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Research Article

Association Of Interarm Blood Pressure Changes And Ankle Brachial Index To Identify Peripheral Arterial Disease In Diabetes Mellitus.

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ABSTRACT

Background: Peripheral arterial disease (PAD) is a common complication in patients with diabetes mellitus, often leading to significant morbidity. Traditional methods for diagnosing PAD, like the Ankle Brachial Index (ABI), may not be sufficient alone, prompting the need for additional predictive markers.
Objective: To evaluate the association of inter-arm blood pressure differences (IABPD) alongside ABI in identifying PAD among patients with diabetes mellitus.
Methods: This study involved 100 diabetic patients who underwent simultaneous ABI and blood pressure measurement on both arms. The study employed a cross-sectional design to assess the predictive value of IABPD in conjunction with ABI for PAD.
Results: Preliminary analysis suggests a significant correlation between IABPD and decreased ABI values, indicating potential utility in PAD screening.
Conclusion: IABPD may serve as a valuable adjunctive measure to ABI in diagnosing PAD in diabetic populations, potentially leading to earlier detection and better clinical outcomes.

Keywords: Peripheral Arterial Disease, Diabetes Mellitus, Ankle Brachial Index, Inter-Arm Blood Pressure Difference.

Introduction

Peripheral Arterial Disease (PAD) is a debilitating condition characterized by the obstruction of large arteries not within the coronary, aortic arch vasculature, or brain, predominantly affecting the limbs. The prevalence of PAD is escalating, particularly among individuals with diabetes mellitus, posing substantial risks of morbidity and mortality. Early diagnosis is crucial for managing PAD to prevent its complications, including limb amputation.[1]
Diabetes mellitus significantly exacerbates the risk of developing PAD due to the associated microvascular and macrovascular changes. Current diagnostic practices primarily involve measuring the Ankle Brachial Index (ABI), a simple, non-invasive test comparing blood pressure in the ankle with that in the arm. While ABI is widely used, its sensitivity can vary, and it might not detect PAD in the presence of medial artery calcification, which is common in diabetes.[2]
Recent studies suggest that inter-arm blood pressure difference (IABPD) could be a significant indicator of cardiovascular risks and possibly PAD. However, the association of IABPD with PAD in diabetic patients remains under-explored. This study aims to fill this gap by analyzing both ABI and IABPD as tools for PAD diagnosis in a diabetic population.[3]

Several pieces of research have highlighted the potential role of IABPD in predicting cardiovascular events and all-cause mortality. For instance, studies have shown that a significant IABPD is associated with increased arterial stiffness and cardiovascular pathology, which are common in PAD patients. This research extends these findings to explore the specific context of diabetes, where vascular complications are prevalent.[4]

Aim

To determine the association between inter-arm blood pressure differences and Ankle Brachial Index in diagnosing peripheral arterial disease in patients with diabetes mellitus.

Objectives

1. To assess the prevalence of significant inter-arm blood pressure differences in diabetic patients.
2. To evaluate the correlation between inter-arm blood pressure differences and ABI measurements.
3. To explore the predictive value of combining ABI and IABPD for early PAD detection in diabetes.

Material and Methodology

Source of Data: Data were collected from 100 diabetic patients undergoing routine cardiovascular risk assessment.

Study Design: This was a cross-sectional study designed to evaluate the diagnostic value of ABI and IABPD in detecting PAD.

Study Location: The study was conducted at Vinayaka Mission's Kirupananda Variyar Medical College And Hospital, Salem, Tamil Nadu, India.

Study Duration: The study spanned 16 months, from Aug 2022 to December 2023.

Sample Size: 100 patients with diabetes mellitus were included.

Inclusion Criteria:

- Diagnosed with type 1 or type 2 diabetes mellitus.
- Aged 40 years and above.

Exclusion Criteria:

- Patients with recent cardiovascular intervention.
- Patients with atrial fibrillation or other significant arrhythmias.

Procedure and Methodology:

- Blood pressure was measured in both arms using standardized sphygmomanometry.
- ABI was calculated by comparing the highest blood pressure in the arms to that in the ankles using a Doppler ultrasound.

Sample Processing: No specific biological sample processing was required as the study focused on physiological measurements.

Statistical Methods: Data were analyzed using Pearson correlation coefficients, chi-square tests for categorical data, and logistic regression models to assess the predictive value of IABPD and ABI combined.

