CLINICAL PROFILE AND ANGIOGRAPHIC CHARACTERISTICS OF PATIENTS WITHCORONARY ARTERY BIFURCATION LESIONS

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In partial fulfillment of the requirements for the award of the degree of

D.M. BRANCH II - CARDIOLOGY

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CHENNAI, INDIA
AUGUST 2014

CERTIFICATE

This is to certify that the dissertation titled "**CLINICAL PROFILE AND ANGIOGRAPHIC CHARACTERISTICS OF PATIENTS WITH CORONARY ARTERY BIFURCATION LESIONS"** is the bonafide original work of Dr**. V. NARENDRA KUMAR**,in partial fulfillment of the requirements for D.M. Branch-II (CARDIOLOGY) examination of THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY to be held in August 2014.The period of study was from December 2013 to February 2014.

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DECLARATION

I, **Dr.V.NARENDRA KUMAR**, solemnly declare that this dissertation entitled, "**CLINICAL PROFILE AND ANGIOGRAPHIC CHARACTERISTICS OF PATIENTS WITH CORONARY ARTERY BIFURCATION LESIONS**" is a bonafide work done by me at the department of Cardiology, Madras Medical College and Government General Hospital during the period 2011 – 2014 under the guidance and supervision of the Professor and Head of the department of Cardiology of Madras Medical College and Government General Hospital, Professor M.S.RAVI M.D.D.M. This dissertation is submitted to The Tamil Nadu Dr.M.G.RMedical University, towards partial fulfillment of requirement for the award of **D.M. Degree (Branch-II) in Cardiology**.

Place: **SIGNATURE OF THE CANDIDATE**

Date:

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INTRODUCTION

Bifurcation coronary lesions constitute 15 – 20 % of total coronary lesions.Bifurcation lesions have diverse clinical presentation, ECG features and angiographic characteristics which are very important in invasive management either by percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) inthese subset of patients[1,3].

Bifurcation lesions involving left main may be silent with an unpredictable presentation, which gives a challenge in terms of both the diagnosis and management. Multivessel coronary artery disease in patients with bifurcation lesions depends on presence of left main coronary artery disease and associated traditional coronary risk factors for atherosclerosis[3]. With left main coronary involvement, it is seen in about 80% of patients. The comprehension of bifurcation lesions relies on the fact that the success rate of percutaneous coronary intervention results are suboptimal due to higher incidence of restenosis and side branch occlusion.

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BIFURCATION LESIONS

EUROPEAN BIFURCATION CLUB[5] hasdefined coronary artery bifurcation lesion as follows:

Coronaryarterynarrowing involving adjacent to and or involving the origin of a significant side branch.

True bifurcation lesion should have significant ostial involvement of a side branch with or without involvement of main vessel[2].

Significant side branch means a branch that shouldn't get occluded in the global purview,while treating a particular patient.

- Size **> 2.5 mm**
- Origin and area supplied
- Percentage of muscle supplied and global LV function
- Responsible for ischemic symptoms

The clinical significance of coronary bifurcation lesion relies in the presence of a side branch[8]. These branches gain importance in the development of atheroma owing to altered hemodynamics and also remains a predictive factor for peri procedural myocardial infarction when percutaneous coronary intervention is performed.

The normal flow in coronary artery bifurcations is pulsatile with antegrade flow during diastole and retrograde during systole with a nonlinear parabolic transverse speed profile[6]. The flow is linear and rapid in carinaie.,at bifurcation points and slow , turbulent along the walls opposite to carina.

Endothelial shear stress[7] is the tangential force on the endothelial surface from the friction of flowing blood .pulsatile laminar flow in straight segments produces high endothelial shear stress in geometrically irregular stress areas as in bifurcations it produces low / oscillatory endothelial shear stress , lateral wall at bifurcations.

Low endothelial shear stress is sensed by endothelial mechanoreceptors which inturn triggers intracellular pathways and activates transcription factor, which finally induces pro-atherogenic gene expression. Carina has high endothelial shear stress and henceforth non atherogenic , but develops atherosclerosis through circumferential progression.

The clinical significance of a side branch depends on its diameter which in turn strongly correlated with its flow and muscular mass that it supplies a particular territory..

There is a negative correlation between endothelial shear stress and intimal thickness.

The major stimulus for atherosclerosis is low endothelial shear stress, which leads to plaque of high risk morphology.

Atherosclerosis [7] occurs mainly in the region of coronary bifurcations with carinal involvement is extremely unusal. Hence occlusion of a side branch ostium while stenting main vessel is due to carinal shift rather than due to plaque shifting or snow- plough phenomenon.

The diameter of a side branch, main branch and of proximal segment of main branch are interdependent as per Murray's law.

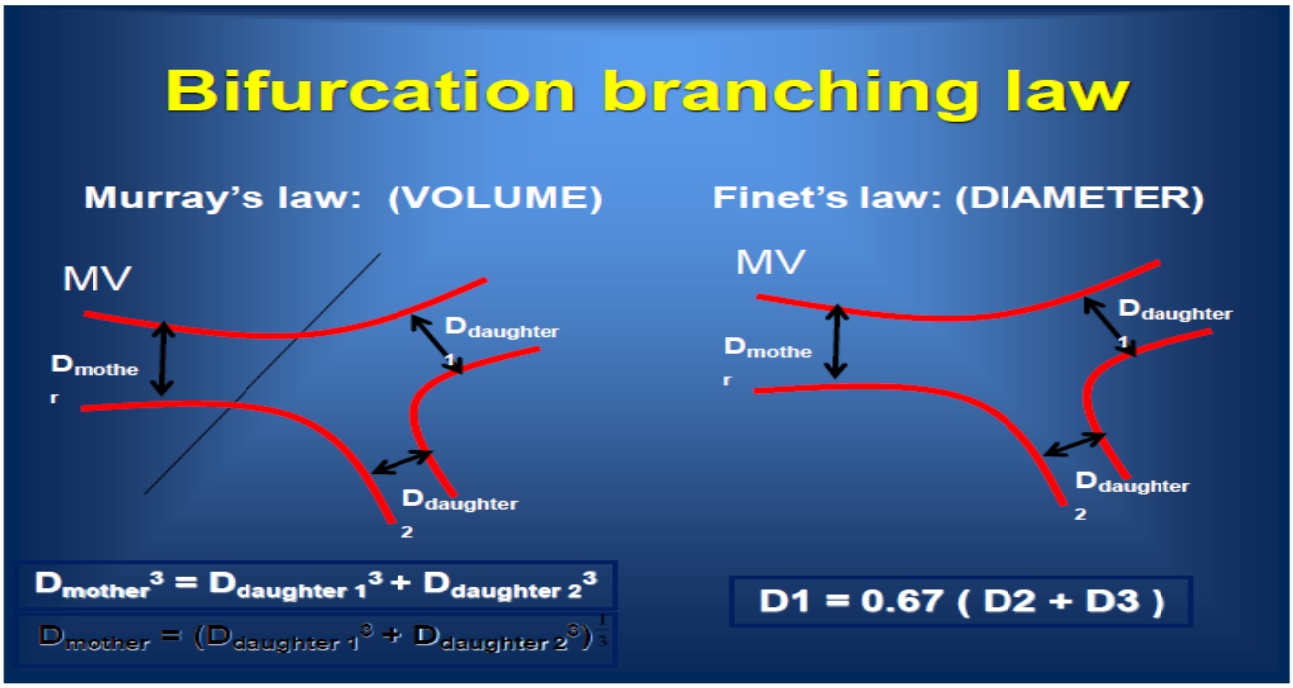
Percutaneous coronary intervention in coronary bifurcation lesions was associated with lower procedural success rate, higher incidence of complications and higher restenosis rate compared to non bifurcationlesions. The use of drug eluting stents resulted in reduced restenosis rate though hasn't eliminated completely.

FUNDAMENTAL ASPECTS

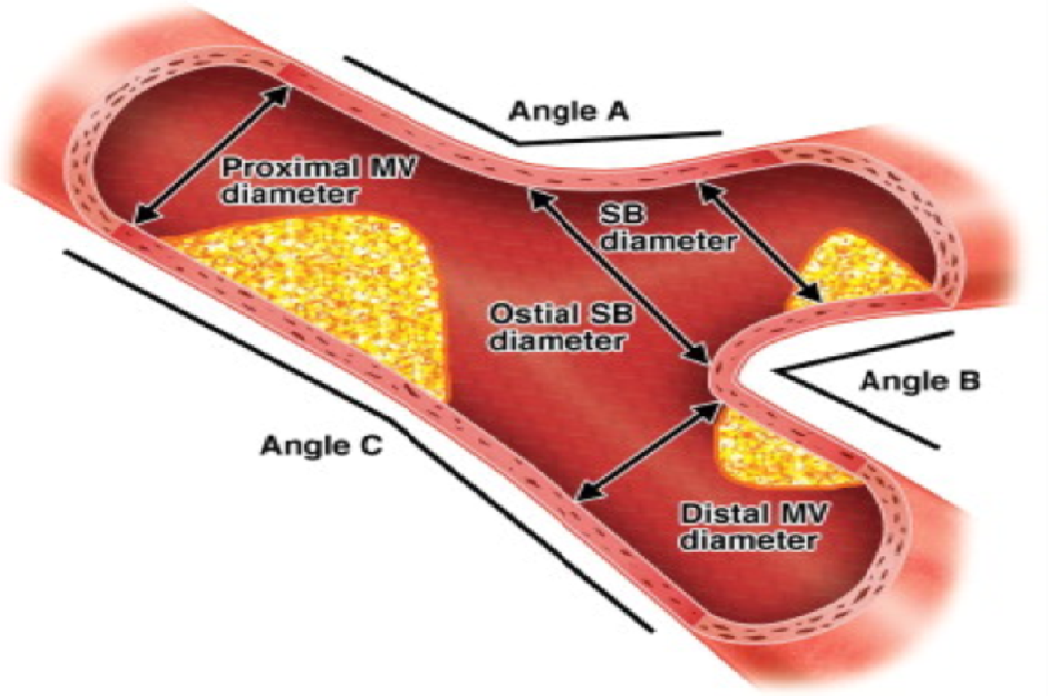
The relationship between vessel diameter in a given coronary artery and flow in its segments, between vessel diameter in a given segment and flow in all segments and vascular volume of its distribution area is always linear [10]. This linear relationship between vessel diameter and muscle mass suppliedby it defines the infarction index for each side branch. Thus the diameter and length of a vessel can be used to determine its physiological, pathological, clinical significance and to identify the main vessel and its side branch.

The diameter of a proximal and both distal segments are defined by **Murray's law** and furthersimplified by **Finet** and colleagues by using IVUS

PROXIMAL MAIN VESSEL = DISTAL MAIN VESSEL + SIDE BRANCH x 0.67



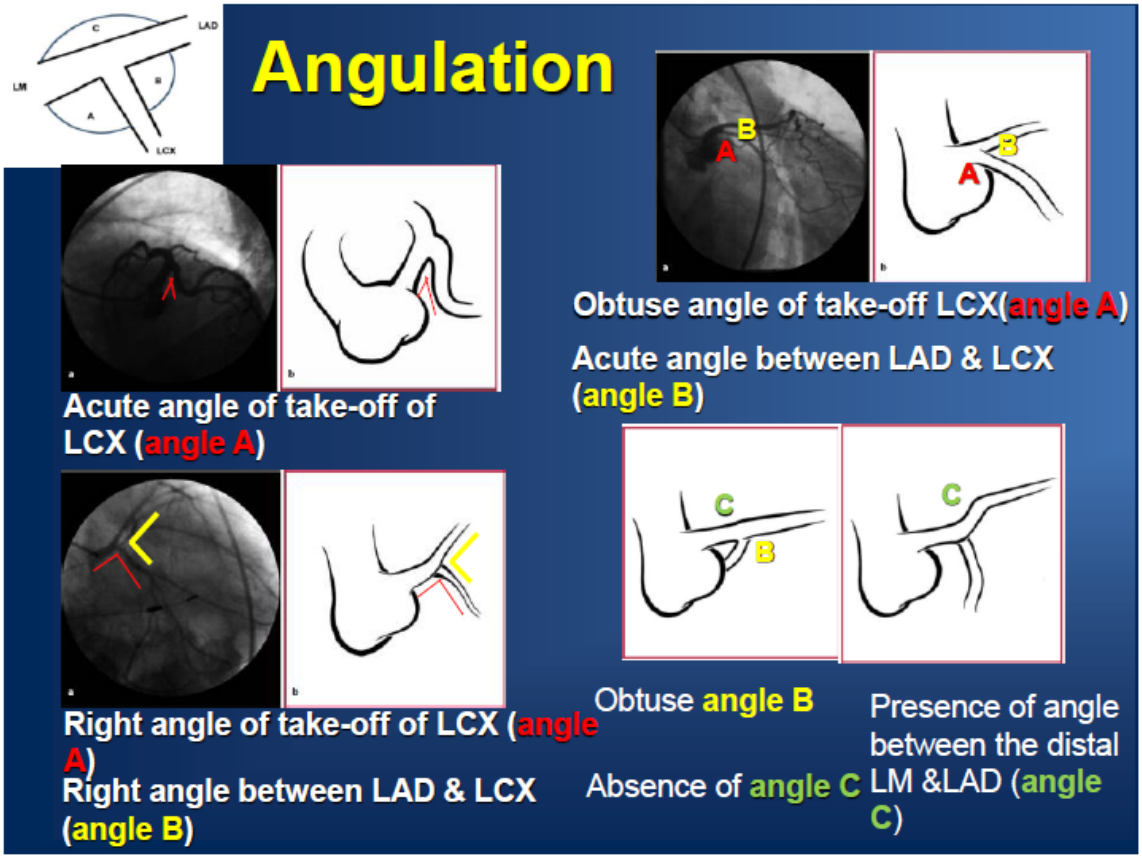
Bifurcation lesion comprises three segments[12]



Since the coronary artery tapers towards distal end, hence the diameter is constant between two bifurcations

Conventional quantitative coronary angiography usually underestimates the reference diameter of the proximal main segment and overestimates the distal segment reference diameter.

ANATOMY OF THE BIFURCATION ANGLE



Angle A – Angle between proximal main vessel and side branch

Measures the difficulty in assessing the Side Branch

Angle B – Angle between distal main vessel and side branch

Acuteness increases the risk of carina displacement,

Side Branch occlusion after stent, Wire deliverability

and Carinalshift.

