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Estimating the Correlation of Ankle Brachial Index with Vascular Risk Factors in Pre-diabetics

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Prediabetes is characterized by a long duration of insulin resistance and increased fasting plasma glucose. Among the various risk factors for cardiovascular atherosclerosis and prediabetes, insulin resistance is one of them. Glycemia has been recognized to affect microvascular damage as compared to macrovascular damage. The ankle-brachial index (ABI) is a simple, affordable and non-invasive test as compared to angiography and has been found to have a high sensitivity and accuracy for the diagnosis of PAD, the gold-standard diagnostic method. This index is based on the fact that in healthy people, systolic blood pressure in the legs is typically equal to or marginally greater than in the upper limbs. This study aims to assess the correlation of ABI with vascular risk factors among subjects with Prediabetes like anthropometric measurement like BMI, Waist hip ratio and neck circumference.
Methods: This will be a observational cross sectional study. The present research will involve a cluster of prediabetic subjects. ABI will be determined for all patients. Anthropometric measurements will be taken and blood investigations will be conducted. All data will be compiled and analyzed with appropriate statistical tests.
Expected Results: We expect a significant association between prevalence of low ABI in prediabetics and heart problems.

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Conclusion: This research will highlight the adequate clinical and sociological assessment of pre-diabetes patients, including those who have been diagnosed for a long period of time.

Keywords: Prediabetics; ankle brachial index; cardiovascular risk; peripheral arterial disease.

1. INTRODUCTION

Prediabetes is characterized by a long duration of insulin resistance during which at the cost of fasting and postprandial hyperinsulinemia, a compensatory rise in the activity of pancreatic cells preserves normal glycemic that later progresses to increase the state of fasting plasma glucose [1]. Among the various risk factors for cardiovascular atherosclerosis and prediabetes, insulin resistance is one of them. Glycemia has been recognized to microvascular damage as compared to macrovascular damage, [2-3] but the latter was also seen to be associated as shown in current literature [3]. Heart problems among diabetic subjects is found more among subjects having diabetes for a long period of time, low ABI value as well as poor metabolic control [4-7]. Subjects with low ABI value must be given the required importance so that diabetes can be diagnosed as early as possible along with its prevention [8-9].

For the elevated cardiovascular risk, experiments include glucose per se and an abnormality in glucose control rarely occurs in isolation. Instead it appears to cluster with other recognized variables of cardiovascular risk. This hypertension, abdominal obesity, and atherogenic dyslipidemia (low high-density lipoprotein [HDL] cholesterol or high triglycerides [TGs]) clustering of impaired fasting glucose is defined as metabolic syndrome. In metabolic syndrome, pro-inflammatory and prothrombotic factors are usually elevated and are often associated with impaired glucose tolerance [10].

The ankle-brachial index (ABI) is a simple, affordable and non-invasive test [11-13] as compared to angiography and has been found to have a high sensitivity and accuracy for the diagnosis of PAD, the gold-standard diagnostic method [10]. This index is based on the fact that in healthy people, systolic blood pressure in the legs is typically equal to or marginally greater than in the upper limbs. In the case of arterial stenosis, the pressure drop happens distally from the lesion [14]. Furthermore, low ABI in other sites has a strong association with arterial disease and has been shown to be a good indicator of mortality in the general population [15,16].

ABI determine the occurrence of asymptomatic peripheral arterial disease (PAD), suggested by ABI values of <0.9, if conducted by qualified health practitioners. Most patients with PAD are asymptomatic and their related cardiovascular risk is as high as in symptomatic situations, which is especially troubling. This is also a quiet disease not only associated with worsening of leg symptoms but also with risk of other arterial territories [17].

Low ABI was linked with death and cardiovascular outcomes among subjects having pre-diabetes, but only limited consideration was paid to its association with other complications. In addition, several studies have investigated the possibility of both high and low ABI values, but it has been difficult to resolve the correlation between the degree of arterial damage (obstruction or pathological constriction) and complications, [18] in particular with respect to microvascular complications. Moreover, recent studies of patients with asymptomatic PAD involved patients with previous coronary events, [19] but primary prevention is of special significance in prediabetes/diabetes patients, as the incidence of a first cardiovascular accident is linked with a rise in morbidity and mortality relative to the diabetes-free population [20].

