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A Study of Ankle- Brachial Index In Patients Of Stroke

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Abstract: *Stroke is the third leading cause of morbidity and mortality all over the world. [1]In both primary and secondary prevention of stroke, Peripheral Arterial Disease (PAD) indicates a high risk of future events and plays an important role in stroke rehabilitation. The basic pathology behind macrovascular diseases is atherosclerosis,thus its early detection with noninvasive techniques such as ankle brachial index (ABI) measurement can be pivotal .A prospective observational cross sectional study was carried out in 50 patients with clinical & imaging based evidence of stroke over 6 months at Mahatma Gandhi Hospital, Jodhpur. All patients with conditions, which affect ABI measurement,were excluded. ABI was calculated by measuring systolic BP in ankle, brachial vessels located using hand held Doppler device. Clinical and radiological assessment with detailed history was carried out. Data obtained was statistically analyzed. Out of 50 stroke patients included, 41 had low ABI indicating PAD. Among them 42% had moderate PAD, 8% had severe PAD and 18% had normal ABI. 24% of patients had past CVA, 16% had previous IHD. Mean systolic BP in upper and lower limb was significantly different. Correlation between ABI and stroke was statistically significant, more with ischemic type. ABI significantly correlated with systolic BP of lower limb and difference of SBP in upper & lower limb at each side. A difference of >10mm Hg in SBP of both upper limbs was found in 23 patients of which 22 had low ABI. Patients with co-morbid conditions as HTN, DM, IHD, past CVA or with abnormal waist –Hip ratio, dyslipidemia, tobacco & smoking addiction were more in low ABI group. We infer that patients of stroke harbor a major burden of atherosclerosis in their various vascular territories, early detection of which can help to determine the prognosis & reduce the morbidity and mortality.*

Keywords: *stroke, ABI, PAD, atherosclerosis*

I. Introduction

Stroke is one of the commonly encountered cases in Department of Medicine associated with significant morbidity and mortality. Stroke or cerebrovascular accident is defined as an abrupt onset neurological deficit attributable to a vascular cause. Complications occurring in rehabilitation period in stroke patients are important determinants of prognosis. Major ones are recurrence of stroke, other major vascular events like CAD which directly increases the morbidity & smortality and PAD, which may hamper the recovery of limb movements. Peripheral Arterial Disease:-Ischemic occlusion, mediated by atherosclerosis or acute embolisation of peripheral vessels manifests as features of PAD- pain, pallor, paresthesia, pulselessness etc. Ankle-Brachial Index**:-**ABI is the ratio of systolic blood pressure in lower limb to systolic BP in upper limb, taken with the help of a portable doppler probe. Normal ABI is 0.9 to 1.3. Abnormal ABI value is defined as <0.9 which suggests the presence of peripheral arterial disease(PAD).Many studies have been conducted which have proven a role of abnormal ABI as predictor of future athero-thrombotic events such as CAD,PAD,CVD.[2,3,4]Further studies have shown to have correlation between low ABI and ischemic stroke[5,6,7,8]It has also been used as a prognostic marker in stroke patients predicting increase in all-cause mortality and morbidity related to cardiovascular & other major vascular events.[9,10]Further low ABI as indicator of asymptomatic PAD is associated with worse limb function, possibly hampering post-stroke recovery. The proper management of PAD can improve stroke rehabilitation.[11]As the other tools or methods, which can be used to indicate these vascular involvements like angiography etc. are either invasive or economically not feasible, ABI has emerged to be an easy screening tool for risk assessment of these events. Hence we planned to carry out a study of ankle brachial index in stroke patients.

II. Materials And Method

A prospective observational study was carried out in patients presenting with stroke to the IPD of General Medicine Department of Dr S N Medical College and Associated Hospitals over a period of more than 6months.
Inclusion Criteria:- All patients with clinical and imaging based evidence of stroke
Stroke is defined as an abrupt onset neurological deficit, which is attributable to a vascular cause, usually diagnosed by brain imaging (CT or MRI)

Exclusion Criteria:-Patients excluded are

- Trauma, surgery or amputation involving the lower limb
- Leg ulcers
- Deep vein thrombosis
- Filariasis or lower limb swelling due to other causes which would impair Doppler image quality.

Data was statistically analyzed using the software SPSS. Statistical analysis was done using chi-square test and student-t test. Parametric data were expressed as mean value± standard deviation (SD) and categorical variables as percentage. The ankle-brachial index is the ratio of the systolic pressure in the ankle to the systolic pressure in the arm. We can measure the ankle-brachial index with a blood pressure cuff, sphygmomanometer, and handheld Doppler device. In our study we used Life drop model L150R hand held Doppler device. We used 5 MHz and 8MHz transducer probe in our study to detect peripheral artery pressure.

