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CORRELATION OF ANKLE/BRACHIAL INDEX AND DIABETIC RETINOPATHY IN TYPE 2 DIABETIC PATIENTS'

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ABSTRACT: Background: This study aims to correlate the ankle/brachial index (ABI) with the severity of diabetic retinopathy in type 2 diabetic patients. **Material and Methods:** A hospital-based prospective study of 100 types 2 diabetic patients aged 40 to 80 years were recruited from the outpatient department. Ankle/brachial index scores and the presence and stage of diabetic retinopathy were assessed and analyzed. **Results:** Significant associations between abnormal ABI score and severe diabetic retinopathy ($p<0.05$) was found. **Conclusion:** Patients with abnormal ankle/brachial index were more likely to have severe diabetic retinopathy and were at increased risk of losing their sight, mandating fundus evaluation in such cases for timely intervention to safeguard the vision of the patient.

INTRODUCTION: Diabetic retinopathy (DR) is a microvascular complication of diabetes mellitus. Studies have reported its association with other microvascular complications like nephropathy (microalbuminuria) [1-5] and macrovascular complications like markers of cardiovascular disease and peripheral vascular diseases [1, 2, 6-8]. Among these markers of macroangiopathy, the ankle/brachial index (ABI) is a simple non-invasive method of determining the presence of peripheral arterial disease (PAD, a macrovascular complication of DM). It is widely used to detect asymptomatic peripheral artery disease (PAD) with a cutoff value of ≤0.90. [9]

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This relationship of ABI scores and PAD with diabetic retinopathy has been well studied, but with varying results [6, 7, 10-16]. As the medial-wall calcifications of the arteries of the lower limb may add to the arterial stiffness and falsely increase ABI values, the prognostic importance of the ABI in individuals with diabetes macroangiopathy is controversial [17, 18]. Few of the previous studies have shown the association between diabetic retinopathy and pulse wave velocity (PWV) as a marker of arterial stiffness [7, 19-22] suggesting severity of DR as a possible predictor of macroangiopathy but whether a macroangiopathy can predict a microangiopathy in diabetic patients is doubtful. None studies have directly investigated the relationship of ankle/brachial index scores with diabetic retinopathy.

The aim of this study is to investigate abnormal ankle-brachial index (ABI) as a predictor for the development of DR by correlating ankle/brachial index (ABI) with severity of diabetic retinopathy

and comparing its sensitivity and specificity with gold standard colour Doppler ultrasonography (CDU) in detecting the vascular stiffness (PAD).

MATERIAL AND METHODS: This is an interdisciplinary hospital based prospective study. A total of 100 patients with type 2 diabetes mellitus in the age group of 40 to 80 years attending the tertiary care hospital with predefined inclusion criteria were included in the study. Diabetic patients having fasting blood sugar ≥ 126 (7 mmol/L) and postprandial blood sugar ≥200 (11.1 mmol/L) were included in the study. Those patients having metabolic syndrome, other causes of raised blood sugar and medial wall calcification with peripheral vascular disease were excluded from the study population. Dense media opacity obscuring the view of the posterior pole, glaucoma, age-related macular degeneration, high myopia, other retinal diseases, ocular procedures that made classifying the diabetic retinopathy difficult were also excluded. Informed consent was obtained from all the patients and the study was approved by the institutional ethical committee (IEC759).

The blood pressure recording of the patient was taken in supine position from brachial and posterior tibial artery using mercury sphygmomanometer. The ABI score was calculated by dividing the lowest tibial BP in either leg by the highest brachial BP in either arm [23]. All measurements were performed by single examiner. An ABI score of <0.9 was the cut off used for the diagnosis of peripheral vascular abnormality and risk for PVD [24].

All the patients also underwent Colour Doppler Ultrasonography (CDU) of the limbs in the department of radiology to auscultate and record blood flow from dorsalis pedis and posterior tibial and brachial arteries and to rule out any medial wall calcification in the limbs.

For the assessment of diabetic retinopathy, each patient underwent detailed ocular examination by same ophthalmologist. Dilated fundus evaluation to assess the presence and severity of diabetic retinopathy was done using slit lamp biomicroscopy and indirect ophthalmoscopy. The International Clinical Disease Severity Scale for DR [25] was used to classify the severity of DR. Patients with mild and moderate nonproliferative diabetic retinopathy (NPDR) were grouped as mild diabetic retinopathy and those with severe NPDR and proliferative diabetic retinopathy were grouped as severe diabetic retinopathy.

Statistical Analysis: The statistical data analysis was done using Open source epidemiologic statistics for public health, version 3.01 (www.openepi.com). For categorical data Chi-square test and Fischer Exact test was used. P values less than 0.05 were considered significant.

RESULTS: A total of 100 patients with type 2 DM were included in the study. The mean age was 59.5 ± 10.1 years with youngest being 39 years old whereas eldest was 80 years old. Majority of the patients were older than 50 years of age (78%) and only 22% cases were below 50 years of age. There were 61 males and 39 female (3:2). The age wise and sex wise distribution of the patients are shown in **Fig. 1**.

