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Original Research Article

Prevalence of metabolic syndrome and its different components in patients with acute coronary syndrome

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ABSTRACT

Background: Several components of the Metabolic Syndrome (MetS) are risk factor for cardiovascular diseases. So, this study was conducted to evaluate the prevalence of MetS and its components in patients with CAD.
Methods: Author included all patients admitted with Acute Coronary Syndrome (ACS), who had CAD confirmed by coronary angiography. They were divided into two groups according to presence or absence of MetS based on International Diabetes Federation criteria. The prevalence of MetS and its individual components was estimated.
Results: It was observed that there is a high prevalence of MetS (66%) in patients admitted with ACS. Metabolic syndrome is more prevalent in female patients (82.4%) than in male patients (57.6%) with ACS. Hypertension is the most prevalent (87.9) component of MetS. Diabetes Mellitus (DM) is the 2nd most prevalent (83.3%) component of MetS. About 65.2% patients with MetS had abnormally raised triglyceride levels and 32(48.5%) had abnormally low HDL-cholesterol level. Among the MetS 38(57.6%) had abnormal waist circumference. Among the study group, the most common triad of MetS components was DM + HTN + abnormal TG. There is significant association between MetS and microalbuminuria, with incidence of 22(33.3%) in this study. Similarly, a significant association between DM and microalbuminuria, 23(33.8%) was observed.
Conclusions: This study confirms a very high prevalence of MetS in Indian patients with CAD. The prevalence of the risk factors was higher in CAD patients with MetS.

Keywords: Coronary artery disease, Diabetes mellitus, Hypertension, Metabolic syndrome, Prevalence, Triglycerides

INTRODUCTION

Coronary Artery Disease (CAD) is a major public health problem worldwide.[1] Its prevalence is increasing due to several reasons such as urbanization, demographic and lifestyle changes. Studies have suggested that the risk of Myocardial Infarction (MI) is mostly due to modifiable risk factors like smoking, physical inactivity, poor diet, psychosocial stress, hypertension, Diabetes Mellitus (DM), dyslipidemia and increased waist-hip ratio. Many of these risk factors occur together with or develop after onset of metabolic syndrome (MetS).

Globally, MetS presents as one of the leading health problems associated with increased morbidity and mortality from Cardiovascular Disease (CVD). It is referred by different terms such as syndrome X, insulin resistance syndrome, "deadly quartet" and obesity dyslipidemia syndrome.[2] In different studies the prevalence of MetS varied from 21.3% to 32.8%.[3]

As per ATP III criteria, MetS diagnosis is based on the existence of more than one of the following five criteria. These include Waist Circumference (WC) >102 in men and >88 in women, high Blood Pressure (BP ≥130/85), high Triglyceride (TG ≥150), high Fasting Blood Sugar (FBS ≥110), and low high-density lipoprotein (HDL <40 in men and <50 in women).[4] The American Heart Association (AHA) and National Health Lung and Blood Institute (NHLBI) modified the ATP III criteria with a reduction in FBS from 110 to 100 mg/ld.[5] The link between MetS and its components with CAD has been documented in many studies.[6]

Individual MetS components are considered as an independent cardiac risk factor. More the number of components of MetS in a patient, higher is the severity of CVD. Central obesity is more atherogenic as compared to peripheral obesity.[6] Waist circumference is evaluated to identify the central obesity. Central obesity has strong association with dyslipidemia, diabetes and increased risk of cardiovascular events. Insulin resistance posse as one of the main components of MetS that affects the development of CAD.[6] Diagnosis of MetS and its components in patients with CAD can influence results of programs for prevention and management of the disease.[6]

MetS, has been linked to a high incidence of both of type 2 diabetes mellitus and CAD. Few studies have reported MetS and documented its association with young CAD patients.[7]

Comprehending the consequences of MetS on CAD is significant for planning public health policy towards its prevention and management. There are limited data available on the prevalence of MetS in Indian population because of varied extent of urbanization, lifestyle patterns, and socioeconomic/ cultural factors. Western studies suggest that MetS is very commonly associated with CAD, but data Indian subcontinent is limited. Hence, this study aimed to ascertain the prevalence of MetS and its clinical and angiographic profile in patients with naive ACS in Indian population.

METHODS

This cross-sectional study was carried out at Holy Family Hospital, Bandra (West), Mumbai from 1st August 2015 to 31st January 2017. The study was conducted after obtaining institutional ethical committee approval. Informed and written consent was obtained from all participants.

