Subject Area:

Association between the metabolic syndrome and C-reactive protein in the general population

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Abstract

Background

In the last few years, metabolic syndrome (MS) has gained much attention. The definition of the MS was established in 2005. Some studies have shown that there is an association between MS and inflammation, proven by high-sensitivity C-reactive protein (hs-CRP), but in limited population-based studies. This study tried to show the association between MS and us-CRP in the general population.

Patients and methods

A total of 200 persons were included in this cross-sectional study. The guidelines from the National Heart, Lung, and Blood Institute and the American Heart Association were used in the diagnosis of MS. Any three of the following traits in the same individual meet the criteria for the MS: (a) abdominal obesity: a waist circumference of 102 cm or more in men and 88 cm or more in women, (b) serum triglycerides of 150 mg/dl or above, (c) high-density lipoprotein cholesterol of 40 mg/dl or lower in men and 50 mg/dl or lower in women. (d) Blood pressure of 130/85 or more, (e) fasting blood glucose of 100 mg/or more. Commercial kits were used to determine the level of CRP.

Results

Individuals with MS had a higher mean us-CRP value in global measures ($P < 0.001$) and were stratified by sex ($P < 0.001$) than individuals without the syndrome. This marker showed a significant difference with different criteria for MS, such as the circumference of waist ($P < 0.001$), triglycerides levels ($P < 0.001$), and diastolic blood pressure ($P < 0.001$), and the highest levels of us-CRP were found in individuals with more MS criteria.

Conclusion

Us-CRP was highly associated with the presence of MS and MS criteria. Us-CRP is a good marker for showing the development of MS and may be used as a reference in routine care.

Keywords: C-reactive protein, cardiovascular risk factors, metabolic syndrome

INTRODUCTION

Metabolic syndrome (MS) is identified as a complex disorder that has a set of cardiovascular risk factors such as hypertension related to centripetal fat distribution and insulin resistance [1]. The incidence of MS is increasing as a consequence of genetic and environmental factors.

MS is common. In the USA, around 32% of the population has MS, and about 85% of those with type 2 diabetes have MS. Approximately 25% of adults in Europe and Latin America are estimated to have MS, and the rising rates are in developing East Asian countries. Within the USA, Mexican Americans have the highest rate of MS. The prevalence of MS occurs more with age and about 40% of people over 60 years are affected [2–4].

Increased cardiovascular risk and diabetes mellitus type 2 (DM2) are directly related to MS, and MS is a growing concern worldwide, primarily because of its relationship to the increased risk of cardiovascular disease (CVD) and its subsequent morbidity and mortality [5–7].

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There is an association between the ultrasensitive C-reactive protein (us-CRP) and the development of CVD, even with a slight increase in the reference range [8,9]. Since the 1970s, this protein has been used primarily for the diagnosis of inflammatory and infectious statues [10,11]. In addition, studies show a positive correlation between serum CRP levels and the existence of MS or its components. But, few studies exist that made an in-depth analysisto determine the differences between sex and age and to estimate more accurate cutoff points of CRP level for predicting the cardiovascular risk in MS patients.

MS is a public health problem as it damages an individual's health and generates costly expenditures [12]. Therefore, measurement of CRP levels may help in the implementation of strategies for prevention and rapid intervention and may assist in the detection of MS. Therefore, this study evaluated the relationship of CRP levels with the presence of MS.

PATIENTS AND METHODS

We performed a cross-sectional study on consecutive 200 people attending the Monday outpatients' clinic in the National Heart Institute.

Data were collected in the period from January to November 2016 and subsequently biochemical analyses on the collected blood samples were done. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were classified according to the VI guidelines on hypertension [13]. Waist circumference was measured. Blood glucose levels, high-density lipoprotein cholesterol (HDL-c), triglycerides (TAG), and CRP blood samples were obtained by venipuncture in patients who fasted for 12 h, and ~10 ml of blood was collected without anticoagulants (i.e. a dry tube) [14].

Data collection in the initial group showed an MS prevalence of 18% ($n = 38$). The presence of MS was classified according to the American Heart Association which identifies the presence of MS when at least three of the following criteria are present: central obesity measured as a waist circumference (PC) greater than 102 cm for men and greater than 88 cm in women; SBP/DBP greater than 130/85 mmHg; fasting blood glucose greater than 110 mg/dl; TAG greater than 150 mg/dl, and HDL-c less than 40 mg/dl for men and less than 50 mg/dl for women [15].

The use of medication for the regulation of blood pressure, and of lipids and blood glucose levels should also be considered in the diagnosis of MS [6]. Adequate CRP was assigned for values less than 1 mg/dl. According to the Centers for Disease Control and the classifications, which were also recommended by the American Heart Association: low risk less than 1 mg/dl; medium risk: 1–3.1 mg/dl; and high risk greater than 3–10 mg/dl [16].

RESULTS

We evaluated the population of our study, and the results showed an MS prevalence of 18% ($n = 38$). In this group of patients with MS, there were high levels of CRP compared with those without MS. These factors demonstrate a high risk for CVD in this group.

Table 1 shows the data of all participants with or without MS. The MS group consisted of 30 men and eight women; it had a higher proportion of men than women. Geometric mean levels of CRP were similar in both men (3.2 mg/dl) and women (3.1 mg/dl).

