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A STUDY OF ARTERIAL STIFFNESS IN DIABETIC PATIENTS

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ABSTRACT

To measure arterial stiffness in type 2 diabetes patients.To correlate arterial stiffness indices with the presence or absence of diabetes in these patients.To be able to provide a simple screening tool to detect abnormal arterial stiffness in patients, thereby aiding in early detection and treatment to reduce vascular complications. There was a higher prevalence of increased arterial stiffness among the female diabetics when compared to the male diabetics.

Keywords
diabetes, atherosclerosis, hypertension and vascular disease

Introduction

Type 2 Diabetes Mellitus consists of an array of dysfunctions characterized by hyperglycemia which results from a combination of resistance to insulin action, inadequate insulin secretion, and excessive or inappropriate glucagon secretion. Poorly controlled type 2 diabetes is associated with microvascular, macrovascular[1], and neuropathic complications [2].
It is well established that patients suffering from Type 2 Diabetes Mellitus have a much higher risk of developing systemic hypertension and vascular complications [3]. Accelerated atherosclerosis and abnormal arterial structure and function are associated with essential hypertension and isolated systolic hypertension. Recent studies indicate that arterial stiffness may be a precursor of essential hypertension[4] and vascular complications [18,19], hence detecting the same in diabetics and early treatment may help in preventing the vascular complications associated with diabetes.

Recent technical advancements have made non- invasive measurement of arterial stiffness feasible in clinical practice. The PeriScope device has been shown to have a high degree of accuracy and reproducibility for the assessment of arterial stiffness [5,6].
In the present study, we plan to evaluate the effect of diabetes on arterial stiffness measured by the PeriScope device in 50 subjects, 25 diabetics and 25 non-diabetics.

Materials and Methods

INCLUSION CRITERIA:

1. Patients with type 2 diabetes mellitus (diagnosed by WHO criteria).
2. No history, symptoms or signs of vascular disease and/or renal disease.
3. Age between 30-50 years.

EXCLUSION CRITERIA:

1. Newly diagnosed diabetics.
2. Hypertensive patients.

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3. Age less than 30 years or over 50 years.

4. History or signs of cardiac and/or kidney disease.

STUDY SAMPLE:

- Total : 50 patients.

- Subjects : 25 randomly selected patients from the diabetic outpatient department.
- Controls : 25 randomly selected age and sex matched patients from the general medicine outpatient department.

STUDY DURATION:

The study commenced on the first of July 2014 and ended on the first of July 2015 at SreeBalaji Medical College Hospital, Chromepet.

SAMPLE SELECTION:

The subjects were selected from patients who presented at the diabetic outpatient department and controls from the general medicine outpatient department in the age group between 30-50 years fulfilling the inclusion and exclusion criteria. Informed consent was obtained in writing after explaining the study.

TESTING METHOD:

The selected patients who fulfilled the inclusion criteria were subjected to an arterial stiffness study and their results were documented. Statistical analysis was performed to see the differences in arterial stiffness measurement parameters between diabetic and non-diabetic patients. Abnormalities found in patients could be a possible marker and precursor to the higher incidence of hypertension and vascular complications in the diabetic population.

Results and Discussion

Data Analysis

Descriptive statistics was done for all data and were reported in terms of mean values and percentages. Suitable statistical tests of comparison were done. Continuous variables were analysed with the unpaired t test. Categorical variables were analysed with the Chi-Square Test and Fisher Exact Test. Multiple regression analysis was done to demonstrate the relationship between independent and dependent variables. Statistical significance was taken as $P < 0.05$. The data was analysed using SPSS version 16 and Microsoft Excel 2007.