The most important angle is angle B,also known as **Bifurcation angle**. [9]

DEGREE OF SB ANGULATION

Y ANGULATION

- <70%
- Less difficulty in accessing side branch
- More chance of plaque shift
- Difficulty in deploying stent at ostium

T ANGULATION

- >70%
- Access to SB more difficult
- Minimal plaque shifting
- Stent placement in ostium more straight

CLASSIFICATION OF BIFURCATION LESION[10]

BASED ON BIFURCATION PLAQUE DISTRIBUTION

- Duke classification
- Medina classification
- Movahed classification

CLASSIFICATION OF BIFURCATION LESIONS

- **Dukes University Classification**
- **Sanborn Classification**
- **Safian Classification**

- **Lefevre Classification**
- **Syntax Study Classification**
- **Medina Classification**
- **Mohaved classification**

DUKE CLASSIFICATION

Type A:
Prebranch stenosis not involving the ostium of the side branch

Type B:
Postbranch stenosis of the parent vessel not involving the ostium of the side branch

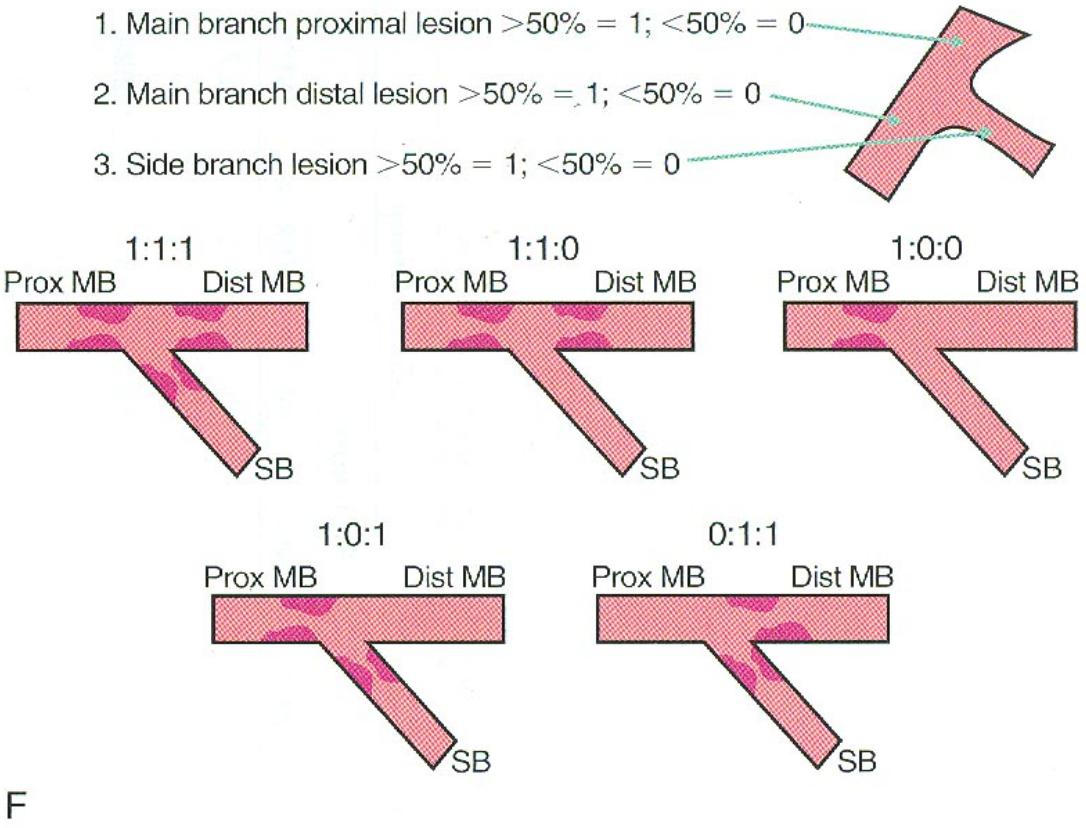
Type C:
Stenosis of the parent vessel not involving the ostium of the side branch

Type D (most common; 40%):
Stenosis involving the parent vessel and the ostium of the side branch. Inverted "Y" pattern.

Type E:
Postbranch stenosis of the parent vessel not involving the ostium of the side branch

Type F:
Stenosis of the parent vessel not involving the ostium of the side branch

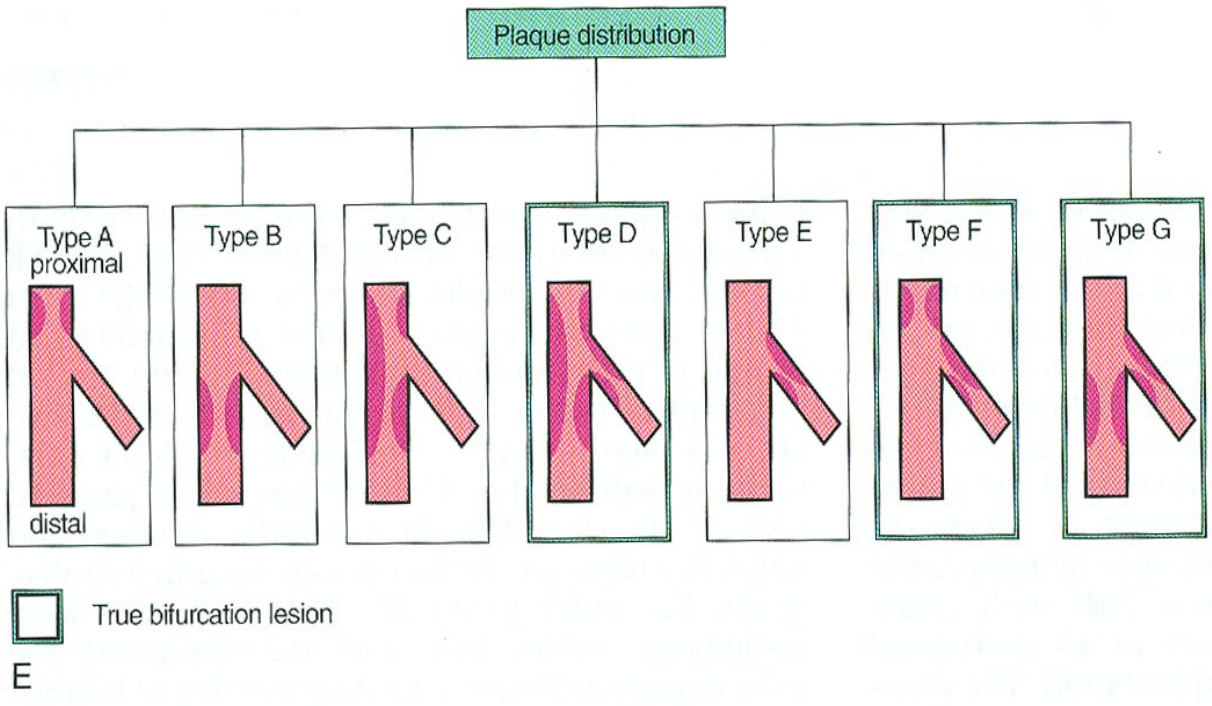
MEDINA CLASSIFICATION[15] **1**



F

The medina classification was used in our study

Syntax Study Classification[10]



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AIMSANDOBJECTIVES

- To study the risk factors, mode of presentation in patients with bifurcation lesions
- To study the clinical profile in patients with bifurcation lesions.
- To study the angiographic characteristics of patients with bifurcation lesions
- To study the pattern of involvement and hospital outcome in patients presenting with bifurcation lesions.

REVIEW OF LITERATURE

Coronary bifurcation lesions are the most challenging lesions in interventional cardiology[16] with higher incidence of complications. Despite the wide spread use of drug eluting stents, higher rates of restenosishas been reported while treating the bifurcation lesions.

The American College of Cardiology (ACC)/ American Heart Association (AHA) has classified bifurcation lesions into type B and C lesions.

Currently, there are six major coronary arterybifurcation lesionclassifications published intheliterature[10]. Of these, four classifications werepublished in the era ofbare metalstents. These are verysimilar in describing a given coronary bifurcation lesion.They failed to describe the important features of abifurcation lesion such asproximal segment and bifurcation angle.

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Two other bifurcation classifications were published in order to improve some of thelimitations of the previous classifications which include medina and syntax classification.

Theydivided bifurcation lesionsinto three segments[15]:

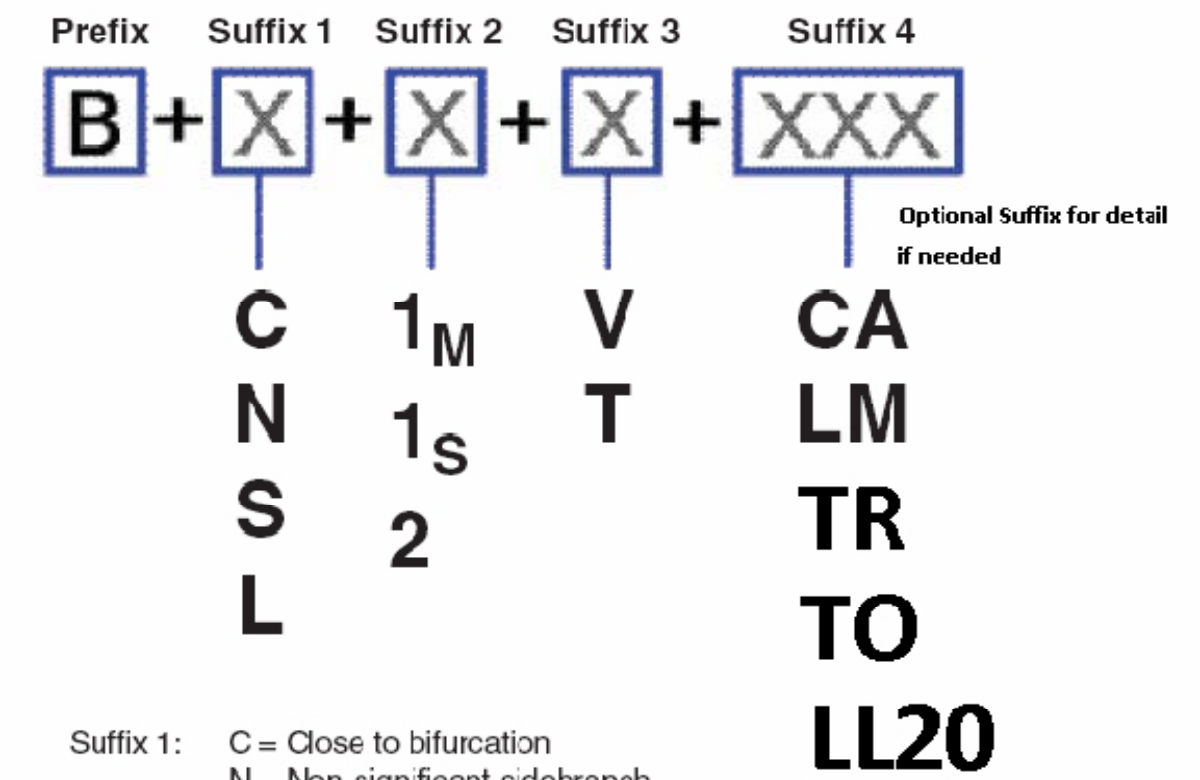
1. Proximal segment ofthe main branch,
2. Side branch ostium, and
3. Distalsegment of the main branch.

Anyinvolvementof coronary artery segment is assigned as suffix 1, suffix 0 was givenfor not involved segment. Forexample, lesion 1,0,1 means that proximal segment and distal part of the main branch hasdisease but side branch ostia are free of disease. Medina classification also fails to include two important features of bifurcation lesions: angulation and the size of the proximal healthy segment.

True bifurcation lesion always indicate significant lesion of ostium of a side branch with either a proximal or distal main vessel involvement orboth.

The only classification which gives about detailed description of a bifurcationlesion is Mohaved classification[14] which addresses both proximal main segment and bifurcation angle.

MOHAVED CLASSIFICATION



Suffix 1: C = Close to bifurcation
N = Non-significant sidebranch
S = Small proximal segment
L = Large proximal segment

Suffix 2: 1_M = Only main branch ostium diseased
1_S = Only sidebranch ostium diseased
2 = Both main and sidebranch ostia diseased

Suffix 3: V = Angle between branch vessels less than 70 degrees
T = Angle between branch vessels more than 70 degrees

Suffix 4: CA = Calcified
LM = Left main involved in bifurcation
TR = Thrombus Containing
TO = Total Occlusion
LL20 = Lesion length of the main branch less than 20

Thus the importance knowing the proximal segment in bifurcation lesions relies on the fact that proximal segment should be at least two thirds the diameter ofbranching vessels inorder to accommodate two stents as in kissing stent strategy.

The bifurcation angles are important because abrupt side branch closure[11] occurs in lesions having steep angles. Also steep angled lesions pose challenge in stentdeployment compared to less angulated lesions. Less angulated lesions will have plaque shift and problems in stent deployment at ostium.

The proper understanding of the morphology of a coronary bifurcation lesions during angiogram relies on the fact that further percutaneous intervention can be planned accordingly and also anticipate complications and prognosis, while addressing these lesions.

In BMC cardiovascular journal 2013, the side branch stenting can be done only when significant ostial disease had been encountered. Percutaneous coronary intervention of a non-significant side branch results in higher incidence of major adverse cardiac invents in immediate post-operative period if side branch gets occluded.

Hence percutaneous coronary intervention done only in patients with significant side branch as well as large proximal segment in order to accommodate two stents in proximal vessel.

The general algorithmic approach[16] to the treatment of coronary bifurcation lesions was quoted in Expert Review Cardiovascular therapy 2008, which states that always assess that patient has true bifurcation lesion or not. True bifurcation lesion signifies that there is always significant ostial disease of a large side branch. When there is a gap between main vessel and side branch, it signifies not a true bifurcation lesion. In such lesions, only main branch stenting will suffice to treat the patient.

If the patient has a true bifurcation lesion[17], then the assessment should be bifurcation angle, which is between distal main vessel and side branch. If the bifurcation angle is than 70 degrees i.e Y angulation, either a Crush or Culotte technique is preferred. If it is T angulated i.e> 70 degrees, then a provisional T stenting or Reverse T stenting can be employed.

Thus the most important aspect in treating coronary bifurcation lesion is to know the diameter of proximal vessel, involvement of ostium of side branch and angle between distal vessel and side branch.

Journal of coronary intervention discussed one stent vs two stent deployment. In most of the patients, the simplest approach could be deployment of one stent and which gives fairly good results in majority of patients.

American journal of cardiology 2006[20], also discussed single vs double stent approach while treating patients with bifurcation lesions. It was found that single stent approach had fairly good results in terms of 6 month follow up using target vessel revascularisation and major adverse cardiac events. It also suggests while treating coronary bifurcation lesions, drug eluting stents are better than bare metal stents.

