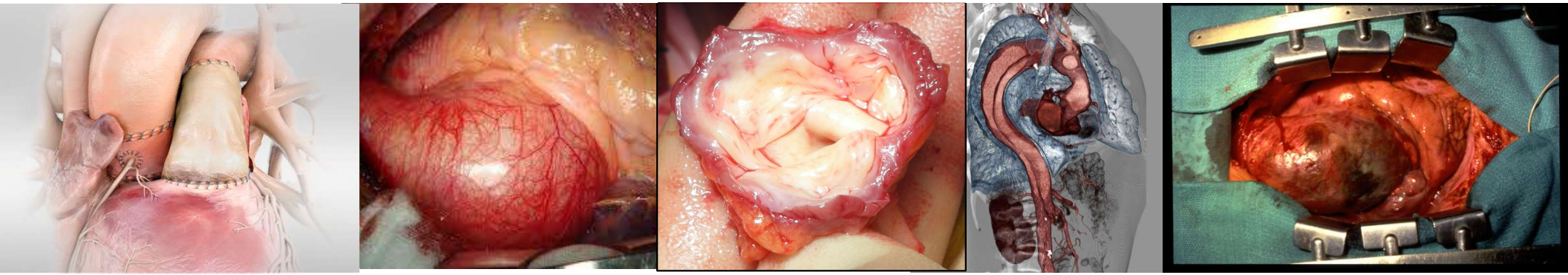


North American Trends in Utilization and Outcomes of the Ross Procedure

Maral Ouzounian MD PhD FRCSC

Head, Division of Cardiovascular Surgery

Munk Chair in Advanced Therapeutics

DeGasperis Chair in Clinical Trials & Outcomes Research

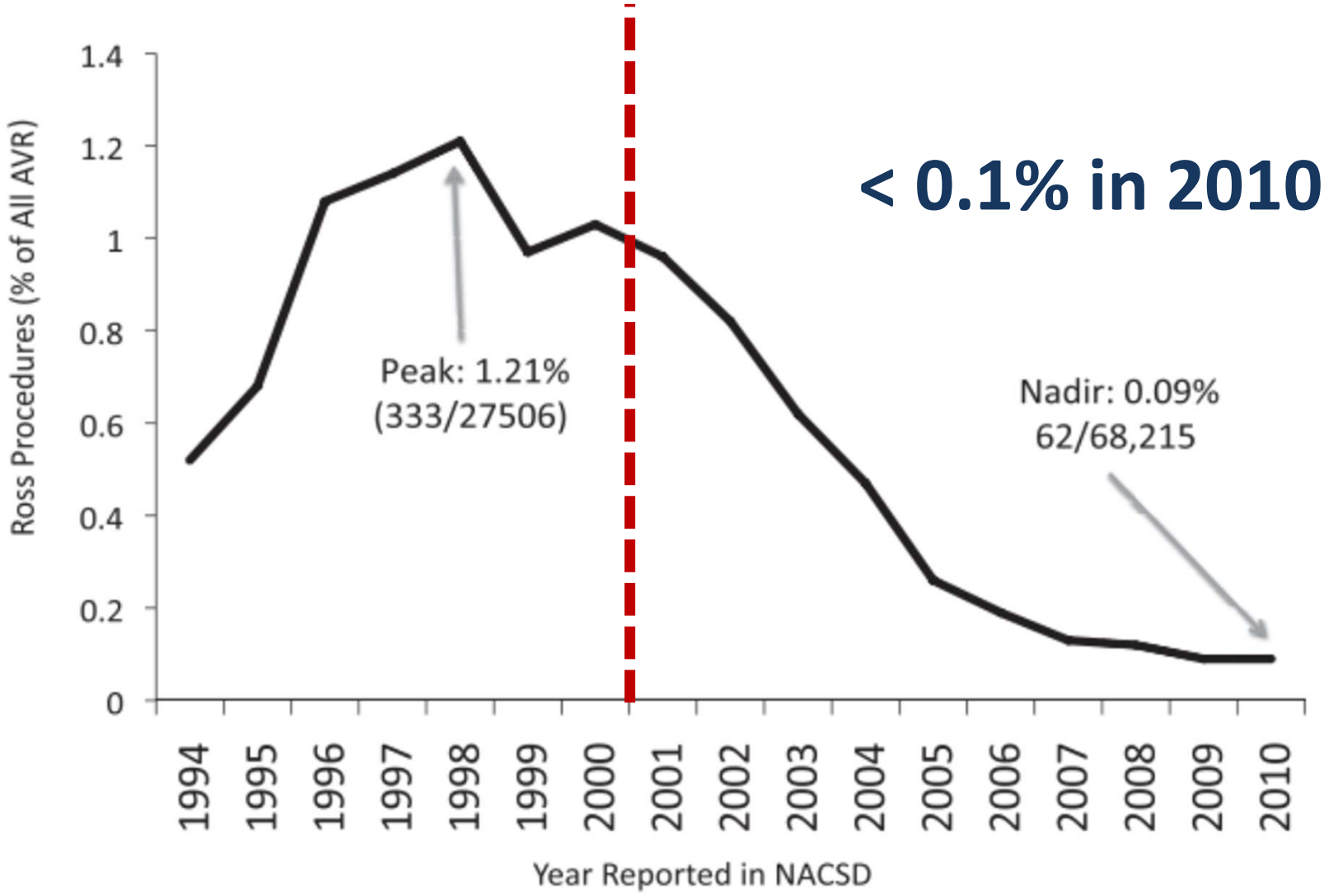
March 5, 2026

@OuzounianMD

UHN Peter Munk Cardiac Centre

UNIVERSITY OF TORONTO

Previous N American trends in the Ross procedure



< 0.1% in 2010

Reece et al. *Ann Thorac Surg* 2014

Rethinking the Ross Procedure in Adults

T. Brett Reece, MD, Karl F. Welke, MD, Sean O'Brien, PhD,