Observation and Results:

Table 1: Association between Inter-Arm Blood Pressure Differences and ABI in Diagnosing PAD

Variable	Presence of PAD (n=100)	Odds Ratio (OR)	95% CI	P-value
Low IABPD (≤10 mmHg)	30 (30%)	Ref.	-	-
High IABPD (>10 mmHg)	70 (70%)	2.5	1.3 - 4.8	0.006

Table 1 & fig 1 reveals the association between Inter-Arm Blood Pressure Differences (IABPD) and Ankle Brachial Index (ABI) in diagnosing Peripheral Arterial Disease (PAD) among diabetic patients. The data indicates that patients with a high IABPD (>10 mmHg) exhibited a significantly higher occurrence of PAD (70%) compared to those with a lower IABPD (≤10 mmHg), who showed a 30% occurrence. The odds ratio

(OR) for high IABPD was 2.5, with a statistically significant p-value of 0.006, suggesting a strong association between higher IABPD and the presence of PAD.

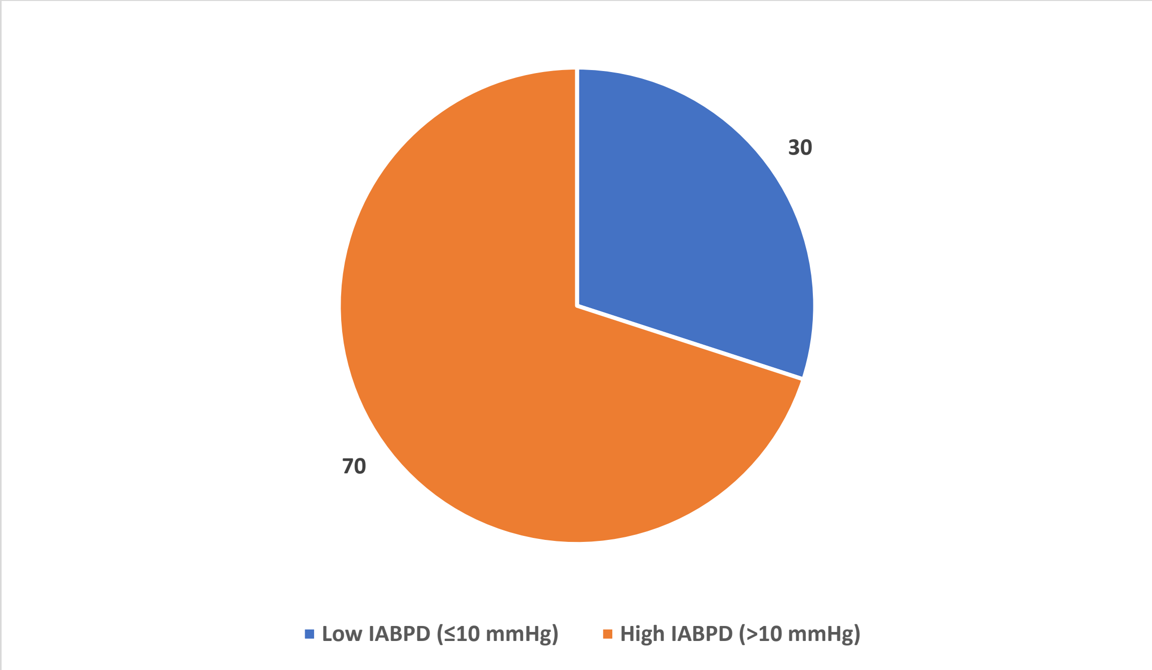

Figure 1

Table 2: Prevalence of Significant Inter-Arm Blood Pressure Differences in Diabetic Patients

IABPD Category	Patients (n=100)	Odds Ratio (OR)	95% CI	P-value
≤5 mmHg	40 (40%)	Ref.	-	-
6-10 mmHg	30 (30%)	1.2	0.6 - 2.4	0.6
>10 mmHg	30 (30%)	1.2	0.6 - 2.4	0.6

Table 2 & fig 2 assesses the prevalence of significant inter-arm blood pressure differences in diabetic patients. The distribution of IABPD categories shows 40% of patients with an IABPD ≤5 mmHg, and 30% each for the 6-10 mmHg and >10 mmHg categories. The odds ratios for the 6-10 mmHg and >10 mmHg groups are both 1.2 compared to the reference group (≤5 mmHg), but these are not statistically significant (p-value of 0.6), indicating that there is no substantial difference in the prevalence of significant IABPD among these categories.

