Research Article

Prevalence of Hypertension in patients with chronic Coronary Artery Disease in Cyprus

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Abstract

Coronary Artery Disease (CAD) is the most common type of heart disease and a major cause of mortality worldwide. This study highlights the significance of hypertension as a risk factor in patients with CAD and compares its prevalence to those of EUROASPIRE IV (EUS-IV), ESC Atlas of Cardiology (Atlas) and Cyprus Survey of Coronary Heart Disease of 2006 (CY-2006).

A retrospective, observational study was conducted, by the Registry of Cyprus Heart Survey, where 375 individuals with chronic CAD were examined in Nicosia General Hospital Cardiology Clinics, between the years 2011 and 2014. Their medical history regarding hypertension was noted and the data was analyzed using Microsoft Excel software.

The total prevalence of hypertension, based on the past medical history of the patients was 59%.

Out of these, 52% were found to have elevated blood pressure on their visit to the Cardiology Clinic. The total mean systolic blood pressure amongst the study group was 136 mmHg, with no significant differences between males and females (136 mmHg and 134 mmHg respectively).

The findings of the present study are the same compared to those of the CY-2006 (52% both), but slightly higher than the findings of EUS-IV (52% *vs.* 42.7%) and significantly higher than those recorded in the Atlas (52% *vs.* 24.8%).

The results show that there is still much potential to improve hypertension management in patients with established CAD.

Introduction

Coronary Artery Disease (CAD) is the most common and most fatal heart condition, affecting 20.1 million adults aged 20 and above and causing 17.9 million deaths worldwide, annually [1-3]. Specifically, in 2020, 382,820 people died because of Coronary Artery Disease, based on the latest statistics published by CDC [1].

CAD is caused when the oxygen needs of the myocardium are not met, due to inadequate blood supply. The major underlying mechanism is the build-up of lipid-rich plaques in the coronary arteries. This leads to progressive vascular obstruction, impaired perfusion of the myocardium, ischemia, and gradual cardiac cell death, resulting eventually in acute coronary syndromes [4,5].

Coronary artery disease is a chronic disease that develops over the years, and it might go unnoticed until the first cardiovascular event. One major contributing factor to the disease is hypertension [4]. Hypertension is defined as more than one reading of blood pressure (BP) above 140/90 mmHg [6] and it is further subclassified into 6 categories, starting from optimal (systolic BP < 120, diastolic BP < 80) and reaching grade 3 hypertension (systolic BP > 180, diastolic BP > 110). More details about the classification can be found in Table 1.

An estimated 1.28 billion adults aged 30 - 79 years worldwide have hypertension [7], while, in the Cypriot population the prevalence of hypertension is 31.2% in males and 21.3% in females (26% on average), according to WHO [8].

Table 1: Classification of clinical hypertension.

Category	Systolic (mmHg)		Diastolic (mmHg)
Optimal	< 120	And/or	< 80
Normal	120-129	And/or	80-84
High normal	130-139	And/or	85-89
Grade 1 Hypertension	140-159	And/or	90-99
Grade 2 Hypertension	160-179	And/or	100-109
Grade 3 Hypertension	> 180	And/or	> 110
Isolated Systolic Hypertension	> 140	and	< 90

The relationship between hypertension and CAD is characterized by complicated pathophysiological mechanisms. Hypertension is responsible for endothelial damage thus, accelerating the creation of atherosclerotic plaques, before destabilizing them [9]. Furthermore, hypertension causes left ventricular and arterial hypertrophy, which subsequently increases ventricular and arterial wall stiffness [9]. This increases the myocardial oxygen demand, which cannot be satisfied since coronary perfusion pressure falls, thus precipitating myocardial ischemia. Lastly, hypertension causes arterial stiffness which leads to increased blood backflow, which further intensifies hypertension. This vicious cycle deteriorates further the already aggravated condition of the heart [9,10].

The aim of this study is to highlight the significance of hypertension as a risk factor in patients with CAD, using data received from the Cyprus Heart Survey registry. Furthermore, the findings are compared to those of EUROASPIRE IV, which addressed secondary prevention of CAD across 24 European countries, and the data given by the ESC Atlas of Cardiology in 2019. Finally, the results are also compared to those announced earlier by the Cyprus Survey in 2006, a study that also assessed the prevalence of coronary risk factors in patients with previous coronary events.

Methods

Study design

A retrospective, observational study was created with data extracted from the Registry of Cyprus Heart Survey. The study consisted of 375 consecutive individuals with a background of CAD who were examined in Nicosia General Hospital Cardiology Clinics between the years 2011 and 2014. The study aimed at the detection of hypertension, past, and current.

Patient selection and subgroups

The eligibility of a patient was determined based on the history of CAD or previous hospitalization for coronary incidents or interventions. Patients from both genders with ages varying from 32 to 92 were selected and each one of the 375 individuals was interviewed by cardiology specialists and a focused history regarding hypertension was obtained.

