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Peripheral arterial occlusive disease and ankle-brachial index in patients who had coronary angiography

Doença arterial obstrutiva periférica e índice tornozelo-braço em pacientes submetidos à angiografia coronariana

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Abstract

Objective: **To evaluate the prevalence of peripheral arterial disease (PAD) in patients with coronary arterial disease, To evaluate the relation between ankle-brachial index (ABI) and coronary arterial disease, and its correlation with cardiovascular risk factors,**

Method: **ABI investigated with Doppler ultrasonic device, Clinical characteristics researched: age, gender, diabetes, hypertension, alcoholism, smoking and obesity, Population: 113 patients who had coronary angiography, First analyses: 2 groups - absence and presence of coronary arterial disease, Second analyses: 3 groups - Group 1 - absence of coronary lesion; Group 2 - stenosis <70%; and Group 3 - stenosis =70%, Third analyses: 2 groups - absence and presence of PAD,**

Results: **90,76% of patients with coronary arterial disease presented PAD, There were significant difference including age (p<0,001), hypertension (p<0,001), smoking (p<0,001), body mass index (BMI) (p<0,001), systolic blood pressure (SBP) (p<0,001), diastolic blood pressure (DBP) (p<0,001) and pulse pressure (PP) (p<0,001) and ABI (p<0,001) between patients with and without coronary lesion, There were significant difference including age (p<0,001), diabetes (p=0,030), hypertension (p<0,001), smoking (p<0,001), BMI (p<0,001), SBP (p<0,001), DBP (p<0,001) and PP (p<0,001) and ABI (p<0,001) between patients divided as severity of coronary arterial disease, There were significant difference including age (p<0,001), hypertension (p<0,001), smoking (p<0,001), BMI (p<0,001), SBP (p<0,001), DBP (p<0,001) and PP (p<0,001) between patients with and without PAD, By Logistic Regression Analysis, old obese patients with ABI<0,90 have a risk of coronary lesion of 98,93%,**

Conclusion: **ITB<0,90 might be a marker of coronary arterial disease in patients at risk of cardiovascular diseases,**

Descriptors: **Ankle, blood supply. Brachial artery. Atherosclerosis. Peripheral vascular diseases. Risk factors.**

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Resumo

Objetivo: **Avaliar a prevalência de doença arterial obstrutiva periférica (DAOP) em coronariopatas. Avaliar a relação entre Índice Tornozelo-Braço (ITB) e doença coronariana, e sua correlação com fatores de risco cardiovascular.**

Método: **ITB investigado com ultra-sonografia Doppler. Características clínicas pesquisadas: idade, sexo, diabetes mellitus, hipertensão arterial sistêmica, etilismo, tabagismo e obesidade. População: 113 pacientes submetidos à angiografia coronariana. Primeira análise: 2 grupos - ausência e presença de coronariopatia. Segunda análise: 3 grupos - Grupo 1 - ausência de lesão coronariana; Grupo 2 - estenose < 70%; e Grupo 3 - estenose ≥ 70%. Terceira análise: 2 grupos - ausência e presença de DAOP.**

Resultados: **90,76% dos coronariopatas apresentaram DAOP. Houve diferença significante quanto à faixa etária (p<0,001), hipertensão (p<0,001), tabagismo (p<0,001), IMC (p<0,001), pressão sistólica (p<0,001), diastólica (p<0,001) e de pulso (p<0,001) e ITB (p<0,001) entre indivíduos com e sem lesão coronariana. Houve diferença significante quanto à faixa etária (p<0,001), diabetes (p=0,030), hipertensão (p<0,001), tabagismo (p<0,001), IMC (p<0,001), pressão sistólica (p<0,001), diastólica (p<0,001) e de pulso (p<0,001) e ITB (p<0,001) entre os pacientes divididos quanto ao grau da coronariopatia. Houve diferença significante quanto à faixa etária (p<0,001), hipertensão (p<0,001), tabagismo (p<0,001), IMC (p<0,001), pressão sistólica (p<0,001), diastólica (p<0,001) e de pulso (p<0,001) entre pacientes com e sem DAOP. Pela Análise de Regressão Logística, pacientes idosos, obesos e com ITB < 0,90 apresentam probabilidade de lesão coronariana de 98,93%.**

Conclusão: **ITB < 0,90 constitui um possível marcador de doença arterial coronariana em pacientes com risco de doenças cardiovasculares.**

Descritores: **Tornozelo, irrigação sanguínea. Artéria braquial. Aterosclerose. Doenças vasculares periféricas. Fatores de risco.**

INTRODUCTION

Asymptomatic or symptomatic peripheral arterial obstructive disease (PAOD) is characterized by a gradual reduction in blood flow, due to an occlusive process in the arterial beds of the lower limbs [1-4]. Generally the cause is atherosclerosis or atherothrombotic phenomena, but it may also reflect the influence of other diseases such as arteritis, aneurysms and embolism [1-4].

