Research Article

IJCRR
Section: Healthcare
Sci. Journal
Impact Factor
4.016

ASSESSMENT OF ARTERIAL STIFFNESS AMONG MIDDLE AGED OFFSPRING OF DIABETIC PARENTS

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ABSTRACT

Background: Genetic susceptibility appears to play an important role in the occurrence of Type 2 Diabetes with high prevalence among first degree relatives .Subjects with type 2 diabetes have 2-3 fold increased risk of cardiovascular disease compared with normal population.

Aim: To compare the arterial stiffness between normotensive normoglycemic middle aged offspring of diabetic parents (Cases) with normotensive normoglycemic middle aged offspring of Non- diabetic parents (Controls). All participants had a sedentary life style.BMI, Blood pressure and glycemic status was matched between cases and controls. Alcoholics, smokers, subjects with peripheral vascular disease and other illness were excluded. Arterial stiffness was assessed from Reflective Index (RI) and Stiffness Index (SI). Reflective index and Stiffness index was measured using IR1 model digital finger tip photo pulse plethysmograph.

Results: Controls RI- MEAN – 47.9 ±2.8%,SI –MEAN 6 ±.7 m/s and Cases -RI- MEAN -55.1± 3.6%,SI MEAN 7±.9 m/s. Paired 't 'test was applied and it showed statistical significance with p value < .001.We conclude that vascular endothelial dysfunction and arterial stiffness is present from an early stage in subjects with family history of diabetes. Life style modifications are suggested to improve the vessel wall compliance and prevent further progression.

Key Words: Stiffness index, Reflective index, Diabetes mellitus

INTRODUCTION

Diabetes has become a worldwide epidemic. In the present scenario early detection and measures to prevent the morbidity and mortality due to diabetes is absolutely necessary .Cardiovascular diseases are the most common cause of disability and death among subjects with non–insulin-dependent diabetes mellitus (1). The atherosclerotic process begins during the prediabetic phase characterized by impaired glucose tolerance, hyperinsulinemia, and insulin resistance. Studies have suggested that glucose and insulin can substantially alter the structure and function of the arterial wall and affect the development of atherosclerosis (2).The adverse association of cardiovascular risk factors in both children and adults with parental history of diabetes is well recognized (3,4).

Increased risk of atherosclerosis is found in prediabetic individuals (5), and in populations at high risk of Coronary Heart Disease, almost half of middle-aged men and women with NIDDM have symptomatic Coronary heart disease at the moment their diabetes is diagnosed (6).

Recording of peripheral pulse wave and digital volume pulse is convenient method to measure stiffness index which can assess large artery stiffness. Reflection index can assess medium and small artery stiffness (7).

RATIONALE OF THE STUDY

There is paucity of data in our country on the vessel wall compliance among the middle aged individuals who are genetically prone to develop diabetes. And also there is lack of simple cost effective screening procedures to assess vascular function and reduce the cardiovascular morbidity.

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Received: 19.11.2014 **Revised:** 30.11.2014 **Accepted:** 13.11.2014

AIM

To assess the vessel wall compliance among the middle aged off spring of diabetic parents.

MATERIALS AND METHOD

All participants gave a written informed consent to participate in this study. Institutional ethical committee clearance was obtained. Information details about socio demographic characteristics, disease history, alcohol consumption, cigarette smoking, drug intake and occupational history were obtained by a structured questionnaire. All participants had a sedentary lifestyle.

Inclusion criteria: Sex = Males, Age= 35- 45 yrs, Blood pressure = < 140/90 mmHg, Fasting blood sugar = 90-100 mg/dl. **Exclusion Criteria:** Alcoholics, smokers, subjects with peripheral vascular disease and other illness were excluded from the study. **Cases** – 50 healthy volunteers normoglycemic , normotensives males with paternal or maternal history of diabetes more than 10 years. **Controls**- 50 healthy volunteers normoglycemic normotensive males with no paternal or maternal history of diabetes.

Anthropometric measurements were taken. Height was measured using stadiometer and weight was measured using precalibrated weighing machine.. Quetlet's index was used to calculate Body mass index (weight/height in m^2).Blood pressure was measured using a standard mercury sphygmomanometer. Fasting blood glucose was measured to rule out diabetic mellitus.

Recording of digital volume pulse (DVP): Digital volume pulse was recorded by in house built instrument IR1 model digital finger photoplethysmography (8) ,using infra- red light with wave length 0f 940 nm; placed on the right index finger of the subjects. The signal from the instrument was digitalized by digital converter with a frequency of 100 Hz which was connected to the computer. DVP was analyzed by software virtual oscilloscope.

Digital volume pulse contains 2 peaks: **Fig-1**

1. Systolic peak.
2. Diastolic peak.

Early systolic peak is formed by pulse wave transmitted from the left ventricle to the finger directly. Second peak or diastolic peak arises from pulse wave transmitted along the aorta to the small arteries in the lower body, from where they are again reflected along the aorta as a reflected wave .This path length is proportional to the subjects height (h) (fig-1).

