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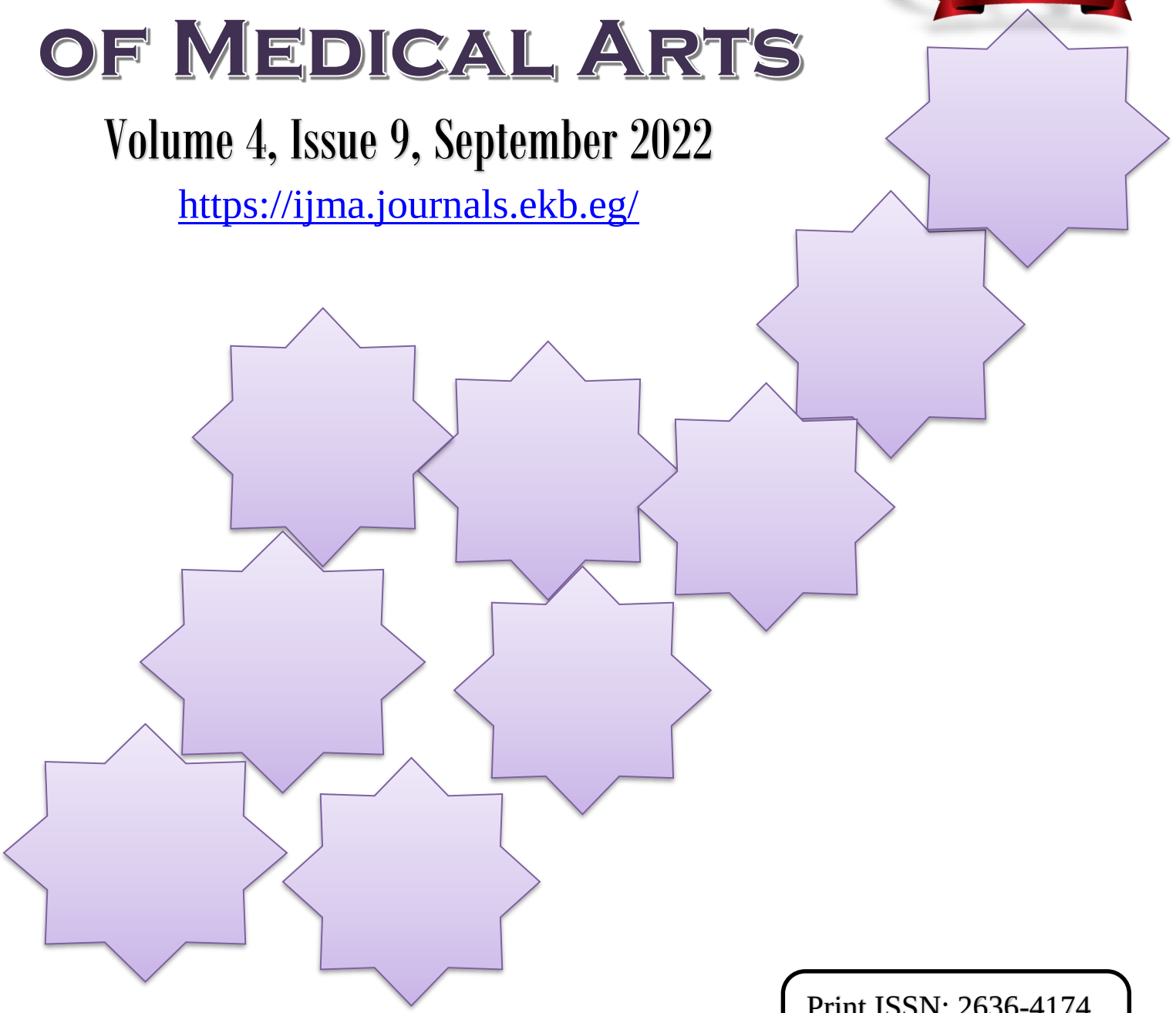

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Original Article

Atrial and Ventricular Arrhythmia Prevalence During Dobutamine Stress Echo in Hypertensive Patients Before Non-Cardiac Surgery

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ABSTRACT

Background: Dobutamine stress echocardiography [DSE] is commonly utilized for the diagnosis and assessment of coronary disease, particularly in individuals with restricted physical activity. limited studies have assessed the effect of dobutamine infusion on hypertensive patient regarding arrhythmia.

