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Prevalence of Peripheral Vascular Disease in Patients of Stroke

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Abstract:
Objectives: *This study was carried out to estimate the prevalence of peripheral vascular disease (PVD) in patients of stroke and to correlate PVD with age, sex, type and risk factors of stroke.*
Materials and Method: *This observational study was carried in AVBR Hospital, DMIMSU over a 24 months period after obtaining due ethical clearance. The study included 120 cases of stroke that were evaluated for presence of associated peripheral vascular disease by Ankle Brachial Pressure Index (ABPI), which was measured by Doppler study. The correlation of the prevalence of peripheral vascular disease in cases of stroke was evaluated. An attempt was made to correlate the PVD with age of patients, type of stroke, sex and with other risk factors like alcohol consumption, smoking, hypertension, diabetes mellitus, previous history of stroke and presence of cardiac disease. The statistical analysis test used was Z test for comparison and calculation of P-values.*
Results: *The male to female ratio was 2.42 :1 . The commonest age group was 60 to 79 years. Amongst 120 cases 88 cases (73.34%) had ischemic stroke while 32 cases (26.66%) had hemorrhagic stroke. We observed that amongst 120 cases studied, 35 cases (29.16%) had ABPI less than 0.9 suggestive of peripheral vascular disease. In remaining 70.84% cases ABPI was more than 0.9.The various risk factors for stroke were evaluated in the present study. It was noticed that, hypertension was the risk factor in 54.16% cases and Diabetes Mellitus was the risk factor in 45% cases. Other risk factors were history of previous stroke in 29.17% cases, History of cardiac disease in 22.5% cases, history of smoking in 26.7% cases and history of alcohol consumption in 10% cases.*
Conclusion: *The prevalence of Peripheral vascular disease based on low ABPI in cases of stroke was 29.16% in the present study. The prevalence was more common with ischemic stroke as compared to hemorrhagic stroke. The low ABPI in stroke cases was more common in cases beyond the age of 60 years of age.*
Keywords: *ABPI, PVD, Hypertension, Diabetes mellitus, stroke*

I. Introduction

Peripheral vasccular disease (PVD) in the legs, sometimes known as peripheral arterial disease, is caused by atheroma (fatty deposits) in the walls of the arteries leading to insufficient blood flow to the muscles and other tissues. Patients with PVD may have symptoms but can also be asymptomatic [(1).] The commonest symptom, intermittent claudication, is characterised by legpain and weakness brought on by walking, with disappearance of the symptoms following rest.Patients diagnosed as having PVD, including those who are asymptomatic, have an increasedrisk of mortality, myocardial infarction and stroke. Relative risks are two to three times thatof age and sex matched groups without PVD[(2).]

Stroke is a major global health hazard. It is the third leading cause of death after heart disease and cancer, after the age of 40 [(3)]. Annually 15 million people suffer a stroke worldwide. Of these, 5 million die and another 5 million are left permanently disabled, placing a burden on family and community [(4)].

A strong association has been demonstrated between a low ABI and an increased incidence of ischaemic stroke .Thus for high risk patients, the prediction of future cerebro-vascular events and vascular death based on pathological ABI is the easiest and accurate non-invasive method for the diagnosis of Peripheral Vascular Disease (PAD) is the determination of ankle–brachial index (ABI). ABI is one of the clinical tools being used to determine the severity of PAD. It is the ratio of the systolic blood pressure measured at the ankle over the systolic blood pressure measured at the brachial artery.[(5)]

ABI is highly specific for the diagnosis of PAD but it is a poorly sensitive method for the assessment of vascular risk in asymptomatic patients.[(6)]

In majority of epidemiological studies, the ABI measured by Doppler ultrasound,[(7,8)] represents the gold standard. A substudy of the Heart Outcomes Prevention Evaluation study (HOPE) trial showed that the ABI, even when determined by palpation of the pedal arteries, is a strong predictor for future cardiovascular events and for all-cause mortality[(9)]useful (Manzano et al 2012).

The present study is therefore designed to find out the prevalence of peripheral vascular disease based on ABI in cases of stroke and its correlation with associated factors.