Intermittent claudication, that is, a burning pain and cramp of the calf or buttocks after physical activities constitutes the commonest clinical manifestation of PAOD [1,3,4].

The diagnostical strategy must include a detailed physical examination with an investigation of suggestive clinical signs such as the absence of peripheral pulses, arterial murmur and skin alterations of the affected limb. Additionally, confirmation of the severity of vascular obstruction, determined by the measurement of the ankle-brachial index (ABI), the ratio between the systolic arterial pressures in the posterior tibial and brachial arteries should be included [3].

Risk factors for PAOD are similar to those associated to coronary artery disease and include advance ages, smoking, diabetes mellitus, hyperlipidemia, obesity and systemic arterial hypertension [1,5]. The prevalence of PAOD in over 55-year-old individuals is 19.1% [6]; whilst in over 65-year-old patients it is 19.8% and 16.8% for men and women, respectively [7].

Due to the frequent coexistence of atherosclerotic processes in distinct vascular territories, previous studies demonstrated that the ABI presents a strong correlation with the presence and severity of atherosclerosis in carotid and coronary arteries [1,8,9]. In middle-aged adults and the elderly, a reduced ABI is associated to an increased mortality rate and a higher risk of coronary arterial and cerebrovascular diseases [1,10]. Studies correlating ABI, PAOD and risk factors for coronary diseases in patients submitted to coronary angiography have been, however, little explored in recent medical publications.

The goal of the current study consists in analyzing the prevalence of PAOD in patients submitted to coronary cineangiography as well as in evaluating the relationship between ABI and coronary artery disease and its correlation with cardiovascular risk factors.

METHOD

Population

After being informed about the nature of the research, patients who agreed to participate in the study were asked to sign a written consent form. Initially, 130 patients accepted to take part and were submitted to coronary cineangiography in the coronary unit of Hospital Santa Lucinda – annex 3 of the Conjunto Hospitalar in Sorocaba, over the period from June 2005 to May 2006. Seventeen patients who presented with ABI ratios greater than 1.3 were subsequently excluded from the initial sample, and thus 113 patients were effectively included in the series and in the statistical analysis of the results. A total of 60 (53.10%) were men and 53 (46.9%) were women.

Method

The design of this work is an inquiry-type observational, cross-sectional study. Prior to the coronary cineangiographic study, a measurement of the ABI was performed by Doppler ultrasonography (Doppler Vascular; DV 610; MEDNEGA, Brazil), and cardiovascular risk factors were investigated using a specially designed questionnaire which included

questions about age (years), gender, smoking, alcoholism, diabetes mellitus, systemic arterial hypertension and obesity. After the coronary angiography, the patients were divided, initially into two groups – with and without coronary artery disease. Subsequently, the patients were divided into three groups, according to the severity of the coronary artery disease: Group 1 – free of coronary artery lesions; Group 2 – mild to moderate obstructive disease (when stenosis was less than 70% in one or more main coronary arteries – left or right coronary arteries and their branches, anterior descending artery or circumflex artery); and Group 3 – severe obstructive disease (when the injury affected 70% or more of the arterial diameter of at least one of the aforementioned main coronary arteries). Patients whose results of coronary angiography showed parietal irregularities, calcification or diffuse atheromatosis, of at least one of the aforementioned coronary arteries were included in Group 2. Values of ABI greater than 1.3 represented the only exclusion criterion of patients from this research, as this finding is associated with diffuse atherosclerotic disease of vessels with calcification of the medial layer and hardened vascular walls, which make the arteries difficult to compress during insufflation of the cuff [3]. This phenomenon, which occurs more frequently in patients with a high-risk for cardiovascular diseases, such as diabetics, the elderly and individuals with chronic renal insufficiency, affects the value and the clinical significance of the ABI [3]. Patients who presented with ABIs > 1.3 were thus excluded from this study. This research was authorized by the Local Teaching and Research Commission.

