Ejection fractions and pressure-heart rate product to evaluate cardiac efficiency. Continuous, real-time diagnosis using blood pressure and heart rate.

Abstract: Ejection fractions, derived from ventricular volumes, and double product, related to myocardial oxygen consumption, are important diagnostic parameters, as they describe the efficiency with which oxygen is consumed. Present technology often allows only intermittent determination of physiological status. This deficiency may be overcome if ejection fractions and myocardial oxygen consumption could be determined from continuous blood pressure and heart rate measurements. The purpose of this study is to determine the viability of pressure-derived ejection fractions and pressure-heart rate data in a diverse patient population and the use of ejection fractions to monitor patient safety. Volume ejection fractions, derived from ventricular volumes, $EF(V)$, are defined by the ratio of the difference of end-diastolic volume, $EDV$, and end-systolic volume, $ESV$, to $EDV$. In analogy, pressure ejection fraction, $EF(P)$, may be defined by the ratio of the difference of systolic arterial pressure, $SBP$, and diastolic arterial pressure, $DBP$, to $SBP$. The pressure-heart rate (heart rate: $HR$) is given by the product of systolic pressure and heart rate, $SBP \times HR$. $EF(P)$ and $SBP \times HR$ data were derived for all patients ($n = 824$) who were admitted in 2008 to the ICU of a university hospital at the specific time 30 min prior to leaving the ICU whether as survivors or non-survivors. The results are displayed in an
efficiency/pressure-heart rate diagram. The efficiency/pressure-heart rate diagram reveals one subarea populated exclusively by survivors, another subarea populated statistically significant by non-survivors, and a third area shared by survivors and non-survivors. The efficiency/pressure-heart rate product relationship may be used as an outcome criterion to assess survival and to noninvasively monitor improvement or deterioration in real time to improve safety in patients with diverse dysfunctions.