

# Importance of Surgeon's Volume in Practicing Valve-Sparing Aortic Root Replacement

# Background

- Aortic root replacement (ARR), particularly valve-sparing root replacement (VSRR) is a challenging procedure requiring technical proficiency<sup>1</sup>
- Patients often undergo such procedures in large volume aortic centers<sup>2</sup>
- Patients undergoing elective aortic procedures at North American hospitals that perform fewer than 30-40 procedures annually have greater risk-adjusted mortality<sup>2</sup>
- Surgeon experience in performing VSRR and other types of root replacement could affect outcomes<sup>3</sup>

1. Miller, Annals (2007)
2. Hughes et al, JTCVS (2013)
3. Bilkhu et al, Seminars (2016)

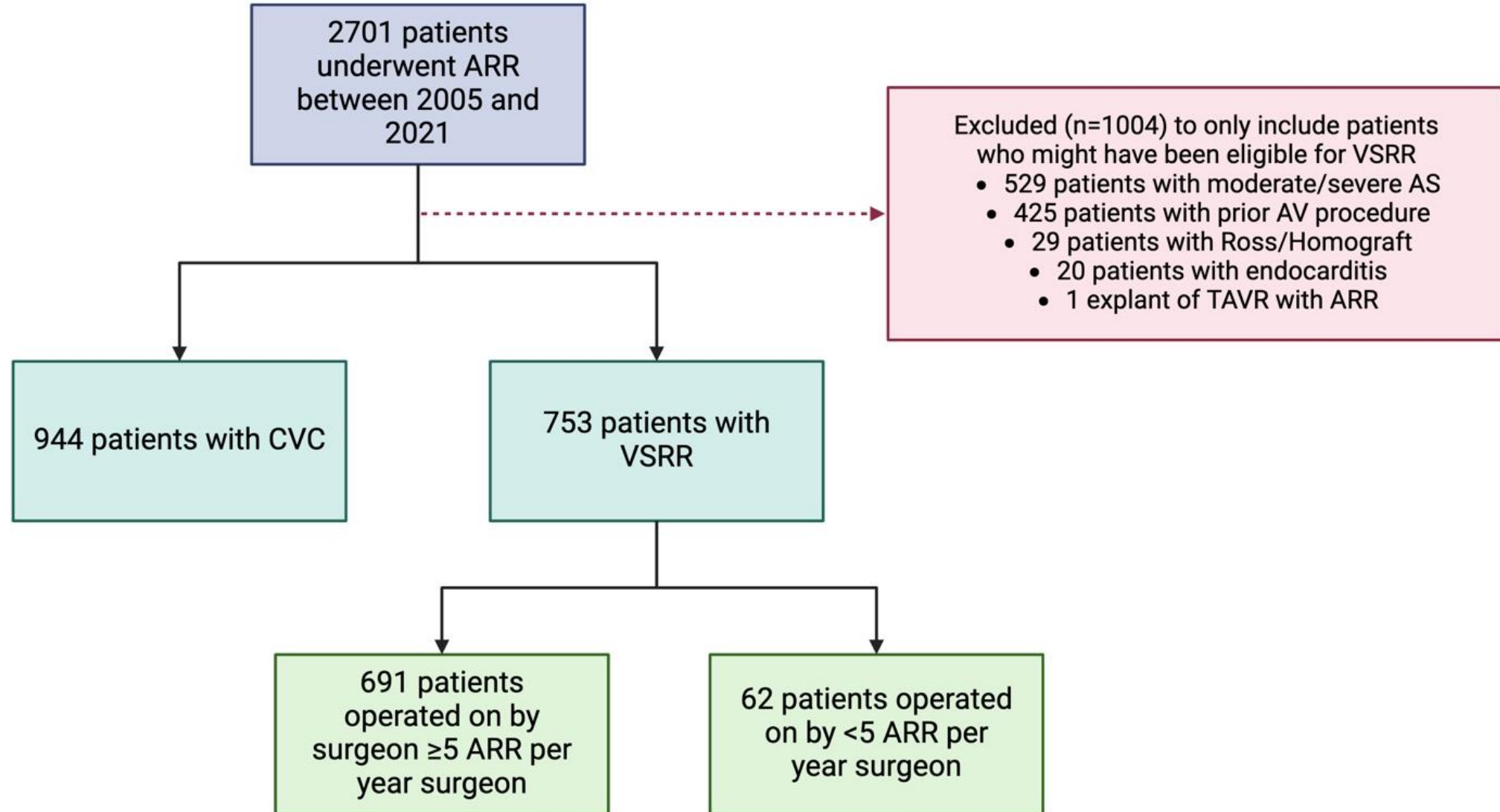
# Hypothesis/Objectives

- We hypothesize that annual surgeon volume of performing ARR affects practice pattern and outcomes in VSRR
- Objectives
  - To compare outcomes of VSRR performed by surgeon volume  $<5$  ARR or  $\geq 5$  ARR annually
  - To elucidate which characteristics are associated with undergoing VSRR in a patient population potentially eligible for VSRR

