"CORRELATION OF INTERARM BLOOD PRESSURE DIFFERENCE WITH TYPE 2 DIABETES MELLITUS"

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ABSTRACT In type 2 diabetes mellitus (DM-2), cardiovascular diseases are the important cause of mortality and morbidity. Regular monitoring of the diabetic condition is essential for the proper management of diabetes & effective controlling of diabetes-related complications. As the recording of IAD (Interarm blood pressure difference) is a simple procedure and it is also related to the vascular complication, it can be a vital indicator of the severity of diabetes. So, it is very important to study IAD concerning Complicated and Non-Complicated DM-2 which will be helpful for planning a better clinical management. In this cross-sectional study, we compare Interarm blood pressure difference in three groups i.e. Control, Non-Complicated DM-2 and Complicated DM-2 groups. There is a significant increase in systolic IAD in DM-2 group as compared to the control group, but no significant difference found between Non-Complicated and Complicated DM-2 groups.

INTRODUCTION

Type 2 diabetes (DM-2) is a chronic, progressive illness that causes considerable morbidity and premature mortality. The global prevalence of DM-2 is high and is increasing steadily. (1) Worldwide the total number of diabetes is projected to rise from 171 million in 2000 to 366 million in 2030. (2) The uncontrolled hyperglycemia of diabetes is related to long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels. (3)

In DM-2, Interarm Blood Pressure Difference (IAD) seems to be more frequent than in the normal population especially systolic BP, and is associated with microvascular/macrovascular damage and related complications. (4) A systolic interarm blood pressure difference (systolic IAD) of ≥10 mmHg has been associated with increased cardiovascular (CV) risk in the general population and also in patients of diabetes mellitus and vascular diseases. (5) Enough research has already been conducted which suggested that a systolic IAD is associated with vascular diseases and mortality. (6)(7) Advances in medical care and improvements in CV risk factor control have resulted in the reduction of CV events and deaths among adults with diabetes. (8) So correct recording of BP is an important factor in cardiovascular risk management and related complications in a diabetic patient. (9)

The current study examines the cross-sectional and prospective associations of an interarm blood pressure difference (IAD) in Complicated and Non-Complicated DM-2 group of patients. Only a few studies have evaluated the prevalence of IAD and its relation to diabetic complications. This study aimed to evaluate the prevalence of interarm systolic blood pressure difference (systolic IAD) and diastolic interarm blood pressure difference (diastolic IAD) in the Non-Complicated DM-2 population compared to the Complicated DM-2 population. Many clinicians and researchers have tried to stage DM-2 for effective evaluation and management of patient's conditions. (10) As IAD has been frequently associated with diabetes-related complications, it may help in the staging of DM-2. IAD recording is a simple, non-invasive, cost-effective, outpatient-based procedure and so definitely it may be more effective in the management of DM-2 patients.

Review of Literature

In Framingham Heart Study, a community-based cohort study, systolic IAD was more frequently associated with a significant risk for cardiovascular events independent to other cardiovascular risk factors. (11) Even modest differences in systolic IAD reflect on cardiovascular risk. (11)(4) Multiple studies have shown that hypertensives had a greater prevalence of systolic IAD and it was noteworthy that the prevalence of IAD significantly increased along with increasing BP.(12) The 2017 study of Claire Lorraine et al. showed that repeated IAD measurement can be a reliable indicator with association with Hypertension. (12),(13)

Mortality & complications due to cardiovascular events are a major burden mainly on uncontrolled diabetic patients. If additional attention to traditional cardiovascular (CV) risk factors be provided, then it will lead to reductions in CV events and mortality in adults with diabetes. (8) In a cross-sectional retrospective study conducted by T. Yoshimitsu et al., the systolic IAD was positively correlated with the markers of subclinical atherosclerosis. Assessing the IAD could be one of the most easily applied clinical tools for detecting macrovascular complications in patients with type 2 diabetes. (6) In another prospective cohort study by Christopher E. Clark et al. in the diabetes population, it was observed that systolic blood pressure differences may be associated with an increased risk of morbidity and mortality. (14)