The prevalence of hypertension in the study population was determined based on the previous and current history of hypertension at a specific time period, which is either well- or poorly controlled. Particularly, at the time of the interview, the assessment of their past medical history regarding hypertension was done using the questions "Have you ever had a problem with your blood pressure?", "Have you been taking medication for high blood pressure?" and "Has your blood pressure ever been elevated in the past?", before proceeding to the measurement of the patient's blood pressure on site.

For blood pressure measurement, the consultants used automatic digital sphygmomanometers on the patient's right arm. All the patients had their blood pressure recorded three times, in the sitting position, and the mean value of the three recordings was considered for the statistical analysis.

For data collection and analysis, the patients were divided into specific subgroups as follows: (i) males on antihypertensive medications, (ii) females on antihypertensive medications, (iii) males with well-controlled hypertension at interview (systolic BP< 140 mmHg), (iv) males with uncontrolled hypertension at interview (systolic BP > 140 mmHg), (v) females with well-controlled hypertension at interview and (vi) females with poorly controlled hypertension at interview, as seen in Table 2.

Antihypertensive medications are defined as the intake of either Angiotensin-converting enzyme (ACE) inhibitors, Angiotensin Receptor blockers (ARBs), or β-blockers.

Statistical analysis

Categorical data, such as gender and age groups, were expressed as absolute numbers and percentages. Continuous variables, such as the systolic BP (SBP) and diastolic (DBP) were described as mean and standard deviation (SD).

The latter set of data was analyzed using Microsoft 365 Excel. Initially, the percentage of patients that had on their

Table 2: Patients with a history of hypertension and controlled/uncontrolled hypertension.

Characteristics	Patients on antihypertensive medication, N = 284 (75.7%)	Patients with well-controlled hypertension on examination, N = 216 (58%)	Patients with uncontrolled hypertension on examination, N = 159 (42%)
Sex, n (%)			
Female	32 (73%)	30 (68%)	13 (29.5%)
Male	252 (76%)	186 (56%)	146 (44%)
Age in years			
Total mean (SD)	66.7 (10.3)	66.5 (10.6)	68 (8.5)
Female mean (SD)	70 (10.6)	69 (10.1)	76 (7.8)
Male mean (SD)	66.2 (10.2)	66 (10.6)	67.4 (8.2)

on-site examination SBP less than 140 mmHg and SBP greater than 140 mmHg, was calculated.

Additionally, each gender population was segregated, and based on each individual's SBP and DBP values, the percentage of male, female and total patients that correspond to the different grades of hypertension was estimated, as seen in Table 3.

Finally, the percentage of patients who were on either ACE inhibitors, ARBs, or β-blockers treatment was calculated, based on the information gathered during the consultations.

Outcome measures

The main outcome measures were the estimation of the total prevalence of hypertension in the patients and the assessment of whether the secondary prevention guidelines of the ESC are appropriately met.

Results

The study population included 375 individuals of whom 12% were females. On presentation to the clinic, the mean systolic blood pressure was 136 mmHg (±17), with no significant differences between males and females, with 136 mmHg (±17) and 134 mmHg (±17.2), respectively. In addition, the percentage of patients who had SBP > 140 mmHg was 42% (females 29%, males 44%).

223 patients (prevalence 59%) had a previous history of hypertension (196 males, 27 females). On their visit to the Cardiology Clinic, on average 9 years after the first event, 116 patients (106 males and 10 females) of these 223 (prevalence 52%), were found to have abnormally elevated blood pressure (Figure 1).

Additionally, 43 patients (40 males, 3 females) of the 125 who did not have a prior history of hypertension, were found on presentation to the clinic to have abnormally elevated BP (prevalence 28%).

Last but not least, the patients who were on cardioprotective/antihypertensive treatment (either ACEIs/ARBs or B Blockers) at the time of the interview were 75.7%. More specifically 59.2% were on ACEIs, 63.2% were on β-blockers, and 46.7% were on both.

Discussion

Comparison of Cyprus Heart Survey 2014 to EUROASPIRE IV

Comparing the results of the Cyprus Heart Survey to the ones of EUROASPIRE IV, the prevalence of hypertension in the EUS-IV study was 42.7%, much lower than the 52% of the present study. Regarding the prevalence of hypertension according to gender, in females, it was found to be 44%, compared to 37%, and in males 42%, compared to 54%, in EUS-IV and Cyprus Heart Survey, respectively [11].

Furthermore, the number of patients in the two studies, who were on antihypertensive therapy was similar. In the EUROASPIRE IV, 78.1% of the total population was on antihypertensive treatment [11], while 75.7% of the total patients enrolled in the Cyprus Registry were taking antihypertensive medications at the time of the interview.

