

PARADOXICAL SINUS DECELERATION DURING DOBUTAMINE STRESS ECHOCARDIOGRAPHY – DIAGNOSTIC SIGNIFICANCE AND THERAPEUTIC APPROACH

PARADOKSALNA SINUSNA DECELERACIJA TOKOM DOBUTAMINSKOG STRES-EHOKARDIOGRAFSKOG TESTA – DIJAGNOSTIČKI ZNAČAJ I TERAPIJSKI PRISTUP

Borislav DOLAMIĆ¹, Ana ALADIN DOLAMIĆ², Anđelko HLADIŠ¹, Dragoslava ŽIVKOV ŠAPONJA³ and Anastazija STOJŠIĆ MILOSAVLJEVIĆ^{1,4}

ORCID NUMBER

Borislav Dolamić – 0009-0006-1122-7181

Ana Aladin Dolamić – 0009-0004-3460-2082

Anđelko Hladiš – 0009-0006-5023-2960

Dragoslava Živkov Šaponja – 009-005-4216-9781

Anastazija Stojšić Milosavljević – 0000-0003-2092-4289

Military Hospital, Novi Sad¹

Institute for Health Care of Children and Youth of Vojvodina, Novi Sad²

Institute for Cardiovascular Diseases of Vojvodina, Sremska Kamenica³

University of Novi Sad, Faculty of Medicine Novi Sad⁴

Case report

Prikaz slučaja

UDK 616.12-07/-08

<https://doi.org/10.2298/MPNS2512300D>

Abstract

Introduction. Paradoxical sinus deceleration is an uncommon hemodynamic response observed during dobutamine stress echocardiography, characterized by a decrease in heart rate despite escalating doses of dobutamine, with or without a concomitant reduction in arterial blood pressure. Earlier studies associated this phenomenon with inferior myocardial ischemia, whereas more recent evidence suggests a potential autonomic mechanism mediated by activation of the Bezold–Jarisch reflex, particularly in the absence of left ventricular segmental wall motion abnormalities. The reported incidence of paradoxical sinus deceleration ranges from 5% to 10%, and its clinical significance appears to depend primarily on the presence of inducible ischemia. **Case Report.** A 53-year-old woman with arterial hypertension, dyslipidemia, and a positive family history of cardiovascular disease was evaluated for atypical anginal symptoms. At the maximal dose of dobutamine, asymptomatic paradoxical sinus deceleration accompanied by transient hypotension was observed. Electrocardiography revealed no ischemic changes or rhythm disturbances, and echocardiography demonstrated no left ventricular segmental wall motion abnormalities. The examination was therefore interpreted as negative for inducible myocardial ischemia. **Conclusion.** In the absence of echocardiographic evidence of ischemia, paradoxical sinus deceleration during dobutamine stress echocardiography does not represent an independent indication for invasive diagnostic procedures. The absence of left ventricular segmental wall motion abnormalities is pivotal in therapeutic decision-making, and conservative medical management with structured clinical follow-up constitutes a rational and safe approach.

Key words: Echocardiography; Stress; Dobutamine; Heart Rate; Arrhythmia; Sinus; Myocardial Ischemia; Electrocardiography; Hypotension; Cardiovascular Diseases; Reflex

Introduction

Dobutamine stress echocardiography (DSE) is a well-established non-invasive diagnostic modality for the detection of inducible myocardial ischemia, particularly in patients unable to perform exercise testing

Sažetak

Uvod. Paradoksalna sinusna deceleracija predstavlja retku hemodinamičku reakciju tokom dobutaminskog stres-ehokardiografskog testa, karakterisanu padom srčane frekvencije pri porastu doze dobutamina, sa sniženjem arterijskog krvnog pritiska ili bez njega. Raniji radovi doveli su ovu pojavu u vezu sa inferiornom ishemijom miokarda, dok novija istraživanja ukazuju na mogući mehanizam autonomne regulacije u okviru Bezold–Jariševog refleksa, naročito u odsustvu poremećaja segmentne kinetike leve komore. Učestalost se procenjuje na 5–10%, a klinički značaj zavisi od prisustva inducibilne ishemije. **Prikaz slučaja.** Pacijentkinja starosti 53 godine sa arterijskom hipertenzijom, dislipidemijom i pozitivnom porodičnom anamnezom na kardiovaskularne bolesti ispitivana je zbog atipičnih anginoznih tegoba. Pri maksimalnoj dozi dobutamina registrovana je asimptomatska paradoksalna sinusna deceleracija sa prolaznom hipotenzijom, bez bola u grudima. Elektrokardiografski nisu evidentirani znaci ishemije niti poremećaji ritma, dok ehokardiografski nije utvrđen poremećaj segmentne kinetike leve komore. Nalaz je ocenjen kao negativan na inducibilnu ishemiju miokarda. **Zaključak.** U odsustvu ehokardiografskih znakova ishemije, paradoksalna sinusna deceleracija tokom dobutaminskog stres-ehokardiografskog testa ne predstavlja samostalnu indikaciju za invazivnu dijagnostiku. Odsustvo poremećaja segmentne kinetike leve komore ima presudan značaj u donošenju terapijske odluke, a medikamentno lečenje uz kliničko praćenje predstavlja racionalan i bezbedan pristup. **Ključne reči:** stress ehokardiografija; dobutamine; srčana frekvencija; sinusna aritmija; miokardna ishemija; elektrokardiografija; hipotenzija; kardiovaskularna oboljenja; refleks