# Methods: Endpoints and Statistics

- Annual surgeon volume was defined as number of ARR performed per year in our database, surgeons were classified as  $<5$  ARR or  $\geq 5$  ARR
- Primary analysis: multivariable logistic regression was used to examine the association between surgeon volume and undergoing VSRR over ARR with composite-valved conduit (CVC)
- Secondary analysis: Inverse probability treatment weighting (IPTW) was used to match patients who had VSRR performed by  $<5$  ARR or  $\geq 5$  ARR and examine differences in outcomes; cumulative incidence of AV reoperation with mortality as a competing risk

# Methods: Patients



# Comparison of ARR practice between <5 ARR and ≥5 ARR Surgeons: Patient Demographics

	Overall	<5 ARR	≥5 ARR	P-value
n	1,697	252	1,445	
Age (median [IQR])	57 [45, 66]	57 [43, 65]	57 [46, 66]	0.39
Female gender (%)	268 (15.8)	41 (16.3)	227 (15.7)	0.90
BMI (median [IQR])	27.8 [24.6, 31.6]	28.4 [25.0, 32.4]	27.8 [24.6, 31.4]	0.13
CKD (%)	308 (18.1)	49 (19.4)	259 (17.9)	0.63
DM (%)	186 (11.0)	27 (10.7)	159 (11.0)	0.98
HTN (%)	1286 (75.8)	200 (79.4)	1086 (75.2)	0.17
Surgical Indication (%)				<0.001
Aneurysm	1496 (88.2)	193 (76.6)	1303 (90.2)	
Dissection	201 (11.8)	59 (23.4)	142 (9.8)	
Dyslipidemia (%)	885 (52.2)	125 (49.6)	760 (52.6)	0.42
CVD (%)	123 (7.2)	23 (9.1)	100 (6.9)	0.27
PVD (%)	130 (7.7)	12 (4.8)	118 (8.2)	0.08
Connective tissue disease (%)	100 (5.9)	13 (5.2)	87 (6.0)	0.70
Bicuspid AV (%)	420 (24.7)	56 (22.2)	364 (25.2)	0.35
Moderate/severe AI (%)	1105 (65.1)	186 (73.8)	919 (63.6)	0.002
Previous MI (%)	43 (5.7)	5 (6.4)	38 (5.7)	0.99
Reoperation (%)	200 (11.8)	32 (12.7)	168 (11.6)	0.70
LVEF (median [IQR])	55 [50, 60]	55 [50, 60]	55 [51, 60]	0.59

# Comparison of ARR practice between <5 ARR and $\geq 5$ ARR Surgeons: Procedural Characteristics

	Overall	<5 ARR	$\geq 5$ ARR	P-value
n	1,697	252	1,445	
Type of Root Replacement (%)				<0.001
Biologic CVC	803 (47.3)	130 (51.6)	673 (46.6)	
Mechanical CVC	141 (8.3)	60 (23.8)	81 (5.6)	
VSRR	753 (44.4)	62 (24.6)	691 (47.8)	
Concomitant aortic procedure (%)				0.001
Hemiarch	706 (41.6)	94 (37.3)	612 (42.4)	
Partial/Total arch	160 (9.4)	11 (4.4)	149 (10.3)	
Concomitant MV procedure (%)	88 (5.2)	9 (3.6)	79 (5.5)	0.27
Concomitant CABG (%)	294 (17.3)	57 (22.6)	237 (16.4)	0.02
CPB time (median [IQR])	189 [144, 233]	206 [175, 257]	185 [139, 230]	<0.001
Cross clamp time (median [IQR])	159 [118, 197]	164 [135, 195]	157 [114, 198]	0.01
Circulatory arrest (%)	878 (51.7)	121 (48.0)	757 (52.4)	0.13

# Results: Surgeon is associated with VSRR as procedure of choice

	OR + 95% CI	P-value
Age	0.95 [0.94-0.96]	<0.001
CKD	0.53 [0.38-0.74]	<0.001
DM	0.94 [0.63-1.38]	0.74
HTN	0.93 [0.70-1.25]	0.63
Dissection	0.73 [0.50-1.08]	0.11
Dyslipidemia	0.95 [0.74-1.22]	0.68
CVD	0.60 [0.37-0.97]	0.04
Bicuspid AV	0.40 [0.31-0.53]	<0.001
Moderate/severe AI	0.25 [0.20-0.32]	<0.001
Reoperation	0.34 [0.23-0.51]	<0.001
LVEF	1.03 [1.02-1.04]	<0.001
Concomitant arch replacement	0.68 [0.53-0.86]	0.002
Concomitant MV procedure	0.46 [0.26-0.81]	0.007
Concomitant CABG	0.83 [0.60-1.13]	0.23
≥5 ARR	3.33 [2.34-4.73]	<0.001

