ORIGINAL ARTICLE

Prognostic significance of indexed stroke volume in asymptomatic patients with moderate or severe aortic stenosis and preserved left ventricular ejection fraction

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Submitted: 21 June 2025
Revised: 28 November 2025
Accepted: 01 December 2025
Online First: 05 December 2025
Published: 31 March 2026

Check for updates

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Summary

Introduction: When to intervene in asymptomatic patients with moderate or severe aortic stenosis (AS) and preserved left ventricular ejection fraction (LVEF) has not yet been determined. In patients with AS, low flow through the aortic valve is defined as indexed stroke volume (SVi) ≤35 ml/m^2. Our work aimed to determine the relationship between SVi and all-cause mortality in asymptomatic patients with moderate or severe AS, concordantly high mean gradient across the aortic valve (P_{mean}), and preserved LVEF.

Methods: The study included 121 asymptomatic patients (69 men, mean age 66±11) with moderate-to-severe AS (aortic valve area ≤1.5 cm^2), concordantly high P_{mean} (≥30 mmHg), and preserved LVEF (≥50%). The median follow-up was 38 months (IQR 35-42 months).

Results: Ten patients (8%) died during the follow-up. All-cause mortality was significantly higher in the group of AS-patients with SVi ≤35 ml/m^2 compared to those with SVi >35 ml/m^2 (15% vs. 4%, p<0.045). The cumulative incidence of all-cause mortality was significantly higher in the group of AS-patients with SVi ≤35 ml/m^2 compared to those with SVi >35 ml/m^2 (log-rank p=0.035). The group of AS-patients with SVi ≤35 ml/m^2 had a 3.8-fold higher risk of all-cause mortality during long-term follow-up compared with those with SVi >35 ml/m^2 (HR: 3.845; 95% CI: 1.004-14.871; p=0.041).

Conclusion: Left ventricular SVi may be a significant predictor of all-cause mortality during long-term follow-up in asymptomatic patients with moderate or severe AS, concordantly elevated $P_{mean,}$ and preserved LVEF. Larger studies are needed to confirm these findings.

Keywords: aortic stenosis, asymptomatic stroke volume, stroke volume index, Doppler echocardiography, outcome

Cite this article as: Aleksandric S, Miljkovic N, Tomovic S, Soldatovic I, Juricic S, Djokovic A, et al. Prognostic significance of indexed stroke volume in asymptomatic patients with moderate or severe aortic stenosis and preserved left ventricular ejection fraction; Medicinska istraživanja 2026; 59(1):27-34; DOI: 10.5937/medi0-59653

INTRODUCTION

Aortic stenosis (AS) is the most frequent valvular disease requiring intervention in high- and mid-income countries (1). AS leads to impaired flow through the aortic valve, resulting in an increased pressure gradient and, in turn, increased left ventricular (LV) afterload. These processes lead to concentric LV hypertrophy to maintain stroke volume (SV), but prolonged pressure overload eventually results in systolic dysfunction and, consequently, reduced SV (2).

Severe AS is defined when the aortic valve area (AVA) is ≤1.0 cm^2, the maximum flow velocity (V_{max}) is ≥4.0 m/s, and the mean pressure gradient (P_{mean}) is ≥40 mmHg (3). However, approximately 50% of patients with severe AS have low SV despite preserved left ventricular ejection fraction (LVEF) (4). A reduction in blood flow across the aortic valve is determined by an LV stroke volume index (SVi) ≤35 ml/m^2 (5).

Patients with severe AS and low SVi with preserved LVEF (≥50%) can be classified into one of the two groups: patients with low flow (SVi ≤35 ml/m^2) and low mean gradient across the aortic valve (P_{mean} <40 mmHg) (either with decreased or with normal LVEF) and patients with low flow and concordantly high P_{mean} across the aortic valve (≥ 40 mmHg) (6-7). Patients with low-flow and low-gradient AS with preserved LVEF have increased mortality during 5-year follow-up (8-9). In contrast, the prognostic significance of low flow in patients with high-gradient AS and preserved LVEF has been much less studied.