Inclusion criteria

- Patients of either sex, 40-80 years of age, with acute coronary syndrome [ST-elevation myocardial infarction (STEMI) and non-ST-elevation myocardial infarction (NSTEMI)] and normal hepatic and renal parameters.

Exclusion criteria

- Patients with previous history of CVD, unstable angina, impaired renal function, neoplastic disease, cardiomyopathies, thyroid dysfunction, acute infection and cardiogenic shock at admission were the exclusion criteria.

Eligible patients were included in the study. Demographic and clinical data were obtained from the clinical histories: age, sex, weight, height, previous atherosclerotic vascular disease (defined as previous coronary disease, stroke, or peripheral arterial disease), hypertension, diabetes mellitus, a sedentary lifestyle (defined as performing less than 30 min of moderate exercise 3 days per week), and previous lipid-lowering treatment.

Careful measurements of Waist Circumference (WC) and blood pressure were taken. About ≥3 measurements of BP were recorded at the time of entry if values were greater than or equal to 140/90 mmHg on an average. Any medications for hypertension was considered significant. Waist circumference was measured as suggested by the national health and nutritional survey. Peripheral venous blood samples were collected after an overnight fast for lipid profile (total cholesterol, High Density Lipoprotein Cholesterol (HDL-C), Low Density Lipoprotein Cholesterol (LDL-C) and triglycerides) and fasting plasma glucose evaluation.

The patients were diagnosed and classified either upon admission or later during the hospitalization, according to definition of ACS by the World Health Organization and the official guidelines of the European Society of Cardiology.[8,9] All patients who presented with symptoms compatible with myocardial ischemia having raised CK-MB or troponin I within 48 hours from admission, were considered to have an ACS. If the electrocardiogram at rest showed ST-segment elevation in 2 contiguous leads (≥2 mm in V1-V3, or ≥1 mm in the other leads) or new left bundle-branch block in conjunction with elevated cardiac enzymes, the syndrome was characterized as ACS with ST-Segment Elevation (STEMI). Cases with elevated cardiac enzymes without the previously mentioned electrocardiogram abnormalities were considered as ACS without ST- Segment Elevation (NSTEMI).

Unstable angina was defined as angina pectoris with at least 1 of the following 3 features: (1) pain at rest (or with minimal exertion), (2) new-onset severe angina (i.e., within 1 month), and occurring with a crescendo pattern. (3) NSTEMI and unstable angina have similar presentation and management and their distinction is based on the measurement of myocardial injury biochemical indices. Patients with unstable angina were not included in the study group, as it is a subjective and ambiguous diagnosis which can vary with the treating physician and history of the patients.

All patients were evaluated for the presence of Metabolic Syndrome based on NCEP ATP III criteria.[10] Patients were diagnosed as MetS if they had any 3 of the following criteria: abdominal obesity (waist circumference >102 cm in males and >88 cm in females), high TG levels (≥150 mg/dL), low HDL-C levels (<40 g/dL in men and <50 mg/dL women), fasting blood glucose level ≥100 mg/dL, and high blood pressure (reported history of hypertension, or treated hypertension, or measured blood pressure ≥130/85). Subjects receiving lipid-lowering treatment, including statins, were regarded as having dyslipidemia.

Statistical analysis

After data entry in Microsoft Excel 2010, data analysis is conducted with help of SPSS software version 15. Qualitative data is presented with the help of frequency and percentage table. Quantitative data is presented with the help of mean and standard deviation. Association among various qualitative variables is done with the help of Chi Square test, p value <0.05 is taken as level of significance.

RESULTS

This was a study conducted at Holy Family Hospital, Bandra (W), Mumbai to evaluate metabolic syndrome in 100 patients with Acute Coronary Syndrome. The patients with ACS had a high prevalence of Metabolic Syndrome 66(66%). In the present study, the mean age of the patients with MetS was 63.02 years and patients without MetS was 60.88 years. Of the 66 MetS cases, 38(57.6%) had abnormal waist circumference as compared to 28(42.4%) patients with normal waist circumference, which is statistically found to be significant (p<0.05).

A high prevalence of metabolic syndrome (66%) was noted in patients admitted with acute coronary syndrome (STEMI and NSTEMI). Metabolic Syndrome was more prevalent in females (82.4%) than in males (57.6%) among the study groups. Among the patients with MetS, 44(66.7%) had STEMI as compared to 22(33.3%) patients with NSTEMI.