IAD is an easily available clinical tool. An appropriate and correct reading of IAD is useful to accurately diagnose and manage hypertension, as recommended by the American College of Cardiology Foundation and American Heart Association guidelines for assessing during the initial visit. (15) All these studies pointed out that repeated blood pressure measurement in both arms is essential in initial diabetic assessment & proper management of CV problems in diabetic patients. (11),(4)

Despite the suggested prognostic implications of IAD, the pathophysiological mechanisms underlying these differences in patients with and without diabetes mellitus are not well understood which would require further studies (9). Because most studies focus mainly on systolic IAD & strong correlation has already been established by other diabetic studies. Here in this cross-sectional study, we focus on diastolic IAD & study relation of IAD to the severity of DM-2 and establish its role in proper diabetes management.

AIMS & OBJECTIVES
1) To study & compare the IAD in normal population & in DM-2 patients.
2) To study & compare the IAD in Non-Complicated DM-2 & Complicated DM-2 patients.

MATERIALS & METHODS
INCLUSION CRITERIA:
1) The study was conducted on subjects aged 30 to 60 years normal and DM-2 patient.

2) Patients who have already a well-documented history of DM-2 and related complications. *

EXCLUSION CRITERIA:
1) Type 1 diabetes mellitus patients were excluded from the study.
2) Control group was not containing any diabetic patients.
3) Subjects who have not given consent for data collection.
4) Persons without appropriate medical history record and could not be labeled as normal, non-complicated DM-2 or Complicated DM-2 patients. *

*Criteria for categorizing diabetic patients as Complicated and Non-Complicated DM-2: -

Non - Complicated DM-2	Complicated DM-2
DM-2 patients with no use of insulin but on a diabetic diet only or 2 glucose-lowering drugs. No history of diabetic feet No history of active diabetic eye disease Controlled CV risk factors (a healthy lifestyle with no IHD) Normal hypoglycaemia awareness No history of renal functions compromise (Defined as a serum creatinine <150μmol/l) No symptoms of autonomic neuropathy	DM-2 patients requiring insulin Active or history of foot ulcer History of lower limb amputation History of Renal failure (Creatinine >150umol/l) History of painful peripheral neuritis History of autonomic neuropathy History of Diabetic eye disease with active proliferative retinopathy/maculopathy or recent laser therapy (last 24 months) History of Uncontrolled CV risk factors (refractory hypertension or dyslipidaemia or ischemic heart disease (IHD)) History of recurrent hypoglycaemia Hypoglycaemia unawareness

Study period
Data was collected & blood pressure was recorded in non-diabetic (Control group) & in DM-2 patients randomly who obtained treatment between May 2019 and June 2019 in Tertiary care medical college.

Procedure
For this cross-sectional study, we recorded the interarm blood pressure differences (IAD) in three groups. 1st group (Control group) consist of normal healthy (non-diabetic) subjects; 2nd group consist of known Non-Complicated DM-2 patients and 3rd group consist of Complicated DM-2 patients. Each group consist of 35 subjects/patients of age group 30-60 yrs.

For calculating the IAD, we used a well-calibrated LED sphygmomanometer. The blood pressure was recorded manually in each hand separately according to a standard protocol after participants lying supine for at least 5 minutes.

Measurements were taken in the right or left hand randomly and repeated twice. The mean blood pressure was taken as a final value to calculate blood pressure difference. An increased IAD was defined as interarm blood pressure difference ≥10 mm Hg.

Data Analysis
For data analysis, Excel Microsoft Office 2019 software was used in which the prevalence of IAD in each group was calculated. Mean of blood pressure differences (systolic and diastolic IAD) of each group was then calculated. The unpaired t-test was applied between two groups (i.e. Control group Vs Non-Complicated DM-2, Control group Vs Complicated DM-2, Non-Complicated DM-2 Vs Complicated DM-2).