II. Aim Of The Study

The present study is carried out with the aim to find out the prevalence of Prevalence of Peripheral Vascular Disease in Stroke.

III. Objectives Of Study

The present study is carried out with the following objectives.

1. To study the prevalence of peripheral vascular disease (PVD) in cases of stroke.
2. To correlate the peripheral vascular disease with types of stroke.
3. To correlate the PVD with age, sex, type of stroke & risk factors of stroke.

IV. Materials And Methods

This study was carried out at Department of medicine, Jawaharlal Nehru medical college and AcharyaVinobaBhave Rural Hospital, Sawangi (Meghe), Wardha, an advanced tertiary care hospital in central India.

Study Design:- The present study was prospective observational cross sectional study.
Study Duration:- The study was carried out for the period of 24 months from September 2012 to September 2014.
Sample Size:- The study consisted of 120 cases of stroke admitted at AcharyaVinobaBhave Rural Hospital, Sawangi (Meghe), Wardha.

Inclusion Criteria: The patients of stroke irrespective of the type of stroke were included in the study.

Exclusion Criteria : Patients with bilateral lymphoedema, bilateral gross edema of lower limbs, with preexisting gangrene of lower limb/limbs or peripheral vascular disease,preexisting Burger's disease or thromboangitisobliterans and who denied the consent to be a part of study.

Study Protocol: Presence of obesity as defined by Body mass index. The Body mass index was calculated using the formula:

- BMI= Weight in Kg/(Height in meters)^2.
- The cases were said to have normal BMI when it ranged between 18.5 to 22.9 kg/m^2.
- The cases were labeled as overweight when BMI ranged between 23- 24.9 kg/m^2.
- Further cases were said to be obese when BMI was more than 25 kg/m^2.

Waist Hip ratio

- The waist circumference was measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest, using stretch resistant tape that provides a constant 100g tension. Hip circumference was measured around the widest portion of the buttocks.

Abdominal obesity was defined when WHR was > 0.9 in males and >0.85 in females.

I. Examination of pulse was carried out in detail including peripheral pulsations for any evidence of peripheral vascular disease. Resting blood pressure was recorded in right arm in supine position by Mercury Sphygmomanometer . The patient was labeled to have hypertension when his/her systolic and diastolic blood pressure was > 150 and 90 mm Hg respectively. (JNC 8).

II. The cases were examined for evidence of Atherosclerosis in the form of Locomotor brachialis, xanthelesma, thickened vessel wall and postural hypotension.

1. The **Neurological examination** was carried out in all cases to find out neurolocalization, anterior or posterior circulation stroke and the type of stroke Ischemic versus hemorrhagic in nature.

V. Investigations

All the cases included were submitted to various investigations.

Blood sugar levels-These included Fasting and Post prandial blood sugar estimated by GODPOD method using Span kit.

Lipid profile (Total Cholesterol, HDL, Triglycerides) was estimated by using CODPOD method by Bayerskit.LDL was calculated using Friedewald formula as:LDL Cholesterol = (Total Cholesterol – HDL Cholesterol – Triglycerides/5).

The sample for fasting blood sugar and fasting Lipid profile were collected early morning after a fasting period of 8 hours and post prandial blood sugar was collected two hours after major meals.

Diabetes mellitus was defined according to WHO diagnostic criteria [10] as fasting plasma glucose more than or equal to 126 mg/dl or two hours plasma glucose more than or equal to 200 mg/dl.

Kidney function tests in the form of Blood urea estimation by GLDH method, serum Creatinine by Modified Joff's Kinetic Method, serum Sodium and Potassium by ISE electrolyte analyzer method was carried out in all cases.

Specific Investigations

1. **CT Scan of Brain:** In all cases included in the study, CT scan of Brain was done to find out type of lesion Ischemic or Hemorrhagic, localization of lesion in brain, as well as site of circulation anterior versus posterior circulation stroke.

2. The Ankle Brachial Pressure Index (Abpi) Measurement

The ankle brachial pressure Index measurement (ABPI) was done in all cases after the cases were stabilized in the wards. This measurement was done using ALOKA PROSOUND;Model-PROSOUND ALPHA 7;Serial No.-20259721;Probe No.-04 machine (without printer).

