



Arterial hypertension and associated factors in patients submitted to myocardial revascularization*

Hipertensão arterial e fatores associados em pessoas submetidas à cirurgia de revascularização do miocárdio

Hipertensión arterial y factores asociados en personas sometidas a la cirugía de revascularización del miocardio

Flávia Cortez Colósimo¹, Alexandre Gonçalves de Sousa², Gilmara Silveira da Silva³, Raquel Ferrari Piotto⁴, Angela Maria Geraldo Pierin⁵

* Extracted from a thesis entitled "Avaliação de uma coorte de pacientes submetidos à cirurgia de revascularização do miocárdio: evolução clínica de hipertensos"; Graduate Program in Adult Health Nursing, Escola de Enfermagem, Universidade de São Paulo, 2015.

¹ PhD student; Graduate Program in Adult Health Nursing, Escola de Enfermagem, Universidade de São Paulo; São Paulo, SP, Brazil.

² Medical researcher; Research Center, Hospital Beneficência Portuguesa; São Paulo, SP, Brazil.

³ MSc student; Escola de Enfermagem, Universidade de São Paulo; São Paulo, SP, Brazil.

⁴ Supervisor, Research Center, Hospital Beneficência Portuguesa; São Paulo, SP, Brazil.

⁵ Full Professor, Escola de Enfermagem, Universidade de São Paulo; São Paulo, SP, Brazil.

ABSTRACT

Objective: To identify the prevalence of arterial hypertension and associated factors in patients submitted to myocardial revascularization. **Method:** Cross-sectional study using the database of a hospital in São Paulo (SP, Brazil) containing 3010 patients with coronary artery disease submitted to myocardial revascularization. A multiple logistic regression was performed to identify variables independently associated with hypertension (statistical significance: $p < 0.05$). **Results:** Prevalence of hypertension was 82.8%. After the variables were adjusted, the associated factors were as follows: age, odds ratio (OR): OR=1.01; 95% confidence interval (CI): CI:1.00-1.02; female gender: (OR=1.77; CI:1.39-2.25); brown-skin race: (OR=1.53; CI:1.07-2.19); obesity: (OR=1.53; CI:1.13-2.06); diabetes: (OR=1.90; CI:1.52-2.39); dyslipidemia: (OR=1.51; CI:1.23-1.85); and creatinine > 1.3: (OR=1.37; CI:1.09-1.72). **Conclusion:** A high prevalence of arterial hypertension and association with both non-modifiable and modifiable factors was observed.

DESCRIPTORS

Hypertension; Prevalence; Myocardial Revascularization; Risk factors.

Correspondence Addressed to:

Angela Maria Geraldo Pierin
Av Dr Enéas de Carvalho Aguiar, 419 - Cerqueira Cesar
CEP 05403-000, São Paulo, SP, Brazil.
pierin@usp.br

Received: 10/31/2014
Approved: 01/12/2015

INTRODUCTION

In Brazil, cardiovascular diseases are the leading cause of death. They are responsible for a high number of hospital admissions and result in high health and social costs. In the period Jan-Jun 2014, 554,850 admissions for diseases in the circulatory system were registered in the Unified Health System, and R\$ 1,253,350,156.33 were spent on these diseases⁽¹⁾.

Cardiovascular risk factors were first identified in the classic study by Framingham. He revealed the importance of factors including arterial hypertension, diabetes, elevated LDL cholesterol, low HDL cholesterol, smoking, family history, obesity, and sedentarism as factors strongly related to atherosclerosis⁽²⁾. Recently, the INTERHEART case-control study, which was conducted in 52 countries (five continents) listed nine factors, including hypertension, as being of greatest risk for the development of acute myocardial infarction⁽³⁾. In a multicenter study conducted in 12 hospitals in the metropolitan region of São Paulo (SP, Brazil), arterial hypertension has emerged as a potent risk factor for acute myocardial infarction, with an odds ratio of 3.26 in relation to non-hypertensive individuals⁽⁴⁾.