Observations and Results
Table no.1 - Demographic profile

	Diabetes (Non-Complicated DM-2 & Complicated DM-2)	Control	P-value
Sex			
Male	53	26	0.873
Female	17	9	
Residence			
Urban	18	11	0.537
Rural	52	24	
Age group			
30 – 40	15	5	0.107
40 – 50	23	19	
50 – 60	32	11	
Mean age	47.43 ± 1.76	46.71 ± 2.44	0.126
Duration of disease (in years)	6.23 ± 3.78		

Table no.2 – Complications in Complicated DM-2 group

Complications	Number of patients
Diabetes patients requiring insulin	35
History of foot ulcer	9
History of painful peripheral neuritis	8
History of Diabetic eye disease	5
History of Uncontrolled CV risk	14

In the control group, there were 3 (8.5%) subjects having systolic IAD ≥ 10 mmHg but no subjects with Systolic IAD ≥ 15 mmHg or diastolic IAD ≥ 10 mmHg. In Non-Complicated DM-2 group, there were 6 (17.14%) cases of systolic IAD ≥ 10 mmHg & 1(2.85%) case of Systolic IAD ≥ 15 mmHg but no case of Diastolic IAD compare to Complicated DM-2 group 7(20%) cases of Systolic IAD (≥ 10 mmHg) & 1(2.85%) case of Systolic IAD (≥ 15 mmHg) with no case of Diastolic IAD.(Figure no. – 1)
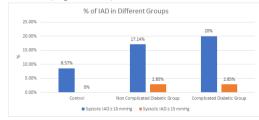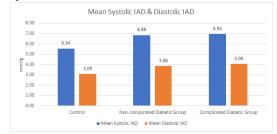

Figure no.1 – Percentage of IAD cases in different groups

Table no.3 – Data related to different variables from different groups

Variables	Control Group	Non-Complicated DM-2 Group	Complicated DM-2 Group
Systolic IAD ≥ 10 mmHg	8.57%	17.14%	20%
Systolic IAD ≥ 15 mmHg	0%	2.85%	2.85%
Mean Systolic Blood Pressure	115 mmHg	120.54 mmHg	120.82 mmHg
Mean Diastolic Blood Pressure	73.8 mmHg	77.2 mmHg	76.85 mmHg
Mean Systolic IAD	5.54 mmHg	6.85 mmHg	6.94 mmHg
Mean Diastolic IAD	3.08 mmHg	3.85 mmHg	4.05 mmHg

Mean Blood Pressure in the control group is 115/73.8 mmHg in comparison to the Non-Complicated DM-2 group where mean Blood Pressure is 120/77.2 mmHg & mean Blood Pressure in Complicated DM-2 Group is 120.82/76.85 mmHg (Table no.3). Mean Systolic IAD value in Control group is 5.54 mmHg and mean Diastolic IAD is 3.08 mmHg. In Non-Complicated DM-2 group mean Systolic IAD is 6.85 mmHg & mean Diastolic IAD is 3.85 mmHg compare to Complicated DM-2 group mean Systolic IAD is 6.94 mmHg & mean Diastolic IAD is 4.06 mmHg. (Figure no. – 2)

Figure no. 2 – Mean Systolic IAD & Diastolic IAD in different groups

By applying an unpaired t-test for the analysis of mean systolic IAD in between the Control group & Non-Complicated DM-2 group we get a p-value significant (≤ 0.05). We also get a significant p-value (≤ 0.05) when compare Systolic IAD in between the Control group & the Complicated DM-2 group. No significant P value (>0.05) get when compare systolic IAD in between Non-Complicated DM-2 and Complicated DM-2 group. (Table no.4)

