Prevalence and Characteristics of Metabolic Syndrome in Northeast Thai Patients with Obstructive Coronary Artery Disease

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Abstract

Background: Metabolic syndrome (MetS) is a risk factor for coronary artery disease (CAD) and is associated with adverse outcomes. However, the prevalence and characteristics of MetS in Northeast (NE) Thai patients with obstructive CAD has not been demonstrated.

Objective: This study examined the prevalence and characteristics of MetS in NE Thai patients with obstructive CAD.

Methods: We studied 120 consecutive patients with evidence of obstructive CAD, which was defined by diameter stenosis of 50% or more in at least one epicardial coronary artery detected by elective coronary angiography between 2008 and 2011. MetS was defined by a combination of the International Diabetes Federation (IDF) and National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATPIII) criteria.

Results: A total of 120 subjects were included in our study cohort (median age 63 [56-66.5], 71% were men and the median body mass index (BMI) was 24 [22.3-27.6] Kg/m^2). The prevalence of MetS was 75% and occurred more frequently in men (62.2% of MetS cases). The patients with MetS had significantly higher BMI (25.21 [IQR: 23.43-28.04] vs. (23.60 [21.3-24.5], p =0.001), waist circumference (91.25 [87-97] vs. 86 [82-89], p=0.01), fasting plasma glucose (102 [91-129.5] vs. 89 [85-97], p=0.009), triglyceride (191 [142-269] vs. 140 [99-178], p=0.003) and rates of hypertension (85.6% vs. 36.7%, p<0.001). Low high-density lipoprotein (HDL)- cholesterol (96.7%) and hypertension (85.6%) were the most frequent components of MetS.

Conclusions: There was a high prevalence of MetS among NE Thai patients with obstructive CAD and it was associated with low HDL cholesterol and hypertension.

Key Words: *prevalence, metabolic syndrome, coronary artery disease,*

Abbreviations

CAD = Coronary Artery Disease
MetS = Metabolic Syndrome
IDF = International Diabetes Federation
NCEP-ATPIII = National Cholesterol Education Program Adult Treatment Panel III

Introduction

The prevalence of coronary artery disease (CAD) has been increasing and remains the leading cause of death worldwide(1). Despite the considerable attention to cardiovascular risk factors and advances in medicine and revascularization treatment, the mortality risk of CAD remains high(1-3). Therefore, there is a need to identify risk factors to prevent the processes that contribute to CAD development and progression.

Metabolic syndrome (MetS) represents a cluster of cardiovascular risk factors, including central obesity, dyslipidemia, hypertriglyceridemia, impaired glucose tolerance and elevated blood pressure(4). In particular, MetS is associated with the risk of CAD and a significant increase in risk of cardiovascular morbidity and mortality(5-7). The prevalence of MetS is rapidly increasing worldwide(8). Moreover, by 2006, the relative contribution of the prevalence and risk factors criteria to MetS varied substantially among countries(9). Whereas, there is little information available about the prevalence and characteristics of MetS in northeast (NE) Thai patients with obstructive CAD. Therefore, in this study, we sought to examine the prevalence of MetS and characteristics of MetS criteria in NE Thai patients with obstructive CAD detected by elective coronary angiography.

Methods

Study Population

This single-center cross-sectional study was approved by the Khon Kaen University Ethics Committee in Human Research (HE591325) and was conducted in accordance with the Declaration of Helsinki. All participants provided written informed consent. We included adult subjects (aged, ≥20 years) with signs or symptoms of CAD who underwent elective, non-urgent coronary angiography at the Queen Sirikit Heart Center of the Northeast, Department of Medicine, Faculty of Medicine, Khon Kaen University, Thailand between 2008 and 2012. We excluded from the study those patients who had experienced acute coronary syndrome or revascularization procedures within 30 days prior to enrollment, or suffered from liver disease, renal disease, cancer, or inflammatory disease. The obstructive CAD was defined by diameter stenosis of 50% or more in at least one epicardial coronary artery as graded by the individual board-certified cardiology staff at the Queen Sirikit Heart Center of the Northeast. Obstructive CAD was defined based on the American College of Cardiology Foundation and American Heart Association guidelines(2, 10). A total of 120 consecutive patients were included in this study.