Nonetheless, the target goal of BP < 140/90 mmHg was achieved in 48% of the patients in the Cyprus Heart Survey, compared to 40% of the Euroaspire IV population. The great diversity among the European populations was perhaps the reason for the lower target goal achievement in the EUROASPIRE IV study.

In summary, the Cyprus Heart Survey has noted a higher prevalence of hypertension by 21%, a lower percentage of patients on antihypertensive medication by 3.8% and a higher percentage of patients achieving their BP target by 16.6%, compared to the EUS-IV.
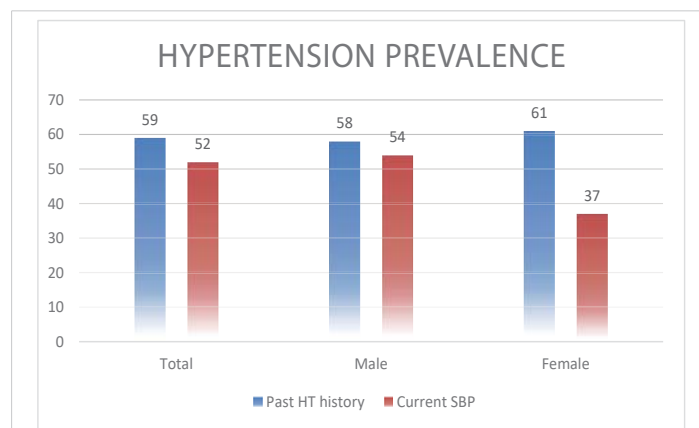

Figure 1: Prevalence of hypertension: past history *vs.* current examination.

Table 3: Classification based on the grade of hypertension.

Category	Systolic	Total (%)	Female (%)	Male (%)	Diastolic	Total (%)	Female (%)	Male (%)
Optimal	< 120	12	11.3	12.3	And/or < 80	32	48	30
Normal	120-129	16.5	18	16.3	And/or 80-84	32.2	32	32.3
High normal	130-139	29	38.6	27.4	And/or 85-89	16.5	16	16.6
Grade 1 Hypertension	140-159	33	13.6	36	And/or 90-99	17	4,5	18.4
Grade 2 Hypertension	160-179	7	16	5.7	And/or 100-109	2	0	2.4
Grade 3 Hypertension	> 180	2.4	0	2,7	And/or > 110	0	0	0
Isolated Systolic Hypertension	> 140	19	20	19	And < 90			

Comparison of Cyprus heart survey 2014 to European society of cardiology Atlas 2019

According to the European Society of Cardiology in 2019, the total prevalence of hypertension in 56 European countries, including Cyprus, appeared to be 24.8%, with median rates of 22.3% for females and 27.0% for males [12]. This difference between our study and ESC Atlas is attributed to the greater sample size (375 *vs.* 10 mil.) of the Atlas.

It is an admirable fact that the results derived from Atlas were compatible with the ones received from our study, highlighting the lower prevalence of hypertension in the female population in the two studies. Although no further information regarding the reason for that difference has been obtained, the similarity in the results shows that there is definitely a correlation between the two genders and the progression of hypertension, making it an interesting topic for further research.

Comparison of Cyprus heart survey 2014 to Cyprus survey 2006

The results obtained from the Cyprus Survey in 2006 showed a total prevalence of hypertension of 52% on the visit to the clinic that took place approximately 1.6 years after the event [13,14], the same as the Cyprus Heart survey 2014. This reveals that there has been no noticeable improvement in the management of hypertension over a period of 8 years.

Limitations

The Cyprus CAD study presents a few limitations. First of all, the sample size of the population studied was small. Additionally, the lack of information regarding further follow-up resulted in a gap of insight into the long-term progression of the hypertension status for each coronary patient. Building upon that, we cannot account for what percentage of those who remained hypertensive, is attributed to the lack of adherence to the medication or the lifestyle modifications. The main strength of the study is that despite the restricted sample size, the Registry of Cyprus withholds records from all the public hospitals of the country, making the results reliable and representative of the Cypriot population, which is less than one million. Furthermore, the BP monitoring was done by highly experienced personnel, who utilized modern and accurate sphygmomanometers, resulting in reliable quality information.

Conclusion

After analyzing and comparing the results of our study to those of EUROASPIRE IV, ESC Atlas 2019, and the Cyprus survey of 2006, it is observed that although they are in accordance, there has been no improvement noted in hypertension management in the island of Cyprus. Therefore, the weight of uncontrolled hypertension remains heavy, and refining the control of hypertension is a strategic initiative of worldwide proportions, in order to decrease the cardiovascular disease burden. Closing the gap requires small and feasible management plans to ensure appropriate diagnosis, optimal treatment, and patient adherence.

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