In circulation 2006[23], Nordic I trial suggests provisional T stenting was as good as regular side branch stenting. Nordic II trial suggests culotte technique fairly gives better results when compared to crush technique.

Mustafa kurt et al 2013, published an article regarding morphological assessment of bifurcation lesions[25]. Among 542 stable patients underwent coronary angiogram, bifurcation lesions found in 19.3% of patients. Medina classification was used to define morphology of bifurcation lesions. Left Anterior descending coronary artery was involved in 56% cases and Medina 1,1,1 was the predominant involvement. Higher incidence of bifurcation lesions was noted in patients with diabetes mellitus.

MATERIALS AND METHODS

The study was conducted in the department of cardiology, Rajiv Gandhi Government General Hospital. This is a prospective observational study.

STUDY GROUP SELECTION

Institutional ethical committee clearance was obtained to conduct our study. All the patients participating in our study were provided with informed written consent in their own vernacular language and explanation of procedure done in detail.

INCLUSION CRITERIA

All the patients undergoing coronary angiogram either electiveor following acute coronary syndrome.

EXCLUSION CRITERIA

- Not willing for angiogram,
- Hypersensitivity to radio contrast agent,
- Chronic Renal Disease,
- Valvular heart disease, Cardiomyopathy, Congenital Heart Disease

All the patients were evaluated before taking for angiogram which includes complete blood count, blood group and typing, urea, creatinine, serum lipid, electrolytes, chest X-Ray, electrocardiogram, echocardiogram using PHILIPS HD 7.

Coronary angiogram was performed in our cath lab by consultant cardiologists using TOSHIBA infinix machine.Quantitative Coronary Angiography (QCA) was performed to evaluate lesion diameter stenosis and bifurcation angles were calculated. Those patients having coronary bifurcation lesions were segregated and included in our study.

Patients showing bifurcation lesions were classified based on medina scoring system and bifurcation angles were noted.

All the patients found to have significant bifurcation lesions were analyzed based on following parameters which include

Age

Sex

Mode of presentation

Risk factors

Clinical features

Blood investigations

Electrocardiogram

X ray Chest

Transthoracic Echocardiogram

Coronary angiographic characteristics

In hospital outcome

The detailed history of all the patients were recorded. The patients undergoing angiogram had three modes presentation which include chronic stable angina, unstable angina / non ST elevation myocardial infarction,ST elevation myocardial infarction.

Patients presenting with chronic stable angina were analysed for nature, character and frequency of angina, functional assessment with NYHA, Canadian Cardiovascular Society grade for angina severity.

Patients presenting with acute coronary syndrome were analysed by TIMI risk score, Killip's score, cardiac biomarkers, presence of

complications including arrhythmias, heart failure, cardiogenic shock, mechanical complications and sudden cardiac death.

The study population were analysed for risk factors for coronary artery disease which includes

Smoking – duration, no. of packs per day, reformed smoker

Hypertension – duration, drugs, compliance, complications

Diabetes – Type I / II, duration of OHA, insulin, HbA1C, compliance, complications

Dyslipidemia – duration, serum lipid levels, on drugs

Family history premature coronary heart disease, sudden cardiac death

Personal history includes alcohol intake, occupation were recorded.

Detailed clinical examination was conducted in all the patients undergoing coronary angiogram which include general examination, recording pulse, blood pressure, cardiovascular examination.

All the patients underwent complete blood count, blood grouping, renal function test, serum lipid, serum electrolytes, coagulation

profile and cardiac biomarkers for those who had acute coronary syndrome.

Electrocardiogram was done for all study patients and analysed for localization of lesion.

X ray chest PA view was taken for stable patients only.

Echocardiogram was done for all patients using PHILIPS HD 7 echo machine. Left ventricular systolic function was assessed in all patients using modified Simpson's method. Normal left ventricular function if ejection fraction greater than 55%.

Left ventricular dysfunction was categorized as mild if ejection fraction 46- 55%, moderate 30-45% and severe if ejection fraction less than 30%.

Other Echo parameters include Left ventricular diastolic function, chamber dimensions, valve regurgitation, presence of thrombus, right ventricular function, presence of pulmonary hypertension, imaging of proximal coronary arteries if feasible.

The coronary angiograms were analysed in study population which include femoral or radial approach and pressure data (aortic and femoral).

Minimal views were taken in patients with suspected left main coronary artery disease. The angiographic views were analysed in detail.

The morphology of coronary lesions were analysed based on ACC/AHA classification of lesions. The bifurcation coronary lesions come under Type B and C lesions.

Diameter and length of left main coronary artery, number of lesions in each coronary segment based on syntax score, percentage of diameter stenosis using quantitative coronary angiogram, location of lesions which include ostial, proximal, mid segment , distal segment, presence of calcification.

Patients showing bifurcation lesions were analysed in detail using Medina's classification.

The angle between the distal bifurcation vessel and side branch vessel is defined asBifurcation angle and was noted in all the patients.

Distal coronary flow was assessed using TIMI grade and Myocardial blush score..

Presence of left or right dominant coronary circulation was noted.

Based on presence of lesions in Left anterior descending, Left circumflex, Right coronary arteries, patients were categorized into single, double, triple vessel disease with or without left main disease.

All the patients who underwent coronary angiogram were monitored for procedural complications which include pressure damping, arrhythmias, pulmonary edema, new onset angina and ECG changes.

Post procedure complications like vascular site lesions, angina, ECG changes, shock, arrhythmias, heart failure if any were observed.

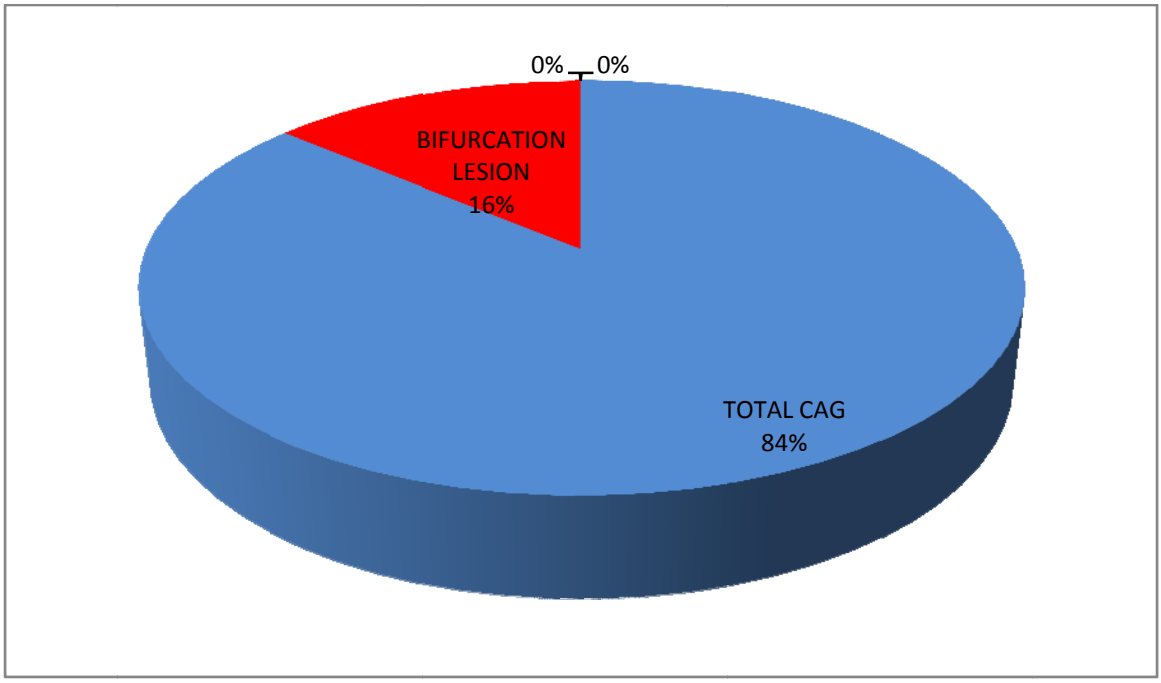
The study subset of patients were followed up in detail during their hospital stay for any development of complications which include acute coronary syndrome, access site, heart failure, cardiogenic shock, arrhythmias and death..

Based on angiographic analysis, patients were given treatment options including guideline directed medical management and invasive approach either percutaneous coronary intervention / coronary artery bypass surgery.

OBSERVATION AND RESULTS

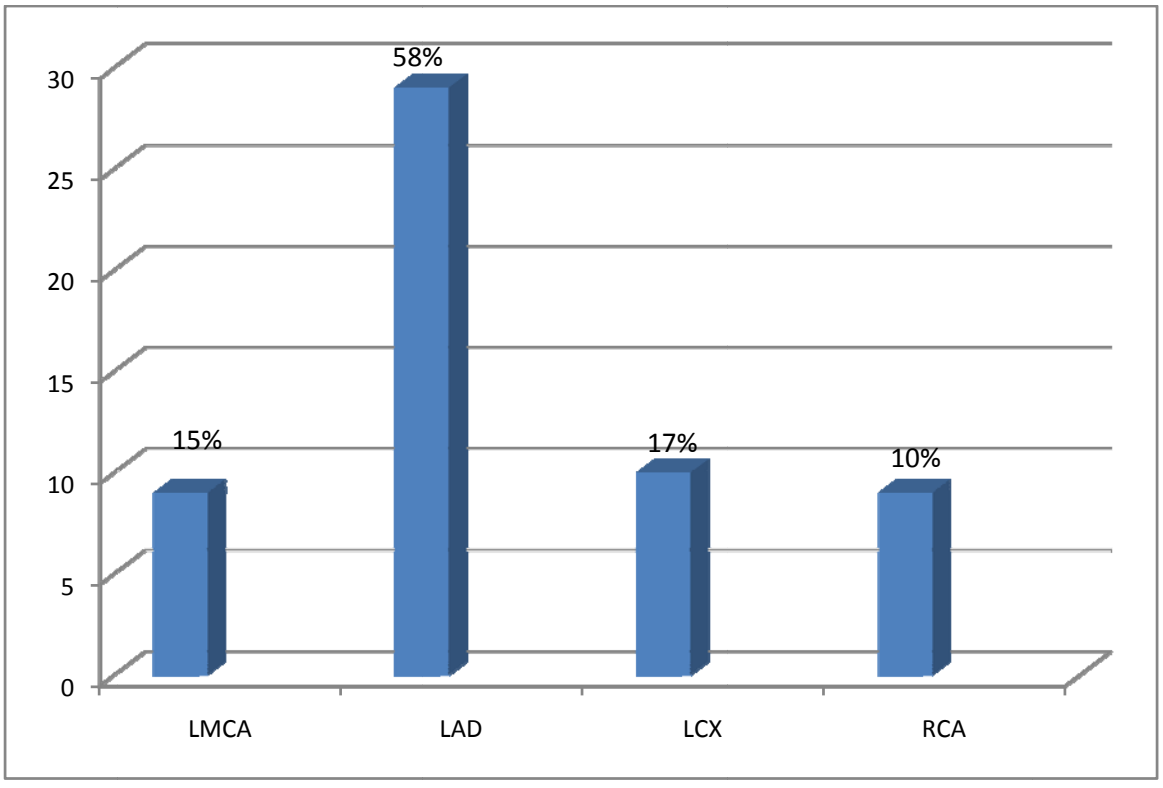
In our study, we analysed about 300 coronary angiograms during the study period. It showed 48 cases with coronary artery bifurcation lesions. This had constituted about 16% incidence of bifurcation lesions in the study population who undergone coronary angiogram.

FIGURE I – DISTRIBUTION OF BIFURCATION LESIONS



Among 48 cases showing bifurcation lesions, Left Anterior Descending artery (LAD) involved in 29 cases which constitutes about 58%, Left Main coronary artery (LMCA) involved in 9 cases (15%), Left Circumflex (LCX) in 10 cases (17%) and Right coronary artery (RCA)in 5 cases (10%) respectively. There was significant overlap of lesions in many patients.

FIGURE 2: DISTRIBUTION AMONG CORONARY ARTERY



Mean age of patients presenting with coronary bifurcation lesions was 55.4 years

Among 48 cases showing bifurcation lesions, 21 number of patients aged above 60 years of age and constitutes about 44%

Number of patients between 50-60 years - 10 (21%)

Number of patients between 40 to 50 years - 12 (25%)

Number of patients below 40 years of age - 5 (10%)

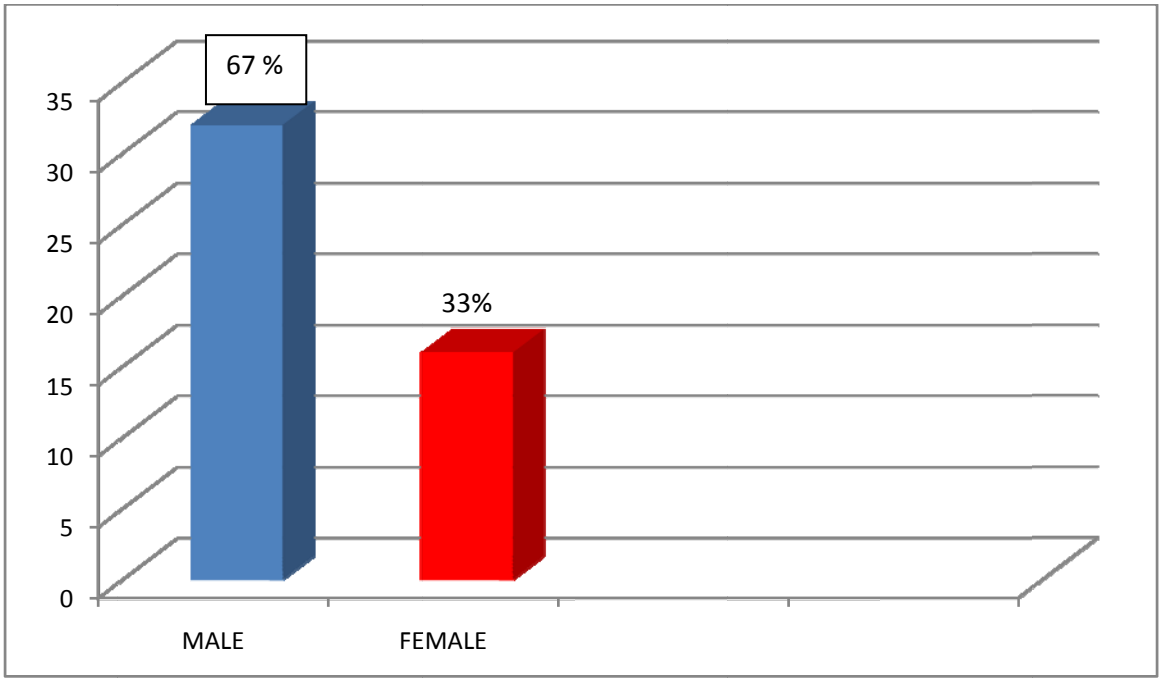
TABLE I:

AG> 60 YEARS	21 (44%)
50- 60 YEARS	10 (21%)
40- 50 YEARS	12 (25%)
< 40 YEARS	5 (10%)
TOTAL	48 (100%)
MEAN AGE	**55.4 YEARS**

Among 48 cases, males constitute 32 cases (67%) and

females being 16 cases (33%). Males are the predominant subset in terms of gender.