MetS was defined using a combination of the International Diabetes Federation (IDF) and national Cholesterol Education Program Adult Treatment Panel III (NCEP-ATPIII) criteria, with modification of waist circumference (WC) for Asian populations (11, 12). This definition requires at least three of the following components: 1) central obesity (waist circumference (WC) ≥ 90 cm in men, and ≥ 80 cm in women), 2) triglyceride concentration ≥ 150 mg/dL or on triglyceride-lowering medication, 3) HDL-cholesterol < 40 mg/dL in men and < 50 mg/dL in women or on medication for low HDL-cholesterol, 4) systolic blood pressure ≥ 130

mmHg and/or diastolic blood pressure ≥ 85 mmHg or on antihypertensive medication, and 5) fasting plasma glucose (FPG) concentration ≥ 100 mg/dL or drug treatment for elevated glucose

Laboratory Testing

Fasting blood samples were collected after 12-hour overnight fasting, before catheterization procedure, and sent for analysis within 3 hours of collection. Analysis of routine biochemical markers were performed on samples using the Hitachi 917 automatic analyser (Roche Diagnostics, Basel, Switzerland). Analysis of high-sensitivity C-reactive protein (hsCRP) was performed using the BN ProSpec® System (Siemens Healthcare Diagnostics products GmbH, Marburg, Germany). An estimated glomerular filtration rate (eGFR, mL/min/1.73m^2) was calculated using the Cockcroft-Gault equation. WC was measured midway between the inferior margin of the last rib and the iliac crest.

Statistical Analyses

Continuous data are presented as mean (standard deviation) or median (interquartile range) and compared with a Student's t-test or non-parametric test when appropriate. Categorical variables are presented numerically (percent, %) and were compared between groups using chi-square tests. All analyses were performed used Stata version10.1 (Stata Corp., College Station, Tx, USA). A p value < 0.05 was considered statistically significant.

Results

Baseline Characteristics

The Baseline characteristics of our study cohort are provided in Table 1.

Overall, the median age of the patients involved in this study was 63, 71% were men, 50% had diabetes, 73% had hypertension, and the median body mass index (BMI) was 24 Kg/m^2.

The prevalence of MetS was 75%. Of these patients, 62.2% were men. The patients with MetS had significantly higher BMI (25.21 [IQR: 23.43-28.04] vs. (23.60 [21.3-24.5], p =0.001), WC (91.25 [87-97] vs. 86 [82-89], p=0.01), fasting plasma glucose (FPG) (102 [91-129.5] vs. 89 [85-97], p=0.009), triglyceride (191 [142-269] vs. 140 [99-178], p=0.003) and rates of hypertension (85.6% vs. 36.7%, p<0.001). In contrast, age of the patients, LDL-cholesterol and eGFR, were similar between patients with MetS and non-MetS. Interestingly, patients with MetS tended to have lower LDL cholesterol, though not at a rate that was statistically significant (102 [75-126] vs. 105 [7l1-132], p=0.53) (Table 1).

Not surprisingly, a higher percentage of MetS patients had high WC (91.9% vs. 8.1%, p<0.001), low HDL cholesterol (79.8% vs. 20.2%, p<0.001), hypertension (87.5% vs. 12.5%, p<0.001), impaired FPG (93.3% vs. 6.6%, p<0.001) and high triglyceride (83.3% vs. 16.7%, p=0.01) compared to non-MetS patients (Table 2). Furthermore, patients with MetS were more likely to be overweight (72.2% vs.27.8%, p<0.001) and obese (88.7% vs. 11.3%, p<0.001), whereas none of the underweight patients had MetS (Table 2).

In our study cohort, the most prevalent metabolic component abnormalities among MetS patients were low HDL-cholesterol (96.7%) and hypertension (85.6%), followed by high WC (75.6%), high triglyceride (66.7%) and impaired FPG (62.2%) (Figure 1).