III. Observations & Results

After scrutinizing 58 patients,50 met the criteria of inclusion, evaluated and following results were found.

1) Maximum patients (14/50) were in 66-75yrs age group. Mean age of females was higher than of males.
2) Among co-morbid conditions, HTN was the most common (46.66%) followed by DM, past CVA, CAD. A significant proportion (24%) had recurrent stroke.
3) WHR was high in 74.3% of all males and 66.6% of all females.
4) 24% were smokers and 32% were tobacco chewers.
5) Mean systolic BP was significantly different in upper & lower limb on each side as shown in table 1. (P <0.001).

Table 1: Mean systolic BP in all 4 limbs

Systolic BP	Upper Limb Mean±SD	Lower Limb Mean±SD	P value
RT	154.84±26.46	122.64±40.48	<0.0001
LT	158.70±26.01	127.30±45.80	<0.0001

6) In our study population 78% had ischemic and 14% had hemorrhagic stroke, while 8% had mixed ischemic + hemorrhagic stroke.
7) Among 50 patients, 42% had low ABI in the range of moderate PVD. (0.4-0.7) shown in figure 1.

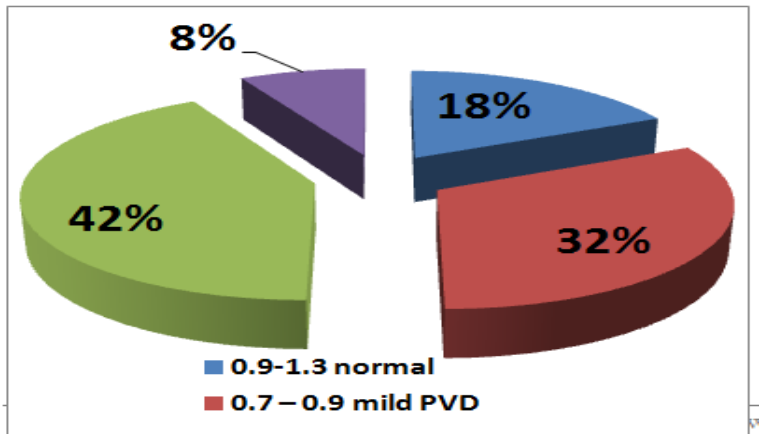

Fig.1: ABI Distribution

8) A statistically significant correlation was found between ischemic type of stroke and ABI. (P<0.001) (Table 4) (Figure 2)

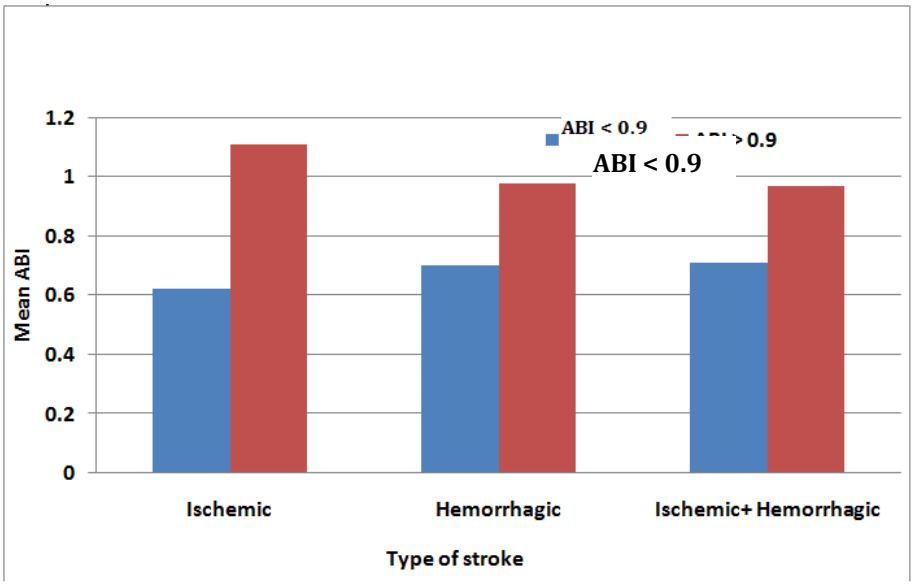

Fig.2: Type of stroke and mean ABI

9) Patients with abnormal WHR were significantly higher in number in low ABI group. (P <0.0001) but mean WHR didn't show significant correlation with ABI. 10) a)The no. of patients with high systolic BP (>140mmHg) was significantly higher in low ABI group. (P<0.001).(table 2)

