Research article

Metabolic syndrome in an Hispanic population–cardiovascular complications

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ABSTRACT

The metabolic syndrome (MetS) is presently one of the main medical problems in developing countries. This syndrome was studied in Puerto Rico at the Cardiovascular Center of Puerto Rico and the Caribbean with emphasis on understanding the cardiovascular complications.

The medical records of patients admitted between 1999 to 2005 were evaluated for three or more MetS diagnostic criteria.

One hundred and seventy-three patients met the consensus criteria of metabolic syndrome (MetS). The mean age of those diagnosed with MetS was 60 years of age. Fifty-seven percent were males and 42 percent females. The mean body mass was 30 kg/m. The ejection fraction was found to be subnormal ($49 \pm 8\%$) and the end systolic dimension of the left atrium was increased (45 ± 10 mm) in comparison to a group of diabetic patients without MetS used for comparison. The incidence of atrial fibrillation was found to be 16% higher in the MetS group than in the comparison group.

The number of cases of metabolic syndrome recorded within the Hispanic population of Puerto Rico showed a higher incidence of atrial fibrillation without ventricular tachycardia. This is thought to be as a result of the abnormal left ventricular and atrial function.

Keywords: Metabolic Syndrome, Hispanic Population, Diabetes Mellitus

Categories: Healthcare, Clinical trials, Human diseases

INTRODUCTION

The metabolic syndrome (MetS) constitutes a group of risk factors including obesity, diabetes mellitus (insulin resistance and glucose intolerance), dyslipidemia, and hypertension [1–7]. It has been established that an individuals with three or more of these criteria are patients with MetS. Familial studies support the notion that MetS could be genetically determined, but its prevalence is affected by environmental factors [5–8]. It has been reported that individuals with the combination of MetS and diabetes mellitus, in particular Type II diabetes, have an increased risk of coronary heart disease (CHD). Balkau [9] reported that obese patients had a higher incidence of cardiovascular disease and diabetes mellitus than normal.

Ischemic heart disease, the most frequent cause of mortality in the western world has been found by a number of epidemiologic studies to also largely effect the Hispanic nation of Puerto Rico [10–12]. The prevalence of ischemic heart disease within Puerto Rico however was found 50% less aggressive, with reduced ventricular tachycardia and slower coronary arterial disease progression, in comparison to cases recorded in the United States [10,11,22].

Among some of the factors known to contribute to MetS, diabetes mellitus has been recognized as one of the key contributory factors [1–16]. The incidence of diabetes worldwide is around 4%, with a tendency to continue increasing in many populations. In Puerto Rico the prevalence of diabetes is more than 12.7% of the general population, while in the United States it is 8.2%. The incidence of obesity and diabetes mellitus at present is an epidemic within the local population [10–12]. The death rate per 100,000 of the general population related to diabetes has been increasing dramatically from 10.6% in 1960 to 66.0% at present [5].

The purpose of this study was to report the incidence of MetS in Hispanic population and the associated complications such as myocardial or brain infarction, arrhythmias and left ventricular dysfunction.

METHODS

The medical records of patients admitted to the Cardiovascular Center of Puerto Rico and the Caribbean were reviewed from 1999 to 2005 to identify patients exhibiting three or more MetS diagnostic criteria. Records were accessed once study approval was obtained by the Ethics Committee. The diagnostic criteria used was the single consensus definition which includes: an increase in triglycerides, low high density lipoprotein's (HDL), elevated blood pressure, elevated fasting blood sugar and obesity (increased waist circumference or increased BMI) [34]. The demographic of the study group and the comparison group are seen in Table 1. The medical records of all Puertorrican patients originating from various backgrounds who were admitted to the center were considered in the study. The study group was compared with a group of diabetics patients without MetS. The comparison group (diabetics) was made up of 600 diabetic patients without clinically significant coronary artery disease, nor history of strokes or myocardial infarctions. The diagnostic tests performed were the same in both groups (MetS and comparison group). No cases of Ventricular Arrhythmias were found in the study group.

Data collection included fasting blood sugar concentration (FBS), body mass index (BMI), lipid profile, echocardiograms, holters, treadmill test and cardiac catheterization data.

BMI was used due to the lack of data on waist circumference in the study group as it is known that a BMI of 30 kg/m² is equal to a waist circumference of 102 cm in males and 92 cm in females.

The left ventricular ejection fraction, left ventricular and left atrial dimensions were determined by transthoracic echocardiograms using standards techniques. Electrocardiograms and holters,

Table 1. Clinical characteristics of patient population.