Multivariable logistic regression for undergoing VSRR vs non-VSRR



# Results: IPTW between patients who underwent VSRR operated on by <5 ARR or $\geq 5$ ARR surgeon

	<5 ARR	$\geq 5$ ARR	P-value	SMD
N	59.3	690.9		
Age (median [IQR])	52 [38, 60]	50 [39, 61]	0.99	0.024
Female sex (%)	9.8 (16.6)	115.6 (16.7)	0.97	0.005
BMI (median [IQR])	27.6 [25.3, 30.7]	27.7 [24.5, 31.6]	0.71	0.001
DM (%)	4.8 (8.1)	56.0 (8.1)	0.99	0.001
CKD (%)	6.4 (10.8)	72.5 (10.5)	0.94	0.010
HTN (%)	39.7 (67.0)	473.5 (68.5)	0.80	0.033
CVD (%)	2.9 (4.9)	31.1 (4.5)	0.87	0.019
Reoperation (%)	4.1 (7.0)	53.2 (7.7)	0.84	0.028
Dissection (%)	7.2 (12.1)	63.5 (9.2)	0.47	0.096
Dyslipidemia (%)	26.0 (43.9)	312.8 (45.3)	0.84	0.027
Connective tissue disease (%)	6.5 (10.9)	72.4 (10.5)	0.91	0.015
Moderate/severe AI (%)	29.9 (50.4)	325.7 (47.1)	0.63	0.065
LVEF (median [IQR])	55 [55, 60]	55 [54, 60]	0.81	0.005

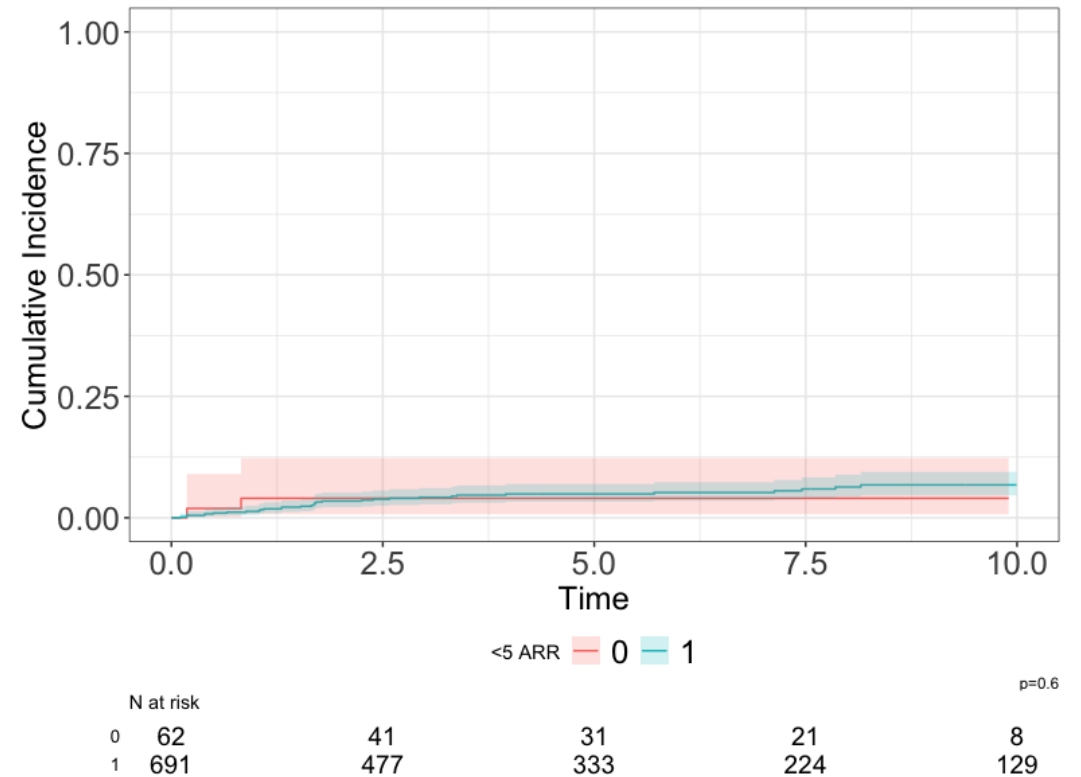
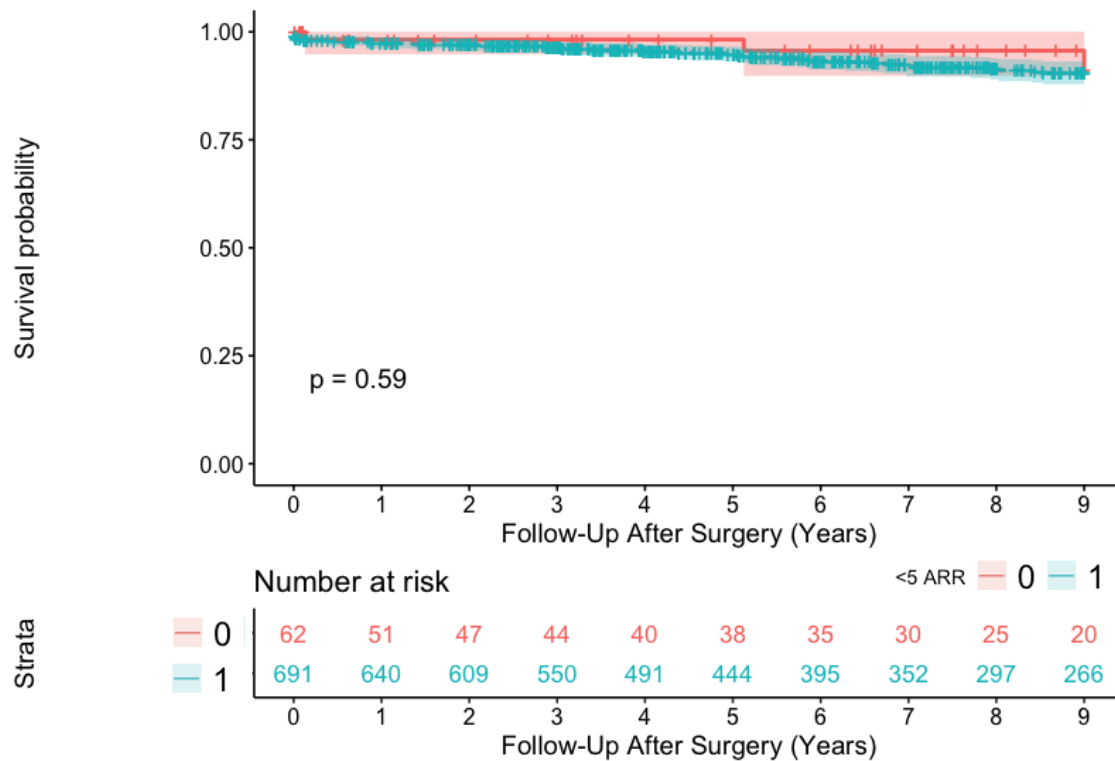
Patient characteristics used for IPTW matching

