Ascending Aortic Pressure Wave Indices and Cardiovascular Disease

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The study by Jankowski et al (p 641) confirms that in yet another country (Poland) the indices of the aortic pressure waveform are related to clinical cardiovascular disease. Other data come from both direct and indirect measures of aortic or central (carotid) pressure, from healthy subjects, patients with coronary artery disease, hypertension, and renal failure, and from populations in China, Japan, France, Austria, Germany, and Australia (Table 1). These results are in accordance with some large studies on brachial pulse pressure,1 but not other studies.2 Those large studies, which show a poor relationship between brachial pulse pressure and cardiovascular events,2 have been criticized on the basis of systematic errors in pressure measurement,3 which are magnified in a measure (pulse pressure) that includes errors from measurement of cuff systolic pressure and of cuff diastolic pressure. In the study by Jankowski et al and other studies4–6 (Table 1), relatively small numbers of patients showed a relationship between cardiovascular disease and pressure measurements in the aorta but not pressure measurements in the brachial artery. This indicates that measures of central pressure are more directly related to cardiovascular events in central arteries than measures of pressure in a peripheral artery. This is what one would expect from general principles.5 Reasons for greater importance of central compared to peripheral pressure have been emphasized by Safar et al,6 and include the errors inherent in measurements of cuff pressure as described by Jankowski et al (their reference 8). Many of those involved in this work have successfully avoided sphygmomanometric cuff errors by relating events to measures such as aortic pressure augmentation index,4,5 aortic pulse wave velocity, and amplification of the pulse waveform between the central aorta and brachial artery (Table 1). All of these can be determined from noninvasive measurement of the central pressure waveform by applanation tonometry, as well as invasive measurements at cardiac catheterization. They are independent of cuff calibration.

Jankowski et al refer to a paper by Davies et al (their reference 20), which questions the validity of using a generalized transfer function for noninvasive measurement of aortic pressure waveforms and concludes that “peripheral blood pressure measurement is as good as applanation tonometry at predicting ascending aortic blood pressure.” If, as suggested in this article, there is a simple linear relationship between peripheral and central aortic pressure, then there would not have occurred in the study by Jankowski et al or other relatively small studies4–6 (Table 1) a definite relationship between disease and central aortic but not peripheral pressure. Such a view also denies the different relationship between central and peripheral systolic and pulse pressure at different ages and under different conditions, as apparent in the earliest careful measurements of arterial pressure waveforms in humans.5,7 Different methods are available for determining aortic pressure values apart from use of a generalized transfer function, but these are in substantial agreement and give similar results5; all depend on pulse wave contour, not on the simple values of systolic and diastolic pressure as recorded by cuff sphygmomanometer in a peripheral artery.6

Results in the study by Jankowski et al and many other studies were obtained during conventional cardiac catheterization where no specific precautions were taken to ensure adequate frequency response of the manometer system. Such was a priority in earlier studies5,7 and prospectively validated the use of a transfer function to the satisfaction of the United States Food and Drug Administration5 (authors’ reference 19). Investigators wishing to extend this type of work are urged to read the original papers (eg, reference 7) and to ensure dynamic manometer accuracy so as to avoid the artifacts that result from deterioration of manometric frequency response from presence of blood or small bubbles in the long fluid-filled catheter or their connections. Authorities8 have castigated cardiologists for “sloppiness” in cuff blood pressure measurement; the same is apparent in some measures of aortic pressure at routine cardiac catheterization.9

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The work presented by Jankowski et al is in accord not only with other recent published work where the pressure pulse waveform was measured directly at cardiac catheterization or noninvasively by applanation tonometry (Table 1). It is also in accord with the older studies on pressure pulse waveform analysis as practiced before clinical introduction of the cuff sphygmomanometer by Riva-Rocci in 1896. Such work identified pressure pulse waveforms that predicted poor prognosis in disease states from stroke, heart failure, or heart attack. These waveforms were identified by careful clinical palpation of the pulse and were confirmed by sphygmographic tracings in the latter part of the nineteenth century, before introduction of either the Riva-Rocci or Korotkov method. Such pulse waveform recordings were also used by the medical examiners of Life Insurance companies to reject asymptomatic persons who applied for life insurance, on the basis of increased risk of future cardiovascular events.

Jankowski’s work is the latest in a series of studies that link the present with the older studies of the pulse by sphygmography and were undertaken more than a century ago before clinical adoption of the cuff sphygmomanometer. All point to the secrets that lie buried in the arterial pressure pulse waveform, and urge on modern physicians, the value of looking beyond the numbers provided by the cuff sphygmomanometer.

In 1996, the International Society of Hypertension celebrated the centennial of Riva-Rocci’s method for indirect measurement of systolic blood pressure. By 1914, this had been established as related to risk of death in the actuarial studies of Fischer for the life insurance industry. In 2005 we will celebrate the centennial of Riva-Rocci’s method for indirect measurement of systolic blood pressure. By 1914, this had been established as related to risk of death in the actuarial studies of Fischer for the life insurance industry. In 2005 we will celebrate the centennial of Riva-Rocci’s method for indirect measurement of systolic blood pressure. By 1914, this had been established as related to risk of death in the actuarial studies of Fischer for the life insurance industry.
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