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abstract

Which parameters of central hemodynamics are significantly better than those of brachial hemodynamics in assessment of CV risk and its reduction?

Studies of brachial cuff pressures and outcomes have established systolic, diastolic and pulse pressure as predictors of cardiovascular (CV) risk. These measures have been used in the life insurance industry to set premium rates at different ages in hundreds of millions of persons over the past century. The fact that they are fallible is apparent from Franklin's analysis of systolic, diastolic and pulse pressure at different ages, the finding from the Prospective Studies Collaboration [1] (in almost one million subjects) that pulse pressure is not related to risk, and the swing in emphasis from diastolic pressure to systolic and pulse pressure in older adults. Studies of therapy, which depend on cuff pressure alone do not always show benefit of the most effective therapies, and have led to search for mechanisms "beyond blood pressure reduction" [2]. Measurement of aortic pressure "beyond the brachial artery" may provide better hemodynamics indices for prediction of events and assessment of therapy.

Non-invasive measurement of aortic pressure in clinical trials has usually been undertaken through use of a transfer function (TF) approach [3,4]. Another promising method entails recognition of the second systolic shoulder of the calibrated radial artery pressure wave, [5] but no long-term trials have yet been reported. Use of the carotid wave calibrated from radial artery tonometry by Safar and colleagues in Paris has provided results virtually identical to the TF approach [6,7]. However when the carotid pressure wave is calibrated from brachial artery tonometry, the central carotid systolic and pulse pressure shows minimal amplification (average 1mmHg in ANBP2, Framingham and ASKLEPIOS studies [8,9,10], unlike the average ~ 10mmHg seen in direct pressure recordings and the TF approach (11). Error is attributable to inappropriate tonometry, with resulting near identical shape and form factor (FF) of carotid and brachial waves [12, see fig]. This issue accounts for inability of the technique to show benefit of "central pressure" in the Framingham and ANBP2 trials [8].

The multiple studies on central pressure and outcome have been subject to meta-analysis and systematic review by Vlachopoulos et al [14]. This is updated in subsequent journal correspondence [15] and the 6th edition of McDonald's Blood Flow in Arteries. The analysis confirms the value of central systolic blood pressure, pulse pressure, and augmentation index on CV outcome and all-cause mortality, when central pressure indices are determined from applanation tonometry of the radial artery. Use of the brachial artery for applanation tonometry is not supported by theory. This artery cannot be flattened (applanated) by the tonometer, applied through the bicipital aponeurosis against the unsupported brachial artery. Equivalence of brachial tonometric and intra-arterial pressure have not been reported whereas such has been reported for the radial and carotid sites. Safar and colleagues have shown substantial equivalence of central carotid pressures calibrated by transfer function or form factor method when radial rather than brachial tonometry was used.