Brachial systolic pressure was measured using doppler in both the arms. The higher of the two brachial arm readings is used to calculate the ABPI. The systolic blood pressure is then recorded in the lower limb using the same doppler method.ABPI is calculated in each lower limbs separately by using the formula given below.

The ABPI is calculated using the following formula;[5]

$$\text{ABPI} = \frac{\text{Ankle systolic pressure (highest ankle pressure for each leg)}}{\text{Brachial systolic pressure (highest of the two arms)}}$$

Classification Of Pvd According To Abpi

At present, the PHC Peripheral Vascular Laboratory uses the following parameters in classifying the severity of PAD by ABI (adapted from AHA guidelines 2005).[11]

1. >1.30 – non compressible(indicates significant medial wall calcification)
2. 1.0-1.29- normal
3. 0.90 -0.99 – equivocal or borderline PAD
4. 0.70-0.89 – mild PAD.
5. 0.40-0.69- moderate PAD
6. <0.39- severe PAD

The values less 0.9 than was considered as suggestive of peripheral vascular disease.Based on the findings of ABPI, the prevalence of Peripheral vascular disease in cases of stroke was calculated.The presence of peripheral vascular disease in cases of stroke was further correlated with the type of stroke. The occurrence of PVD in cases of ischemic and hemorrhagic stroke was calculated separately.The prevalence of peripheral vascular disease in cases of stroke was further correlated with age, sex, type of stroke & risk factors of stroke.

The various risk factors of stroke with which the correlation was done included the risk factors like smoking, Alcohol intake, Diabetes Mellitus,Hypertension,previous history of stroke and presence of cardiac disease.

The data thus obtained was further analyzed and results presented.

Data Analysis

The individual case data obtained from the study population was transferred on the excel sheet and analyzed further using standard statistical tests.

The statistical tests used were Z test for comparison and calculation of P-values.The software used for analysis was SPSS 17.0 and graph pad prism 5.0.The P values <0.05 and Z value >1.90 is considered as level of significance in the present study.

Observations

The results obtained are summarized below.

1. Corelation Of Abpi With Age

Table number 1 depicts the correlation of ABPI with age of the cases studied. It was observed that maximum cases (15 cases) from the age group of 60 t0 69 years of age had ABPI <0.9. This constituted 42.85 % cases in which ABPI was less than 0.9. ABPI was less than 0.9 in 9 25.59% cases in then age group of 50 to 59 years of age while 7 cases (20%) in the age group of 70 to 79 years of age ha ABPI less than 0.9. This difference

in the various age groups was statistically insignificant using z-test for comparison in all the age groups except the age group of 70 to 79 years of age where it was significant.

Table No. 1: Correlation of ABPI with age

Age range in years	Total cases	ABPI < 0.9	ABPI > 0.9	z-value	p-value
30 to 39	5	01(20%)	04(80%)	0.80	0.043,NS
40 to 49	19	03(15.79%)	16(84.21%)	1.02	0.026,NS
50 to 59	32	09(28.13%)	23(71.88%)	1.50	0.0004,NS
60 to 69	52	15(28.85%)	37(71.15%)	1.90	0.0002,NS
70 to 79	12	7(58.33%)	05(41.67%)	7.80	P< 0.0001, S
Total	120	35(29.17%)	85(70.83%)		

2. Corelation Of Abpi With Sex

Table number 2 depicts the correlation of ABPI with sex of the cases studied. It was observed that out of 85 males, 28 cases (32.85 %) had ABPI less than 0.9.while amongst 35 females 7 cases(20%) had ABPI less than 0.9.This difference was statistically significant (p<0.0001).

Table no.2-Correlation of ABPI with sex

Sex	Total cases	ABPI < 0.9	ABPI > 0.9	z-value	p-value
Males	85	28(32.94%)	57(67.06%)	4.70	P<0.0001,S
Females	35	07(20%)	28(80%)	7.80	P<0.0001,S
Total	120	35(29.17%)	85(70.83%)		

3. Corelation Of Abpi With Other Risk Factors

The results of low ABPI (<0.9) were correlated with other risk factors like hypertension ,diabetes mellitus, smoking, alcohol consumption, previous history of stroke and cardiac disease. Table no.3 shows the results.