Maria V. Grau-Sepulveda, MD, Frederick L. Grover, MD, and James S. Gammie, MD

Department of Surgery, University of Colorado, Denver, Colorado; Division of Cardiothoracic Surgery, Oregon Health Sciences Center, Portland, Oregon; Duke Clinical Research Institute, Durham, North Carolina; and Division of Cardiac Surgery, University of Maryland, Baltimore, Maryland

STS Cohort
n = 3054 Ross
1994-2010

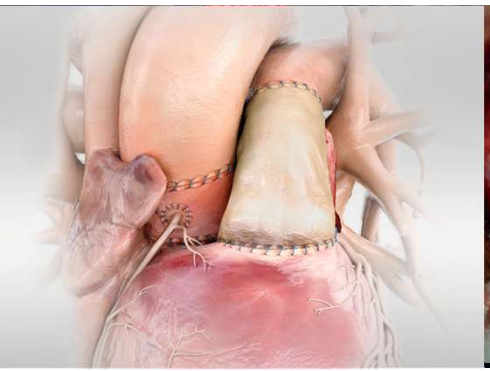
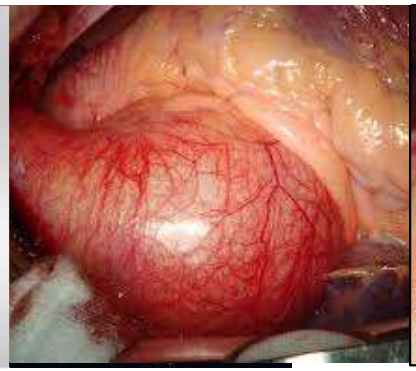
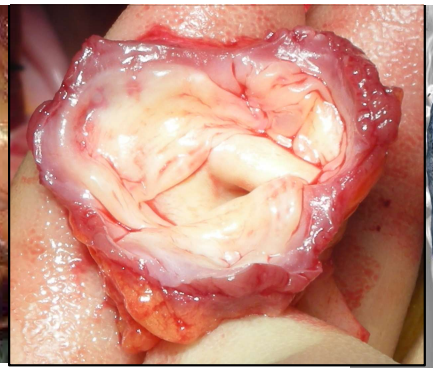
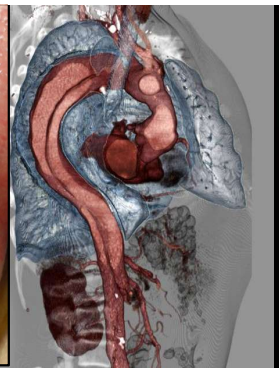
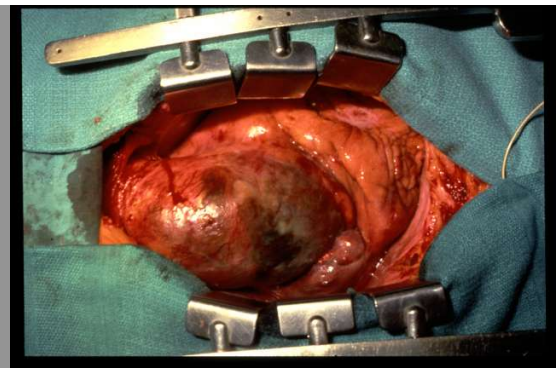
216 surgeons
< 20 performed > 5 Ross total