Aim of the work: This study aimed to determine the prevalence of atrial and ventricular arrhythmia during Dobutamine stress echo in hypertensive patients before non-cardiac surgery.

Patients and methods: This prospective comparative study included 182 Participants divided as regards the presence of hypertension into 2 groups, a Case group [76 hypertensive patients], and a control group [106 non-hypertensive patients]. All participants were subjected to Dobutamine Stress Echocardiography**.**

Results: As regards the prevalence of Arrhythmia, the most prevalent type of arrhythmia in both groups was the PVC [28.9% of cases and 19.9% of control] followed by PAC [7.9% of cases and 7.5% of control], SVT, and AF, with no significant difference between the 2 groups [P value = 0.1, 0.9, 0.3, 0.09 respectively].

Conclusion: The risk of dangerous arrhythmia during DSE is small and similar in both groups.

Keywords: Arrhythmia; Dobutamine stress echo; Hypertension; Non-cardiac surgery.

INTRODUCTION

Among hypertensive patients, exercise electrocardiography showed moderate accuracy in making the diagnosis of ischemic heart disease [1, 2]. Exercise nuclear imaging and nuclear coronary angiography showed good results in many studies, even though these patients did not have significant epicardial coronary artery disease [3].

Dobutamine stress echocardiography [DSE] is commonly utilized for the diagnosis and assessment of coronary disease, particularly in individuals with restricted physical activity [4, 5]. Dobutamine lowers systemic resistance and stimulates beta receptors, producing a favorable inotropic and chronotropic response [6, 7]. Dobutamine stress echo has been shown to have higher sensitivity and specificity than exercise ECG in the identification of ischemic heart disease in hypertensive patients [8]. Infusion of large amounts of dobutamine raises oxygen demand via positive inotropic and chronotropic effects, allowing for the detection of ischemic heart disease by increased oxygen demand [6]. Limited studies have assessed the hemodynamic profile, of dobutamine stress testing in Subjects with hypertension, and it is unknown to what extent hypertensive people can tolerate the potential increases or decreases in systolic blood pressure that dobutamine infusion may cause. In hypertensives the autonomic nervous system is dysregulated, this dysregulation is assumed to affect the feasibility of dobutamine stress testing. Several studies have reported that βeta receptor function may be reduced in hypertensive patients [9, 10]. Also, it is not known the effect of dobutamine infusion on hypertensive patients regarding arrhythmia. Patients undergoing noncardiac surgery are at risk for postoperative cardiovascular complications. The addition of a preoperative DSE is important in discovering postoperative cardiovascular outcomes [11]. Dobutamine is commonly used in the pharmacological Stress test. Several arrhythmias either ventricular or atrial can happen during the test, but these arrhythmias are rare, confirming, thus, the safety of using DSE [12, 13].

The incidence of ventricular arrhythmia including ventricular ectopic, ventricular tachycardia, and ventricular fibrillation, with DSE, varies from 0.02 to 4%. Sustained monomorphic ventricular tachycardia [VT] has been reported to occur in 0–0.3% of DES [14].

AIM OF THE WORK

This study aimed to determine the prevalence of atrial and ventricular arrhythmia during Dobutamine stress echo in hypertensive patients before non-cardiac surgery.