The role of hypertension as a risk factor for cardiovascular disease and its high prevalence in many countries in the world makes this disease a considerable public health problem. Although a Brazilian study on its prevalence is not available, about 30% of the Brazilian adult population is estimated to be hypertensive, and this rate is doubled in the elderly⁽⁵⁾. Treatment in the pharmacological and non-pharmacological modalities was shown to be effective, but control of arterial hypertension is hardly satisfactory⁽⁶⁾. Sustained high pressure levels cause damage in target organs, with serious complications such as myocardial infarction, stroke, and kidney failure.

Regarding treatment of coronary heart disease, much progress was achieved in terms of either medicines for clinical treatment or technologies for percutaneous and surgical approach. Surgery for myocardial revascularization has been widely carried out all over the world by virtue of the high technical development and favorable results. However, the results also depend on the clinical condition of the patient, who often has multiple factors for cardiovascular risk and associated comorbidities⁽⁷⁻⁸⁾.

Although Brazilian studies have described the clinical and demographic profile of patients submitted to surgical myocardial revascularization⁽⁸⁻¹¹⁾, no study described association of arterial hypertension with other risk factors and comorbidities in this population. The purpose of this study was to identify prevalence of arterial hypertension and associated factors in coronary artery disease patients submitted to myocardial revascularization surgery.

METHOD

This study was conducted with data from the database for myocardial revascularization surgery of a large hospital in the city of São Paulo (SP, Brazil). The database contains information about 3010 patients who were submitted to this type of surgery in the period July 2009-Jul 2010.

Data for sociodemographic characteristics, cardiovascular risk factors, associated diseases, as well as characteristics of the surgical procedure, complications, and postoperative outcome (discharge or death) were collected from medical records. A structured questionnaire was completed by trained researchers. Subsequently, data were entered into a spreadsheet prepared with the Delphi program.

Only preoperative characterization data were used in this study. Therefore, it is configured up as a cross-sectional study. Hypertension, defined as a history of hypertension, registered in medical records, and categorized as yes or no, was considered as a dependent variable. The independent variables were divided into sociodemographic variables (gender, age, race, and source of funding for hospital admission) cardiovascular risk factors (diabetes, dyslipidemia, smoking, obesity, and family history of coronary artery disease), and other diseases (chronic obstructive pulmonary disease, chronic kidney disease, peripheral arterial disease, and cerebrovascular disease). For characterization of patient race, similarly to what was used in population censuses by the Instituto Brasileiro de Geografia e Estatística (IBGE), we used self-defined skin color as informed by the individual for his/her identification with the hospitalization service. The sources for funding hospitalization were dichotomized in SUS, for resources of the Unified Health System, or non-SUS, for resources of either health insurance or private resources. We considered as current smokers individuals who reported smoking in the last month before surgery and former smokers those who have stopped smoking for 30 or more days before surgery. The body mass index (BMI) was calculated by the equation $BMI = w/h^2$ (w : weight in kg; h : height in m), using the weight and height values as measured and registered in the medical records during the medical or nursing anamnesis performed at admission. The following classification was adopted using the values for BMI: normal weight (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²), and obesity (≥ 30.0 kg/m²)⁽¹²⁾. Diabetes, dyslipidemia, family history of coronary heart disease, and other comorbidities were defined according to the previous history of these conditions as registered in the medical records. The last value of preoperative serum creatinine, as dosed by the hospital clinical laboratory, was also considered.

In the statistical analysis, the chi-square test or Fisher's exact test were used to verify equal proportion of categorical variables between interest groups, and Student's *t* test was used for continuous variables. In order to estimate the independent effect of the variables on the outcome (arterial hypertension), the variables with values for $p < 0.20$ in the bivariate analysis were selected to integrate the multiple logistic regression model. We adopted the statistical significance level of 5%.

The project was approved by the Research Ethics Committee (Protocol No. 658-10) of the institution where the study was conducted.

RESULTS

All 3010 patients of the institution's database were included in this study. Patients submitted to myocardial

revascularization were predominantly of the male gender (69.9%), with an average age of 62.2 years (standard deviation: 9.4). White-skinned individuals (84.6%) predominated

and a large majority of hospital admissions was funded by SUS (92.2%). Arterial hypertension was present in 2491 patients (82.8%).

Table 1 – Sociodemographic variables in hypertensive and non-hypertensive patients submitted to myocardial revascularization - São Paulo, SP, Brazil, 2014.

