CKD) and perioperative course was noted. Dyslipidemia and chronic kidney disease (CKD) were defined as per ACC and KDIGO criteria⁽⁵⁾. The patients were followed up to 3 months Graft patency and overall outcomes were assessed by two dimensional echocardiography and CT coronary angiography. The size and morphology of coronary arteries were based on conventional coronary angiography. Angiographic grading of diffuse CAD was according to the concept of described by Graham et al⁽⁶⁾.

Surgical techniques – After induction with general anaesthesia and insertion of arterial line and central venous line patient was positioned, prepared and draped. Midline sternotomy was performed predicted LITA was harvested using low energy electro cautery. Saphenous venous graft was also harvested. Pericardium was opened and the standard technique of CABG was carried out with heparinization. When the planned reconstruction of LAD segment was 2 to 4 cm. it was preferred to do it off-pump using suction stabilization device (Magnet ACROBAT- I stabilizer system). In the case of extensive reconstruction (>4cm) of coronary artery, it was done on pump with arterial cannula in the ascending aorta and two venous cannula, inserted through the right atrial appendage.

The myocardial protection was achieved using intermittent aortic cross clamp and fibro-fibrillatory arrest technique with mild hypothermia. The sequence of grafting was first to LAD followed by grafting to other diseased coronary arteries once the arteriotomy was done; the vessel was inspected for the atheromatous plaques. The length of incision was extended depending upon the extent of atheromatous plaques and skip lesions. Intra-operative assessment of the diameter of coronary artery was done using intra-coronary shunts which available in the sizes of 1.0mm, 1.25mm, 1.5mm, 1.75mm and 2mm. the shunt was snugly fitted into coronary artery was taken as the inner diameter of the coronary artery.

The arteriotomy length was measured and LITA or saphenous vein graft was opened accordingly, 8-0 prolene suture used for anastomosis. The suture bites were fashioned in a

manner such that the lateral plaques were exteriorized to anastomosis producing smooth surface for blood flow with decreased chances of turbulence or thrombus formation at the site of anastomosis.

Alternate technique to endarterectomy of LAD was used to graft obtuse marginal (OM) and PDA (proximal anastomosis of saphenous venous graft was done on ascending aorta after a portion of it was excluded after aside biting clamp was applied. Graft de-airing was done after completing each proximal anastomosis. In case of pump surgery, standard decannulation technique was followed after weaning bypass. The used inotropes used were Noradrine and dobutamine. Protamine was started after checking bleeding at anastomotic sites and chest closure was done.

Post-operative course and follow up post-operative parameters like duration of mechanical ventilation and inotropic and intra-aortic balloon pump (TABP) requirements were studied. Post-operative hospital stay morbidity and mortality were noted. For patients with coronary artery, plasty without edarterectomy, intravenous heparin, low dosage aspirin (150mg/day) and clopidogrel (75mg/day) was started in the immediate post-operative period. The intravenous heparin was stopped on fourth post-operative day.

In patients undergoing endarterioectomy, acenocoumarol was started after bridging with intra venous heparin until target international normalised ratio of 2.0 to 2.5 was reached along with aspirin. Acenocoumarol was continued for 3 months, Post-surgery. Follow up was done at 1, 3 and 6 months patients were evaluated with standard 12 lead Electro-gram (ECG) in each visit and 2D echocardiography (Echo) on the 3rd month follow up check coronary angiography was advised whenever there were new onset symptoms. ECG changes or regional wall motions abnormality in the follow up Echo.

Duration of surgery was March 2012 to March 2015

Statistical analysis: Various coronary artery diseases were classified with percentage, post-operative characters variations. Surgically treated patients were compared with medically managed patients with Z test. The statistical analysis was carried out SPSS software. The ratio of male and females were 2:1

Observation and Results

Table-1: Weighting of segments by angiographic appearance 0=Not a risk, >2mm large normal vessel, 1.5 to 2.00 mm is medium, Normal or large with mild disease, 1.0-2.0 mm is moderate disease, 0.5 to 1.00 mm is severe disease, <0.5 mm is very severe disease or totally occluded and poorly visualised or not suitable for revascularisation by CABG.

