Coronary vasodilator reserve in left ventricular hypertrophy

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Cardiac hypertrophy is a morphological adaptive increase in myocardial mass in response to chronic work overload and is a common clinical finding affecting 23% of men and 33% of women over the age of 59 years1. Pressure or volume overload on the myocardium results in an increase in myocardial wall stress and hypertrophy may be seen as an attempt to normalise wall stress and oxygen demand2,3. The increased myocardial mass requires an increase in coronary blood flow to maintain function. Indeed, ventricular hypertrophy may be associated with myocardial ischaemia even with angiographically normal coronary arteries4-6. Left ventricular hypertrophy (LVH) significantly increases the risk of myocardial infarction, congestive heart failure and sudden cardiac death7-9. It is also associated with a greater prevalence of cardiac arrhythmias10 and is an important risk factor for cardiac morbidity and mortality11,12.

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The coronary vasodilator reserve (CVR), defined as the ratio of myocardial blood flow (MBF) during near maximal hyperaemia to baseline MBF, is reduced in LVH due to hypertension13, aortic stenosis14, aortic regurgitation15, supravalvar aortic stenosis and hypertrophic cardiomyopathy16 and in experimental models of LVH17-20 (Fig. 1). The reduced CVR limits the ability of hypertrophied hearts to meet the metabolic requirements when demand is increased. Despite normal myocardial oxygen consumption20 and myocardial perfusion per unit mass21,22 at rest, the hypertrophied heart is more vulnerable to ischaemia23-26.

Experiments in animals3,23 have demonstrated that the impairment of CVR is more marked in the subendocardial layers of the left ventricle, with some evidence of an alteration in the normal subendocardial-subepicardial distribution of perfusion during near maximal vasodilatation in patients with hypertrophic cardiomyopathy27. More recently14 we have demonstrated that CVR is impaired in patients with LVH secondary to aortic stenosis and that the impairment correlates with the severity of the transvalvular gradient. In addition, as the gradient increases, subendocardial CVR becomes progressively more impaired than subepicardial CVR (Fig. 2).

Effect of left ventricular hypertrophy regression on the impairment of coronary vasodilator reserve

Experimental studies have reported that antihypertensive treatment of spontaneously hypertensive rats reduces LVH28-31 with improvements in left ventricular compliance and reduced vulnerability to ischaemia although CVR remained impaired32. In contrast, other studies have demonstrated some recovery in coronary vascular morphology33,34 and CVR35 with regression of experimental hypertrophy. Reduction in echocardiographically measured left ventricular mass has been observed clinically after treatment36-43 in patients with hypertension. Regression of LVH does occur following aortic valve replacement44 but may remain incomplete in 50% of such patients45. In contrast to the intense interest in regression of left ventricular mass, few studies have examined whether this is accompanied by reversal of the pathophysiological effects of LVH.
liminary results from our study in patients with aortic stenosis and LVH show that reduction in left ventricular mass following aortic valve replacement is associated with a marked improvement of overall CVR. It is unclear whether similar changes occur with regression of LVH in hypertension. One study has demonstrated an improvement in CVR with antihypertensive treatment, although it remains to be established whether regression of LVH correlates with improvement in CVR.

References


