Letters to the Editor

Use of pulse wave analysis to measure arterial stiffness in old age

SIR—We read with interest Fantin’s cross-sectional study comparing the influence of age on arterial stiffness using the technique of applanation tonometry with pulse wave analysis (PWA) [1]. Their study is particularly welcome since the literature contains few direct comparisons of different markers of arterial stiffness [2].

The overall PWA completion rate was 66% (302/458) for carotid tonometry and 99% (453/458) for radial tonometry. This is consistent with previous research that has found carotid tonometry technically more demanding, less acceptable to patients and less repeatable than radial artery tonometry [3]. This might explain why the fitted straight-line for female carotid augmentation pressure (AG) appears inconsistent with the rest of the data [1]. The relationship between radial AG and age was best described by a simple straight line. The relationship between radial augmentation index (AIx) and age was best explained by a quadratic curve with a plateau at around 60 years for women and 80 years for men.

We have also used SphygmoCor (with radial artery tonometry) in a preliminary comparative study of arterial stiffness in acute stroke patients, individuals with equivalent cardiovascular risk and healthy volunteers (N = 59, 73% aged over 55 years; LREC Ref:05/S0801/45). While our sample size is insufficient to permit a useful comparison by sex (and we share with Fantin the problem of a heterogeneous study population) we also observed similar age-related patterns (see Figure 1).

Both AIx and AG had an initial linear relationship with age, before levelling off (at 55 years for AIx and 75 years for AG) and finally dipping at the extremes of older age. We suspect this final dip reflects a ‘healthy survivor effect’ (a bias to which cross-sectional data is particularly prone) rather than a true physiological reversal of arterial ageing. Our analysis employs both simple linear regression and non-parametric ‘local linear regression smoothing’ (SPSS v15). The latter approach is useful for exploring arterial stiffness across age-bands without having to make assumptions about the overall distribution of the observations [4]. Since AIx varies with heart rate [5], it is also shown standardised to 75 bpm. It would have been useful to see the results of similar analyses in Fantin’s study.

While our findings appear comparable with Fantin’s much larger study, we think it is premature to conclude that AG is a better guide to arterial ageing than AIx for two main reasons [1]. Firstly, pooling data from several cross-sectional surveys creates a heterogeneous study population, which restricts generalisability and potentially compounds any individual study biases. Secondly, as the accompanying editorial suggests, the clinical utility of AG and AIx will depend upon their relative prognostic ability to predict future cardiovascular events [2]. Nevertheless, Fantin’s findings justify further research into the role of PWA indices in cardiovascular risk stratification.


Figure 1.

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doi:10.1093/ageing/afm070

Reply

SIR—We thank Dr Soiza, Williams and Crilly for their interest in our paper regarding the relationships between applanation tonometry, pulse wave analyses and age.

Their experience, although in a smaller population than ours, substantially confirms our findings of a linear regression of Augmentation Pressure (AG) on age and a quadratic regression of Augmentation Index (AI) on age [1]. In fact they found an initial linear regression for AI before levelling off at 55 years whilst a plateau only after 75 years for AG. They conclude that this final dip reflects a possible ‘healthy survivor effect’ rather than a true physiological reversal of arterial ageing. We agree that cross-sectional data are difficult to interpret in this type of study. However, our findings of a linear regression of AG on age clearly show that there is an increased stiffness in old age also in our study populations, confirming previous studies [2–4]. Taking into consideration this finding, it is difficult to consider that the quadratic regression of AI on age reflects a ‘healthy survivor effect’. If this was so we would have found a quadratic regression for both the indices and not only for AI. AI does not increase with age in old age because of the method used to calculate AI, which includes a denominator Pulse Pressure (PP) [1]. PP increases disproportionately with age compared with AG and AI should not be considered a surrogate of biological age in the elderly.

For this reason we still suggest that AI should not be employed in an older population as there is physiological increase of PP [5] which negatively influences the measure of AI.

AG, which is the real measure of contribution that the wave reflection makes to the systolic arterial pressure, measured in mmHg, does not take into consideration PP and, especially in the elderly, is a better index of arterial function and overall cardiovascular health than AI.

We agree with Soiza et al. that AI varied with heart rate (HR) [6] and for this reason we compared the two groups of the study population (under and over 55 years) in terms of HR and we did not find any significant differences.

Of course we agree that some further and possibly longitudinal studies are required before using pulse wave analytic analysis in clinical practice.

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doi:10.1093/ageing/afm069