

Assessment of Arterial Stiffness and Cardiovascular Disease Risk Factors at King Fahd University Hospital

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Abstract

Background: Arterial stiffness is the result of an ageing process that leads to structural and functional changes to arterial wall. Lately studies have found some correlations linked with the Cardiovascular Disease (CVD) risk factors.

Objectives: To determine the association between arterial stiffness and cardiovascular risk factors in Saudi population (Eastern province). To promote early detection of Cardiovascular Disease (CVD) risk factors in order to prevent further complications like stroke and coronary artery disease in our Saudi population (Eastern province).

Methods: An observational study, recruited from 85 patients from the internal medicine outpatient clinics at King Fahd University Hospital (KHUH) in Saudi Arabia. The investigators recorded patients' demographics, like body mass index and clinical information of cardiovascular disease risk factors such as smoking, hypertension, Diabetes Mellitus (DM), dyslipidemia, and obesity. Moreover, arterial stiffness and blood pressure.

Results: The mean Cardio Ankle Vascular Index (CAVI) was 8.22 (Standard deviation=1.82), the mean blood pressure was 137 systolic (Standard deviation=13) and the mean body mass index was 32.304 (Standard deviation=6), the mean HbA1c was 8.7 (Standard deviation=1.8). Moreover, the mean of total cholesterol was 168.7 (Standard deviation=47.8), LDL was 97.8 (Standard deviation=37.6), HDL was 44.2 (Standard deviation=13.9) and Triglycerides was 157 (Standard deviation= 91.23).

Conclusion: The results showed that there is a significant association between an increased CAVI result and CVD risk factors which support the main objective of this study.

Keywords: Cardiovascular disease; Arterial stiffness; Arterial stiffness; Diabetes

Introduction

Arterial stiffness is the result of an ageing process involving the arteries inducing structural and functional changes to their wall, which hinders the vascular ability to mechanically adapt in response to varying blood pressure. This functional loss of distensibility is an essential element for developing many cardiovascular events, including coronary heart disease and stroke. Smoking has been excessively linked to the causation of arterial stiffness owing to its negative effects on the vascular endothelium. A positive correlation was found between the arterial stiffness in patients with hypertension, diabetes and its duration. Moreover, dyslipidemia is an established risk factor that was significantly associated with arterial stiffness. Furthermore, an increased BMI, weight circumference and visceral fat is correlated with arterial stiffness. Lastly, sedentary lifestyle damages the vessels which eventually leads to arterial stiffness [1].

Purpose

To determine the association between arterial stiffness and cardiovascular risk factors in Saudi population [2].

Materials and Methods

Inclusion criteria

All patients with modifiable CVD risk factors. Particularly, smoking, hypertension, diabetes mellitus, dyslipidemia, high BMI level and sedentary lifestyle [3].

Exclusion criteria

Patients with atrial fibrillation, valvular heart diseases, A.V fistula, and amputated limb (arm or leg) will be excluded [4].

Variables

In this study, there is no actual interaction with the study subjects, but rather, subjects' data are obtained and examined thoroughly [5].

Procedures

The investigators will collect clinical and laboratorial information includes age, gender, height, weight, BMI, BP, HbA1C, fasting blood sugar level, CAVI and lipid values from King Fahd University Hospital (KFUH) QuadraMed's Computerized Patient Record (QCPR) healthcare information system [6].

Hypertension

Diagnosed if blood pressure consistently ranges at 140 systolic and 90 diastolic mm Hg or higher on three separate visits. (According to American heart association {AHA}).

Dyslipidemia

According to AHA:

Total cholesterol level to be considered abnormal is more than ≥ 200 mg/dL.

- Total Triglycerides more than ≥ 130 mg/dL.
- HDL less than <40 mg/dL.
- LDL more than ≥ 130 mg/dL.

BMI: Measurement of BMI according to National Center for Health Statistics is by taking weight in kilogram (kg) and height in meter (m), then divide weight/square of height (kg/m^2). A BMI of $25 \text{ kg}/\text{m}^2$ to $29.9 \text{ kg}/\text{m}^2$ is considered overweight, while a BMI of 30 and more is considered an indicator of obesity [7].

CAVI: Is measured by VASERA (FUKUDA). The method of recording is patient should be in supine position with simultaneous blood pressure, electrocardiographic, and cardiac phonographic monitoring. Then CAVI can be obtained. Also, systolic and diastolic blood. Pressures can be taken through the sphygmomanometer cuffs on the upper arm and ankle as well as PWV through dividing the distance between the aortic valve and the ankle. All the items above were obtained from the QCPR system [8].

Statistical analysis

Mean values and standard deviations of variables will be calculated through Excel software

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Data analysis

The following data has been organized and analyzed through Excel, we have measured the average and the standard deviation of each item.

