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Original Article

Relationship between cardiac ejection fraction and blood pressure in coronary heart patients*

Relação entre fração de ejeção cardíaca e pressão arterial em pacientes coronariopatas

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Objective: to analyze the existence of a relationship between cardiac ejection fraction during hospitalization with blood pressure values obtained before and during hospitalization in patients hospitalized for coronary disease. **Methods:** correlational study, with 303 patients with coronary artery disease. Sociodemographic data were obtained through interviews and the clinical parameters consulted in the medical record. **Results:** of the participants with low systolic blood pressure, 54.0% had decreased cardiac ejection fraction, showing an association (p<0.001). Systolic pressure during hospitalization was not associated with the cardiac ejection fraction (p=0.060). During hospitalization, diastolic blood pressure and the cardiac ejection fraction showed a statistically significant association (p<0.001) that was directly proportional in the female sex. **Conclusion:** systolic blood pressure lower than 120mmHg is associated with reduced cardiac ejection fraction in coronary arteries. There was a relationship between increased diastolic blood pressure and elevated left ventricular ejection fraction in women with coronary disease.
Descriptors: Coronary Disease; Cardiovascular Diseases; Arterial Pressure; Stroke Volume; Nursing.

Objetivo: analisar a existência de relação entre fração de ejeção cardíaca durante a internação com valores da pressão arterial obtidos antes e durante a internação em pacientes hospitalizados por doença coronariana. **Métodos:** estudo correlacional, com 303 pacientes coronariopatas. Os dados sociodemográficos foram obtidos por meio de entrevista e os parâmetros clínicos consultados no prontuário. **Resultados:** dos participantes com pressão arterial sistólica baixa, 54,0% possuíam fração de ejeção cardíaca diminuída, evidenciando-se associação (p<0,001). A pressão sistólica durante a hospitalização não esteve associada à fração de ejeção cardíaca (p=0,060). Durante a internação, a pressão arterial diastólica e a fração de ejeção cardíaca mostraram associação estatística significativa (p<0,001) diretamente proporcional no sexo feminino. **Conclusão:** pressão arterial sistólica inferior a 120mmHg está associada à fração de ejeção cardíaca reduzida em coronariopatas. Houve relação entre aumento da pressão arterial diastólica e elevação da fração de ejeção do ventrículo esquerdo em mulheres com doença coronariana.
Descritores: Doença das Coronárias; Doenças Cardiovasculares; Pressão Arterial; Volume Sistólico; Enfermagem.

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Introduction

Left ventricular ejection fraction is the percentage of blood that the ventricle ejects into the aorta during systole. Its value is estimated on the echocardiogram examination by means of the final systolic and diastolic volumes in the ventricle[1]. This parameter is a valuable index to estimate the follow-up of patients[2], although there are conflicting opinions about the ability of this data to predict survival[3].

However, left ventricular ejection fraction is widely considered an important predictor of mortality. Investigations indicate that the worst prognosis is related to the reduction of the cardiac ejection fraction, in comparison to the preserved parameter[4-5].

Among the markers associated with the occurrence of negative events in patients with decreased cardiac ejection fraction are advanced age, high systolic blood pressure, and diastolic blood pressure at hospital admission and elevated plasma levels of cerebral natriuretic peptide[6]. The traditional risk factors that increase the mortality of patients with diminished cardiac ejection fraction may not apply to patients with preserved cardiac ejection fraction[7]. Thus, it is imperative to know the risk factors and warning signs related to the alteration of left ventricular ejection fraction.

The decrease in systolic ventricular function has an important relationship with coronary heart disease, since deterioration of coronary function may result in the development of heart failure[8]. In acute myocardial infarction, systolic dysfunction is an important marker of poor prognosis. The myocardium deforms simultaneously in three dimensions and the parameters of left ventricular function, such as volume and ejection fraction, can remain compensated despite changes in the properties of myocardial deformation[9].

The accumulation of comorbidities in people with ventricular dysfunction may lead to an inflammatory state leading to myocardial dysfunction[7]. Systolic ventricular dysfunction after acute myocardial infarction has been extensively studied in relation to the development of heart failure and increased mortality[10]. Recent meta-analyzes show that infarct size is related to the occurrence of new cardiovascular events, whereas left ventricular ejection fraction is more related to patient mortality[11].

It is essential to know the mechanisms responsible for ventricular dysfunction caused by coronary diseases[8]. In addition, healthcare professionals should be able to identify the presence of their signs and symptoms.

The relationship between blood pressure, cardiac ejection fraction and prognosis of heart failure has been investigated, mainly in developed countries. It is observed that systolic blood pressure variation has been shown to be associated with ventricular dysfunction, linked to the preserved or reduced ejection fraction parameter[12-16].