FIGURE 3: GENDER



Among the 32 male patients showing bifurcation lesions,

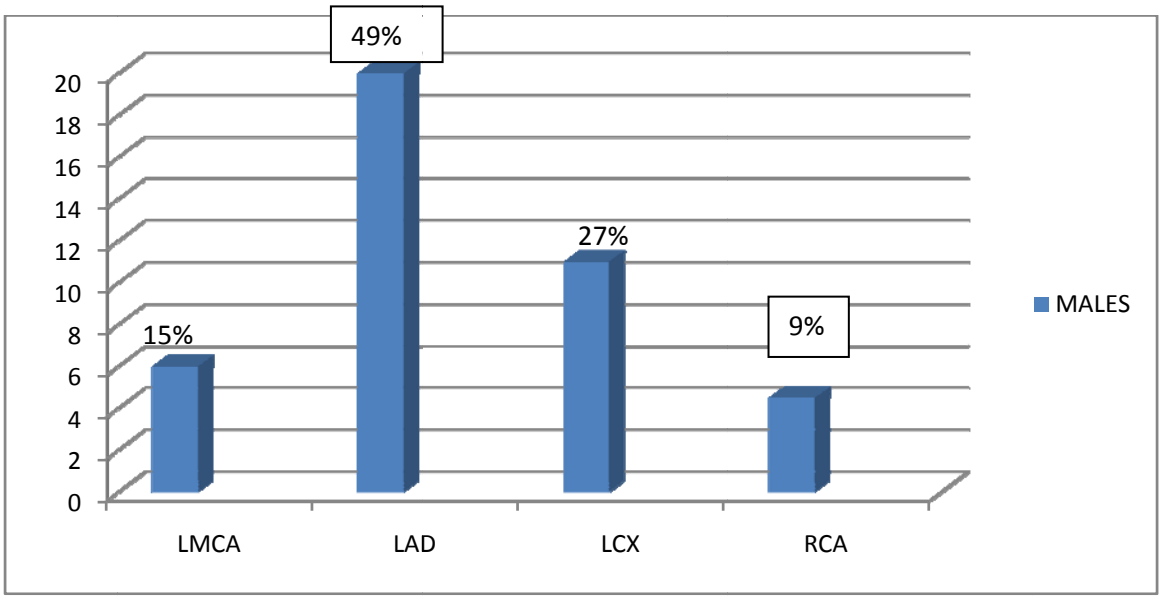
LAD was involved in 20 cases and constitutes about 49%.

LMCA involved in 6 cases (15%)

LCX in 11 cases (27%)

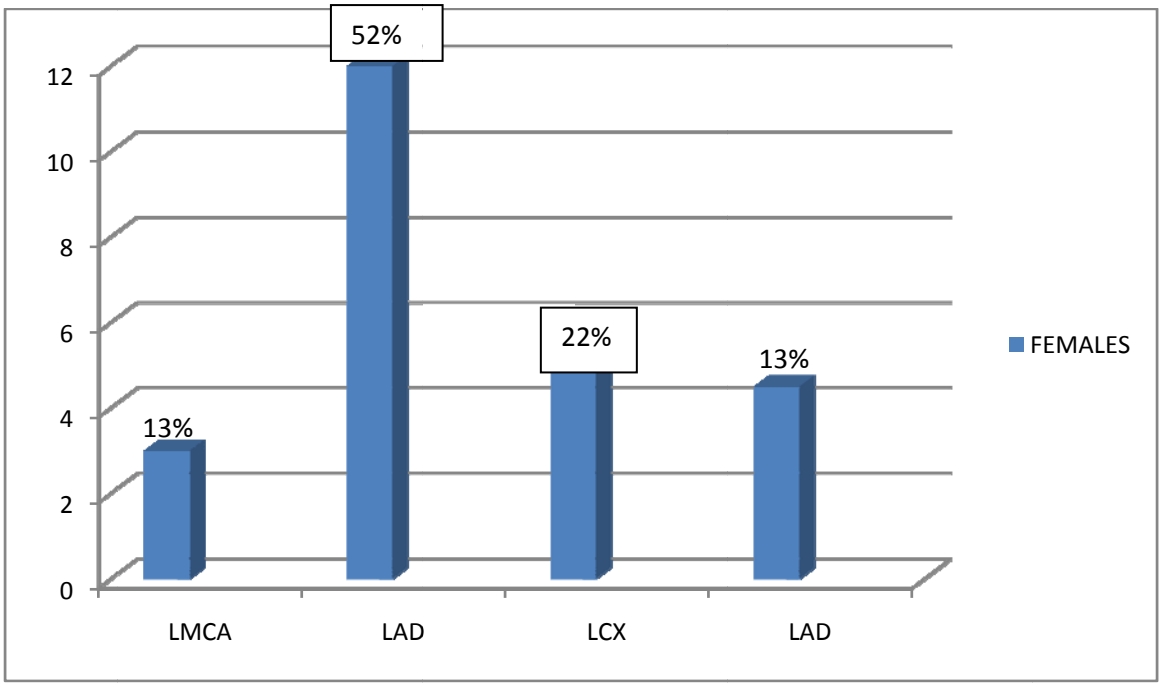
RCA involved in 4 cases and constitutes 9% respectively.

FIGURE 4: DISTRIBUTION IN MALES



Among the 16 female patients with bifurcation lesions,LAD was involved in 12 cases and constitutes 52%. LMCA was involved in 3 cases(13%), LCX in 5 cases (22%), RCA involved in 3 cases and constitutes 13% respectively.

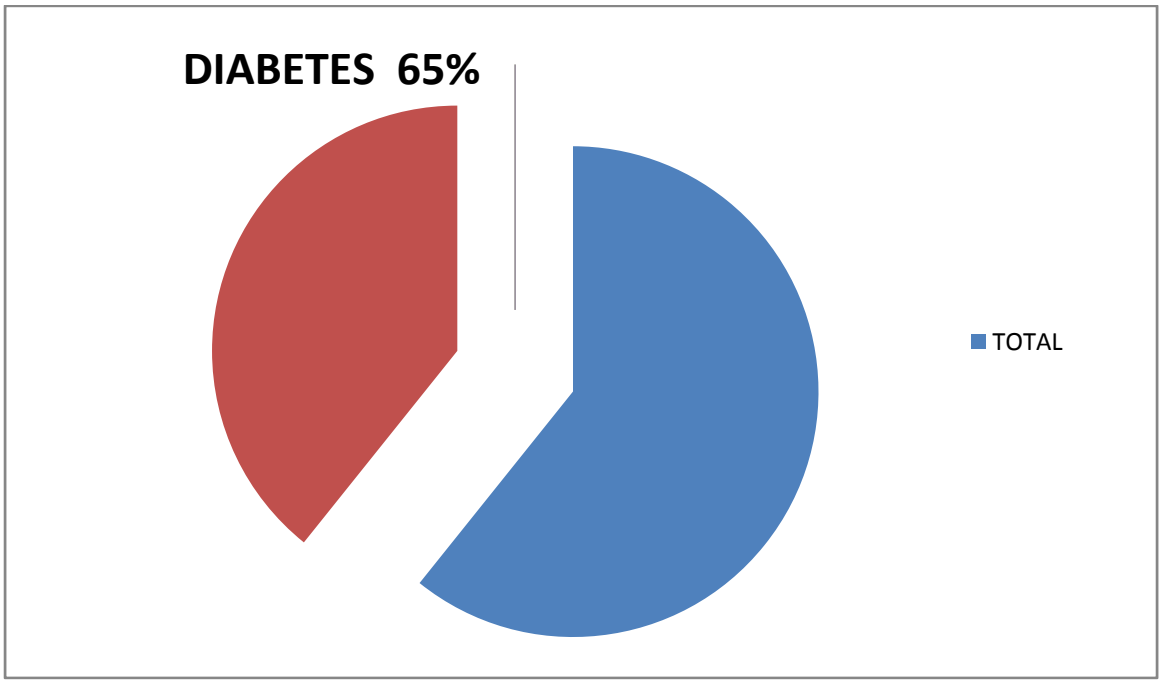
FIGURE 5: DISTRIBUTION IN FEMALES



DIABETES MELLITUS

Out of the total number of patients with bifurcation lesions, patients with Diabetes Mellitus constitute 65% (i.e) 31 patients had diabetes out of total 48 cases.

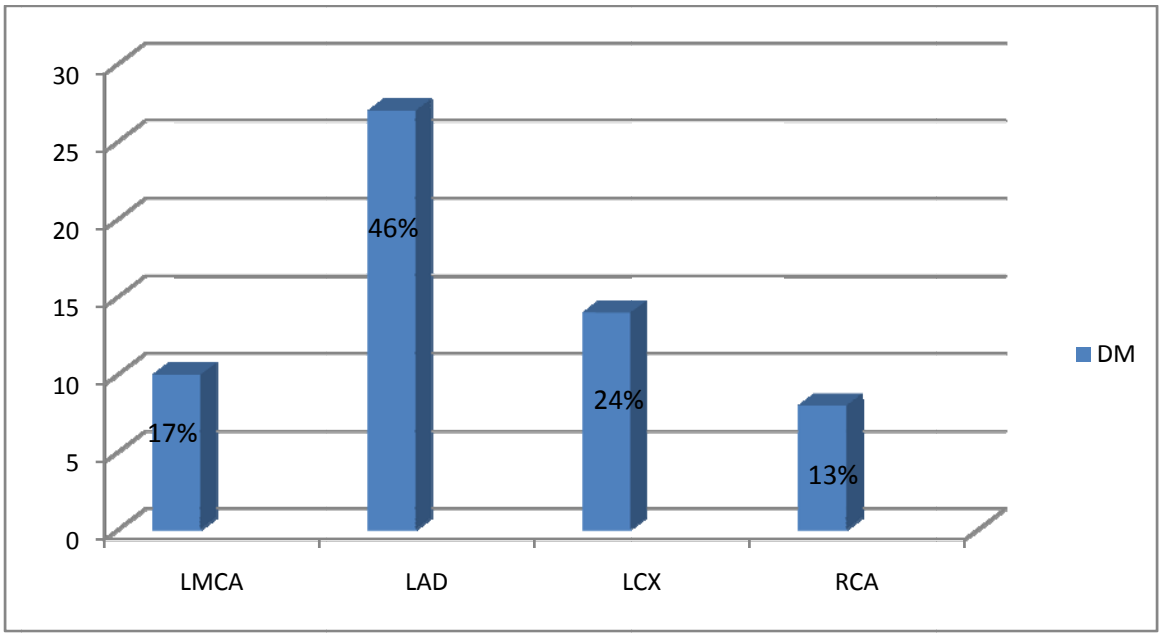
FIGURE 6:



Among the 31 patients who had diabetes, the distribution of coronary bifurcation lesions was as follows

- LMCA involved in 10 cases (17%)
- LAD involved in 27 cases (46%)
- LCX involved in 14 cases (24%)
- RCA involved in 8 cases (13%)

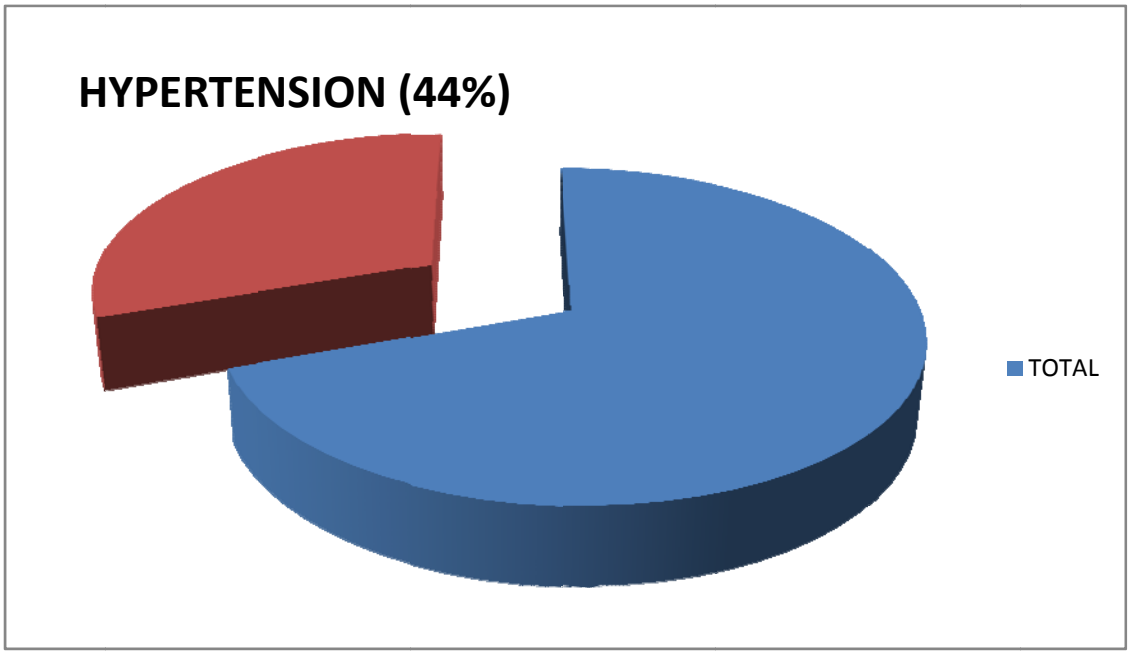
FIGURE 7:



HYPERTENSION

Among the total number of patients showing bifurcation lesions, hypertension was present in 21 cases which constitute about 44% of total number of cases.