Table 2: Systolic BP of patients and ABI (upper Limb)

Systolic BP Upper Limb	Number	ABI < 0.9	ABI > 0.9	P value
141-160	14	13	01	0.001
>160	27	22	05	0.001
Total	41	35	6	0.000

b) ABI was found to be significantly correlated with difference in systolic BP of upper & lower limb at each side. Mean of difference was significantly higher in low ABI group. **(P value 0.03**at Lt. & **0.02** at Rt**.)**Systolic BP in each lower limb was significantly different in low & normal ABI group (P value <0.0001)

Table.3: Mean systolic BP in low & normal ABI patients

SYSTOLICBP	**ABI < 0.9 (n=41)**	**ABI > 0.9 (n=9)**	P value
Upper Limb RT	154.92±27.64	154.44±21.61	0.961
Upper Limb LT	158.60±25.80	159.11±28.55	0.959
Lower Limb RT	111.46±32.37	173.56±35.20	**<0.0001**
Lower Limb LT	116.32±40.82	177.33±32.88	**<0.0001**
RT-RT (upper/lower)	43.95±26.44	21.33±19.90	**0.020**
LT-LT(upper/lower)	45.32±31.55	21.33±15.94	**0.032**
Upper limb (RT-LT)	17.15±13.90	8.22±6.44	0.067
Lower Limb (RT-LT)	12.66±10.33	4.67±6.08	**0.031**

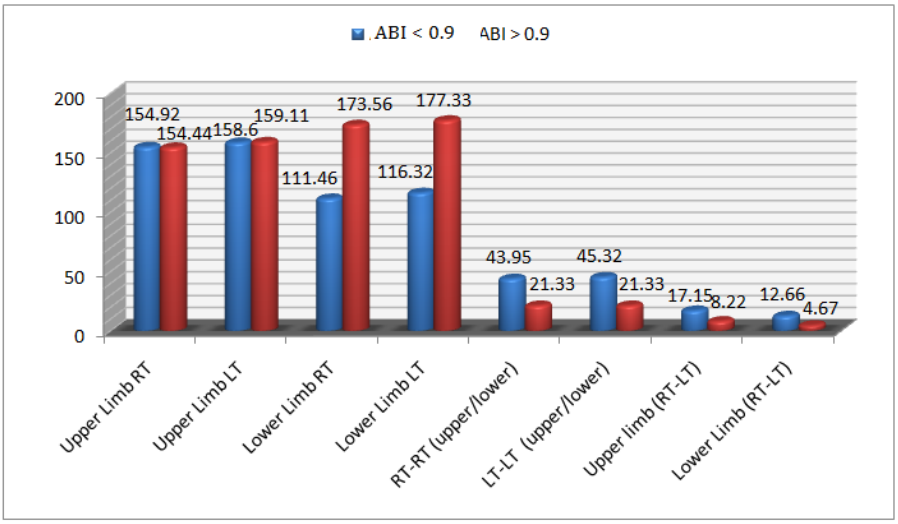

fig.3 Mean systolic BP in low & normal ABI patients

c) Out of 50 stroke patients 46% (23/50)had difference of >10mmHg in SBP of both upper limbs and 22 of them had low ABI. Although the correlation was not statistically significant, yet it was clinically relevant as it shows the severity of atherosclerosis.

11) Number of patients with co-morbid conditions was higher in low ABI group but no statistical correlation could be established between ABI and any co-morbidity.

12) Patients with high blood sugar and dyslipidemia were significantly higher in no. in low ABI group but the mean values had no statistical correlation with ABI.

Table 4: Overview of risk factors and other clinical parameters in stroke patients

Parameters	All patients	ABI < 0.9	ABI > 0.9	P value
Mean age (in years)	62.68±15.04	62.92±14.15	61.56±19.56	0.807
Male/ Female	35/ 15	27/ 14	8/ 1	0.247
Urban/ Rural	36/ 14	30/ 11	6/ 3	0.697
Hypertension	17	14	03	0.963
Diabetes	25	22	03	0.269
IHD	08	08	00	0.148
Past CVA	12	10	02	0.890
Smoking	13	11	02	**.013**
Tobacco	16	14	02	**0.003**
Alcohol	05	04	01	0.180
Opium	02	01	01	1.000
Hyperlipidemia	21	18	03	**0.001**
Waist Hip Ratio	0.952±.12	0.947±.13	0.977±.10	0.512
Systolic BP	164.54±25.55	165.34±25.47	160.89±27.15	0.641
Upper limb (RT-LT) difference		17.15±13.90	8.22±6.44	0.067
Lower Limb (RT-LT) difference		12.66±10.33	4.67±6.08	**0.031**
ABI	0.721±.227	0.645±.17	1.07±.13	**<0.0001**
Ischemic stroke	39	33 (0.62±0.17)	06 (1.11±0.14)	**<0.0001**
Hemorrhagic stroke	07	05 (0.70±0.10	02 (0.98±0.12)	0.257