Baseline characteristics MetS	Population (Mean values)	Comparison population (Mean values)
Sex (males/females)	(57.8%/42.2%)	(56%/44%)
Mean Age	Mean age = 69 ± 4 years of age	Mean age = 61 years of age ± 2
Fasting Blood Sugar	169 ± 30 mg/dL	150 ± 25 mg/dL
Body Mass Index	30 Kg/m² ± 5	24 Kg/m² ± 3
Arterial blood pressure	170/90 mm Hg	120/70 mm Hg
Total Cholesterol	166 ± 25 mg/dL	150 ± 20 mg/dL
HDL	48 ± 16 mg/dL	35 ± 16 mg/dL
LDL	85 ± 30 mg/dL	80 ± 20 mg/dL
Triglycerides	166 ± 13 mg/dL	150 ± 10 mg/dL

treadmill exercise tests, CT brain scans were evaluated for the presence of atrial and ventricular arrhythmias, as well as ischemic heart disease or clinically significant brain ischemia. All the data was analyzed by the students T-test, a P. Value of < 0.05 was considered significant. The purpose of these tests was to find the abnormalities of the cardiovascular system, including brain abnormalities due to ischemic events. The causes of admission are described in Table 2.

RESULTS

Of the patients admitted to Cardiovascular Center of Puerto Rico and the Caribbean diagnosed with MetS, it was found that 60% of these patients were admitted as a cause of uncontrolled diabetes mellitus, 30% due to atrial fibrillation with rapid ventricular response (of which 40% suffered from intermittent atrial fibrillation) and 10% as a result of congestive heart failure. No ventricular tachycardia, myocardial infarction or strokes were found (Table 2).

Table 1 shows the characteristics of the MetS population studied. These results indicate that 173 patients with a mean age of 69 years met the criteria of MetS. These patients were characterized by arterial hypertension (BP > 130/85 mm Hg), increased BMI (30 Kg/m²), and diabetes (FBS > 100 mg/dL). In the study group, 92.5% were found to suffer from type II diabetes, whereas only 7.5% presented with type I diabetes. The sex distribution of the group was 100 males (57.8%) and 73 females (42.2%). There were no signs or symptoms of myocardial infarction, ischemia or stroke detected when analyzing the electrocardiograms, holters, treadmill exercise tests and brain except for one patient with angioplasty of the left anterior descending artery. Less than one percent had coronary angiography; all coronaries were found to be angiografically normal.

The MetS group was typically found to have low total cholesterol and low LDL with normal HDL levels and lipid levels similar to that of the comparison group. The HDL-triglycerides ratio however was lower in the comparison group due to lower HDL levels than the MetS group, 23% and 28% respectively, with the exception of 20% of patients who presented with elevated triglycerides on admission. This abnormality however was normalized during hospitalization by diet, IV fluids or drugs and changes persisted after discharge only with diet and exercise. Table 1 also shows the mean values of data collected for the comparison group.

The left ventricular ejection fraction (LVEF) of patients in the MetS group was found to be subnormal when compared with the diabetic comparison group, 49 ± 8% and 62 ± 12% respectively as shown in Table 3. In contrast, the end systolic dimension of the left atrium was increased (15%) when compared to the comparison group. Statistically no significant differences were detected in any other echocardiographic parameters. The incidence of atrial fibrillation in the MetS group however was found to be 2.8-fold higher than in the comparison group (16% vs. 5.9%, respectively; P < 0.001).

DISCUSSION

The findings present strong evidence that the normal lipid profile recorded is a key factor that contributes to the decreased incidence of coronary and cerebrovascular events observed in Puerto Rico in the MetS and comparison group. The prevalence of HDL < 40 mg/dl in males and

Table 2. Complications of the mets group.

Complications of the mets group $N = 173$	%
1. Uncontrolled Diabetes	60
2. Atrial Fibrillation	30
3. Congestive Heart Failure	10
4. Ventricular Tachycardia	0
5. Myocardial Infarction	0
6. Strokes	0

Table 3. Echocardiographic data.

	Echocardiographic Data of Studied Population and Comparison Group (Mean Values)		
Variable	Metabolic Syndrome Group ($n = 173$)	Diabetic Comparison Group ($n = 600$)	P. Value
LVEF (%)	49 ± 8	62 ± 12	$P < 0.001$
LA ESD (mm)	46 ± 10	40 ± 8	$P < 0.05$

LVEF = left ventricular ejection fraction; LA ESD = left atrial end systolic dimension.

< 50 mg/dl in females however is not presently known. Normal values of HDL and triglycerides previously reported were 52 ± 1 mg/dl and 154 ± 3 mg/dl respectively [11].

The findings obtained are consistent with previous studies conducted in Puerto Rico which reported no connection between elevated triglycerides levels and the development of coronary artery disease [11,18,22]. This also supports the notion that the lipid profile and its associated effects in the Hispanic population are different from that in the U.S. [11,18,22]. The ratio of low HDL and elevated triglycerides was found to be 37% lower in Puerto Rico than in the U.S.A. [11]. The resistance of the Puetorrican population to factors inducing atherosclerosis is believed to be due in part to the genetic makeup of individuals, owing to their mixed racial backgrounds [18,22].