A review was carried out in 2017 by Liliana Chevtchouk et al. [21] on the ankle-brachial index and diabetic neuropathy. The authors concluded that in patients with type 1 diabetes and type 2 diabetes, particularly those who are asymptomatic, the ABI test is important. More than 10 years ago, ABI was reformed by a diagnosis, regardless of the presence of neuropathic pain or ischemic signs.

1.1 Rationale

Previous studies have indicated that individuals with asymptomatic peripheral vascular disease have involved patients having past heart problems, still primordial cure is of special significance among people having prediabetes/diabetes. This might be due to the

fact that incidence of Ist cardiovascular occurrence is correlated with a rise in poor quality of life and death relative to the population with a pre-diabetes/diabetes event. Our research aims to determine the relationship of categorized ABI in patients with pre-diabetes with death, cardiovascular outcomes, and microvascular complications.

1.2 Objectives

1. To evaluate the association among ABI & demographics profile and anthropometric measurement like BMI, Waist hip ratio and neck circumference.
2. To evaluate the association among ABI and cardiovascular menace variables viz lipid profile.

This study will be done in AVBH, Sawangi (Meghe) & it will be an observational cross sectional study. The duration of study will be from 2020 to 2022.

Study design: Cross sectional study.

1.3 Selection of Subjects

All cases will be selected from the university students, staff and patients attending OPD and inpatients admitted. The present research will involve a cluster of prediabetic subjects. Those subjects having age >18 years and who were diagnosed as having prediabetic condition by the expert doctor.

1.4 Exclusion Criteria

Patients with bilateral filariasis, cellulitis, malignancy as well as amputation of lower limb and who not willing to give consent will be excluded from the study.

2. METHODS

Detailed history and examination of the patients will be undertaken. Family history and previous history of diabetes, H/O smoking and Alcohol intake, medication history will be taken. Assessment of pre-existing comorbidities in patient if any will be enquired by H/O raised blood pressure, malignancy, CKD and CLD.

a. Measurement of the ankle-brachial index

Measurements will be carried out on patients lying down with fully balanced head and heels, i.e. not leaning over the end of the test table and after a 5-10 minute break. Patients would be prohibited from deleterious habits like cigarette smoke, alcohol consumption and severe physical effort two hrs prior to the test. Two Doppler systolic pressure readings, two auscultatory systolic pressure readings and two diastolic pressure readings at the right posterior tibial artery, and the final two auscultatory systolic pressure readings and two diastolic pressure readings at the right posterior tibial artery were obtained consecutively. A handheld 8 MHz Aloka Prosound Alpha-7 (20259721) in Bangalore, India, and a normal mercury sphygmomanometer will be used by the observer for the Doppler measurements. For Doppler calculation, an 8 MHz Doppler probe would be used. Dopplergel from system would be spread over the sensor. The probe will be mounted in the region of the pulse at forty-sixty degree angle to the surface of the skin after the Doppler unit is turned on. The probe then jumped about until it heard a strong signal. The cuff is then steadily inflated up to 20 mmHg above the level of the loss of the flow signal and then slowly deflated to detect the reappearance of the flow signal pressure level. There would be a maximum inflation of 300 mmHg. As noted by the maximum amplitude of the waveform seen on the Doppler system display, the systolic pressure would be reported in both the lower limbs. The tubing position of the cuff should be away from the probe, as this may conflict with the orientation of the probe. By dividing the average systolic BP of the index ankle artery by the average systolic BP of the index limb, the ABI is determined. We found an ABI score of <0.9 and more than 1.4 as possibly sign of PAD & incompressible arteries respectively, in accordance with existing guidelines.

2.1 Laboratory Investigation

- Complete blood count
- Fasting blood glucose
- HbA1c
- Platelet indices
- Blood lipids: HDL, LDL, Total Triglycerides, Total Cholesterol.

2.2 Anthropometric Measurements

Anthropometric features include BMI, waist hip ratio and neck circumference measurement by standard method.

ABI: By dividing the average SBP of the index ankle artery by the average SBP of the index

arm, the ABI will be determined. ABI value of more than 1.3, more than 0.90, 0.70-0.89, 0.50-0.69 and <0.05 is considered as non-compressible severely calcified vessel as is the case in old age, normal, mild, moderate and severe disease status respectively.