PATIENTS AND METHODS

A prospective comparative study included 182 Participants were divided regarding the presence of hypertension into 2 groups, a Case group [76 patients], and a control group [106 non-hypertensive patients]. We recruited our subjects from the Echocardiography and outpatient Cardiology units of Al-Azhar university hospital, Damietta from September 2021 to September 2022. The sample size was calculated with Power and Sample Size software [PASS] program, version 15, as per the flow of cardiac patients to ECG and echocardio-gram units, using error at alpha = 5%, and 80% power. The study followed Helsinki declaration principles. After approval of the ethics committee at Al-Azhar University. Informed written consent from all patients, we recruited the patients according to the following criteria;

The Inclusion criteria: patients with impaired exercise capacity referred for assessment of myocardial ischemia by Dobutamine stress echocardiography before non-cardiac surgery.

The Exclusion criteria: 1] Patients with significant heart failure. 2] Patients with marked valvular disease. 3] Patients with uncontrolled blood pressure ≥180/110 mm Hg. 4] Patients with significant hypotension with blood pressure <90/60 mm Hg. 5] Patients with the acute coronary syndrome.

Patients in group I were managed with antihypertensive combinations including ACEI [angiotensin converting enzyme inhibitors], CCB [calcium channel blockers] and beta blockers. IF the patients were managed with beta blockers they advised to hold it 3 days before DSE.

Data collection

All participants were subjected to the following during recruitment; 1] full history taking especially, a history of risk factors such as diabetes, hypertension, and smoking, history of cardiac disease, ischemic heart disease, and

AF. 2] general and local cardiac examinations. 3] Twelve-lead ECG to assess current cardiac rhythm and document the presence or absence of left ventricular hypertrophy in the study cases. 4] Dobutamine Stress Test and Stress Echocardiography.

Dobutamine Stress Test: Dobutamine was administered by infusion into the antecubital vein, beginning with a low dose of five micrograms per kilogram per minute and rising by ten micrograms per kilogram every three minutes up to a maximum dose of forty micrograms per kilogram per minute. People who were unable to achieve their age-predicted maximal heart rate were given atropine [up to 1 mg]. During the dobutamine infusion, the electrocardiogram was monitored continuously. Blood pressure was recorded both at rest and at 3-minute intervals during the Dobutamine stress echo. These are all causes to stop DSE; chest pain [severe and typical], ST segment depression greater than two millimeters, major arrhythmia, uncontrolled blood pressure [blood pressure less than 240 / 120 mm Hg], hypotension with a fall in systolic pressure greater than 40 mm Hg, and any serious side effects produced by dobutamine. It was planned to provide Inderal [1 mg/mm injectable solution] via the intravenous method in case the adverse effects of dobutamine did not resolve by themselves [15]. LVH was determined according to the Sokolov-Lyon criteria: S wave depth in V1+tallest R wave height in V5-V6>35 mm.

Stress Echocardiography: Every patient had rest, stress, and recovery echo pictures. The echo images and movies were recorded on hardware [Philips iE 33 Xmatrex machine [Philips, Philips IE 33 Ultrasound, Bothell, Washington, USA], ultrasound device, and a 4S-RS [3.5-Mhz] probe] and shown side by side in quad-screen format [using a Philips iE 33 Xmatrex machine and a 4S-RS [3.5-Mhz] probe]. LV was scored on a 4-point scale [1=normal, 2=hypokinesis, 3=akinesis, 4=dyskinesis]. The wall motion score index [WMSI] was derived by dividing the 16 subject l scores by 16. Two cardiologists blinded to the clinical data of the patients took the images [16].

Statistical analysis: Statistical analysis was performed by SPSS statistical software, version 26 [IBM, Chicago, Illinois, USA]. Categorical data were presented as numbers and percentages and were compared using the Chi-Square Test. The normality of continuous data was initially checked by the Kolmogorov-Smirnov test. As our continuous data were not parametric data, we presented it as median and Interquartile range [IQR], and the comparison between the 2 groups was done by the Mann-Whitney U test.