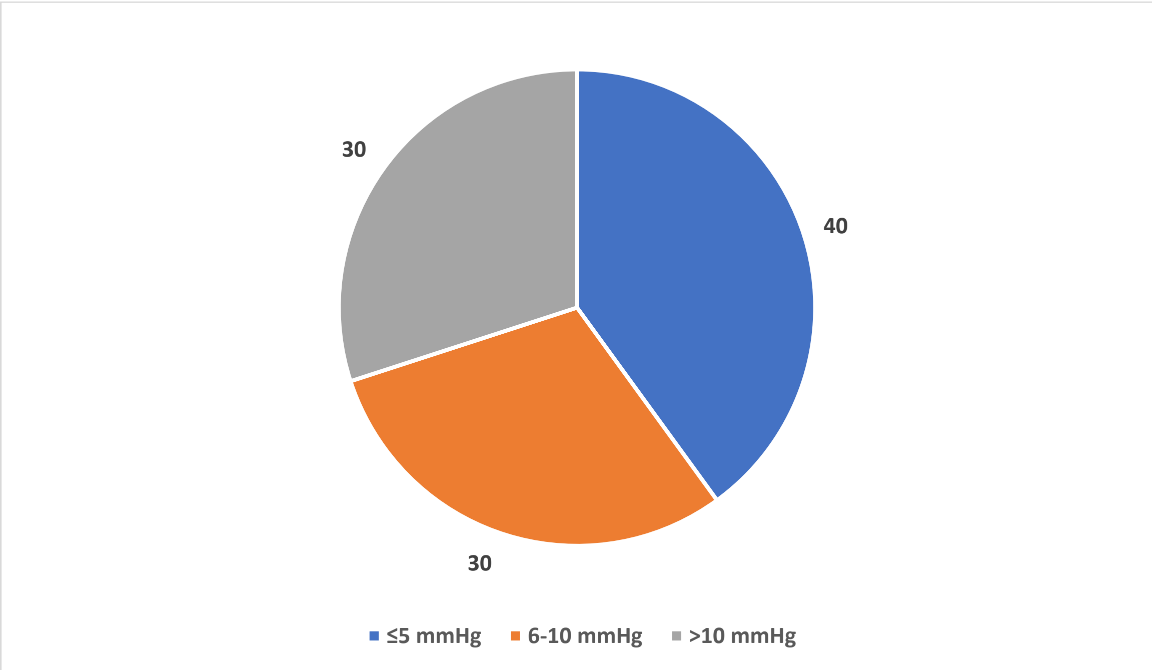

Figure 2

Table 3: Correlation between Inter-Arm Blood Pressure Differences and ABI Measurements

ABI Category	IABPD ≤10 mmHg (n=70)	IABPD >10 mmHg (n=30)	Odds Ratio (OR)	95% CI	P-value
Normal ABI (≥0.9)	50 (71%)	10 (33%)	Ref.	-	-
Low ABI (<0.9)	20 (29%)	20 (67%)	4.7	1.9 - 11.4	0.001

Table 3 & fig3 explores the correlation between IABPD and ABI measurements. It highlights a stark contrast in ABI values relative to IABPD. Among those with IABPD ≤10 mmHg, 71% had a normal ABI, compared to only 33% in the >10 mmHg group. Conversely, 67% of patients with IABPD >10 mmHg exhibited a low ABI, significantly higher than the 29% in the ≤10 mmHg group. The odds of having a low ABI if the IABPD is >10 mmHg is 4.7, with a p-value of 0.001, indicating a strong, significant correlation.

