Letter to the Editor
Mol Imaging Radionucl Ther 2024;33:66-67 DOI:10.4274/mirt.galenos.2023.69345

About the Article Titled "A Different Scintigraphic Perspective on the Systolic Function of the Left Ventricle-1"

"Sol Ventrikül Sistolik Fonksiyonuna Sintigrafik Olarak Farklı Bir Bakış Açısı-1" Başlıklı Makale Hakkında

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Keywords: Gated myocardial perfusion imaging, systolic volume change, radioactive decay formula, decay constant

Anahtar kelimeler: Kapılı miyokard perfüzyon sintigrafisi, sistolik hacim değişimi, radyoaktif bozunma formülü, bozunma sabiti

Dear Editor,

This article examines whether the decay formula meets the systolic volume change (1), but there is a doubt that it is the correct model to express the systolic ejection dynamics mentioned in the text. The exponential decay formula emphasizes that the activity/substance/volume halves at a certain time and is used to calculate the remaining at a given time. Therefore, the formula expressed here would not be exact to represent the systolic function.

Ejection fraction (EF) shows the ejection volume percentage in each cardiac beat without considering time, which is chronotrophy represented by Heart rate (HR) [EF = (Stroke volume/End diastolic volume (EDV)) x100]. Cardiac output (CO = HR/min × stroke volume) takes time into account with volume. Factors affecting CO, HR, and stroke volume (inoptophy, cardiac muscle power, Frank starling rule) also affect EDV, end systolic volume (ESV), systole, and diastole time. Preload and afterload are the factors that influence all these cardiac functions (2). Some other factors such as partial oxygen pressure and hemoglobin levels do not originate from the heart but affect the cardiac functions at the end (2). This study does not search the remaining volume at a given time, but searches ejection constant (Ec) (k), which might indicate the influences of all structural and functional factors related to cardiac ejection. For this purpose, this study scrutinizes the systolic part of the heartbeat, which is a good idea.

However, this idea needs to be proved clinically and mathematically because the purpose of the decay formula is completely different. The formula needs to be tested particularly on how it responds to situations with different HRs. There areno representative satisfying calculations with volume curves of real patients in the text. Therefore, the clinical value of Ec may be tested with imaginary situations. For example, for EDV: 125 and ESV: 35; EF: 72%. For beat per minute (BPM) =60/min; CO = HR/min × stroke volume: 60x90=5400 mL/min (stroke volume: EDV-ESV: 125-35=90). The normal range for EF is 50-70% and

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Received: 22.03.2023 **Accepted:** 18.09.2023

for CO is about 4-8 L/min. Cardiac cycle time: 1000/16 ms, systole time: 5.5 frame x (1000/16) ms =343.75 ms. With the decay formula: ESV = EDV. e^{-kt}; k =0.0037/ms; (Ec) k =3.7/s. In summary, for BPM =60/min, CO =5.4 L/min, EF: 72%, Ec: 3.7 are found, and these results are categorized as normal in the text.

"At a normal heart rate of 72 beats/min, systole comprises approximately 0.4 of the entire cardiac cycle" (2). Considering this statement from Guyton and Hall's Physiology, letus see what happens when the same patient has 72/min HR. Letus take the systole time as 6.4/16 unit time (40% of total cardiac cycle time), and EF =60%, EDV: 100 and ESV: 40, also mentioned as normal in Guyton and Hall's Physiology. Based on these values, Ec (k) is found to be 2.7, which is categorized as "ischemic" in the text. (EF 60%, CO =72x60=4320 mL/min). Despite being within the normal limits (change in BPM: 60 to 72/min), the cardiac HR differences changed Ec (k) dramatically (from normal group into ischemic one). Does this mean that patients can fall into the ischemic category when they are excited? Sympathetic and parasympathetic stimulations influence all parameters (especially the systole time, EDV and ESV), but we know that some compensation mechanisms keep the perfusion constant (2).

As shown in Figures 8a and 8c, different ES and ED volumes in patients with normal EF values might indicate different clinical presentations. For Figure 8a; EDV: 68, ESV: 20, stroke volume: 48 (normal range of stroke volume: 50-100 mL). EF: 70%, Ec (k): 2.5 (normal). For Figure 8c; EDV: 130, ESV: 60, stroke volume: 70. EF: 54%, Ec (k): 1.6 (infarct). Figures 8a and 8c indicate that the infarcted myocardium may have a higher stroke volume than normal. Does the size of the infarct area make a difference? Although Ec (k) does not directly take HR into account, the category of the curve changes. Does this change reflect the myocardial perfusion situation? Robustly, this does not seem very normal logically. On the other hand, the number of patient groups seems similar, and no data are given about the pretest probabilities for each group.

Visual evaluation of the volume curve is a routine part of gated myocardial perfusion imaging interpretation. If there is a constant k value as in the decay constant (λ), it is expected that each heart with the same k value would have a certain systolic volume decrease half-time. Because HR does not take part in the formula, this constant (k) must not change with different HRs. By the way, it is mentioned that all the volume curves were created automatically by QGS software, and it is questionable whether there would be any need to make changes in the drawings.

Although the decay formula does not exactly meet the systolic volume change, it is also exponential. It is not the same but similar. Thus, Ec seems to have a good correlation with EF, EDV, and ESV. EF and Ec that both refer to EDV and ESV are the logically correlated parameters. However, any case with EF and Ec uncorrelated might be an explanatory example.

In fact, visual evaluation seems better than Ec (k) calculation. The visual evaluation of the curve itself can provide more information than this imaginary decay formula. EDV, ESV, stroke volume, systole and diastole time, the slope of the systolic volume curve, and EF can be calculated, and normal and abnormal curves can simply be evaluated visually. The (k) calculation adds nothing more than visual evaluation and may mislead the clinical evaluation.

Ethics

Financial Disclosure: The author declared that this study received no financial support.

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