Dear Editor,

The article ‘Critical evaluation of indices of myocardial contractility derived from the isovolumic phase of contraction’ by Urschel et al. (1) once again raises the question of the validity and applicability of V\text{max} and other force-velocity indices as measures of the contractile state, independent of changes in preload.

The authors, acknowledging the debate on the concept of V\text{max} and its applicability to the intact ventricle, state that ‘The technique clearly appears to be applicable on an empiric basis despite the formidable number of assumptions that are made’.

I would like to explain why I consider that the indices, as they are actually measured and not what the ‘V\text{max} concept’ assumes they represent, reflect changes in the contractile state and have low sensitivity to changes in preload. All the indices mentioned in the article by Urschel et al. are calculated according to the ratio

\[
\frac{dp(t_1)}{dt} \div P(t_i)
\]

This ratio has a good basis to be a successful index regardless of the validity of the chain of assumptions made by the ‘V\text{max} concept’. This can be implicitly concluded from data presented by Reeves et al. (2) 20 years ago on intraventricular pressure measurements, and...
Fig. 1. The effect of changes in initial muscle length. PI A = Positive inotropic agents; NIA = negative inotropic agents.

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by Reeves and Hefner (3) on measurements by strain-gauge arch sutured to the left ventricle in anesthetized dogs. In these experiments, changes in initial muscle length did not change the ratio between $\frac{dp}{dt_{\text{max}}}$ (or $dT/dt_{\text{max}}$) and systolic peak pressure (or $T_{\text{max}}$); however, positive inotropic agents increased, while negative inotropic agents diminished, this ratio for any given initial muscle length (fig. 1). Hence, because variations in preload change the instantaneous rate of development of pressure ($dp/dt$) and the instantaneous pressure ($p$) to the same extent, this may explain the empirical independency of all the indices based on this ratio at various combinations. However, the empirical data neither strengthen nor weaken the validity of the many assumptions made, beginning at the behavior of the velocity of the contractile element at zero load up to the behavior of the isovolumic pressure.

All these indices have the dimension of time ($t^{-1}$); this may indicate that changes in initial muscle length introduce quantitative changes but not time-dependent changes (4). Because measuring time-dependent parameters indirectly has the disadvantage that extremely high values are attained when the denominator is small, it may be preferable to extract them directly from the time domain. Such indices could be the time from onset of contraction to $dp/dt_{\text{max}}$ ($t_{\text{-}dp/dt}$) or other time parameters derived directly from the intra-ventricular pressure as a function of time (4).

References