Cardiovascular risk factors

The Body Mass Index (BMI) was calculated as weight divided by the height squared (Kg/m^2). Obesity was considered with BMIs greater than 30 kg/m^2. Smokers were grouped according to the classification of the patients in smokers at the time of the interview (at least 10 cigarettes per day) and non-smokers (those that had given up smoking at least two years prior to the interview or those that had never smoked). Alcohol consumption was defined as alcoholics at the time of interview (independently of the quantity consumed) and non-alcoholics (including ex-alcoholics who had spent at least one year without drinking). Systemic arterial hypertension was defined as systolic arterial pressure = 140 mmHg and diastolic arterial pressure = 90 mmHg or currently using antihypertensive drugs to control the blood pressure. Patients were considered diabetics when they had prior diagnosis of diabetes or when they reported using insulin or hypoglycemiant agents or when the fasting blood sugar level was equal to or greater than 126 mg/dL in the absence of prior diagnosis. The total cholesterol, cholesterol fractions and triglyceride values were not included as variables in this study due to the difficulty of obtaining laboratorial measurements.

Ankle-brachial index

The ABI constitutes a simple, noninvasive, cost-effective method for the early detection of PAOD which complements the assessment of cardiovascular risk. This examination has been recommended for routine clinical use, with the aim of measuring the patency of the arterial circulation of the lower limbs. The researchers of this study were specifically trained to measure the ABI under standard conditions. The measurements were achieved after the patient had rested for 5 minutes in the dorsal decubitus position. Systolic arterial pressures were checked in the following order: right brachial artery; posterior tibial artery and right dorsalis pedis artery; posterior tibial artery and left dorsalis pedis artery; and left brachial artery. The ABI was calculated as a ratio between the highest of the two systolic pressures (posterior tibial artery and dorsalis pedis artery) below the ankle with the highest pressure in the brachial portion. The pressures of both legs were measured and the ABI was calculated for both legs. In cases where the ABI value of one of the legs or of the brachial systolic pressure of one of the arms could not be calculated (amputation), the value of the contralateral limb was utilized. Moreover, with the absence of a value of the arterial pressure of one of the legs (posterior tibial or dorsalis pedis artery) the value of the other leg was utilized to calculate the ABI. The PAOD was defined as an ABI > 0.9. The lowest value of the ABI of the two legs was utilized as a reference for data analysis. Thus, patients were divided into two groups according to the value of the ABI: ABI = 0.9 and ABI <0.9.

Statistical analysis

The Statistical Package for Social Sciences (SPSS) version 13.0 was utilized to analyze the results. Parametric variables are presented as means ± standard deviation. The Mann-Whitney test was used to analyze the sample divided into two groups related to the absence and presence of coronary lesions. The patients were divided into three groups according to the degree of involvement of the coronary arteries which were compared initially employing the Kruskal-Wallis test and, subsequently, variables presenting with statistical significant differences were analysed as pairs using the Mann-Whitney test. An analysis using the Spearman Correlation was performed to evaluate the existence of associations between cardiovascular risk factors and the ABI in relation to the presence of coronary artery lesions. Logistic Regression analysis, involving the statistically significant variables identified by the Spearman Correlation was performed to evaluate the probability of coronary artery lesions based on the ABI and cardiovascular risk factors investigated in this study. The Mann-Whitney test was utilized to compare the two groups (ABI = 0.9 and

< 0.9). The Odds ratio (OR) and confidence intervals (CI) were calculated for nonparametric variables, both in relation to PAOD and to coronary artery disease. P-values < 0.05 were considered statistically significant.

RESULTS

Table 1 shows the clinical characteristics of patients with and without coronary artery disease. Of the 113 patients included in the statistical analysis, 53.1% were men and 46.9% were women. The mean age was 65.91 ± 13.44 years old and the mean BMI was 30.09 ± 4.39 kg/m^2. A total of 47.79% of the participants were smokers, 61.95% were diabetics, 66.37% had hypertension and 15.04% were alcoholics. The mean values of systolic pressure, diastolic pressure and pulse pressure were 149.09 ± 22.44 mmHg, 92.84 ± 11.84 mmHg and 56.16 ± 14.57 mmHg, respectively. There was a significant difference in respect to ages (p<0.001), systemic arterial hypertension (p<0.001), smoking (p<0.001), BMI (p<0.001), systolic pressure (p< 0.001), diastolic pressure (p<0.001) and pulse pressure (p<0.001) between individuals who presented with and those that did not have coronary artery lesions. There was no significant difference in respect to the gender (p=0.186) and diabetes mellitus (p=0.145).