In any case, if a patient with AS is symptomatic, the management is obvious, and aortic valve replacement is mandatory. However, the treatment approach to asymptomatic AS patients is still debatable. Timely risk stratification of these patients is crucial to achieving optimal outcomes. Thus, additional parameters, including echocardiography-derived parameters, could facilitate patient-tailored decisions.

Our study aimed to determine whether low SVi was associated with all-cause mortality in asymptomatic patients with moderate or severe AS (AVA ≤1.5 cm^2), concordantly high P_{mean} across the aortic valve (≥ 30mmHg), and preserved LVEF (≥50%).

METHODS

Patient population

Between 2009 and 2018, 121 asymptomatic patients with moderate (AVA ≤1.5 cm^2) or severe AS (AVA ≤1.0 cm^2) and preserved LVEF (≥50%) were prospectively enrolled in the study **(Table 1)**. Key exclusion criteria were: patients ≤18 years old; the presence of mild AS (AVA >1.5 cm^2); the presence of subvalvular or supravalvular AS; the presence of significant mitral regurgitation; the presence of more than moderate mitral regurgitation or more than mild mitral stenosis; severe chronic kidney disease with estimated glomerular filtration rate (eGFR) <30 ml/min/1.73 m^2; and shortened life expectancy (<3 years). A detailed list of inclusion and exclusion criteria is given in Table 1. The study was conducted in the clinical echocardiography laboratory at the Cardiology Department, University Clinical Center of Serbia, Belgrade, Serbia, in accordance with national legal requirements, institutional policies, and the revised Declaration of Helsinki. All patients gave written informed consent to participate in the study, which was approved by the Ethical Committee of the University of Belgrade - Faculty of Medicine (number: 440IVI-13, June 19th 2009).

Echocardiography

Commercially available ultrasound systems were used to perform a comprehensive Doppler echocardiographic study in all patients. Transthoracic echocardiographic

Table 1. Full inclusion and exclusion criteria for patient participation in the study.

Inclusion criteria	Exclusion criteria
1. Presence of moderate or severe aortic stenosis (AVA ≤1.5 cm^2); 2. Left ventricular ejection fraction ≥50%; 3. The patient can sign informed consent.	1. Patients aged ≤18 years old; 2. Mild aortic stenosis (AVA >1.5 cm^2); 3. Subvalvular or supravalvular aortic stenosis; 4. Mitral regurgitation and/or aortic regurgitation ≥2+; 5. Moderate or severe mitral stenosis (mean gradient >5 mmHg); 6. Patients with a significantly dilated ascending aorta (>45 mm); 7. Presence of a prosthetic aortic valve and/or mitral valve; 8. Patients with a shortened life expectancy (<3 years); 9. Coronary artery disease is defined as the presence of at least one coronary stenosis >50% diameter stenosis assessed by visual estimation. 10. Any previous myocardial infarction; 11. Any previous percutaneous coronary intervention; 12. Previous aorto-coronary by-pass grafting surgery (CABG); 13. Left ventricular hypertrophy; 14. Cardiomyopathies (dilated, hypertrophic, restrictive); 15. Chronic kidney disease (<30 ml/min/1.73 m^2).