220 centers
Only 9 centers averaged ~5 / year

Early mortality 2.7% (vs. 0.9% AVR)
Mortality Ross vs. AVR: OR 3.0

'increased morbidity + mortality do not justify it as a viable alternative to AVR'

Reece et al. *Ann Thorac Surg* 2014

What has prompted the Ross Renaissance?

UHN Peter Munk Cardiac Centre

UNIVERSITY OF TORONTO

JACC
VOL. ■, NO. ■, 2026

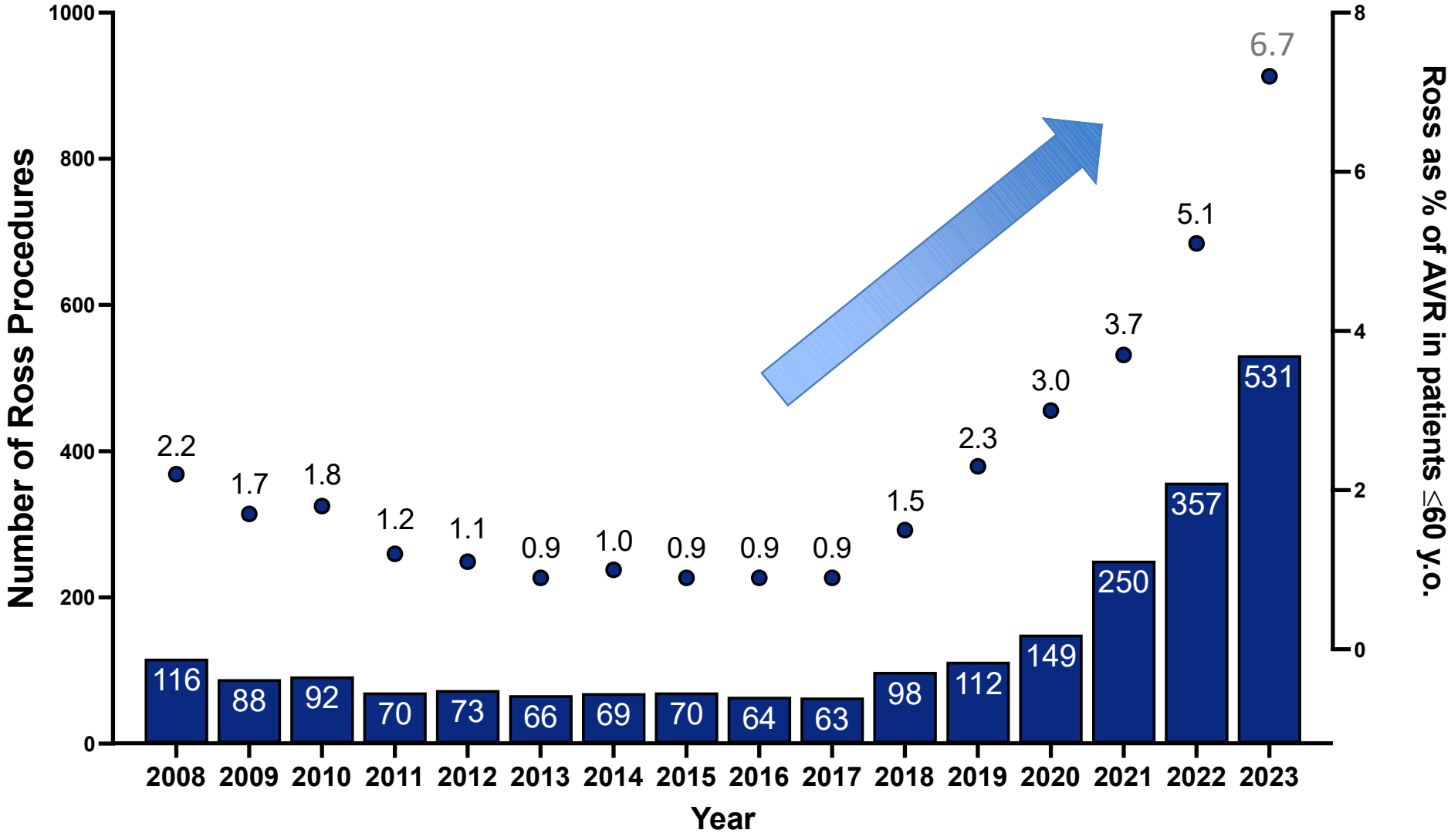
Use of the Ross Procedure in North America

