EVALUATION OF METABOLIC SYNDROME, ITS CORRELATION WITH CLINICAL AND ANGIOGRAPHIC PROFILE IN PATIENTS WITH CORONARY ARTERY DISEASE- A PROSPECTIVE STUDY AT TERTIARY HOSPITAL

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ABSTRACT

BACKGROUND

Coronary artery disease has a major share for cardiovascular disease in a developing country like India, which is in epidemic proportion. There are number of risk factors for development of coronary artery disease. According to INTERHEART study, there were 9 modifiable risk factors with population attributable risk of 90 percent in men and 94 percent in women. Metabolic syndrome cluster of risk factors, which include insulin resistance, subclinical inflammation, increased future risk of diabetes and coronary artery disease. In south Asian people are increased tendency to develop metabolic syndrome because of their high percentage of body fat, abdominal obesity and insulin resistance. Metabolic syndrome has more mortality and morbidity from CAD. It is desirable identifying this subset of patients, which could improve patient or physician adherence to risk-reducing behaviours or interventions and improve clinical outcomes. There are reports in literature on association inflammatory markers and insulin resistance with severity of disease in CAD. There are few studies, which correlated severity of CAD with SYNTAX score in patients with metabolic syndrome, so in these study prospectively evaluated clinical and angiographic profile in patients with CAD in subset patients with metabolic syndrome, CAD severity was assessed with SYNTAX scoring system and thrombus burden was evaluated.

MATERIALS AND METHODS

Among 101 patients who were diagnosed to have metabolic syndrome according to ATP III guidelines were evaluated in the study. All patients were evaluated by clinical examination including waist circumference, body mass index, routine blood investigations were carried out. Lipid profile, ECG and 2D echo was done. Then, patients were evaluated with coronary angiogram and among patients who underwent coronary angiography, the lesions were classified according to AHA/ACC classification into type A, type B and type C for assessing lesion complexity. Syntax score was calculated and along with thrombus burden was assessed by TIMI thrombus grading.

RESULTS

A total of 101 patients were included in the study from 2013 January to 2015 December. Of total cohorts, males were 70 (69.3%, n=70) and female were 31 (30.7%, n=31). The mean age of the studied population was 48.96±10.1 SD years. The clinical profile of the patients with the metabolic syndrome patients who satisfied 3 out of 5 criteria were 24.75% (n=25), who satisfied 4 out of 5 criteria were 48.51% (n=49) and patients who satisfied 5 out of 5 criteria were 26.73% (n=27), respectively. In the present study, there was 47.46% (n=28) of myocardial infarction patients were thrombolysed and remaining 52.54% (n=32) were not thrombolysed. The thrombolytic agent, which was used in 82.14% (n=23) was streptokinase and in 17.86% (n=5) the thrombolytic used was tenecteplase. Among the patients who underwent coronary angiogram, 92 patients were having coronary artery disease and remaining 7 patients had normal epicardial coronary artery disease (92.1% vs. 6.9%), about 71% (n=5) of patients in the normal epicardial coronary group were females. The coronary artery lesions when assessed by the AHA/ACC classification, most of the lesions were type B lesions 41.6% (n=46) followed by type A lesions 25.7% (n=26) and type C lesions 14.8% (n=15). Total 93 patients with coronary disease with metabolic syndrome, 7.9% (n=8) patients had grade V thrombus followed by 4.9% (n=5) who had grade I, 2.97% (n=3) had grade III and 1% (n=1) each had grade II and grade IV, respectively. The mean syntax score in patients with metabolic syndrome with diabetes was 11.4±7.5 SD and the mean syntax score in the patients with metabolic syndrome without diabetes was 8.6±5.5 SD.

CONCLUSION

In present study in which patients with metabolic syndrome with coronary artery disease were evaluated prospectively with mean age of 48.96±10 years, smoking ($p<0.001$) and alcohol consumption ($p<0.05$) were more in male gender, hypertension was more in the female gender, diabetes was equal in both genders. Coronary angiogram showed more single vessel involvement in both genders, more of type B lesions. Mean syntax score in patients with metabolic syndrome with diabetes was higher when compared with metabolic syndrome without diabetes, although it was not statistically significant (11.4±7.5 vs. 8.6±5.5, $p>0.05$), metabolic syndrome with coronary artery disease had low mean HDL (29±8.49 mg%, mean high triglyceride 189±124.45 mg%), mean high blood pressure (140/90 mm of Hg, mean), in both genders.

KEYWORDS

Metabolic Syndrome, Clinical and Angiographic Profile, Coronary Artery Disease.

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BACKGROUND

Coronary artery disease has a major share for cardiovascular disease in a developing country like India, which is in epidemic proportion. There are number of risk factors for development of coronary artery disease. According to INTERHEART study, there were 9 modifiable risk factors with population attributable risk of 90 percent in men and 94 percent in women. Metabolic syndrome cluster of risk factors, which include insulin resistance, subclinical inflammation, increased future risk of diabetes and coronary artery disease. In south Asian people are increased tendency to develop metabolic syndrome because of their high percentage of body fat, abdominal obesity and insulin resistance. Metabolic syndrome has more mortality and morbidity from coronary artery disease, it is desirable identifying this subset of patients, which could improve patient or physician adherence to risk-reducing behaviours or interventions and improve clinical outcomes. There are reports in literature on association inflammatory markers and insulin resistance with severity of disease in coronary artery disease. There are few studies, which correlated severity of coronary artery disease with SYNTAX score in patients with metabolic syndrome, so in these study prospectively evaluated clinical and angiographic profile in patients with coronary artery disease in subset patients with metabolic syndrome, coronary artery disease severity was assessed with SYNTAX scoring system and thrombus burden was evaluated.

AIM

To correlate the clinical profile of patients with metabolic syndrome and coronary artery disease and to assess the coronary artery involvement by syntax score.

Insulin Resistance, Identified by 1 of the Following
Type 2 diabetes.
Impaired Fasting Glucose.
Impaired Glucose Tolerance.
Or for those with Normal Fasting Glucose Levels (<110 mg/dL), Glucose Uptake Below the Lowest Quartile of Background Population Under Investigation Under Hyperinsulinemia, Euglycaemic Conditions.
Plus any 2 of the Following.
Antihypertensive Medications and/or High Blood Pressure (>/= 140 or 90 mm of Hg).
Plasma Triglycerides >/= 150 mg/dL (>1.7 mmol/L).
HDL Cholesterol <35 mg/dL (<0.9 mmol/L) in men or <39 mg/dL (1.0 mmol/L) in women.
BMI >30 Kg/m2 and/or waist: hip ratio >0.9 in men, >0.85 in women.
Urinary Albumin Excretion Rate >/= 20 ug/min. or Albumin: Creatinine ratio >/= 30 mg/g.

