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# Prevalence of Peripheral Artery Disease in Obese and Non Obese patients of Stroke.

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***Abstract:*** ***Aim:****This study was carried out to evaluate for and compare the presence of Peripheral Artery disease by Ankle Brachial Pressure Index (ABI) in obese and non-obese patients of stroke.*

***Materials and Method:****This prospectivecross-sectional observational study was carried out in Acharya VinobhaBhave Rural Hospital, DMIMS over 24 months after obtaining due ethical clearance. The study included 120 cases of stroke which were divided into obese and non-obese groups based on Body Mass Index (BMI) and were later evaluated for the presence of associated peripheral vascular disease by Ankle Brachial Pressure Index (ABI), which was measured by Doppler study. The correlation of the prevalence of the peripheral vascular disease in cases of stroke in both obese and non-obese groups was evaluated. An attempt was made to correlate and compare risk factors like alcohol consumption, smoking, hypertension, diabetes mellitus, previous history pre-existing of cardiac disease in obese patients with stroke and non-obese patients with stroke. The statistical analysis test used was Z test for comparison and calculation of P-values.*

***Results:*** *A total of 120 patients were enrolled in the study of which 75 (62.5%) were classified under obese category whereas 45 (37.5) were classified under non-obese category respectively. It was noticed that hypertension was the risk factor in 54.67 %, Diabetes Mellitus in 44 %, previous history of cardiac disease in 21%, history of smoking in 18.67% and history of alcohol consumption in 9.33% of obese patients. It was noticed that the mean ABI was lesser than 0.9 in the obese group (0.81+/-0.05) as compared to the non-obese group (0.93+/-0.12).*

***Conclusion:*** *The prevalence of Peripheral vascular disease based on low ABI in cases of stroke was more in obese patients (53.33%) as compared to non-obese patients (33.33%).*

***Keywords:*** *ABI, PVD/PAD, Obese, Body Mass Index, Hypertension, Diabetes mellitus, stroke*

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## I. Introduction

Body Mass Index (BMI) is often used to categorize overweight and obesity in the adult population. (1) World Health Organization (WHO) has defined overweight and obesity as abnormal or excessive fat accumulation that presents a risk to health. (2) BMI (kg/m2) is equal to an individual's weight (in kilograms) divided by the square of his height (in meters). According to WHO, BMI ≥25 is classified as overweight whereas BMI ≥30 is classified as obesity. (2)

In the Asian population, the cut-off for overweight is ≥23.0kg/m2 and for obesity is ≥25.0kg/m2. The cut-off values in Asian population are lower than the values defined by WHO, due to various risk factors and co-morbidities. (1)

Increased BMI is an important risk factor leading to cerebrovascular morbidity and mortality.

Stroke may be defined as a clinical syndrome which is characterized by rapidly developing clinical signs and/or symptoms offocal or complete loss of neurological function, with symptoms lasting for more than 24 hours or causing earlier death, and with no obvious cause other than the possibility of vascular origin. (3) Stroke is one of the most important global health concern. (4) It is the second major cause for death and the fourth commonest cause of disability in the adult population globally, after cardiovascular diseases and cancer. (5) As per the Global Burden of Diseases (GBD) study, stroke was accountable for 5.87 million deaths worldwide in 2010. (6) Stroke is broadly categorized into ischemic and hemorrhagic strokes.

Ischemic strokes comprise of 50-85% of strokes across the world and are caused by a sudden thrombotic occlusion of the arterial supply of the brain. Hemorrhagic strokes (subarachnoid/intracerebral hemorrhage) on the other hand, comprise approximately, 1-27% of strokes worldwide. (5) Advancing age, male sex, ethnicity, low birth weight, genetic factors, and family history are the non-modifiable risk factors responsible for the stroke. Modifiable risk factors for stroke include hypertension, alcoholism, cigarette smoking, Diabetes mellitus, Dyslipidaemia, Prior history of a cerebrovascular episode. (5)(6) Pre-existing coronary artery disease and large vessel atherosclerosis are considered to be reliable predictors in the pathogenesis of stroke. (5) As per 2011 NICE guidelines, a non-contrast CT Brain is used for confirming the diagnosis of stroke. (5)