examination was performed on the General Electric Vivid 4 and Vivid 9 cardiac ultrasound systems (BTO6, 1.5-3.6 MHz; GE Healthcare Technologies, Waukesha, WI, USA). Patients were examined in all standard echocardiographic positions. The left ventricle's internal dimensions, the posterior wall thickness (PWT), and the interventricular septal thickness (IVST) were measured in end-diastole apically in relation to the tips of the mitral valve leaflets in the two-dimensional long-axis parasternal view (10). Using the corrected formula of the American Society of Echocardiography and body surface area indexing, the LV mass of each individual was calculated (11). The Simpson biplane model was used to determine LV end-diastolic and end-systolic volumes, as well as LVEF (12). Online software was used to calculate maximum velocity, velocity-time integral, systolic ejection time, maximum pressure, and pressure differences from continuous-wave Doppler recordings at the apex and the right intercostal space. The simplified Bernoulli equation was used to calculate gradients across the aortic valve (13). The AVA was determined using the continuity equation. A parasternal long-axis view at mid-systole was used to measure the subaortic diameter at the level of the aortic leaflets. Apical five-chamber pulsed Doppler recordings were obtained with the sample volume shifted axially from the aortic annulus, typically 0.5 to 1.0 cm below the valve, to measure maximum velocity and velocity-time integrals. Stroke volume was calculated as VTI LVOT × CSA LVOT, the main systolic transvalvular volume flow ratio as SV/SEP (14) (left ventricular outflow tract [LVOT], cross sectional area [CSA]; velocity time integral [VTI]; systolic ejection period [SEP], measured as the time between the opening and closing of the aortic valve echoes in the aortic Doppler recording. Indexed stroke volume was calculated in ml as Stroke volume / Body surface area in m^2, where: Stroke volume = Cardiac Output in ml / Heart rate in beats per minute (bpm) (14).

A single operator did all echocardiographic measurements.

Follow-up

Clinical data during follow-up were obtained from all patients either through direct examination or a telephone interview. The primary endpoint was all-cause mortality. Documentation provided by patients and/or hospital data was used to confirm the primary endpoint. The patients were followed up for an average of 38 months (interquartile range [IQR] 35-42 months).

Statistical analysis

Continuous variables were tested for normality using the Kolmogorov-Smirnov test and were reported as mean ± SD, while categorical variables were reported as counts and percentages. Patients were divided into two groups based on the previously defined SVi threshold of 35 ml/m^2 (5). For statistical analysis, Pearson's chi-square test for independence or Fisher's exact test was used, depending on group size, along with the Student's t-test for independent samples. Survival rates and 95% confidence intervals (95% CI) were estimated using Kaplan-Meier analysis and the log-rank test. Univariate Cox proportional hazards regression was used to examine the association between individual variables and all-cause mortality. A multivariate Cox proportional hazards regression analysis was not conducted due to a small number of events of interest and an unfavorable ratio between outcomes and predictors. Statistical significance was set at $p<0.05$. All data were entered into a database and processed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corporation, Armonk, New York).

RESULTS

Demographic, clinical, and echocardiographic characteristics of the study population, according to SVi, are presented in **Table 2**. The mean age was 66 ± 11 years (range: 23-83 years), and 69 patients (57%) were male. Ninety-two patients (76%) had severe AS (AVA: 0.75 ± 0.15 cm2, V_{max}: 4.34 ± 0.46 m/s, peak gradient (P_{max}): 76.22 ± 16.07 mmHg, P_{mean}: 44.93 ± 10.64 mmHg), whereas 29 (24%) of them had moderate AS (AVA: 1.16 ± 0.12 cm2, V_{max}: 3.79 ± 0.37 m/s, P_{max}: 58.11 ± 11.19 mmHg, P_{mean}: 32.65 ± 8.27 mmHg). A total of 47 patients (39%) had SVi ≤35 ml/m^2, of which 41 (87%) had severe AS and 6 (13%) had moderate AS.

As shown in **Table 2**, the study groups based on SVi > and ≤35 ml/m^2 showed no differences in terms of age, gender, body mass index, frequency of hypertension, diabetes, smoking, hyperlipidemia, or family history. Among echocardiographic parameters, LVEF, LV end-systolic diameter, LV mass, LV mass index, relative wall thickness, as well as V_{max}, P_{max}, and P_{mean}, were similar between the two patient groups (Table 2). In contrast, AVA, AVA index, LV end-diastolic diameter, cardiac output, and cardiac index were significantly lower in the group of AS-patients with SVi ≤35 ml/m^2 compared with those with SVi >35 ml/m^2 (Table 2). Also, the LV diastolic function parameter E/e` was higher in the group of AS-patients with SVi ≤35 ml/m^2 compared with those with SVi >35 ml/m^2, at the level of borderline significance **(Table 2)**.