Table 1. WHO Clinical Criteria for Metabolic Syndrome

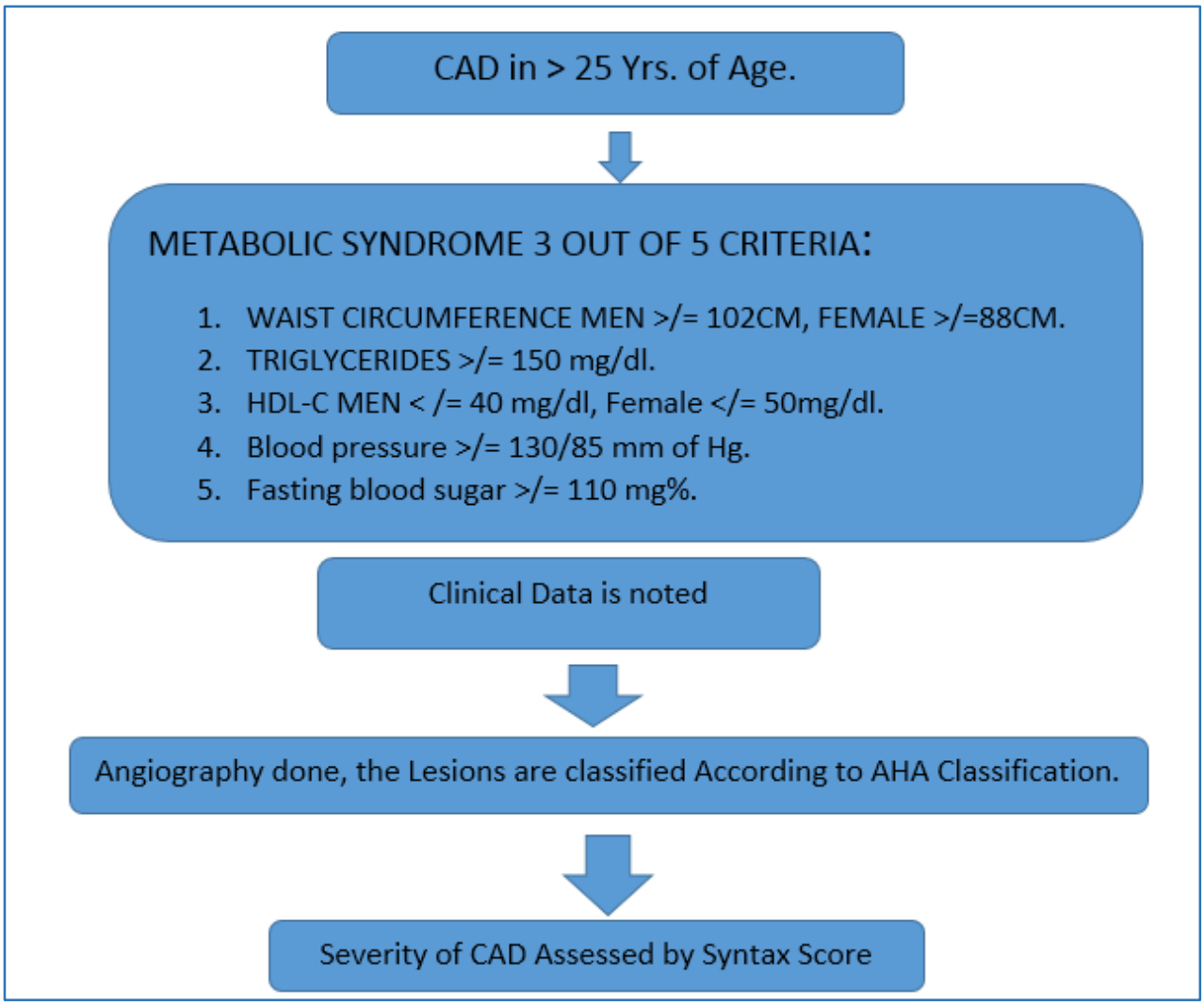
METHODS

A prospective study to evaluate metabolic syndrome, its correlation with clinical and angiographic profile in patients with coronary artery disease was done from 2013 December to 2015 December in patients more than 25 years presenting to Osmania General Hospital. After taking informed consent from the patient, the clinical presentation, weight, height and waist circumference is noted and biochemical analysis was done from overnight fasting venous sample from which HDL-C, triglycerides and fasting blood sugar levels are noted. If patient satisfy 3 out of 5 criteria of metabolic syndrome, they were included in the study.

Exclusion Criteria

1. Congenital Hypercholesteremia.
2. Congenital Hypertriglyceridemias.
3. Endocrine Disorders - Hypothyroidism, Cushing Syndrome.
4. Drugs - Patient Taking Steroids, Antipsychotic Drugs, Antiretroviral Drugs.
5. Chronic Renal Failure.

Among patients who underwent coronary angiography, the lesions were classified according to AHA/ACC classification into Type A, Type B and Type C for assessing lesion complexity.[1] After classifying individual patients, the severity of lesion was assessed by the SYNTAX score by software (www.syntaxscore.com). The component of the syntax score includes the presence of up to 12 lesions with greater than 50% diameter stenosis in vessels greater than 1.5 mm in diameter with a multiplication factor of 2 for nonocclusive lesions and 5 for occlusive lesions and weighing by its contribution to the myocardial bed that it supplies. Each lesion is assessed for its severity, presence of a total occlusion, side branch and collaterals, and lesion complexity is weighed by multiple tandem lesions, aorto-ostial location, diffuse disease, severe tortuosity, length more than 20 mm, heavy calcification and thrombus. The syntax score is widely accepted CAD complexity score based on lesion morphology, which well correlates with cardiovascular mortality and morbidity.[2]



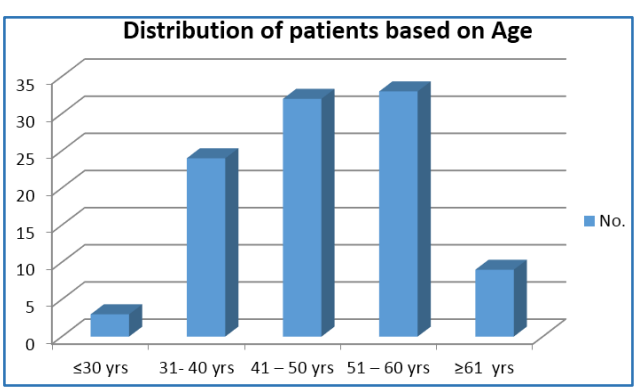
RESULTS AND STATISTICAL ANALYSIS

The present study was undertaken in the Department of Cardiology at Osmania Medical College and General Hospital, Hyderabad. The data was analysed using SPSS software version 17.0. Appropriate statistical tests were used to assess the clinical and angiographic profile of the metabolic syndrome in patients with coronary artery disease patients**.** Descriptive results are expressed as mean and SD of various parameters in different groups. Probability value (p value) was used to determine the level of significance p value <0.05 was considered as significant, p value <0.01 was considered as highly significant.

No.	Age in Yrs.	%
3	≤30 yrs.	2.9
24	31 - 40 yrs.	23.7
32	41 - 50 yrs.	31.7
33	51 - 60 yrs.	32.7
9	≥61	8.9
101	**Total**	**100**
48.96±10.1		Mean±SD

Table 2. Distribution of Patients Based on Age

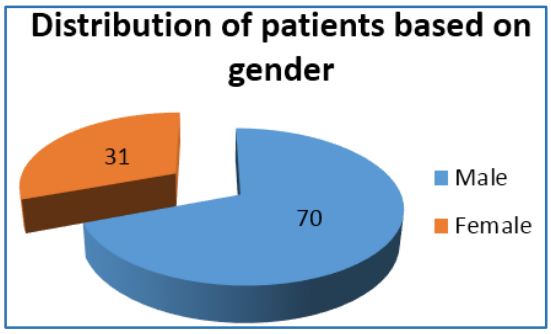
In the present study, 32.7% cases were in the age group of 51-60 yrs. followed by 31.7% between 41-50 yrs., 23.7% between 31-40 yrs.



Sex	Frequency	Percent
Male	70	69.3
Female	31	30.7
Total	**101**	**100**

Table 3. Distribution of Patients Based on Gender

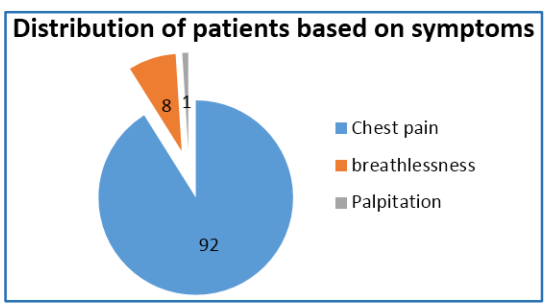
In the present study, 69.3% were males and 30.7% of cases were females. The ratio of Male:Female was 2.26:1.



Symptoms	Frequency	Percent
Chest Pain	92	91.1
Breathlessness	8	7.9
Palpitation	1	1
Total	**101**	**100**

Table 4. Distribution of Patients Based on Symptoms

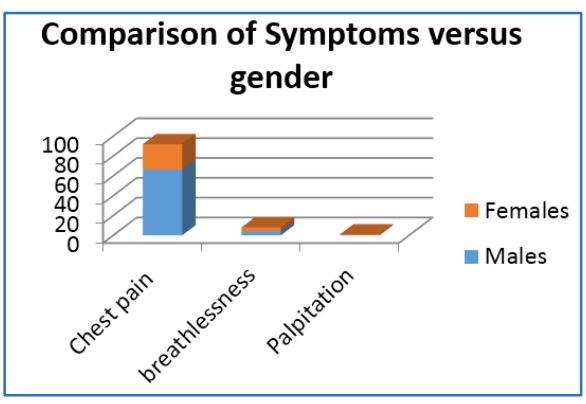
In the present study, 91.1% of cases had chest pain as symptom followed by 7.9% had breathlessness and 1% presented with palpitation.