The mean value of ABI was 0.83 ± 0.18 in the total sample, 0.98 ± 0.08 in patients without coronary artery disease and 0.71 ± 0.14 in patients with coronary artery disease. There was significant difference between these two groups (p< 0.001).

Patients with coronary artery disease were older than those without this disease (73.08 ± 10.15 versus 56.21 ± 11.09 years), and there was a prevalence of men (58.46% versus 45.83 %), greater proportion of smokers (69.23% versus 18.75%), hypertension (84.62% versus 41.67%) and diabetes (67.69% versus 54.17%), higher mean BMI (32.35 ± 2.67 versus 27.02 ± 4.42), systolic pressure (160.34 ± 21.11 versus 133.85 ± 13.45), diastolic pressure (98.34 ± 11.12 versus 85.40 ± 8.21) and pulse pressure (62.00 ± 15.78 versus 48.25 ± 7.48); and lower mean ABI (0.71 ± 0.14 versus 0.98 ± 0.08).

Table 1 – Clinical characteristics of patients with and without coronary arterial disease (CAD)

		CAD (-) (n = 48)	CAD (+) (n = 65)	Total (n = 113)	p-value
Age (years)		56.21 ± 11.09	73.08 ± 10.15	65.91 ± 13.44	<0.001
Gender	Male	45.83%	58.46%	53.10%	0.186
	Female	54.17%	41.54%	46.90%	
Diabetes	Yes	54.17%	67.69%	61.95%	0.145
	No	45.83%	32.31%	38.05%	
Hypertension	Yes	41.67%	84.62%	66.37%	<0.001
	No	58.33%	15.38%	33.63%	
Smoker	Yes	18.75%	69.23%	47.79%	<0.001
	No	81.25%	30.77%	52.21%	
Alcoholism	Yes	16.67%	13.85%	15.04%	0.680
	No	83.33%	86.15%	84.96%	
BMI (kg/m2)		27.02 ± 4.42	32.35 ± 2.67	30.09 ± 4.39	<0.001
Systolic Pressure (mmHg)		133.85 ± 13.45	160.34 ± 21.11	149.09 ± 22.44	<0.001
Diastolic Pressure (mmHg)		85.40 ± 8.21	98.34 ± 11.12	92.84 ± 11.84	<0.001
Pulse Pressure (mmHg)		48.25 ± 7.48	62.00 ± 15.78	56.16 ± 14.57	<0.001
ABI		0.98 ± 0.08	0.71 ± 0.14	0.83 ± 0.18	<0.001

Data presented as means ± Standard deviation or percentage of patients: Mann-Whitney test used; ABI - ankle-brachial index; BMI - Body Mass Index

Table 2 illustrates the clinical characteristics of the patients divided into three groups according to the severity of the coronary artery disease. In respect to the age range, the mean age of Group 1 individuals was 56.21 ± 11.09 years; of Group 2 it was 66.67 ± 7.00 years and of Group 3 it was 77.63 ± 9.61 years. In Group 1, 45.83% were men and 54.71% were women; in Group 2, 48.15% were men and 51.85 were women and in Group 3, 65.79% were men and 34.21% were women. The mean age (p=0.001), diabetes mellitus (p=0.030), systemic arterial hypertension (p<0.001), smoking (p<0.001), BMI (p<0.001), systolic pressure (p<0.001), diastolic pressure (p<0.001) and pulse pressure (p< 0.001) presented with statistically significant differences among the three groups. Moreover, the mean ABI was 0.98 ± 0.08 in patients of Group 1, 0.80 ± 0.12 in Group 2 and 0.65 ± 0.11 in Group 3. There was a significant difference among the three groups in respect to the ABI (p<0.001).

On analyzing the three groups in pairs (Group 1 versus Group 2, Group 1 versus Group 3 and Group 2 versus Group 3) we observed that the patients of the three groups differed significantly to each other in relation to age, BMI, systolic pressure, diastolic pressure, pulse pressure and ABI. There was no significant difference between Groups 2 and 3 in respect to smoking and systemic arterial hypertension and there was no significant difference between Groups 1 and 2 for diabetes mellitus.