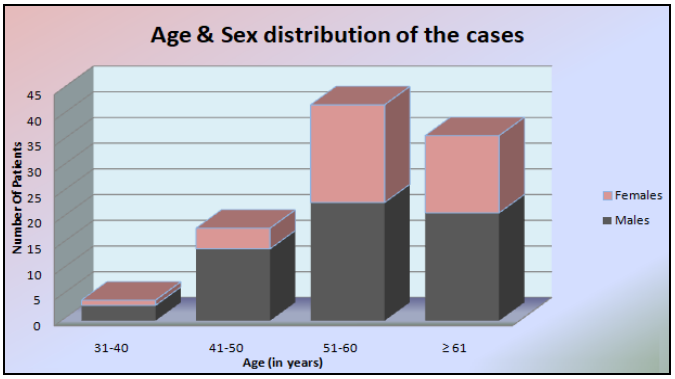

FIG. 1: AGE AND SEX DISTRIBUTION OF THE PATIENTS

The mean duration of type 2 diabetes mellitus was 7.75 years (SD 1.50). Among all the patients, 22% were having diabetes less than 5 years of duration whereas only 2% patients were having diabetes more than 15 years of duration as shown in **Fig. 2**.

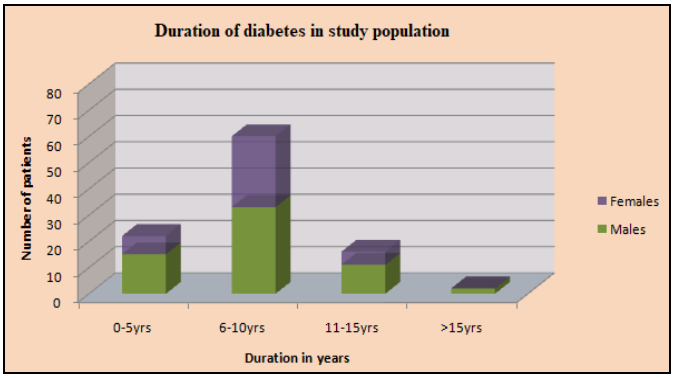

FIG. 2: DURATION OF THE DISEASE AMONG THE PATIENTS

Out of 100 patients qualified for the study, 81 patients were found to have normal ABI score of ≥0.9 to <1.3 and 19 patients were having abnormal ABI score (<0.9). Among 81 patients with normal ABI score, 64 patients had mild to moderate DR with 61 patients having normal CDU and 3 patients having diminished flow on CDU whereas 17 patients had severe DR with 14 patients having normal CDU and 3 patients having abnormal CDU. Similarly, among 19 patients with abnormal ABI score, 9 patients had mild to moderate DR with 6 patients having abnormal CDU and 3 patients having normal CDU whereas 10 patients had severe DR with 7 patients having abnormal CDU and 3 patients having normal CDU as shown in **Table 1**.

TABLE 1: PARAMETERS OF THE CASES

Ankle/ Brachial Index (ABI)	Cases		Colour Doppler Ultrasonography (CDU)
	Mild to moderate DR	Severe DR	
Abnormal	3	3	Normal CDU
ABI	6	7	Abnormal CDU
Normal	61	14	Normal CDU
ABI	9	3	Abnormal CDU
Total Cases (n=100)	73	27	

The uncorrected chi square value for one degree of freedom was 7.8 with a p value of 0.005 and the Yates corrected chi square value was 6.3 with a p value of 0.012; both were statistically significant indicating association between severity of DR and abnormal ABI score. The odds ratio was 4.1 signifying that the odds of abnormal ABI score in severe DR is 4.1 times the odds in mild to moderate DR. Similarly for severe DR patient group, the odds of abnormal vascular flow on CDU having abnormal ABI score is 10.89 times the odds having normal ABI score significantly associating abnormal ABI score (macroangiopathy) with severity of the DR (microangiopathy) (fischer exact test, p value < 0.05).

On comparison of the ABI score with gold standard CDU test as shown in table 2, the fischer exact test is highly significant (p value <0.05) and the sensitivity and specificity of ABI score in detecting macroangiopathy (abnormal flow, PAD) is 68.42% and 92.59% respectively with a diagnostic accuracy of 88%. The odds of abnormal ABI score in detecting diminished vascular flow (CDU) is 27 times the odds in normal flow.

DISCUSSION: The findings in our study show association between abnormal ABI score and advanced stage of DR in type 2 DM. Similar positive associations were reported between diabetic retinopathy and the presence of ABI abnormalities in large population-based studies of Rani P, Raman R, Gupta A, *et al*., [3] and Kawasaki R, Cheung N, Islam A, *et al*., [6]

Similar results were also reported by several previous cross-sectional studies [12-15, 26-28]. Szu-Chia Chen *et al*., also evaluated the association between ABI and the development of DR in patients with type 2 DM without pre-existing DR and showed that abnormal ABI (<0.9 or ≥1.3) was independently associated with DR development. They also identified PAD as a risk factor for development of DR [29].

Our study also compared the sensitivity and specificity of abnormal ABI score (<0.9) with CDU in detecting PAD (macroangiopathy). Fishbane S *et al*., [30] Fowkes FG *et al*., [31] and Newman AB *et al*., [32] also reported ABI as a marker of atherosclerosis in their studies with ABI < 0.9 being helpful in detecting PAD.

Small sample size, lack of study of cause effect relationship in DR patients and clinical assessment of fundus for grading of DR instead of gold standard stereoscopic fundus photography are limitations of our study. But the major strength of this study is type 2 DM patients as study population and the ability to study the association of ABI abnormality with diabetic retinopathy.

CONCLUSION: Our study shows that patients with abnormal ABI scores are more likely to have severe diabetic retinopathy. ABI score is a simple bed side tool. It can be used in type 2 DM patients not only as a marker for microangiopathy in diagnosing PAD but also for predicting severity of DR in medical wards and outdoors.

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CONFLICT OF INTEREST: There are no conflicts of interests regarding this study.

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