Symptoms	Males		Females	
	No.	**%**	**No.**	**%**
Chest Pain	66	94.3	26	83.9
Breathlessness	4	5.7	4	12.9
Palpitation	0	0	1	3.2
Total	**70**	**100**	**31**	**100**
Chi-Square	3.9		p value	0.141

Table 5. Comparison of Symptoms Versus Gender

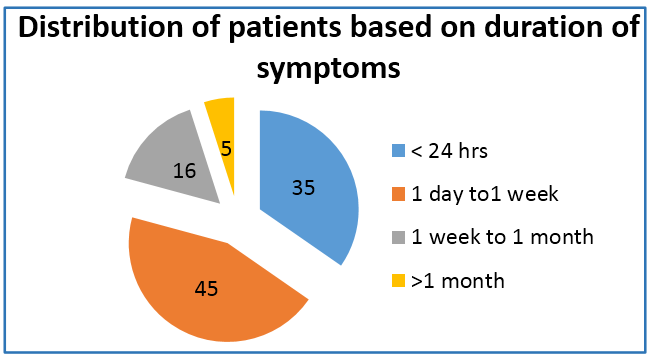
In the present study, there was no significant difference between gender of patient and occurrence of symptoms p >0.05.



Duration Symptoms	Frequency	Percent
<24 hrs.	35	34.7
1 day to1 week	45	44.6
1 week to 1 month	16	15.8
>1 month	5	5
Total	**101**	**100**

Table 6. Distribution of Patients Based on Duration of Symptoms

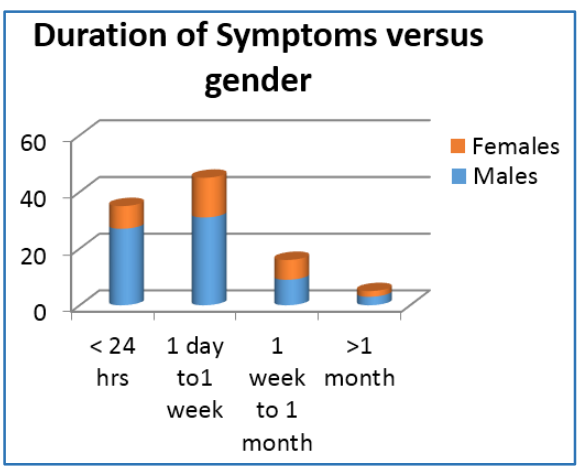
In the present study, 44.6% of cases had symptom duration between 1 day to 1 week followed by 34.7% had symptom duration of less than 24 hrs. and 15.8% had symptom duration between 1 week to month.



Symptoms	Males		Females	
	No.	**%**	**No.**	**%**
<24 hrs.	27	38.6	8	25.8
1 day to 1 week	31	44.3	14	45.2
1 week to 1 month	9	12.9	7	22.6
>1 month	3	4.3	2	6.5
Total	**70**	**100**	**31**	**100**
Chi-Square	2.5		p value	0.47

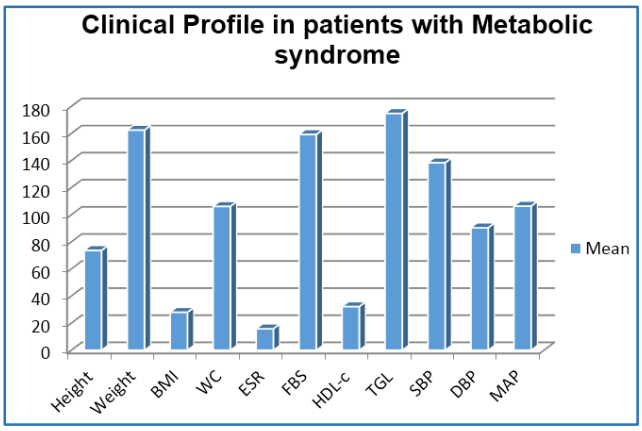
Table 7. Comparison of Duration of Symptoms Versus Gender

In the present study, there was no significant difference between gender of patient and duration of symptoms p >0.05.



Parameter	Mean	SD
Height	73.6	14.8
Weight	162.4	8.6
BMI	27.9	5.08
Waist Circumference	106.1	26.3
ESR	15.7	12.9
FBS	159.2	61.6
HDL-C	32.1	7.5
Triglycerides	174.7	56.7
SBP	138.3	15.6
DBP	90.3	9.4
MAP	106.3	10.6

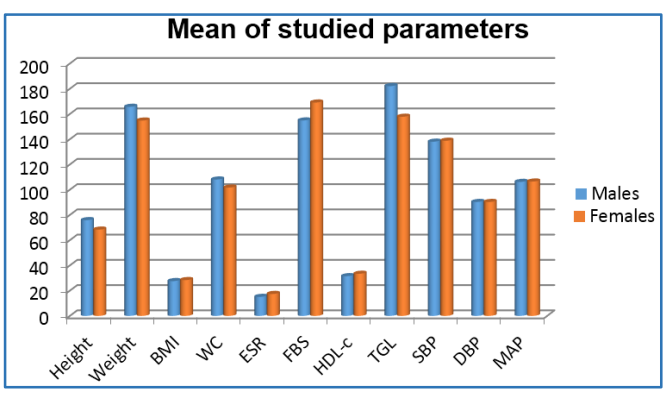
Table 8. Clinical Profile in Patients with Metabolic Syndrome



Parameter	Males		Females		t value	p value
	Mean	SD	Mean	SD		
Height	75.9	15	68.4	13.3	2.38	0.019
Weight	165.7	7.1	154.8	6.8	7.18	<0.001
BMI	27.6	5.2	28.4	4.7	0.80	0.42
Waist Circumference	108.1	26.1	101.7	26.6	1.12	0.26
ESR	15.1	12.2	17.4	14.8	0.80	0.42
FBS	154.9	60.8	169.1	63.5	1.05	0.29
HDL-C	31.5	7.4	33.4	7.5	1.12	0.26
Triglycerides	182.1	61.4	157.8	40.4	2.34	0.021
SBP	138.08	15.4	138.8	16.4	0.231	0.81
DBP	90.3	9.1	90.3	10.2	0.01	0.99
MAP	106.2	10.3	106.5	11.3	0.14	0.88

Table 9. Clinical Profile in Patients with Metabolic Syndrome

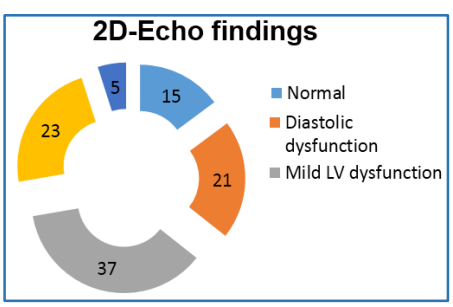
In the present study, clinical profile of metabolic syndrome patients was compared with gender. It was observed that mean height, mean weight and mean triglycerides were significantly higher in males compared to females, p <0.05.



2D Echo	No.	Percentage
Normal	15	14.9
Diastolic Dysfunction	21	20.8
Mild LV Dysfunction	37	36.6
Moderate Dysfunction	23	22.8
Severe Dysfunction	5	5
Total	**101**	**100**

Table 10. Distribution Based on 2D Echo Findings

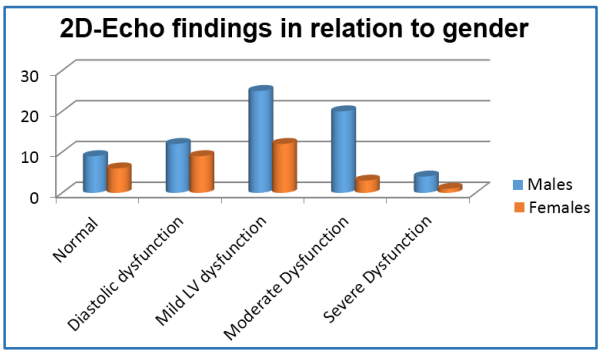
It was observed that 36.6% patients had mild LV dysfunction followed by 22.8% patients with moderate dysfunction, 20.8% had diastolic dysfunction and 5% patients had severe LV dysfunction.



