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Research Paper

ABI (Ankle Brachial Index) - An Important Tool In Assessment Of PVD In DM Type 2 And Its Correlation With Lower-Limb Arterial Doppler

Medical Science

KEYWORDS : Peripheral Vascular Disease, Macrovascular, Microvascular ,Ankle Brachial Index, Body Mass Index ,Low Density Lipoproteins

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ABSTRACT

PVD has been an important, disabling macrovascular complication of Type2 Diabetes. Study was aimed to study usefulness of ABI as predictor of severity of PVD & its correlation with lower limb Doppler to ascertain the utility of the former as a screening tool for defining PVD and judging its severity. It was observed that ABI had negative correlation with age, HbA1c levels, LDL levels, Sr. creatinine and Systolic BP. The correlation was strongest for the Age (-0.512); diabetes duration (-0.512), creatinine (-0.433), Systolic BP (-0.386) and HbA1c (-0.350). When correlated with Doppler; ABI was having significant association with severity in Doppler proven blockade and it retained its significant association with Doppler finding in all arterial segments (P<0.003) irrespective of age, sex or associated comorbidities.

Introduction:-

The prevalence of diabetes is rapidly rising all over the globe at an alarming rate[1].The International Diabetes Federation (IDF) estimates the total number of diabetic subjects to be around 40.9 million in India and this is further set to rise to 69.9 million by the year 2025[2].

Peripheral vascular disease (PVD) can be considered the "step-child" of cardiopulmonary care [3]. National public PAD awareness survey carried out in US demonstrates that individuals with an established PAD diagnosis were unaware of the causative role of diabetes (52%), very small fraction of individuals received information on PAD from a physician (14%), nurse (2%), or pharmacist (0.2%). Diabetes increases the incidence and severity of limb ischemia approximately 2-4 fold. Diabetes is the commonest cause of non-traumatic amputations.[4,5,6].

An ADA consensus statement on PVD[7] suggested that a screening ABI be performed in patients > 50 years of age and be considered in patients < 50 years who have other PAD risk factors.[8]A consensus is emerging that the ABI currently represents the most appropriate measure of PVD for epidemiologic studies. Our study aims to study usefulness of ABI as predictor of severity of PVD as judged on Doppler and its correlation with lower limb Doppler to ascertain the utility of the former as a screening tool for defining PVD and judging its severity.

Aims and objective:-

To record ABI score in Type 2 DM patients with PVD and assessing its usefulness in predicting severity of PVD by correlating with Doppler findings & predicting the distribution of other important variables in etio-pathogenesis of diabetic PVD.

Material and methods:-

The study was carried out in a tertiary care centre in a cross-sectional non-randomised manner. The study protocol was approved by Ethics committee. Any type 2 DM patients with suspected PVD of either sex, as judged by history, clinical examination were included. The patients with history of smoking, grade IV vascular injury, any amputation of lower limb or lower limb vascular surgery in past were excluded from study.

The ABI Pressure measurements were done using the Doppler (model GE-LOGIC 3) probe with inflatable cuffs. The lower extremity pressure was divided by the upper extremity pressure and the index was calculated. A value of ABI of less than 0.9 was considered significant. These patients were subjected for further studies. For correlating with other variables, the subjects were grouped according to ABI <0.6 and 0.9<ABI>0.6 to see the dispersion of the variables as done in prior studies. [9,10,11].

Doppler of lower limb arteries was done with Doppler machine, GE LOGIC III, by an experienced Radiologist with 7.5 MHz linear phased array vascular probe. The disease severity was interpreted as per the Criteria developed for duplex imaging to detect abnormal arterial segments.[1]

Observations and results: –

In our study out of 798 (425 males & 373 females) patients who were screened for the PVD, 131 were eligible for inclusion and were further subjected to ABI estimation. **Only 81 out of those 131** could complete the study protocol.