or in those with an intermediate or high pre-test probability of chronic coronary artery disease (CAD). Although dobutamine is primarily administered for its positive inotropic and chronotropic effects, paradoxical hemodynamic responses may occur during pharmacological stress testing. One such response is para-

✉ Corresponding author: Borislav Dolamić, E-mail: boradolamic@yahoo.com, anastazija.stojisic@mf.uns.ac.rs

Abbreviations

DSE	– Dobutamine Stress Echocardiography
PSD	– Paradoxical Sinus Deceleration
RR interval	– interval between two R waves on electrocardiogram
D2	– standard limb lead II
aVF	– augmented unipolar limb lead directed toward the inferior wall of the heart
CT	– computed tomography

doxical sinus deceleration (PSD), defined as an unexpected decrease in heart rate during escalating doses of dobutamine, most commonly observed at peak pharmacological stress, with or without a concomitant reduction in arterial blood pressure. Available data indicate an incidence of 5-10% during DSE [1–3]. The underlying pathophysiological mechanism is most frequently attributed to activation of the Bezold–Jarisch reflex, which involves stimulation of mechanoreceptors and chemoreceptors located predominantly in the inferoposterior left ventricular wall. This reflex is mediated via enhanced vagal tone, resulting in bradycardia and hypotension [4]. While earlier studies considered PSD an indirect marker of ischemia, more recent investigations suggest that its association with hemodynamically significant CAD is heterogeneous and lacks sufficient specificity [1,3,5].

Case Report

A fifty-three-year-old woman was referred for cardiological evaluation as part of routine follow-up for arterial hypertension. Her medical history included intermittent atypical chest discomfort without a clear relationship to physical exertion. The family history was positive for ischemic heart disease at a comparable age. Present cardiovascular risk factors included arterial hypertension, dyslipidemia, and active smoking. On physical examination, the patient was hemodynamically stable, with blood pressure 120/70 mmHg. Electrocardiography showed sinus rhythm at 63 beats per minute, normal intervals, and no signs of ischemia or arrhythmia. Resting transthoracic echocardiography demonstrated preserved left ventricular ejection fraction, absence of segmental wall motion abnormalities, and no evidence of diastolic dysfunction. Holter monitoring revealed sustained sinus rhythm, rare isolated supraventricular and ventricular premature beats, no RR pauses, no conduction disturbances, and no ischemic changes. Laboratory analysis indicated mild hypercholesterolemia. During DSE, dobutamine was administered up to a maximal dose of 40 $\mu\text{g}/\text{kg}/\text{min}$. At peak pharmacological stress, an asymptomatic decrease in heart rate from 134 to 100 beats per minute was observed, accompanied by a reduction in blood pressure from 140/90 mmHg to 100/60 mmHg. The patient did not report any anginal

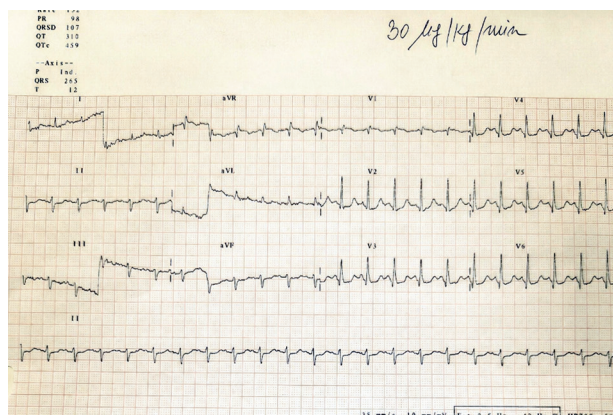


Figure 1. Electrocardiogram at dobutamine dose of 30 $\mu\text{g}/\text{kg}/\text{min}$