Hypertension was the most prevalent component of MetS in the present study. In the present study, among the 66 patients with MetS, 58(87.9%) had hypertension as compared to 15(12.1%) non hypertensive patients, which is statistically found to be significant (p<0.05). Thus, it was the most prevalent component of MetS in the present study. Whereas, of the 66 patients with MetS, 55(83.3%) had diabetes mellitus as compared to 11(16.7%) nondiabetic patients, which is statistically found to be significant (p<0.05). Diabetes Mellitus was the 2nd most prevalent component of MetS in the present study.

There was significant association between MetS and microalbuminuria that is 22(33.3%) cases of 66 MetS patients as compared to 44(66.6%) patients without microalbuminuria, which is statistically found to be significant (p<0.05). In the present study, 68 patients were found to be Diabetics, of which 23(33.8%) had microalbuminuria which was statistically found to be significant (p<0.05). There is significant association between diabetes mellitus and microalbuminuria with incidence of 23(33.8%) among 68 diabetic study participants.

Among the 66 patients with MetS in the present study, 43(65.2%) had abnormally raised TG levels as compared to 23(34.4%) patients with normal TG levels, which is statistically found to be significant (p<0.05). Whereas, 32(48.5%) had abnormally low HDL-cholesterol level as compared to 34(51.5%) patients with normal HDL-cholesterol level, which is statistically found to be significant (p<0.05). The clinical profile of the CAD patients with MetS and no metabolic syndrome is summarized (Table 1).

Table 1: Clinical profile of CAD patients with metabolic syndrome and no metabolic syndrome.

Parameter	Metabolic syndrome (n=66)	No metabolic syndrome (6=44)
Age (years)		
40 to 49	11(16.7%)	5(14.7%)
50 to 59	13(19.7%)	9(26.5%)
60 to 69	20(30.3%)	11(32.4%)
70 to 79	22(33.3%)	9(26.5%)
Male	38(57.6%)	28.(42.8)
Female	28(82.4%)	6(17.6%)
STEMI	44(66.7%)	23(67.67)
NSTEMI	22(33.3%)	11(32.4)
Hypertension	58(87.9%)	47.1(%)
Diabetes mellitus	55(83.3%)	13(38.2%)
Triglycerides (>150) mg/dL	43(65.2%)	3(8.8%)
HDL (Normal-Male>40, Female > 50)	32(48.5%)	4(11.8%)
Waist circumference (Normal-Male <102, Female <88)	38(57.6)	2(5.9%)

Among the study group, the most common triads of MetS components was DM + HTN + abnormal TG. Among 66(66%) patients with MetS, 44 patients had 3 components, 17 patients had 4 components and 5 patients had all 5 components of MetS (Figure 1).

In the present study, it is seen that all 5 components of Metabolic Syndrome were found more frequently in ACS patients with the metabolic syndrome as compared to

ACS patients without MetS, which is statistically found to be significant ($p<0.05$). In the present study group, the most common triads of Metabolic Syndrome components are DM + HTN + TG, DM + HTN + Abnormal Waist circumference and DM + Abnormal HDL + Abnormal TG (Figure 2). DM was common to all 3 triads (Figure 2).

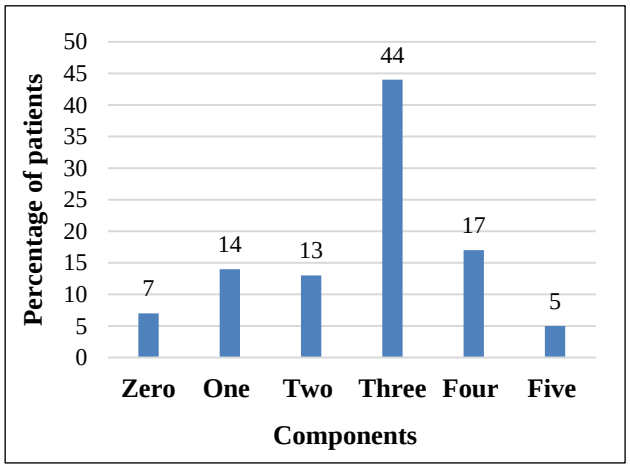

Figure 1: Distribution of study group as per components of metabolic syndrome.

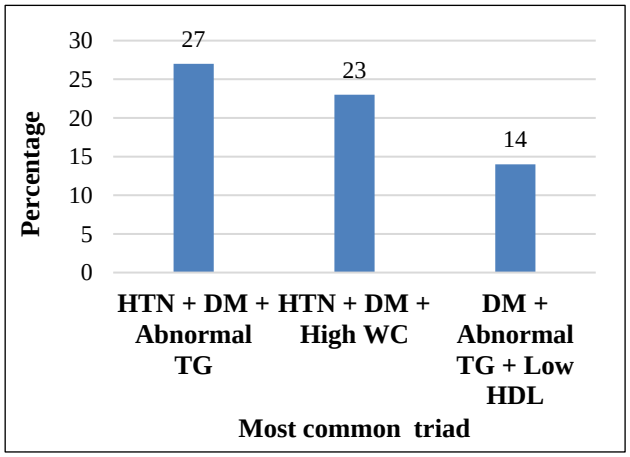

Figure 2: Most frequent combination triads of the metabolic syndrome components.