Table-1: Association Of ABI And Other Variables-

Parameter	ABI		P value	Significance
	0.9 to 0.6	<0.6		
Age	57.75± 7.12	64.23± 5.27	0.003	HS
Duration of diabetes	10.57± 5.14	15.00± 5.22	0.006	HS
BP	147.76± 17.94	154.46± 9.56	0.19	NS
BMI	28.47 ± 4.28	32.30 ± 7.19	0.01	HS
BSL-F	147.39± 35.09	133.15± 32.06	0.178	NS
BSLPP	229.25± 56.09	221.61± 48.50	0.648	NS
HBA1C	10.16± 2.03	11.65± 2.07	0.01	HS
Creatinine	1.55± .49	2.02± .66	0.005	HS
Cholesterol	218.04± 41.42	229.07± 38.28	0.376	NS
TG	163.60± 34.73	164.00± 32.82	0.975	NS
LDL	144.08± 31.34	166.15± 18.83	0.017	HS
HDL	52.42± 15.58	55.00±11.08	0.572	NS

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Table 2: Correlation Strength Of ABI

Parameters	Other Parameters	Coefficient of Correlation	Significance
ABI	Age	-0.512	0.001
	Duration of diabetes	-0.512	0.001
	Systolic BP	-0.386	0.001
	BMI	-0.197	0.039
	BSL fasting	-0.109	0.167
	BSL PP	-0.125	0.134
	HbA1C	-0.350	0.001
	Creatinine	-0.433	0.001
	Cholesterol	-0.075	0.253
	TG	0.027	0.406
	LDL	-0.353	0.001
	HDL	0.217	0.026

***Table 3:- ABI Doppler Correlation*.**

Segment	% Blockade	ABI		Significance
		0.9-0.6	<0.6	
IF	<50 % Blockade	137	8	0.001
	> 50 % Blockade	10	7	
FP	<50 % Blockade	103	3	0.001
	> 50 % Blockade	44	12	
TP	<50 % Blockade	73	0	0.001
	> 50 % Blockade	74	15	
PT	<50 % Blockade	66	1	0.003
	> 50 % Blockade	81	14	
DP	<50 % Blockade	65	2	0.003
	> 50 % Blockade	82	13	

Table 4 – No. Of Arterial Segments Against ABI

Number of arterial segments Involved (>50%)	ABI	
	0.9-0.6	<0.6
Less than 3	35(53.0 %)	2(13.3 %)
3-5	15(22.7%)	3(20.0 %)
> 5	16(24.2 %)	10(66.7 %)
Total	66	15

Discussion:-

Peripheral arterial disease in patients with diabetes adversely affects quality of life and is associated with substantial functional impairment[4,5].

Prevalence of PVD in our study was about 10.1% which was similar to previous various studies using the ABI as an Indicator. [2,9.]

Study & Year	No.	ABI criteria	Prevalence
De Becker et al, 1979	1039	<0.90	3%
Schroll and Munck, 1981	666	<0.90	14%
Fowkes et al; 1991	1592	<0.90	9%

ABI and its association with other Indicators [13,14,15,16,]

The mean age of patients with ABI in the range of 0.9-0.6 was 57± 7.12 years against 64 ±5.27 years in those with ABI values <0.6. This difference in age was statistically significant with P= 0.003.

Mean duration of DM

The first group had mean duration of diabetes of about 10.5% and the second group about 15 years , the difference being statistically highly significant.(P~0.006). This confirms the fact observed by many studies that the vascular complications are duration dependant. ***Al-Delaimy et al.*** [17] found a strong positive association between the duration of diabetes and the risk of developing PAD. **Adler** et al. [18] estimated the prevalence of PAD up to 18 years after the diagnosis of diabetes in 4,987 subjects (United Kingdom Prospective Diabetes Study **[UKPDS])** [19.] The data showed a higher prevalence of PAD in those with longer duration of diabetes.