Such evidence is concentrated in patient groups from North America, Europe, and timidly from Asia. No similar investigations were identified in the Brazilian population. In addition, the correlation between systolic blood pressure and left ventricular ejection fraction is commonly analyzed in patients with heart failure, although the ejection fraction, as evidenced, is also an important parameter for individuals with coronary diseases, because of their relationship with morbidity-mortality and the etiology of the disease, which tends to progress to heart failure.

Since nursing performs cardiac monitoring in the hospital setting and monitoring of blood pressure in the outpatient setting, knowing the relationships between left ventricular ejection fraction and arterial pressure are fundamental for the accurate assessment of cardiac function by these professionals.

To contribute to nursing care and clinical management of patients with heart disease, the present study has the following research question: Is there an association between blood pressure and left ventricular ejection fraction in patients with coronary he-

art disease? Therefore, the purpose of this study was to analyze the existence of a relationship between cardiac ejection fraction during hospitalization with blood pressure values obtained before and during hospitalization in patients hospitalized for coronary disease.

Methods

A correlational study carried out in the cardiology units of a reference hospital for the diagnosis and treatment of heart and lung diseases in the Northeast Region of Brazil. Data collection occurred between November 2015 and April 2016.

The study included 303 patients hospitalized for coronary heart disease who met the following inclusion criteria: age 18 or older, hospitalized for coronary heart disease diagnosis, and an accessible medical record for consultation with an echocardiographic report performed during the current hospitalization. Patients with physical or cognitive limitations that precluded clinical evaluation or interview response were excluded.

The participants were identified by means of diagnostic information available at the hospitalization units of the research site. The invitation to participate in the study and the collection of data were performed in front of the patient's bed.

Data were collected through a research protocol containing three sections: sociodemographic information, blood pressure values and clinical data in the medical record.

Sociodemographic information was obtained through a structured interview with an average duration of 10 minutes, addressing the origin, marriage condition, family income, schooling and occupation. After the initial interview, blood pressure was verified according to the technique recommended by guidelines and relevant literature[17].

The records were then collected and the records of the following parameters were collected: cardiac ejection fraction provided by echocardiography of the current hospitalization and values of systolic and diastolic blood pressure before hospital admission.

The data were included in a Microsoft Excel spreadsheet program by double typing and processed by the Statistics Package for Social Sciences program version 22.0 and organized into tables with absolute and percentage frequencies. The Pearson Chi-square test and the Mann-Whitney test were used to identify the association between systolic blood pressure, diastolic blood pressure and left ventricular ejection fraction. Statistical conclusions were discussed at the 5% level of significance for both tests. The relationship between the variables studied was verified using Spearman's correlation coefficient, with a significance level of 10%.

The study respected the formal requirements contained in the national and international norms regulating research involving human beings.

Results

The average age of participants was 64.7 years (± 10.3). There was a predominance of males (51.8%) and people from the countryside towns (54.7%). The most frequent educational level was up to four years of study (50.5%). The marital status of fixed partnership was identified in 77.5% of respondents.

As shown in Table 1, at hospital admission, systolic blood pressure was elevated in 71.0% of the participants. During hospitalization, 67.7% of the patients had increased systolic blood pressure. This parameter was lower than 120 mmHg in 29.0% of patients at admission and 32.3% during hospitalization.

The pre-hospitalization diastolic pressure was high in 57.7% of the patients, the majority (52.1%) with levels between 80 and 89 mmHg. During hospitalization, elevated levels totaled 29.3%, with most participants with values below 80 mmHg.

Table 1 - Systolic and diastolic blood pressure values of patients hospitalized for coronary disease

Blood pressure (mmHg)	Admission n (%)	During hospitalization n (%)
Systolic		
< 120	88 (29.0)	98 (32.3)
121 – 159	176 (58.1)	193 (63.7)
≥ 160	39 (12.9)	12 (4.0)
Diastolic		
<80	128 (42.2)	214 (70.7)
80-99	158 (52.1)	88 (29.0)
>100	17 (5.6)	1 (0.3)

Of the 303 participants, 135 (44.6%) presented decreased cardiac ejection fraction at hospital admission and 54 (40.0%) had systolic blood pressure <120 mmHg; of the others with preserved ejection fraction, 106 (63.1%) presented systolic blood pressure between 121 and 159 mmHg (Table 2). A statistically significant association was found between the cardiac ejection fraction and the systolic blood pressure lower than 120 mmHg (p<0.001). The values of diastolic blood pressure at the time of admission were not statistically related to the cardiac parameter studied.

Table 2 - Correlation between cardiac ejection fraction and systolic blood pressure, before hospitalization of the participants

Systolic blood pressure (mmHg)	Cardiac ejection fraction (%)		p
	< 50% n	≥ 50% n	
< 120	54	34	<0.001
121 – 159	70	106	
≥ 160	11	28	
Total	135	168	

Table 3 shows the correlation between the sexes of systolic and diastolic blood pressure verified during hospitalization with the cardiac ejection fraction. According to the data presented, diastolic blood pressure and the cardiac ejection fraction have a significant statistical association (p<0.001) in the female sex. Positive Spearman's correlation coefficient indicates a proportional association in the variables, so that when diastolic blood pressure in females is elevated, there is a tendency for the cardiac ejection fraction to also increase.