The mean value of CRP was 3.1 mg/dl in the MS group which was significantly higher than the non-MS group which showed a mean CRP of 3.1 mg/dl. The maximum value of CRP in the MS group was 6 mg/dl with a minimum of 0.05 mg/dl.

The mean value of BMI, SBP, DBP, fasting blood glucose, serum cholesterol, serum TAG, and waist circumference were significantly higher than in the non-MS group ($P < 001$).

Smokers showed a higher level of CRP than nonsmokers in both groups of patients, which was significantly different:

DISCUSSION

Thirty-eight persons of the 200 examined persons had MS (18%) This group of people had higher CRP level than another group without MS.

There was a significant difference ($P < 0.001$) compared to that without MS. This demonstrates how us-CRP can predict the risk of developing MS. Individuals of both sexes who are free from MS exhibited lower us-CRP values than individuals with MS ($P < 0.001$). Therefore, this variable is beneficial to conclude a risk of MS development in women and men without regard for age, in those patients.

MS is a worldwide concern because it is related to cardiovascular comorbidities. Discrete increase in us-CRP concentrations, even within the reference range, may help in the prediction of the occurrence of CVD and DM [9,17]. Us-CRP has received special attention as its character as a highly specific marker for coronary events and its potential role in pathogenesis [18].

The prevalence of MS in a population-based study in Vitoria, Espirito Santo, was generally 29.8% (95%

Table 1: General characteristics of the participant with or without metabolic syndrome

	MS ($n=38$)	Non-MS ($n=162$)	P
Age (years)	55.4	52.2	NS
BMI (kg/m²)	27.1	23.1	<0.001
SBP (mmHg)	149.8	134.4	<0.001
DBP (mmHg)	85.0	76.1	<0.001
Fasting glucose (mg/dl)	113.2	97.4	<0.001
TC (mg/dl)	217.7	98.2	<0.001
TAG (mg/dl)	186	149	<0.001
CRP (mg/dl)	3.42	1.52	<0.001

CRP, C-reactive protein; DBP, diastolic blood pressure; MS, metabolic syndrome; SBP, systolic blood pressure; TAG, triglycerides; TC, total cholesterol.

confidence interval: 28–32%), with no difference between sexes. This study also showed a high prevalence of MS in younger individuals, which may contribute to subsequent mortality and consequent public load [3]. The importance of us-CRP was demonstrated as a marker to predict and observe the development of MS.

In this study, the criteria for MS showed some association with us-CRP concentrations with TAG, SBP, and waist circumference. These criteria were also examined in a study: age, SBP, DBP, BMI, TAG, total cholesterol, and low-density lipoprotein cholesterol (LDL-c) were positively correlated with CRP concentrations. Education and HDL-c variables were inversely correlated with CRP concentrations [9]. Flores *et al.* [19] demonstrated that the CRP levels were positively associated with age, fasting glucose, hypertension, DM, BMI, PC, and PAS. However, menopause, alcohol consumption, and smoking were not related.

Similarly, Zeba *et al.* [20] reported that us-CRP concentrations in Ouagadougou (Burkina Faso's capital, a country in Sub-Saharan Africa) were significantly different between participants who exhibited overweight, abdominal obesity, high-fat percentage body, more criteria for MS, high LDL-c, low HDL-c, and high TAG only in women ($P=-0.049$).

The association of CRP concentrations with excess body fat, overweight, abdominal obesity, and elevated TAG levels may be associated with the metabolic character of the adipose tissue, as the adipose tissue is responsible for the generation of 30% of the proinflammatory cytokine interleukin-6 (IL-6). Adipocytes also produce tumor necrosis factor-α (TNF-α) and IL-1. CRP synthesis that occurs in the adipocytes even produce TNF-α and IL-1. CRP synthesis happens in the liver, and it is primarily managed by IL-6, although IL-1 and TNF also share in this modulation. So, the resulting increase in these proinflammatory cytokines from the adipose tissue leads to an increase in hepatic production of CRP. The presence of insulin inhibits CRP and cytokine synthesis mechanisms. But the insulin resistance state leads to a failure of this control mechanism by increasing the production of hepatic CRP [6,9,11].

In addition to MS criteria, smoking was associated with CRP levels. Individuals who smoked had a higher average us-CRP concentration.

A study of the Virgem da Gracas and Caju communities showed no association between smoking and serum CRP levels [9]. However, tobacco distribution showed a significant positive association with CRP levels in Pelotas/BR but only in men [18].

Conclusion

The measurement of serum us-CRP levels is easy and help in the detection of subclinical and clinical inflammation, and showed an increased risk of cardiovascular events. The early observation of a change in us-CRP is an exciting marker because it would help to implement therapeutic and prophylactic measures faster. The determination of us-CRP levels is feasible for any laboratory of average complexity.

So, these study results support the realization of the us-CRP level in routine care as a marker to predict the risk of MS complications and other cardiovascular comorbidities, such as hypertension and dyslipidemia. Further studies can concentrate on testing the possible inclusion of this marker to the classification criteria of MS because of the strong association we observed in this study.

Conflicts of interest
There are no conflicts of interest.

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