2D Echo	Males		Females	
	No.	%	No.	%
Normal	9	12.9	6	19.4
Diastolic Dysfunction	12	17.1	9	29
Mild LV Dysfunction	25	35.7	12	38.7
Moderate Dysfunction	20	28.6	3	9.7
Severe Dysfunction	4	5.7	1	3.2
Total	**70**	**100**	**31**	**100**
Chi-Square	5.76		P value	0.218

Table 11. Distribution Based on 2D Echo Findings in Relation to Gender

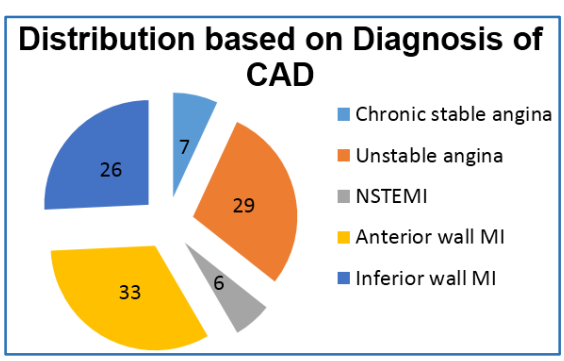
No statistically significant relation was observed between 2D echo findings and gender.



CAD	No.	Percentage
Chronic Stable Angina	7	6.9
Unstable Angina	29	28.7
NSTEMI	6	5.9
Anterior Wall MI	33	32.7
Inferior Wall MI	26	25.7
Total	**101**	**100**

Table 12. Distribution Based on Diagnosis of CAD

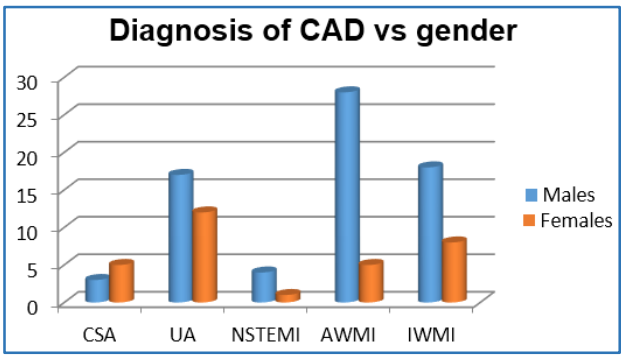
In the present study, it was observed that 32.7% patients had anterior wall MI followed by 28.7% patients who had unstable angina, 25.7% had inferior wall MI, 6.9% patients had chronic stable angina and 5.9% patients had NSTEMI.



CAD	Males		Females	
	No.	**%**	**No.**	**%**
Chronic Stable Angina	3	4.3	5	16.1
Unstable Angina	17	24.3	12	38.7
NSTEMI	4	5.7	1	3.2
Anterior Wall MI	28	40	5	16.1
Inferior Wall MI	18	25.7	8	25.8
Total	**70**	**100**	**31**	**100**
Chi-Square	9.37		p value	0.05

Table 13. Distribution Based on Diagnosis of CAD Versus Gender

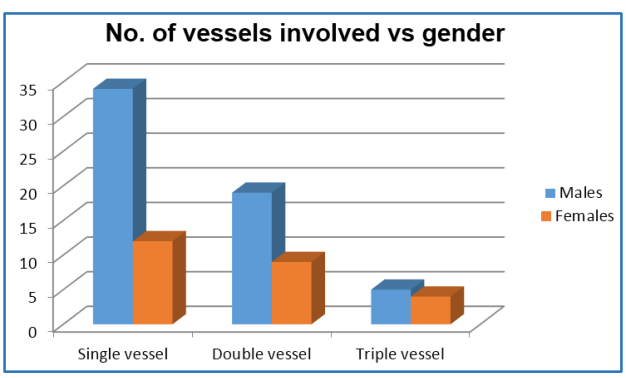
In the present study, no statistically significant relation was observed between CAD and gender.



Type of Vessels	Males		Females	
	No.	**%**	**No.**	**%**
Single Vessel	37	58.73	13	50
Double Vessel	21	33.33	8	30.77
Triple Vessel	5	7.94	5	19.23
Total	**63**	**100**	**26**	**100**
Chi-Square	1.28		p value	0.525

Table 14. Distribution Based on No. of Vessels Involved versus Gender

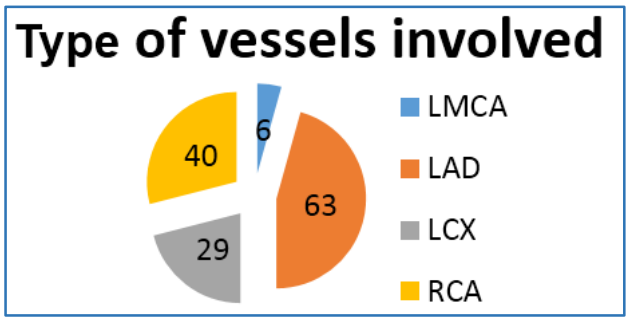
In the present study, no statistically significant relation was observed between no. of vessels involved and gender.



Type of Vessels	No.	Percentage
LMCA	6	5.9
LAD	63	62.4
LCX	29	28.7
RCA	40	39.6

Table 15. Distribution Based on Type of Vessels Involved

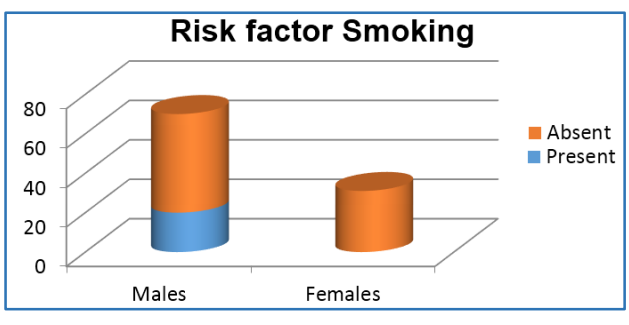
In the present study, 62.4% patients had involvement of left anterior descending artery followed by 39.6% who had involvement of right coronary artery, 28.7% had involvement of left circumflex artery and 5.9% had triple vessel disease.



Smoking	Males		Females	
	No.	%	No.	%
Present	20	28.6	0	0
Absent	50	71.4	31	100
Total	**70**	**100**	**31**	**100**
Chi-Square	11.04		p value	0.001

Table 16. Comparison of Gender with Risk Factor Smoking

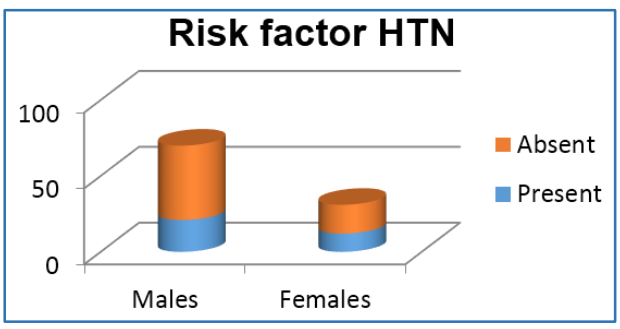
There was a statistically significant relation between gender and risk factor smoking, 28.6% of males had smoking as risk factor compared to 0% in females.



HTN	Males		Females	
	No.	%	No.	%
Present	21	30	12	38.7
Absent	49	70	19	61.3
Total	**70**	**100**	**31**	**100**
Chi-Square	0.74		p value	0.34

Table 17. Comparison of Gender with Risk Factor HTN

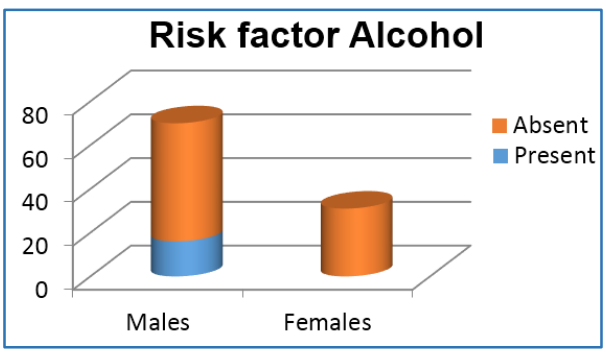
There was no statistically significant relation between gender and risk factor HTN, p>0.05.



