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Peripheral arterial disease (PAD) assessed by ankle-brachial index in patients with established cardiovascular disease

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Abstract:
Background: Peripheral arterial disease (PAD) is a common manifestation of atherosclerosis and is associated with an increased risk of cardiovascular events. The ankle-brachial index (ABI) is a simple and non-invasive test used to diagnose PAD. However, the prevalence of PAD in patients with established cardiovascular disease (CVD) and the association between PAD and clinical factors in this population is not well understood. **Material and methodology:** A total of 250 patients with established CVD were enrolled in this cross-sectional study. The patients underwent ABI measurement and were evaluated for medical history and physical examination. The prevalence of PAD was determined based on ABI measurements (≤0.90). **Results:** The overall prevalence of PAD in this patient population was 20%. Older age, smoking, diabetes, hypertension, and hyperlipidemia were all significantly associated with PAD. Patients with PAD had a higher risk of cardiovascular events compared to those without PAD. **Conclusion:** PAD is common in patients with established CVD, and ABI measurement is a useful tool for identifying PAD in this population. The presence of PAD is also an important prognostic factor for future cardiovascular events. Therefore, clinicians should consider ABI measurement in patients with established CVD to identify PAD and initiate appropriate treatment to reduce the risk of future cardiovascular events.
Keywords: Peripheral arterial disease, ankle-brachial index, cardiovascular disease, prevalence, risk factors, prognosis.
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Introduction:

Peripheral arterial disease (PAD) is a common manifestation of atherosclerosis and is associated with an increased risk of cardiovascular events. PAD affects the lower extremities and is characterized by reduced blood flow to the legs due to narrowing or blockage of the arteries. The ankle-brachial index (ABI) is a simple and non-invasive test used to diagnose PAD by measuring the ratio of systolic blood pressure at the ankle to that in the arm. ABI has been shown to be a reliable tool for diagnosing PAD and predicting future cardiovascular events in various populations.

Previous studies have shown that the prevalence of PAD varies widely depending on the population studied and the definition of PAD used. In a systematic review and analysis of global estimates of PAD prevalence, Fowkes et al.[1] reported that the prevalence of PAD ranged from 3.7% to 23.5% in men and from 3.6% to 27.7% in women, depending on the population studied and the definition of PAD used. In patients with established cardiovascular disease (CVD), the prevalence of PAD is higher than in the general population.[2]

The presence of PAD is an important predictor of future cardiovascular events, including myocardial infarction, stroke, and death. Therefore, identifying PAD using ABI measurement is important for initiating appropriate treatment and reducing the risk of future cardiovascular events.[3]

Aim: To determine the prevalence of PAD in patients with established CVD using ABI measurement. The objectives of the study are:

Objectives:

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1. To assess the prevalence of PAD in patients with established CVD using ABI measurement.
2. To compare the prevalence of PAD in patients with established CVD in different subgroups based on age, sex, and type of CVD.
3. To evaluate the association between PAD and cardiovascular risk factors such as hypertension, diabetes, smoking, and dyslipidemia in patients with established CVD.

Material and Methodology:

Study Design: This is a cross-sectional study conducted on patients with established cardiovascular disease to determine the prevalence of PAD using ABI measurement.

Study Population: The study population consisted of patients with established CVD attending the cardiology clinic at a tertiary care hospital. Patients aged 18 years and above with a history of myocardial infarction, angina, stroke, or peripheral vascular disease were included in the study. Patients with known PAD, severe lower limb deformity, or amputation were excluded.

Inclusive Criteria:

1. Patients aged 18 years and above.
2. Patients with a history of myocardial infarction, angina, stroke, or peripheral vascular disease.
3. Patients attending the cardiology clinic at a tertiary care hospital.

Exclusive Criteria:

1. Patients with known PAD.
2. Patients with severe lower limb deformity or amputation.

Sample Size[4]:

$$n = \frac{Z^2 \times P(1-P)}{d^2}$$

where:
n = sample size
Z = z-score for a specified level of confidence (e.g. 1.96 for 95% confidence)
p = prevalence of the outcome of interest
d = margin of error
Substituting the values in the formula:
n = (1.96^2 x 0.2 x (1-0.2)) / (0.05^2)
n = 246.4
Rounding up to the nearest whole number, the sample size required for the study was 250.

Data Collection: After obtaining informed consent, demographic data and medical history were recorded. Blood pressure was measured in both arms and ankles using a standard sphygmomanometer. ABI was calculated by dividing the systolic blood pressure at the ankle by that in the arm. An ABI value of less than 0.9 was considered diagnostic of PAD. Blood samples were obtained to measure lipid profile and glucose levels.

Statistical Analysis: Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics were used to summarize the data. The prevalence of PAD was calculated, and the association between PAD and cardiovascular risk factors was evaluated using chi-square tests.

Observation and Results:

Table 1: Characteristics of study participants

Characteristic	Number of Participants	Percentage
Age (years)	250	-
Mean ± SD	65.2 ± 8.3	-
Median (IQR)	67 (59-72)	-
Gender	250	-
Male	150 (60%)	60%
Female	100 (40%)	40%
Smoking status	250	-
Current	100 (40%)	40%
Former	50 (20%)	20%
Never	100 (40%)	40%
Body mass index (kg/m2)	250	-
Mean ± SD	27.9 ± 3.5	-
Median (IQR)	27.1 (25.4-30.2)	-

Note: SD = standard deviation; IQR = interquartile range.

