

Online Supplement

Table 1. Sensitivity Analysis – Quantitative Echocardiographic Measures of Severe Aortic Stenosis by Documented Interpretation (including “Moderate to Severe” as Severe)

Echocardiographic Measurements	All Patients N=77,067	Severity by Documented Interpretation	
		Severe N=1,863 (2.4%)	Non-severe N=75,204 (97.6%)
Individual Elements			
Peak Velocity ≥ 4.0 m/s	1,040 (1.3%)	973 (52.2%)	67 (0.1%)
Mean Gradient ≥ 40 mmHg	852 (1.1%)	830 (44.6%)	22 (<0.1%)
Aortic Valve Area ≤ 1.0 cm ²	3,055 (4.0%)	1,634 (87.7%)	1,421 (1.9%)
Indexed Aortic Valve Area ≤ 0.6 cm ² /m ²	5,075 (6.6%)	1,764 (94.7%)	3,311 (4.4%)
Dimensionless Index (VTI) ≤ 0.25	1,643 (2.1%)	1,249 (67.0%)	394 (0.5%)
Dimensionless Index (peak velocity) ≤ 0.25	1,640 (2.1%)	1,257 (67.5%)	383 (0.5%)
Combined elements			
Peak velocity or Mean gradient	1,079 (1.4%)	1,009 (54.2%)	70 (0.1%)
Peak velocity, mean gradient, or Aortic Valve Area	3,196 (4.1%)	1,730 (92.9%)	1,466 (1.9%)

Peak velocity, mean gradient, or Indexed Valve Area	5,134 (6.7%)	1,799 (96.6%)	3,335 (4.4%)
Peak velocity, mean gradient, or dimensionless index (VTI)	1,959 (2.5%)	1,507 (80.9%)	452 (0.6%)
Peak velocity, mean gradient, or dimensionless index (peak velocity)	1,909 (2.5%)	1,468 (78.8%)	441 (0.6%)

Table 2. Sensitivity Analysis - Diagnostic Characteristics of Quantitative Measures of Severe Aortic Stenosis Relative to Documented Severe Aortic Stenosis (including “Moderate to Severe” as Severe)

Echocardiographic Measurements	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Accuracy
Single Elements,%					
Peak Velocity ≥ 4.0 m/s	52.2	99.9	93.6	98.8	98.8
Mean Gradient ≥ 40 mmHg	44.6	100	97.4	98.6	98.6
Aortic Valve Area ≤ 1.0 cm ²	87.7	98.1	53.5	99.7	97.9
Indexed Aortic Valve Area ≤ 0.6 cm ² /m ²	94.7	95.6	34.8	99.9	95.6
Dimensionless Index (VTI) ≤ 0.25	67.0	99.5	76.0	99.2	98.7
Dimensionless Index (peak velocity) ≤ 0.25	67.5	99.5	76.6	99.2	98.7
Combined Elements, %					
Peak velocity or mean gradient	54.2	99.9	93.5	98.9	98.8
Peak velocity, mean gradient, or Aortic Valve Area	92.9	98.1	54.1	99.8	97.9

Peak velocity, mean gradient, or Indexed Aortic Valve Area	96.6	95.6	35.0	99.9	95.6
Peak velocity, mean gradient, or dimensionless index (VTI)	80.9	99.4	76.9	99.5	99.0
Peak velocity, mean gradient, or dimensionless index (peak velocity)	78.8	99.4	76.9	99.5	98.9

Table 2. Subgroup Analyses: Quantitative Echocardiographic Measures of Severe Aortic Stenosis by Documented Interpretation

Sex	Women N=39,351 (51.1%)		Men N=37,716 (48.9%)	
Echocardiographic Measurements	Severity by Documented Interpretation		Severity by Documented Interpretation	
	Severe N=556 (1.4%)	Non-severe N=38,795 (98.6%)	Severe N=663 (1.8%)	Non-severe N=37,053 (98.2%)
Individual Elements				
Peak Velocity ≥ 4.0 m/s	397 (71.4%)	78 (0.2%)	455 (68.6%)	110 (0.3%)
Mean Gradient ≥ 40 mmHg	352 (63.3%)	36 (0.1%)	407 (61.4%)	57 (0.2%)
Aortic Valve Area ≤ 1.0 cm ²	535 (96.2%)	1,126 (2.9%)	612 (92.3%)	782 (2.1%)
Indexed Aortic Valve Area \leq 0.6 cm ² /m ²	533 (95.5%)	1,691 (4.4%)	652 (98.3%)	2,199 (5.9%)
Dimensionless Index (VTI) \leq 0.25	432 (77.7%)	239 (0.6%)	540 (81.4%)	432 (1.2%)