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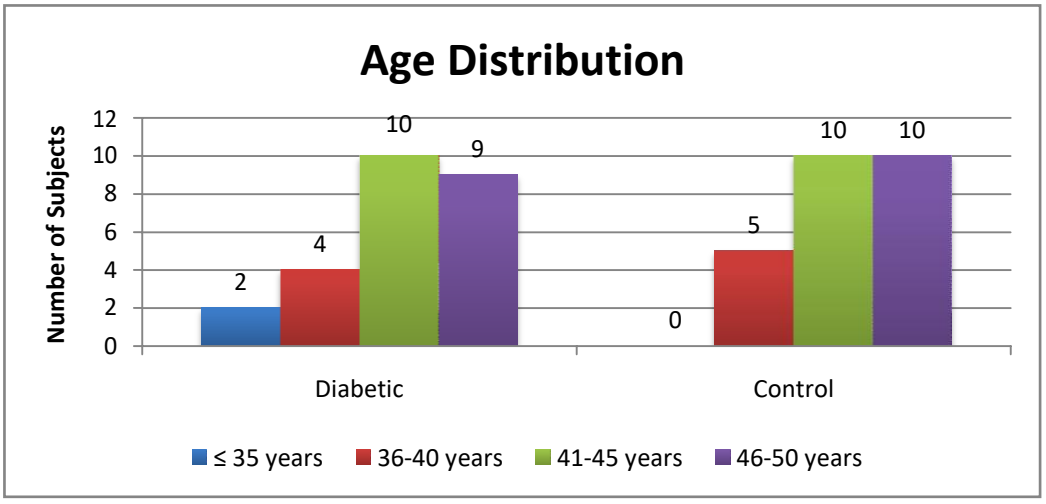

Figure 1: Age Distribution

Majority of the diabetic group patients belonged to the 41-45 years age class intervals (n=10, 40%) with a mean age of 43.84 years. In the control group patients, majority belonged to the same age class interval (n=10, 40%) with a mean age of 43.88 years. The association between the study groups and age distribution is considered to be not statistically significant since p > 0.05 as per 2 tail unpaired t test.

TABLE 1 : Gender Distribution

Gender Distribution	**Diabetic**	**%**	**Control**	**%**
Male	11	44.00	13	52.00
Female	14	56.00	12	48.00
Total	25	100	25	100
P value Chi Squared Test			0.5713	

Majority of the diabetic group patients belonged to the female gender class interval (n=14, 56%). In the control group patients, majority belonged to the male gender class interval (n=13, 52%). The association between the study groups and gender distribution is considered to be not statistically significant since p > 0.05 as per chi squared test.

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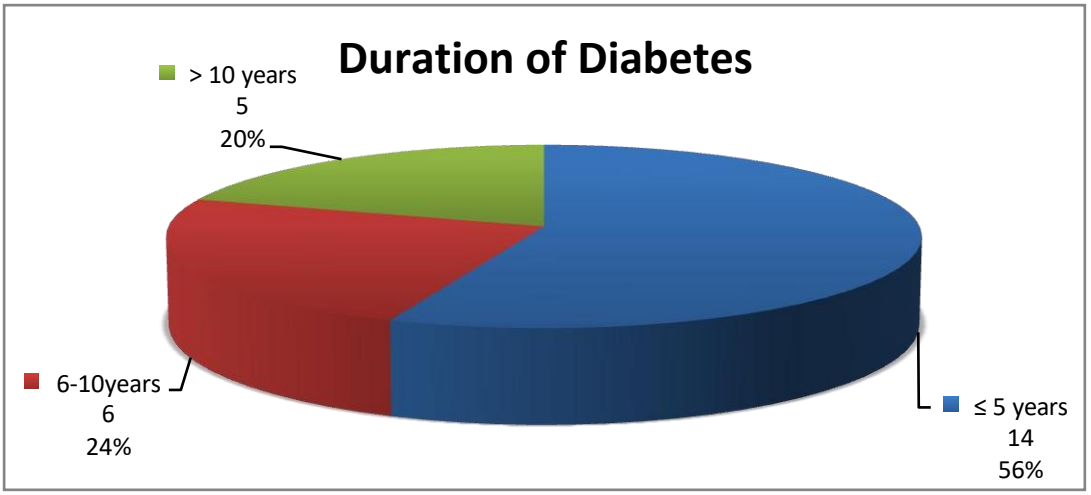
Figure 2: Duration of Diabetes



When duration of diabetes distribution was calculated, majority of the study patients belonged to ≤ 5 years duration (n=14, 56%) followed by 6-10 years duration (n=6, 24%) and then > 10 years duration (n=5, 20%).