Lipid accumulation and calcific deposits in the arterial walls causing atheroma formation leads to obstruction of blood flow to the peripheral vasculature. (7) Peripheral artery disease (PAD)/ Peripheral Vascular Disease (PVD) results from obstruction to blood flow of the main arteries below the level of the aortic bifurcation. (8) Atherosclerosis is the major cause of PAD leading to ischemia of the lower extremities responsible for the lower limb disability and symptoms. (4)(8) The Fontaine classification classifies PAD/ PVD into 4 stages depending upon the severity of the symptoms. (4) Patients belong to Stage I are the asymptomatic patients and comprise a major subgroup of patients with PAD. Around one-fourth patients, present with intermittent claudication (IC), which may often be the only presenting symptom of PAD. In a few patients, IC may advance to Stage III (critical limb ischemia with nocturnal/rest pain) or Stage IV (Limb Necrosis/ Gangrene). (4)(8) Data of several studies suggest a strong positive correlation between PAD and development of cardiovascular morbidity, mortality, and stroke. (4)(7)

Ankle Brachial Pressure Index (ABI/ABI) is a sensitive and reliable indicator for detecting PAD. ABI has proven value as the most useful noninvasive and easy test, which when performed adds to the diagnostic accuracy of CT Angiography, in the diagnosis of PAD. An ABI value in the range of 1.1 to 1.4 is suggestive of good arterial flow. (9) However, an ABI of < 0.9 is associated with an increased risk of micro as well as macrovascular complications, athero-occlusive arterial disease, and PAD. Individuals with ABI < 0.9 are two to three times more prone to develop cardiovascular and cerebrovascular morbidity and mortality. (8)(9)(10)

The aim of the present study was, therefore, to determine the prevalence of Peripheral vascular Disease using Ankle Brachial Pressure Index in Obese and Non Obese patients of Stroke

## II. Materials and Methods

This prospective observational cross-sectional study was conducted in 120 patients of stroke who were admitted at the Acharya VinobaBhave Rural Hospital, Sawangi (Meghe), Wardha for a period of 2 years (From June 2017 to June 2019). The main objectives of this study were:-

Inclusion Criteria included all the patients who had a stroke on CT/MRI Brain Imaging (irrespective of the type of stroke). 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, were excluded from the study. Also, those patients who denied consent to be a part of the study were excluded from the study.

A detailed history regarding age, sex, occupation, family history, personal habits, socio-economic status, history of diabetes mellitus or hypertension or pre-existing heart disease, alcoholism, smoking was taken. Symptoms of intermittent claudication, exertional limb pain and rest pain in lower limbs were also enquired. A thorough clinical examination including examination of all peripheral pulses was done. Examination of the pulse was carried out in detail including peripheral pulsations for any evidence of peripheral vascular disease. Resting blood pressure was recorded in the right arm in the 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). The cases were examined for evidence of Atherosclerosis in the form of Locomotor brachialis, xanthelasma, thickened vessel wall, and postural hypotension. The Neurological examinationwas carried out in all cases to find out neurolocalization, anterior or posterior circulation stroke and the type of stroke.

The following anthropometric measurements were recorded:-

*Body mass index:* BMI was calculated using the formula:

BMI= Weight ( in Kg)/Height (in meters2).

The cases were said to have normal BMI when it ranged from 18.5 to 22.9 kg/m2.

The cases were labeled as overweight when BMI ranged between 23- 24.9 kg/m2.

Further cases were said to be obese when BMI was more than 25 kg/m2.

Two study groups were formed group I with non-obese stroke patients and group II obese stroke patients

*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.

The following routine investigations were performed :

*Blood sugar levels:* These included Fasting and Postprandial blood sugar estimated by GOD POD method using Span kit.

*Lipid profile (Total Cholesterol, HDL, Triglycerides):* was estimated by using COD POD method by Bayers kit. LDL was calculated using the Friedewald formula as:

LDL Cholesterol = (Total Cholesterol – HDL Cholesterol – Triglycerides/5).

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

* Diabetes mellitus was defined according to WHO diagnostic criteria 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.

Other Specific Investigations were carried out which were as follows:-

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

*The Ankle Brachial Pressure Index (ABI) Measurement:* The ankle-brachial pressure Index measurement (ABI) was done in all cases after the cases were stabilized in the wards Measurement of ankle-brachial pressure index (ABI) was made in the supine position after 10 minutes of rest and in a quiet room. The index is a ratio of systolic blood pressure measured at the ankle to the systolic blood pressure measured at the brachial artery. This measurement was done using ALOKA PRO SOUND; Model-PRO SOUND ALPHA 7; Serial No.- 20259721; Probe No.-04 machine (without printer). Brachial systolic pressure was measured using doppler in both the arms after placing a pneumatic cuff over the arms. The systolic pressure was assessed by the routine manner with the use of a stethoscope to listen for the first Korotkoff sound or a Doppler probe to listen for the onset of flow during cuff deflation. The higher of the two brachial arm readings were used to calculate the ABI. The systolic blood pressure was then recorded in the lower limb using the same doppler method. The pneumatic cuff placed around the ankle was inflated to supra systolic pressure and subsequently deflated while the onset of flow was detected with a Doppler ultrasound probe placed over the dorsalispedis artery and posterior tibial artery, thus denoting ankle systolic blood pressure. The ankle systolic blood pressure was calculated in each lower limbs separately. The ABI was subsequently calculated using the following formula