2.3 Sample Size

In testing terminology, a sample is a group of entities, objects or things for evaluation taken from a wider population. To ensure that we can generalize the results from the test study to the population as a whole the survey should be representative of the population.

According to the formula i.e. $n=z^2pq/d^2$,

P= Prevalence of pre-diabetes=14%.

So minimum sample size required will 184 patients

In this study were will recruit two hundred subjects.

Expected outcome: We expect this study reveals high prevalence of low ABI in prediabetics which might lead to heart problems. We anticipate our research that ABI lower value i.e. ≤1.00 might give an indication of diabetes i.e. whether it will happen in future or not. However to validate this findings, further studies will be required in the upcoming time. Also from our findings we recommend that subjects with low ABI value must be given the required importance so that diabetes can be diagnosed as early as possible along with its prevention.

3. DISCUSSION

Prediabetes is a condition where the level of blood sugar is greater than average but not yet elevated enough to be graded as Type 2 DM, and Type 2 diabetes is expected to evolve in 10 years or less without intervention. Tests for all people of any age having obesity along with any other associated risk variables responsible for diabetes must be conducted. Macrovascular disorders and type 2 diabetes, leading causes to microvascular disorder, are the most adverse effects in people with prediabetes. In India, over the last three decades, the incidence of CAD has doubled. ABI is non-invasive and can prove to be a valuable tool both in the detection of possible issues and in the tracking of therapy and its effects, especially in prediabetes. Using the idea of prediabetes in a term may be a valuable intervention technique for avoiding both macrovascular and microvascular illness.

A review was carried out in 2017 by Liliana Chevtchouk et al. [21] on the ankle-brachial index and diabetic neuropathy. The authors concluded that in patients with type 1 diabetes and type 2 diabetes, particularly those who are asymptomatic, the ABI test is important. More than 10 years ago, ABI was reformed by a diagnosis, regardless of the presence of neuropathic pain or ischemic signs.

Hirday Pal Singh Bhinder et al. [22] tested 100 prediabetes patients in 2018 and participated in similar numbers of age- and sex-matched monitors. In the common carotid artery, a bilateral IMT examination was performed. The findings showed that about 56 percent of cases were male and 44 percent were female, with 58 percent being male and 42 percent being female in controls. The mean age of the cases was 45.06 ± 13.08 and 44.15 ± 13.64 for the controls. The mean CIMT value was higher for the cases (0.79 ± 0.06 mm) than for the controls (0.72 ± 0.02 mm). The discrepancy was found to be statistically important between the two groups ($P < 0.05$, S). The authors concluded that the mean CIMT was higher relative to controls in the prediabetes group; however, CIMT was not in the elevated category in both categories. Compared to monitors, body mass index and waist-hip ratio is substantially greater in prediabetes. In contrast to controls, systolic and diastolic blood pressures were considerably higher in prediabetes. In prediabetes, overall cholesterol, low-density lipoprotein (LDL), triglyceride (TG) and rather LDL were substantially higher, and high-density lipoprotein (HDL) in prediabetes was significantly lower relative to controls. According to this model, the highest variability of CIMT was found to be responsible for serum Tg and age, among other cases.

Lia Alves-Cabratosa et al. [23] measured values of the ankle-brachial index and the possibility of complications of diabetes mellitus in 2019. The investigators concluded that various chances of type 2 diabetes complications were correlated with the analysed types of ABI in asymptomatic PAD patients in primary cardiovascular prevention. In this group, these results may be useful in improving

preventive strategies according to the ABI definition.

T.K Kamble [24] researched the myocardial output index and its association with other cardiovascular risk factors for prediabetes. The findings revealed that body mass index, waist hip ratio, total cholesterol, triglycerides, lipoprotein of low density and lipoprotein of very low density were significantly higher in prediabetes and lipoprotein of high density was significantly lower in prediabetes than regulation. Few of the prediabetes related studies were reported [25-33].

4. CONCLUSION

The current research will highlights the adequate clinical and sociological assessment of pre-diabetes patients, including those who have been diagnosed for a long period of time. Our results would indicate that in all patients with pre-diabetes type, ABI calculation is important.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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