Table 1. Baseline Characteristics of Study Subjects

| Variable	Metabolic Syndrome, (n=90)	Non-Metabolic Syndrome (n=30)	P Value
Age, years	62.5 (57-67)	64(58-70)	0.49
Male, %	56(62.2)	29(96.7)	<0.001
BMI, (Kg/m^2)	25.21(23.43-28.04)	23.60(21.3-24.5)	0.001
Waist circumference, (cm)	91.25(87-97)	86(82-89)	0.01
Hip Circumference, (cm)	95(92-99)	90(87-95)	0.004
Current Smoker, %	16(17.8)	13(43.3)	0.005
Diabetes mellitus, %	56(62.2)	4(13.3)	<0.001
Hypertension, %	77(85.6)	11 (36.7)	<0.001
Systolic BP, mmHg	131.5(122-144)	123(113-129)	0.001
Diastolic BP, mmHg	73(68-82)	70(64-76)	0.14
Total cholesterol, mg/dl	187(153-211)	184.5(143-212)	0.003
LDL cholesterol, mg/dl	102(75-126)	105(71-132)	0.53
HDL cholesterol, mg/dl	37(31-46)	41(35-48)	<0.001
Triglyceride, mg/dl	191(142-269)	140(99-178)	0.003
FPG, mg/dl	102(91-129.5)	89(85-97)	0.009
eGFR, (mL/min/1.73m^2)	65.6(51.8-78.8)	59.40(46.6-80.4)	0.61

Value expressed in median (interquartile range) or %

BMI=Body Mass Index, cm = centimeter, BP=blood pressure, LDL=low-density lipoprotein, HDL=high-density lipoprotein, FPG=fasting plasma glucose, eGFR=estimated glomerular filtration rate.

Table 2. Characteristics of Metabolic Syndrome (MetS) Criteria and Body Mass Index
(BMI) category between MetS and non-MetS

	Metabolic Syndrome	Non-Metabolic Syndrome	P Value
Metabolic Syndrome Criteria			
Impaired FPG (n=60)	56 (93.3)	4 (6.7)	<0.001
Hypertension (n=88)	77 (87.5)	11 (12.5)	<0.001
High Triglyceride (n=72)	60 (83.3)	12 (16.7)	0.009
Low HDL-C (n=109)	87 (79.8)	22 (20.2)	0.001
High WC (n=74)	68 (91.9)	6 (8.1)	<0.001
Body Mass Index (BMI, kg/m², Category			
Underweight, BMI<18.5 (n=2)	0	2 (100)	0.001
Normal, BMI 18.5-22.9 (n=29)	17 (59)	12 (41)	0.01
Overweight, BMI 23-24.9 (n=36)	26 (72.2)	10 (27.8)	<0.001
Obese, BMI >25 (n=53)	47 (88.7)	6 (11.3)	<0.001

Abbreviations as in Table 1.
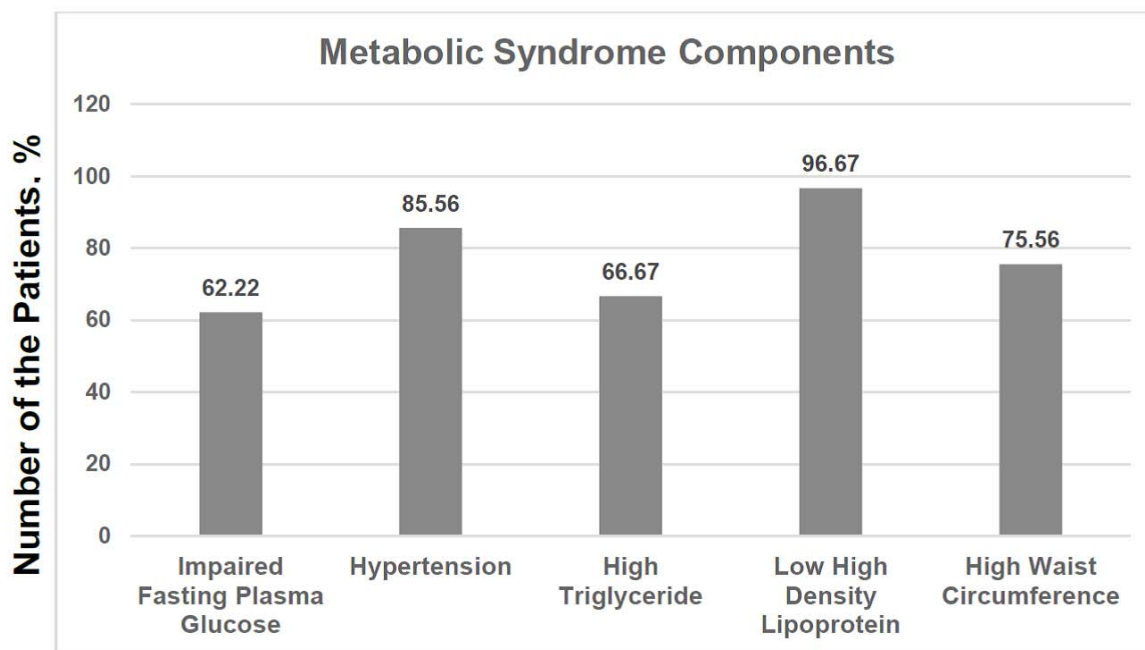
Figure 1. Prevalence of Metabolic Syndrome Criteria among Patients with Metabolic
Syndrome

