Metabolic syndrome in hypertensive patients: Correlation between anthropometric data and laboratory findings

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Running Title: Metabolic syndrome in hypertensive patients

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Cardiovascular disease is the principal cause of morbidity and mortality in Brazil with a mortality coefficient of 442/100,000 inhabitants (1). In 90% of the individuals with a diagnosis of arterial hypertension, no causal agent is identified; however, current knowledge tends to suggest the importance of increased body mass index (particularly as a result of visceral fat) in the physiopathology of this disease. In 1988, Reaven (2) identified the following components of a specific syndrome that would define increased cardiovascular risk: insulin resistance, glucose intolerance, hyperinsulinemia, elevated triglycerides, reduced HDL cholesterol and arterial hypertension.

The prevalence of metabolic syndrome increases substantially with aging, as does the incidence of diabetes mellitus (3). Metabolic syndrome is strongly predictive of future diabetes (4) and its presence in hypertensive patients who may be at risk for diabetes should be investigated. The objective of the present study was to evaluate the prevalence of metabolic syndrome in hypertensive, non-diabetic outpatients.

**Research Design and Methods**

This cross-sectional study included 102 hypertensive outpatients consecutively seen between December 2003 and May 2005 at a Teaching Hospital in Brazil. All patients included were >18 years of age with systemic arterial hypertension diagnosed according to the criteria defined by the IV Brazilian Guidelines for Arterial Hypertension (5). Exclusion criteria consisted of: secondary hypertension, clinical or laboratory evidence of congestive heart failure, coronary disease, history of cerebral vascular accident, valve defect or diabetes mellitus.

The following variables were evaluated: age, gender, BMI, arterial pressure, waist circumference, total cholesterol, HDL cholesterol, triglycerides, fasting glucose and glycemic levels two hours after a 75 gram oral glucose load, fasting insulin, microalbuminuria, and insulin resistance index as determined by homeostasis model assessment (HOMA-IR). Blood pressure was measured using a previously calibrated aneroid sphygmomanometer with a 12 x 23 cm cuff or a 17 x 32 cm cuff in the case of obese patients. Following a 20-minute rest period, blood pressure was taken with the patient seated, with an empty bladder, and without having smoked or consumed coffee or alcohol in the thirty minutes prior to the test. Arterial hypertension was defined as arterial pressure $\geq 130/85$ mmHg or treatment with antihypertensive medication. Hypertensive patients were evaluated to define whether they fulfilled the criteria for metabolic syndrome in accordance with the definitions of the National Cholesterol Education Program - Adult Treatment Panel III (NCEP/ATPIII) and the International Diabetes Federation (IDF).

NCEP/ATPIII defines metabolic syndrome as the presence of three or more of the following associated conditions: fasting glucose $\geq 110$ mg/dl, central obesity (waist circumference $\geq 102$ cm for men and $\geq 88$ cm for women), arterial pressure $\geq 130/85$ mmHg or pharmacologically treated hypertension, triglycerides $\geq 150$ mg/dl or current use of fibrates, HDL cholesterol $< 40$ mg/dl for men and $< 50$ mg/dl for women (6).

IDF defines metabolic syndrome as waist circumference $\geq 90$ cm for men and $\geq 80$ cm for women, plus at least two of the following factors: arterial pressure $\geq 130/85$ mmHg or pharmacologically...
treated, triglycerides, 150 mg/dl or current use of fibrates, HDL cholesterol <40 mg/dl for men and <50 mg/dl for women or the use of specific pharmacological therapy, and fasting glucose, 100 mg/dl or previously diagnosed diabetes (7).

Biochemical evaluation was preceded by three days of normocaloric diet with no carbohydrate restrictions and a 12-hour fasting period. Total cholesterol, HDL cholesterol and triglycerides were measured enzymatically. LDL cholesterol was calculated using Friedwald’s formula \[\text{LDL-C} = \text{CT} - (\text{HDL-C} + \frac{\text{TG}}{5})\] for triglyceride levels < 400mg/dl. Diabetes was defined as: fasting glucose >126 mg/dl or glycemic levels two hours after a 75 gram oral glucose load >200mg/dl. (8).

Microalbuminuria was measured using immunoturbidimetry (APTEC, intra-assay coefficient of variation 3.99% and inter-assay CV 3.35%), values ≥ 40 mg/24 hours being considered positive.

Results

Table 1 lists the clinical and laboratory data of the patients in this study. Prevalence of metabolic syndrome was 71.6% and 82.4% according to the NCEP/ATPIII and IDF classification definitions, respectively. Concordance between the two classification systems showed good reproducibility (k=0.67).

There was a statistically significant difference between individuals with and without metabolic syndrome according to the NCEP and IDF classifications when the parameters of glucose levels two hours after a 75 gram oral glucose load, HDL-cholesterol and triglycerides were evaluated (Table 1).

According to the NCEP/ATPIII criteria and IDF criteria, the prevalence of abnormal waist circumference was 90.41% and 100% respectively, while low HDL cholesterol and hypertriglyceridemia had a prevalence of 76.71% and 67.12% and 64.29% and 57.14%, respectively. Abnormal fasting glucose was the variable with the lowest prevalence in the study sample according to both criteria (32.88% according to NCEP/ATPIII and 57.14% according to IDF).

When the percentage of risk factors of the patients with metabolic syndrome was analyzed according to the NCEP/ATPIII classification, 46% of patients in the study sample had three of the defining criteria for metabolic syndrome, whereas 35.7% had two and 17.9% had five of the associated conditions.

Conclusions

The high prevalence of metabolic syndrome found in this study may be related to the mean age of the study sample, and the fact that the data were obtained from an analysis of hypertensive patients in a reference hospital in which the waiting time for an appointment is long.