Variables	Hypertensive patients		Non-hypertensive patients		Total		p values
	N	%	N	%	N	%	
Genders							
Male	1689	67.8	416	80.2	2105	69.9	<0.000
Female	802	32.2	103	19.8	905	30.1	
Skin colors							
White	2096	84.1	451	86.9	2547	84.6	0.177
Brown	266	10.7	39	7.5	305	10.1	
Black	98	3.9	23	4.4	121	4.0	
Yellow	31	1.2	6	1.2	37	1.2	
Funding sources							
SUS *	2305	92.5	471	90.7	2776	92.2	0.167
Non-SUS	186	7.5	48	9.3	234	7.8	
Ages, years, mean (SD)*	62.43 (9.47)		61.08 (9.53)		62.2 (9.4)		0.003

* SUS- Sistema Único de Saúde (Unified Health System); SD- Standard deviation

Table 1 shows sociodemographic characteristics according to the groups of hypertensive and non-hypertensive. Hypertensive patients had significantly higher age and prevalence

of female gender compared with non-hypertensive patients ($p < 0.05$). Significant association between arterial hypertension and race or funding source was not observed.

Table 2 – Cardiovascular risk factors and comorbidities in hypertensive and non-hypertensive patients submitted to myocardial revascularization - São Paulo, SP, Brazil, 2014.

Variables	Hypertensive patients		Non-hypertensive patients		Total		p values
	N	%	N	%	N	%	
Yes	983	39.5	119	22.9	1102	36.6	0.0001
No	1508	60.5	400	77.1	1908	63.4	
Dyslipidemia							
Yes	1159	46.5	179	34.5	1338	44.5	<0.0001
No	1332	53.5	340	65.5	1672	55.5	
Body Mass Index (Kg/m2)*							
Normal	814	33.7	187	37.2	1001	34.3	<0.001
Overweight	1078	44.6	241	47.9	1319	45.1	
Obesity	526	21.7	75	14.9	601	20.6	
Smoking							
Never	1129	45.3	216	41.6	1345	44.7	0.03
Stopped	999	40.1	205	39.5	1204	40.0	
Yes	363	14.6	98	18.9	461	15.3	
Family history Coronary Artery Disease							
Yes	718	28.8	163	31.4	881	29.3	0.239
No	1773	71.2	356	68.6	2129	70.7	
Chronic kidney disease							
Yes	152	6.1	18	3.5	170	5.6	0.01
No	2339	93.9	501	96.5	2840	94.4	
Stroke							
Yes	150	6.0	18	3.5	168	5.6	0.021
No	2341	94.0	501	96.5	2842	94.4	
Peripheral arterial disease							
Yes	131	5.3	15	2.9	146	4.8	0.022
No	2360	94.7	504	97.1	2864	95.2	
Carotid artery disease							
Yes	49	2.0	5	1.0	54	1.8	0.117
No	2442	98.0	514	99.0	2956	98.2	
Yes	74	3.0	10	1.9	84	2.8	0.189
No	2417	97.0	509	98.1	2926	97.2	

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Variables	Hypertensive patients		Non-hypertensive patients		Total		p values
	N	%	N	%	N	%	
Chronic lung disease							
Yes	182	7.3	27	5.2	209	6.9	0.086
No	2309	92.7	492	94.8	2801	93.1	
Angina							
Yes	1870	75.1	368	70.9	2238	74.4	0.048
No	621	24.9	151	29.1	772	24.6	
Serum creatinina (mg/dL)							
≤1.3	1742	69.9	392	75.5	2134	70.9	0.010
>1.3	149	30.1	127	24.5	876	29.1	

*n=2921

Regarding cardiovascular risk factors and other diseases, such as diabetes, dyslipidemia, obesity, chronic kidney disease, previous stroke, and peripheral arterial disease, their presence in hypertensive patients was more frequent than in non-hypertensive patients ($p < 0.05$). In hypertensive patients, frequency of former smokers and non-smokers ($p < 0.05$), serum creatinine values above 1.3 mg/dL, and complaints of angina in the preoperative period (Table 2) were also higher than in non-hypertensive patients.