RESULTS

Our study included 182 participants; 76 cases, and 106 control. The median age of the cases and control were around 60 years old with no difference between the 2 groups [p-value = 0.6]. In terms of the gender distribution of the participants, we found that females were more prevalent in cases [55.3%] and control [51.9%] than males, however, the comparison between the two groups revealed no significant difference between them regarding gender [p-value = 0.68]. In our cases, 39.5% were smokers, 21.1% were diabetic, 44.7% were obese [BMI > 30 kg/m^2], 18.4% were with a positive family history of premature CVD, and 81.6% were dyslipidemic. The difference between the 2 groups regarding the above variables was not significant statistically [p-value = 0.2, 0.5, 0.9, 0.8, 0.1 respectively]. Regarding the LVH, 48.6% of the cases were positive. Unlike the control group in which all of them were negative for the LVH, with a statistically significant difference between the 2 groups [p-value = 0.01] [Table 1].

According to the hemodynamics of the participants, we measured the heart rate and Blood pressure at the rest and the peak, and we found that all parameters were significantly higher in the case group than in the control group [p-value = 0.001] [table 2].

Regarding the prevalence of Arrhythmia, the most prevalent type of arrhythmia in both groups was the PVC [28.9% of cases and 19.9% of control] followed by PAC [7.9% of cases and 7.5% of control], SVT, and AF, with no significant difference between the 2 groups. As regards the wall motion, 22.4% of cases had wall motion abnormalities in comparison to 19.8% of the control, this difference was not significant [P value = 0.6] [table 3].

Correlation analysis between each type of arrhythmia and the different study variables was done to determine any other risk factors that can affect the arrhythmia occurrence. In terms of PAC, in cases, we found a significant association between the PAC and gender, and all PAC patients were male [P value = 0.006].

However, in the control group, we found a significant association between PAC and smoking [P value = 0.006] [table 4].

As regards the SVT, we found no significant association between it, and any factors except dyslipidemia in cases [P value = 0.03]. In PVC, the only significant association was between it and the BMI of cases in which, 18.4% of the positive cases were with BMI > 30 kg/m^2 [P value = 0.03] [table 5].

In the case group, we found 37 patients had LVH, 19 of them were male, 16 were smokers, 6 were diabetic, 19 with BMI > 30 kg/m^2, 31 with dyslipidemia, and 5 had a positive family history of premature CVD. The difference between the LVH and none LVH patients regarding all the above variables was not significant statistically [table 6].

All participants with positive wall motion abnormalities had undergone coronary angiography, and we found that seven cases [41.2%] and seven controls [33.3%] had significant coronary angiography [P value = 0.4] [table 7].

Table [1]: Demographics and clinical characteristics of the study participants

Variables	Case [n = 76]	Control [n = 106]	P-value
Age [years] [Median and IQR]	60 [51 – 70]	61 [52 – 70]	**0.58** [a]
Gender. N [%]			**0.65**[b]
Male	34 [44.7%]	51 [48.1%]	
Female	42 [55.3%]	55 [51.9%]	
Smoking. N [%]			**0.23**[b]
Smoker	30 [39.5%]	48 [45.3%]	
Not smoker	46 [60.5%]	58 [54.7%]	
Diabetes. N [%]			**0.58**[b]
Diabetic	16 [21.1%]	26 [24.5%]	
Not diabetic	60 [78.9%]	80 [75.5%]	
Body mass index N [%]			**0.94**[b]
≥ 30 [kg/m^2]	34 [44.7%]	48 [45.3%]	
< 30 [kg/m^2]	42 [55.3%]	58 [54.9%]	
Dyslipidemia. N [%]			**0.12**[b]
Positive	62 [81.6%]	76 [71.7%]	
Negative	14 [18.4%]	30 [28.3%]	
Family history of premature CVD. N [%]			**0.81**[b]
Positive	14 [18.4%]	21 [19.8%]	
Negative	62 [81.6%]	85 [80.2%]	
Left Ventricular Hypertrophy. N [%]			**0.001** [b]
Positive	37 [48.6%]	0 [0%]	
Negative	39 [51.3%]	106 [98.1%]	

CVD: Cardio Vascular Disease. **a:** Mann-Whitney U test. **b:** Chi-square test.

