Low Stroke Volume Index is an Independent Predictor of Mortality among Patients with Low Gradient Severe Aortic Stenosis and Preserved Left Ventricle Function

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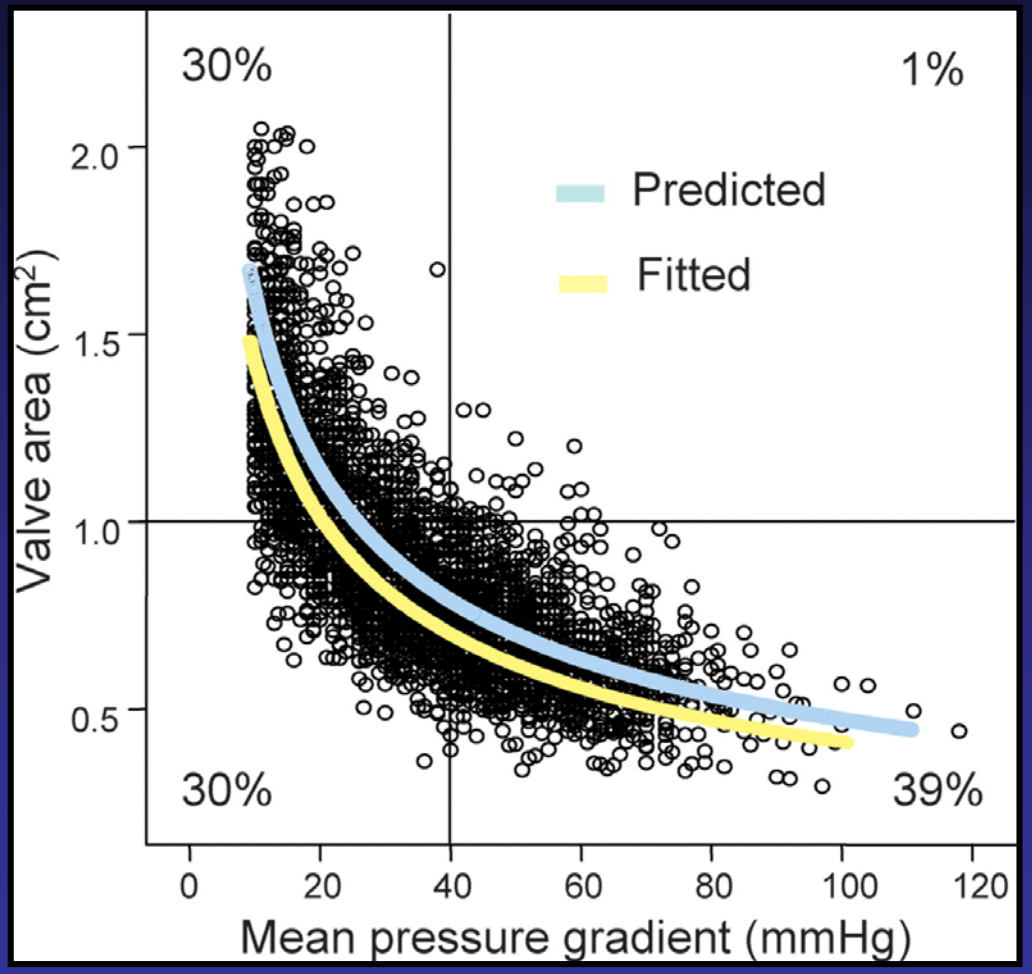
Disclosures