Figure 3: Height Distribution

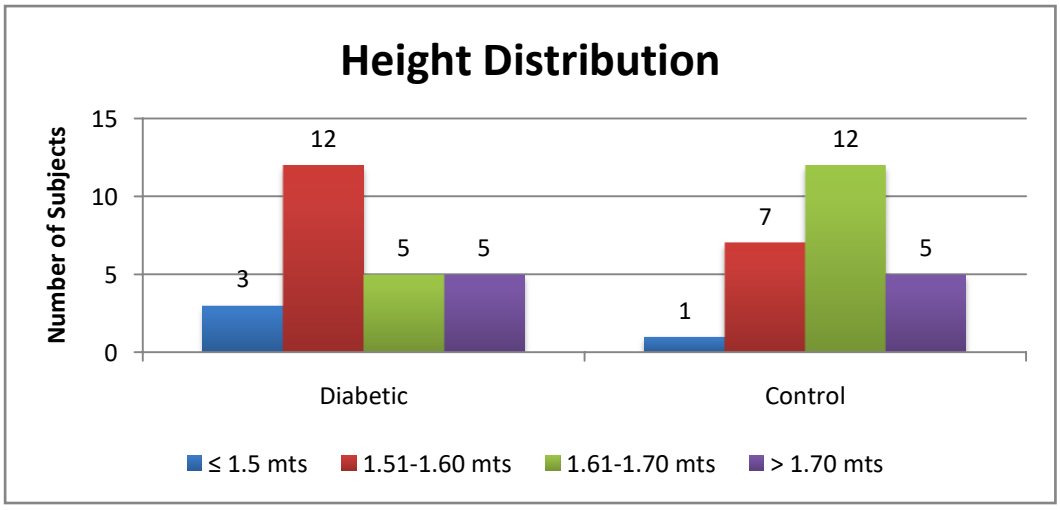


TABLE - 2: Height Distribution

Height Distribution	Diabetic	Control
N	25	25
Mean	1.60	1.65

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SD	0.09	0.08
P value Unpaired t Test		0.0644

Majority of the diabetic group patients belonged to the 1.51-1.60 mts height class intervals (n=12, 48%) with a mean height of 1.60 mts. In the control group patients, majority belonged to the 1.61-1.70 mts height class interval (n=12, 48%) with a mean height of 1.65 mts.The association between the study groups and height distribution is considered to be not statistically significant since $p > 0.05$ as per 2 tail unpaired t test.

TABLE 3: Weight Distribution

Weight Distribution	Diabetic	Control
N	25	25
Mean	65.92	67.48
SD	9.12	11.10
P value Unpaired t Test		0.5897

Majority of the diabetic group patients belonged to the

≤ 60 kgs weight class intervals (n=9, 36%) with a mean weight of 65.92 kgs. In the control group patients, majority belonged to the same weight class interval (n=10, 40%) with a mean weight of 67.48 years. The association between the study groups and weight distribution is considered to be not statistically significant since $p > 0.05$ as per 2 tail unpaired t test.

TABLE 4: BMI Distribution

BMI Distribution	Diabetic	Control
N	25	25
Mean	25.72	24.78
SD	3.21	3.43
P value Unpaired t Test		0.3203

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Majority of the diabetic group patients belonged to the overweight BMI class intervals (n=15, 60%) with a mean BMI of 25.72. In the control group patients, majority belonged to the normal BMI class interval (n=18, 72%) with a mean BMI of 24.78. The association between the study groups and BMI distribution is considered to be not statistically significant since p > 0.05 as per 2 tail unpaired t test. In patients belonging to diabetic group, the mean right ankle arterial stiffness index measurement is 50.81. In control group the mean right ankle arterial stiffness index measurement is 47.14. The association between the study groups and right ankle arterial stiffness index is considered to be not statistically significant since p > 0.05 as per 2 tail unpaired t test. In patients belonging to diabetic group, the mean Brachial Ankle PWV (Left) measurement is 1698.36. In control group the mean Brachial Ankle PWV (Left) measurement is 1140.46. The mean Brachial Ankle PWV (Left) measurement was significantly more in diabetic group compared to the control group by 49% with a mean difference of 557.90 and is statistically significant as the p value is 0.0000 as per unpaired t - test indicating a true difference among study groups. In this study we can safely conclude that the Brachial Ankle PWV (Left) measurement was significantly and consistently higher in diabetic group compared to the control group.

TABLE 5: Predictors for Augmentation Index

Independent Variables	**Augmentation Index > 16 %**		
	Odds Ratio	**95% Confidence Interval**	**P value**
Age > 40 years	2.74	0.10-5.38	0.042*
Gender - Female	4.44	3.40-7.90	0.0074*
BMI (Normal)	-0.35	(-0.62)-(-3.4)	0.2241
Duration of Diabetes > 5 years	2.45	1.78-3.38	0.045*

Multivariate analysis demonstrated that the risk of developing Augmentation Index > 16 % among study subjects with age > 40 years is 2.74 times significantly more than in study subjects with age < 40 years. It is statistically significant with a p-value of 0.042. The risk of developing Augmentation Index > 16 % among female study subjects is 4.44 times significantly more than in male study subjects. It is statistically significant with a p-value of 0.0074. The risk of developing Augmentation Index > 16 % among study subjects with duration of diabetes > 5 years is 2.45 times significantly more than in study subjects with duration of diabetes < 5 years. It is statistically significant with a p-value of 0.045.