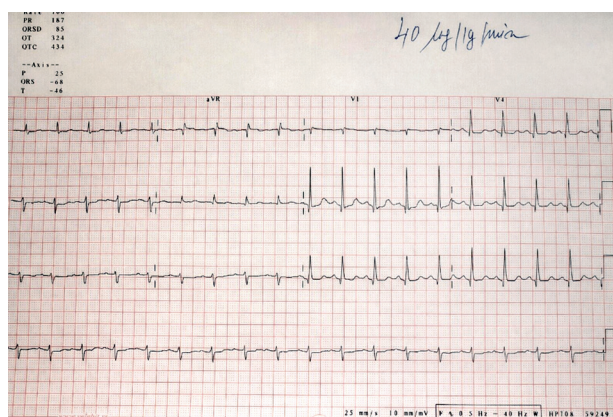


Figure 2. Electrocardiogram at dobutamine dose of 40 $\mu\text{g}/\text{kg}/\text{min}$

symptoms. Electrocardiographically, shallow biphasic T waves were noted in leads D2 and aVF at dobutamine doses of 30 and 40 $\mu\text{g}/\text{kg}/\text{min}$ (Figures 1 and 2). However, echocardiographic assessment revealed no left ventricular segmental wall motion abnormalities during peak stress or recovery (Figures 3 and 4). Based on these findings, there was no evidence of re-

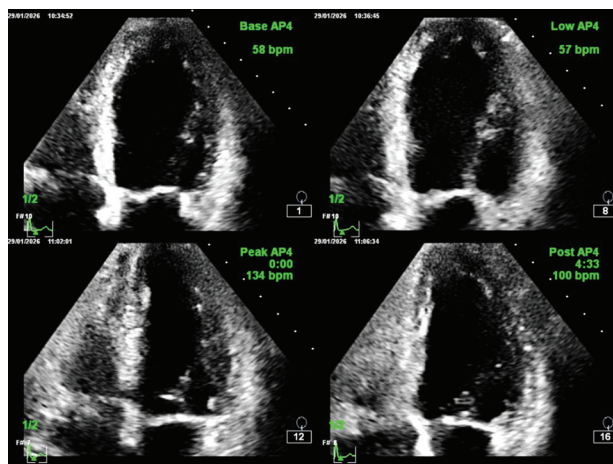


Figure 3. Diastolic phase during DSE assessment

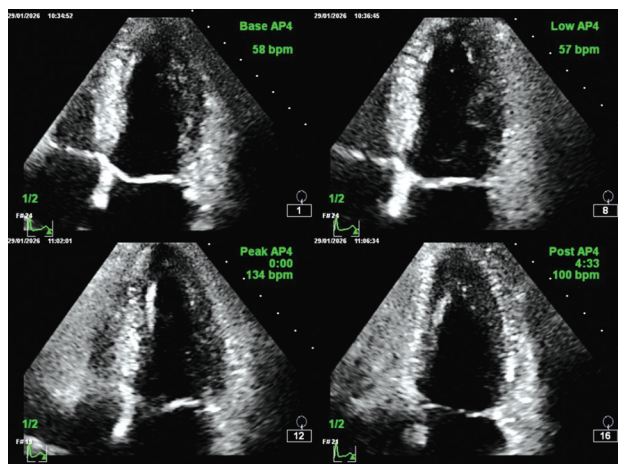


Figure 4. Systolic phase during DSE assessment

duced coronary reserve, and optimal medical therapy with continued clinical follow-up was recommended.

Discussion

Paradoxical sinus deceleration (PSD) during dobutamine stress echocardiography (DSE) represents a complex and not yet fully elucidated phenomenon. Discrepancies between earlier and more recent studies may be explained by differences in study design, patient selection, and the availability of advanced non-invasive imaging modalities.

In the classic study by Attenhofer Jost et al. [3], which included patients referred for DSE due to suspected ischemic heart disease, coronary angiography was performed in most individuals exhibiting PSD. Significant CAD (>50% stenosis) was identified in approximately 57% of these patients, most frequently involving the right coronary artery. These findings supported the hypothesis that PSD was an indirect marker of inferior ischemia in the context of limited coronary reserve.

Conversely, a more recent case series by Sulo et al. [1] employed a more selective diagnostic strategy, including more frequent use of coronary computed tomography (CT) angiography and stricter criteria for invasive procedures. In that cohort, a substantial portion of patients with PSD had no hemodynamically significant CAD, and no increase in cardiovascular events was observed during follow-up among those managed conservatively. The authors concluded that PSD often reflects a functional autonomic response

rather than a direct manifestation of myocardial ischemia. These divergent findings may also reflect differences in baseline cardiovascular risk. Earlier investigations predominantly included patients with higher pre-test probabilities of CAD, whereas contemporary cohorts often comprise individuals with atypical symptoms and low-to-intermediate risk profiles.