ABI = Ankle systolic pressure (highest ankle pressure for each leg i.e. PLeg) /Brachial systolic pressure (highest of the two arms i.e. PArm)

Classification Of PAD/PVD According To ABI:-

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

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

A value of less than 0.9 was considered to be suggestive of peripheral vascular disease. Based on the findings of ABI, the prevalence of Peripheral vascular disease in cases of stroke in both obese and non-obese group was calculated. The presence of various risk factors of stroke included the risk factors like smoking, Alcohol intake, Diabetes Mellitus, Hypertension, previous history of stroke and presence of cardiac disease were correlated in both obese and non-obese group. The data thus obtained was further analyzed and results presented.

## III. Results

A total of 120 patients were enrolled in the study of which 75 (62.5%) were classified under obese category whereas 45 (37.5) were classified under non-obese category respectively.

Regarding the risk factors of the study patients, in both obese and non-obese groups, Smoking was present in 14 (18.67%) obese patients while it was present in 18 (40%) of non-obese patients. This difference was statistically significant. History of alcohol consumption was present in 7 (9.33%) obese patients and 5 (11.11%) non-obese patients. DM was 33(44%) and 21 (46.67%) in the obese and non-obese group respectively. HTN was 41(54.67%) in the obese group and 24 (53.33%) in the non-obese group. The previous history of

cardiac diseases was 21(28%) and 6 (13.33%) in obese and non--obese patients respectively. The difference was not statistically significant (P>0.05) between two groups (obese and non-obese) in case of alcohol consumption, DM, HTN, Previous history of cardiac disease. (Table 1)

**Table 1:** History of risk factors in Obese and Non Obese groups

| Risk Factors | Obese | Non Obese | X2-value | p-value |
|---|---|---|---|---|
| **Smoking** | **14 (18.67%)** | **18 (40%)** | **6.54** | **0.011,S** |
| Alcohol | 7 (9.33%) | 5 (11.11%) | 0.09 | 0.75,NS |
| DM | 33(44%) | 21 (46.67%) | 0.08 | 0.77,NS |
| HTN | 41(54.67%) | 24 (53.33%) | 0.02 | 0.88,NS |
| H/O Cardiac Disease | 21(28%) | 6 (13.33%) | 3.47 | 0.06,NS |

Regarding the ABI of the study patients in both obese and non-obese groups, the mean ABI was found to be 0.81+/-0.05 in obese patients while the mean ABI was 0.93+/-0.12 in non-obese patients. The difference was statistically significant (P<0.05) between the two groups. (Table 2)

**Table 2:** Comparison of ABI in Obese and Non Obese groups (Student's unpaired t-test)

| Group | N | Mean | Std. Deviation | Std. Error Mean | t-value | p-value |
|---|---|---|---|---|---|---|
| Obese | 75 | 0.81 | 0.05 | 0.006 | 8.04 | 0.0001,S |
| Non Obese | 45 | 0.93 | 0.12 | 0.018 | | |

Regarding the Presence of PVD in the study patients in both obese and non-obese groups, PVD was present in 40(53.33%) obese patients and 15(33.33%) non-obese patients.PVD was absent in 35(46.67%) obese patients and 30(66.67%) non obese patients respectively. This difference was statistically significant (P<0.05).

**Table 3:** Comparison of PVD in Obese and Non Obese groups

| PVD | Obese | Non Obese | X2-value |
|---|---|---|---|
| Present | 40(53.33%) | 15(33.33%) | |
| Absent | 35(46.67%) | 30(66.67%) | 4.53 |
| Total | 75(100%) | 45(100%) | P=0.033,S |

## IV. Discussion

In recent years, Obesity has been implicated as one of the major independent risk factors responsible for hypertension, cardiovascular disease, diabetes mellitus, cerebrovascular disease, and death. (11) This has also been described in the scientific statement issued by the American Heart Association (AHA) in 2013. (12) A study by Huang Y et al has suggested that increased Body Mass Index has a causal association with Peripheral artery disease prevalence. PAD caused as a result of atherosclerosis, is associated with increased risk of cardiovascular and cerebrovascular morbidity and mortality and affects the quality of life. Obesity or increased BMI is considered to be a major independent risk factor implicated in the development of long-standing atherosclerosis and subsequent PAD. (13) Peripheral artery disease of the lower extremities is a commonly encountered phenomenon after cerebrovascular stroke presenting with either hemiplegia or hemiparesis. (14)

