THEORETICAL CONSIDERATIONS ABOUT THE EFFICIENCY OF CARDIAC PUMP-FUNCTION


For any specific myocardial workload a certain constellation of hemodynamic parameters should exist to achieve an optimum of myocardial efficiency.

Since the cardiac efficiency is, by definition, the ratio between left ventricular stroke work and energy demand, changes in hemodynamics influence cardiac work and energy demand competitively. An increase in hemodynamics results in an increase in the cardiac work which would give a better cardiac efficiency but on the other hand, also increases the energy demand which influences the cardiac efficiency in the opposite direction. These two competitive effects may or may not be to the same extent.

Based on these considerations a mathematical model for estimating the optimal myocardial efficiency under various hemodynamic conditions has been developed. These theoretical optima are compared to experimental data within a broad hemodynamic range.

AN INDIRECT METHOD FOR CONTINUOUS REGISTRATION OF CARDIAC OUTPUT FROM HEMODYNAMIC PARAMETERS


To estimate changes of cardiac output (CO) and of corresponding parameters determined from this (peripheral resistance, cardiac efficiency) an attempt was made to calculate CO continuously from hemodynamic parameters according to the formula:

\[ CO = \text{heart rate} \times (\text{end-diastolic volume} - \text{end-systolic volume}) \]

Previous investigations have shown a close correlation \((r = 0.89)\) between ESV/100 g measured by the Holt technique and EDV/100 g calculated by the formula: \(\frac{P_{sys}}{dP/dt_{max}}^{1/2}\), by analyzing 29 steady-states in normal and mild hypervolaemia in dogs. EDV/100 g remained practically constant \((K = 64.6 \pm 6.3 \text{ ml})\). Under these premises, on-line monitoring of \(P_{sys}\), \(dP/dt\) and heart-rate allows, by the aid of a micro-computer, the continuous calculation of a so-called dynamic CO. The correlation between CO measured by thermodilution and CO calculated by this indirect method was analyzed in 46 steady-states \(\text{range of CO: 1-12 l/min}\) leading to a correlation coefficient of 0.939.

Based on these data, we suggest that this simple method gives valuable information about qualitative changes in the functional state of the heart and circulatory system under experimental conditions.