# Results: IPTW between patients who underwent VSRR operated on by <5 ARR or $\geq 5$ ARR surgeon

	<5 ARR	$\geq 5$ ARR	P-value
<b>N</b>	59.3	690.9	
<b>In-hospital mortality (%)</b>	0.7 (1.2)	9.1 (1.3)	0.95
<b>Stroke (%)</b>	0.7 (1.2)	13.1 (1.9)	0.67
<b>Renal failure (%)</b>	1.8 (3.1)	26.0 (3.8)	0.79
<b>Postoperative dialysis (%)</b>	0.7 (1.2)	16.1 (2.3)	0.52
<b>Respiratory failure (%)</b>	8.4 (14.2)	74.6 (10.8)	0.44
<b>Reoperation for bleeding (%)</b>	5.2 (8.7)	29.2 (4.2)	0.12
<b>Postoperative TEE AI (%)</b>			0.27
None/trace	23.7 (72.6)	499.8 (84.6)	
Mild	8.2 (25.2)	79.8 (13.5)	
Moderate	0.7 (2.2)	10.0 (1.7)	
Severe	0.0 (0.0)	1.0 (0.2)	
<b>Pre-discharge TTE AI (%)</b>			0.98
None/trace	47.2 (87.1)	580.3 (87.4)	
Mild	6.2 (11.4)	75.6 (11.4)	
Moderate	0.8 (1.5)	8.0 (1.2)	

Results of IPTW matching

# No significant difference in long-term mortality or AV reoperation among VSRR performed by <5 ARR or $\geq 5$ ARR surgeon



# Limitations

- Limited sample size of VSRR performed by <5 ARR surgeons
- Volume cutoff of 5 ARR was arbitrary
- Retrospective nature of study
- Limited generalizability given all surgeons are experienced in heart surgery working in a high-volume program. Additionally, 40% of VSRR performed by <5 ARR surgeons were assisted by a  $\geq 5$  ARR surgeon

# Conclusions

- In high volume aortic centers VSRR may be safely performed by a lower volume surgeon
- However, surgeon's volume and expertise may influence patient selection for VSRR