Impact of stroke volume index on outcome

During a median (IQR) follow-up of 38 months (35-42 months), 10 patients (8%) died, with a significant difference in all-cause mortality between the two groups **(Table 3)**. All-cause mortality was significantly higher in the group of patients with SVi ≤ 35 ml/m^2 when compared to the group of patients with SVi >35 ml/m^2 (15% vs. 4%, $p<0.045$) **(Table 3)**.

Table 2. Demographic, clinical, and echocardiographic characteristics of the whole study group and according to the stroke volume index (SVi) cut-off of 35 mL/m².

Variable	All (n=121)	SVi >35 ml/m² (n=74)	SVi ≤35 ml/m² (n=47)	p-value
Age, years, (mean ± SD)	66 ± 11	66 ± 12	67 ± 9	0.381
Gender, males, n (%)	69 (57)	44 (59)	25 (53)	0.497
BMI, kg/m², (mean ± SD)	27.4 ± 4.0	27.5 ± 4.1	27.4 ± 4.1	0.953
Hypertension, n (%)	86 (71)	54 (73)	32 (68)	0.563
Diabetes, n (%)	25 (21)	13 (18)	12 (26)	0.292
Smoking, n (%)	16 (13)	7 (9)	9 (19)	0.125
Hyperlipidemia, n (%)	54 (45)	32 (43)	22 (47)	0.701
Family history, n (%)	12 (10)	6 (8)	6 (13)	0.534
LVEF, %, (mean ± SD)	72 ± 7	72 ± 7	72 ± 7	0.825
LV EDD, cm, (mean ± SD)	5.09 ± 0.50	5.17 ± 0.49	4.96 ± 0.49	0.021
LV ESD, cm, (mean ± SD)	3.18 ± 0.51	3.22 ± 0.50	3.15 ± 0.52	0.470
LV mass, g, (mean ± SD)	275.28 ± 74.89	283.67 ± 81.04	255.29 ± 57.63	0.130
LV mass index, g/m², (mean ± SD)	139.71 ± 30.97	144.39 ± 34.58	129.98 ± 20.05	0.063
Relative wall thickness, (mean ± SD)	0.50 ± 0.08	0.49 ± 0.07	0.52 ± 0.09	0.132
Left atrium, cm, (mean ± SD)	4.18 ± 0.57	4.16 ± 0.52	4.21 ± 0.64	0.588
Cardiac output, L/min, (mean ± SD)	4.92 ± 1.88	5.50 ± 1.85	4.06 ± 1.63	<0.001
Cardiac index, L/min/m², (mean ± SD)	2.66 ± 0.976	3.00 ± 0.89	2.12 ± 0.85	<0.001
AVA, cm², (mean ± SD)	0.84 ± 0.23	0.91 ± 0.23	0.74 ± 0.19	<0.001
AVA index, cm/m², (mean ± SD)	0.45 ± 0.11	0.48 ± 0.11	0.38 ± 0.09	<0.001
Vmax, m/s, (mean ± SD)	4.21 ± 0.50	4.25 ± 0.49	4.14 ± 0.49	0.234
Peak PG, mmHg, (mean ± SD)	72.09 ± 16.88	73.41 ± 17.19	69.61 ± 15.99	0.225
Mean PG, mmHg, (mean ± SD)	42.12 ± 11.37	43.07 ± 17.81	40.51 ± 9.77	0.219
E/E`, (mean ± SD)	12.73 ± 5.16	12.17 ± 4.71	14.04 ± 5.63	0.052
Pnet, (mean ± SD)	32.20 ± 10.67	32.97 ± 11.52	31.61 ± 8.92	0.507

