Letter and Reply
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Pitfalls in comparison of left ventricular mass measurements by echocardiography and cardiovascular magnetic resonance imaging

Sir,
We read with interest the recent report by Getts et al. [1] on the use of volumetric cardiovascular magnetic resonance (CMR) imaging to follow regression of left ventricular (LV) hypertrophy after bilateral nephrectomy. The authors note that echocardiography may overestimate LV mass in end-stage renal disease patients and that CMR may be particularly valuable for serial cardiac examinations. We agree with both assertions, but we emphasize two related points. First, clinical echocardiography can overestimate LV mass, because a cubed-power mathematical formula is used to estimate mass from linear measurements of the LV [2] and the underlying geometric assumptions may be invalid in diseased and distorted ventricles. Errors increase with excess LV wall thickness and elevated LV end-diastolic diameter [3]. The overestimation is not a deficiency of echocardiography per se as three-dimensional echocardiography (3DE), which does not rely on geometric models, is able to measure LV mass accurately with respect to CMR [4].

For the case report, applying the commonly used Penn (geometric) LV mass formula to their linear CMR measurements yields 'echo-equivalent' geometric LV mass of 580 g pre-nephrectomy and 362 g post-nephrectomy, both greater than the actual (volumetric) CMR LV masses of 262 g pre-nephrectomy and 208 g post-nephrectomy. This gives the interesting, but erroneous, result of post-nephrectomy 'geometrical-echo' mass being greater than pre-nephrectomy volumetric CMR mass. (LV diameters, of 46.3 mm pre-nephrectomy and 48.1 mm post-nephrectomy, were back-calculated using data in the Figures and in Table 2.) This leads to the second point: a volumetric-CMR LV mass cannot directly be compared with the standard clinical-echo estimate of LV mass, as the geometric formulas not only frequently overestimate LV mass but also stratify patients discordantly relative to volumetric CMR. In a study of 292 adults from the Framingham Heart Study Offspring cohort, one-third of participants were assigned to different quartiles of LV mass when ranked by geometric-formula mass versus volumetric-CMR mass [5]. In summary, a lower volumetric-CMR LV mass, as compared with prior clinical-echo LV mass, does not necessarily imply a true decrease in LV mass. Thus volumetric methods such as CMR and 3DE are preferred for evaluation of cardiac function and LV mass, particularly across serial examinations.

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Reply
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SIR,

We thank Dr Chuang and Dr Manning for their thought-provoking letter [1], in which they raise interesting points that expand upon the illustrative value of the case we presented [2]. Three-dimensional echocardiography (3DE) has shown promise as another method to avoid the geometrical modelling errors inherent in the two-dimensional echocardiography as currently available.

The intellectual exercise of subjecting magnetic resonance imaging (MRI) measurements to the same erroneous geometrical models used in conventional echocardiography is stimulating and illustrates that the independence of MRI measurements from calculations based on such geometrical assumptions is an important strength. In addition, their calculation demonstrates the inability to make meaningful comparisons between an MRI study and a preceding two-dimensional echocardiogram, as has been noted [3]. Undoubtedly, dialysis patients would be well served by more accurate depiction of cardiac anatomy. An optimal future will require expansion of both MRI and 3DE beyond current limited availability.

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