Table 2. Clinical characteristics of patients according to the severity of the coronary artery disease

		Group 1 N=48	Group 2 N=27	Group 3 N=38	p-value
Age (years)		56.21 ± 11.09	66.67 ± 7.00	77.63 ± 9.61	<0.001
Gender	Male	45.83%	48.15%	65.79%	0.157
	Female	54.17%	51.85%	34.21%	
Diabetes	Yes	54.17%	51.85%	78.95%	0.030
	No	45.83%	48.15%	21.05%	
Hypertension	Yes	41.67%	77.78%	89.47%	<0.001
	No	58.33%	22.22%	10.53%	
Smoker	Yes	18.75%	59.26%	76.32%	<0.001
	No	81.25%	40.74%	23.68%	
Alcoholism	Yes	16.67%	14.81%	13.16%	0.903
	No	83.33%	85.19%	86.84%	
BMI (kg/m2)		27.02 ± 4.42	31.56 ± 3.04	32.92 ± 2.25	<0.001
Systolic Pressure (mmHg)		133.85 ± 13.45	150.11 ± 16.42	167.61 ± 21.24	<0.001
Diastolic Pressure (mmHg)		85.40 ± 8.21	96.15 ± 12.30	99.89 ± 10.07	<0.001
Pulse Pressure (mmHg)		48.25 ± 7.48	53.96 ± 11.03	67.71 ± 16.26	<0.001
ABI		0.98 ± 0.08	0.80 ± 0.12	0.65 ± 0.11	<0.001

Data presented as means ± Standard deviation or percentage of patients, Kruskal-Wallis test used; Group 1: absence of coronary injury; Group 2: mild to moderate obstructive disease, (stenosis < 70%); Group 3: severe obstructive disease; ABI - ankle-brachial index; BMI - Body Mass Index

Table 3 shows the risk factors and comorbidities associated to coronary arterial disease based on the calculation of the odds ratio. We observed in this analysis that age (OR: 3.750; CI: 1.377- 10.209; p=0.010), systemic arterial hypertension (OR: 4.900; CI: 1.675 – 14.336; p= 0.004), smoking (OR: 6.303; CI: 2.193-18.116; p=0.001) and BMI (OR: 19.341; CI: 5.502 – 67.991; p=0.001) were strongly associated to coronary artery lesions < 70%; whilst ABI = 0.90 (OR: 0.026; CI: 0.007 – 0.101; p< 0.001) was not associated to coronary artery lesions <70%, and is therefore a protective factor against this type of lesion. Similarly, age (OR: 25.500; CI: 7.492 – 86.790; p < 0.001), diabetes mellitus (OR: 3.173; CI: 1.209 -8.326; p=0.019), systemic arterial hypertension (OR: 11.900; TI: 3.641 – 38.895; p< 0.001), smoking (OR: 13.963; CI: 4.928-39.562; p < 0. 001) and BMI (OR: 60.545; CI: 12.534-292.466; p<0.001) were strongly associated to coronary artery lesions = 70%; whilst ABI = 0.90 (OR: 0.003; CI: 0.000-0.028; p<0,001) was not associated to coronary artery lesions = 70%, and is also a protective factor against severe coronary artery disease.

From the analysis of the Spearman Correlation, age (p< 0.001), systemic arterial hypertension (p< 0.001), smoking (p<0.001), BMI (p< 0.001) systolic pressure (p< 0.001), diastolic pressure (p< 0.001), pulse pressure (p<0.002) and ABI (p<0.001) were directly correlated to the presence of coronary artery lesions. There was no statistically significant correlation between the gender (p=0.187) or diabetes mellitus (p=0.146) and coronary injury.

By Logistic Regression Analysis we found that patients with ABI < 0.90, BMI = 30 kg/m^2 and age = 50 years presented the highest probability of coronary lesions (98.93%), while patients with ABI = 0.90, BMI < 30 kg/m^2 and age <60 years presented the smallest probability of coronary artery disease (1.33%). But, patients with ABI = 0.90, BMI = 30 kg/m^2 and age = 60 years presented a possibility of coronary artery lesions of 53.71%, while patients with ABI < 0.90, BMI < 30 kg/m2 and age < 60 years presented a possibility of coronary artery lesions of 51.86%.

Table 3. Risk Factors and comorbidities associated to coronary artery disease according to analysis of odds-ratio