Data are expressed as mean ± SD or as number (%). AVA = aortic valve area; AVR = aortic valve resistance; BMI = body-mass index; LV = left ventricle; LVEF = left ventricle ejection fraction; EDD = end-diastolic diameter; ESD = end-systolic diameter; ELI = energy loss index; PG = pressure gradient; Pnet = net pressure; Vmax = maximal aortic jet blood velocity; E/E' – indicator of left ventricular diastolic function.

According to the Kaplan–Meier analysis **(Figure 1)**, the cumulative incidence of all-cause mortality at mid- to long-term follow-up was significantly higher among patients with SVi ≤35 ml/m² than among those with SVi >35 ml/m² (log-rank p=0.035). The univariate Cox regression analyses **(Table 4)** demonstrated that higher SVi was associated with a lower hazard for all-cause mortality (HR: 0.872; 95% CI: 0.810-0.939; p<0.001). Accordingly, the all-cause mortality risk at long-term follow-up in AS patients decreases by 15% (1/0.872=1.15) for an additional measurement unit in SVi. Similarly, the group of AS-patients with SVi ≤35 ml/m² was associated with a 3.8 higher risk of all-cause mortality during long-term follow-up compared to the group of AS-patients with SVi >35 ml/m² (HR: 3.845; 95%CI: 1.004-14.871; p=0.041). Other variables significantly associated with all-cause mortality were AVA (HR: 0.014; 95% CI: 0.001-0.426; p=0.014) and AVA index (HR: 0.001; 95% CI: 0.001-0.022; p=0.003).

DISCUSSION

The most important finding of our study is that a reduced left ventricular SVi below 35 ml/m² may predict all-cause mortality during long-term follow-up in asymptomatic patients with moderate or severe AS, concordantly high P_{mean} across the aortic valve, and preserved LVEF. The predictive importance of low-flow in asymptomatic patients with severe AS was also documented by Marechaux et al. (8) and Rusinaru et al. (15), but our study is the first to extend this finding to SVi ≤35 ml/m² rather than ≤30

Table 3. All-cause mortality at median follow-up of 38 months (interquartile range 35-42 months) in the whole study group and according to stroke volume index (SVi) cut-off of 35 ml/m².

	All (n=121)	SVi >35 ml/m² (n=74)	SVi ≤35 ml/m² (n=47)	p-value
All-cause mortality, n (%)	10 (8)	3 (4)	7 (15)	0.045