Table-2: Characters of pre-operative patients

NYHA class presentation

- a) I grade Nil, II-35 patients, III-200, IV=240 patients
- b) Coronary artery disease-
 - 212 (44.1%) LMCA, 82 (17.08%) SVD, 71 (14.7%) DVD, 327 (68%) TVD, 98 (20.4%) recent MI, 340 (70.8%) Diabetes Mellitus, 289 (60.2%) Hypertension, 11 (2.2%) CKD, 83 (17.2%) pre-operative IABP, 52.14 (7.1%) pre-operative EF

Table-3: Post-operative characters 08.11 (± 2.64) was mean duration of ventilators (in hours), 52.4 (± 4.82) was number of transfusion (mean unit), 11 (20%) CVA, 62 (± 12.7) new onset AF, 0.8 (± 0.7) mean duration of hospital stay, 10 (± 2) deaths

Table-4: Comparison between surgically and medically treated patients having coronary artery diffusion.

- Mean Age 60.5 (± 10.4) in surgery, 58.8 (± 8.85) in Medical patients, t test was 2.80, $p < 0.005$.
- Recurrence of symptoms 67 (± 2.5) in surgery 215 (± 5.2), t test -571 and $p < 0.001$
- New ECG changes NIL in surgery and 112 (± 2.4) in medicine patients
- Post treatment MI NIL in surgery, 172 (± 2.8) in medicine patients
- Readmission into hospital NIL in surgery, 82 (± 3.5) in medicine
- Pre-treatment EF mean value 52.12 (± 6.20) in surgery, 47.16 (± 5.12) in medicine and t test 13.5 and $p < 0.001$
- Post-treatment EF 52.10 (± 4.35) in surgery and 43.2 (± 7.34), t test was 14.8 and $p < 0.001$
- Stroke 10 (± 1.5) only in surgery
- Kidney dysfunction 69 (± 2.8) in surgery, 133 (± 4.5) in medicine, t test was 23 and $p < 0.001$
- New onset of arrhythmias 62 (± 2.5) in surgery, 80 (± 3.5) in medicine patients, t test value was 92.9 and $p < 0.001$
- Total number of deaths 10 (2%) in surgery and 75 ($\pm 15\%$) in medicine patients, t test was -57.3 and $p < 0.001$

Discussion

Present study of surgical management of diffuse CAD patients of Maharashtra as per the New York heart association the diffused CAD were classified II grade were 35, III grade 200 and IV grade were 240 patients, 212 (44.1%) had LMVA, 82 (17.08%) had SVD, 71 (14.7%) had DVD, 327 (68.1%) had TVD, Recant 98 (20.4%) MI, 340 (70.8%) DM, 289 (60.2%) HTN, 11 (2.2%) had CKD, 83 (17.2%) had IABP, 52.1 (7.1%) had pre-operative EF (Table-2). Mean duration on ventilator was 08.45 (± 2.04) hours, post-operative EF 52.4 (± 4.82) Number of transfusion (mean units), 2.75 (± 1.22), 11 (2.2%) CVA, New onset of AF 62 (12.9%), Hospital stay 08 (± 0.7) days, 10 (2%) deaths (Table-3), The surgically treated and medicinally treated were compared and surgically treated had better outcomes (Table-4). These findings are more or less in agreement with previous studies⁽⁸⁾⁽⁹⁾⁽¹⁰⁾.

The choice of surgical method depends on nature of coronary artery and multi segment plaque and healthy area intervals simplify complete revascularisation on the other hand, a more aggressive, treatment modality should be preferred when no soft site can be identified for arteriotomy or there is an extensively decreased area that is not amenable for grafting. The less invasive technique are “don't touch the plaque” techniques (jumping multi-bypass sequential bypass, hybrid interventions). In simple forms a limited long-segment anastomosis of conduits eliminates the occlusion of the limited atherosclerotic plaque where whole lesion is opened and cross covered by the graft⁽¹¹⁾.

In general severity and distribution of coronary atherosclerosis tend to increase with time but rate of increase is highly variable and difficult to predict under such scenario surgery is not advisable and managed with medicines only.

Summary and Conclusion

Present surgical management of diffused CAD can undergo CABG with long segment coronary artery reconstruction with acceptable morbidity and mortality. Similar to conventional CABG surgically managed patients also have a better outcome when compared medically treated patients with diffuse CAD. This study demands such surgical management in large number of patients with diffuse CAD patients to confirm, validate the present study.

Limitation of Study – Owing to tertiary location research centre, small number of patients and lack of latest techniques we have limited findings and results.