Alcohol	Males		Females	
	No.	%	No.	%
Present	16	22.9	0	0
Absent	54	77.1	31	100
Total	**70**	**100**	**31**	**100**
Chi-Square	8.42		p value	0.004

Table 18. Comparison of Gender with Risk Factor Alcohol

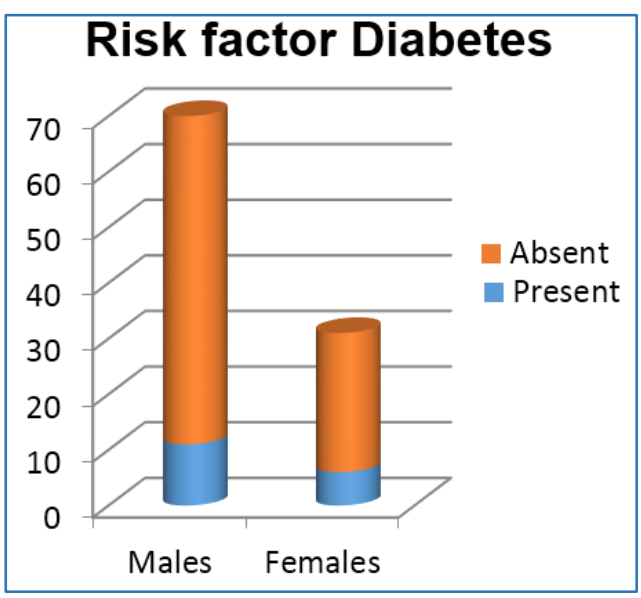
There was a statistically significant relation between gender and risk factor alcohol, 22.9% of males had alcohol as risk factor compared to 0% in females.



Diabetes	Males		Females	
	No.	%	No.	%
Present	11	15.7	6	19.4
Absent	59	84.3	25	80.6
Total	**70**	**100**	**31**	**100**
Chi-Square	0.203		p value	0.652

Table 19. Comparison of Gender with Risk Factor Diabetes

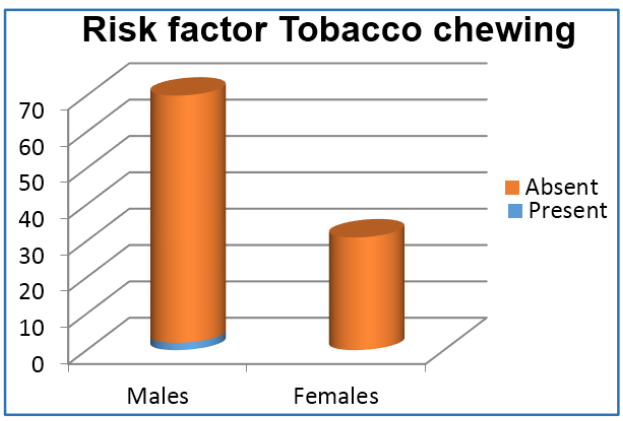
There was no statistically significant relation between gender and risk factor diabetes, p >0.05.



Tobacco Chewing	Males		Females	
	No.	%	No.	%
Present	2	2.9	0	0
Absent	68	97.1	31	100
Total	70	100	31	100
Chi-Square	0.904		p value	0.342

Table 20. Comparison of Gender with Risk Factor Tobacco Chewing

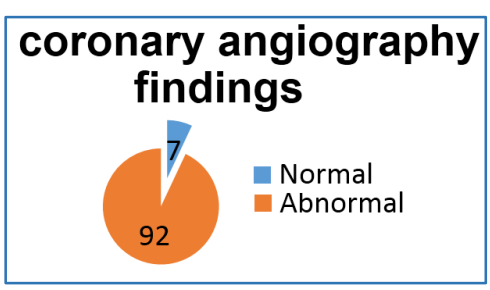
There was no statistically significant relation between gender and risk factor tobacco chewing, p>0.05.



Coronary Angiography	No.	Percentage
Normal	7	6.9
CAD	92	92.1

Table 21. Distribution of Patients Based on Coronary Angiography Findings

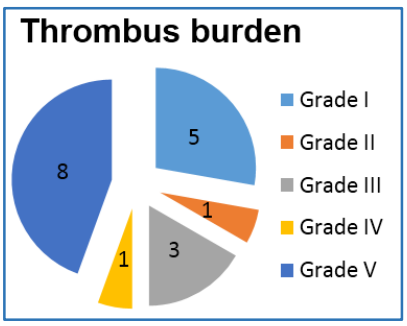
In the present study, it was observed that 92.1% patients had abnormal coronary angiography findings.



Thrombus Burden	No.	Percentage
Grade I	5	4.9
Grade II	1	1
Grade III	3	2.97
Grade IV	1	1
Grade V	8	7.9

Table 22. Distribution of Patients Based on Thrombus Burden

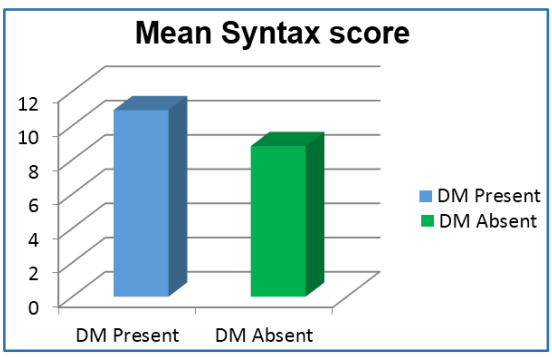
In the present study, 7.9% patients had grade V thrombus followed by 4.9% who had grade I, 2.97% had grade III and 1% each had grade II and grade IV, respectively.



Diabetes	Syntax Score	
	Mean	SD
Present	11.4	7.5
Absent	8.6	5.5
T value	1.8	p = 0.07

Table 23. Comparison of Mean Syntax Score in Relation to Diabetes

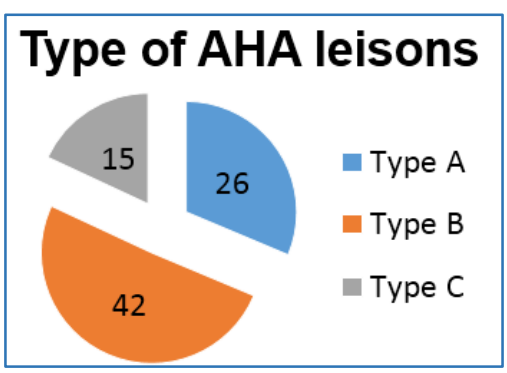
In the present study, it was observed that the mean syntax score was more in diabetic patients compared to nondiabetic. However, the increase in mean was not statistically significant p >0.05.



AHA Lesion	No.	%
Type A	26	25.7
Type B	42	41.6
Type C	15	14.8

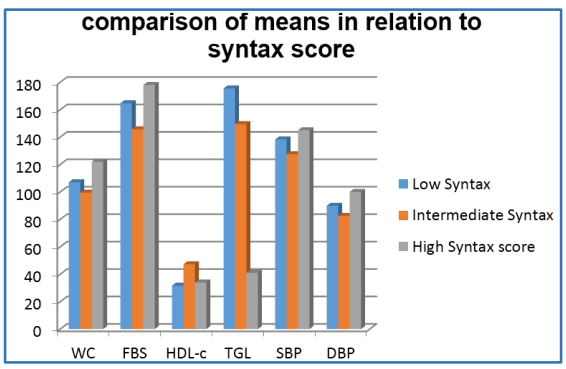
Table 24. Distribution of Patients Based on Type of AHA Lesions

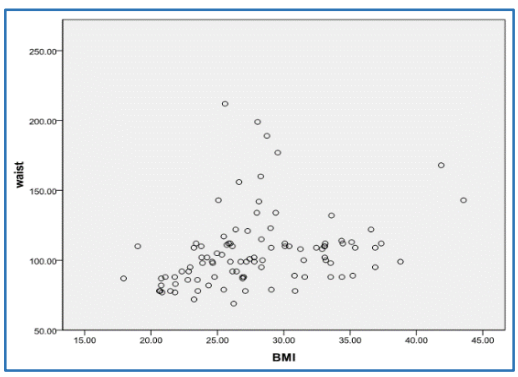
In the present study, it was observed that type A lesion was seen in 25.7% cases, type B lesion was seen in 41.6% cases and type C lesions were seen in 14.8% cases.