In a cross-sectional study (10), the prevalence of metabolic abnormalities associated with arterial hypertension in individuals in the control and hypertensive groups ranged from 0.8% to 35.3%, respectively. Around 91.3% of the hypertensive patients had at least one associated cardiovascular risk factor. The combination most frequently found was arterial hypertension and hypertriglyceridemia.

In the present study, the most frequent combination was arterial hypertension and increased waist circumference followed by
low HDL-cholesterol, which is the factor of the metabolic syndrome most associated with hypertension.

The presence of metabolic syndrome is highly predictive of new-onset diabetes. Many studies show that hyperglycemia at pre-diabetic levels is an independent risk factor for cardiovascular diseases (11,12) and diabetes is accompanied by a significantly increased prevalence of hypertension and dyslipidemia (13).

Detecting metabolic syndrome is a simple method of evaluating individuals at high risk of diabetes mellitus and it is important to investigate its presence in hypertensive patients who may be at risk for diabetes.

The synergistic impact of arterial hypertension and other components of metabolic syndrome illustrate the need for screening for the metabolic syndrome in hypertensive patients at initial diagnosis.

In view of the relevance of this topic, our objective with this Brief Report on the metabolic syndrome in hypertensive patients was to describe the high prevalence of this syndrome in patients receiving care at a University Teaching Hospital in the city of Salvador, Brazil, and based on data from the literature that shows the metabolic syndrome to be an important predictor of diabetes mellitus, to call attention to the need to investigate this condition in hypertensive individuals.
References


5. IV Diretrizes Brasileiras de Hipertensão Arterial. *Arq Bras Cardiol* 82 (suplemento IV) 2004


<table>
<thead>
<tr>
<th>Variable</th>
<th>Sample (n = 102)</th>
<th>MS according to NCEP criteria</th>
<th>MS according to IDF criteria</th>
<th>p-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Absent (n = 29)</td>
<td>Present (n = 73)</td>
<td>Absent (n = 18)</td>
<td>Present (n = 84)</td>
</tr>
<tr>
<td>Males</td>
<td>21</td>
<td>11</td>
<td>10</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Females</td>
<td>81</td>
<td>18</td>
<td>63</td>
<td>11</td>
<td>70</td>
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<tr>
<td>Age (years)</td>
<td>60.71 ± 10.45</td>
<td>61.17 ± 12.44</td>
<td>60.52 ± 9.64</td>
<td>59.67 ± 12.57</td>
<td>60.93 ± 10.02</td>
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<tr>
<td>Time since diagnosis of hypertension (years)</td>
<td>6.20 ± 5.73</td>
<td>4.86 ± 4.87</td>
<td>6.81 ± 5.94</td>
<td>3.72 ± 4.30</td>
<td>6.74 ± 5.88</td>
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<td>Weight (kg)</td>
<td>72.73 ± 10.96</td>
<td>69.83 ± 10.21</td>
<td>73.91 ± 11.10</td>
<td>70.39 ± 10.39</td>
<td>73.24 ± 11.07</td>
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<tr>
<td>Height (m)</td>
<td>1.59 ± 0.07</td>
<td>1.60 ± 0.07</td>
<td>1.59 ± 0.08</td>
<td>1.60 ± 0.08</td>
<td>1.59 ± 0.07</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>28.70 ± 4.20</td>
<td>27.38 ± 3.76</td>
<td>29.23 ± 4.28</td>
<td>27.66 ± 4.03</td>
<td>28.92 ± 4.23</td>
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<tr>
<td>Waist circumference (cm)</td>
<td>96.10 ± 8.76</td>
<td>92.86 ± 8.70</td>
<td>97.38 ± 8.51</td>
<td>91.22 ± 9.58</td>
<td>97.14 ± 8.27</td>
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<tr>
<td>Hip (cm)</td>
<td>109.64 ± 9.98</td>
<td>105.93 ± 9.11</td>
<td>111.11 ± 9.99</td>
<td>105.28 ± 10.27</td>
<td>110.57 ± 9.73</td>
</tr>
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<td>Glycemia (mg/dl)</td>
<td>106.63 ± 33.98</td>
<td>90.97 ± 12.69</td>
<td>104.53 ± 38.77</td>
<td>87.06 ± 11.91</td>
<td>103.54 ± 36.44</td>
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<tr>
<td>Glycemia 2 h following OGTT (mg/dl)</td>
<td>146.71 ± 56.36</td>
<td>115.96 ± 40.20</td>
<td>158.25 ± 57.43</td>
<td>110.94 ± 28.91</td>
<td>154.13 ± 57.91</td>
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<td>HDL-cholesterol (mg/dl)</td>
<td>46.70 ± 12.30</td>
<td>55.52 ± 13.28</td>
<td>43.25 ± 10.12</td>
<td>52.56 ± 9.13</td>
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<td>Triglycerides (mg/dl)</td>
<td>169.02 ± 123.78</td>
<td>97.03 ± 27.67</td>
<td>197.62 ± 135.20</td>
<td>102.11 ± 40.89</td>
<td>183.36 ± 130.86</td>
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<td>Microalbuminuria (mg/24hs)</td>
<td>24.88 ± 15.97</td>
<td>24.45 ± 13.80</td>
<td>25.05 ± 16.84</td>
<td>23.86 ± 17.04</td>
<td>25.10 ± 15.84</td>
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<tr>
<td>Insulin (µU/ml)</td>
<td>8.18 ± 6.08</td>
<td>6.87 ± 6.54</td>
<td>8.69 ± 5.87</td>
<td>6.30 ± 6.05</td>
<td>8.58 ± 6.05</td>
</tr>
</tbody>
</table>

MS: metabolic syndrome; BMI: body mass index; OGTT: oral glucose tolerance test (75g)