Discussion

Our study demonstrates a high prevalence of MetS in NE Thai patients with obstructive CAD. Moreover, the prevalence of obesity (BMI>25 kg/m^2) in patients with MetS was significantly higher than patients without MetS. Among patients with MetS, low HDL-cholesterol and hypertension were the most frequent metabolic abnormalities.

Established CAD was strongly associated with concomitant atherosclerosis in multiple vascular beds and cardiovascular death and mortality(13, 14). Moreover, MetS significantly increased risk for progression and mortality among patients with CAD(3, 15, 16). It is also recognized that patients with MetS have higher cardiovascular-related and overall mortality than those without MetS (5, 6)

The prevalence of MetS in the present study (75%) was higher than that in a recent report of CAD patients from four hospitals in Netherlands (47.3%)(17), which reflects a high mortality risk in NE Thai patients. The most frequent component of MetS in the present study was low HDL-cholesterol levels, which was associated with poor dietary habits and low physical activity (18, 19). Interestingly, these data are consistent with findings from a study on a population with MetS in the United Arab Emirates(20). A previous study found an MetS prevalence of 27% among women and 19% among men in the general Thai population aged ≥ 35 years, which was quite high when compared to the population worldwide(9). Moreover, in our study, a significantly high percentage of MetS patients were overweight or obese. Taken together, our findings demonstrate that lifestyle changes, including poor dietary habits and sedentary behavior, may contribute greatly to the high prevalence of MetS in NE Thailand.

Recently, Kim et al, demonstrated that MetS is associated with higher coronary artery calcium scores and greater progression of coronary stenosis and vulnerable plaque in stable patients who had obstructive CAD as detected by computed tomography angiography(16). Our recent studies demonstrated that MetS was associated with increased arterial stiffness, which was a marker of vascular damage and or remodeling (21). Therefore, screening and detection of MetS in patients with obstructive CAD is important.

Our findings demonstrated a high prevalence of MetS in NE Thai patients with obstructive CAD, which may be important in understanding the metabolic risk of CAD. Further research is needed to determine whether lifestyle modification and pharmacologic intervention could improve and/or reduce the risk factors for MetS (specifically, the underlying low HDL-cholesterol and hypertension, which were the most common components of MetS in our patients in NE Thailand).

Study Limitations

This was a single, tertiary care center study that recruited patients at the time of cardiac evaluation for coronary angiography. Therefore, we cannot exclude the presence of selection bias for the patients undergoing evaluation and treatment for CAD. Because MetS was assessed at only 1 point in time, we were unable to evaluate changes in MetS criteria over time. In addition, we lacked complete information regarding severity of CAD, but we addressed this issue by enrolling patients who were in stable condition. We also believe that the inclusion of patients with

epicardial coronary artery stenosis of 50% or more made them relatively representative of a contemporary patient population with obstructive CAD.

Conclusions

The prevalence of MetS is high in NE Thai patients with obstructive CAD. MetS patients were more likely to be overweight or obese, and the most frequent metabolic abnormalities were low HDL cholesterol and hypertension

Acknowledgments

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