

Golden ratio in congestive heart failure: A promising proportion for prognosis and decompensation

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The article published by Kowalczyk et al. [1] was read with great enthusiasm and interest. Briefly, the prognostic value of daytime heart rate (HR), systolic (SBP) and diastolic (DBP) blood pressure (BP), and their multiplication products and ratios was assessed in congestive heart failure (CHF) patients. Accordingly, it was found that daytime DBP and products including $HR \times DBP$ and $HR \times SBP$ may be valuable risk stratification factors for predicting death and decompensation in stable patients [1]. Beyond the prognostic implication of HR, BP and their products in patients with stable CHF, attention was paid to the value of SBP and DBP itself, in terms of the golden ratio. In the study population, Kowalczyk et al. [1] found mean daytime SBP and DBP of patients with stable CHF as 114 mmHg and 70 mmHg, respectively. The ratio of SBP to DBP gives 1.62, which is very close to the golden ratio as described previously by the famous mathematicians Euclid and Fibonacci [2]. In addition, it is also noteworthy to calculate the ratio of SBP to DBP in patients with decompensated (107.0/60.7 mmHg) and non-decompensated (115.3/72.1 mmHg) status during the follow-up period. SBP/DBP in patients without decompensation is 1.59; whereas it is 1.76 in decompensated patients, which shows a distinct deviation from the golden ratio.

In principle, golden proportion is an observation that the ratio of any two sequential Fibonacci numbers approximates to the value of 1.618, which is named as the Greek letter Phi (ϕ) [2]. The Fibonacci series or golden ratio represents itself in a variety of natural settings such as the design of patterns in flowers, branching of leaves; and have

also been used in the modeling of biological and financial systems as well as in electronics and music [2–4]. By defining the systolic phase interval as the time between the tip of the R wave and the end of the T wave on electrocardiography, the diastole/systole ratio has demonstrated as 1.611 and R-R interval/diastole ratio as 1.618, which is very close to golden ratio [5]. Furthermore, the ratio of the left ventricular end-diastolic to the end-systolic diameters gives a ratio equal to 1.614, which is quite close to the golden ratio [6]. In a similar manner, Henein et al. [7] have demonstrated that vertical and transverse dimensions of the heart are in accordance with the golden ratio in healthy humans. However, in the end-stage HF patients the ratio significantly decreases [7]. Likewise, SBP to DBP ratios have been shown to be very close to the golden ratio both in the systemic and pulmonary vascular system [8–10]. Yetkin et al. [8] observed that night-time proportions of systemic systolic to diastolic pressures are the closest results to the golden ratio; however, during the daytime it is a bit far from the golden ratio which might be explained by the changing balance between sympathetic and parasympathetic activity [8]. In this regard, it is exciting to observe the SBP/DBP ratio as very close to the golden proportions in stable CHF and deviated in decompensated patients. Values of the SBP/DBP rate, which are higher than or show considerable deviation from the golden ratio, might be a useful criterion for predicting decompensation in stable CHF patients with the support of future clinical studies.

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