Table [2]: Hemodynamic characteristics of the study participants

Variables	Case [n = 76]	Control [n = 106]	P-value [a]
Heart rate at rest	77 [69 – 84]	74.5 [69 – 87.25]	0.34
Heart rate at Peak	132.5 [130 – 143]	141 [140 – 145.5]	**0.001***
SBP at rest	140 [130 – 145]	120 [120 - 125]	**0.001***
SBP at Peak	160 [150 – 160]	140 [140 - 140]	**0.001***
DBP at rest	85 [80 – 85]	70 [70 - 75]	**0.001***
DBP at Peak	92.5 [90 – 95]	80 [80 - 85]	**0.001***

a: Mann-Whitney U test. ***:** significant p value. **SBP**: Systolic Blood pressure. **DBP**: Diastolic Blood Pressure

Table [3]: Prevalence of Arrhythmias at the peak of dobutamine stress echocardiography

Variables		Case [n = 76]	Control [n = 106]	P-value [a]
Premature atrial contractions, N [%]		6 [7.9%]	8 [7.5%]	0.93
Premature ventricular contractions, N [%]		22 [28.9%]	20 [18.9%]	0.11
Supra ventricular tachycardia, N [%]		2 [2.6%]	1 [0.9%]	0.37
Atrial fibrillation, N [%]		2 [2.6%]	0 [0%]	0.09
Ventricular tachycardia, N [%]		0 [0%]	0 [0%]	-
Wall motion abnormalities	Positive	17 [22.4%]	21[19.8%]	0.67
	Negative	59 [77.6%]	85 [80.2%]	

a: Chi square test.

Table [4]: Association between the PAC and different study variables in both groups

Variables	PAC					
	Case			Control		
	Positive	Negative	P value [a]	Positive	Negative	P value [a]
Gender. N [%]						
Male	6 [7.9%]	28 [36.8%]	**0.006***	2 [1.9%]	49 [46.2%]	0.1
Female	0 [%]	42 [55.3%]		6 [5.7%]	49 [46.2%]	
Smoking. N [%]						
Smoker	4 [5.3%]	26 [34.2%]	0.2	0 [0%]	48 [45.3%]	**0.006***
Not smoker	2 [2.6%]	44 [57.9%]		8 [7.5%]	50 [47.2%]	
Diabetes. N [%]						
Diabetic	2 [2.6%]	14 [18.4%]	0.6	0 [0%]	26 [24.5%]	0.09
Not diabetic	4 [5.3%]	56 [73.7%]		8 [7.5%]	72 [67.9%]	
BMI. N [%]						
≥ 30 [kg/m^2]	4 [5.3%]	32 [42.1%]	0.6	4 [3.8%]	44 [41.5%]	0.7
< 30 [kg/m^2]	2 [2.6%]	38 [50%]		4 [3.8%]	54 [50.9%]	
Dyslipidemia. N [%]						
Positive	6 [7.9%]	56 [73.7%]	0.2	4 [3.8%]	72 [67.9%]	0.1
Negative	0 [0%]	4 [18.4%]		4 [3.8%]	26 [24.5%]	
Family history of premature CVD. N [%]						
Positive	2 [2.6%]	12 [15.8%]	0.3	2 [1.9%]	19 [17.9%]	0.7
Negative	4 [5.3%]	58 [76.3%]		6 [5.7%]	79 [74.5%]	
LVH. N [%]						
Positive	4 [5.3%]	33 [70%]	0.4	0 [0%]	0 [0%]	-
Negative	2 [2.6%]	37 [48.7%]		8 [7.5%]	98 [92.5%]	

PAC: Premature atrial contractions. **CVD**: Cardio Vascular Disease. **LVH:** left Ventricular Hypertrophy. *: Significant correlation. **a:** Chi square test.