- BMIBP
- Hemoglobin
- A1C Fasting
- blood sugar
- Total Lipids
- CAVI

Results

In this study, 43 participants were men, while 42 were women. The mean of CAVI was 8.22 (SD=1.82), the mean BP was 137 systolic (SD=13) and 79 diastolic (SD=7.5). The mean BMI was 32.304 (SD=6), mean FBS 181 (SD=57) for HbA1c was 8.7 (SD=1.8), mean T. cholesterol was 168.7 (SD=47.8), for LDL was 97.8 (SD=37.6), for HDL was 44.2 (SD=13.9), for Triglycerides was 157 (SD=91.23), further correlations between arterial stiffness and CVD risk factors could not be assessed. We have found out that subjects who are showed risk factors of cardiovascular disease had a higher CAVI results.

CVD risk factors/CAVI	Average	Standard deviation
BMI	32.3	6.2
BP (Systolic)	137.2	15.3
BP (Diastolic)	79.1	7.5
Fasting blood sugar	181	58
Hemoglobin A1C	8.7	1.8
CAVI	8.2	1.8

Table 1: Average and standard deviation of CVD risk factors and CAVI.

Lipid profiles	Average	Standard deviation
T. Cholesterol	168.7	47.8
LDL	97.8	37.6
HDL	44.2	13.9
Triglycerides	157.3	91.2

Table 2: Shows average and standard deviation of lipid profiles.

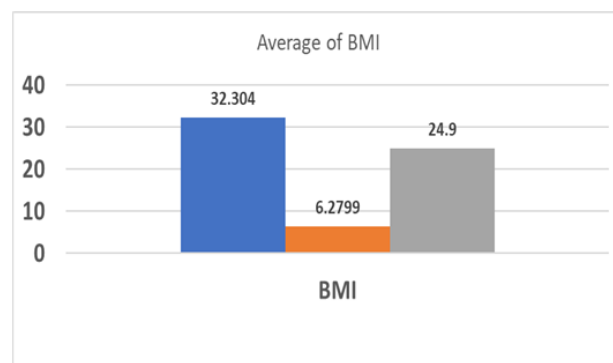


Figure 1: Shows average of BMI. **Note:** ■ Average ■ Standard deviation ■ Normal upper limit.

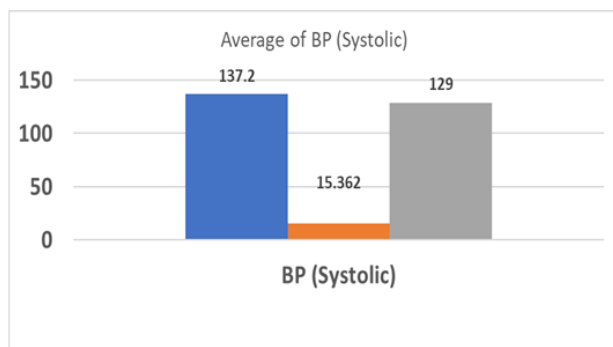


Figure 2: Shows average BP. **Note:** ■ Average ■ Standard deviation ■ Normal upper limit.

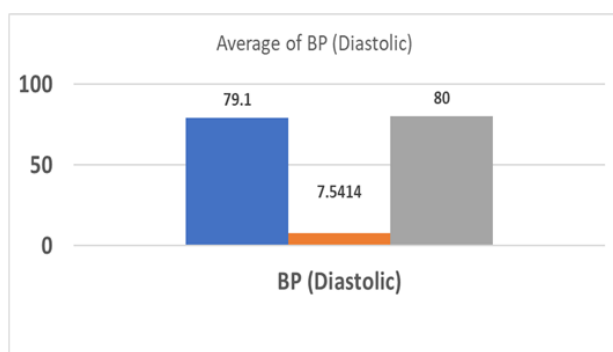


Figure 3: Shows average BP. **Note:** ■ Average ■ Standard deviation ■ Normal upper limit.

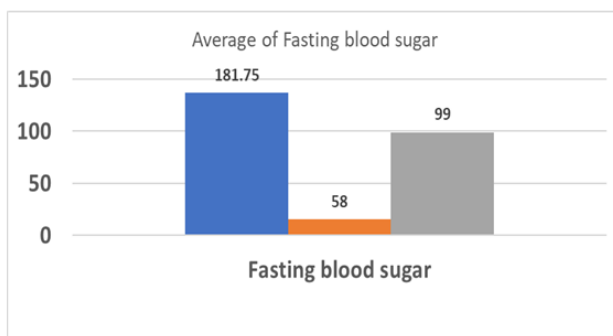


Figure 4: Shows Average of fasting blood sugar. **Note:** ■ Average ■ Standard deviation ■ Normal upper limit.

