Original Article

Non invasive assessment of arterial stiffness by arterial stiffness index with oscillometric method in patients of ischemic heart disease

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Abstract

Introduction: Arterial stiffness measurement could serve as an important tool in identifying patients at risk of cardiovascular disease and the ability to adentify these patients could lead to better risk stratification and earlier and more effective preventive therapy. **Objective:** To evaluate arterial stiffness by arterial stiffness index in patients of ischemic heart disease with multiple risk factors like diabetes mellitus, hypertension, dyslipidemia and smoking and comparing it with healthy controls without these risk factors. **Methodology:** We have studied 30 patients of ischemic heart disease. Any patient of myocardial infarction and angina pectoris is included in our study Diagnosis of IHD was based on symptoms and typical changes in electrocardiogram. This was further conformed by echocardiography whenever necessary. We have studied simultaneously 30 controls. They should have normal blood pressure, blood sugar, lipid profile and should be non smoker with no history of IHD and stroke. Arterial stiffness was measured by arterial stiffness index in all patients by oscillometric method with periscope. Results were compared in these groups by applying unpaired" t" test. **Result:** It is found that in subjects with ischemic heart disease arterial stiffness index is significantly higher than healthy subjects (P< 0.05). **Conclusion:** Finally we have concluded that the arterial stiffness index is significantly higher in patients of ischemic heart disease with multiple risk factors like diabetes mellitus, hypertension, smoking and dyslipidemia ($p < 0.05$).it is also clear that arterial stiffness index is significantly higher in older age groups i.e.61- 70 years, hence higher risk of coronary artery disease in these age groups.

Keywords: ASI (arterial stiffness index), IHD (ischemic heart disease), HTN (hypertension), DM(diabetes mellitus) ECG(in electrocardiogram).

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INTRODUCTION

Arterial stiffness is a growing epidemic associated with increased risk of cardiovascular events, dementia and death[18].Arterial stiffness measurement could serve as a important tool in identifying patients at risk of cardiovascular disease and the ability to identify these patients could lead to better risk stratification and earlier and more effective preventive therapy.[10] As the changes can be detected before the appearance of clinically apparent vascular disease, arterial stiffness may act either as a marker of the development of future atherosclerotic disease or may be more directly involved in the process of atherosclerosis.[5] Arterial stiffness index is one of the measures of arterial stiffness. Higher the stiffness, higher the arterial stiffness index values.[6] To measure these parameters of arterial stiffness a new device called periscope is used. It covers all the parameters which are independent predictors of cardiovascular risk, thus a complete cardiovascular profile of a patient emerges from a simple test.[12]

MATERIALS AND METHODS

Periscope

It uses principles of pulse wave analysis and polymechanocardiography.

Patients Inclusion Criteria

We have studied 30 patients having IHD. Any patient with myocardial infarction and angina pectoris is included

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in our study with or without associated risk factors like diabetes, hypertension, smoking and dyslipidemia.
We have studied pts in age groups of 30-70 years (mean age 59.2)

Diagnosis

Diagnosis of IHD is Based on symptoms and typical changes on ECG.This was further conformed by echocardiography whenever necessary.

Excusion Criteria

Non invasive cardiovascular testing is not possible in following Patient condition.

1. Acute cases of low blood pressure
2. Arrhythmias
3. Peripheral edema
4. Pacemaker
5. Very high blood pressure(>240 mm of Hg)

Controls

We have studied 30 controls in between 30-70 years with mean age 45.5 years.

Inclusion Criteria

Controls should have normal

1. Blood pressure
2. Blood sugar
3. Lipid profile and should be non smoker with no history of IHD and stroke.

MEASUREMENTS: Calculation of arterial stiffness index

Arterial stiffness index is another measure of arterial stiffness. It quantifies the shape of the oscillometric envelope. As arterial stiffness increases it becomes harder to collapse the arteries by applying external pressure, hence oscillometric envelope becomes flatter as the stiffness increases. The ASI gives clear indication of flattening process. It is calculated as:[20]

ASI= (Systolic side value of cuff pressure at 80% of maximal oscillation amplitude of cuff – (diastolic side of cuff pressure at 80% of maximal oscillation amplitude of cuff)[20]

The device acquires and computes the following parameters

- 2 channel ECG
- Brachial BP of both limbs
- Ankle BP of both limbs
- Mean arterial pressure
- %MAP
- Ankle brachial index
- Atrerial stiffness index.