Table No. 3: Corelation Of Abpi With Other Risk Factors

Risk Factors	Total cases	ABPI <0.9	ABPI >0.9	z- value	P value
HTN	65	28(43.08%)	47(72.31%)	1.8	0.54 ns
DM	54	27(50%)	27(50%)	1.9	0.5 ns
SMOKING	32	12(37.50%)	20(62.50%)	1.78	0.23 ns
ALCOHOL	12	5(41.67%)	7(58.33%)	1.9	0.1 ns
Previous H/O stroke	35	15(42.86%)	20(57.14%)	7.03	0.001 s
H/O cardiac disease	27	5(18.52%)	21(77.78%)	1.9	0.5 ns
Total	120	35(29.17%)	85(70.83%)		

It was observed that out of 65 patients having hypertension 28 patients(43%) were found to have ABPI less than 0.9.Similarly out of 54 patients having diabetes mellitus 27(50%) were found to have ABPI less than 0.9.Amongst 32 smokers 12 patients(37.5%) were found to have ABPI less than 0.9.While only 5 cases(41.66%) with alcohol intake had ABPI <0.9.The previous history of stroke was present in 35 cases and amongst these significantly low ABPI that is <0.9 was present in 15 cases(42.85%).Amongst 27 cases with history of cardiac disease only 5 cases(18.51%) had low ABPI.

The statistical significance of these findings is shown in table no.3. The findings of correlation of various risk factors with abnormal ABPI were statistically not significant with any of the risk factors except history of previous stroke.

4. Corelation Of Abpi With Type Of Stroke

In the present work, out of 120 cases studied, 88 cases (73.34%) had ischemic stroke while 32 cases (26.66%) had hemorrhagic stroke. Results are depicted in table number 6.

The difference in ischemic versus hemorrhagic stroke cases was statistically significant (p<o.001, z value 41.71 for ischemic stroke and 13.57 for hemorrhagic stroke).

Table 4: Types Of Stroke

S/No	Type of Stroke	No. of Cases	Percent	z-value	p-value
1	Ischemic stroke	88	73.34%	41.71	P<0.0001,S
2.	Hemorrhagic stroke	32	26.66%	13.57	P<0.0001,S
	Total	120	100%		

5. Abpi In Stroke Cases

The Ankle Brachial Pressure Index (ABPI) was calculated in all cases of stroke. The cut off value of < 0.9 was considered as suggestive of Peripheral vascular disease in the present work.

It was observed that amongst 120 cases studied, 35 cases (29.16%) had ABPI less than 0.9 suggestive of peripheral vascular disease. In remaining 70.84% cases ABPI was more than 0.9. This difference was statistically significant using Z-test and calculation of p values (<0001).

Thus it is concluded that the prevalence of Peripheral vascular disease bases on low ABPI in cases of stroke was 29.16% in the present study. The results are summarized in table no. 5.

Table No. 5: ABPI in stroke cases

S/No	ABPI	No. of Cases	Percent	z-value	p-value
1.	<0.9	35	29.16%	15.07	P<0.0001,S
2.	>0.9	85	70.84%	40.21	P<0.0001,S
	Total	120	100%		

VI. Discussion

The present study entitled," Prevalence of Peripheral Vascular Disease in Stroke**"** was carried out at Department of medicine, Jawaharlal Nehru medical college and AcharyaVinobaBhave Rural Hospital, sawangi (Meghe), Wardha, The present study was primarily aimed to study the prevalence of Peripheral vascular Disease in cases of Strokes and the correlation of peripheral vascular disease with type of stroke, age, sex, & risk factors of stroke. This study was prospective observational cross sectional study carried out over the period of two years and included 120 cases of stroke.

It was noticed in the present work that, maximum cases i.e. 43.34% cases were in the age group of 60 to 69years of age while 26.67% cases in the age group of 50 to 59 years of age. Further only 10% cases were above 70 years of age and 4.16% cases were young between 30 to 39 years of age. The mean age was 57.5years.