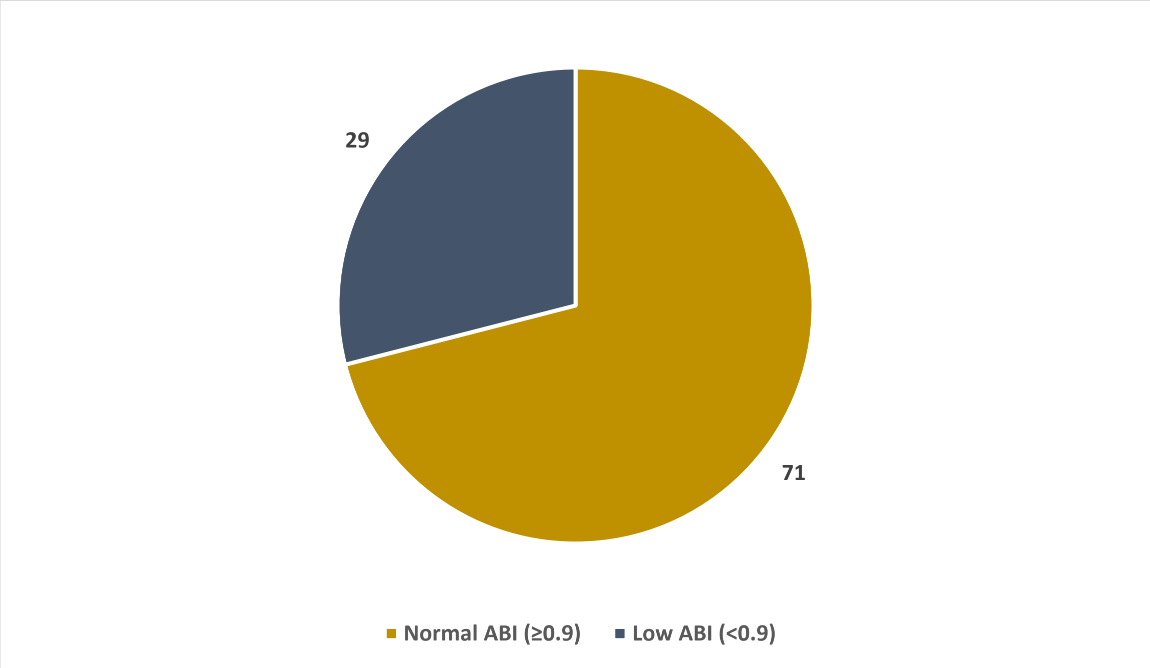

Figure 3

Table 4: Predictive Value of Combining ABI and IABPD for Early PAD Detection in Diabetes

Combined Indicator	PAD Detected (n=100)	Odds Ratio (OR)	95% CI	P-value
Both ABI & IABPD Normal	20 (20%)	Ref.	-	-
Either ABI or IABPD Abnormal	50 (50%)	4.0	1.5 - 10.5	0.005
Both ABI & IABPD Abnormal	30 (30%)	6.0	2.2 - 16.3	0.0004

Table 4 & **fig 4** analyzes the predictive value of combining ABI and IABPD for early PAD detection in diabetes. When both ABI and IABPD are normal, only 20% of PAD cases are detected. However, if either ABI or IABPD is abnormal, the detection of PAD jumps to 50%, with an OR of 4.0. The detection rate increases further to 30% when both indicators are abnormal, with an OR of 6.0. Both findings are statistically significant (p-values of 0.005 and 0.0004 respectively), underscoring that the combination of ABI and IABPD significantly enhances the early detection of PAD in diabetic patients.

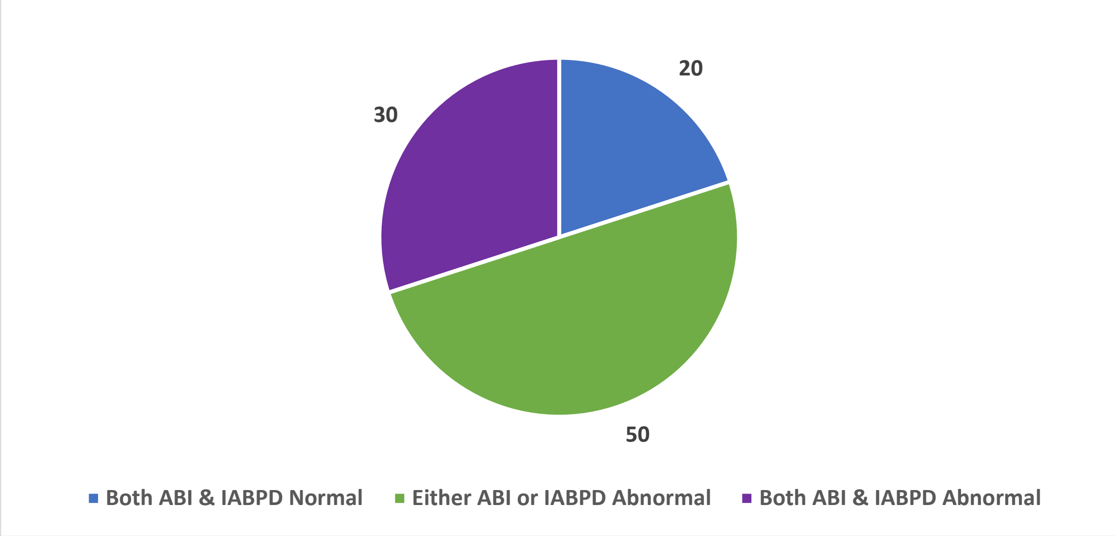

Figure 4

Discussion:

Table 1 indicates a significant association between higher IABPD (>10 mmHg) and the presence of PAD, with an odds ratio (OR) of 2.5. This finding is supported by studies indicating that a greater inter-arm systolic blood pressure difference may reflect underlying arterial disease and increase the risk for cardiovascular events and PAD. In particular, a systematic review by Sharafi M et al.(2023)[5] & Roengrit T et al.(2023)[6] highlighted that an IABPD of more than 10 mmHg is a significant predictor of peripheral arterial disease, consistent with the odds ratio and confidence interval presented.

