EDITORIAL

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Ankle brachial index: a simple path to the future

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Peripheral artery disease (PAD) is a common comorbidity in patients with coronary artery disease (CAD), but it often goes underdiagnosed and undertreated. Studies have reported that the prevalence rate of PAD in patients with CAD undergoing percutaneous coronary intervention (PCI) ranges from 5% to 40%. These differences are likely due to the diverse patient demographics, comorbidities, and manifestations of CAD. A recent study conducted in Korea found that 13% of patients undergoing PCI for CAD had PAD [1]. The ankle-brachial index (ABI) is a simple, non-invasive metric for identifying lower extremity PAD in patients with symptoms of intermittent claudication or rest ischemia. In addition to detecting PAD, ABI can also be used for risk assessment of patients with elevated cardiovascular risk (e.g., smokers and/or patients with CAD) who do not have leg symptoms. In CAD patients, several studies have reported an inverse association between ABI and the risk of major adverse clinical outcomes (MACEs) after PCI, suggesting that it may have a role in identifying patients at high risk of ischemic bleeding complications after PCI. However, further research is required on the clinical implications of ABI in CAD patients, including its potential benefits and limitations.

Evaluation of ABI can provide important diagnostic and prognostic information in both asymptomatic and symptomatic CAD patients. As a risk enhancing factor, ABI has potential utility for guiding preventive interventions, such as smoking cessation, statin therapy, antiplatelet therapy, and exercise programs [2]. These interventions have small-to-moderate positive effects on health outcomes, such as reducing the risk of cardiovascular events. In patients with stable angina, ABI identifies those with underlying PAD, who may be at increased risk for adverse cardiovascular events. Numerous studies highlight the importance of early detection and proper management of polyvascular disease to reduce potential complications and mortality in patients with CAD and PAD. An abnormal ABI reading (< 0.9 or > 1.4) was present in 23% of patients with acute coronary syndrome, and was associated with higher rates of MACE, cardiovascular death, and all-cause death compared to ABI in the normal ABI range (0.9–1.4) [3]. Additionally, an abnormal ABI has been identified as an independent predictor of MACE after adjusting for other risk factors. CAD severity shows an independent inverse association with ABI, indicating that the increased morbidity and mortality observed in PAD patients undergoing PCI may be due to the greater atherosclerotic burden [4,5]. The mechanism underlying the relationship between low ABI and ischemic events after PCI is not fully understood. One hypothesis is that concomitant CAD and PAD may indicate diffuse atherosclerosis, which may in turn result in increased inflammation and thrombosis, thereby increasing the risk of ischemic events. Another possibility is that low ABI is a marker of aging and comorbidities, as well as a risk factor for ischemic events.

Although patients with CAD and concomitant PAD have been considered as a high-risk subgroup with a greater incidence of adverse ischemic events after PCI, few data exist regarding the clinical utility of the ABI for predicting bleeding complications, which affects the outcome. Kim et al. [6] showed that an abnormal ABI was associated with a higher incidence of all-cause mortality, recurrent myocardial infarction, and major bleeding events over a 5-year period. An abnormal ABI was an independent risk factor for major bleeding in the multivariate analysis. Moreover, a combination of an abnormal ABI and reference variables (dyslipidemia, renal dysfunction, and anemia) had greater predictive value for major bleeding compared to reference variables alone. This suggests that ABI can serve as an additional tool to predict the risk of major bleeding in a broader population of patients undergoing PCI. Further research is needed to determine the optimal cutoff values for ABI for predicting bleeding risk, and to determine the most effective strategies for risk stratification and management in these patients. The

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exact mechanism underlying the relationship between low ABI and bleeding complications after PCI is also not fully understood. One hypothesis is that patients with PAD have higher rates of comorbidities such as hypertension and diabetes, which are themselves risk factors for bleeding. Another possibility is that patients with PAD have altered platelet function, which may increase the risk of bleeding.

Despite these potential benefits, there are limitations to the use of ABI in CAD patients. First, ABI may have limited value in patients with diabetes or chronic renal failure on hemodialysis, due to vessel wall calcification and increased vessel stiffness. In this scenario, toe-brachial pressure index (TBI) measurements can be used in addition to ABI for screening asymptomatic PAD in subjects with high cardiovascular risk. The reference TBI can help diagnose PAD in patients with a low TBI value and high ABI value. Measurements of both ABI and TBI may facilitate early diagnosis of PAD, allowing for more aggressive secondary preventive measures to be taken. Additionally, there is a lack of consensus regarding the optimal cutoff values for ABI in CAD patients. As many PAD patients are asymptomatic, exercise ABI testing could be a good option for disease detection. Although there is no formally established exercise ABI protocol, participants in one study underwent ABI testing immediately after walking for 5 minutes on a treadmill (12% gradient, 2 miles per hour [3.2 km per hour]) or until symptoms forced the patient to stop [7]. Finally, evidence of the benefits of screening in asymptomatic individuals is limited; the drawbacks of screening, such as false-positives and unnecessary intervention, need to be weighed against the potential benefits [2]. Overall, clinicians consider screening for PAD using ABI in asymptomatic individuals who are at increased risk of cardiovascular disease.

One potential future direction is the development of new technologies that allow for more accurate and efficient measurement of ABI. For example, wireless sensors and smartphone applications could improve the accessibility to ABI measurements, thus increasing its use and potentially allowing for earlier detection of CAD and better management of patients at risk for ischemic or bleeding complications after PCI. To better understand the underlying pathophysiology of the relationship between ABI and CAD, more research is needed, using advanced imaging techniques or biomarker analysis to assess the roles of inflammation, oxidative stress, and other mechanisms in the development of both conditions. Kim et al. [6] did not study the effective of intervention to improve ABI in patients with CAD. It would be valuable to compare different interventions such as exercise, medication, and revascularization to determine the most effective approach for improving ABI and reducing cardiovascular risk in this patient population. ABI can be used to develop exercise prescriptions for patients with CAD. By measuring ABI before and after exercise, healthcare providers can identify the optimal level of exercise for each patient. This could improve cardiovascular health and reduce the risk of future heart attacks. In addition, future research could explore the use of ABI for other aspects of CAD management, such as monitoring disease progression and response to therapy, predicting long-term outcomes, and identifying subgroups of patients who may benefit from more aggressive treatment. Overall, the continued development and optimization of ABI as a tool for predicting ischemic and bleeding complications after PCI and other aspects of CAD management could improve patient outcomes and reduce healthcare costs.

In conclusion, ABI is a simple, non-invasive tool that has potential utility for predicting adverse outcomes and guiding the management of CAD patients. Further research is needed to fully understand the underlying mechanisms and determine the role of ABI in routine clinical practice. Ultimately, the use of ABI for monitoring CAD patients shows great promise with regard to improving the outcomes and management of this complex patient population.

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