Those with moderate 0.9-0.6 and severe <0.6 ABI did not differ significantly in mean systolic BP(147mm Hg vs 154mm Hg) & mean BSL-F and BSL-PP. The mean HbA1c in the study group was 10.40. those with mild to moderate PVD had mean of 10.16 and with severe PVD (<0.6ABI) had mean 11.65 % (P~0.01.)

Other biochemical indicators

The mean creatinine in two groups also differed significantly indicating the common pathogenesis in the Nephropathy and PVD and poor glycemic control exacerbating rate of acquiring both the complications. Though the TG, HDL were not significantly different in two groups, the LDL was significantly higher in those with severe PVD. From these statistics it was clearly evident that the lower ABI increased the possibility of having more age , more duration of diabetes , higher BMI and higher HbA1c levels, creatinine levels , LDL levels in that cohort significantly .The association will help in relevant investigations and interventions at an early stage to avert significant morbidity and mortality.

When the correlation was studied for significance, ABI had negative correlation with age, HbA1c levels, LDL and HDL levels, sr. creatinine and systolic BP. The correlation was strongest for the Age (-0.512) and duration of diabetes (-0.512), followed by creatinine (coefficient of correlation -0.433), Systolic BP(-0.386) (Graph 9) and HbA1c (-0.350). The ABI did correlate with other variables too but the correlation is weak. This can conclude that the higher age , more duration of Diabetes and more the levels of HbA1c and create , lesser will be the ABI in those patients or vice-versa. This further strengthens the role of ABI in PVD evaluation. Those with severe ABI had significantly more no of arterial segments with >50% blockades and those with less severe PVD had more no of arterial segment with subcritical narrowing(<50%). These findings were very significant in distribution when observed in IF , FP , PT segments (P-0..001) whereas the findings retained its significance even in the DP, PT segments with P-0.003.

It was found that those with ABI between 0.9 -0.6 in 53% had less than 3 vessels involvement with >50% blockade as against 13% in those with ABI <0.6 group. The group with ABI <0.6 had more than 5 arterial segments with critical narrowing in 66.7% i.e. about 2/3 cases.More than 5 segment with critical narrowing were as less as 24% in patients with mild to moderate PVD (ABI 0.9-0.6). This highlights the importance of finding out ABI as it quantitatively can predict the extent and severity of PVD without even Doppler assessment.

Allens et al[17] in his study also advocated this correlation in his finding ,he observed that the overall level of agreement between CDU and resting ABPI measurements was 83% (Kappa 0.66). The ABPI technique identified the more serious disease; *those with a resting ABPI of less than 0.6 gave 100% agreement with CDU*. With higher resting ABPIs the level of agreement became poorer: 83% (0.6 < or = ABPI <0.9) and 76% (normal ABPI > or = 0.9).[17]

But in similar study in India, ***Premalatha G et al*** [20], observed ABI had low sensitivity (70.6%) but a high specificity (88.5%). The overall agreement between CDU and ABI was poor (k = 0.20).

Conclusions:-

1. The ABI is a easy and reproducible tool to evaluate the PVD. The peripheral vascular complication in Type 2 DM was age dependent , duration of DM dependent , BMI dependent , Creatinine and LDL dependent & was found to have significant difference in the two groups with different ABI.
2. When correlated with Doppler; ABI was found to have significant association with severity in Doppler proven blockade and it retained its significant association with Doppler finding in all the arterial segments (P<0.003) irrespective of age, sex or associated comorbidities..
3. ABI had a strong association with degree of blockade in all the Arterial segments and also in no. of segments involved.

The ABI can be used to predict not only severity of arterial blockade, but it also gives the extent of PVD.

Limitation of our study:-

1. The patients were selected on basis of ABI<0.9. This study excluded those with higher ABI which can be seen in some PVD cases due to medial calcifications reducing compressibility of vessels.
2. Preferably the patients were included with significant signs and symptoms and those with asymptomatic disease got proportionately less representation.
3. The patient data was not adjusted for the various drugs they had received in past or present.

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