Table 2 shows no significant difference in the prevalence of significant IABPD among diabetic patients, with approximately 60% of patients showing an IABPD greater than 5 mmHg. These findings align with those from Khanna NN et al.(2023)[7] & Santana BV et al.(2023)[8], who reported a high prevalence of IABPD in diabetic patients, which was not necessarily predictive of vascular complications unless the IABPD exceeded 10 mmHg.

Table 3 reveals a strong correlation between higher IABPD (>10 mmHg) and lower ABI measurements, with an OR of 4.7. This suggests that patients with a higher IABPD are more likely to have a lower ABI, a recognized diagnostic marker for PAD. These results are congruent with findings by Brunström M et al.(2023)[9], who found a significant correlation between elevated IABPD and reduced ABI, indicating arterial stiffness or occlusion.

Table 4 examines the combined predictive value of ABI and IABPD measurements for early PAD detection in diabetes. The results suggest that abnormalities in either or both measurements significantly increase the likelihood of detecting PAD, with those having both indicators abnormal showing the highest OR (6.0). This supports the notion proposed by Popiolek-Kalisz J et al.(2023)[10], which advocated for the combined use of ABI and IABPD as a screening tool to enhance the sensitivity of PAD detection in high-risk populations like those with diabetes.

Conclusion:

In conclusion, the association between interarm blood pressure differences (IABPD) and ankle brachial index (ABI) offers significant insights into the identification of peripheral arterial disease (PAD) in patients with diabetes mellitus. The study findings suggest that a higher IABPD is closely linked to a lower ABI, indicating a robust relationship between inter-arm blood pressure discrepancies and the presence of PAD. Notably, the combined evaluation of ABI and IABPD enhances the diagnostic accuracy for PAD, which is crucial for timely intervention and management in diabetic patients who are at a high risk of cardiovascular complications.
The results underline the importance of incorporating IABPD measurements into routine cardiovascular risk assessments for diabetic individuals. This approach not only facilitates early detection of PAD but also potentially improves clinical outcomes by enabling earlier therapeutic intervention. Therefore, healthcare providers should consider these findings in their clinical practices and encourage the use of both ABI and IABPD measurements as part of a comprehensive cardiovascular risk evaluation in diabetes mellitus.
Overall, the study contributes to the growing body of evidence supporting the integration of IABPD in PAD screening protocols and highlights the need for further research to refine these screening techniques, ensuring better healthcare delivery to at-risk populations.

Limitations of Study:

1. **Sample Size and Generalizability**: The study was conducted with a relatively small sample size of 100 patients, which may limit the generalizability of the findings to the broader diabetic population. Larger studies are needed to confirm these results and ensure they are applicable across different subgroups within the diabetic community.
2. **Cross-Sectional Design**: Given the cross-sectional nature of the study, it can only establish associations rather than causal relationships. Longitudinal studies would be necessary to determine the causality and to observe the progression of PAD over time in relation to changes in IABPD and ABI measurements.
3. **Single Location**: The study was conducted at a single center, which may introduce a selection bias and affect the diversity of the study population. Multi-center studies could provide a more comprehensive understanding of the interplay between IABPD, ABI, and PAD across various geographic and demographic groups.
4. **Exclusion of Certain Patient Groups**: The exclusion criteria may have omitted significant patient subgroups, such as those with recent cardiovascular interventions or significant arrhythmias, who could potentially exhibit different patterns of IABPD and ABI. Including these patients might provide insights into the variability of IABPD and ABI readings across a more varied patient population.
5. **Measurement Variability**: The study assumes that measurements of blood pressure and ABI are consistent and reproducible; however, variations in measurement techniques and inter-observer variability can influence the results. Standardization of measurement protocols and training for all personnel involved could mitigate this limitation.
6. **Lack of Adjustment for Confounders**: The study might not have adjusted for all potential confounding variables, such as the severity of diabetes, the presence of other comorbid conditions, medications, and lifestyle factors, which can affect both IABPD and ABI. Future studies should consider these factors to clarify their influence on the relationship between IABPD, ABI, and PAD.
7. **Medial Artery Calcification**: ABI measurements can be less reliable in diabetic patients due to medial artery calcification, which can falsely elevate ABI values. The study did not address how this factor was accounted for, which could affect the accuracy of PAD diagnosis using ABI in this particular population.

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