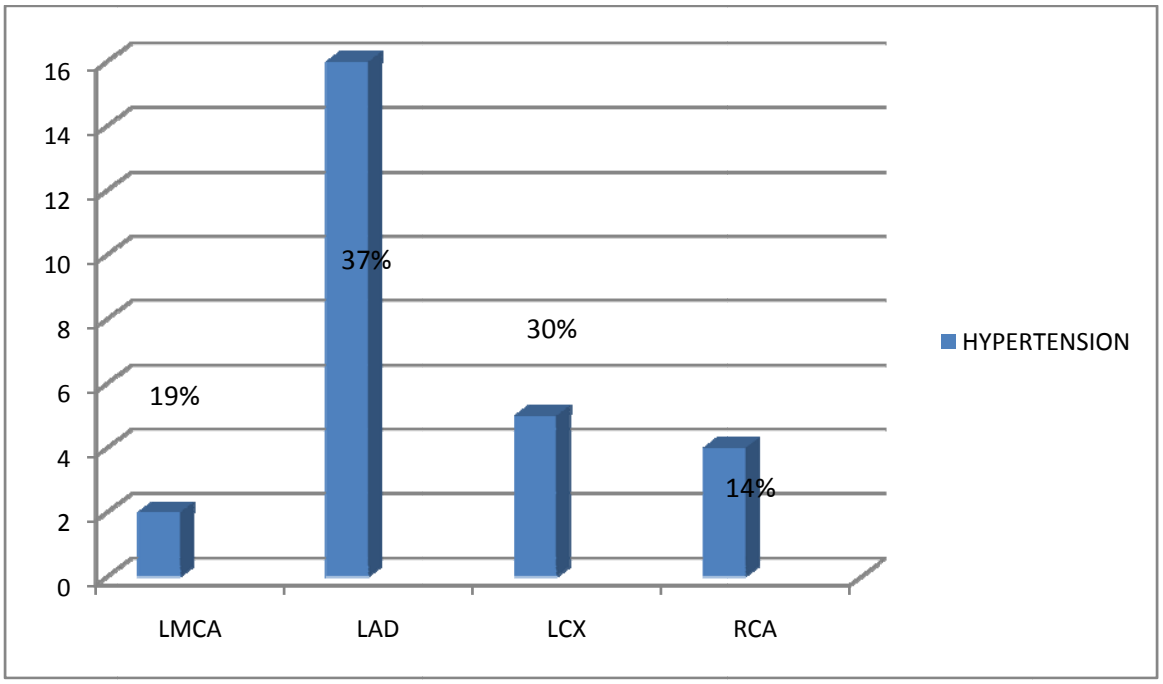
FIGURE 8:



Among the 21 patients who had hypertension, the distribution of coronary bifurcation lesions was as follows

- LMCA involved in 8 cases (19%)
- LAD involved in 16 cases (37%)
- LCX involved in 13 cases (30%)
- RCA involved in 6 cases (14%)

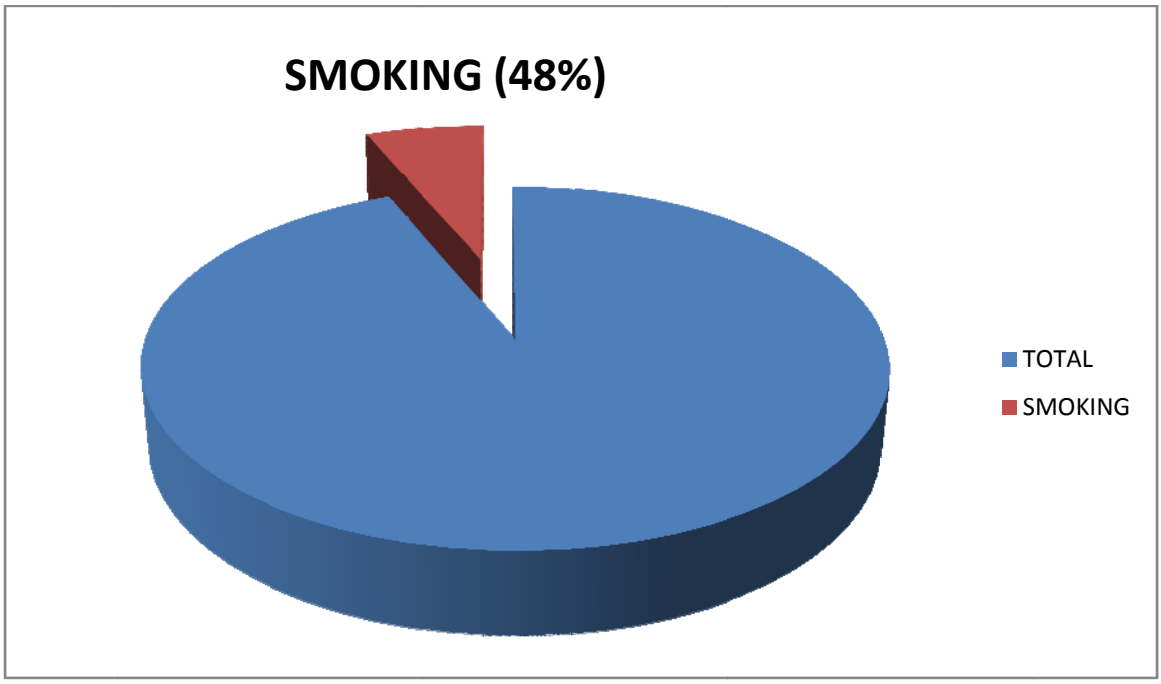
FIGURE 9:



SMOKING

Among the total number of patients showing bifurcation lesions, H/o smoking was present in 21 cases which constitute about 48% of total number of cases. All the patients who had smoking history were males and none of them were females.

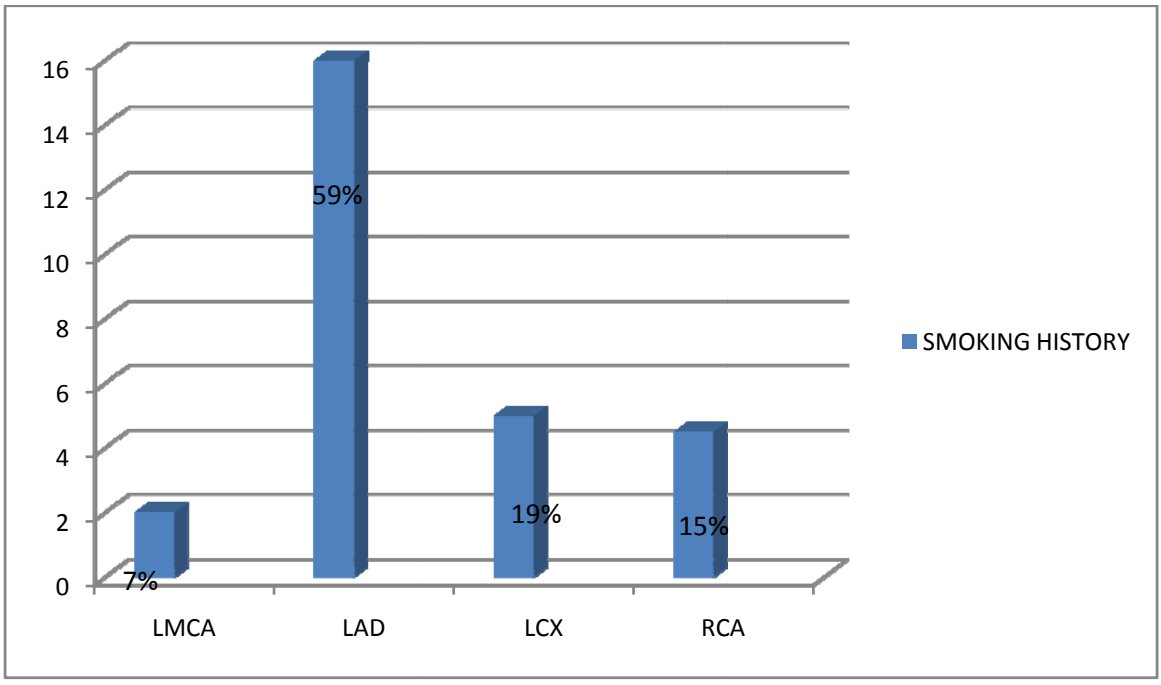
FIGURE 10:



Among the patients who had H/o smoking, the distribution of coronary bifurcation lesions was as follows

- LMCA involved in 2 cases (7%)
- LAD involved in 16 cases (59%)
- LCX involved in 5 cases (19%)
- RCA involved in 4 cases (15%)

FIGURE 11:



Among the total number patients with bifurcation lesions only 11 patients gave history regarding treatment for dyslipidemia.

None of the patients had family history of premature coronary artery disease and sudden cardiac death in our study.

CLINICAL PRESENTATION

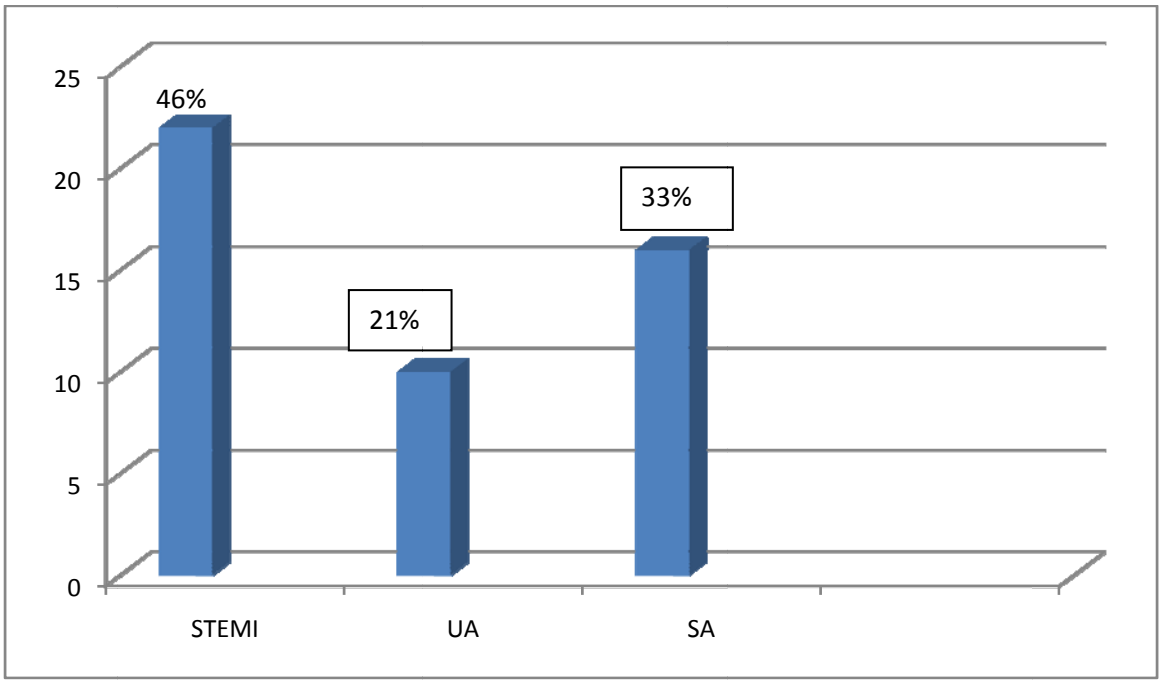
The clinical presentation of patients with coronary bifurcation lesions were analysed in all the 48 patients.

Among the patients taken for coronary angiogram showing bifurcation lesions, Acute coronary syndrome contributed 32 cases out of total 48 cases.

ST elevation myocardial infarction(STEMI) constitute 22 cases (46%). Anterior wall STEMI constitutes 18 cases (38%) and Inferior wall STEMI had 4 cases (8%).

Unstable angina / Non ST elevation myocardial infarction (UA/ NSTEMI) had constituted 10 cases which contributes about 21% of total number of patients.

FIGURE 12:



Stable angina was the clinical presentation in about 16 patients out of the total number of 48 patients who had bifurcation lesions in coronary angiogram.

Stable angina constitutes about 33% of patients with bifurcation lesions.

Those patients showing bifurcation lesions in STEMI group presented with cardiogenic shock had significant left main and ostial LAD lesions which was seen in 6 cases out of 22 cases and contributes 27% of total number of patients with significant bifurcation lesions.

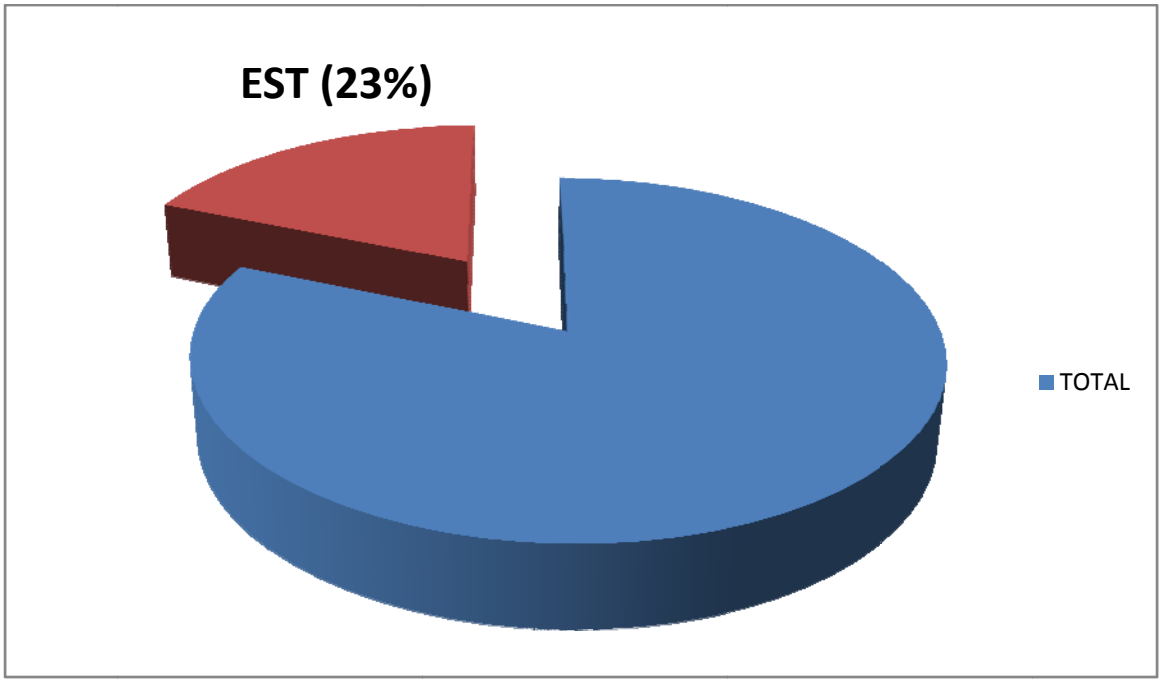
Patients with stable angina with significant LMCA and LAD lesions had Canadian Cardiovascular Society class III angina and NYHA functional class III.