Current guidelines emphasize that the absence of stress-induced segmental wall motion abnormalities confers a high negative predictive value for hemodynamically significant CAD [5–8]. In this context, isolated electrocardiographic changes or hemodynamic responses – such as PSD and associated hypotension – lack sufficient diagnostic specificity when not accompanied by echocardiographic evidence of ischemia.

This interpretation is further supported by studies demonstrating an extremely low incidence of future cardiovascular events in patients with negative stress echocardiography findings [2,7,9,10]. Although PSD during DSE frequently occurs in the absence of segmental wall motion abnormalities and does not, in itself, indicate inducible ischemia, transthoracic echocardiography remains essential for comprehensive assessment of cardiac function and for ensuring procedural safety. As highlighted by Vulin et al., standard electrocardiographic parameters alone may be insufficient for precise diagnostic stratification, whereas echocardiographic assessment provides a more reliable basis for therapeutic decision-making [11]. The presented case is consistent with the contemporary interpretative framework of DSE, wherein the decision to defer coronary angiography is primarily guided by the absence of segmental wall motion abnormalities, stable clinical status, and supporting evidence from current literature.

Conclusion

Paradoxical sinus deceleration during dobutamine stress echocardiography is a relatively uncommon but well-recognized hemodynamic response. In the absence of stress-induced segmental wall motion abnormalities, paradoxical sinus deceleration does not constitute an independent indication for coronary angiography. This case illustrated that a conservative pharmacological strategy combined with structured clinical follow-up is both justified and safe in appropriately selected patients.

References

1. Sulo E, Davidsen ES, Lønnebakken MT, Bleie Ø, Saeed S. Paradoxical sinus deceleration during dobutamine stress echocardiography: case series and review of the literature. *Eur Heart J Case Rep.* 2022;6(10):ytac180.
2. Picano E, Mathias W Jr, Pingitore A, Bigi R, Prevaliti M. Safety and tolerability of dobutamine-atropine stress echocardiography: a prospective, multicentre study. *Lancet* 1994;344 (8931):1190-2.

3. Attenhofer CH, Pellicka PA, McCully RB, Roger VL, Seward JB. Paradoxical sinus deceleration during dobutamine stress echocardiography: description and angiographic correlation. *J Am Coll Cardiol.* 1997;29(5):994-9.

4. Mark AL. The Bezold-Jarisch reflex revisited: clinical implications of inhibitory reflexes originating in the heart. *J Am Coll Cardiol.* 1983;1(1):90-102.

5. Pellicka PA, Arruda-Olson A, Chaudhry FA, Chen MH, Marshall JE, Porter TR, et al. Guidelines for performance, interpretation, and application of stress echocardiography in ischemic heart disease: from the American Society of Echocardiography. *J Am Soc Echocardiogr.* 2020;33(1):1-41.e8.

6. Castillo-Moreno JA, Ramos-Martín JL, Molina-Laborda E, Florenciano-Sánchez R, Ortega-Bernal J. Ecocardiografía con dobutamina en pacientes con angina crónica estable y ergometría de riesgo bajo o intermedio: utilidad en la valoración del pronóstico a largo plazo. *Rev Esp Cardiol.* 2005;58(8):916-23.

7. Geleijnse ML, Krenning BJ, Nemes A, van Dalen BM, Soliman OII, Ten Cate FJ, et al. Incidence, pathophysiology, and

treatment of complications during dobutamine-atropine stress echocardiography. *Circulation.* 2010;121(15):1756-67.

8. Steeds RP, Wheeler R, Bhattacharyya S, Reiken J, Nihoyannopoulos P, Senior R, et al. Stress echocardiography in coronary artery disease: a practical guideline from the British Society of Echocardiography. *Echo Res Pract.* 2019;6(2):G17-33.

9. Samiei N, Parsaee M, Pourafkari L, Tajlil A, Pasbani Y, Rafati A, et al. The value of negative stress echocardiography in predicting cardiovascular events among adults with no known coronary disease. *J Cardiovasc Thorac Res.* 2019;11(2):85-94.

10. Cortigiani L, Urluescu ML, Coltelli M, Carpeggiani C, Bovenzi F, Picano E. Apparent declining prognostic value of a negative stress echocardiography based on regional wall motion abnormalities in patients with normal resting left ventricular function due to the changing referral profile of the population under study. *Circ Cardiovasc Imaging.* 2019;12(6):e008564.

11. Đurović V, Vulin A, Petrović M, Popović M. Correlation between electrocardiographic and echocardiographic parameters in the diagnosis of left ventricular hypertrophy in hypertensive patients. *Med Pregl.* 2023;76(5-6):156-61.

Rad je primljen 3. II 2026.

Recenziran 23. II 2026.

Prihvaćen za štampu 24. II 2026.

BIBLID.0025-8105:(2025):LXXVIII:9-12:300-303.