DISCUSSION

MetS is a major public health problem of 21st century. It is characterized by a collection of risk factors such as raised triglyceride, low HDL, glucose intolerance, hypertension and abdominal obesity that may lead to the development of CAD. Asian including Indians are more vulnerable to diabetes and premature CAD, which is attributed to increased insulin resistance and characteristic abdominal obesity.

Using NCEP-ATP III criteria for defining MetS, this study observed that patients with ACS had 66% prevalence of MetS which is alarmingly high. The studies determining the prevalence of MetS and/or associated risk factors in CAD patients showed that the rate of MetS in patients with ACS was between 43% and 51%.[11] Suwaidi et al, and Sinha et al, reported the prevalence of MetS in ACS as 46% and 37.65% respectively.[12,13] However, Danciu et al, and Pandey et al, reported 26% and 26.19% prevalence of MetS in ACS respectively which was on the lower side.[14,15] It has recently been confirmed that MetS is an independent predictor of ACS in patients that can be controlled by secondary prevention.[16] Authors findings demonstrate that the prevalence of MetS in CAD patients is comparatively higher than other parts of the world. Reason for these differences could be due to definition of MetS using different criteria, cultural factors, lifestyle-related factors such as wrong dietary habits, lack of physical activity, stress and variation in sample size.

Diverse blends of the components of MetS have different impact on CVD; nonetheless, each component acts as an independent risk factor for CAD. Moreover, and together they interact synergistically resulting in higher risk of CAD.[1] The differences in prevalence of individual components of MetS in CAD patients has been documented in various studies.[1,11,17]

In the present study, the mean age of the patients with MetS was 63.02 years and patients without MetS was 60.88 years similar to that reported by Pandey et al, and Sinha et al.[13,15] Patients with MetS were 3 years older than without MetS. Similar finding was observed by Yasar et al, and Dohi et al.[18,19] Though, the difference in age is not statistically significant.

Many countries have similar prevalence of MetS between women and men, while some have significantly higher numbers of women than men that meet the MetS criteria.[20] Several studies have documented that women are at higher risk for MetS than men.[21] In the present study, it is seen that MetS is more prevalent in females (82.4%) than in males (57.6%) which is similar to other studies.[21-23] Zaliunas R et al, reported prevalence of 70.2% and 52.6% MetS in females and males respectively.[22] In the study by Ana Jover et al, it was seen that MetS was present in 66.3% females as compared to 47.3% males, similar to authors results.[23] In the study counted in south west of Iran, it was seen that MetS was present in 52.8% females as compared to 47.2% males, comparable to the present study.[21] There is an ongoing debate in the relation between gender and MetS in different studies as some studies have documented higher prevalence of MetS in men women.[20] Several factors could be responsible for higher prevalence of MetS in women such as genetic, cultural, physical activity and nutritional differences.

Central obesity, abnormal lipid levels, dyslipidemia (high TG and low HDL-C), hypertension and hyperglycemia are the most common components of MetS. The severity of CAD is directly proportional to the number of

components.[24] In the present study, it was seen that all 5 components of MetS were more frequently in ACS patients with the MetS as compared to without MetS, which is statistically significant ($p<0.05$). This was in congruence with study findings by Ranjith et al.[25] MetS increases cardiovascular risk and each of its components is associated with an increased risk of CVS. A clinical study demonstrated that amid different components of MetS, low HDL, high FBG, and high BP had the highest Odd Ratio for CAD which also increases number of diseased vessel affected.[26] Another study revealed that MetS was independently associated to coronary parameters such as obstructive plaque and coronary artery calcium score in the non-diabetic CAD patients.[6]

Hypertension is one of the main the components of MetS in individuals with CAD. Similar to this study, hypertension was most prevalent component of MetS in study by Osei-Yeboah J et al, with prevalence of 66.67% in ACS patients.[27]

Amongst the different components of MetS, diabetes is markedly associated with CAD. A study reported that the prevalence of CHD in the diabetic patients with MetS was significantly higher than in those without MetS.[28] About 83.3% patients with MetS had diabetes which was the 2nd most prevalent component of MetS in this study group. The high prevalence of diabetes in patients with established CAD have been documented few other studies as well.[29] However, study by Prasad et al, reported a lower prevalence (19%) of diabetes in MetS patients.[30] It is now confirmed that long duration diabetes is associated with the development and progression of atherosclerosis.