The multiple logistic regression model showed an independent association of sociodemographic variables, some risk factors, and comorbidities with arterial hypertension. Thus, the chance of a patient to have arterial hypertension increases with each year of age, being higher in women and brown-skinned subjects compared to white, obese, diabetic, and dyslipidemic patients, as well as those with serum creatinine higher than 1.3 mg/dL (Table 3).

Table 3 – Multiple logistic regression model: variables associated with arterial hypertension in patients submitted to myocardial revascularization - São Paulo, SP, Brazil, 2014.

Variables	Odds Ratios	CI (95%)		p values
Age	1.01	1.00 -	1.02	0.037
Gender				
Male	1.00			-
Female	1.77	1.39 -	2.25	<0.001
Skin color				
White	1.00			-
Black	1.07	0.66 -	1.76	0.777
Brown	1.53	1.07 -	2.19	0.020
Yellow	0.95	0.39 -	2.33	0.903
Body Mass Index (kg/m²)				
<25	1.00			-
25-29.9	1.04	0.84 -	1.29	0.729
≥30	1.53	1.13 -	2.06	0.005
Diabetes				
No	1.00			-
Yes	1.90	1.52 -	2.39	<0.001
Dyslipidemia				
No	1.00			-
Yes	1.51	1.23 -	1.85	<0.001
Serum creatinina (mg/dL)				
≤1.3	1.00			-
>1.3	1.37	1.09 -	1.72	0.007

DISCUSSION

The main results of this study are related to the high prevalence of arterial hypertension in the study population and its association with modifiable cardiovascular risk factors such as diabetes, dyslipidemia,

and obesity. Association between arterial hypertension and non-modifiable biological variables such as age, gender, and race were also observed in this study.

The notable prevalence of arterial hypertension identified in this study (82.8%) was much higher than that found

in the general population. This result is somewhat expected, if the known association between arterial hypertension and coronary heart disease is taken into account. Equally high prevalences were reported in other studies also conducted with individuals submitted to myocardial revascularization surgery⁽⁸⁻¹¹⁾ reaching rates as high as 90%⁽¹⁰⁾.

For the general population, epidemiological studies conducted in different regions of Brazil show a prevalence of arterial hypertension that varies in the range of 23.0-41.4%⁽¹³⁻¹⁶⁾. The variation observed between rates can be explained by the different methodologies used in the studies, as well as the heterogeneity of the study populations. Data from the telephone survey VIGITEL (Monitoring of Risk Factors and Protection for Chronic Diseases by Telephone Survey), which monitors risk factors for chronic diseases in 26 Brazilian capitals and the Federal District, indicate a prevalence of self-reported arterial hypertension of 23.0% in the population aged over 18 years, ranging from 16.6% (Boa Vista, RR) to 29.7% (Rio de Janeiro, RJ)⁽¹⁷⁾. A population-based household survey was conducted in 100 Brazilian municipalities and showed a prevalence of 16.3% in adults aged below 59 years⁽¹⁸⁾.

Regarding frequency of arterial hypertension in the male and female genders, the results of different investigations are controversial. Although frequency of arterial hypertension has been assumed to be higher among men or even similar between genders until the age of 50 years, occurrence of arterial hypertension among women showed to be higher⁽¹⁹⁾ and its predominance in this gender regardless of age was also demonstrated⁽²⁰⁾. In the present study, association between arterial hypertension and female gender was observed even after ages were adjusted. Data from the VIGITEL 2012 study showed a higher prevalence of arterial hypertension among women of all age groups in almost all states in Brazil⁽¹⁷⁾. However, it should be considered that studies based on self-reported arterial hypertension can indicate a higher prevalence of this disease among women because they know better their health and seek more for health services than men do. However, we believe that this bias has been minimized in this study, because such patients generally have a previous health monitoring, know their condition, being referred to a tertiary service for specialized surgery.

Our study shows that women have a 10% increase per year of life in the chance of presenting arterial hypertension. The increase in prevalence of arterial hypertension with progression of age is well established in the literature. Very often, arterial hypertension prevalences greater than 50% are reported for ages over 50 years, and rates of up to 70% were found for ages over 70 years⁽²¹⁾. Despite to the known increase in prevalence of this disease with advancing age, high rates of arterial hypertension in younger age groups have been reported, possibly influenced by occurrence of overweight in these age groups in the study population⁽²⁰⁾.

