

## **Introduction**

It has been suggested that papillary muscle (PM) and mitral valve (MV) abnormalities may manifest earlier than frank left ventricular (LV) hypertrophy in the clinical presentation of hypertrophic cardiomyopathy (HCM). Hypertrophied PMs and abnormal anterior PM fusion to the LV walls can promote systolic anterior motion of MV and LV outflow tract obstruction. Little is known about PM and MV changes in young patients with HCM, particularly in earlier stages of disease. We hypothesized that increased PM mass and apical displacement are present in younger patients with mild and moderate HCM, and investigated PM and MV structure and function using real-time three-dimensional echocardiography (3DE).

## **Methods**

Transthoracic research 3DE was performed in HCM patients and age and gender matched controls (iE33; X7-2t; Philips). Anterolateral and posteromedial PM mass, and apical displacement of anterolateral PM were measured (4 D Cardioview 3.0) and indexed to body surface area. The MV annulus structure and function was analyzed (4D MV 2.0, TomTec). Individual PMs were manually planimetered by tracing the endocardial borders on each mid systole frame, taking care to distinguish PMs as distinct from the LV wall (Figure). Apical displacement of the PM was expressed as ratio of the distance between the apex and the base of the anterolateral PM to the entire length of the LV lateral wall (APM ratio).

## **Results**

Twenty-six subjects were studied, including 13 HCM patients (age  $20.5 \pm 12.9$  years, 10 male and 3 female), and 13 controls ( $20.6 \pm 13.0$  years, 10 male and 3 female). The indexed LV mass in HCM was  $100 \pm 46$  compared to  $58 \pm 20$  in controls ( $p < 0.01$ ). The anterolateral and combined PM mass were  $3.8 \pm 1.5 \text{ g/m}^2$  and  $5.7 \pm 1.8 \text{ g/m}^2$  in HCM, and differed from respective measurements of  $2.1 \pm 0.6 \text{ g/m}^2$  ( $p < 0.01$ ) and  $4.4 \pm 0.7 \text{ g/m}^2$  in controls ( $p < 0.05$ ). The posteromedial PM mass in HCM ( $2.0 \pm 0.9 \text{ g/m}^2$ ) was not statistically different from controls ( $2.3 \pm 0.6 \text{ g/m}^2$ ,  $p = 0.153$ ). The mitral valve annular parameters (annulus circumference, height and area) in HCM also did not show significant difference from controls. The APM ratio in HCM was lower ( $0.4 \pm 0.1$  vs.  $0.5 \pm 0.05$  in controls,  $p < 0.01$ ).

## **Conclusion**

It is feasible to assess PM size and function in children and young adults with HCM using 3DE. The APM ratio is decreased in HCM from apically displaced anterolateral PM. This data suggests that morphologic and functional changes of anterolateral PM may precede the mitral valve annulus changes. Associations of PM indices with clinical outcomes in HCM need to be further explored.