Heart failure was in 7 STEMI patients who were taken angiogram and showed significant disease in LMCA and LAD, which constitutes about 32% of totalnumber of patients showing bifurcation lesions.

EXERCISE STRESS TEST (EST)

Among the 48 patients showing bifurcation lesions, 11 patients had positive exercise stress test which contributes 23% of total number of cases. Patients with multiple vessel disease and diabetes showed positive results at low workloads during stress test, which involved multiple leads and persisted into recovery

FIGURE 12:



.**ELECTROCARDIOGRAM**

All the patients who taken for angiogram, detailed evaluation of ECG was done. Significant ECG changes were present in those patients had acute coronary syndrome. ECG showed significant ST-T changes who had diffuse disease.

X Ray CHEST

Chest X ray was taken in stable patients only who underwent coronary angiogram.

Chest X ray was taken in 27 cases out of total 48 patients.

Cardiomegaly was seen in 7 patients who had clinical signs of heart failure out of 27 cases.

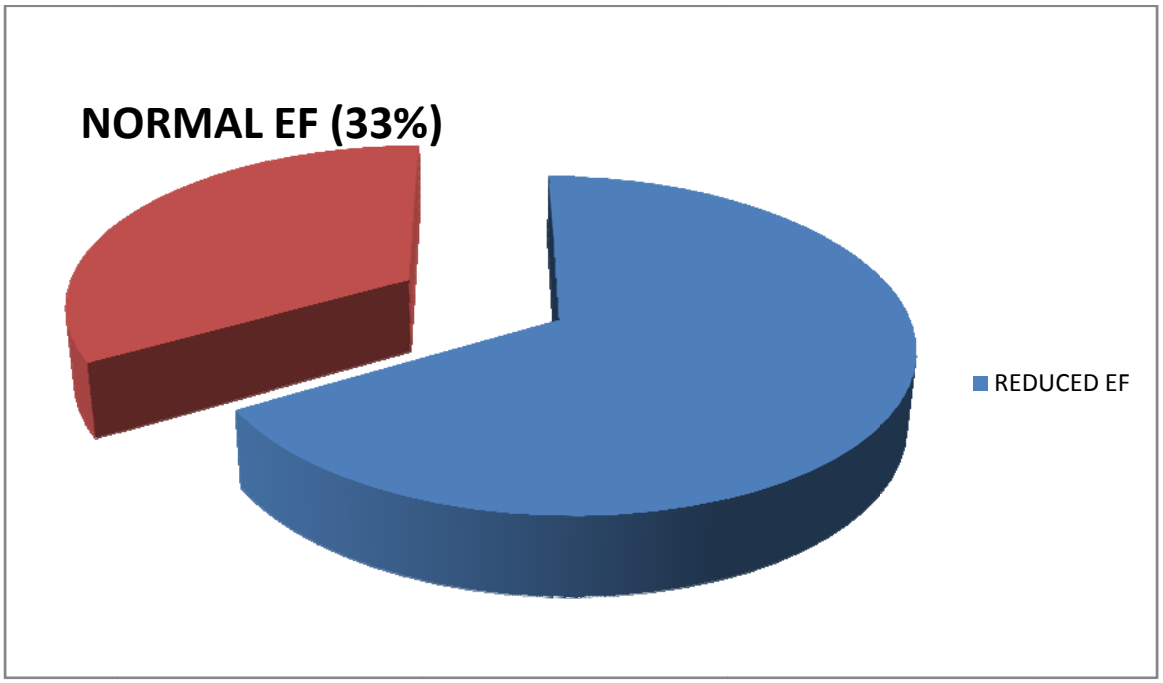
ECHOCARDIOGRAM

Regional wall motional abnormalities confined to LAD territory was seen in 18 patients who had Anterior wall STEMI and LCX / RCA territory seen in 4 patients with Inferior wall STEMI.

Hypokinesia in area corresponding to LAD and LCX territories were seen in 4 patients with Unstable angina.

Normal Left ventricular systolic function was seen in about 16 patients (33%).

FIGURE 13:



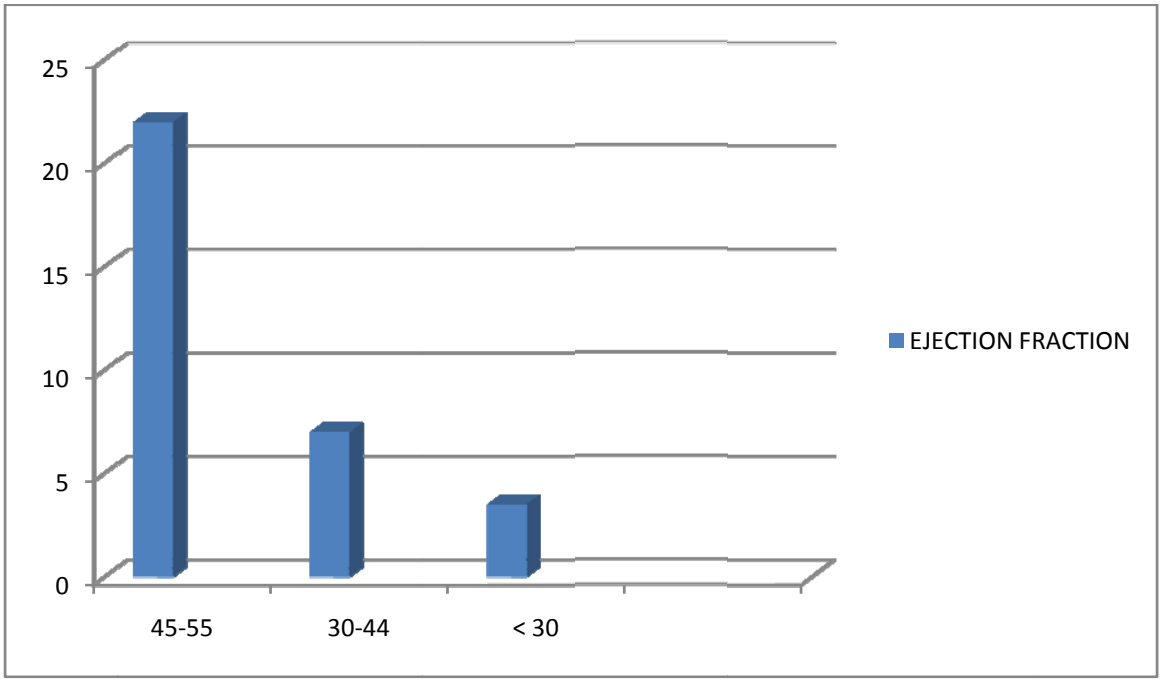
Based on Left ventricular ejection fraction, our study group was stratified as follows:

Mild LV systolic dysfunction – EF 45-55% - 22 patients (46%)

Moderate LV systolic dysfunction – EF 30-44% - 7 patients (15%)

Severe LV systolic dysfunction – EF <30% - 3 patients (6%)

FIGURE 14:



CORONARY ANGIOGRAM

Coronary angiogram was performed by femoral route in 30 patients (63%) and radial route in 18 patients (37%).

Those patients with suspected LMCA lesion, only minimal views were taken. All other patients had standard angiographic views. The coronary bifurcation lesions was analysed using Medina's scoring system and bifurcation angles were noted.The pattern of involvement in coronary bifurcation lesion as follows:

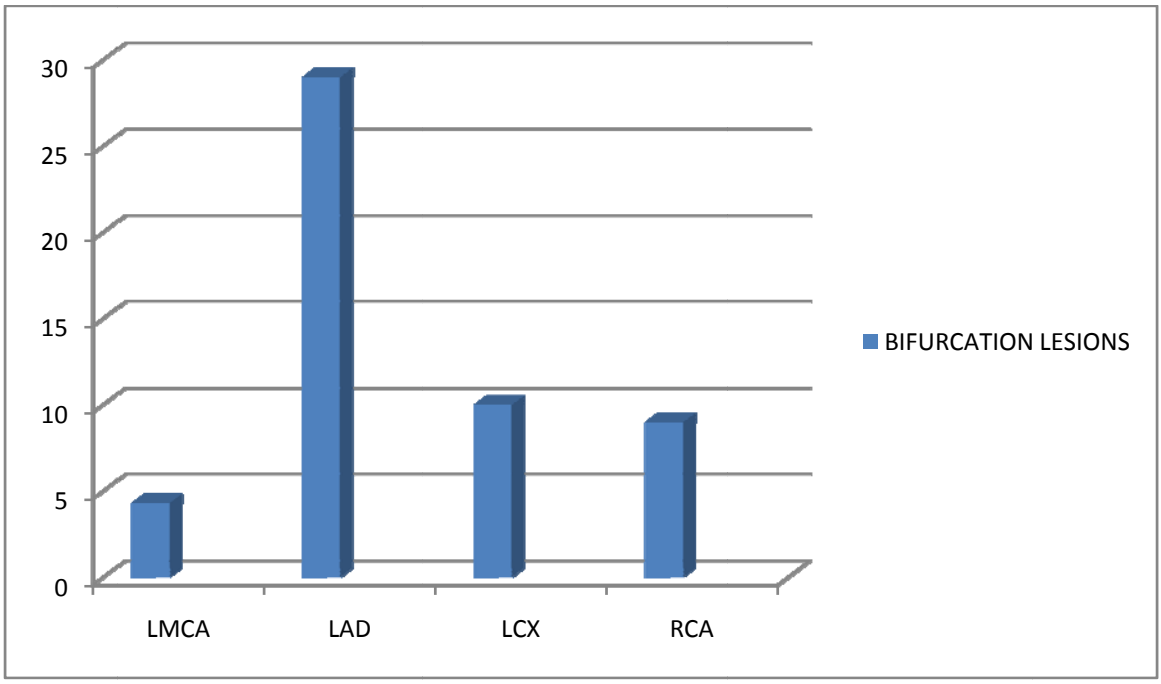
LMCA – 9 patients (16%)

LAD – 29 patients (51%)

LCX – 10 patients (17%)

RCA – 9 patients (16%)

FIGURE 15:



True bifurcation lesion was seen in 42 patients out of total number of 48 patients with bifurcation lesions, which constitute around 87.5%.

Single vessel disease was present in 24 number of patients (50%)

Three patients had double vessel disease (6%)

Triple vessel disease was present in 21number of patients (44%).

Among the patients showing bifurcation lesions, LAD dominates the pattern of involvement and constitutes 58% of total number of patients.

LMCA was in 15% cases, LCX 17% and RCA in 10% cases

FIGURE 16: NO. OF VESSEL INVOLVED

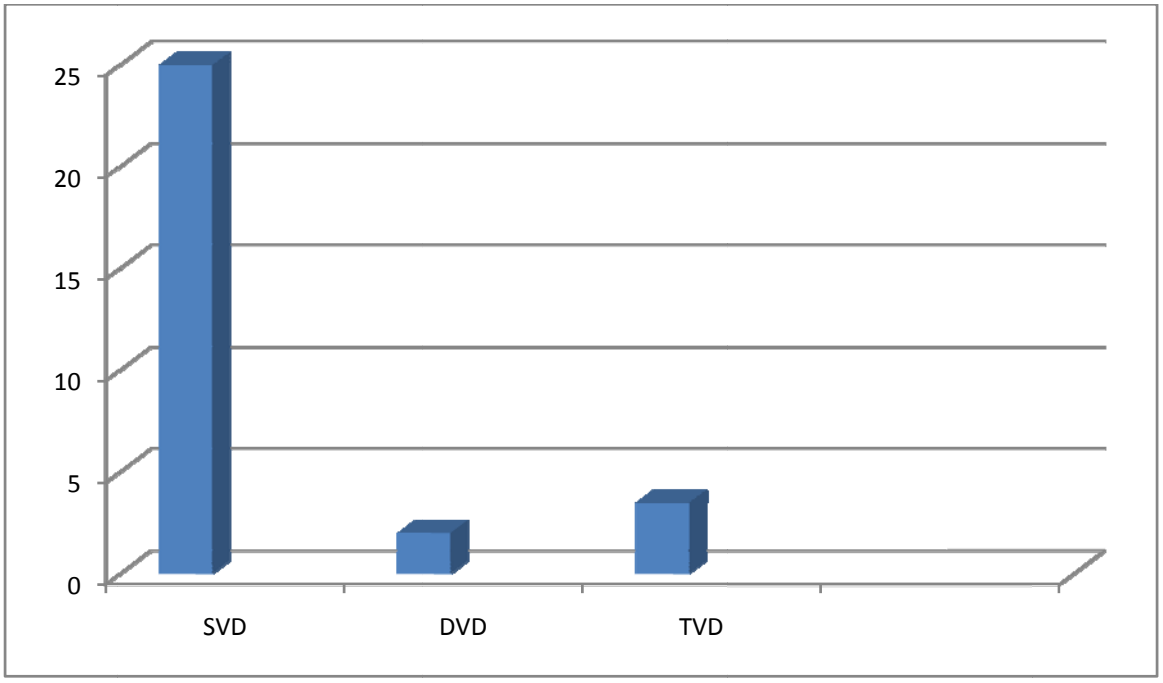
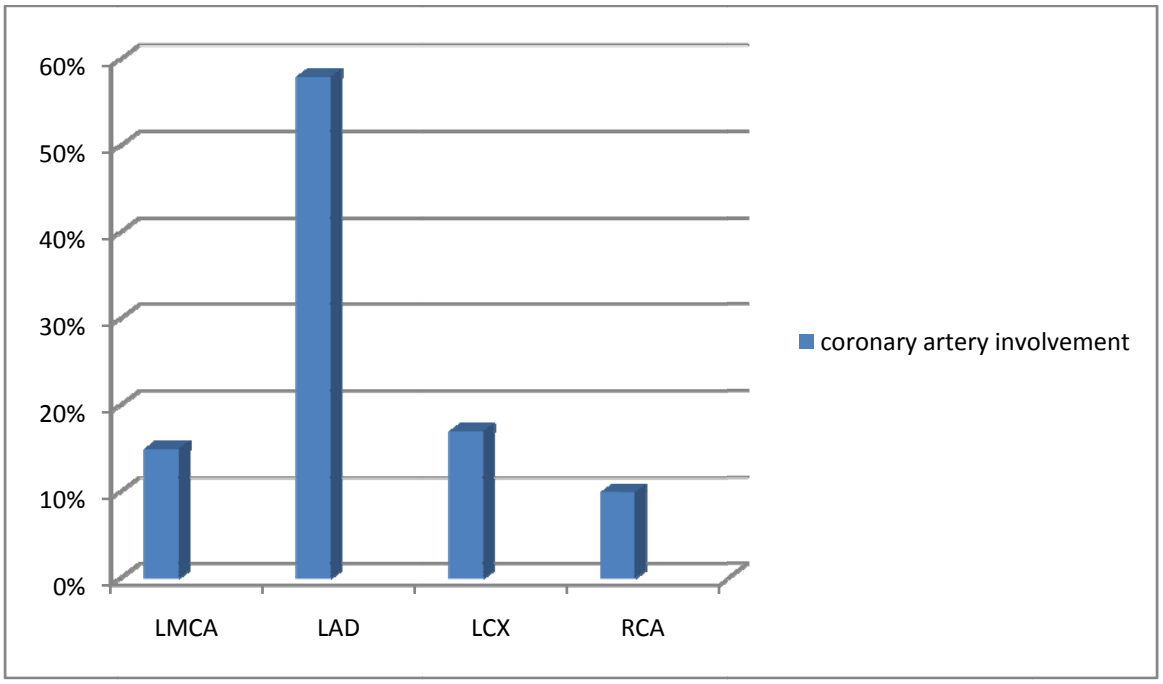