The highest prevalence of hypertension in black-skinned individuals has also been demonstrated in epidemiological studies^(15,20). In a recent study conducted in Brazil, a 45.4% prevalence of arterial hypertension was found in quilombola

communities. Such rate is higher than that shown in general population studies⁽²²⁾. The present study shows a higher prevalence of arterial hypertension in mulatto compared with that of white-skinned individuals. We can consider that the strong miscegenation that exists in Brazil and the criterion adopted for definition of race (self-declaration) may have contributed to this result, because individuals self-declared as brown-skinned may have characteristics and genetic inheritance of black-skinned individuals.

Beyond the biological aspect related to black-skinned individuals, many authors call attention to the low education and income which are frequent among them. In a study conducted in Salvador (BA, Brazil), the authors state that an improvement in the educational level and, therefore, in the socioeconomic level could minimize the effects of racial influence on the high prevalence of cardiovascular risk factors found in that population⁽²³⁾. Possible explanations for the influence of the lower socioeconomic level on health conditions of the population fall on their lack of access to the health system, beyond the lower degree of information and understanding of the disease and their determinants⁽²⁴⁾. In addition, studies have already shown the negative impact the lower socioeconomic level exerts on physical activity and adoption of a healthy diet⁽²⁵⁾. In the present study, the socioeconomic variable was represented by the source of funding of patient surgery, dichotomized into the SUS and non-SUS groups, but association between this variable and arterial hypertension was not demonstrated. Whether the funding source variable used in the study adequately reflects the mentioned aspects (access, information, and understanding) for this sample, it could be questioned. A publication used the same sample of this study and showed that other preoperative clinical characteristics were not different for the SUS and non-SUS groups⁽²⁶⁾.

Regarding the modifiable risk factors, the present study corroborates evidence from other studies that show association of arterial hypertension with diabetes, altered levels of triglycerides and cholesterol, and overweight⁽²⁷⁾. The frequent simultaneity of these factors could express a common pathophysiological mechanism. The Salvador (BA, Brazil) study showed that arterial hypertension alone, i.e., in the absence of other cardiovascular risk factors, occurred in only 0.9% of both men and women⁽²³⁾.

A population study on risk factors for arterial hypertension in a city in the countryside of São Paulo State showed a significantly higher prevalence of diabetes among hypertensive patients (odds ratio=6.54)⁽²¹⁾.

A study on factors associated with arterial hypertension in river communities involved case series with specific features, potentially different from those of the general population. However, after adjusted analysis it showed association of arterial hypertension with overweight, elevated glycemia, and age over 60 years in men, and with age and high triglyceride and glucose blood levels in women⁽²⁸⁾.

Overweight is currently a global epidemic. In this study, overweight and obesity were pooled (65.7% of subjects), being the second most prevalent cardiovascular risk factor. In obese individuals, the chance of hypertension

was 53% greater than in eutrophic ones. Several studies on factors associated with hypertension also revealed such relationship^(16,20-21).

The present study also evidenced occurrence of higher levels of serum creatinine in hypertensive compared with non-hypertensive patients even after the variables were adjusted. Although the study has a cross-sectional character and does not allow to establish causal relationships between the two variables, this fact points to the existence of target organ injury, indicating a worse renal function in hypertensive patients. Similarly, the study demonstrated a significantly higher hypercreatinemia in hypertensive patients (odds ratio=5.42) of a general adult population, in addition to a 4.5 times greater chance of renal dysfunction (defined as a creatinine clearance <60 ml/min) in hypertensive individuals⁽²¹⁾. In the present study, other target organ injuries such as histories of stroke, peripheral arterial disease, and chronic kidney disease were significantly associated with arterial hypertension, demonstrating the deleterious role of hypertension on specific body organs and putting the hypertensive coronary patient at a level of greater clinical severity.

