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Original Article

Relation between Outcome of Coronary Artery Intervention and Hypertension Phenotypes

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Abstract

Background: Predicting of coronary artery disease (CAD) severity and percutaneous coronary intervention (PCI) outcomes is important to improve health and longevity. Blood pressure (BP) phenotype recognition is simple and can be easily done. So using it for percutaneous coronary intervention outcome prediction is crucial and promising.

Aim: To assess coronary angiographic findings and PCI outcomes in relation to different hypertension phenotypes.

Methods: This observational study included 105 participants diagnosed with coronary artery disease and were planned for PCI. The 24h ambulatory blood pressure monitoring was performed to all patients. Patients were categorized into three groups based on the observed phenotypes of hypertension; 26 patients (24.76%) were classified as white-coat hypertension group, 42 patients (40%) as masked hypertension group and 37 patients (35.42%) as sustained hypertension group.

Results: There was no statistical significant difference between the three studied groups regarding to number of diseased coronaries, SYNTAX score, mortality and non-fatal MI.

Conclusion: ABPM for targeting WCHT and MHT is crucial, as they are not less than SHT regarding coronary artery disease severity and percutaneous coronary intervention outcome.

Keywords: Hypertension, Phenotypes, CAD, Outcomes.

INTRODUCTION

Coronary artery disease is one of the main causes of death and disability in affluent countries. Despite a decline in CAD over the last 40 years, it continues to be the cause of at least one third of all fatalities in individuals aged 35 and above [1].

Arterial hypertension is one of risk factors of CAD all over the world with significant impact on the clinical outcome of these patients [2]. It is therefore essential to accurately diagnose hypertension so that treatment can be focused on those at high risk of adverse events [3, 4].

Blood pressure monitoring yields different phenotypes i.e., controlled BP, uncontrolled BP, dipping and non-dipping hypertension, white coat hypertension, and concealed hypertension [5].

BP alterations are associated with cardiovascular events [6], but little is available regarding PCI outcome in relation to different BP phenotypes [7].

Detection the predictors of CAD severity and PCI outcomes are important to improve health and longevity. BP phenotype recognition is simple and can be easily done[7]. So using it for PCI outcome prediction is crucial and promising. The aim of work is to assess coronary angiographic findings and PCI outcomes in relation to different hypertension phenotypes.

METHODS

This cross-section study was carried out in Cardiology Department of Zagazig university hospital during the period from December 2021 till December 2022. Local institutional review board (IRB) approval and informed consents from all patients were obtained. This study strictly complied with the Declaration of Helsinki, which was released by the World Medical Association to protect subjects taking part in medical research.

Study population

The study included a comprehensive sample of chronic coronary patients who were subjected for PCI. Patients with previous revascularization, cardiomyopathy, significant valvular heart disease, arrhythmias, paced rhythm, invalid ABPM recognitions and patients refused sharing in the study, were excluded from the study.

Patient demographic and clinical data including age, sex, body mass index, smoking status,, diabetes (receiving ant diabetic treatment, or fasting blood sugar ≥110 mg/dL, or ≥140 mg/dL in a 2-hour 75g oral glucose tolerance test), heart failure , renal disease (positive proteinuria or serum creatinine ≥1.1 mg/dL) , stroke, and use of antihypertensive medication were obtained Laboratory investigations were done using blood samples collected from the antecubital vein under fasting conditions to assess complete blood picture CBC, serum urea and creatinine according to the standard laboratory methods.

The LV mass derived from two-dimensional linear LV measurements has been measured using the equation recommended by ASE [8].