Parameter	Low Syntax		Intermediate Syntax		High Syntax Score	
	Mean	SD	Mean	SD	Mean	SD
Waist Circumference	107.1	28.9	99.5	9.8	122	
FBS	164.7	64.8	145.7	23.5	178	
HDL-C	31.7	6.4	47.25	12.2	34	
Triglycerides	175.5	55.7	149.5	33.5	41	
SBP	138.3	16.2	127.5	18.9	145	
DBP	89.9	9.7	82.5	9.5	100	

Table 25. Comparison of Means in Relation to Syntax Score





Scatter Diagram Showing Relation between Waist Circumference and BMI

DISCUSSION

In this prospective observational study, to evaluate the clinical and angiographic profile of metabolic syndrome with coronary disease, a total of 101 patients were included in the study from 2013 January to 2015 December of total cohorts, males were 70 (69.3%, n=70) and females were 31 (30.7%, n=31) patients. Studies have shown more prevalence of metabolic syndrome in female.[3] Although, some studies have shown more prevalence in men, which correlates with this study (69.3%, n=70 vs. 30.7%, n=31). Chow CK et al who studied lipid adiposity and metabolic abnormalities among 4535 Asian Indians found that by NCEP-ATP III classification metabolic syndrome were met by 26.9% of men and 18.4% in women.

The mean age of the studied population was 48.96±10.1 SD years, patients with less than 30 yrs. were 2.9% (n=3), patients with 31-40 yrs. were 23.7% (n=24), patients in the age group of 41-50 yrs. 31.7% (n=32), patients in the age group of 51-60 yrs. were 32.7% (n=33), patients in the age group >61 yrs. were 8.9% (n=9). The most common symptom, which was observed in the study was chest pain 91.1% (n=92) followed by breathlessness 7.9% (n=8). There was no statistical difference (>0.05) is observed in the study population between the gender and the symptoms, although chest pain was the major symptom in both male (94.3%, n=66) and female (83.9%, n=26) gender. With respect to the duration of symptoms, less than 24 hrs. was observed in 34.7% (n=35) patients, 1 day to 1 week was observed in 44.6% (n=45) patients, 1 week to 1 month in 15.8% (n=16) patients and 5% (n=5) presented after 1 month duration after onset of symptoms.

The Clinical Profile of the Patients Studied in This Study Represented in the Following Chart:

Parameter	Males		Females		t value	p value
	Mean	SD	Mean	SD		
Height	75.9	15	68.4	13.3	2.38	0.019
Weight	165.7	7.1	154.8	6.8	7.18	<0.001
BMI	27.6	5.2	28.4	4.7	0.80	0.42
Waist Circumference	108.1	26.1	101.7	26.6	1.12	0.26
ESR	15.1	12.2	17.4	14.8	0.80	0.42
FBS	154.9	60.8	169.1	63.5	1.05	0.29
HDL-C	31.5	7.4	33.4	7.5	1.12	0.26
Triglycerides	182.1	61.4	157.8	40.4	2.34	0.021
SBP	138.08	15.4	138.8	16.4	0.231	0.81
DBP	90.3	9.1	90.3	10.2	0.01	0.99
MAP	106.2	10.3	106.5	11.3	0.14	0.88

The clinical profile of the patients with the metabolic syndrome patients who satisfied 3 out of 5 criteria were 24.75% (n=25) who satisfied 4 out of 5 criteria were 48.51% (n=49) and patients who satisfied 5 out of 5 criteria were 26.73% (n=27), respectively. The mean height of all patients was 162.4 cm±8.6 SD, mean weight of the patients was 73.6 Kg/m 2±14 SD, mean BMI 27.9 Kg/m 2±5.08 Kg/m2. According to world health organisation classification of obesity,[4] most of the study cohorts were in overweight group representing 40% (n=40) followed by normal range of BMI 29% (n=29), class I obesity in 21% (n=21) patients, class II obesity was present 7% (n=7), class III obesity 2% (n=2) and under nutrition was seen in 1% (n=1) patients. In patients with metabolic syndrome, increased BMI >30 Kg/m2 is associated with increased mortality caused by cardiovascular disease.[5]

The mean BMI in male was 27.6±5.2 SD, female was 28.4±4.7 SD, which was not statistically significant when compared between the genders. The waist circumference, mean value in the males study cohort was 108.1±26.1 SD, females 101.7±26.6 SD, which was not statistical significant when gender was compared waist circumference. Among the patients in the study, mean fasting blood sugar was 159.2±61.2 mg/dL SD, mean HDL in study cohort was 32.1±7.5 mg/dL SD, mean triglycerides observed was 174.7±56.7 mg/dL SD, mean systolic and diastolic blood pressure, which was recorded in the study group was 138.3/90.3±15.6/9.4 mm of Hg. In the present study, it was observed that mean height (165.7 cm vs. 154.8, p=<0.001), mean weight (75.9 kg vs. 68.4 kg, p=0.019) and mean triglycerides (182.1 vs. 157.8, p=0.02) were being higher in males when compared females with statistically significant p value.

The components of the metabolic syndrome vary in the rate occurrence. The Seychelles study reported high blood pressure and adiposity as the metabolic syndrome defining criteria that occurred most commonly irrespective of the metabolic syndrome definition used. The present study cohorts except mean height, mean weight and triglycerides were higher in the male patients when compared with females, the other clinical profile was comparable in both genders. The 2D echo findings in the study group that were observed was in 5% (n=5) patients, there was severe LV systolic dysfunction, 22.8% (n=23) patients had moderate LV systolic dysfunction, 36.6% (n=37) patients had mild LV systolic dysfunction, 20.8% (n=21) patients had diastolic dysfunction and 14.9% (n=15) patients had a normal LV systolic function.

There was no statistical significance when the LV systolic function was compared between the genders, although the incidence of moderate-to-severe LV systolic dysfunction was higher in the male gender (28.6% n=20, 5.7% n=4 vs. 9.7% n=3, 3.2%, n=1). Crendal et al have examined the parameters of LV performance in patients with metabolic syndrome. They showed that these patients have higher LV mass, impaired LV diastolic function and lowered longitudinal strain.[6] In the present study, it was observed that 32.7% (n=33) patients had anterior wall MI followed by 28.7% (n=29) patients who had unstable angina, 25.7% (n=26) had inferior wall MI, 6.9% (n=7) patients had chronic stable angina and 5.9% (n=6) patients had NSTEMI. In young patients (age <45 yrs.) with acute MI, Zarich et al also reported that the prevalence of metabolic syndrome was high. In the present study, also MI accounted for 58.4% (n=59) with mean age group of 48±10 yrs. SD.

In the present study, there was 47.46% (n=28) of myocardial infarction patients were thrombolysed and remaining 52.54% (n=32) were not thrombolysed. The thrombolytic agent, which was used in 82.14% (n=23) was streptokinase and in 17.86% (n=5), the thrombolytic used was tenecteplase. When the diagnosis of coronary artery disease is correlated with gender, in females most common diagnosis was unstable angina 38.7% (n=12) and male gender the most common diagnosis was anterior wall myocardial infarction 40% (n=28). There was no statistically significant relation between clinical diagnosis of coronary artery disease and the gender (p= 0.05). In the study cohorts, male patients with single vessel disease was seen in 58.73% (n=37), double vessel disease was seen in 33.33% (n=21) patients, triple vessel disease was seen in 7.94% (n=5) patients.

