Abstract

CURRENT PERSPECTIVES ON MEASUREMENT OF CENTRAL BLOOD PRESSURE AND ARTERIAL STIFFNESS

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Central Aortic Blood Pressure. The inherent limitations of the cuff sphygmomanometer are widely recognised. However, there is still no other device to replace it as a convenient and non-invasive means of quantifying arterial pressure. Diagnosis, treatment and determination of risk have been largely based on systolic and diastolic pressure obtained with the brachial cuff. The relationship between central and peripheral systolic and pulse pressure is variable, and depends on a range of factors including arterial stiffness, intensity and timing of wave reflection, heart rate, age and gender. Developments in non-invasive estimation of central pressure included quantification of this relationship by means of a transfer function between aortic and peripheral pressure for the upper limb. The overall stability of the transfer function model during changes in blood pressure due to vasoactive agents or physiological maneuvers allowed the application of a generalised model for the adult population. This has enabled the combination of the cuff sphygmomanometer and a peripheral pulse transducer to estimate calibrated values of central aortic systolic and diastolic pressure and to obtain a central aortic pulse waveform. Further developments of the generalized transfer function methods have led to attempts at individualization or group specific models, but the improvement in these has been marginal and variable. Other techniques for central blood pressure measurement include the registration of the carotid pulse with brachial cuff measurements in terms of mean and diastolic pressure, association of pressure value of systolic shoulder of the radial pulse and central systolic pressure. Regression models have also been attempted, but these have not yet been widely implemented in commercial devices.

Arterial Stiffness. Pulse wave velocity (PWV) is the established non-invasive surrogate measure of arterial stiffness. This is readily done by pulse transit time measurement in the limbs and the aortic trunk. Aortic PWV has been shown to have a greater variation with age than limb PWV and has been shown to be a strong predictor of cardiovascular risk. While PWV is obtained from transit time using two separate pulse measurements, features in the single peripheral or central arterial pulse are also used to determine indices of arterial stiffness and wave reflection, such as the relative systolic augmentation with respect to early systolic inflection (augmentation index) or time to inflection. Other techniques include relative time delays using pulses in peripheral limbs and calculated distances based on body height. These methods do not give actual values of PWV, but rather relative indices of PWV and stiffness. Global parameters of arterial stiffness are also quantified in terms of arterial compliance. Aortic compliance values may be obtained from first order model estimates of the arterial pulse waveform by fitting exponential functions during the diastolic portion of the cardiac cycle or area integral methods. Parametric models are also used for large and small artery compliance estimations. These methods require measurement of arterial blood flow rate, and some techniques use anthropometric estimates of cardiac output. While these would give reasonable estimates of compliance at rest, the inherent assumptions cause substantial errors in conditions of marked alterations in cardiac output. In contrast, PWV obtained from pulse transit time measurement does not depend on cardiac ejection and determined only by passive and active factors affecting stiffness of the arterial wall.