Relation Between Surgical Volume and Operative Mortality

Amine Mazine, MD, PhD,[a] Jessica Weiss, MSc,[b] Joanna Chikwe, MD,[c] Nimesh D. Desai, MD, PhD,[d] Jennifer C.-Y. Chung, MD, MSc,[a] Jad Malas, MD,[c] Qiudong Kevin Chen, MD,[c] Angel Chen, BSc,[b] Kyle Runeckles, MSc,[b] Chun-Po Steve Fan, PhD,[b] Michael E. Bowdish, MD,[c] Joseph E. Bavaria, MD,[e] Maral Ouzounian, MD, PhD[a]

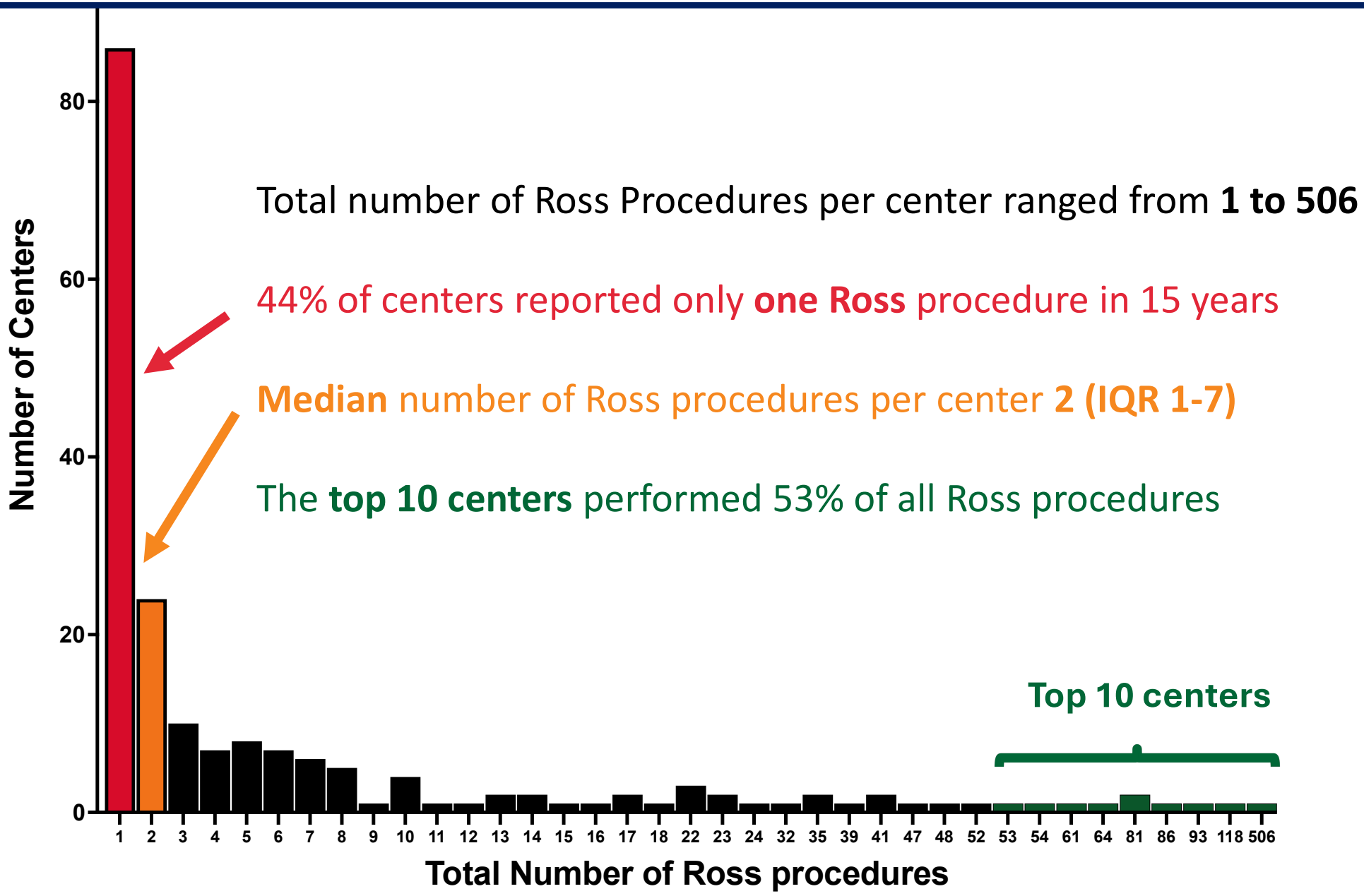
Peter Munk Cardiac Centre

Current Ross volumes in N America



Mazine A….Ouzounian M J Am Coll Cardiol 2026

Distribution of Ross procedures