Female patients with single vessel disease was seen in 50% (n=13), double vessel disease was observed in 30.77% (n=8), triple vessel disease was observed in 19.23% (n=5). Namita et al reported that patients associated with metabolic syndrome had more multivessel involvement (34% vs. 16%, p <0.001) than patients without metabolic syndrome.[7] In our study, most of the patients with metabolic syndrome had single vessel involvement (57.38%). This may be due to mean age, which was more in their study population (60±12.4 SD yrs. vs. 48.96±10.1 SD yrs.) when compared to our study. There was no statistical significance between the gender and number of vessels involved in patients with metabolic syndrome with coronary disease. In the present studied cohorts, the frequency of involvement of coronary arteries in patients with metabolic syndrome with coronary disease, the LAD was involved in 62.4% patients, LCX was involved in 28.7% patients, RCA was involved in 39.6% patients and triple vessel involvement was seen in 3.9% patients. When the risk factors are assessed in the study Cohorts, cigarette smoking was more associated with male patients when compared with female patients, which had statistical significance (p=0.001). The male (28.6%) patients had significantly higher smoking risk when compared to female patients.

In the Framingham study, the risk of myocardial infarction also increased with the daily number of cigarettes smoked. An increase of 10 cigarettes per day increased the risk of cardiovascular disease by 18% in men and 31% in women of all ages.[8] In the above study by postal questionnaire, 13,926 survivors of myocardial infarction (cases) recently discharged from hospitals in the United Kingdom and 32,389 of their relatives (controls) were taken into the study. The age group of 30-49 age group, smokers are 5 times more likely to develop myocardial infarction than the nonsmokers. In the present cohort, 30% of males

(p=21) were known hypertensives when compared to female gender where 38.7% (n=12) were known hypertensive patients. There was no statistical significance based on hypertension as a risk factor when compared between the genders (p>0.05), although there was more prevalence of hypertension among females.

Although, in metabolic syndrome patients, insulin resistance and central obesity are the main factors that contribute for development of hypertension. According to Franklin SS et al, metabolic syndrome patients have 2-fold risk of new-onset hypertension.[9] In the present study who were hypertensive on treatment before diagnosis of coronary artery disease were 32% with average waist circumference of 123.5 cm in both genders and average fasting blood sugars were 135 mg%, which states that group of patients having more central obesity and more deranged fasting blood sugars have higher incidence of hypertension. Among the patients with metabolic syndrome with coronary disease, t alcohol consumption was more commonly observed in the male gender when compared with the female gender (22% vs. 0%, p<0.05), which was statistically significant. This group of patients had a mean HDL of 32.14±4 SD mg/dL and triglycerides 175.59±62.23 SD mg/dL. Tobacco chewing was observed in 2.9% (n=2) cases in the present study with no statistical significance between the genders. In the present study, 16.83% (n=17) patients were diabetic at time of presentation with metabolic syndrome with coronary artery disease. The mean HDL was 26.5±4.95 SD mg/dL, mean triglycerides were 157±21.92 SD mg/dL, mean waist circumference 146±9.90 SD cm and mean blood pressure was 150/85 mm of Hg.

According to the WISE study[10] in which they evaluated the interrelationship between angiographic CAD, the metabolic syndrome and incident cardiovascular events 25% of cohorts were having metabolic syndrome. Patients with metabolic syndrome with diabetes apart from high fasting glucose level, the other 4 metabolic components were higher in this group of cohorts, which correlates with the present study in which the 4 components (HDL, triglycerides, waist circumference and blood pressure) were significantly abnormal. In the WISE study, angiographic coronary artery disease was higher in women with metabolic syndrome with diabetes when compared with women with normal metabolic status and those with only metabolic syndrome (57% vs. 26% vs. 33%).

Although, the above study included only female cohort, in the present study both males and females were included with metabolic syndrome with coronary artery disease. More number of diabetic patients were noticed in the female gender (19.4% vs. 15.7%), although there was no statistical significance when diabetes and gender was compared (p>0.05). In the present study, coronary artery disease with metabolic syndrome, out of total 101 patients, 99 patients underwent coronary angiogram. Out of the remaining 2 patients, one patient died and other patient had LV apical clot. So, angiogram was deferred in this patient.

Among the patients who underwent coronary angiogram, 92 patients were having coronary artery disease and remaining 7 patients had normal epicardial coronary artery disease (92.1% vs. 6.9%). Among the patients with normal coronary angiogram, most of the patients were females (males=2, females=5), i.e. about 71% of patients in the normal epicardial coronary group were females. In the WISE study, 40% of metabolic syndrome patients had normal coronaries, which was intermediate between the diabetic and normal metabolic status women (28% vs. 45%). This group of patients with normal coronaries were having intermediate 4-year event free survival rates when compared with the normal metabolic status and those with diabetic cohorts.

In the study by Timoteo et al,[11] conventional angiogram was used in a prospective study of 300 patients with suspected CAD of whom 40.5% had metabolic syndrome by AHA/NHLBI criteria, but not diabetes, 23% were diabetic and 36.7% had neither diagnosis. Significant CAD was present in 53.1% of the total population, 62.2% of the diabetic group, 46.3% of the metabolic syndrome group and 48.2% of the group with neither diagnosis. Half the patients in the study had normal coronary arteries (51%). The results of recent studies in patients with symptoms of ischaemia and in the absence of obstructive CAD. These patients have increased mortality and low quality of life. Non-atherosclerotic mechanism can contribute to the pathophysiology of this entity, spontaneous thrombosis, inflammation, endothelial dysfunction, microvascular dysfunction and angiogenesis have been shown to trigger myocardial ischaemia.[12]

Patients with coronary artery disease (>50% stenosis coronary artery stenosis on coronary angiography) with metabolic syndrome were 92.1% (n=92) were present in the study. The components of metabolic syndrome, the mean HDL 29±8.49 SD mg/dL, mean triglycerides 189±124.45 SD mg/dL, mean waist 100±18.38 SD cm, fasting blood sugars 101±12.73SD mg/dL and the mean blood pressure 140/90 mm of Hg. When compared to other cohorts with normal coronary arteries with metabolic syndrome except for mean blood pressure 130/87 mm of Hg, which was lower in this cohort, mean HDL was observed to be higher (34 vs. 29 mg%). The other components, mean triglycerides level was 193 mg%, mean waist circumference was 116 cm and fasting blood sugar was 191.5 mg% were also observed to be high in this cohort group metabolic syndrome with normal coronary arteries.

It is well accepted and established that multiple risk factors confer greater risk than a single risk factor. The Framingham experience has certainly suggested that multiple risk factors increase the risk of CVD more than the sum of the individual risk factors.[12] As in the Framingham study, the factors which contribute most to cardiovascular disease outcome was high blood pressure and low HDL. The same finding was seen in the present study of the metabolic syndrome with coronary artery disease, where our patients with CAD and metabolic syndrome had low HDL and high blood pressure when compared with a normal coronary artery with metabolic syndrome cohorts. In the Framingham study,[13] the metabolic syndrome was defined by ATP III

criteria. The patients who satisfy at least 3 out of 5 criteria were included in the study. The cardiovascular disease was defined as the presence of 1 or more definite manifestations of coronary artery disease (angina pectoris, coronary insufficiency, myocardial infarction and sudden or not sudden death as consequence of coronary artery disease).

In the participants who had metabolic syndrome (n=776; 376 men and 400 women), they were in turn divided into 3 triads: [1] high blood pressure, large waist circumference and high triglycerides; [2] high blood pressure, large waist circumference and lower HDL; [3] large waist circumference, high triglycerides and low HDL. The average follow up was 14 years. In total, there were 244 CVD events for a rate of 11.0% (244/2217), which was equivalent to 0.00769 CVD events per person- year of follow-up, men having a 14.3% CVD and women rate was 8.3%. The triad with large waist circumference, high blood pressure, hyperglycaemia conferring the highest risk of developing CVD (hazard ratio 2.36; 95% CI, 1.54 to 3.61), which had >3 fold increased risk of future mortality. The other significant triad was that of low HDL + high blood pressure + hypertriglyceridemia.

In the present study, the patients with metabolic syndrome with coronary disease had mean low HDL (29±8.49 SD mg/dL) + mean high blood pressure (140/90 mm of Hg, mean) + mean high triglyceride (189±124.45 SD mg/dL) in both genders.

In our observational cross-sectional study, patients with coronary artery disease with metabolic syndrome, 101 patients were evaluated.