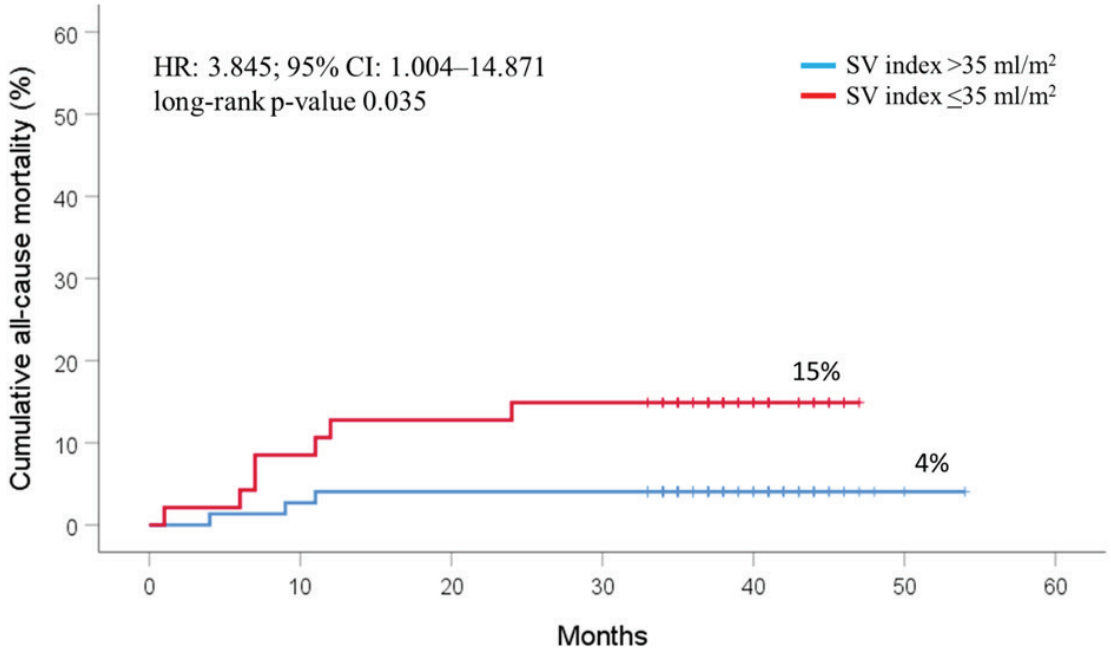

Figure 1. The Kaplan–Meier survival curve of all-cause mortality according to stroke volume (SV) index > and ≤35 ml/m². Median follow-up was 38 months (interquartile range: 35–42 months). CI – confidence interval; HR – hazard ratio.

Table 4. Univariate Cox regression analyses for all variables in predicting long-term all-cause mortality rate in patients with moderate-to-severe aortic stenosis with preserved ejection fraction and nonobstructed coronary arteries.

Univariate Cox regression analysis			
Variable	**HR**	**95% CI**	**p-value**
Age, years	1.039	0.965 – 1.119	0.306
Gender, males	1.053	0.297 – 3.731	0.937
BMI, kg/m²	1.085	0.921 – 1.278	0.332
Hypertension	1.603	0.340 – 7.549	0.551
Diabetes	2.469	0.697 – 8.751	0.161
Smoking	1.729	0.367 – 8.144	0.488
Hyperlipidemia	1.865	0.482 – 7.213	0.366
Family history	23.502	(–) - (-)	0.500
LVEF, %	0.955	0.873 – 1.045	0.316
LV EDD, cm	1.857	0.544 – 6.340	0.323
LV ESD, cm	2.739	0.836 – 8.972	0.096
LV mass, g	0.999	0.986 – 1.011	0.821
LV mass index, g/m²	0.993	0.960 – 1.027	0.679
Relative wall thickness	0.001	0.001 – 55.162	0.175
Left atrium, cm	2.053	0.708 – 5.947	0.185
Cardiac output, L/min	0.795	0.563 – 1.123	0.193
Cardiac index, L/min/m²	0.553	0.266 – 1.152	0.113
AVA, cm²	0.014	0.001 – 0.426	0.014
AVA index, cm/m²	0.001	0.001 – 0.022	0.003
Vmax, m/s	1.305	0.376 – 4.530	0.675
Peak PG, mmHg	1.008	0.972 – 1.045	0.675
Mean PG, mmHg	1.005	0.952 – 1.061	0.858
E/E`	1.047	0.940 – 1.167	0.402
Pnet	1.017	0.962 – 1.076	0.550
SV index, ml/m² (continuous variable)	0.872	0.810 – 0.939	<0.001
SV index, ml/m² (categorical variable)	3.845	1.004 – 14.871	0.041

Dependent variable: all-cause mortality at long-term follow-up.
CI – confidence interval; HR – hazard ratio; SV – stroke volume. Other abbreviations are in **Table 2**.

ml/m². However, our cohort is small and has few events, and thus should be viewed as hypothesis-generating.