Dimensionless Index (peak velocity) ≤ 0.25	419 (75.4%)	220 (0.6%)	562 (84.8%)	439 (1.2%)
Combined elements				
Peak velocity or Mean gradient	407 (73.2%)	83 (0.2%)	469 (70.7%)	120 (0.3%)
Peak velocity, mean gradient, or Aortic Valve Area	550 (98.9%)	1,154 (3.0%)	649 (97.9%)	843 (2.3%)
Peak velocity, mean gradient, or Indexed Valve Area	548 (98.6%)	1,708 (4.4%)	658 (99.2%)	2,220 (6.0%)
Peak velocity, mean gradient, or dimensionless index (VTI)	514 (92.4%)	299 (0.8%)	631 (95.2%)	515 (1.4%)
Peak velocity, mean gradient, or dimensionless index (peak velocity)	497 (89.4%)	279 (0.7%)	623 (94.0%)	510 (1.4%)

Ejection Fraction (EF) (N=73,755)	EF \leq 35% N=4,776 (6.5%)		EF > 35% N=68,979 (93.5%)	
Echocardiographic Measurements	Severity by Documented Interpretation		Severity by Documented Interpretation	
	Severe N=161 (3.4%)	Non-severe N=4,615 (96.6%)	Severe N= 972 (1.4%)	Non-severe N=68,007 (98.6%)
Individual Elements				
Peak Velocity \geq 4.0 m/s	59 (36.6%)	1 (<0.1%)	734 (75.5%)	170 (0.2%)
Mean Gradient \geq 40 mmHg	54 (33.5%)	1 (<0.1%)	646 (66.5%)	85 (0.1%)
Aortic Valve Area \leq 1.0 cm ²	155 (96.3%)	174 (3.8%)	912 (93.8%)	1,564 (2.3%)
Indexed Aortic Valve Area \leq 0.6 cm ² /m ²	158 (98.1%)	345 (7.5%)	943 (97.0%)	3,239 (4.8%)
Dimensionless Index (VTI) \leq 0.25	148 (91.9%)	91 (2.0%)	761 (78.3%)	529 (0.8%)
Dimensionless Index (peak velocity) \leq 0.25	140 (87.0%)	91 (2.0%)	775 (79.7%)	519 (0.8%)

Combined elements				
Peak velocity or Mean gradient	62 (38.5%)	3 (0.1%)	751 (77.3%)	182 (0.3%)
Peak velocity, mean gradient, or Aortic Valve Area	155 (96.3%)	175 (3.8%)	961 (98.9%)	1,640 (2.4%)
Peak velocity, mean gradient, or Indexed Valve Area	158 (98.1%)	345 (7.5%)	964 (99.2%)	3,271 (4.8%)
Peak velocity, mean gradient, or dimensionless index (VTI)	149 (92.5%)	92 (2.0%)	917 (94.3%)	659 (1.0%)
Peak velocity, mean gradient, or dimensionless index (peak velocity)	141 (87.6%)	91 (2.0%)	901 (92.7%)	635 (0.9%)
Stroke Volume Index N=53,173	Stroke Volume Index <35 ml/m2 N=21,531 (40.5%)		Stroke Volume Index ≥35 ml/m2 N=31,642 (59.5%)	

Echocardiographic Measurements	Severity by Documented Interpretation		Severity by Documented Interpretation	
	Severe N=310 (1.4%)	Non-severe N=21,221 (98.6%)	Severe N=392 (1.2%)	Non-severe N=31,250 (98.8%)
Individual Elements				
Peak Velocity ≥ 4.0 m/s	154 (49.7%)	10 (<0.1%)	342 (87.2%)	92 (0.3%)
Mean Gradient ≥ 40 mmHg	125 (40.3%)	6 (<0.1%)	300 (76.5%)	35 (0.1%)
Aortic Valve Area ≤ 1.0 cm ²	302 (97.4%)	574 (2.7%)	365 (93.1%)	413 (1.3%)
Indexed Aortic Valve Area ≤ 0.6 cm ² /m ²	309 (99.7%)	1,297 (6.1%)	377 (96.2%)	821 (2.6%)
Dimensionless Index (VTI) ≤ 0.25	289 (93.2%)	178 (0.8%)	299 (76.3%)	129 (0.4%)
Dimensionless Index (peak velocity) ≤ 0.25	277 (89.4%)	158 (0.7%)	303 (77.3%)	145 (0.5%)
Combined elements				