Unpaired t-test showing insignificant p-value (>0.05) when compare Diastolic IAD in between Control Vs Non-Complicated DM-2, Control Vs Complicated DM-2 group, and Non-Complicated DM-2 Vs Complicated DM-2. (Table no.4)

Table no.4 -Result of unpaired t-test in Systolic & Diastolic IAD

Variables	Unpaired t-test	P-value	Significant (≤ 0.05)
Systolic IAD	Control Vs Non-Complicated DM-2 group	0.043	Yes
	Control Vs Complicated DM-2 group	0.033	Yes
	Non-Complicated DM-2 Vs Complicated DM-2 group	0.9	No
Diastolic IAD	Control Vs Non-Complicated DM-2 group	0.18	No
	Control Vs Complicated DM-2 group	0.06	No
	Non-Complicated DM-2 Vs Complicated DM-2 group	0.72	No

DISCUSSION

According to the current definition of IAD means the interarm difference of more than 10 mm Hg can be considered as significant and (16) we found the prevalence of IAD cases in the normal population is 8.57% which is relevant to a previous study done by F.Spannella et al. (4)

In other studies, the relationship between systolic IAD and arterial stiffness is well documented. A cross-sectional study found a relation between systolic IAD $\geq$10 mm Hg with increased ankle-brachial pulse wave velocity, which is an indicator of stiffness in arteries. (4) By considering previous reports Peripheral vascular disease with arterial stenosis, a recognized risk factor for future CV events and mortality has been assumed to be one of the pathological bases for IAD. (13) The IADs observed may result from more diffuse stiffening in the arteries, since structural changes in large arteries as a result of hypertension and diabetes begin early in the course of the condition and are insidious. In our study, we clearly see an increase prevalence of IAD in Non-Complicated DM-2, Complicated DM-2 group (17.14%, 20%) respectively.

The study by T. Yoshimitsu et al. showed that the IAD correlates with subclinical atherosclerosis, the IAD which is useful for the predictive score for future CVD. (6) There in our study, we found a significant correlation of systolic IAD in the diabetic group compared to the normal population. Also seen a slight increase in systolic IAD in the Complicated DM-2 group but it was non-significant compare to the Non-Complicated DM-2 group but significant compared to the normal population.

In some previous studies, diastolic IAD did not correlate with the markers for subclinical atherosclerosis. (6) The diastolic blood pressure IAD could not be a marker of subclinical atherosclerosis, contrary to the systolic IAD. In our study, we haven't found any significant association of diastolic IAD with any study group.

However, as like other studies, we found an increase mean blood pressure value increase also increase systolic IAD.(11)(Table no.3)

CONCLUSIONS

The systolic IAD is significantly correlated with DM-2. IAD is one of the important clinical tools for the early assessment of the diabetic patient. But the relation between the severity of DM-2 & IAD is not established by this study.

SUMMARY

In this Cross-sectional study, the diabetic group overall has a higher prevalence of IAD compared to the normal population. The systolic

IAD has a significant association with the diabetic group compared to the normal population but there is no significant association of systolic IAD in between Non-Complicated DM-2 and Complicated DM-2 group. No significant relation of diastolic IAD found in between any our study groups.

Average systolic and diastolic blood pressure increase in the diabetic group overall compared to the control group. The average systolic blood pressure reading increase more than the average diastolic blood pressure in the diabetic group overall but there is a very slight difference in the average systolic and average diastolic blood pressure reading in between the Non-Complicated DM-2 and Complicated DM-2 group. However, the systolic IAD increased with an increase in average systolic blood pressure reading.

The only significant association found in our study is increased Systolic IAD in Diabetic group overall compare to normal.

IMPLICATIONS

IAD is a non-invasive procedure that may help in the early identification of diabetic cases from a healthy population. Even though we haven't found a significant association of systolic IAD with the severity of DM-2 but to rule out this possibility we require a study on a larger group of Non-Complicated DM-2 and Complicated DM-2 population which may helpful in the stratification of DM-2 patient for proper clinical management.

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