A Thai study showed the mean age of all ischemic stroke patients was 63.5±14 years, 70.3±14.6 years in patients with abnormal ABPI and 61.9± 13.4 years in patients with normal ABPI.(**Ratnakom et al, 2012)[12]Manzano et al (2012)**[13] obtained the mean age as 64.04 ± 12.24 years in patients with normal ABPI and 70.48 ± 11.78 years in patients with abnormal ABPI.

As far as sex is concerned amongst 120 cases studied, 85 cases (70.84%) were males while 35 cases (29.16%) were females. The male to female ratio was 2.42:1.

In a study by **Mohammad SelimShahi et al (2013)**[14] males were predominant with 33 (66.0%) in cases with low ABPI and 35 (70.0%) in cases with normal ABPI. Subramanian et al (2011) noticed a very high occurrence of stroke in females being noticed in with 51.8% females.

Tziomalos Ket al (2014) [15] in their study of Predictive value of the ankle brachial index in patients with acute ischemic stroke also noticed higher prevalence in females (62.6% as compared to 37.4% males).

The results similar to the present work were observed by **Gronewold J et al (2014) [16]**in their study of Ankle-brachial index to predict stroke in the general population. They noticed that 47.3% were men and 52.7% were females.

Thus the finding of male preponderance in the present work was different from the female preponderance as observed by other authors.

The various risk factors for stroke were evaluated in the present study. It was noticed that, Hypertension was the risk factor in 54.16% cases and Diabetes Mellitus was the risk factor in 45% cases. Other risk factors were History of previous stroke in 29.17% cases, History of cardiac disease in 22.5% cases, history of smoking in 26.7% cases and history of alcohol consumption in 10% cases.

Hypertension is the single most important modifiable risk factor for ischemic stroke. The studies carried out by various previous workers show similar observations.

IvicaBilic et al (2009)[17]studied various risk factors for ischemic and hemorrhagic strokes. The study included 1066 stroke patients. In cases with ischemic stroke, the common risk factors included Atherosclerosis 51.4% cases, Smoking 12.0% cases, Alcohol consumption in 10.8% cases, Atrial fibrillation (22.2%, history of Previous stroke in 18.7% cases, hyperlipidemia in 11.2% and Diabetes in 19.3% cases.

Similarly in hemorrhagic stroke group, the common risk factors were Atherosclerosis in 37.3% cases, Smoking in 14.7% cases, and Alcohol consumption in 24.3% cases, hypertension in 29.1% cases and Diabetes Mellitus in 27.4% cases.

The authors concluded that, Atherosclerosis was more common in patients suffering from ischemic stroke than in those with hemorrhagic stroke. Atrial fibrillation and dyslipidemia were also more common as risk factors in ischemic than in hemorrhagic stroke. Patients with ischemic stroke were older than those with hemorrhagic stroke. Lethal outcome was more common in patients with hemorrhagic stroke, the difference being statistically significant P = 0.004).

In the present work, out of 120 cases studied, 88 cases (73.34%) had ischemic stroke while 32 cases (26.66%) had hemorrhagic stroke. It was also observed that out of 120 cases, 98 cases (81.67%) had anterior circulation stroke while 22 cases (26.66%) cases had posterior circulation stroke. This finding was statistically significant.

Biswas et al (2009)[18] noticed significant difference in the occurrence of small vessel versus large artery stroke in Indian American and white American population. They noticed small artery stroke in 45.2 % cases in Indo American population as compared to 22.6 % of large artery stroke in same population. As against this the small artery stroke was observed only in 22.8 % population in white American population and large artery stroke was observed in much higher proportion of 34.9 % in same population.

Thus the finding of type of stroke in the present study is similar to observations by other studies.

The Ankle Brachial Pressure Index (ABPI) was calculated in all cases of stroke. The cut off value of < 0.9 was considered as suggestive of Peripheral vascular disease in the present work.

It was observed that amongst 120 cases studied, 35 cases (29.16%) had ABPI less than 0.9 suggestive of peripheral vascular disease. In remaining 70.84% cases ABPI was more than 0.9. This difference was statistically significant.

Thus it is concluded in the present study that the prevalence of Peripheral vascular disease based on low ABPI in cases of stroke was 29.16%.