- None

Severe Aortic Stenosis

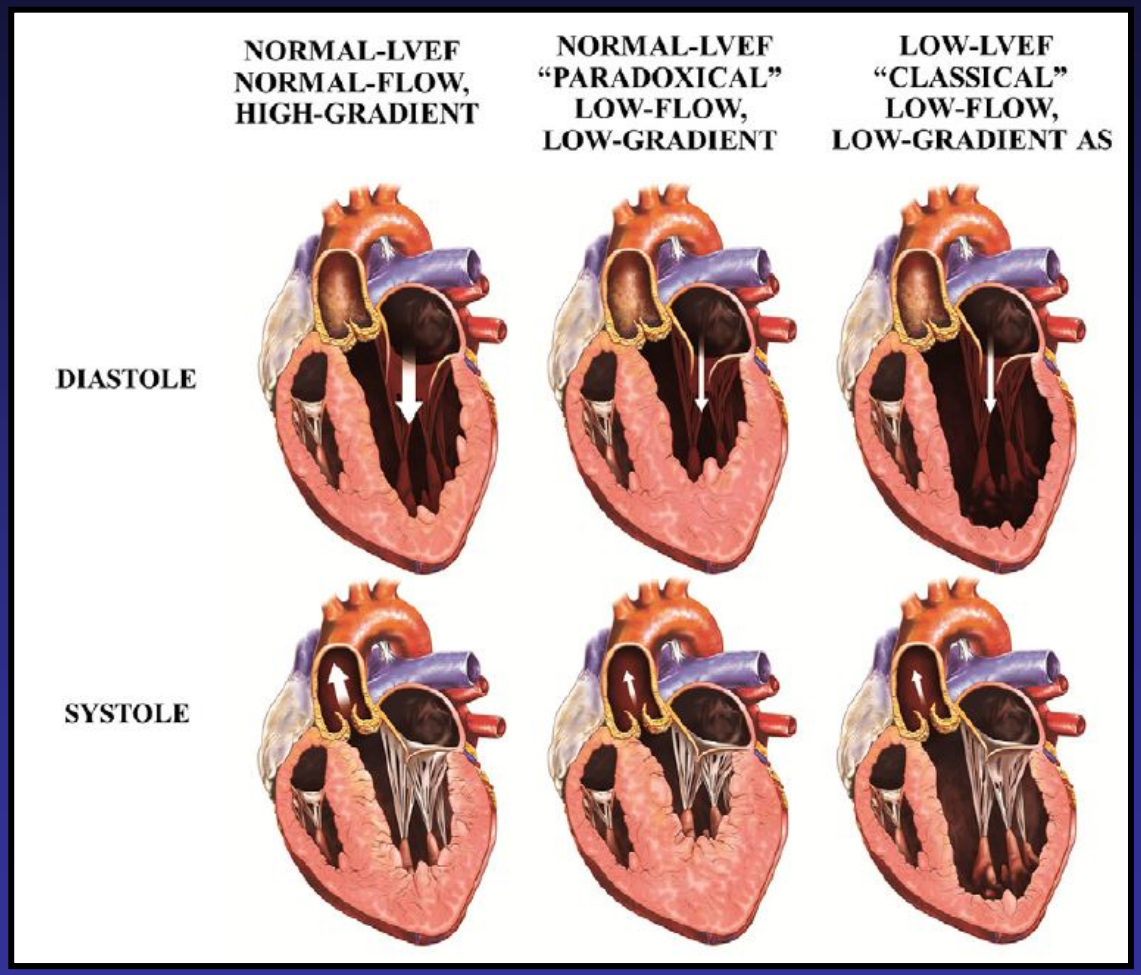
- Aortic valve area ≤ 1 cm^2
  - Index aortic valve area ≤ 0.6 cm^2/m^2
- Mean pressure gradient ≥ 40 mmHg
- Peak transvalvular velocity ≥ 4 m/s

Inconsistencies in Echocardiographic Criteria



Minners J et al. Eur Heart J 2008;29:1043-1048

Low Gradient Severe Aortic Stenosis



Pibarot et al. J Am Coll Cardiol 2012;60:1845–53

Low Gradient Severe Aortic Stenosis with Preserved Ejection Fraction

– Low gradient severe aortic stenosis and preserved ejection fraction has **similar** outcome to moderate AS

Jander N et al. Circulation. 2011; 123:887–895

– Low gradient low flow severe aortic stenosis carries **worse prognosis** then that of high gradient with normal flow

Clavel MA et al. JACC 2012; 60:1259–1267

Low Gradient Severe Aortic Stenosis with Preserved Ejection Fraction

- Stroke volume index (SVI)≤35 ml/m^2 has been arbitrarily selected to identify increased risk among patients with low gradient severe aortic stenosis in a single retrospective study (N=512).