Coronary artery lesion	Variable	Odd Ratio	Confidence Interval		p-value
			Lower limit	Upper limit	
Group 1 x Group 2	Age	3.750	1.377	10.209	0.010
Group 1 x Group 3	Age	25.500	7.492	86.790	< 0.001
Group 1 x Group 2	Gender	1.097	0.427	2.822	0.847
Group 1 x Group 3	Gender	2.273	0.944	5.470	0.067
Group 1 x Group 2	Diabetes	0.911	0.354	2.343	0.847
Group 1 x Group 3	Diabetes	3.173	1.209	8.326	0.019
Group 1 x Group 2	Hypertension	4.900	1.675	14.336	0.004
Group 1 x Group 3	Hypertension	11.900	3.641	38.895	< 0.001
Group 1 x Group 2	Smoking	6.303	2.193	18.116	0.001
Group 1 x Group 3	Smoking	13.963	4.928	39.562	< 0.001
Group 1 x Group 2	Alcoholism	0.870	0.236	3.207	0.834
Group 1 x Group 3	Alcoholism	0.758	0.226	2.537	0.653
Group 1 x Group 2	BMI	19.341	5.502	67.991	< 0.001
Group 1 x Group 3	BMI	60.545	12.534	292.466	< 0.001
Group 1 x Group 2	ABI	0.026	0.007	0.101	< 0.001
Group 1 x Group 3	ABI	0.003	0.000	0.028	< 0.001

Group 1: absence of coronary artery lesions; Group 2: mild to moderate obstructive disease (stenosis < 70%); Group 3: severe obstructive disease (stenosis = 70%).

Table 4 shows the clinical characteristics of patients with and without PAOD, divided according to the ABI. Of the 113 patients included in the study, 56.60% (64) presented with PAOD (ABI <0.90) and 90.76% (59) of the patients with coronary artery disease had concomitant PAOD. The prevalence of PAOD was greater in men (57.80%) than in women (42.20%). Patients with PAOD were older than those without PAOD (72.34 ± 11.40 versus 57.51 ± 11.11 years), and there was a prevalence of men (57.80% versus 46.90%); higher proportion of smokers (68.75% versus 20.41%); hypertension (85.94% versus 40.82%) and diabetes (68.75% versus 53.06%), higher mean value of BMI (32.13 ± 2.99 versus 27.42 ± 4.53), systolic pressure (161.33 ± 20.42 versus, 133.10 ± 12.93), diastolic pressure (98.73 ± 10.97 versus, 85.14 ± 7.89) and pulse pressure (62.59 ± 15.32 versus 47.76 ± 7.74); and a lower mean value of ABI (0.70 ± 0.11 versus 0.98 ± 0.01). There were significant differences in ages (p<0.001), systemic arterial hypertension (p<0.001), smoking (p<0.001), BMI (p<0.001), systolic pressure (p< 0.001), diastolic pressure (p<0.001) and pulse pressure (p<0.001) comparing individuals with and without PAOD. There was no significant difference in respect to gender (p=0.253) and to diabetes mellitus (p=0.090).

Table 4. Clinical characteristics of patients with and without PAOD, according to the value of the Ankle-Brachial Index (ABI)

		ABI ≥ 0.90 (n = 49)	ABI < 0.90 (n = 64)	TOTAL (n = 113)	p-value
Age (years)		57.51 ± 11.11	72.34 ± 11.40	65.91 ± 13.44	<0.001
Gender	Male	46.90%	57.80%	53.10%	0.253
	Female	53.10%	42.20%	46.90%	
Diabetes	Yes	53.06%	68.75%	61.95%	0.090
	No	46.94%	31.25%	38.05%	
Hypertension	Yes	40.82%	85.94%	66.37%	<0.001
	No	59.18%	14.06%	33.63%	
Smoker	Yes	20.41%	68.75%	47.79%	<0.001
	No	79.59%	31.25%	52.21%	
Alcoholism	Yes	20.41%	10.94%	15.04%	0.165
	No	79.59%	89.06%	84.96%	
BMI (kg/m2)		27.42 ± 4.53	32.13 ± 2.99	30.09 ± 4.39	<0.001
Systolic Pressure (mmHg)		133.10 ± 12.93	161.33 ± 20.42	149.09 ± 22.44	<0.001
Diastolic Pressure (mmHg)		85.14 ± 7.89	98.73 ± 10.97	92.84 ± 11.84	<0.001
Pulse Pressure (mmHg)		47.76 ± 7.74	62.59 ± 15.32	56.16 ± 14.57	<0.001
ABI		0.98±0.01	0.70±0.11	0.83±0.18	<0.001

Data presented as means ± Standard deviation or percentage of patients; Mann-Whitney test used; Peripheral Obstructive Arterial Disease (PAOD) = ABI <0.90; ABI - ankle-brachial index; BMI - Body Mass Index

Table 5. Risk factors and comorbidities associated with Peripheral Arterial Obstructive Disease in the analysis of Odds ratio