Relatively few data exist on the relationship between ABPI and stroke, and those studies have presented conflicting Results. **Murabito JM, Evans JC, Nieto K. (2004)**[19] showed that low ABPI independently predicted stroke risk while **Newman AB et al (1999)**[20] did not find such an association. Furthermore, many of these studies were focused largely on a single race, gender, or a narrowly defined age group29-31. For these discrepancies the current study was conducted to evaluate the association of ABPI with ischemic stroke in the Indian population.

In the present work, the correlation of low ABPI with type of stroke was evaluated. It was observed that amongst 88 cases of ischemic stroke, 26 cases (29.55%) had ABPI below 0.9 suggesting the evidence of peripheral vascular disease in 29.55% cases with ischemic stroke. In remaining 70.45% cases ABPI was more than 0.9.

Similarly, amongst 32 cases of hemorrhagic stroke, 12.5% cases had ABPI < 0.9 while 87.5% cases had ABPI > 0.9.

Statistical analysis of this observation showed that in ischemic stroke the finding of ABPI < 0.9 in 29.55% cases was statistically significant (Z value 2.9 and p value 0.003), while in hemorrhagic stroke the finding of ABPI < 0.9 in 12.5% cases was statistically not significant (z value 1.9 and p value 0.053)

This indicates that the measurement of ABPI in stroke cases is more useful in cases of ischemic stroke compared to hemorrhagic stroke.

Apart from the diagnostic tool, ABPI is also a predictor for the development of atherosclerotic vascular accidents in future. The cases with abnormally low ABPI are thus more likely to develop stroke at a later age. Therefore it is recommended to measure ABPI in all cases that are at high risk for atherosclerosis and therefore development of stroke at a later date.

An association was correlated between low ABPI and associated risk factors like smoking, Hypertension, Diabetes Mellitus, Alcoholism and family history. In the present study though there was no statistically significant correlation, these factors are known risk factors for early atherosclerosis and hence development of stroke at later date. It is therefore recommended to discourage smoking or alcohol intake and to control the modifiable risk factors like hypertension, Diabetes Mellitus especially in those individuals who have low ABPI. This will help in reducing the prevalence of stroke in susceptible individuals.

The total number of cases studied in ischemic and hemorrhagic group is not matcheable. It is therefore difficult to draw the conclusions in the hemorrhagic stroke group.

The prevalence of peripheral arterial disease is also assessed by calculating the Carotid Artery Intima Media Thickness. In the present work Carotid Artery Intima Media Thickness was not calculated. Measurement of this investigation might have further strengthened the association of prevalence of peripheral vascular disease in stroke cases.

VII. Conclusions

The present study was designed to find out the prevalence of peripheral vascular disease in stroke cases. It was prospective observational cross sectional study carried out over the period of two years.

The prevalence of Peripheral vascular disease based on low ABPI in cases of stroke was 29.16% in the present study. The prevalence was more common with ischemic stroke as compared to hemorrhagic stroke. The low ABPI in stroke cases was more common in cases beyond the age of 60 years of age.

The total number of cases studied and the duration of the study period is inadequate to draw the conclusions.

The total number of cases studied in ischemic and hemorrhagic group are notmatcheable.

The prevalence of peripheral arterial disease is also assessed by calculating the Carotid Artery Intima Media Thickness. In the present work Carotid Artery Intima Media Thickness was not calculated. It is recommended to include Carotid artery Intima Media Thickness measurement as a marker for atherosclerosis especially in ischemic stroke.

Low ABPI is definitely a predictor for occurrence of stroke at a later date. It is therefore recommended to evaluate ABPI at regular intervals in the high risk individuals and in the cases above 60 years of age.

Though not significant statistically, in the present work, risk factors like smoking, Hypertension, Diabetes Mellitus, Alcoholism and family history are known risk factors for early atherosclerosis and hence development of stroke at later date.

It is therefore recommended to discourage smoking or alcohol intake and to control other modifiable risk factors like hypertension, Diabetes Mellitus especially in those individuals who have low ABPI. This will help in reducing the prevalence of stroke in susceptible individuals.

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