Table [5]: Association between the PVC and different study variables in both groups

Variables	PVC					
	Case			Control		
	Positive	Negative	P value [a]	Positive	Negative	P value [a]
Gender. N [%]						
Male	10 [13.2%]	24 [31.6%]	0.8	9 [8.5%]	42 [39.6%]	0.4
Female	12 [15.8%]	30 [39.5%]		11 [10.4%]	44 [41.5%]	
Smoking. N [%]						
Smoker	8 [10.5%]	22 [28.9%]	0.7	9 [8.5%]	39 [36.8%]	0.5
Not smoker	14 [18.4%]	32 [42.1%]		11 [10.4%]	47 [44.3%]	
Diabetes. N [%]						
Diabetic	4 [5.3%]	12 [15.8%]	0.7	5 [4.7%]	21 [19.8%]	0.5
Not diabetic	18 [23.7%]	42 [55.3%]		15 [14.2%]	65 [61.3%]	
BMI. N [%]						
≥ 30 [kg/m^2]	14 [18.4%]	20 [26.3%]	0.03*	7 [6.6%]	41 [38.7%]	0.2
< 30 [kg/m^2]	8 [10.5%]	34 [44.7%]		13 [12.3%]	45 [42.5%]	
Dyslipidemia. N [%]						
Positive	20 [26.3%]	42 [55.3%]	0.1	13 [12.3%]	63 [59.4%]	0.3
Negative	2 [2.6%]	12 [15.8%]		7 [6.6%]	23 [21.7%]	
Family history of premature CVD. N [%]						
Positive	2 [2.6%]	12 [15.8%]	0.3	1 [0.9%]	20 [18.9%]	0.053
Negative	20 [26.3%]	24 [55.3%]		19 [17.9%]	66 [62.3%]	
LVH. N [%]						
Positive	11 [14.5%]	26 [34.2%]	0.8	0 [0%]	0 [0%]	-
Negative	11 [14.5%]	28 [34.2%]		20 [18.9%]	86 [81.1%]	

PVC: Premature Ventricular contractions. **CVD**: Cardio Vascular Disease. **LVH:** left Ventricular Hypertrophy. *: Significant correlation. **a:** Chi square test

Table [6]: Demographics and clinical characteristics of the patients as regards the presence of LVH

Variables	LVH [n = 37]	None LVH [n = 39]	P-value
Age [years] [Median and IQR]	60 [49 – 70]	61 [51– 70]	0.58 [a]
Gender. N [%]			0.31[b]
Male	19 [51.4%]	15 [38.5%]	
Female	18 [48.6%]	24 [61.5%]	
Smoking. N [%]			0.63[b]
Smoker	16 [43.2%]	14 [35.9%]	
Not smoker	21 [56.8%]	25 [64.1%]	
Diabetes. N [%]			0.28[b]
Diabetic	6 [16.2%]	10 [25.6%]	
Not diabetic	31 [83.3%]	29 [74.4%]	
Body mass index. N [%]			0.34[b]
≥ 30 [kg/m^2]	19 [51.4%]	15 [38.5%]	
< 30 [kg/m^2]	18 [48.6%]	24 [61.5%]	
Dyslipidemia. N [%]			0.42[b]
Positive	31 [83.8%]	31 [79.5%]	
Negative	6 [16.2%]	8 [20.5%]	
Family history of premature CVD. N [%]			0.21[b]
Positive	5 [13.5%]	9 [23.1%]	
Negative	32 [86.5%]	30 [76.9%]	

CVD: Cardio Vascular Disease. **LVH:** left Ventricular Hypertrophy. **a:** Mann-Whitney U test. **b:** Chi square test

Table [7]: Coronary angiography in patients and controls

		Groups		
		Case (N = 17)	**Control (N = 21)**	**P value**
Coronary Angiography	Significant	7 (41.2%)	7 (33.3%)	**0.4**
	Not significant	10 (58.8%)	14 (66.7%)	

DISCUSSION

Dobutamine stress echocardiography [DSE] is commonly utilized for the diagnosis and assessment of coronary disease, particularly in individuals with restricted physical activity [4, 5].