IV. Discussion

Atherosclerosis, being a generalized process affects all major vascular territories as coronary & cerebral vessels, peripheral vessels are no exception. CAD, CVD being the field of major concern now-a-days, PAD still remains a neglected part. In our previous study we had shown a correlation between asymptomatic CAD and PAD in

type-2 DM patients[14]. Prevalence of Peripheral Arterial Disease (PAD) in stroke patients plays an important role in secondary prevention & rehabilitation. Early detection of PAD with easy, non-invasive and economic tool –ABI, can help to take necessary steps to facilitate functional recovery & to prevent complications related to atherosclerosis and thus to decrease all cause morbidity & mortality in stroke patients. Hence we carried out a study of Ankle- Brachial Index in stroke patients.

A total 50 consecutive patients of cerebrovascular stroke, who were admitted in our hospital, were included. Their risk factors (h/o DM, HTN, IHD, past CVA) and other clinical parameters (WHR, Systolic BP) were studied and ABI was measured. All these parameters were compared in low & normal ABI group.

Mean age of patients was 62.68±15.04year. Among risk factors, WHR was high in majority (72%), HTN was the most common co-morbid condition, 24% had recurrence of stroke. Tobacco addiction was the most common in addiction habits.

Systolic BP was significantly different in upper & lower limb at each side($P<0.0001$).

Majority of patients (39/50) had ischemic stroke. Mean ABI was 0.72±0.227 and most of the patients had low ABI in range of moderate PVD(0.4-0.7).We found low ABI in 82% of patients, Weimer et al[6]found ABI <0.9 in 52.8% of his ischemic stroke patients. Prevalence of low ABI was 40.5% in a study byAlvarez_Sabin et al[12]where mean ABI was 0.92±0.21. Patients with high SBP were more in low ABI group. Although no statistical correlation was found between SBP and ABI, similar with Chung et al. [7] ,Chun Yi-Li et al.[13]Systolic BP in lower limb was significantly different in low & normal ABI group.(P value<0.0001).A difference of >10mmHg between SBP of both upper limbs was found in 23/50 patients, majority (22/23) of which had low ABI. It was found as an important marker of severity of atherosclerosis. A statistically significant correlation was found between ABI and ischemic stroke ($P<0.001$). Similarly Chun Yi-Li et al.[13]found a strong correlation between ABI and ischemic stroke (P value <0.008)where the prevalence of low ABI was 25.9%.

Low ABI was associated with recurrence of atherosclerotic major vascular events (IHD, recurrent CVA).Weimer et al[6]also found that Patients with an ABI <0.9 had a significantly higher risk of recurrent stroke or cardiovascular death and a higher recurrent stroke risk than patients with ABI>0.9. Alvarez-Sabin et al[12] found that patients of stroke with low ABI had more vascular events (27% Vs. 14%). Patients with dyslipidemia and high WHR were more common in low ABI group but no correlation was found between mean values of lipid profile, WHR and ABI. Chung et al.[7] also found that dyslipidemia was more common in patients with low ABI, but mean levels of blood sugar, all parameters of lipid profile didn't show any correlation with ABI. Chun Yi-Li et al.[13] also did not find a significant correlation between ABI and mean levels of lipid profile.

V. Conclusion

This study is an attempt to highlight the universality of atherosclerotic process involving all blood vessels in the body. Patients with PAD are three times more likely to develop stroke. Despite this well established fact, PAD remains understudied and often under-rated as a risk factor for stroke. In our study, a statistically significant correlation was found between ABI and stroke, more with ischemic type with major burden of PAD (41/50) as low ABI. A significant proportion of patients had previous stroke and IHD.A clinically relevant difference of >10mmHg in SBP of both upper limbs was found, showing the burden of atherosclerosis. In our previous study in asymptomatic DM-2 patients, a good correlation was also found between ABI & CAD.[14]. Although the number of patients was small in our study, statistically significant values linking stroke & ABI was found. It needs to be further evaluated in a detailed multicentric prospective study.sss

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Abbreviations:-

ABI : Ankle- Brachial Index\
PAD : Peripheral Arterial Disease
IHD : Ischemic Heart Disease
HTN : Hypertension
DM : Diabetes Mellitus