Table 3 - Correlations between sexes, systolic and diastolic blood pressure and cardiac ejection fraction during hospital stay

Variables	Cardiac ejection fraction (%)	
	Famale (n=149)	Male (n=157)
Systilic blood pressure (mmHg)	0.133	0.150
p-value*	0.105	0.061
Diastolic blood pressure (mmHg)	0.184	0.088
p-value*	0.025	0.276

*Refers to Spearman's correlation coefficient

Discussion

The study presents limitations as to the method used, since there was no comparison of blood pressure with the fraction of cardiac ejection prior to hospital admission. The quality of the blood pressure data recorded in the medical record was also considered a limitation.

High systolic blood pressure tends to be associated with preserved cardiac ejection fraction, and is not a risk factor for this parameter. It is suggested that people with heart failure and normal or low systolic blood pressure are prone to have decreased cardiac ejection fraction, leading to higher in-hospital and post-discharge mortality rates[12-13].

Patients with normal or low systolic blood pressure before hospital admission are more likely to have reduced left ventricular ejection fraction, suggesting that low systolic blood pressure is characterized as an unsatisfactory hemodynamic condition when associated with low cardiac output[15]. This investigation corroborates this correlation, since it identified statistical significance between the occurrence of systolic blood pressure lower than 120 mmHg and reduced cardiac ejection fraction. Thus, it was evidenced that the two parameters are related not only to patients with heart failure, as pointed out in the pertinent lit-

erature[4-5,7], but also to those with coronary diseases.

The correlation verified occurred at hospital admission, that is, before the beginning of tertiary interventions for treatment and/or control of coronary disease. The finding is similar to other evidences that point to a non-significant association between diastolic blood pressure and left ventricular ejection fraction[13,15]. In this context, diastolic blood pressure is considered a poorly predictive parameter for mortality[13].

This study also proceeded to analyze blood pressure values during hospitalization, characterized as a period in which the patient is already receiving interventions.

During hospital admission, systolic blood pressure was not related to decreased cardiac ejection fraction, as well as other similar investigations[13,15]. In contrast, diastolic blood pressure values were associated with the cardiac parameter in female patients in a directly proportional way, indicating that the increase in diastolic blood pressure in women tends to increase the ejection fraction, being clinically beneficial.

Thus, it is understood that the verification of the systolic blood pressure at admission makes it possible to differentiate the groups of patients regarding the clinical characteristics, prognosis and pathophysiology. In addition, therapy may differ between patients with high, normal and low systolic blood pressure[13]. In women, during tertiary interventions, the effect of diastolic blood pressure on the cardiac ejection fraction should be better explored to understand the intervals in which this association remains present and clinically beneficial.

Recent assessments of the first phase of cardiac ejection demonstrate that the deep degrees of early systolic dysfunction result in a reduction in the fraction greater than 25.0%, although this can be seen in the absence of any change in the overall ejection fraction. The sustained contraction observed in association with the reduced first-phase cardiac ejection fraction may represent a compensatory mechanism to maintain the overall parameter, so that the ejection fraction is preserved for some time, even in the face of systolic dysfunction[16].

The relationship between systolic blood pressure and left ventricular ejection fraction makes blood pressure verification a powerful tool in the identification of coronary heart patients at risk for decreased ejection fraction and those with the already reduced parameter. While determination of the cardiac ejection fraction requires medium to difficult-to-access technological equipment, blood pressure is a simple and low-cost procedure that should be used as a screening instrument to identify the presence of a reduction in the ventricular ejection parameter in the cardiac patients in question.

Therefore, blood pressure assessment should use adequate technique and equipment validated, and add to the data of the patient's personal and family history and physical examination[17]. When blood pressure is accurately verified in potentially at risk patients, the institutions' human and financial resources are used more efficiently, leading to more accurate diagnoses and care plans[18]. However, we still identify the presence of gaps in knowledge about physiology and the appropriate measurement technique[19].

The applicability of the study derives from the relationship between decreased systolic blood pressure in coronary arteries and the presence of reduced cardiac ejection fraction. Once aware of this knowledge, nursing, as a component of the health team linked to the verification and monitoring of vital signs, is able to identify patients with potential changes in ventricular function in clinical situations prior to hospital admission.

Conclusion

Systolic blood pressure, lower than 120mmHg, is associated with reduced cardiac ejection fraction in coronary arteries. There was a relationship between increased diastolic blood pressure and elevated left ventricular ejection fraction in women with coronary disease.

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Collaborations

Albuquerque NLS contributed for the design of the project, data analysis and interpretation, article writing and final approval of the version to be published. Oliveira ASS, Silva JM and Peres AAA contributed with data analysis and interpretation and article writing. Araujo TL contributed with conception and design, relevant critical revision of the intellectual content and final approval of the version to be published.

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