Hachicha et al. Circulation. 2007; 115: 2856-2864

Study Purpose

- Identify a stroke volume index (SVI) threshold that can be used to improve risk stratification among patients with low gradient severe aortic stenosis and preserved ejection fraction

Study population (2004-2012)

Inclusion Criteria	Exclusion Criteria
• Ejection Fraction ≥ 50% • Aortic valve area ≤ 1 cm^2 • Mean pressure gradient < 40 mmHg	• Ejection Fraction < 50% • Any significant other valvular disease

N=416

Methods

- Echocardiographic parameters
- Clinical data
- Valvular intervention
- Death records from the ministry of health

Stroke Volume Index Assessment

- **"Classic"** criteria: SVI ≤ 35 ml/m^2
- **By SVI tertiles**:
  - Lower tertile: SVI ≤ 37 ml/m^2
  - Middle tertile: 37 < SVI ≤ 42 ml /m^2
  - Upper tertile: 42 ml/m^2 < SVI
- SVI as a **continuous** measurement

Baseline Characteristics

	SVI≤35 (N=113)	SVI>35 (N=303)
Male (%)	48	40
Age (Years)	79±11	77±11
BMI (Kg/m^2)	30±6*	27±5
BSA (m^2)	1.9±0.2*	1.8±0.2

SVI – Stroke Volume Index (ml/m^2)
* P < 0.01

Baseline Characteristics

	SVI≤35 (N=113)	SVI>35 (N=303)
Diabetes Mellitus (%)	43	34
Hypertension (%)	65	69
Dyslipidemia (%)	47	50
Active Smokers (%)	6	6
Chronic renal failure (%)	32*	20
Ischemic heart disease (%)	51	44
Cerebrovascular disease (%)	22	17

SVI – Stroke Volume Index (ml/m^2)
* P < 0.05

Echocardiographic Characteristics

	SVI≤35 (N=113)	SVI>35 (N=303)
Left Ventricle Ejection Fraction (%)	60±5	60±5
Left Ventricle Mass (gr)	195±50	192±47
Left Ventricle Diastolic Dimension (cm)	4.6±0.5	4.6±0.5
Left Ventricle Systolic Dimension (cm)	2.7±0.5	2.7±0.5
Septum Width (cm)	1.2±0.2	1.2±0.2
Left Atrium Area (cm^2)	24±6	23±7
Estimated Pulmonary Artery Pressure (mmHg)	39±11	41±12