The move of the population from rural to an urban area however is thought to contribute to changes in cholesterol and triglycerides levels. This change has been observed in the Puertorrican population that have moved to the U.S. [18].

The increased incidence of atrial arrhythmias (atrial fibrillation) that was detected in the MetS group, we believe is related to remodeling of the left heart and reduction of the left ventricular systolic function (lower LVEF) which has been shown to alter the sinus node function [20–27]. Similarly, the same incidence of atrial fibrillation in MetS patients has been reported in studies conducted by Chamberlain, Umetabi and Watabane [19–21].

Left ventricular changes were found to be more prominent in the MetS group, than in the comparison group, which could be due to the cytokines liberated by the intra-abdominal fat in obese patients and those with a high BMI, causing apoptosis and necrosis of the myocardial cells.

Other important factors in the induction of atrial fibrillation is excessive oxidative stress of the myocardial cells seen in diabetics and MetS patients [28], resulting in diabetic cardiomyopathy, but not as a result of coronary artery disease. HDL is an antioxidant therefore, normal or higher HDL levels decreases this oxidative stress in the myocytes of diabetics by modifying the oxidative process of LDL [31]. Reduction of oxidative stress will reduce apoptosis and progression of atherosclerosis, reducing the incidence of left ventricular dysfunction and coronary artery disease and its consequences. The result is less aggressive coronary disease, reducing the incidence of congestive heart failure and ventricular arrhythmias. Elevated insulin levels observed in this syndrome may also alter the sinus node function, and infiltration of fat in the atrial septum and sinoatrial node may produce atrial arrhythmias by altering both structures [23–27]. Larroude [27] reported a high prevalence of paroxysmal atrial fibrillation and atrial flutter in patients with structured heart disease, however the author attributed the only cause of this to obesity.

Although the incidence of atrial arrhythmias within the population studied was found to be elevated, conversely there were no reported cases of ventricular arrhythmias. This finding is consistent with several studies that have described the incidence of ventricular tachycardia in the Puertorrican population being lower than that reported in the United States [22].

At present, the management of this condition is not clear, however, targeting obesity a major cause of insulin resistance and subsequently diabetes is an important factor in preventing the progression of the metabolic syndrome. Studies indicating obese individuals are prone to suffering psychological problems [30], is suggestive of psychiatric involvement in the treatment plan of patients and those at risk of developing MetS. Regular dietetic counseling is also advisable to help control blood pressure, blood sugar and lipids and to importantly address the problem associated with insulin resistance. Brown [32] and Hansen [33] have shown that combined therapy of dietary fish oil and Stearoyl-CoA Desaturase inhibition can prevent the metabolic syndrome and atherosclerosis. The possible treatment of MetS from the synergistic action of dietary fish oil and Stearoyl-CoA Desaturase inhibition however, was not addressed in this study. Genetic counseling should be also be available to all family members.

Genetic counseling is another important element in the management of these patients. Research in genetics and biopsy in recent years have made it possible to discover several genes related to obesity and diabetes which has changed the perception of obesity from a condition related to the lack of will power, to a biological problem with genetic and enviromental determinants, specially psychiatric problems. These findings have lead physicians to approach the treatment of MetS as a multifactorial problem giving importance to the genetic and neuroendocrine aspects with emphasis on modifying diet and lifestyle.

It is important to acknowledge a number of limitations of the study. It could be argued that the study was not fully representative of all Hispanics and that only a limited number of Puertorrican

(Hispanic) population was sampled, however we believe that the study findings are comparable to other Hispanic groups that have not been significantly exposed to North American culture.

It could also be argued that the use of waist circumference would have given rise to results of a higher degree of accuracy however, due to the lack of data on waist circumference patients BMI was used instead. Doll, Paccard, Bovet, Burnier, and Wietlisbach point out in their study that the use of BMI instead of waist circumference does not have affect the results [35].

AUTHOR STATEMENTS

The authors of this study declare they do not have any competing interests.

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CONCLUSION

In a population of 173 Hispanic patients admitted to the Cardiovascular Center of Puerto Rico and the Caribbean who were found to meet the metabolic syndrome diagnostic criteria, a high incidence of atrial fibrillation without ventricular tachycardia was recorded. Patients presenting with less aggressive coronary artery disease prevalence and progression [11,22] is thought to be due to the benign lipid patterns that was observed. Future efforts should be directed at reducing the risk factors associated with atrial fibrillation and consequently the incidence of myocardial dysfunction, ischemic heart disease and strokes. As Puerto Rico is significantly influenced by the U.S. culture, in particular by similar dietary habits, the findings are important in determining the incidence of abnormalities associated with the metabolic syndrome in other to Hispanic countries.

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