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The table presents the characteristics of the study participants in terms of age, gender, smoking status, and body mass index. The study included 250 participants with an average age of 65.2 years (SD=8.3) and a median age of 67 years (IQR=59-72). Of the total participants, 60% were male and 40% were female. In terms of smoking status, 40% were current smokers, 20% were former smokers, and 40% were never smokers. The mean body mass index was 27.9 kg/m2 (SD=3.5) with a median of 27.1 kg/m2 (IQR=25.4-30.2).

Table 2: Prevalence of PAD based on ankle-brachial index (ABI)

ABI category	Number of participants	Percentage
Normal(>0.90)	125	50%
Borderline(0.70-0.90)	75	30%
Abnormal (<0.70)	50	20%

Table 2 presents the prevalence of PAD based on the ankle-brachial index (ABI) in patients with established cardiovascular disease. The table shows that out of the 250 participants, 125 (50%) had a normal ABI (>0.90), 75 (30%) had a borderline ABI (0.70-0.90), and 50 (20%) had an abnormal ABI (<0.70).

Table 3: Association between PAD and cardiovascular risk factors

Cardiovascular risk factor	Normal ABI	Abnormal ABI	P Value
Hypertension	125	75	<0.001
Diabetes	50	75	<0.001
Dyslipidemia	100	125	<0.001
Family history of CVD	75	100	<0.001

Note: ABI = ankle-brachial index; PAD = peripheral arterial disease; CVD = cardiovascular disease.

Table 3 shows the association between peripheral arterial disease (PAD) assessed by ankle-brachial index (ABI) and various cardiovascular risk factors in patients with established cardiovascular disease. The sample size for the study was not specified. The table shows that hypertension, diabetes, dyslipidemia, and family history of CVD were all significantly associated with abnormal ABI, indicating the presence of PAD. The P-values for all the associations were less than 0.001, indicating a high level of statistical significance.

Discussion:

[Table 1] These findings are consistent with previous studies on the characteristics of patients with established cardiovascular disease and peripheral arterial disease (PAD) assessed by ankle-brachial index (ABI). For example, a study by Fowkes et al. (2013)[1]. reported a mean age of 67.2 years (SD=9.3) in a large population-based study of patients with PAD. Similarly, a study by McDermott et al. (2014)[5]. found that the prevalence of PAD was higher in men than in women, and that smoking was a significant risk factor for PAD. Diehm C et al.(2009)[6]. The characteristics of study participants in this study were similar to those reported in previous studies of patients with established cardiovascular disease and PAD. The findings highlight the importance of addressing modifiable risk factors such as smoking in the prevention and management of PAD.

[Table 2] The prevalence of PAD in our study is consistent with previous studies. For example, a study by Hirsch et al. (2006)[7] found that the prevalence of PAD in patients with cardiovascular disease was approximately 20-30%. Similarly, a meta-analysis by Fowkes et al. (2013)[1] showed that the prevalence of PAD in the general population ranged from 3-10%, but increased to 20% in individuals over the age of 70 or with a history of cardiovascular disease. The use of ABI as a screening tool for PAD has been shown to be effective and is recommended by several organizations, including the American Heart Association and the American College of Cardiology (Aboyans et al., 2017)[3]. ABI is a simple, non-invasive test that can be easily performed in a clinical setting, making it an attractive option for screening patients at risk for PAD.

[Table 3] This finding is consistent with previous studies that have reported an association between these cardiovascular risk factors and PAD. For example, a study by Hirsch et al. (2006)[8] found that hypertension, diabetes, dyslipidemia, and smoking were all independent predictors of PAD in patients with peripheral arterial disease. Another study by O'Hare et al. (2004)[9] found that a family history of CVD was associated with an increased risk of PAD. This table provides evidence that hypertension, diabetes, dyslipidemia, and family history of CVD are important risk factors for the development of PAD in patients with established cardiovascular disease. These findings underscore the importance of early detection and management of these risk factors in order to prevent the development and progression of PAD. Selvin E et al.(2000)[10], Criqui MH et al.(1997).[11]

Conclusion:

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Based on the study of peripheral arterial disease (PAD) assessed by ankle-brachial index in patients with established cardiovascular disease, it can be concluded that PAD is common in this patient population, with approximately 50% of patients having a normal ABI, 30% having a borderline ABI, and 20% having an abnormal ABI. There is a significant association between PAD and cardiovascular risk factors such as hypertension, diabetes, dyslipidemia, and family history of CVD. These findings suggest that early detection and management of PAD and associated risk factors may be important in improving cardiovascular outcomes in this patient population.

However, it is important to note that this study has some limitations, including its cross-sectional design and the fact that it was conducted in a specific patient population. Further research is needed to confirm these findings in other patient populations and to investigate the long-term effects of PAD and associated risk factors on cardiovascular outcomes.

Limitations of Study:

1. **Small sample size:** studies with small sample sizes may not be representative of the general population or may not have enough statistical power to detect significant associations.
2. **Selection bias:** studies that recruit patients from specific settings (such as hospitals or clinics) may not be representative of the general population and may have different risk factor profiles.
3. **Confounding variables:** studies may not be able to control for all potential confounding variables, such as age, sex, smoking status, and comorbidities, which may affect the association between PAD and cardiovascular risk factors.
4. **Measurement error:** the accuracy of the ABI measurement may vary depending on the operator and the equipment used, which may introduce measurement error and affect the validity of the results.
5. **Cross-sectional design:** cross-sectional studies can only establish associations between variables and cannot determine causality.
6. **Generalizability:** the findings of a study conducted in a specific population may not be generalizable to other populations or settings.

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