Risk Factor	Odd Ratio	Confidence Interval		p-value
		Lower limit	Upper limit	
Gender	0.64	0.30	1.36	0.252
Diabetes	1.76	1.53	2.02	<0.001
Hypertension	1.06	1.05	1.07	<0.001
Smokers	1.17	1.04	1.19	<0.001
Alcoholism	2.08	0.73	5.95	0.169
BMI	0.08	0.03	0.20	<0.001

Table 5 demonstrates the risk factors and comorbidities associated to PAOD, based on the odds ratio (OR). We observed, in this analysis, that diabetes mellitus (OR: 1.76; CI: 1.53-2.02; p<0.001), systemic arterial hypertension (OR: 1.06; CI: 1.05-1.07; p<0.001) and smoking (OR: 1.17; CI: 1.04-1.19; p<0.001) were strongly associated to PAOD, whilst BMI < 30 kg/m^2 (OR: 0.08; CI: 0.03-0.20; p<0.001) was not associated to PAOD, and thus is a protective factor against PAOD.

DISCUSSION

Patients submitted to coronary cineangiography present with, per se, an increased cardiovascular risk, as they have significant percentages of risk factors for atherosclerotic phenomena in coronary arterial beds and acute myocardial infarction, which include being older, being men, smoking, diabetes mellitus, systemic arterial hypertension and obesity [11].

Among the 65 patients with coronary artery disease in this study, we found the individuals were older; more were smokers, and more had hypertension and diabetics; they had higher mean values of systolic pressure, diastolic pressure and pulse pressure, when compared with the patients who did not present with coronary artery disease. Additionally, analysis using the Spearman Correlation showed that the age, systemic arterial hypertension, smoking, BMI, systolic pressure, diastolic pressure and pulse pressure were strongly associated to the presence of coronary artery lesions. Our results agree with the data reported by Iglézias et al. [11] and Brevetti et al. [12], demonstrating a strong influence of cardiovascular risk factors in the development of atherosclerotic and coronary atherothrombotic phenomena. Moreover, Sesso et al. [13] reported that, in under 60-year-old patients the systolic and diastolic pressures are significant cardiovascular risk predictors, whereas, in over 60-year-old patients only the systolic and pulse pressures are cardiovascular risks.

We also analyzed in this study the relationships that exist between cardiovascular risk factors and the severity of coronary artery disease. Our results showed a significant difference in respect to age, smoking, diabetes mellitus, systemic arterial hypertension and BMI. In addition, we found that the severity of coronary artery disease is directly associated to higher ages, greater mean values of BMI and higher mean systolic, diastolic and pulse pressures. Based on the calculation of the odds ratio, the age, systemic arterial hypertension, smoking and BMI are strongly associated with the presence of both mild or moderate coronary artery lesions (< 70%) and severe coronary artery lesions (= 70%), again showing, the impact of cardiovascular risk factors on the development of atherosclerotic processes in coronary arterial beds.

In respect to the ABI, we found a significantly lower mean value in patients with coronary artery disease compared to individuals without coronary artery disease (p<0.001). Additionally, based on the calculation of the odds ratio, an ABI = 0.90 constituted a protective factor both against mild and moderate coronary artery lesions (< 70%) and against severe compromise of the coronary arteries (= 70%). These results agree with the findings of other researchers, suggesting a strong inverse correlation between ABI and coronary artery disease [8,14-16],

We also found in this study, using analysis of Logistic Regression that older, obese patients with reduced ABIs (< 0.90) had a 98.39% probability of coronary artery lesions; whilst younger, non-obese patients with normal ABIs (= 0.90) presented a probability of just 1.33%. In addition,

younger, non-obese patients with reduced ABIs (<0.90) have a risk of 51.86% of suffering from coronary artery lesions. These results indicate that a reduced ABI is a possible marker and predictor for coronary atherosclerotic disease, either independently or associated to other cardiovascular risk factors, again suggesting a strong inverse relation between ABI and the presence of coronary artery lesions.

Based on the direct relationship between the severity of coronary artery disease and the reduction of the ABI demonstrated in this study, cardiovascular surgeons must be aware of the importance of measuring the ABI during the physical examination of patients with a risk of coronary artery disease, as well as its participation as an important tool to decide about the necessity of coronary artery bypass grafting in patients with severe coronary lesions.