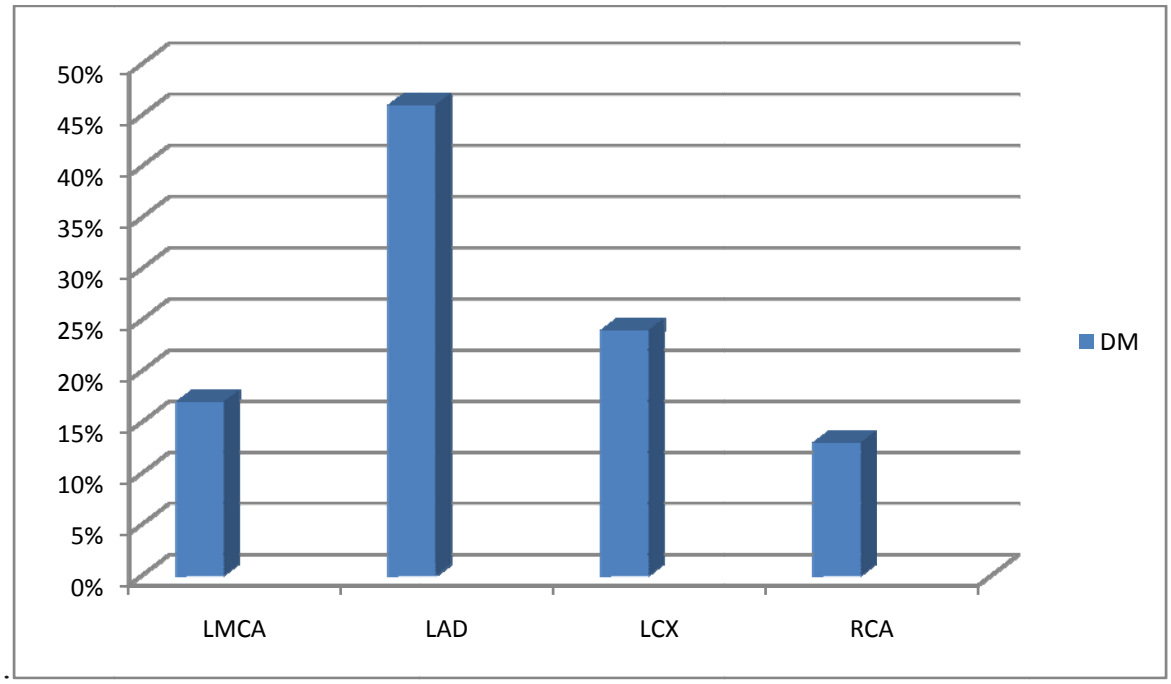
FIGURE 17: PATTERN OF INVOLVEMENT



Among the patients with bifurcation lesions, obstructive coronary involvement was seen in21 number of patients(44%) who had history of smoking compared to non smokers.

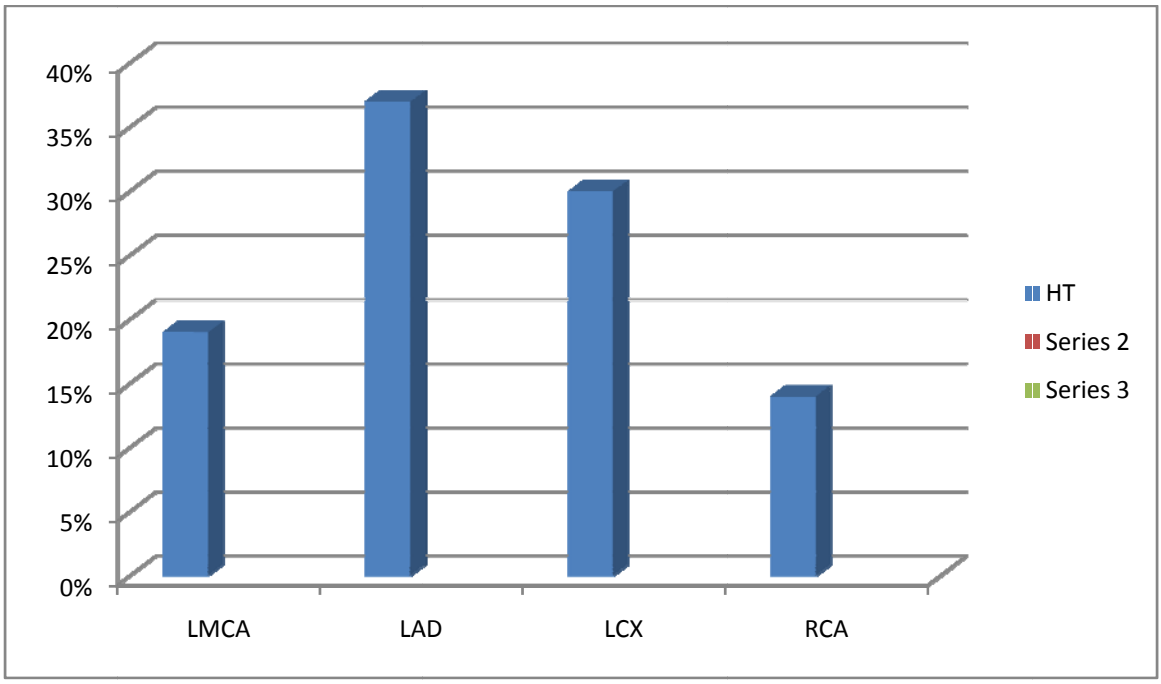
Among the patients with bifurcation lesions, obstructive coronary involvement was seen in 31 number of patients who had Diabetes mellitus. The pattern of involvement in diabetic patients with bifurcation was as follows:

FIGURE 18:



Among the patients with bifurcation lesions, obstructive coronary involvement was seen in 21 number of patients who had Hypertension. The pattern of involvement in hypertensive patients with bifurcation was as follows

FIGURE 19:



COMPLICATIONS

During the procedure 4 cases out of 48 patients had angina along with transient ST T changes and was disappeared after the procedure. No other complications were noted during the procedure.

None of the patients had post procedure complications.

No mortality was noted in any of the patients who underwent study.Patients with significant left main disease and high syntax score were referred to coronary artery bypass surgery.

Percutaneous coronaryintervention was done in 15cases.Re canalized infarct related artery noted in 5 cases.

DISCUSSION

This study was undertaken to correlate clinical risk factorsandangiographic characteristics in patients with coronary bifurcation lesions.

Coronary bifurcation lesions are often seen in cardiacinterventional practice and poseschallenges in terms of management. The treatment of bifurcationlesions by percutaneouscoronaryintervention accompanies low success and high re-stenosis ratescompared to those withoutbifurcation lesions.High success rate in percutaneouscoronary intervention may becomprehendedby a well-defined bifurcation anatomy.

In this study, 300 coronary angiograms were analysed and 48 patients were shown to have coronary bifurcation lesions, which contributes to anoverallincidence of 16%. This result is consistent with various studieswhich showed an overall incidence of 15-20% in coronary angiograms.

The most frequent coronary artery involved in our study was left anterior descending artery in 29 cases (51%). The left main coronary artery was involved in 9 cases (16%). The left circumflex artery was

involved in 10 cases (17%) and Right coronary artery in 9 cases (16%).

This study shows that coronary bifurcation lesions are frequently encountered in angiograms done for various indications. The most prevalent artery involved was Left Anterior Descending which is also consistent with other studies.

The Medina classification was used in our study to delineate bifurcation lesion. The most common Medina score noted in our study was 1,1,1which was found in 37 patients (77%)and occurred in greater frequency.

True bifurcation lesions which indicates significant (>50%) ostial disease of side branch with eiter a proximal or distal main vessel was seen in 42 patients which constitute around 87.5% in the study population.

Of which in Left anterior descending artery-28 cases (58%),

Left Main coronary artery along with involvement of LAD and LCX – 10 lesions (15%),

Left Circumflex alone -9 patients (17%), Right coronary artery – 5 patients (10%).

Males constitute 32 cases (67%) and females around 16 cases (33%).

The mean age of study population was 55.4 years

20 patients belong to age above 60 years and 5 patients below 40 years.

The incidence of true bifurcation lesions in males was as follows

Left Main Coronary artery - 15%

Left Anterior Descending artery – 49%

Left Circumflex – 27%

Right Coronary artery – 9%

The incidence of true bifurcation lesions in females was as follows

Left Main Coronary artery – 13%

Left Anterior Descending artery – 52%

Left Circumflex – 22%

Right Coronary artery – 13%

Smoking was a risk factor in found in 48% of total cases. The most common clinical presentation among smokers was acute coronary syndrome- ST elevation myocardial infarction. All the smokers were males in our study. The distribution of truebifurcation among smokers include LMCA- 7%, LAD- 59%, LCX-19%, RCA- 15%.

Patients with diabetes mellitus contribute to 61% of our study population and it is the most common risk factor .The predominant mode of presentation was Acute coronary syndrome.

The Left Anterior descending artery wasmost commonly involved which contributes 46%,followed by Left Circumflex around 24%.Left main disease was seen in 17% and Rightcoronary artery in 13% cases respectively. The higher

incidence of bifurcation lesions in this study isconsistent with Mustafa kurt et al study.

Hypertension was seen in 44% as a risk factor in patients with bifurcation lesions. It's the third most common risk factor. Patients with hypertension more commonly presented as unstableangina. Left anterior descending artery was most commonly involved and contribute 37%. Left circumflex in 30%, Left main in 19% and Right coronary in 14%.

The most common clinical presentation in our study was STEMI (46%). Of which Anterior wall STEMI was seen in 38% cases and Inferior wall in 8% cases.

Among STEMI patients, the incidence of bifurcation lesion was 52% in LAD, LMCA – 13%, LCX- 22%, RCA- 14%.

The second most common presentation was stable angina, seen in 33% of patients. LAD was the most artery of involvement and seen in 38% cases. LMCA in 17%, LCX in 35% and RCA in 10% cases respectively.

Unstable angina was seen in 21% of patients. The true bifurcation lesion was seen in 78% cases in LAD, LMCA and LCX together 11%. No RCA involvement was seen in this group.

Among the clinical features, heart failure was seen in 7 patients (15%). All the patients who had heart failure were STEMI. Three patients had triple vessel disease , one had double vessel disease and three had triple vessel disease.

Cardiogenic shock was in STEMI patients only and contributes 13% of study group. Coronary angiogram showed triple vessel disease in 4 patients, one each had double and single vessel disease.

Exercise stress test was done in stable angina patients and was positive in 11 patients which constitutes around 23%. Those patients who had positive stress test at low workloads, had significant bifurcation lesion involving left main was seen.

There were no specific electrocardiographic changes were noted.

Echocardiogram showed normal ejection in 16 patients (33%). Mild left ventricular systolic dysfunction was noted in 22 patients and constitutes (46%) the majority in the study population.

Moderate left ventricular systolic dysfunction was seen in 7 patients (15%) and severe in 3 patients (6%).

Regional wall motion abnormalities seen in all patients who had ST elevation myocardial infarction. One patient with unstable angina had hypokinesia in LAD territory probably due to hibernating myocardium during ischemia.

Cardiogenic shock and heart failure seen only in STEMI patients who had moderate to severe left ventricular systolic dysfunction.

Coronary angiogram showed True bifurcation lesions in 42 patients which constitutes around 87.5% in our study.

The overall incidence of bifurcation lesions seen in our study is 16% out of a total of 300 angiograms, which is consistent with the incidence of other major studies.

The medina classification was to assess the morphology of bifurcation lesions. The most common pattern of involvement was 1 , 1, 1 and the coronary artery most frequently was Left anterior descending artery.

TABLE II: MEDINA CLASSIFICATION

Medina score	1 1 1	1 1 0	1 0 1	0 0 1	0 1 1	0 1 0	1 0 0	Total
Patients	37	3	1	1	2	3	1	48

As per medina's score, the commonest pattern of involvement is 1, 1, 1 was in 37 patients and constitutes around 77%.

This study results was consistent with other major studies interms of coronary artery involvement and also pattern of involvement as per medina's score.

Left Anterior Descending artery is the artery of involvement in 58% cases, Left Circumflex around 17%, Left Main 15% and Right coronary artery in 10% cases.

The commonest bifurcation angle noted was < 70 degrees in 37 patients which gives an overall incidence of 77% in our study patients.

Diabetes and smokers had a higher incidence of bifurcation lesions. LAD was the commonest artery to be involved.

Among the study population, 50% had single vessel disease, 44% had triple vessel disease and 6% had double vessel disease.

More than one coronary artery bifurcation lesion was see in 16 patients which comes around 33% of incidence.

No significant post procedural complications noted after coronary angiogram. Four patients had transient ECG changes during procedure.

CONCLUSION

The incidence of coronarybifurcation lesions in this study was 16% .

The incidence of true bifurcation lesion was seen in 42 patients in a total of 48 patients which gives an overall incidence of 87.5% in our study.

The major study population was above 50 years constitutes nearly 65%.

Males are the predominant population and females show higher percentage of bifurcation lesions.

Nearly 33% had normal ejection fraction and 46% had ejection fraction between 45-55%

.Diabetes was a major risk factor noted in 65% of study groups and 100 % incidence of bifurcation lesions among them.

Smoking and Hypertension were other two risk factors noted. The incidence of bifurcation lesions was higher in smoking cohorts.

Acute coronary syndrome was the dominant group in study population. Of which STEMI contributes 46% and UA 21%.

Cardiogenic shock and heart failure noted in STEMI subsets, in which majority had triple vessel disease with left main disease.

Single vessel disease noted in 24 patients and triple vessel in 21 patients.

The most common coronary artery involved was Left Anterior Descending artery.

Left main disease seen in 15% of patients.

