

Cardiopulmonary Exercise Testing Unmasks Functional Impairment in Severe Aortic Stenosis and Refines Timing of Valve Intervention in Asymptomatic Patients

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Background: The optimal timing of aortic valve intervention in asymptomatic patients with severe aortic stenosis (AS) remains one of the greatest challenges in VHD management. CPET may objectively identify functional impairment beyond conventional clinical assessment, allowing earlier recognition of patients who may benefit from intervention while supporting safe continuation of watchful waiting in patients with normal CPET. We evaluated the impact of CPET on clinical decision-making in patients with asymptomatic or doubtful symptoms severe AS managed through a structured integrated care pathway.

Methods: 100 patients with asymptomatic severe AS (Jan-2025 and Jun-2026) were included. Primary endpoint was change in clinical management following CPET. Pathological CPET was defined as peak VO_2 <80% predicted. Abnormal CPET was defined as patient with pathological CPET and clinician judgement of other CPET parameters specific to each patient case. Patients with normal CPET managed conservatively underwent prospective follow-up to assess cardiovascular outcomes.

Variable	N	Mean	SD
Percentage of VO_2 predicted (%)	99	82.14	18.20
Baseline heart rate (bpm)	100	73.45	12.32
Peak heart rate (bpm)	100	122.51	21.92
Percentage of maximum heart rate (%)	99	83.14	13.95
Breathing reserve (%)	98	39.06	15.57
Peak RER	84	1.08	0.12
PETCO ₂ at VT1 (mmHg)	90	34.95	3.90
VO ₂ /watts	92	7.79	2.60

Variable	N	Median	Q1	Q3
Age (years)	100	74	67.75	79
Mean aortic gradient (mmHg)	93	44	40	50
Aortic Valve Area (cm ²)	83	0.90	0.70	0.95
LVEF (%)	91	60	55	67
NTproBNP (pg/mL)	93	318	161	556
Peak VO ₂ (mL/kg/min)	100	15.55	12.20	18.50
METS	100	4.44	3.50	5.52
Watts	100	80	50.75	101.25
Percentage of predicted watts (%)	98	91	65	110.5
VE/VCO ₂	100	32.89	29.12	37.09
O ₂ /HR	100	9.10	7.70	11.00
Percentage of predicted VO ₂ at VT1 (%)	99	46.9	41	54.95
Baseline PETCO ₂ (mmHg)	89	31.87	29.17	33.60

Table 1. Descriptive statistics of clinical, echocardiographic and CPET variables

LVEF, left ventricular ejection fraction; METS, metabolic equivalents; NTproBNP, N-terminal pro B-type natriuretic peptide; O₂/HR, oxygen pulse; PETCO₂, end-tidal carbon dioxide pressure; RER, respiratory exchange ratio; VE/VCO₂, minute ventilation/carbon dioxide production slope; VO₂, oxygen uptake; VT1, first ventilatory threshold.

Results: CPET changed clinical management in 20 patients. Management changed from watchful waiting to planned aortic valve intervention in 16 patients (80%). Of these, 11 (69%) had symptoms that were uncertain or had not reached conventional thresholds for intervention; CPET objectively confirmed functional limitation and supported referral for valve replacement. The remaining 9 patients were considered asymptomatic before testing, with CPET serving as the principal trigger for reclassification.

Conclusions:

In patients with severe AS managed through an integrated VHD care pathway, CPET changed clinical management in approximately one in five patients. CPET results influenced decision-making through two complementary mechanisms. First, by identifying previously unrecognized functional limitation in patients considered asymptomatic and second, by objectively confirming clinically relevant exercise limitation in patients with uncertain symptoms. CPET also supported continued watchful waiting in asymptomatic patients without objective functional impairment, with no adverse cardiovascular events observed during short-term follow-up. These findings support incorporating CPET into routine assessment of patients with severe AS to optimize the timing of aortic valve intervention.