TABLE 6 : Predictors for Brachial Ankle PWV

Independent Variables	**Brachial Ankle PWV > 1355 cm/s**

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	Odds Ratio	95% Confidence Interval	P value
Age > 40 years	3.04	1.33-6.95	0.008*
Gender - Female	4.29	1.12-16.52	0.039*
BMI	-0.96	(-0.94)-(-0.99)	0.104
Duration of Diabetes > 5 years	4.59	1.38-12.34	0.0001*

Multivariate analysis demonstrated that the risk of developing Brachial Ankle PWV > 1355 cm/s among study subjects with age > 40 years is 3.04 times significantly more than in study subjects with age < 40 years. It is statistically significant with a p-value of 0.008. The risk of developing Brachial Ankle PWV > 1355 cm/s among female study subjects is 4.29 times significantly more than in male study subjects. It is statistically significant with a p-value of 0.039. The risk of developing Brachial Ankle PWV > 1355 cm/s among study subjects with duration of diabetes > 5 years is 4.59 times significantly more than in study subjects with duration of diabetes < 5 years. It is statistically significant with a p-value of 0.0001

DISCUSSION

Increasing arterial stiffness in addition to intimal medial thickening has been observed with advancing age. These changes are accelerated in both diabetics and hypertensives. Several recent clinical studies have shown the adverse cardiovascular effects of accelerated vascular stiffening and that raised indices of vascular stiffness were predictors of hypertension [7-9], coronary eventsand a major cardiovascular risk factor [10-13]. Increased arterial stiffness has been shown to be an independent predictor of mortality[14]. Arterial stiffness can be assessed by several means; of which some are more applicable in a clinical setting than others. This assessment can be done by measuring pulse pressure, pulse wave velocity, ultrasound derived indices, MRI derived indices, wave form analysis and oscillometric blood pressure measurement. These indices have been shown to have prognostic importance and are stronger predictors of vascular disease than the traditional blood pressure measurement [14]. An increased pulse wave velocity was shown to be an independent predictor of mortality in a population based study[15]. Thus, abnormal arterial stiffening like intimal medial thickening should be viewed as another risk factor for cardiovascular disease. The PeriScope device which has been shown to have a high degree of accuracy and reproducibility for the measurement of arterial stiffness [6] was used in this study and is based on the oscillometric technique.

A study was conducted by Namrata et al in Sir HN Hospital and Research Centre, Mumbai, in which 114 patients were divided into four groups based upon their diabetic and or hypertensive

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status; Group I: patients with diabetes > 5 years and hypertension, Group II: newly detected diabetes without hypertension, Group III: hypertensive patients and Group IV: control group. They were then subjected to oscillometric measurements using the Periscope device. The results showed a raised pulse wave velocity (PWV), arterial stiffness index (ASI) and augmentation index (AIx) in diabetics as compared to the control group. An even greater increase in PWV, ASI and AIx was observed in patients with both diabetes and hypertension [16-19]. Another study conducted in Brazil also showed a significant association between diabetic status and raised PWV measurement[20]. In the present study, PWV and AIx were significantly elevated in patients with DM as compared to healthy controls. We did not observe a statistically significant difference in the ASI between the study and control groups. Interestingly there seemed to be a significantly higher incidence of raised arterial stiffness in female patients suffering from diabetes as compared to male diabetics. Further studies are needed to throw light on this possible risk factor. As demonstrated in the previous studies , arterial stiffness was increased in people with diabetes for a longer duration. Hence a routine screening for arterial stiffness when a patient is diagnosed with diabetes may also hint at the possible duration of undetected diabetes.[17] Another significant advantage of screening is that measures to decrease arterial stiffness may be initiated earlier to prevent vascular complications.

CONCLUSIONS

There was a statistically significant higher prevalence of increased arterial stiffness among the diabetic patients. There was a higher prevalence of increased arterial stiffness among the female diabetics when compared to the male diabetics. There was a higher prevalence of raised arterial stiffness among patients who were diabetic for a longer duration.

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Ethical approval: The study was approved by the Institutional Ethics Committee

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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