The ABI, as a marker of asymptomatic PAOD, provides important information in respect to subclinical atherosclerosis, as well as constituting an important predictor of cardiovascular events [17]. An ABI < 0.9 presents sensitivity of from 90% to 97% and specificity between 98% and 100% to detect arterial stenosis that affects 50% or more of the lumen of one or more of the larger vessels of the lower limbs [3]. In this research, 56.60% of patients presented with PAOD; more men (57.80%) were involved compared to women (42.20%). Additionally, 90.76% of patients with coronary artery disease concomitantly presented with PAOD, ratifying the systemic character of the atherosclerotic phenomena. In respect to the prevalence of PAOD, our results surpass the 25.4% found by Hasimu et al. [18]; while our data show the presence of PAOD in less than the 98% of patients with coronary artery disease reported by Sukhija et al. [19].

Lu et al. [20], in a work on smoking and peripheral arterial disease, demonstrated smoking as an important risk factor not only for coronary artery disease, but for PAOD. The results found in this study agree with published results, as the prevalence of smoking was greater both in individuals with coronary artery disease (69.23%) and in those with PAOD (68.75%). Smoking also presented a direct association with the severity of coronary artery disease and also seems to increase the risk of PAOD by 1.17. The aforementioned results demonstrate the influence of this risk factor on the development of generalized atherosclerotic and atherothrombotic phenomena, both in coronary artery beds and in peripheral artery disease [18,21].

Cordova et al. [22], on evaluating the beneficial cardiovascular proprieties of wine, affirmed that consumption of a moderate quantity of alcohol (20 to 30 g/day) is a protective factor against coronary artery disease, reducing the risk for coronary artery disease by 40%. In this study, the prevalence of alcoholism was high both for patients without coronary artery disease (16.67%) and in individuals without PAOD (20.41%), proving to be a possible independent protective factor, albeit non-significant, for PAOD and coronary artery disease, as has already been reported by Meijer et al. [23].

According to the Framingham study [24], systemic arterial hypertension increases the risk of PAOD by 2.5% in men and 3.9% in women, with the pulse pressure being a stronger predictor of cardiovascular events than the systolic or diastolic pressures in isolation. In our study, the impact of systemic arterial hypertension on the development of atherothrombotic phenomena was observed both in coronary arteries and in peripheral artery beds, as a high percentage of hypertensive patients presented coronary artery disease (84.62%) and PAOD (85.94%). Systemic arterial hypertension also demonstrated a direct association with the severity of the coronary artery disease, as well as apparently increasing in the risk of developing PAOD by 1.06.

In this study a significant difference was also observed concerning the systolic, diastolic and of pulse pressures, not only among patients with coronary artery disease but also among individuals with PAOD. In respect to the systolic and of pulse pressures, our results agreed with those of Hasimu et al. [18], thus highlighting the role of these risk factors in the development of atherosclerotic processes in distinct vascular territories, as well as confirming concomitance of risk factors both in coronary artery disease and PAOD.

Murabito et al. [25], on evaluating the prevalence and clinical correlations of peripheral arterial disease, identified diabetes mellitus as an important risk factor not only for coronary artery disease but also for asymptomatic and symptomatic PAOD. Additionally, they affirmed that the prevalence of diabetes mellitus increases in patients with reduced ABIs. The results of this study agree with prior publications, as the prevalence of diabetes was greater in individuals with coronary artery disease (67.69%) compared to patients with PAOD (68.65%). Diabetes mellitus also presented a direct association with the severity of coronary artery disease, and it seems to increase the risk of developing PAOD by 1.76. Our results demonstrate the influence of diabetes mellitus on the development of the atherosclerotic phenomena, both in coronary and peripheral arteries [18,21,23].

From the aforementioned data, it is important to valorize a reduction in the ABI independent of the extent, as it is an important risk factor in individuals with symptoms compatible with coronary artery disease, and also provides an important indication of the degree of coronary artery occlusion. Two comorbidities were observed, PAOD and coronary artery disease, which significantly influence each other negatively, due to their interrelationships, contributing

dramatically to the evolution of ischemic heart disease and to the necessity of coronary artery bypass grafting.

CONCLUSION

This study suggests that a reduced ABI (<0.90) constitutes a possible marker of coronary artery disease in patients with a risk of atherosclerotic cardiovascular disease. Due to the high concomitance between PAOD and coronary artery disease found in this study (90.76%), the importance of determining the ABI as an instrument in the physical assessment of patients with risk for coronary artery disease must be stressed. Moreover, an ABI = 0.90 constitutes a protective factor both against moderate and severe coronary artery lesions. This work also suggested that risk factors, such as diabetes mellitus and systemic arterial hypertension, are adequately treated and that obesity and smoking are strongly discouraged.

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