- This research paper was approved by Ethical committee of MGM Medical college and hospital Aurangabad-431005, Maharashtra
- No Conflict of Interest
- No Funding

Table – 1
Weighting as segments by angiographic appearance

Grade	Description
0	Not a risk
1	> 2mm : large Normal vessel
2	1.5-2.0 mm Medium, Normal or large with Mild disease
3	1.0-1.5 Moderate disease
4	0.5-1.0 severe disease
5	<0.5 mm very sever disease or totally occluded and poorly visualised or not suitable for revascularisation by CABG

Table – 2
Pre-operative patient's characteristics NYHA (New York Heart Association) class on presentation

Particulars	No. of Patients
I	Nil
II	35
III	200
IV	240

Coronary	Artery Disease
LMVA	212 (44.16%)
SVD	82 (17.08%)
DVD	71 (14.7%)
TVD	327 (68.1%)
Recent MI	98 (20.4%)
Diabetes Mellitus	340 (70.8%)
Hyper tension	289 (60.2%)
CKD	11 (2.2%)
Prior CVA	Nil
Pre-operative IABP	83 (17.2%)
Pre-operative EF	52.14 (7.19)

DVD = Double vessel Disease

DVA = Cerebra-vascular Accident

CKD = Chronic Kidney Disease

EF = Ejection Fraction

IABP = Intra aortic Balloon pump

LMCA = Left Main coronary Artery

MI = Myocardial Infarction

SVD = Single vessel Disease

TVD = Triple Vessel Disease

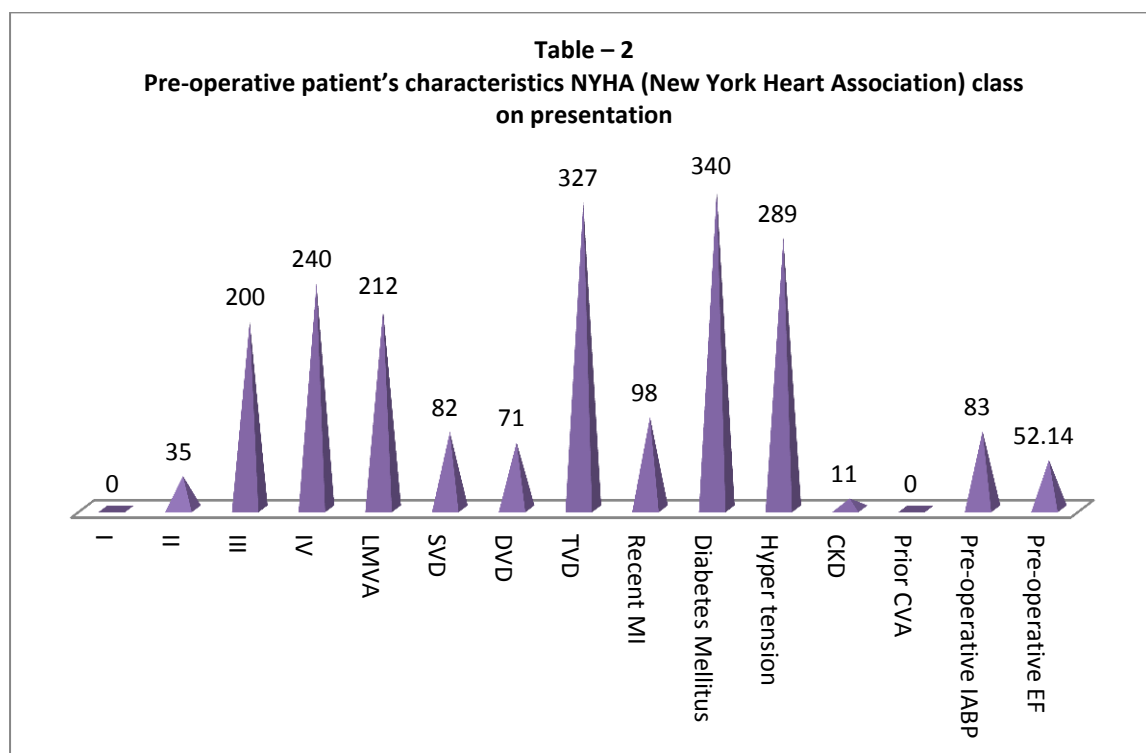


Table – 3
Post-operative Characters

Variation	Values
Mean duration (in hours)	08.11 (\pm 2.04)
Post-operative EF	52.45 (\pm 4.82)
Number of transfusion (Mean units)	2.75 (\pm 1.22)
Peri-operative MI	NIL
Post-operative MI	NIL
CVA	11 (\pm 2.2%)
New onset AI	62 (\pm 12.9%)
AKI	NIL
Requirement of dialysis	NIL
Hospital stay (Mean number of days)	0.8 (\pm 0.7%)
Deaths	10 (\pm 2%)
Re-exploration	NIL
Sterna wound infection	NIL