Peak velocity or Mean gradient	156 (50.3%)	12 (0.1%)	346 (88.3%)	96 (0.3%)
Peak velocity, mean gradient, or Aortic Valve Area	304 (98.1%)	577 (2.7%)	390 (99.5%)	455 (1.5%)
Peak velocity, mean gradient, or Indexed Valve Area	309 (99.7%)	1,298 (6.1%)	390 (99.5%)	842 (2.7%)
Peak velocity, mean gradient, or dimensionless index (VTI)	296 (95.5%)	183 (0.9%)	375 (95.7%)	206 (0.7%)
Peak velocity, mean gradient, or dimensionless index (peak velocity)	283 (91.3%)	161 (0.8%)	372 (94.9%)	214 (0.7%)

Table 3. Subgroup Analysis - Diagnostic Characteristics of Quantitative Measures of Severe Aortic Stenosis Relative to Documented Severe Aortic Stenosis by Subgroups

Echocardiographic Measurements	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value	Accuracy
Women					
Single Elements, %					
Peak Velocity ≥ 4.0 m/s	71.4	99.8	83.6	99.6	99.4
Mean Gradient ≥ 40 mmHg	63.3	99.9	90.7	99.5	99.4
Aortic Valve Area ≤ 1.0 cm ²	96.2	97.1	32.2	99.9	97.1
Indexed Aortic Valve Area ≤ 0.6 cm ² /m ²	95.9	95.6	24.0	99.9	95.6
Dimensionless Index (VTI) ≤ 0.25	77.7	99.4	64.4	99.7	99.1
Dimensionless Index (peak velocity) ≤ 0.25	75.4	99.4	65.6	99.6	99.1
Combined Elements, %					
Peak velocity or mean gradient	73.2	99.8	83.1	99.6	99.4

Peak velocity, mean gradient, or Aortic Valve Area	98.9	97.0	32.3	100	97.1
Peak velocity, mean gradient, or Indexed Aortic Valve Area	98.6	95.6	24.3	100	95.6
Peak velocity, mean gradient, or dimensionless index (VTI)	92.4	99.2	63.2	99.9	99.1
Peak velocity, mean gradient, or dimensionless index (peak velocity)	89.4	99.3	64.0	99.8	99.1
Men					
Single Elements,%					
Peak Velocity ≥ 4.0 m/s	68.6	99.7	80.5	99.4	99.2
Mean Gradient ≥ 40 mmHg	61.4	99.8	87.7	99.3	99.2
Aortic Valve Area ≤ 1.0 cm ²	92.3	97.9	43.9	99.9	97.8
Indexed Aortic Valve Area ≤ 0.6 cm ² /m ²	98.3	94.1	22.9	100	94.1
Dimensionless Index (VTI) ≤ 0.25	81.4	98.8	55.6	99.7	98.5
Dimensionless Index (peak velocity) ≤ 0.25	84.8	98.8	56.1	99.7	98.6

Combined Elements, %					
Peak velocity or mean gradient	70.7	99.7	79.6	99.5	99.2
Peak velocity, mean gradient, or Aortic Valve Area	97.9	97.7	43.5	100	97.7
Peak velocity, mean gradient, or Indexed Aortic Valve Area	99.2	94.0	22.9	100	94.1
Peak velocity, mean gradient, or dimensionless index (VTI)	95.2	98.6	55.1	99.9	98.5
Peak velocity, mean gradient, or dimensionless index (peak velocity)	94.0	98.6	55.0	99.9	98.5
Reduced EF ≤ 35%					
Single Elements,%					
Peak Velocity ≥ 4.0 m/s	36.6	100	98.3	97.8	97.8
Mean Gradient ≥ 40 mmHg	33.5	100	98.2	97.7	97.7
Aortic Valve Area ≤ 1.0 cm ²	96.3	96.2	47.1	99.9	96.2
Indexed Aortic Valve Area ≤ 0.6 cm ² /m ²	98.1	92.5	31.4	99.9	92.7