The coronary artery lesions when assessed by the AHA/ACC classification,[14] most of the lesions were type B lesions 41.6% (n=46) followed by type A lesions 25.7% (n=26) and type C lesions were 14.8% (n=15). The main purpose of classification of coronary lesions is to assess the procedural success, which is high for type A lesion (>85%), least for type C lesions (<60%) and intermediate for type B lesions (60-85%). In our study, mostly type B lesions (41.6%) were noted, which had moderate procedural success. A study by Andhi Purabaya et al[15] in which 43 patients with or without metabolic syndrome who underwent a coronary angiogram enrolled based upon the NCEP ATP III criteria for metabolic syndrome for Asian populations. The results showed that metabolic syndrome patients (n=25, 58%) found to have type B lesions 40% and type C lesions were 60% with an incidence of total occlusion being 48%. In comparison with the present study, the patients with metabolic syndrome with coronary disease were 93 patients were studied in which type B lesion accounted up to 41%, which correlates with above study, but type C lesions were less (60% vs. 15.8%) and there were more of type A lesions (0% vs. 25.7%). Although, the type B lesions correlate with the above study, but not other type of lesions. This may be due to the sample size of the study, which was lower than the present study.

The thrombus burden was assessed in cohorts with metabolic syndrome with coronary disease by the TIMI thrombus scale,[16] which divides five grades from 0 to 5, grade 0- no thrombus, grade 1- angiographic features suggestive of thrombus like a smooth convex meniscus at the site of occlusion, grade 2- definite thrombus greatest dimension less than ½ vessel dimension, grade 3- definite thrombus greatest dimension >1/2 to <2 vessel dimension, grade 4- definite thrombus greatest dimension more 2 vessel dimension, grade 5- definite complete thrombotic occlusion of vessel.

The mainstay pharmacological treatment for thrombus containing lesions include aspirin, heparin, glycoprotein IIb/IIIa platelet receptor antagonists, thienopyridines, direct thrombin inhibitors and thrombolytic agents. The four main contemporary technologies for mechanical thrombus aspiration, powered sourced thrombectomy devices and embolic protection systems.

The largest prospective, randomised study (total trial)[17] evaluated the effectiveness of routine aspiration thrombectomy + PCI vs. routine PCI in patients with STEMI in 10, 732 patients. The routine thrombus aspiration during PCI for STEMI did not reduce long-term clinical outcomes and might be associated with an increase in stroke.

In the present study of total 93 patients with coronary disease with metabolic syndrome, 7.9% (n=8) patients had grade V thrombus followed by 4.9% (n=5) who had grade I, 2.97% (n=3) had grade III and 1% (n=1) each had grade II and grade IV, respectively. In the present cohort, only 3 patients with diabetes had thrombus in involved vessel.

In the present study, patients with metabolic syndrome with coronary artery disease when the severity of coronary artery disease was assessed by the syntax score in patients with diabetes and nondiabetics. It was observed that the mean syntax score was more in diabetic patients compared to nondiabetic. However, the increase in mean was not statistically significant (p >0.05). The mean syntax score in patients with metabolic syndrome with diabetes was 11.4 ±7.5 SD and the mean syntax score in the patients with metabolic syndrome without diabetes was 8.6±5.5 SD.

According to IDF criteria of diabetes patients with fasting blood glucose level more 7 mmol/L (126 mg%), the patient is diagnosed as diabetes. In the present study, patients metabolic syndrome with diabetic range 89.17% (n=74). In the present study, cohorts patients with metabolic syndrome with coronary artery disease, the syntax score[18] is divided into low (0-22), intermediate (23-32), high (>33) score.

The study cohort components of the metabolic syndrome where the mean values were compared with the high, intermediate and low syntax score. The patients with metabolic syndrome with coronary disease, the study cohorts mean waist circumference was compared with syntax score. The patients with high syntax score had more mean waist circumference (122 cm) compared with intermediate and low Syntax score. The mean fasting blood sugar levels when compared with a syntax score in the cohorts, the fasting high blood sugar levels were seen in patients with high syntax score (178 mg%) followed by cohorts having a low score (164.7±64.8 mg% SD), then

patients with an intermediate score had a mean fasting blood sugar levels (145.7±23.5 mg% SD).

When compared with other components of metabolic syndrome, mean HDL was low syntax score (31.7±6.4 mg% SD), the mean triglyceride levels were more in study cohorts with low syntax score (175.5±55 mg%), the mean blood pressure in the study cohort was more in patients with high syntax score (145/100 mm of Hg). So, the patients with low syntax score had high mean triglyceride levels, low HDL levels and where study cohorts with high syntax score had more mean waist circumference, high fasting blood sugar levels and high blood pressure levels.

A study by Noha Hassanin et al[19] in which they studied metabolic syndrome and coronary artery disease in Egyptians presenting with acute coronary syndrome patients included 122 patients in which 85 were men (69.7%) and 37 were women (30.3%) with mean age of 44.12±5.56 yrs. of this 50 patients were having metabolic syndrome were men (61.7%) and 31 were women (38.3%). In the study, they found that reduced HDL, increasing triglycerides and increased fasting blood sugars were the most common finding in patients with metabolic syndrome with CAD.

The number of coronary arteries affected were in the frequency of SVD- 37% patients, two vessel disease- 27% and multivessel- 36% of patients. The mean syntax score in patients with metabolic syndrome were 18.265±11.947. A positive correlation was found between the presence of metabolic syndrome and Syntax score (p=0.001). In comparison with the above study, our study had more male patients when compared to female patients and the mean age was 48.96±10.1 SD years. Total number of patients included in our study were 101, which is more than the above study in which 81 patients were included. The above study had a control group with no metabolic syndrome patients, while in our study, there was no control group to compare. In the present study cohorts, there was more single vessel involvement, least common was a triple vessel disease.

The diabetic population was 53.09% in the above study, but in our study, patients with diabetes at the time inclusion of study were 16.83%. The mean syntax score in the study cohort was lower than the mean syntax score of above study maybe due to more diabetics in the study population of the above study (18.265±11.9 vs. 9±1.41 SD). In the present study, the study cohort mean values of the different components were compared with the syntax score based upon low, intermediate and high syntax score. The mean waist circumference, fasting blood sugars and blood pressure were high in patients with high syntax score. There was a linear correlation between the BMI and waist circumference in the present cohorts with metabolic syndrome.

CONCLUSIONS

The present study in which patients with metabolic syndrome with coronary artery disease were evaluated prospectively from which following conclusions can be inferred:

1. More than 50% of cohorts were below the age of 50 yrs. with mean age of 48.96±10 years.
2. The most common symptom, which observed was chest pain in both genders.
3. Most cohorts in the study were satisfying 4 out of 5 criteria for metabolic syndrome.
4. (48.51%), most of the patients were in the overweight group of BMI, the mean height, mean weight and mean triglycerides were more in the male gender.
5. Most of the patients in the study presented with following clinical diagnosis anterior wall MI 32.7% (n=33), unstable angina 28.7% (n=29), inferior wall MI 25.7% (n=26), chronic stable angina 6.9% (n=7) and NSTEMI 5.9% (n=6).
6. Smoking ($p<0.001$) and alcohol ($p<0.05$) was more associated with male gender, hypertension was common in the female gender, diabetes was equal in both genders.
7. Coronary angiogram in this cohorts showed more single vessel involvement in both genders, more of type B lesions and grade V thrombus was seen in 7.9% of patients.
8. Mean syntax score in patients with metabolic syndrome with diabetes was higher when compared with mean syntax score in the patients with metabolic syndrome without diabetes, although it was not statistically significant (11.4±7.5 vs. 8.6±5.5, $p >0.05$).
9. The mean waist circumference, fasting blood sugars and blood pressure were higher in patients with high syntax score.
10. Normal coronary arteries with metabolic syndrome had a high mean HDL, mean triglycerides level, mean waist circumference, fasting blood sugars and whereas mean blood pressure was low.
11. Metabolic syndrome with coronary artery disease had mean low HDL (29±8.49 mg/DL, mean high blood pressure (140/90 mm of Hg, mean), mean high triglycerides (189±124.45 mg/DL) in both genders.

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