Regarding demographic data of the patients, the median age of the participants was 61 years old, with no significant difference between the two groups. The age of our patients was similar to the age of and the patients in a study done by **Zamorano *et al.*** [17] who found that the mean and SD of the studied patients was 63±11 years. This old age of the patients is considered a risk factor for ischemic heart disease [18].

Regarding gender, females were more prevalent in each group, which disagree with the results of **Sheldon *et al.*** [19] who studied the prevalence of AF during Dobutamine stress echo. This difference may be due to different sample size, population, and we did our study to determine all types of arrhythmia not only AF. However, our result is in line with previous study reported that the incidence of ischemic heart disease in females more than males [20].

In the present study, there was no significant difference between study and control subjects regarding smoking, diabetes, and family history of premature cardiovascular disease. These results disagreed with the results of **Nicolas *et al.*** [21], and **Abdou *et al.*** [22]. This disagreement may be explained by different sample sizes of the two studies.

According to the dyslipidemia, it is considered one of the major risk factors for ischemic heart disease especially in patients with familial hypercholesterolemia as reported by **Mundal *et al.*** [23]. In our study 81.6% of the cases, and 71.7% of the control had dyslipidemia, so most of them are at risk of IHD, which must be taken in consideration during the dobutamine stress echo.

In our study, we reported electrocardiography voltage criteria of LVH in the hypertensive group with statistically significant differences between the case and control. This result was in line with the findings of **Cuspidi *et al.*** [24] who did a systematic review included 37.700 patients with hypertension with a prevalence of LVH of 41%.

As regards the hemodynamic characteristics of the study participants, regarding heart rate, there was a statistically insignificant difference between patient and control during rest but there was a statistically significant difference during peak DSE. Regarding systolic and diastolic

blood pressure during rest and peak DSE, there was a statistically significant difference between the patients and the control. This result agreed with the study done by **Abdou *et al*. [22]**.

In our study the prevalence of premature atrial contractions was [7%], premature ventricular contractions [23%], supraventricular tachycardia [2%], atrial fibrillation1 [1%], and the overall prevalence was 4.8%. This result agreed with the study done by **Meters *et al*. [16]** who showed the prevalence of different types of atrial arrhythmias during dobutamine stress testing was similar in patients with and without hypertension which equal [4.1%].

In the present study, no cases developed ventricular tachycardia this disagreed with the study done by **Demosthenes *et al*. [14]** that showed the prevalence of VT was equal to [0.3%].

In our study, a significant correlation was stated between the premature atrial contraction occurrence and the gender in which the PAC was significantly more prevalent in the male of case group, with no female affection. Also, we found a significant correlation between the PVC and the obesity in cases. Based on these results we recommend for the clinician to consider the gender, and obesity as a risk factor for arrhythmia occurrence in hypertensive patients during the during the Dobutamine stress Echo.

According to the wall motion abnormalities, we reported 22.4% of the cases had wall motion abnormalities, which disagree with the finding of **Aftab *et al*. [25]** who found that 50% of the patients had wall motion abnormalities during the dobutamine stress Echo. This disagreement may be explained by that, all patients in **Aftab *et al*. [25]** study had end stage renal disease, which may affect the effect of dobutamine on the heart, however we didn't include any case with end stage renal disease in our study.

In conclusion, the risk of dangerous arrhythmia during DSE is small and similar in both groups' atrial arrhythmia and atrial fibrillation during DSE is uncommon, VT is a rare complication of DSE, cardioversion is rarely needed to manage arrhythmia of DSE, DSE is an alternative method for evaluation of coronary artery disease in hypertensive patients, with a diagnostic accuracy comparable to that in patients without hypertension. It is suggested to postpone high-risk surgery and to do coronary re-vascularization for patients with a significant positive result of DSE.

Study Limitations: The majority of subjects in this study were taking cardiac drugs that may affect the cardiovascular response to dobutamine infusion; the diagnosis of HTN relied on the referring physician.

Conflict of interest and Financial disclosure: None

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