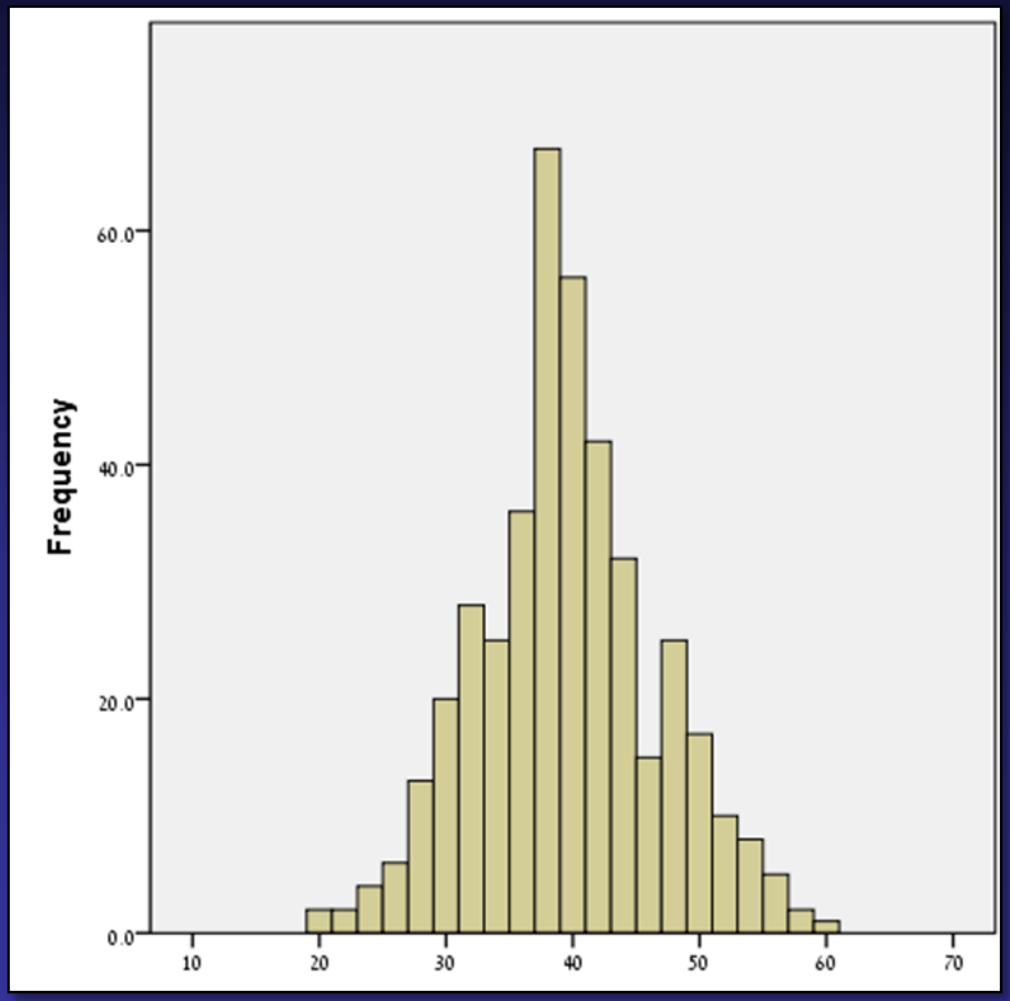
SVI– Stroke Volume Index (ml/m^2)