A low ABI of less than 0.9 has approximately 75% sensitivity and almost 86% specificity for diagnosing PAD. It is thought that ABI <0.9 is related with 50% or greater vessel stenosis and is also a significant marker of generalized atherosclerosis. Lower levels of ABI (<0.9) have been related to higher rates of myocardial infarction, coronary disease, cerebrovascular stroke and total mortality.(9)

The present study conducted with a primary goal of determining the Prevalence of Peripheral Vascular Disease in obese and non-obese in patients of Stroke using Ankle Brachial Pressure Index (ABI) was carried out at Department of Medicine, Jawaharlal Nehru Medical college and Acharya VinobaBhave Rural Hospital, Sawangi (Meghe), Wardha. This study was a prospective observational cross-sectional study carried out over two years and included 120 cases of stroke. Out of these 120 patients, 75(67.5%) patients were categorized under the obese category while 45(32.5%) patients were categorized under non-obese category respectively.

Studies published to date, have shown a correlation between obesity and an elevated risk for stroke. Obesity is also associated with increased risk of complications such as hypertension, diabetes mellitus, and Dyslipidaemia, which are proven independent risk factors implicated in causing a cerebrovascular episode. (15)

Results from Table 1, depict various risk factors that can cause a catastrophic event like a stroke. The above table shows that apart from smoking, all the other risk factors contributing towards the development of stroke including HTN, DM, Alcohol consumption and history of pre-existing cardiac disease were in greater proportion in the obese group than in the non-obese group.

Bilić I et al concluded from their study that Hypertension, is the major single, an independent modifiable risk factor that has been implicated in the development of stroke. The authors also inferred that

atherosclerosis leading to atherosclerotic plaque formation is a frequently encountered finding in patients of stroke.(16)

A 32-study meta-analysis conducted by Shinton R et al showing the dose-response relationship between smoking and development of stroke in 1989, suggested that those who smoked a lesser amount of tobacco i.e. <10 cigarettes/day were found to have a RR of stroke of 1.37 as compared to smokers who smoked greater amounts i.e. ≥20 cigarettes/day who had a RR of 1.82(17). Results from Table 1 show that smoking is an independent variable or risk factor leading to stroke, irrespective of the obesity status of the patient. It was observed that out of 120 patients who developed stroke, 32 patients had a positive history of smoking. Of these 32 patients, 14 (18.67%) and 18 (40%) patients belonged to the obese and non-obese group respectively. This difference was statistically significant.

Smoking along with hypertension is responsible for a low ankle-brachial pressure index, which may subsequently lead to the development of peripheral artery disease. (18) (19)

Golledge J et al pointed out that, obesity and severity of peripheral arterial disease (judged using ABI) were related to each other. Obesity was considered to be an independent risk factor contributing to the development of lower extremity arterial disease(20) Hypertension, Obesity, dyslipidemia, and sedentary lifestyle are the factors responsible for causing a low ABI. Shetty VU et al pointed out that obesity was a significant risk factor leading to atherosclerosis and was also responsible for the progression of the severity of the peripheral arterial disease. (21)

In Table 2 of our study, regarding the Ankle Brachial Pressure Index (ABI) it was observed that the mean ABI was lesser than 0.9 in the obese group (0.81+/-0.05) as compared to the non-obese group (0.93+/-0.12). This difference was statistically significant.

Alvim R de O et al found that in individuals who were obese, lacked physical activity and who had a positive history of smoking had a relatively higher prevalence of PAD.(22) In our study , Table 3 shows that prevalence of peripheral vascular disease was higher in obese individuals than in Non obese individuals and the difference was statistically significant.

## V. Conclusion

Thus, from the above study, it can be concluded that :

1. Obesity is an important independent risk factor leading to stroke or cerebrovascular episode
2. Obesity is responsible for causing a decrease in the values of the Ankle Brachial Pressure Index
3. Low ABI is implicated towards the development of both stroke and peripheral arterial disease
4. Obesity is a single, independent important risk factor that can lead to lower extremity arterial disease or peripheral arterial disease.
5. Co-existing Obesity and stroke, are associated with an increased risk of development of Peripheral Arterial Disease.

Although the other risk factors such as hypertension, Diabetes mellitus, alcohol and previous history of a pre-existing heart disease were statistically insignificant in this study, it is a well-known fact that these factors play an important role in cardiovascular and cerebrovascular morbidity and mortality. It is therefore strongly recommended that lifestyle modification, weight management, smoking cessation, alcohol abstinence and control of other modifiable risk factors such as hypertension, diabetes should be promoted especially in people who have a low ABI, to lower the incidence of development of stroke and peripheral arterial disease.

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