There is a higher incidence of bifurcation lesions noted in patients with triple and double vessel disease.

The most common coronary bifurcation lesion pattern noted in Medina's classification was**1, 1, 1**in 37 patients among a total of 48 patients.

77% of study patients had a bifurcation angle < 70 degrees.

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PATIENT CONSENT FORM

Study Details :Clinical profile and angiographic characteristics of patients with coronary artery Bifurcation lesions

Centre : Department of Cardiology,
Madras Medical College and
Rajiv Gandhi Government General Hospital,
Chennai - 600003.

Patient may check (✓) these boxes:

I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ☐

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ☐

I understand that the investigator of the clinical study, others working on his behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ☐

I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or wellbeing or any unexpected or unusual symptoms. ☐

I hereby give permission to undergo complete clinical examination and to the clinical diagnosis, diagnostic tests including hematological, biochemical, ECG, Echo, if appropriate ☐

I hereby consent to participate in this study.

Signature / Thumb impression: Place : Date Patient Name and Address:

Signature of Investigator: Place :Date :

Study Investigator's Name :

PROFORMA

NAME AGE/SEX

CAD STABLE ANGINA / ACS

RISK FACTORS

DIABETES type I/II, duration, OHA, insulin, HBA1c, complications

HYPERTENSION duration**,** drugs, compliance

SMOKING duration, no.of packs, reformed smoker

ALCOHOL duration, quantity

FAMILY HISTORY premature CAD, sudden cardiac death

MENSTRUAL STATUS

BLOOD INVESTIGATIONS – CBC, FBS,PPBS, RFT, lipid profile, Blood grouping

CLINICAL FEATURES

Chest pain – nature, duration, CCS grade, progressive/ static

Dyspnea – NYHA class, duration, PND/ Orthopnea

Palpitation - duration, rest/ exertion

Syncope- duration, exertion/ rest, no.of episodes

H/o features suggestive of heart failure, cardiogenic shock

CLINICAL PRESENTATION

STABLE ANGINA – duration, CCS grade, on treatment or not, compliance

ACUTE CORONARY SYNDROME

UNSTABLE ANGINA / NSTEMI - duration, killip class, TIMI score, biomarkers

STEMI - type, duration, lysed or not, ECG changes, Killip class, TIMI score

CLINICAL EXAMINATION

Pulse, BP, JVP, pedal edema, features of heart failure, shock

CVS – heart sounds, murmur, additional sounds

Respiratory system – rales

ECG – rate, rhythm, axis, p wave, QRS, ST T changes,arrhythmias

TMT - done for stable patients

ECHO – RWMA, wall motion score

Ejection fraction, cardiac dimensions, diastolic function,

Valve function and morphology

LV clot, RV function, presence of PHT

X RAY Chest

CORONARY ANGIOGRAM

Femoral / Radial

Aortic / femoral pressure

Angiographic views

Number of lesions – percentage of diameter stenosis, typeof lesion, presence of thrombus, dissection, calcification

Distal TIMI flow

Presence of bifurcation lesion – Medina classification type of vessel involvement, ostial lesion, true bifurcation lesion, bifurcation angle

Presence of collaterals

Left or Right dominance

Other vessel involvement

Any complications during procedure and post procedure, In hospital outcome

CORONARY ANGIOGRAM

SVD

DVD

TVD

LMCA DISEASE

NORMAL

PRESENCE AND NUMBER OF BIFURCATION LESION

LOCATION OF BIFURCATION LESION

TRUE BIFURCATION LESION OR NOT

TYPE OF BIFURCATION LESION - MEDINA CLASSIFICATION

ANGLE OF BIFURCATION LESIONS

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CLINICAL PROFILE AND ANGIOGRAPHIC CHARACTERISTICS OF PATIENTS WITH CORONARY ARTERY BIFURCATION LESIONS

Dissertation submitted to

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

In partial fulfillment of the requirements for the award of the degree of

D.M. CARDIOLOGY
BRANCH II – CARDIOLOGY

MADRAS MEDICAL COLLEGE&
RAJIV GAN DHI GOVERNMENT GENERAL HOSPITAL
CHENNAI – 600 003

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY
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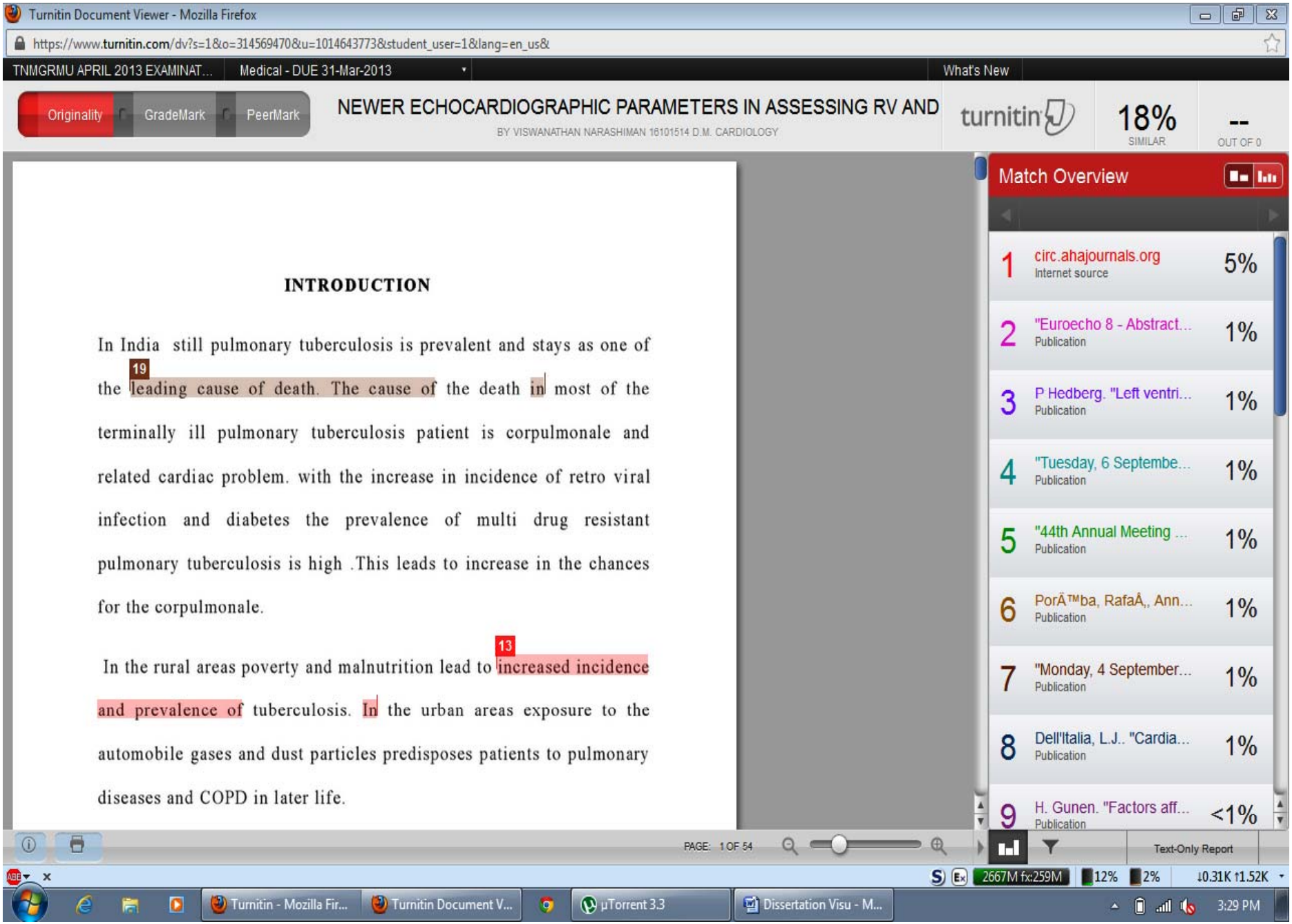
AUGUST 2014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INTRODUCTION
In India still pulmonary tuberculosis is prevalent and stays as one of the leading cause of death. The cause of the death in most of the terminally ill pulmonary tuberculosis patient is corpulmonale and related cardiac problem. with the increase in incidence of retro viral infection and diabetes the prevalence of multi drug resistant pulmonary tuberculosis is high .This leads to increase in the chances for the corpulmonale.
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Case no	Gender	Age	Presentation	DM	HT	Smoker	Heart failure	Card. Shock	RWMA	EF	MEDINA SCORE	Other vessel	complication	True BL	BA
1	M	63	SA	N	Y	Y	N	N	N	58	0 0 1 D1	SVD	N	N	< 70
2	M	46	UA	N	Y	Y	N	N	N	62	0 1 0 OSTIAL LAD	DVD	N	N	< 70
3	M	58	UA/NSTEMI	Y	N	Y	N	N	N	64	1 1 0 LMCA, LAD	SVD	N	Y	< 70
4	M	67	STEMI	Y	Y	N	Y	Y	Y	30	OM1	DVD	N	Y	<70
5	M	62	STEMI	Y	N	N	Y	N	Y	46	0 1 0 LAD	SVD	N	N	<70
6	M	55	SA	Y	Y	Y	N	N	N	60	0 1 1 LCX,OM1	TVD	N	Y	>70
7	M	45	STEMI	Y	N	Y	N	N	Y	40	1 1 1 LAD, D2	SVD	Y	Y	<70
8	M	65	SA	Y	N	N	N	N	N	60	1 1 1 LAD, D1	SVD	N	Y	<70
9	M	62	SA	Y	Y	N	N	N	N	58	1 1 1 LMCA, LAD, LCX	TVD	N	Y	>70
10	M	38	STEMI	N	N	Y	Y	N	Y	50	1 1 1 LAD, D1	SVD	N	Y	<70
11	F	35	UA	Y	N	N	N	N	N	56	1 1 1 LAD, D2	SVD	N	Y	<70
12	M	63	STEMI	Y	Y	N	N	N	Y	30	1 1 1 LMCA,LAD,LCX	TVD	N	Y	> 70
13	M	68	SA	Y	Y	N	N	N	N	58	1 1 1 LMCA,LAD,LCX	TVD	N	Y	<70
14	M	67	STEMI	Y	N	N	N	Y	Y	48	1 1 1 LAD, D1	SVD	N	Y	<70
15	M	65	SA	Y	Y	N	N	N	N	60	1 1 1 RCA, AM	TVD	N	Y	<70
16	F	65	STEMI	Y	Y	N	Y	N	Y	50	1 1 1 LAD, D1	TVD	Y	Y	<70
17	M	54	SA	Y	Y	Y	N	N	N	65	1 1 0 RCA,PLV 1 1 1 LCX, OM1	TVD	N	Y	> 70
18	F	44	UA	N	N	N	N	N	Y	40	1 1 1 LAD,D1	DVD	N	Y	<70
19	M	65	STEMI	Y	Y	N	N	Y	Y	45	1 1 1 LAD, D1	TVD	N	Y	<70
20	M	42	STEMI	N	N	Y	N	N	N	55	1 1 1 LCX, OM	SVD	N	Y	<70
21	M	40	STEMI	N	N	Y	Y	N	Y	48	1 1 1 LAD, D1	SVD	N	Y	<70
22	M	54	STEMI	Y	N	Y	N	N	Y	48	1 1 1 LAD, D1 1 1 1 RCA,PDA,PLV	TVD	N	Y	<70
23	F	50	SA	Y	N	N	N	N	N	60	LCX,OM1	TVD	N	Y	>70
24	F	57	SA	Y	N	N	N	N	N	62	1 1 1 LAD, D1 1 1 O RCA, PDA	TVD	Y	Y	<70
25	M	62	STEMI	Y	Y	N	Y	Y	Y	40	1 1 1 LMCA, LAD, LCX	TVD	N	Y	<70
26	M	40	STEMI	N	N	Y	N	N	Y	50	1 1 1 LCX, OM1	SVD	N	Y	>70
27	M	45	STEMI	N	N	Y	N	N	Y	40	1 1 1 LAD, D1	SVD	N	Y	<70
28	M	33	UA	N	N	Y	N	N	N	60	1 1 O LAD, D1	SVD	N	N	<70
29	M	60	SA	N	N	N	N	N	N	58	1 1 1 LAD, D1	SVD	N	Y	<70
30	M	48	UA	N	Y	Y	N	N	N	60	1 0 0 LAD D1	SVD	N	N	>70
31	F	53	UA	N	N	N	N	N	N	62	1 1 1 RCA, PDA, PLV	SVD	N	Y	<70
32	F	69	STEMI	Y	Y	N	Y	Y	Y	30	LCX,OM1	TVD	N	Y	<70
33	F	62	STEMI	Y	N	N	N	N	Y	46	0 1 0 OSTIAL LAD	SVD	N	N	<70
34	F	55	SA	Y	Y	N	N	N	N	60	0 1 1 LCX, OM1	TVD	N	Y	>70
35	M	65	SA	Y	Y	Y	N	N	N	62	1 1 1 LAD, D1	TVD	N	Y	<70

36	F	54	SA	Y	Y	N	N	N	N	58	OM1	TVD	y	Y	<70
37	M	44	STEMI	Y	Y	Y	N	N	Y	40	1 1 1 LAD, D1	SVD	N	Y	>70
38	M	65	SA	N	N	Y	N	N	N	64	1 1 1 LAD,D1	SVD	N	Y	<70
39	M	62	SA	Y	Y	Y	N	N	N	60	1 1 1 LMCA, LAD, LCX	TVD	N	Y	<70
40	M	36	STEMI	N	N	Y	N	N	Y	50	1 1 1 LAD, D1	SVD	N	Y	<70
41	F	37	UA	N	N	N	N	N	N	65	1 1 1 LAD,D1	SVD	N	Y	<70
42	M	62	STEMI	Y	Y	Y	N	Y	N	45	1 1 1 LAD, D1 1 1 1 RCA, AM	TVD	N	Y	>70
43	F	69	SA	Y	Y	N	N	N	N	60	1 1 1 LMCA,LAD,LCX	TVD	N	Y	<70
44	M	66	STEMI	Y	Y	Y	N	N	Y	50	RCA,PDA,PLV	TVD	N	Y	<70
45	F	41	UA	N	N	N	N	N	N	62	1 0 1 LAD, D1	SVD	N	Y	<70
46	F	53	STEMI	N	N	N	N	N	Y	48	1 1 1 LAD, D2	SVD	N	Y	>70
47	F	61	STEMI	Y	Y	N	N	N	Y	40	PDA,PLV	TVD	N	Y	<70
48	F	46	UA	Y	N	N	N	N	N	64	1 1 1 LAD , D2	SVD	N		<70