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Research Article

Abnormal Durations of Adult Cardiac Systole and Diastole: The Long and the Short of It

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Abstract
Prolongation and shortening of the durations of both systole and diastole have been reported for many years. These changes may be seen in several physiologic and pathophysiologic conditions. Awareness of these abnormalities may be helpful to the clinician in understanding and treating these conditions.

Keywords: Systole, diastole, duration

Introduction
It has generally been accepted that the duration of systole is about 33%, while the duration of diastole is about 67% of the cardiac cycle at a resting heart rate. Some studies report the normal duration to be 32-42% for systole, and 58-68% for diastole (1-2). In any case, these durations have been reported to be abnormally long or short in several conditions including: bradycardia, tachycardia, heart failure with reduced ejection fraction, heart failure with preserved ejection fraction, hypertension, left ventricular hypertrophy, aortic stenosis, aortic insufficiency, hypertrophic cardio-myopathy, hypothermia, and in athlete's heart (1-11). This paper reviews these abnormal durations and their clinical implications.

Methods and Results
A literature search was undertaken. In these studies, the durations of systole and diastole were measured from echocardiogram and doppler measurements. The results are summarized in Table 1. The durations are reported in milliseconds.

Table 1.

	Systole	Diastole	Comments
Normal at Rest	270-300	500-590	normal ranges (70 beats-min)
Bradycardia	300	700-800	longer diastole
Tachycardia	260-280	200-250	shorter diastole
Hypertension-LVH	310-330	450-500	longer systole diastole shorter or normal
Aortic Stenosis	340-360	400-450	longer systole diastole may be shorter
Aortic Insufficiency	270-300	400-450	diastole shorter at higher rates
HFpEF	300-320	400-450	systole normal or slightly long diastole shorter
HFrEF 50%	280	580	
40%	300	560	Resting (70 beats
30%	330	530	per minute)
20%	360-380	480-500	
HFrEF 50%	190	400	
40%	210	380	Resting (100 beats
30%	240	370	per minute)
20%	260	345	

HCM	330-370	400-460	longer systole shorter or normal diastole
Athlete	260-310	480-500	systole slightly long or slightly short diastole slightly long at slow rates
Hypothermia	300-330	450-500	systole longer diastole shorter

Discussion

Based on the above data, there are several interesting observations. In bradycardia, the diastolic duration can increase significantly. However, in tachycardia, diastole is dis-proportionally shortened compared to systole in the normal heart. Importantly, in HFrEF systole is prolonged, while diastole is significantly shortened especially at high rates with low ejection fraction (20 and 30%). This compressed diastole reduces diastolic filling time causing incomplete LV filling, increased LA pressure and pulmonary congestion, leading to clinical decompensation. This supports the idea that in such

patients, rapid heart rates should be avoided, perhaps with the use of beta-blockers.

In HFpEF, systole is normal or only slightly long, while diastole again is shortened, consistent with LV diastolic dysfunction. Shorter diastole can also be seen with aortic insufficiency at high heart rates, which may also be of concern.

In high afterload states such as aortic stenosis, hypertension, and HCM, systole is prolonged is response to ejection in the face of high resistance, while diastole may reduce.

In athletes, systole may be slightly shortened due to more efficient contractility as a result of training, plus the increased vagal tone associated with a slower resting heart rate may prolong diastole.

In hypothermia, the contraction process is slower leading to a longer systole and a shorter duration of diastole.

Conclusions

Awareness of abnormalities in the durations of systole and diastole can be helpful for the clinician in understanding and treating various cardiac disorders.

References

1. Bachani N, Vijay S, et al. The diastolic duration as a percentage of the cardiac cycle in healthy adults: a pilot study. Indian Heart Journal 2025 Feb19:50019-4832(25)00040-9. Doi:10.1016/j.ihj.2025.02.005.
2. Bombardini T, Gemigucim V, et al. Diastolic time-frequency relation in the stress echo lab: filling time and flow at different rates. Cardiovasc Ultrasound 2008;6:(15). Doi:10.1186/1476-7120-6-15. PMID 18426559.
3. Chung C, Karamanoglu M, et al. The duration of diastole and its phases as a function of heart rate during supine bicycle exercise. Am J Physiol Heart Circ Physiol 2004;287(5):56. Doi:10.1152/ajpheart.00404.2004.
4. Cheng L, Liao K, et al. Diastole to systole durations and echocardiography, measurements and its application to a classification of heart failure phenotypes. Int J Gen Med 2021;10(14):5493-5503. Doi:10.2147/IJGM.S324319. PMID 34531677.
5. Iman H, Karmakar C, et al. Analyzing systolic-diastolic interval interaction characteristics in diabetic cardiac autonomic neuropathy progression. IEEE J Transl Eng Health Med. 2015;31900510. Doi:1109/JTEHM.2015.2462339. PMID 27170895.
6. DeScalzi M, DeLeonaidis V. Relationship between systolic time intervals and arterial blood pressure. Clin Card 1986;9(11):545-549. PMID 3802602. Doi:1002/c/c.4960091104.
7. Ranard L, Bonow R. Imaging methods for evaluation of chronic aortic insufficiency in adults. JACC 2023;82(20): 1953-1966. Doi.org/10.1016/j.jacc.2023.08.051.
8. Bombardini T, Sicari R. Abnormal shortened diastolic time length at increasing rates in patients with abnormal exercise-induced increase in pulmonary artery pressure. Cardiovasc Ultrasound 2011;9(36). PMID 22104611. Doi:10.1186/1476-7120-9-36.
9. Archad W, Duncan H, et al. Systole-diastole mismatch in HCM is caused by stress induced left ventricular outflow tract obstruction. American Heart J2004;148(5): 903-909. Doi:org/10.1016/j.ahj.2004.04.010.
10. Hiis H, Casson M, Dahl C, et al. Hypothermia elongates the contraction-relaxation cycle in explanted human failing heart, decreasing the time for ventricular filling during diastole. Amer J Physiol Heart and Circulatory Physiol 2018;315(5). Doi:org/10.1152/ajpheart.00208.2018.
11. Singh J, Ellingson C. Cardiac cycle timing intervals in university varsity athletes. Eur J Sport Sci 2023;23(7):1457-62. Doi:10.1080/17461391.2023.2178329. PMID 36752085.

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