Non-Invasive Assessment of Peripheral Arterial Disease: Automated Ankle Brachial Index Measurement and Pulse Volume Analysis Compared to Ultrasound Duplex Scan

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Abstract : Introduction: There is, at present, a clear and recognized need to optimize the diagnosis of peripheral arterial disease (PAD), particularly in non-specialist settings such as primary care, and this arises from several key facts. Firstly, PAD is a highly prevalent condition. In 2010, it was estimated that globally, PAD affected more than 202 million people and furthermore, this prevalence is predicted to further escalate. The disease itself, although frequently asymptomatic, can cause considerable patient suffering with symptoms such as lower limb pain, ulceration, and gangrene which, in worse case scenarios, can necessitate limb amputation. A further and perhaps the most eminent consequence of PAD arises from the fact that it is a manifestation of systemic atherosclerosis and therefore is a powerful predictor of coronary heart disease and cerebrovascular disease. Objective: This cross sectional study aimed to individually and cumulatively compare sensitivity and specificity of the (i) ankle brachial index (ABI) and (ii) pulse volume waveform (PVW) recorded by the same automated device, with the presence or absence of peripheral arterial disease (PAD) being verified by an Ultrasound Duplex Scan (UDS). Methods: Patients (n = 205) referred for lower limb arterial assessment underwent an ABI and PVW measurement using volume plethysmography followed by a UDS. Presence of PAD was recorded for ABI if < 0.9 (noted if > 1.30) if PVW was graded as 2, 3 or 4 or a hemodynamically significant stenosis > 50% with UDS. Outcome measure was agreement between measured ABI and interpretation of the PVW for PAD diagnosis, using UDS as the reference standard. Results: Sensitivity of ABI was 80%, specificity 91%, and overall accuracy 88%. Cohen's kappa revealed good agreement between ABI and UDS (k = 0.7, p < .001). PVW sensitivity 97%, specificity 81%, overall accuracy 84%, with a good level of agreement between PVW and UDS (k = 0.67, p < .001). The combined sensitivity of ABI and PVW was 100%, specificity 76%, and overall accuracy 85% (k = 0.67, p < .001). Conclusions: Combing these two diagnostic modalities within one device provided a highly accurate method of ruling out PAD. Such a device could be utilized within the primary care environment to reduce the number of unnecessary referrals to secondary care with concomitant cost savings, reduced patient inconvenience, and prioritization of urgent PAD cases.

Keywords : ankle brachial index, peripheral arterial disease, pulse volume waveform, ultrasound duplex scan