OBSERVATIONS AND RESULTS

Table 1: Basic characteristics of the patients

	Mean	Standard Deviation
Age(years)	59.233	10.6
Weight(kg)	62.133	7.786
Height(cm)	154.466	5.616
BMI(kg/m2)	23.316	3.08
Cholesterol(mg/dl)	170.96	33.152
LDL(mg/dl)	105.23	45.9
HDL(MG /DL)	58.13	17.16

Table 2: Basic characteristics of controls

	Mean	Standard Deviation
Age (years)	45.6	10.6
Weight (kg)	53.2	7.8
Height (cm)	153.7	14.89
BMI (kg/m2)	21.649	2.47
Cholesterol (mg/dl)	129.96	19
LDL (mg/dl)	78.66	16
HDL (mg/dl)	41.83	4.6

Table 3: Arterial stiffness index

	Patients	controls	
Age patients	ASI	ASI	Age controls
30-40	52.25	44	30-40
	51.5	39	
40-50	30	56	
	45	56	
	70	47	
	60	55.5	
	40	47	
50-60	55	45	
	72	40	
	68	26	
	28	45	
	60	49	
	90	39	
	50	50	
	51	62	
61-70	60	38.5	41-50
	60	45	
	40	46	
	45	62	
	70	43.5	
	38	59.5	51-60
	96	42	
	55	73	
	55	71	
	40	30	
	89	51	
	87	59	61-70
	55	53	
	75	55	
	57	45	
MEAN	58.1333	49	
SD	17.3337234	7.274	

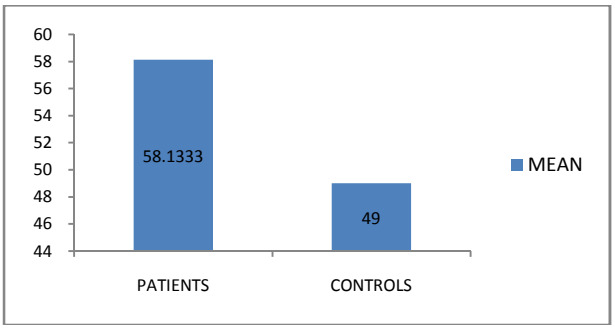

Table no 3 and Bar diagram shows that: Mean arterial stiffness index in patients= 58.1333 and controls =49 Standard deviation in patients =17.7234 and in controls = 7.274. Thus mean arterial stiffness index in patients is higher than in controls.

Table 4: Age related changes in arterial stiffness index

Age	ASI(MEAN)
30-40	52
41-50	49
51-60	59.75
61-70	61.46

Table no 4 shows that: Arterial stiffness index increases with age and is significantly higher in age group of 61-70-i.e 60.26

Table 5: Final outcome

	ASI
IHD PATIENTS	58.133
CONTROLS	49
	P< 0.05

Table no 5 shows that: The ASI is significantly higher (P<0.05) in patients of IHD.

RESULTS

ASI is calculated and compared between patients and controls by unpaired "t" test. It is found that ASI is significantly higher in patients of IHD than controls (p<0.05)

CONCLUSION

1. Finally we have concluded that the arterial stiffness index is significantly higher in patients of IHD with multiple risk factors like DM, HTN, smoking and dyslipidemia
2. It is also clear that arterial stiffness index is significantly higher in older age groups i.e.61-70 years. Hence higher risk of coronary artery disease in these age groups
3. It is also found that patients of IHD had multiple risk Factors like DM, HTN, smoking and dyslipidemia in 24 out 30 patients. Hence there is increased risk of arterial stiffness and atherosclerosis in patients with these risk factors

DISCUSSION

An indirect argument for the influence of arterial stiffness on the occurrence of cardiovascular risk events comes from cross sectional studies showing that arterial stiffness and cardiovascular risk factors for atherosclerotic lesions are correlated. Umamaheshwar Rao naidu *et al* measured ASI by oscillometric periscope. It was found that ASI was significantly higher in patients of IHD than controls (p<0.001). This study correlates with our study. The study by Park S.M.*et al* showed that arterial stiffness index is the clinical parameter of atherosclerotic coronary artery disease. In total 34 patients had significant coronory artery disease.ASI was higher in coronary artery disease patients than those without (p<0.001).[13] The Altunkan S.*et al* proposed that ASI is screening test for cardiovascular risk, a comparative study of ASI and coronary artery calcification(CAC). They investigated correlation between ASI and CAC. It was found that in patients over 50 years age a moderate positive and significant correlation was found between the CAC score and ASI measurement.[7] K.Hiramatsu *et al* showed superiority of ASI over pulse wave velocity (PWV) and pulse pressure in evaluation of arterial stiffness. Sato H. *et al* studied a population based study of ASI in relation to cardiovascular risk factor. They compared the ASI in patients of with multiple risk factor with controls without any major risk factors. Subjects with 2 risk factors showed significantly higher ASI than those without a risk factor.[4] Double mortality outcome study (DOMS) demonstrated that use of ambulatory stiffness index is a measure of arterial stiffness provides predictive addition to pulse pressure for development of cardiovascular diseases.[2] An initial analysis of DOMS in 166 pts that evaluated the relationship between ambulatory arterial stiffness index and pulse wave velocity demonstrated a linear correlation between them (P <0.0001) for cardiovascular mortality rates. ASI correlates with target organ damage and health outcome, the shanghai team comments. they cite one study with 5.3 years follow up that showed that high AASI was predictive of cardiovascular mortality over and beyond classical risk factors[4]

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