Echocardiographic Characteristics

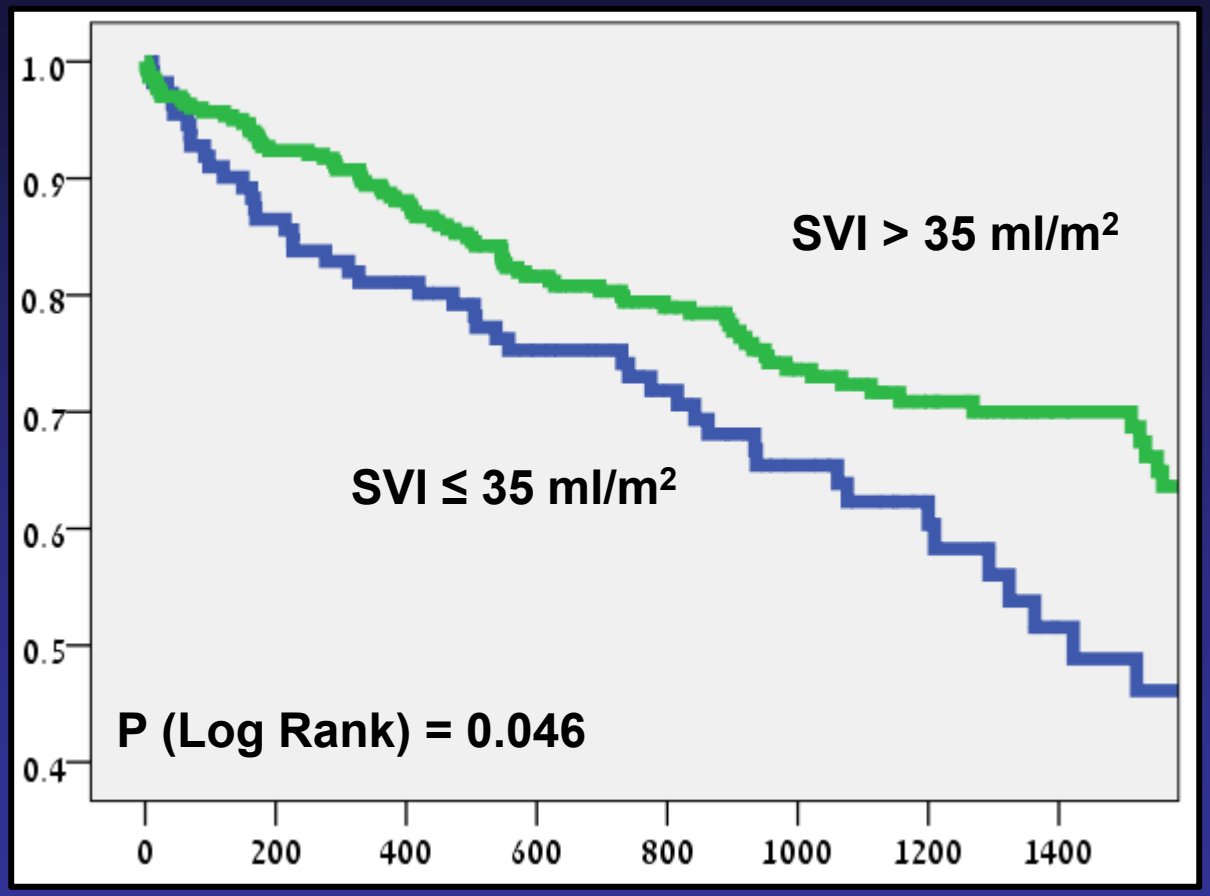
	SVI≤35 (N=113)	SVI>35 (N=303)
Aortic Valve area (cm^2)	0.8±0.1*	0.9±0.1
Indexed Area (cm^2/m^2)	0.4±0.1*	0.5±0.1
Aortic Valve Mean Gradient (mmHg)	28±7*	32±5
Peak Velocity (m)	3.4±0.7*	3.7±0.4
Stroke Volume Index (ml/m^2)	31±4*	42±5
Cardiac Index ($L/min*m^2$)	2.3±0.4*	2.9±0.5

