Left Ventricular Preload-Adjusted Maximal Power: Clinically Useful Marker of LV Contractility?
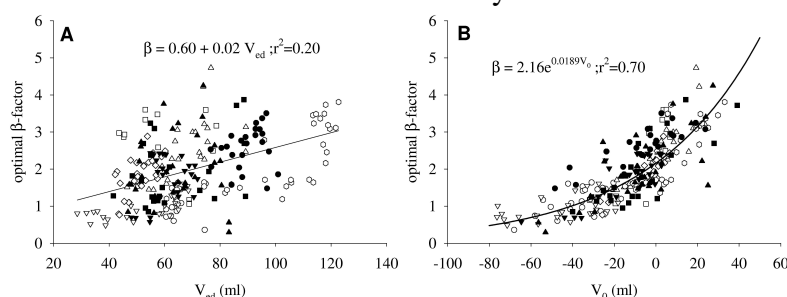
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Maximal left ventricular (LV) hydraulic power output (PWR_{max}), corrected for preload (V_{ed}: end-diastolic volume) as PWR_{max}/V_{ed}^{β} is an index of left ventricular (LV) contractility. While preload-adjusted maximal power (PAMP) is usually calculated with $\beta=2$, there is uncertainty about the optimal value of β ($\beta = 1$ for normal and 2 for dilated LV). The aim of this work is to study the determining factors of β. The data set consisted of 245 recordings (steady state and vena cava occlusion) in 10 animals in an ischemic heart pig model. The occlusion data yielded: (i) the slope (E_{es}; 2.01±0.77 mmHg/ml; 0.71-4.16 mmHg/ml) and intercept (V_0; -11.9±22.6 ml; -76 to 39 ml) of the end-systolic PV relation; (ii) the optimal β-factor (assessed by fitting an exponential curve through the V_{ed}-PWR_{max} relation) was 1.94±0.88 (0.29 to 4.73). The relation of β with V_{ed} was weak ($\beta = 0.60+0.02\ V_{ed}$;$r^2=0.20$) . In contrast, we found an excellent exponential relation between V_0 and β ($\beta = 2.16e^{0.0189V0}$; $r^2 = 0.70$). PAMP, calculated from the steady state data, was 0.64±0.40 mWatt/ml^2 (range 0.14-2.83) with a poor correlation with E_{es} (r=0.30; P<0.001). An alternative formulation of PAMP as $PWR_{max}/(V_{ed}-V_0)^2$, incorporating V_0, yielded 0.47±0.26 mWatt/ml^2 (range 0.09-1.42) and was highly correlated with E_{es} (r=0.89; P<0.001). In conclusion, we have demonstrated that in our animal model, preload-adjusted maximal power poorly correlates with the slope of the end-systolic PV relation. Moreover, the β-factor, optimally used for preload correction, is not constant, but varies with the intercept of the end-systolic PV relation. This limits the clinical applicability of PAMP as an index of LV contractility.