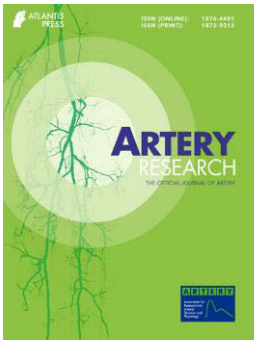

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ABSTRACT OF ARTERY

METHODOLOGICAL CONSIDERATIONS ON MEASURING CENTRAL BLOOD PRESSURE AND WAVE REFLECTION

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Because of pressure wave travel and reflection, blood pressure values and the contour of the pressure wave differ from one measuring location to another. Upon its path from the central aorta towards the periphery, the amplitude of the pressure pulse is amplified. As a result, systolic blood pressure will be substantially higher in peripheral vessels such as the brachial and radial artery, than in the central aorta. This amplification is heart rate dependent, and thus has consequences for the interpretation of the effect of blood pressure lowering drugs. Two drugs with the same effect on brachial blood pressure not necessarily reduce central blood pressure to the same extent.

Pressure wave reflection by itself is, more and more, being recognized as an important factor that contributes to the increase in blood pressure in hypertension. When the heart ejects, a forward running (from the heart to the periphery) pressure wave is generated, which reflects in the periphery and returns as a backward running wave from the periphery towards the heart. The pressure as measured will therefore consist of the superposition of this forward and backward pressure wave. The morphology of the measured pressure wave, as well as its amplitude (the pulse pressure), will depend on the magnitude and relative timing of the forward and backward wave. With increasing age, the arteries get stiffer, and the speed with which the waves propagate in the arteries (the pulse wave velocity), increases. In addition, the magnitude of wave reflection increases. The more important reflected wave is thus superimposed on the forward wave in early systole, rather than in late systole to diastole as in young subjects. This causes the morphology of the central pressure waveform to evolve from a so-called C-type in young subjects to an A-type wave in older subjects, boosts systolic blood pressure and increases the load on the heart.

Given the above, it is needless to state that in the past decades, there is an increased interest in the analysis of the pressure waveform and the (non-invasive) assessment of central arterial hemodynamics and wave reflection, with the naissance of the Artery Research society as a logical consequence. Many of its members are measuring and analysing pressure waveform data, often using different methodologies and strategies. It is not always clear in how far data and conclusions are truly exchangeable from one centre to another. For that purpose, an overview is given of the most commonly applied methods of measurement of central blood pressure and wave reflection, with a focus on methodological aspects.

First, strategies to assess central blood pressure waveforms are discussed: (i) applanation tonometry at a vessel as close to the heart as possible, where the carotid artery is an obvious choice; (ii) applanation tonometry at the radial artery - where measurements are somewhat easier to perform - and to use a transfer function to generate ''synthesized'' central pressure waveforms from the radial ones. Methodological aspects that will be discussed in detail involve the calibration of the tonometer waveforms, the (in)sensitivity of the outcome to the transfer function used, pitfalls in the derivation and use of generalized transfer functions, the use of diameter distension waveforms as surrogate for applanation tonometry waveforms.

Second, it will be addressed how wave reflection parameters can be derived from these central pressure waveforms. Using our Asklepios data base, where central pressure and flow have been acquired in >2000 healthy middle-aged men and women, we first use wave separation analysis to obtain reference values for wave reflection, wave travel times and the effective length of the arterial tree. Next, we use only the pressure waveform data and use techniques to identify ''characteristic points'' on the pressure waveform (inflection and shoulder point) to derive wave travel times, augmentation index and the effective length of the arterial tree. These data are confronted with the values obtained from the waveform analysis. Finally, we also briefly address two recently introduced techniques, i.e., wave intensity analysis (based on pressure and flow), and the ''triangulation method'', where the flow waveform is approximated by an arbitrarily scaled triangle to derive the reflection magnitude.

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