SVI– Stroke Volume Index (mL/m^2)
*P value < 0.01

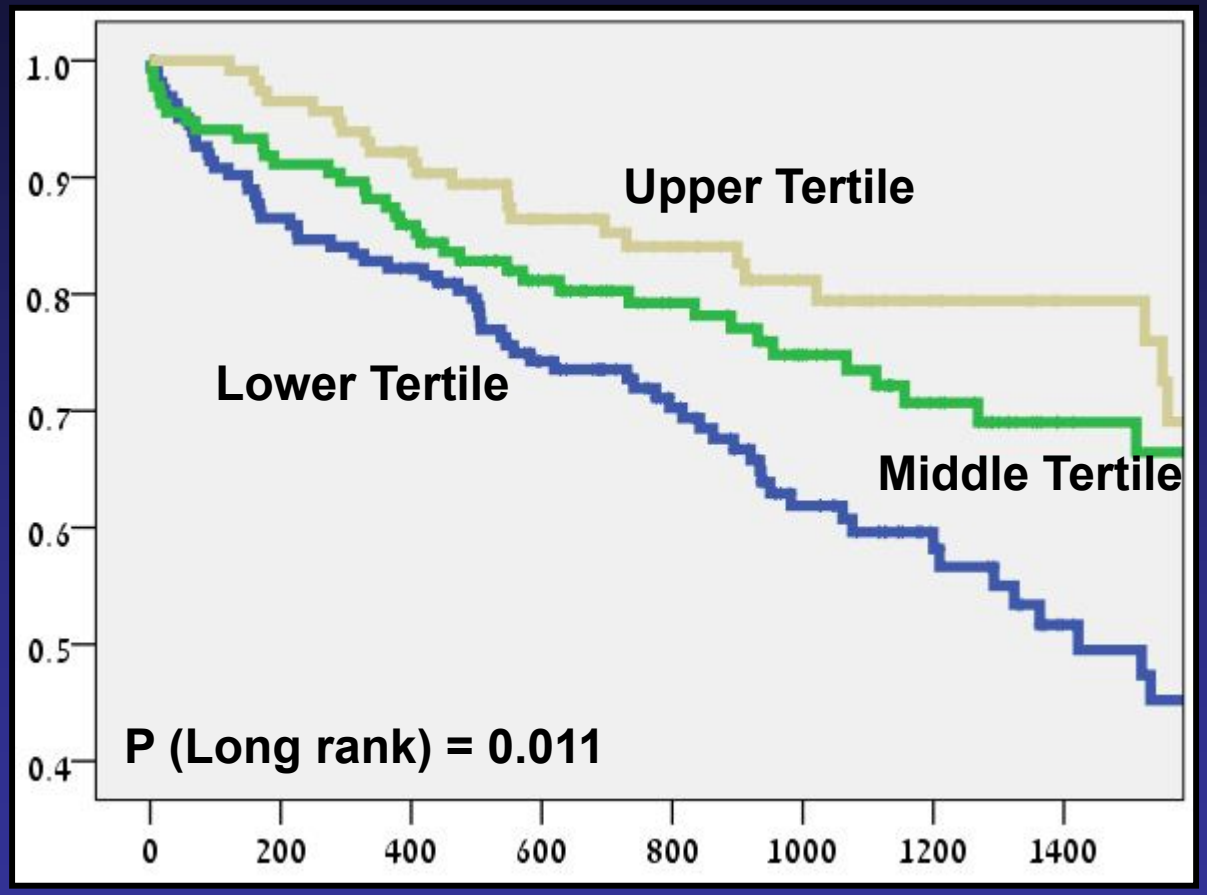
Stroke Volume Index Histogram



Kaplan Meier by Stroke Volume Index



Kaplan Meier by SVI Tertiles



Multivariate Cox Regression

		Hazard Ratio	P value
Model 1	SVI ≤ 35 ml/m^2	1.28	0.24
Model 2	Continuous SVI (for each 5 ml/m^2)	1.19	0.01
Model 3	Middle vs. Upper tertile	1.34	0.25
	Lower vs. Upper tertile	1.69	0.04

* Adjusted for: gender, age (dichotomous at 80), Obesity , Ischemic heart disease , and aortic valve intervention (time dependent)

Forward Stepwise Regression

	Hazard Ratio	P value
Female	0.86	0.44
Obesity	1.00	0.69
Ischemic Heart Disease	1.29	0.17
Intervention (Time Dependent)	0.59	0.08
Age >80	4.53	<0.01
Stroke Volume Index (For Each 5 ml/m^2)	1.19	0.01

- **Prespecified covariates**: Gender, Age, Obesity, IHD and Aortic Intervention
- **Non significant Echocardiographic Covariates**: Aortic valve area, Left ventricle diastolic diameter, Intraventricular septum diameter, Left atrium area, Left ventricular mass.

Limitations

- Retrospective Analysis
- Single Center Cohort
- Measurements Error
  - Stroke volume measurements
- Ejection Fraction Estimation
- Lack of data regarding functional class

Conclusions

- Stroke volume index is an **independent predictor** of poor prognosis among subjects with low gradient severe aortic stenosis and preserved ejection fraction

- Stroke volume index may be evaluated as a **continuous variable** in the risk stratification of patients with severe aortic stenosis