Does Load Dependence of Relaxation Differ Between Left and Right Cardiac Muscle?

Differences in load dependence of relaxation between the left and right ventricular myocardium of the rat have recently been reported by Capasso et al. These authors have shown that, in both adult Fischer and Sprague-Dawley rats, myocardial relaxation of right ventricular papillary muscles does not depend on the prevailing load throughout the physiological range of afterloaded contractions, contrary to what is observed in the left ventricle. In Sprague-Dawley rats, these typical profiles of relaxation are maintained with age. Conversely, in Fischer rats, the load independence of relaxation observed in right ventricular papillary muscles slightly decreases with age, whereas left ventricular papillary muscles become progressively less dependent on loading conditions. The authors write that "the load independence of relaxation in the right ventricle may interfere with the rapid filling phase of diastole" and "may imply that the right ventricle possesses a limited supportive role when left ventricular dysfunction develops." Such results would be of pathophysiological relevance if differences in load sensitivity of relaxation between the right and left myocardium had really been observed in most mammalian heart muscles. Unfortunately, a load-dependent relaxation of right myocardium has been widely documented in numerous species.

In their princeps study, Brutsaert et al. have shown that relaxation of right ventricular papillary muscles of the cat is particularly load dependent. They have also observed that relaxation behaves in a similar load-dependent manner in the right ventricular myocardium of both rabbit and pig. Load sensitivity of relaxation has also been described in right ventricular papillary muscles of ferrets. Finally, Lecarpentier et al. have shown that right ventricular papillary muscles and trabeculae of adult Wistar rats clearly exhibit a load-dependent relaxation. In all these right ventricular specimens, the isometric relaxation phase of afterloaded twitches always occurs before that of the fully isometric twitch. In particular, the load dependence of relaxation has also been revealed in the right ventricle of the rat by imposing rapid load clamps during the last third of the contraction phase. Such loading steps induce a premature onset of the lengthening phase of the sarcomere, the real-time kinetics of which have been measured by laser diffraction. This mechanical response to late load clamps is typical of a load-dependent relaxation.

Differences in the relaxing behavior of the right ventricle of rats between the study of Capasso et al. and our studies remain speculative. It has been demonstrated that the expression of load sensitivity of relaxation is highly dependent on both the extent of muscle shortening and the isotropic state. However, classical mechanical parameters quantifying muscle performance (such as muscle force, extent of muscle shortening, and shortening velocity) are not presented in the study of Capasso et al. Lastly, Brutsaert et al. have demonstrated that the expression of load dependence of relaxation is more pronounced in right than in left ventricular specimens. These findings are strongly at variance with those of Capasso et al.

In conclusion, the load-dependent behavior of cardiac relaxation as first described by Brutsaert et al. is a characteristic mechanical property of mammalian myocardium and is observed in both left and right ventricles, even in the rat. No pathophysiological effects related to a hypothetical absence of load sensitivity of relaxation in the right ventricle can be inferred regarding high and low pressure systems.

References


Reply to the Preceding Letter

We appreciate the comments of Lecarpentier et al regarding our work. However, we do not agree with their conclusions. The cited literature in support of their conviction that the right myocardium of rats is load dependent refers to cat, pig (n = 1), ferret, and rabbit (n = 3), whereas only left muscles were examined in rats. Moreover, in their letter, Lecarpentier et al indicate that their previous work demonstrated load dependency in trabeculae from the right ventricle of the rat. Their contention is based on the presentation of one afterloaded isotonic twitch that is illustrated in Figure 4 of Reference 3. Sarcomere mechanics was the major part of that investigation, and the phenomenon describing the load dependency of the myocardium...
Does load dependence of relaxation differ between left and right cardiac muscle?

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