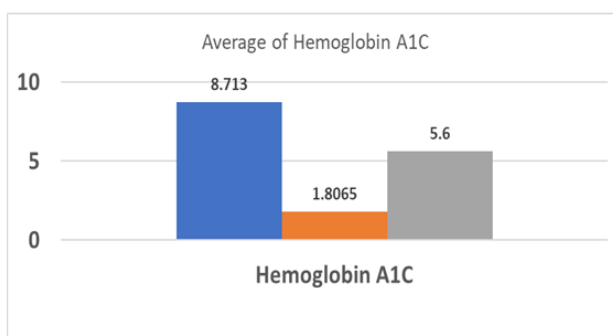


Figure 5: Shows average of hemoglobin A1C. **Note:** ■ Average ■ Standard deviation ■ Normal upper limit.

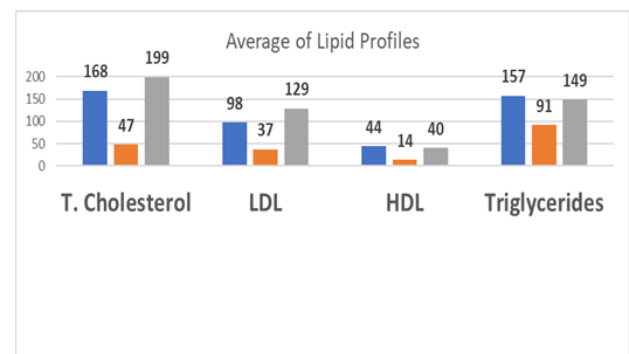


Figure 6: Shows average of lipid profile. **Note:** ■ Average ■ Standard deviation ■ Normal upper limit.

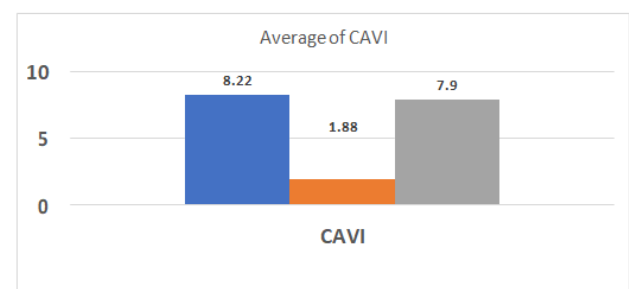


Figure 7: Shows average of CAVI. **Note:** ■ Average ■ Standard deviation ■ Normal upper limit.

Discussion

Our research hypothesis was suggesting that with more CVD risk factors coexistence, the more CAVI is going to be elevated which reflects more stiffened arteries. With just simple math this correlation can be approved, patients who has shown more risk factors, or even higher numerical on their lipids, HbA1C, BP etc., have also shown higher CAVI than those who are lower. The average levels of CAVI in this study was higher than the normal healthy population range and this can be explained by the fact that the average results of most of the risk factors are on the higher side (BMI of 32, A1C of 8.7,...). Thus, these results are the products of so many factors, like obesity, uncontrolled diabetes, sedentary life style and smoking, these risk factors were all somehow correlated to arterial stiffness; for example, an interesting study of a 169 diabetic and non-diabetic controls, the results have shown that diabetic patients (type two) has Pulse Wave Velocity (PWV) higher than normal individuals by 15 years in which it is higher than their peers of the same age and sex. The numbers get even higher with the clustering of CVD risk factors, and other micro and macrovascular diabetic complications. Some studies have also found correlation between arterial stiffness and nephropathy in diabetes patients, this study was done where he studied patients with DM-type two and found that 1/3 of them was positive for microalbuminuria, those who were positive had a higher Pulse Wave Velocity (PWV) than those without microalbuminuria.

Similarly, hypertension can be considered one of the factors that increases vascular thickness and structural stiffening. In addition, high BMI values are associated with arterial stiffness, as some studies were showing that high BMI and waist circumference were associated with elevated pulse wave

velocity. A high lipid profile is also linked to arterial stiffness, which can be seen in a cross-sectional that has found a significant association between total cholesterol levels and arterial stiffness.

Limitation

The present study also has certain limitations. The major disadvantage of STA block is the inability to block visceral pain, which can be substantial, both intra and post operatively. The other major limitation is dermatomal limitation of the block. STA block provides reliable analgesia covering T6-T10 dermatomes.

Conclusion

Arterial stiffness is an aging process that could results in varying cardiovascular events. Therefore, the aim of this study is to demonstrate the association between arterial stiffness and CVD risk factors in Saudi population. The results showed that there is a significant association between CAVI and CVD risk factors which support the main objective of this study. Thus, healthcare providers should be aware of the importance of early detection of CVD risk factors in order to prevent its complications.

Limitations and Recommendations

The Corona virus disease (COVID-19) has impacted our data collection stage, as we were planning for a larger sample size. We also were limited in resources, as we tried to make this study an experimental one, the perfect setting to measure the arterial stiffness through a CAVI machine was not there, which resulted in this study being observational.

Conflict of Interest

Tariq Al-Shairbeeney, Abdullah Al-Sahow, Hassan Al-Hammad, Ali Al-Khalil, Mohammed Al-Marzooq and Faisal Al-Zahrani declare that they have no conflict of interest.

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