Blood Pressure Monitoring

All participants were subjected for 24 hours ambulatory BP monitoring, within 24 hour before PCI. They returned to the clinic after wearing the ABPM for ≥24 hours, where ABPM data was downloaded and analyzed after informing the time of sleeping and waking up. The European Society of Hypertension recommendations defined ambulatory hypertension as a mean blood pressure reading of 130/80 mmHg or higher during the day, 135/85 mmHg or higher during the night, and/or 120/70 mmHg or higher during the 24-hour period. White coat hypertension (WHT) was defined as the presence of an elevated office blood pressure (BP) of ≥140/90 mmHg and a normal mean 24-hour blood pressure (<130/80 mmHg). Masked hypertension (MHT) was defined as the presence of a normal office blood pressure (<140/90 mmHg) and an increased mean 24-hour blood pressure (≥130/80 mmHg). Sustained hypertension (SHT) was defined as the elevation of both office and ABPM BPs. [9].

PCI

Trained cardiologists had assessed the severity of CAD that was expressed as number of diseased coronaries and the sum of all vascular lesions for each patient. Vascular access, interventional strategy, and stent selection, were at the sole discretion of the operator. PCI outcome within 24 hours , regarding sudden death and myocardial infarction (definite ST elevation, typical or atypical symptoms and abnormal enzymes) was detected.

Statistical Analysis

SPSS 26.0 for Windows (SPSS Inc., Chicago, IL, USA) was used to gather, tabulate, and statistically analyze all of the data. Percentage and number were used to describe the qualitative data. The terms mean, standard deviation, median, and range (lowest and maximum) were used to characterize quantitative data. Every statistical comparison had two tails and was considered significant. A P-value of less than 0.05 suggests a significant difference, p <0.001 a highly significant difference, and P> 0.05 a non-significant difference. The Chi-square (X2) test of significance was employed as the test to compare the proportions of the various qualitative factors. F-test (ANOVA): To compare more than two groups for quantitative variables that are regularly distributed.

RESULTS

Patients were categorized into three groups based on the observed phenotypes of hypertension; 26 patients (24.76%) were classified as white-coat hypertension group, 42 patients (40%) as masked hypertension group and 37 patients (35.42%) as sustained hypertension group. Demography, associated comorbidities (DM, CKD or cerebrovascular diseases) , showed no significant differences between groups. (P >0.05) (Table1).

Daytime SBP, daytime DBP, night-time SBP, and night-time DBP showed statistical significant increase in masked and sustained groups (p <.001) (Table 2). There was significant increase of urea and creatinine in sustained HPN group in comparison to the other groups (p 0.02) (Table 3). Echocardiographic measurements of LVDD, LVSD, and EF , showed no statistical significant difference between the three groups (p > 0.05).LVMI (g/m2) was statistically larger in masked and sustained groups (p 0.02) (Table 4).

Regarding number of diseased coronaries, and SYNTAX score, there was no statistical significant difference between the three groups (p > 0.05) (Table 5). Regarding major cardiac complications post PCI, there was no significant difference between the three studied groups regarding mortality, and non-fatal MI (p > 0.05) (Table 6). Logistic regression for predicting major cardiac complications was performed. Age and diabetes were the only predictors of MACE post PCI (p<0.001) (Table 7).

Table 1: Demographic data and associated comorbidities among the study population

	White-coat group (n = 26)	Masked group (n = 42)	Sustained group (n = 37)	Test of Sig.	p
Age Mean ± SD	63.81 ± 7.82	61.26 ± 8	61.59 ± 8.26	F 0. 9	0.4
Sex **Male** **Female**	 13 (50%) 13 (50%)	 20 (47.62%) 22 (52.38%)	 15 (40.54%) 22 (59.46%)	X2 0.1	0.7
Residence **Urban** **Rural**	 10 (38.46%) 16 (61.54%)	 13 (30.95%) 29 (69.05%)	 7 (18.92%) 30 (81.08%)	X2 1.5	0.2
Diabetes	4 (15.38%)	7 (16.67%)	6 (16.22%)	X2 0	0.9
Chronic kidney disease	3 (11.54%)	6 (14.29%)	7 (18.92%)	X2 0.1	0.7
Cerebrovascular disease	2 (7.69%)	4 (9.52%)	3 (8.11%)	X2 0.0	0.9

χ2: Chi- Square test, F: ANOVA test, SD: standard deviation
P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.001: Highly significant

Table 2: 24 hours ambulatory blood pressure measurements among the study population