Triglyceride levels are raised in patients with MetS. This is also evidenced in studies by Ana Jover et al, and Pandey et al, where abnormally raised TG levels were present in 65.2% and 59% of patients, respectively.[15,23] The results of this study are in congruence with these finding.

The hypertension, increased triglycerides and decreased HDL cholesterol levels can be attributed to lifestyle, especially dietary habits such as high carbohydrate, cholesterol and excess salt intake and lack of exercise.

Atherogenic dyslipidemia is more prevalent in south Asians with low HDL-C and higher levels of small dense LDL in comparison to Caucasian population.[31] Among the individual components of MetS, low HDL-C levels were distinctly associated with CAD in these patients. In this study 32(48.5%) patients with MetS had low HDL-cholesterol ($p<0.05$). This is in congruence with study by Rajeev Goyal et al, where abnormally low HDL cholesterol levels were present in 62.5% ACS patients with MetS. Higher percentage of low HDL in Indian population was reported by Goswami et al, in MetS patients with CAD.[32]

Genetic factors probably are critical cause of higher prevalence of lower HDL and some specific genes may be responsible.[33] The variation in the prevalence of MetS in different parts of the world can be significant as the diagnostic criteria.

Waist Circumference (WC) has been recognized as one of the important predictive tools for MetS. In the present study, 38(57.6%) patients with MetS had abnormal waist which was comparable to 63.6% in study by Pandey et al.[15] Waist circumference is convenient, cheap and non-invasive investigational tool that can be utilized in clinical practice. The validated WC cut points (≥94 cm in men and ≥80 cm in women) for European populations are available, unfortunately country specific WC cut-offs are unavailable for screening abdominal obesity.[34]

The most common triads of MetS components observed in this study were DM + HTN + TG, DM + HTN + abnormal WC and DM + abnormal HDL + abnormal TG. DM being common to all 3 triads. In the study by Ana Jover et al, it was seen that the most common triad of MetS components in patients with ACS was carbohydrate metabolism disorder, hypertension and abnormally low HDL-cholesterol.[23]

In this study, 33.3% patients with MetS had microalbuminuria ($p<0.05$) which was in congruence with 35% microalbuminuria in study done by XH li et al.[35] In the study done by CS Sheng et al, 12% of the patients of MetS had microalbuminuria as compared to 2.9% of the patients without MetS.[36] In this study, 68 patients were had diabetes, of which 23(33.8%) had microalbuminuria ($p<0.05$). Chowta et al, reported 37% of the diabetic patients had microalbuminuria which is comparable to the present study.[37] Whereas Padmaja K Rani et al, reported slightly lower microalbuminuria 15.9% in of the diabetic patients.[38]

In the present study, the CAD patients with MetS had higher levels of BMI, WC, BP, serum lipid profile, and FBG, and lower HDL-C levels; however, regression analysis revealed that the rate of different components of MetS, including singularly a much higher rate of low HDL-C, high blood glucose and high WC, with the highest OR, and a relatively high prevalence of high TG and high BP was found in patients with MetS than those without MetS. Genetic factors probably are critical cause of higher prevalence of lower HDL and some specific genes may be responsible.[33]

This study being observational, has the inherent limitations of observational studies which is not possible to eliminate because of the nonrandomized nature and unmeasured confounding factors. The number of patients enrolled in this prospective single center study represents a relatively small sample size. The study was carried out in hospital which is situated in urban area. So, the result of this study cannot be generalized. Follow-up is needed

to study the prognosis after ACS in patients with and without MetS.

CONCLUSION

There is high prevalence of metabolic syndrome in patients with ACS. Women with ACS show a higher prevalence of MetS than men. Hypertension is the most prevalent component in patients with ACS followed by DM. The most common triads of MetS components are DM + HTN + Abnormal Triglyceride, DM + HTN + Abnormal WC and DM + Abnormal TG + Abnormal HDL with DM being common to all 3 triads. Healthcare professionals should always make efforts to early identification of components of MetS. They should routinely measure waist circumference and screen for low HDL, which is usually ignored in practice. The presence of MetS or any of its components should trigger an aggressive approach toward patient education and implementation of primary and secondary measures to help reduce the prevalence of ACS. This study suggests that there are several modifiable and reversible components which could be managed by early lifestyle and pharmacological intervention which could reduce the prevalence of MetS in patients with ACS.

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