AF = Arterial Fibrillation

CVA = Cerebra vascular accident

MI = Myocardial infarction

AKI = Acute kidney injury,

EF = Ejection Fraction

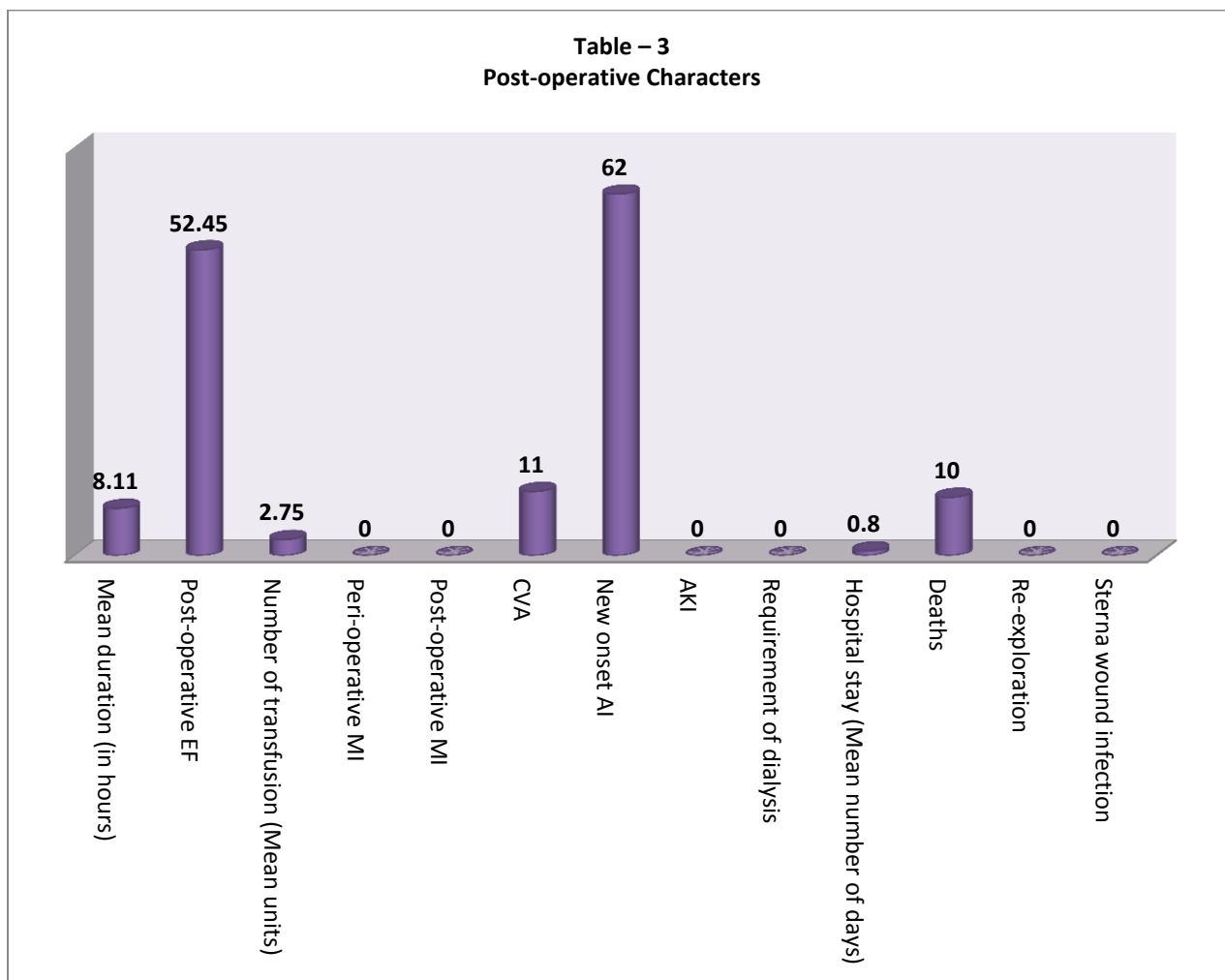
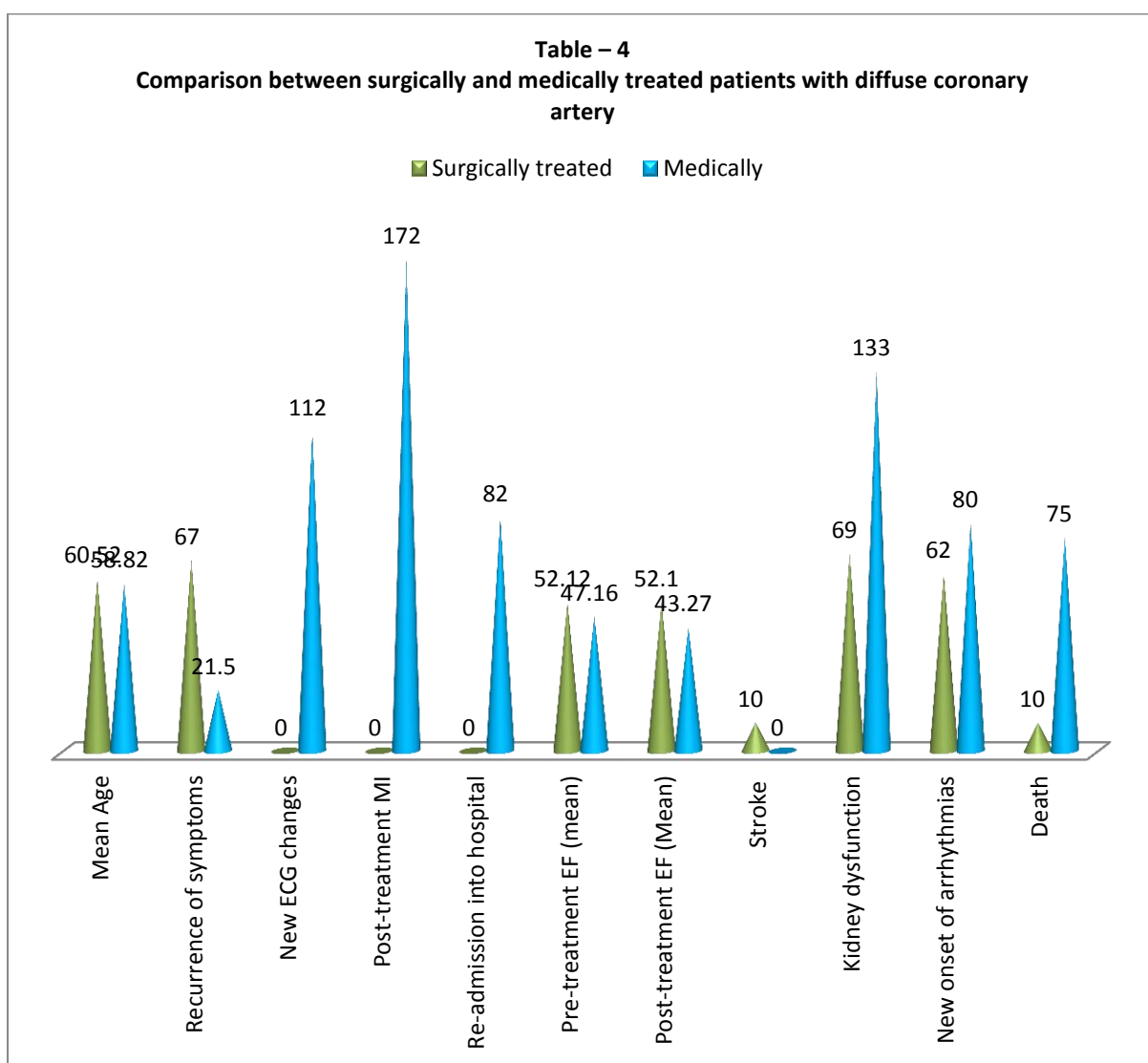


Table – 4
Comparison between surgically and medically treated patients with diffuse coronary artery

Variable	Surgically treated (480 patients)	Medically (500 patients)	t test	p value
Mean Age	60.52 (± 10.04)	58.82 (±8.85)	2.80	P<0.005
Recurrence of symptoms (chest discomfort)	67 (±2.5)	21.5(±5.2)	-57	P<0.001
New ECG changes	NIL	112 (±2.4)		
Post-treatment MI	MIL	172 (±2.8)		
Re-admission into hospital	NIL	82 (±3.5)		
Pre-treatment EF (mean)	52.12 (±6.20)	47.16 (±5.12)	13.5	P<0.00
Post-treatment EF	52.10	43.27	14.8	P<0.001

(Mean)	(±4.33)	(±7.34		
Stroke	10 (±1.5)	-	-	-
Kidney dysfunction	69 (±2.8)	133 (±4.5)	23	P<0.001
New onset of arrhythmias	62 (±2.5)	80 (±3.5)	92.9	P<0.001
Death	10 (±2)	75 (±15)	-573	P<0.001



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