	White-coat group (n = 26)	Masked group (n = 42)	Sustained group (n = 37)	Test of Sig.	p
Daytime SBP Mean ± SD	**126.1 ± 9.6****	**135.8 ± 8.9**	**138.9 ± 8.6**	**F 16.2**	**0.001**
Daytime DBP Mean ± SD	**72.6 ± 5.9 ****	**77.1 ± 6. 7**	**77.6 ± 6.6**	**F 5.3**	**0.007**
Night-time SBP Mean ± SD	**113.7 ± 8.5****	**129.3 ± 7.7**	**130.8 ± 7.9**	**F 40.9**	**<0.001**
Night-time DBP Mean ± SD	**62.6 ± 5.3 ****	**70.8 ± 4.9**	**68.8 ± 5.8**	**F 19.4**	**<0.001**

SBP=systolic blood pressure, DBP= diastolic blood pressure

Table 3: Laboratory investigations among the study population

	White-coat group (n = 26)	Masked group (n = 42)	Sustained group (n = 37)	Test of Sig.	p
RBCs count Mean ± SD	4.7 ± 0.2	4.7 ± 0.2	4.8 ± 0.2	F 0.5	0.6
Hb Mean ± SD	14.1 ± 0.4	14.0 ± 0.4	14.01 ± 0.4	F 0.1	0.9
WBCs count Mean ± SD	6.2 ± 1.3	6.8 ± 1.4	6.5 ± 1.3	F 1.8	0.2
Platelets count Mean ± SD	229.7 ± 34.9	237.7 ± 35.4	235.2 ± 35.7	F 0.4	0.7
Urea (mg/dl) Mean ± SD	22.9 ± 5.6	26.5 ± 6.1*	23.5 ± 5.4	F 4.2	0.02
Creatinine (mg/dl) Mean ± SD	0.7 ± 0.1	0.9 ± 0.2**	0.8 ± 0.1	F 8.2	<0.001
CK (U/L) Mean ± SD.	112.5 ± 34. 5	111.8 ± 34.9	111.1 ± 33.0	F 0.01	0.9

	White-coat group (n = 26)	Masked group (n = 42)	Sustained group (n = 37)	Test of Sig.	p
CK-MB (ng/mL) Mean ± SD.	2.0 ± 0.7	2.0 ± 0.8	2.0 ± 0.8	F 0.03	0.9
Troponine (ng/mL) Mean ± SD	0.02 ± 0.01	0.02 ± 0.01	0.02 ± 0.01	F 0.4	0.7

Table 4: LV functions test results among the study population

	White-coat group (n = 26)	Masked group (n = 42)	Sustained group (n = 37)	Test of Sig.	p
LVDD (cm) Mean ± SD	4.4 ± 0.3	4.5 ± 0.3	4.5 ± 0.4	F 0.6	0.5
LVSD (cm) Mean ± SD	2.8 ± 0.2	2.9 ± 0.3	2.8 ± 0.3	F 2.2	0.1
LVMI (g/m2) Mean ± SD	93.4 ± 13. 5*	101.7 ± 10.2	100.7 ± 13.9	F 3.9	0.02

Table 5: Angiographic findings of the studied groups

	White-coat group (n = 26)	Masked group (n = 42)	Sustained group (n = 37)	Test of Sig.	p
CAD **1-vessel disease** **2-vessel disease** **3-vessel disease**	 18 (69.23%) 6 (23.08%) 2 (7.69%)	 26 (61.90%) 10 (23.81%) 6 (14.29%)	 24 (64.86%) 9 (24.32%) 4 (10.81%)	X2 0.1	0.9
SYNTAX score Mean ± SD	155.8 ± 21.9	143.2 ± 23.0	150.1 ± 28.8	F 2.1	0.1

Table 6: post PCI outcome among the study groups

	White-coat group (n = 26)	Masked group (n = 42)	Sustained group (n = 37)	Test of Sig.	p
Mortality	2 (7.69%)	0 (0%)	1 (2.70%)	X2 1.8	0.2
Non-fatal MI	2 (7.69%)	1 (2.38%)	1 (2.70%)	X2 0.5	0.5