In patients with severe AS, a state of low LV stroke volume, defined as SVi ≤35 ml/m², can be associated either with a concordantly high P_{mean} or lower-than-expected P_{mean} over the aortic valve. These patients with severe AS and low SVi can be further divided into:

a) patients with reduced LVEF (<50%; so-called "classical low-flow low-gradient AS"); and
b) patients with preserved LVEF - (≥50%; so-called "paradoxical low-flow low-gradient AS") (3,5-8).

The poorer prognosis of patients with "classical low-flow low-gradient AS" is not surprising, given the generally increased risk of adverse events in patients with low LVEF. However, it has also been shown that patients with so-called "paradoxical low-flow low-gradient AS" who, by definition, have normal LVEF and low SVi, have a less favorable prognosis than patients with concordantly high mean-gradient AS (3). On the other hand, data on the prognostic significance of low SVi in AS patients with concordantly high P_{mean} over the aortic valve are limited. Our results similarly show that SVi has prognostic importance in patients with AS and concordantly high P_{mean} across the aortic valve, with the threshold for low SVI set at 35 ml/m², a value previously proposed for patients with low-flow low-gradient AS (3-7). Our cohort, similar to patients with "paradoxical low-flow low-gradient" AS, is characterized by increased LV afterload, high systolic wall stress, and compensatory LV hypertrophy. Both parameters lead to impaired flow across the aortic valve and consequent multi-organ hypoperfusion. This also translates to myocardial hypoperfusion and potential scarring of the myocardium. The process of hypoperfusion often precedes AS-related symptoms, while consequential myocardial damage may be irreversible even in the case of a successful aortic valve replacement (AVR) procedure (16). Furthermore, almost all echocardiographic parameters used to determine AS severity are flow-dependent; thus, it is important to recognize the low-flow state and avoid underestimating AS severity, which might, as stated above, delay the AVR, a life-saving and myocardial-saving procedure.

Until recently, the prognosis for asymptomatic patients with moderate and/or severe AS and preserved LVEF was considered relatively favorable, meaning that no intervention was indicated for these patients (17). However, it has been shown that the natural history of asymptomatic patients with moderate or severe AS is not benign (18-19). Moreover, in recent years, several randomized studies have shown that early intervention in these patients leads to better long-term outcomes than monitoring and medical management of comorbidities until symptoms develop or other guidelines-directed indications for intervention arise (20-22). It is not known whether the benefits of early surgical or transcatheter aortic valve replacement observed in the aforementioned randomized studies can be extrapolated to asymptomatic patients with low-flow AS, as this subgroup was not explicitly addressed in these studies. Until the indication for early aortic valve replacement in truly asymptomatic patients with moderate-to-severe AS and normal LVEF is confirmed, additional parameters could help guide decisions regarding potential intervention. These parameters include assessment of extracardiac damage, detection of myocardial fibrosis using cardiac magnetic resonance, and echocardiographic analysis of LV parameters, including LV SVi (23).

Study limitations

Our study has limitations given the relatively small number of patients and the few events of interest. Therefore, larger, prospective studies are required to further confirm the prognostic significance of LV SVi in the analyzed patient population with hemodynamically significant aortic stenosis. We were also unable to stratify mortality by cardiovascular or non-cardiovascular causes, which would further aid in understanding the prognostic significance of SVi.

We did not assess intraobserver variability. However, as we included both patients with moderate and severe AS, we believe that the possibility of including patients without hemodynamically significant AS was minimal. Similarly, given that V_{max} is the echocardiographic variable least susceptible to measurement error, we do not believe that intraoperator variability significantly affects the accuracy of AS severity assessment or flow across the aortic valve.

CONCLUSION

The left ventricular SVi could be a significant predictor of all-cause mortality during long-term follow-up in asymptomatic patients with moderate or severe AS, concordantly high Pmean, and preserved LVEF. Further research with a larger number of patients is needed to confirm SVi as a risk-stratification and decision-making tool for these patients.

Acknowledgement: N/A

Funding information: The authors declare that the study received no funding.