Pulse transit time (PTT or ΔT) is the time interval between systolic peak and diastolic peak. It was measured by software image tool (which was provided by Stanford university). Magnitude of systolic and diastolic peak were also measured Stiffness index is based on the subjects height (9).Stiffness index and Reflective index were calculated by the following formulas.

$$\text{Stiffness index } (SI_{DVP}) = \frac{\text{Subject's height (h).}}{\text{Pulse transit time } (\Delta T).}$$

$$\text{Reflection index (RI)} = \frac{\text{Magnitude of diastolic peak (b)} \times 100.}{\text{Magnitude of systolic peak (a).}}$$

RESULT

Statistical analysis was done Using SPSS Software 16.0 and Paired t- Test applied. Table-1 shows the descriptive statistics of BMI, Blood sugar, Systolic blood pressure, Diastolic blood pressure. Table 2- shows arterial stiffness indices of both control and study group.

Paired 't' test applied between stiffness index and reflective index of controls with study group and it showed a statistically significance with p value < 0.001.

DISCUSSION

In our present study Reflective index and Stiffness index of normoglycemic healthy offspring of type 2 diabetic parents, was found to be greater than the control group with no family history of diabetes. Stiffness index and Reflective index are reliable indicator of Arterial stiffness (10,11,12). Arterial stiffness, an early feature of diabetic vasculopathy, has been recognised as a powerful and independent predictor for Cardio vascular disease (13,14,15) and considered as a "transitional medicine biomarker for CV risk factor"(16).

Thus, subjects with a pronounced familial background has high probability of developing diabetes (17) show arterial stiffening already at a stage in which blood glucose is normal. Giannattasio et al reported that arterial stiffening can increase the risk of cardiac and vascular morbid or fatal events presumably because a reduction in the ability of the arteries to distend increases blood pressure and is associated with an increase in arterial impedance and, thus, in the after load to the heart, and endothelial damage because a reduced distensibility enhances the traumatic effect of the intravascular pressure on the vessel wall (18).

Similar study by Cristina et al and Rahman et al says subjects with predisposition to diabetes show carotid artery stiffening and alterations in arterial mechanical properties even in the absence of blood pressure alterations, as well as substantial alterations of glucose metabolism, body mass index, and changes in carotid wall thickness and further added that normoglycemic offspring of newly diagnosed parents have increased arterial stiffness, indicating early manifestations of preclinical vasculopathy, which may predate the onset of type 2 diabetes (19,20) .The mechanisms responsible for the early arterial stiffening of normoglycemic offspring of diabetic parents are not clarified by our study as the glucose values were normal and similar between the offspring of diabetic parents and control subjects, the arterial stiffening probably could not be due to any adverse effect of glucose on the functional characteristics of the vessel wall. Laurent et al says Genetic influences operating through other mechanisms may be responsible in the majority and further added that diabetes is accompanied by an increased wall thickness even in the absence of microvascular and macrovascular complications (21). Thus in this context early detection and screening of predisposed group can be beneficial.

CONCLUSION

Arterial stiffness assessed by reflective index and stiffness index are increased in the offspring of diabetic parents. **Implication:** Our study was designed to prevent the morbidity and mortality in the offspring of diabetic parents due to their genetic influence. Noninvasive, cost effective, portable and rapid method used in our study can be used for screening measures, based on which life style modifications can be suggested to delay and improve the vascular function.

ACKNOWLEDGEMENT

Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed. Authors sincerely thank Dr K N Maruthy, Professor, Narayana medical college, Nellore for his extensive guidance. Funding for the project was shared by the authors and there is no conflict of interest.

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ANNEXURE 1

Table 1: Descriptive statistics:

n-50	CONTROLS	CASES
Age	39±2	39±1
BMI (Kg/m2)	26±3	27±1
Systolic blood pressure(mm Hg)	122±3	124±3
Diastolic blood pressure(mm Hg)	82±3	83±3
Blood sugar (mg/dl)	95±3	97±3

Table 2: Arterial stiffness indices of control and study group.

Parameters n-50	Control (off springs of non dia-betics)	Cases (off springs of diabet-ics)	P value
Stiffness index (m/s)	6 ± .7	7 ± .9	< 0.000*
Reflective index (%)	47.9 ±. 2	55.I ± 3.6	< 0.000*

ANNEXURE 2

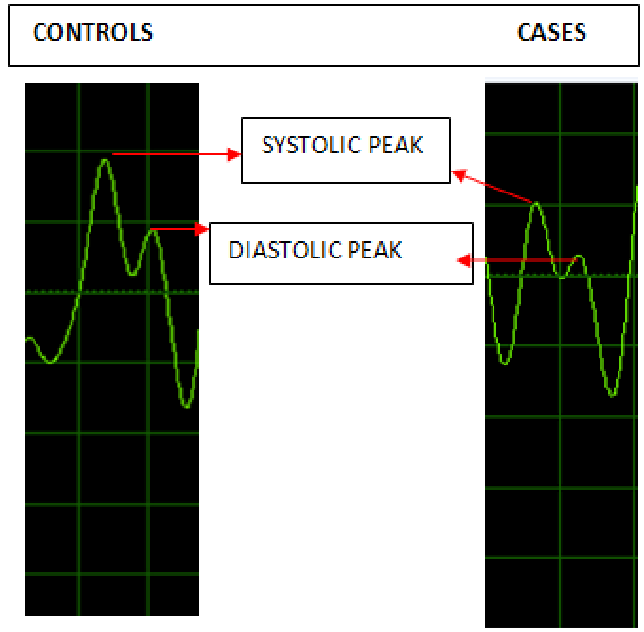

Figure 1: Digital volume pulse