Pulse Wave Velocity

Subjects: Nursing | Cardiac & Cardiovascular Systems

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Pulse wave velocity (PWV) is a simple, reproducible and non-invasive technique to assess arterial stiffness. It estimates the velocity of arterial wave propagation to travel a known distance between two anatomic sites within the arterial system [1]. PWV has been established as an independent predictor of cardiovascular mortality and is consequently used for diagnosis and prognosis in patients at risk of atherosclerotic cardiovascular disease [2]; however, PWV's significance relies on the fact that arterial stiffness, specially of muscular arteries can be modified by interventions that improve endothelial function such as exercise training, which makes PWV an important tool for cardiovascular risk management [3].

Keywords: pulse wave velocity ; cardiovascular risk ; arterial stiffness ; vascular function

1. Definition

Pulse wave velocity (PWV) is a simple, reproducible and non-invasive technique to assess arterial stiffness. It estimates the velocity of arterial wave propagation to travel a known distance between two anatomic sites within the arterial system [1]. PWV has been established as an independent predictor of cardiovascular mortality and is consequently used for diagnosis and prognosis in patients at risk of atherosclerotic cardiovascular disease [2]; however, PWV's significance relies on the fact that arterial stiffness, specially of muscular arteries can be modified by interventions that improve endothelial function such as exercise training, which makes PWV an important tool for cardiovascular risk management [3].

2. Introduction

Pulse wave velocity (PWV) is considered the gold standard method for assessing aortic stiffness [4][5]. Arterial stiffness measures, and carotid femoral PWV (cfPWV) in particular, are being included in the routine clinical assessment of patients and within the framework of large-scale clinical studies [4] as new instrumental solutions that allow the PWV assessment, such as photoplethysmography or magnetic resonance emerge [6] (Table 1). Nevertheless, an introduction into clinical practice has not been implemented further due to the fact that there is a lack of established reference values based on a large population and due to the absence of a standardized methodology for PWV assessment [7].

3. Methods used to Determine PWV

Table 1. Methods used to determine PWV. aPWV: aortic pulse wave velocity; baPWV: brachial-ankle pulse wave velocity; cfPWV: carotid-femoral pulse wave velocity; DVP: digital volume pulse; ECG: electrocardiogram; PWV: pulse wave velocity.

Method	Description	Measure

	Applanation tonometry	Apply a pressure sensor through the skin and applanate a superficial artery by applying a downward pressure sufficient to flatten the artery.	baPWV, cfPWV
	Computerized oscillometry	Simultaneous acquisition and analysis of the pulsation of the artery, which is caused by the heart, as the pressure oscillation in the cuff.	Heart-brachial PWV, heart-ankle PWV, brachial-ankle PWV, cfPWV
Non-invasive methods	Mechanotransducer	Two dedicated piezoelectric pressure mechanotransducers directly applied to the skin in a simultaneous measurement of pressure pulses	carotid–femoral, carotid–brachial or femoral–dorsalis pedis PWV
	Ultrasound	Doppler pulses are recorded sequentially in 2 different arterial sites and compared using the R-wave of the ECG	baPWV, cfPWV
	Photoplethysmography	DVP measured by the photoplethysmography transducer	DVP associated with aPWV
	Magnetic Resonance Imaging	Assessment of the blood flow velocity with an enough temporal and spatial resolution to study the propagation of the aortic systolic flow wave	Local PWV
Invasive methods	Aortic angiography	Intra-aortic catheter measurements	Local PWV

Previous meta-analyses have attempted to calculate quantitative estimates of the predictive value of PWV for different outcomes. However, to the best of our knowledge, no previous meta-analysis has estimated the predictive performance (diagnostic odds ratio (dOR), sensitivity, specificity, positive likelihood ratio (PLR), and negative likelihood ratio (NLR)) of PWV considering the thresholds for a higher risk of cardiovascular or all-cause mortality estimated using hierarchical summary receiver operating characteristic (HSROC) models. Moreover, reference values for PWV have been established through cross-sectional studies [7] or expert consensus [8], in which subjects by age and blood pressure categories with no additional identified cardiovascular risk factors were considered.

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