Conflict of Interest: The authors disclose no conflict of interest relevant to this research

Author contributions:

MB, IN, SA, and VG contributed to the conception and design of the work, the interpretation of data, the critical revision of the manuscript, and the overall supervision of the project. They also provided technical support with echocardiographic indexing and visualization. IS performed statistical analysis. NM and ST contributed to data analysis and interpretation, and drafted the manuscript. SJ, AĐ, NB, and SD were responsible for acquiring and processing echocardiographic and clinical data. MO,

MR, IB, and KŽ contributed to patient selection, data quality control, and clinical interpretation. DŠ, TS, LP, AB, and AS assisted in database management and literature review.

All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Ethical approval: Ethical Committee of the University of Belgrade - Faculty of Medicine (number: 440IVI-13, June 19th 2009).

Informed consent: All patients gave written informed consent to participate in the study.

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PROGNOSTIČKI ZNAČAJ INDEKSIRANOG UDARNOG VOLUMENA KOD ASIMPTOMATSKIH PACIJENATA SA UMERENOM DO TESNOM AORTNOM STENOZOM I OČUVANOM EJEKCIONOM FRAKCIJOM LEVE KOMORE

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Sažetak

Uvod: Kad intervenisati kod asimptomatskih pacijenata sa umerenom/tesnom aortnom stenozom (AS) i očuvanom ejekcionom frakcijom leve komore (EFLK) još nije utvrđeno. Kod pacijenata sa AS nizak protok preko aortne valvule se definiše kao indeksiran udarni volumen (UVi) ≤35 ml/m^2. Cilj našeg rada je bio da utvrdimo odnos između UVi i ukupnog mortaliteta kod asimptomatskih pacijenata sa umerenom ili tesnom AS, odgovarajuće visokim srednjim gradijentom preko aortne valvule ($P_{srednje}$) i očuvanom EFLK.

Metode: U studiju je uključen 121 asimptomatski pacijent (69 muškaraca, prosečne starosti 66±11 godina) sa umerenom ili tesnom AS (površina aortnog ušća ≤1,5 cm^2), odgovarajuće visokim $P_{srednje}$ (≥30 mmHg) i očuvanom EFLK (≥50%). Medijana perioda praćenja pacijenata je iznosila 38 meseci (IQR 35-42 meseca).

Rezultati: Tokom perioda praćenja umrlo je deset pacijenata (8%). Ukupna smrtnost je bila značajno veća u grupi AS-pacijenata sa UVi ≤35 ml/m^2 u odnosu na grupu AS-pacijenata sa UVi >35 ml/m^2 (15% vs. 4%, p<0,045). Kumulativna incidenca ukupnog mortaliteta je bila značajno veća u grupi AS-pacijenata sa UVi ≤35 ml/m^2 u odnosu na grupu AS-pacijenata sa UVi >35 ml/m^2 (log-rank p=0,035). Grupa AS-pacijenata sa UVi ≤35 ml/m^2 je bila udružena sa 3,8 puta većim rizikom od ukupnog mortaliteta u dugoročnom periodu praćenja u odnosu na grupu AS-pacijenata sa UVi >35 ml/m^2 (HR: 3,845; 95%CI: 1,004-14,871; p=0,041).

Zaključak: Na osnovu naših rezultata, UVi bi mogao biti značajan prediktor mortaliteta kod asimptomatskih pacijenata sa umerenom ili tesnom AS, visokim $P_{srednje}$ i očuvanom EFLK. Studije sa većim brojem ispitanika i događaja su neophodne kako bi potvrdile ove rezultate.

Ključne reči: aortna stenoza, asimptomatski udarni volumen, indeksiran udarni volumen, Doppler ehokardiografija, ishod

Primljen: 21.06.2025. | **Revidiran:** 28.11.2025. | **Prihvaćen:** 01.12.2025. | **Online First:** 05.12.2025. | **Objavljen:** 31.03.2026.

Medicinska istraživanja 2026