

Correspondence

Pitfalls and limitations in the use of impedance cardiography

Sir,
Technical improvements, method standardisation, and a better understanding of the limitations of transthoracic differentiated impedance cardiography have contributed to a recent resurgence of interest in the use of this technique as a non-invasive tool for the continuous monitoring of cardiac performance in man. We compliment Dr S A Smith and his colleagues on their interesting data (1988;59:292-8) but we are concerned that the well documented lack of accuracy of a specific electrical bioimpedance cardiograph (BoMed NCCOM3), which uses new and not well-defined techniques and mathematical procedures, might result in a general rejection of this method.

The accuracy of impedance cardiography is indeed limited; none the less, the technique is useful for the assessment of within subject changes of cardiac performance.^{1,2} The following additional limitations are too often ignored or underestimated: (a) the bioimpedance method merely offers "estimates" or "equivalents" of stroke volume; (b) the equations used to calculate these estimates are based on (over) simplified physiological assumptions³; (c) analysis of the impedance signals is often difficult, if not impossible, if a high quality phonocardiographic tracing does not detect aortic closure⁴; and (d) physiological, pathological, or drug induced distortions of the impedance signals by small amplitude high velocity presystolic impedance changes⁵ may invalidate the standard approach to the analysis of the signals.

Careful graphical analysis, manual or computerised, of the various tracings therefore remains essential for validity. Because this approach is tedious and time consuming, "simplified" techniques have been developed. The equipment assessed in the paper by Smith *et al* is a negative example of this approach. This equipment can indeed be criticised on many accounts: (a) it uses its own equation to estimate stroke volume, unlike the standard method of Kubicek *et al*⁶ and this equation does not accord with this standard,⁷ (b) it does not use a phonocardiogram as a reference for the analysis of the impedance signals, and (c) because it is designed as a "blind box" (that is, without analogue signal display) it does not allow the assessment of signal quality for distortion.

The conclusions of Smith *et al* therefore are not surprising; but it would be inappropriate for them to lead to the general rejection of impedance cardiography.

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