Table 7: Logistic regression with odds ratios and 95% confidence intervals (CI) predicting major cardiac complications

	Major cardiac complications			
	OR	95% CI		P
		Lower	Upper	
Age (years)	1.286	1.103	1.500	0.001
Sex (Male)	3.929	0.755	20.455	0.104
Residence (Urban)	1.556	0.348	6.962	0.563

	OR	95% CI		P
DM	23.455	4.204	130.848	<0.001
CKD	3.877	0.826	18.192	0.086
Cerebrovascular disease	9.1	1.743	47.509	0.009

DISCUSSION

The most recent guidelines for the diagnosis and treatment of hypertension recommend using ambulatory blood pressure monitoring (ABPM) for blood pressure assessments conducted outside of the office [10-12]. Office blood pressure monitoring is not as good a predictor of cardiovascular events as ABPM, but data on its relation to coronary angiographic findings and PCI outcome is scarcy. This current study was performed to determine whether distinct BP phenotypes are related to coronary angiographic findings and 24h post PCI outcome.

In the present study, masked hypertension was more prevalent, followed by sustained hypertension, and a less fraction had white-coat hypertension. In the general community, concealed hypertension affects approximately 1 in 3 [13, 14]. The high incidence of masked hypertension in different communities, suggests a significant public health challenge. Unlike our results, there is comparable prevalence of masked hypertension and white-coat hypertension [15].

Overall, characteristics of studied patients were similar (old age, and no sex predilection). It was discovered in a sizable cooperative study involving 13 population-based cohorts that the distinction between ambulatory BP phenotypes differs markedly according to age [16]. Another analysis included 642 untreated subjects aged 5 to 78 years , had confirmed that there is a crossing age point after age of 40 years where ABP tends to have similar values [17].

In the present study, both daytime and nighttime BP was elevated in masked and sustained hypertension. Higher systolic blood pressure at night has been linked to a higher relative risk of coronary heart disease [18].

The most common type of harm to the target organ is left ventricular hypertrophy to increase risk for future cardiovascular disease [19]. Previous studies have shown that nighttime BP is strongly correlates with left ventricular hypertrophy [20]. Limited evidence is now available to link selective rise of blood pressure outside of the workplace to echocardiographic left ventricular hypertrophy [21]. Another study had highlighted the importance of the early detection of masked hypertension as it shows an increased left ventricular mass index [22].

The current study noted that the difference in coronary angiographic findings in ambulatory BP phenotypes did not reach statistical significance difference. Despite that Our findings appear to be in line with evidence that patients with WCH and MH exhibit similar levels of myocardial perfusion as patients with SH [23], the small sample size of patients might be likely has an effect . A study by Cai et al. [24] had shown that there was no discernible difference in the WCHT group's incidence of CAD, but it was higher in the MHT and SHT groups.

In addition, we agreed with previous study [25], that ABP phenotypes has no impact on PCI outcome, as Hypertension seems to be not associated with a higher mortality rate after PCI. Hypertension when associated with DM, but not alone was found to be related to a rise in mortality following PCI [26] for three years. According to other reports, DM was a highly reliable indicator of death. In another study, in patients with acute coronary syndrome, hypertension was an independent predictor of post-PCI mortality [27]. The results from these studies differed from our results due to variations in the number of patients studied, the follow-up period, and the inclusion criteria.

CONCLUSION

This ABPM study showed that among patients with chronic coronary patients, masked hypertension is an underappreciated problem. Ambulatory hypertension phenotypes were found to be not related to the CAD and PCI outcome in such patients, which means that WCHT, and MHT probably are hypertension phenotypes with coronary artery injury. This highlights the potential for the importance of ABPM for targeting WCHT and MHT which are not less than SHT regarding CAD severity and PCI outcome.

Declaration of interest

The authors report no conflicts of interest. The authors along are responsible for the content and writing of the paper.

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