The evidence of aggregation of cardiovascular risk factors shown in this study reinforces the recommendation that health education strategies aimed to reduce cardiovascular risk should cover several risk factors together. Although in the national guidelines⁽⁵⁾ of arterial hypertension the changes in lifestyle are described as non-pharmacological interventions, and its orientation is considered a role of the multidisciplinary health team, this tool is still underutilized. In a survey conducted in the city of Sao Paulo, just over half of the hypertensive patients interviewed stated they

had received guidance on forms of non-pharmacological treatment for hypertension in health services⁽¹³⁾. In another nationwide study, only 45.4% of the hypertensive adults received guidance to maintain ideal weight and 47.9% to perform physical activity⁽¹⁸⁾. On the other hand, controlled studies conducted in primary care units showed a significant improvement in the control of risk factors, especially in blood pressure levels, after the educational program for hypertensive patients was implemented⁽²⁹⁻³⁰⁾.

Study limitations include cross-sectional design, which allows to identify association between variables without however establishing causal relationships, and use of data collected through medical records, which allows the bias of lack of registration.

CONCLUSION

While our results show an association between arterial hypertension and other cardiovascular risk factors, especially factors sensitive to lifestyle modifications, in patients submitted to myocardial revascularization surgery, they reinforce the need to implement comprehensive educational strategies and at all levels of health care.

In the hospital context of myocardial revascularization surgery, patient care is performed by a multidisciplinary team. Nurses play an extremely important role, as these professionals assist patients continuously during all their stay. Therefore, in addition to the technical skills necessary for nurses to take care of surgical patients, they must take the role of co-educators in health, guiding and encouraging patients to adopt healthy habits that will reflect in all risk factors and comorbidities present in individuals with coronary artery disease.

RESUMO

Objetivo: Identificar a prevalência da hipertensão arterial e fatores associados em pacientes submetidos à cirurgia de revascularização miocárdica. **Método:** Estudo transversal utilizando banco de dados de um hospital em São Paulo-SP, Brasil contendo 3010 coronariopatas submetidos à revascularização miocárdica. Procedeu-se à regressão múltipla para identificação das variáveis independentemente associadas à hipertensão, considerando-se significância estatística $p < 0,05$. **Resultados:** A prevalência de hipertensão foi de 82,8% e os fatores associados, após ajuste das variáveis, foram: idade Oddsratio (OR) = 1,01, intervalo de confiança 95% (IC): 1,00-1,02; sexo feminino OR = 1,77, IC:1,39-2,25; raça parda OR = 1,53, IC:1,07-2,19; obesidade OR = 1,53, IC:1,13-2,06; diabetes OR = 1,90, IC:1,52-2,39; dislipidemia OR = 1,51, IC:1,23-1,85; e creatinina >1,3 OR = 1,37, IC:1,09-1,72. **Conclusão:** Verificou-se elevada prevalência de hipertensão arterial e associação tanto com fatores não modificáveis, como com fatores modificáveis.

DESCRITORES

Hipertensão; Prevalência; Revascularização Miocárdica; Fatores de risco.

RESUMEN

Objetivo: Identificar la prevalencia de la hipertensión arterial y los factores asociados en pacientes sometidos a la cirugía de revascularización miocárdica. **Método:** Estudio transversal utilizando banco de datos de un hospital en São Paulo-SP, Brasil, conteniendo a 3010 coronariopatas sometidos a la revascularización miocárdica. Se procedió a la regresión múltiple para la identificación de las variables independientemente asociadas con la hipertensión, considerándose significación estadística $p < 0,05$. **Resultados:** La prevalencia de hipertensión fue del 82,8% y los factores asociados, después del ajuste de las variables, fueron: edad Oddsratio (OR) = 1,01, intervalo de confianza del 95% (IC): 1,00-1,02; sexo femenino OR = 1,77, IC:1,39-2,25; raza morena OR = 1,53, IC:1,07-2,19; obesidad OR = 1,53, IC:1,13-2,06; diabetes OR = 1,90, IC:1,52-2,39; dislipidemia OR = 1,51, IC:1,23-1,85; y creatinina >1,3 OR = 1,37, IC:1,09-1,72. **Conclusión:** Se verificó elevada prevalencia de hipertensión arterial y asociación tanto con factores no cambiables como con factores cambiables.

DESCRIPTORES

Hipertensión; Prevalencia; Revascularización Miocárdica; Factores de Riesgo.

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