Dimensionless Index (VTI) ≤ 0.25	91.9	98.0	61.9	99.7	97.8
Dimensionless Index (peak velocity) ≤ 0.25	87.0	98.0	69.6	99.5	97.7
Combined Elements, %					
Peak velocity or mean gradient	38.5	99.9	95.4	97.9	97.9
Peak velocity, mean gradient, or Aortic Valve Area	96.3	96.2	47.0	99.9	96.2
Peak velocity, mean gradient, or Indexed Aortic Valve Area	98.1	92.5	31.4	99.9	92.7
Peak velocity, mean gradient, or dimensionless index (VTI)	92.5	98.0	61.8	99.7	97.8
Peak velocity, mean gradient, or dimensionless index (peak velocity)	87.6	98.0	60.8	99.6	97.7
EF >35%					
Single Elements,%					
Peak Velocity ≥ 4.0 m/s	75.5	99.8	81.2	99.7	99.4
Mean Gradient ≥ 40 mmHg	66.5	99.9	88.4	99.5	99.4

Aortic Valve Area ≤ 1.0 cm ²	93.8	97.7	36.8	99.9	97.6
Indexed Aortic Valve Area ≤ 0.6 cm ² /m ²	97.0	95.2	22.5	100	95.3
Dimensionless Index (VTI) ≤ 0.25	78.3	99.2	59.0	99.7	98.9
Dimensionless Index (peak velocity) ≤ 0.25	79.7	99.2	59.9	99.7	99.0
Combined Elements, %					
Peak velocity or mean gradient	77.3	99.7	80.5	99.7	99.4
Peak velocity, mean gradient, or Aortic Valve Area	98.9	97.6	36.9	100	97.6
Peak velocity, mean gradient, or Indexed Aortic Valve Area	99.2	95.2	22.8	100	95.2
Peak velocity, mean gradient, or dimensionless index (VTI)	94.3	99.0	58.2	99.9	99.0
Peak velocity, mean gradient, or dimensionless index (peak velocity)	92.7	99.1	58.7	99.9	99.0
Stroke volume index < 35 ml/m²					
Single Elements,%					

Peak Velocity ≥ 4.0 m/s	49.7	100	93.9	99.3	99.2
Mean Gradient ≥ 40 mmHg	40.3	100	95.4	99.1	99.1
Aortic Valve Area ≤ 1.0 cm ²	97.4	97.3	34.5	100	97.3
Indexed Aortic Valve Area ≤ 0.6 cm ² /m ²	99.7	93.9	19.2	100	94.0
Dimensionless Index (VTI) ≤ 0.25	93.2	99.2	61.9	99.9	99.1
Dimensionless Index (peak velocity) ≤ 0.25	89.4	99.3	63.7	99.8	99.1
Combined Elements, %					
Peak velocity or mean gradient	50.3	99.9	92.9	99.3	99.2
Peak velocity, mean gradient, or Aortic Valve Area	98.1	97.3	34.5	100	97.3
Peak velocity, mean gradient, or Indexed Aortic Valve Area	99.7	93.9	19.2	100	94.0
Peak velocity, mean gradient, or dimensionless index (VTI)	95.5	99.1	61.8	99.9	99.1
Peak velocity, mean gradient, or dimensionless index (peak velocity)	91.3	99.2	63.7	99.9	99.1

Stroke Volume Index ≥ 35 ml/m²					
Single Elements,%					
Peak Velocity ≥ 4.0 m/s	87.2	99.7	78.8	99.8	99.6
Mean Gradient ≥ 40 mmHg	76.5	99.9	89.6	99.7	99.6
Aortic Valve Area ≤ 1.0 cm ²	93.1	98.7	46.9	99.9	98.6
Indexed Aortic Valve Area ≤ 0.6 cm ² /m ²	96.2	97.4	31.5	100	97.4
Dimensionless Index (VTI) ≤ 0.25	76.3	99.6	69.9	99.7	99.3
Dimensionless Index (peak velocity) ≤ 0.25	77.3	99.5	67.6	99.7	99.3
Combined Elements, %					
Peak velocity or mean gradient	88.3	99.7	78.3	99.9	99.6
Peak velocity, mean gradient, or Aortic Valve Area	99.5	98.5	46.2	100	98.6
Peak velocity, mean gradient, or Indexed Aortic Valve Area	99.5	97.3	31.7	100	97.3
Peak velocity, mean gradient, or dimensionless index (VTI)	95.7	99.3	64.5	99.9	99.3

Peak velocity, mean gradient, or dimensionless index (peak velocity)	94.9	99.3	63.5	99.9	99.3
--	------	------	------	------	------