Total number of Ross Procedures per center ranged from **1 to 506**

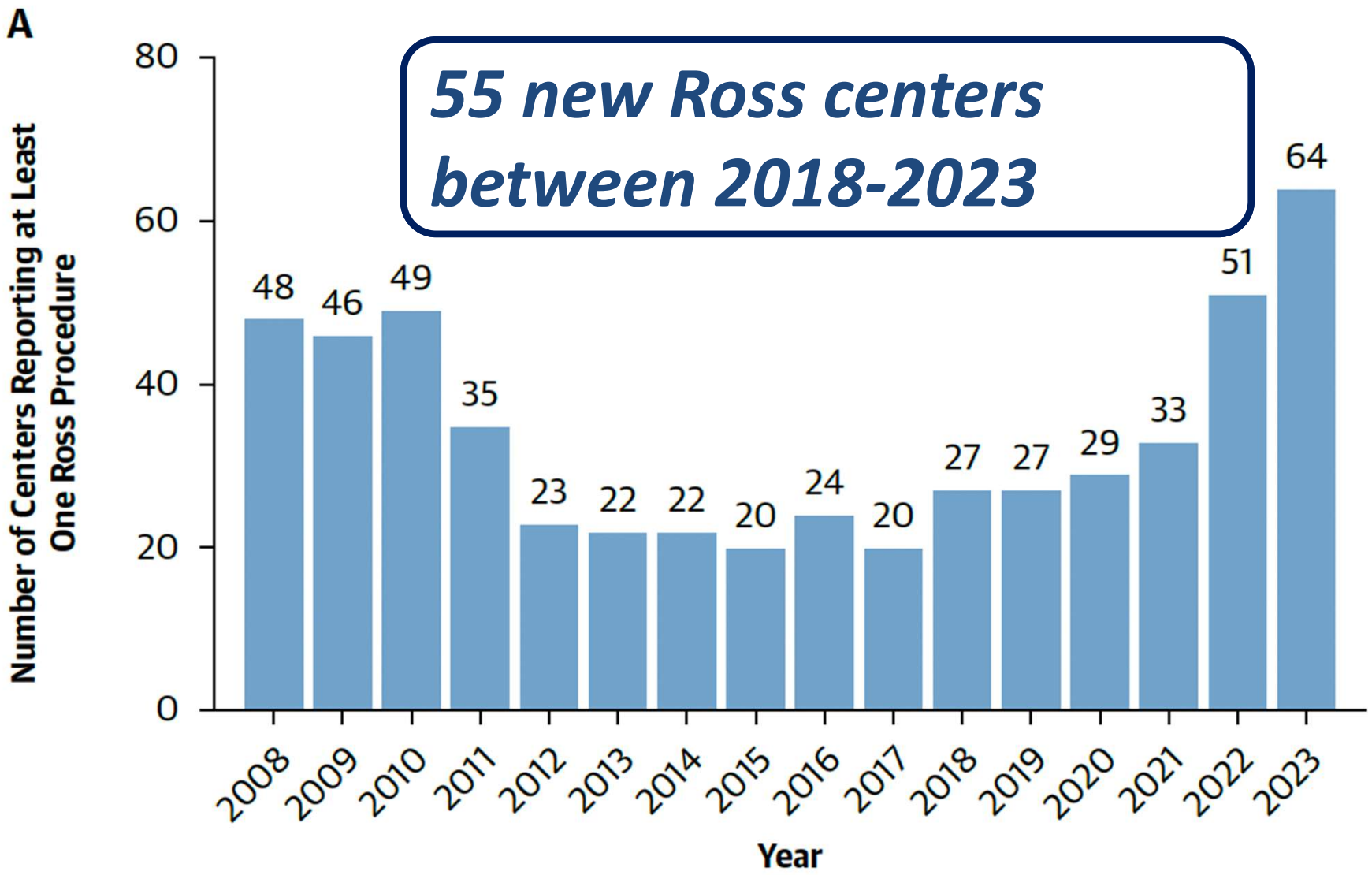
44% of centers reported only **one Ross** procedure in 15 years

Median number of Ross procedures per center **2 (IQR 1-7)**

The **top 10 centers** performed 53% of all Ross procedures

Mazine A….Ouzounian M J Am Coll Cardiol 2026

Number of centers reporting at least one Ross



Mazine A….Ouzounian M J Am Coll Cardiol 2026

Baseline Characteristics

TABLE 1 Baseline Patient Characteristics

	Overall (N = 2,268)	Low Volume (1 or 2 per Year) (n = 425)	Medium Volume (3-10 per Year) (n = 749)	High Volume (>10 per Year) (n = 1094)	*P* Value
Age, y	43 (32-52)	40 (30-51)	42 (31-51)	44 (33-52)	0.008
Male	1,550 (68)	280 (66)	508 (68)	762 (70)	0.34
LVEF, %	60 (55-65)	60 (55-63)	60 (55-65)	60 (56-65)	<0.001
Infective endocarditis	203 (9)	50 (12)	60 (8)	93 (9)	0.072
Aortic stenosis	1,571 (71)	226 (57)	552 (75)	793 (73)	<0.001
Aortic insufficiency					0.027
None/trivial	340 (15)	70 (16)	122 (16)	148 (14)	
Mild	414 (18)	67 (16)	135 (18)	212 (19)	
Moderate	488 (22)	82 (19)	174 (23)	232 (21)	
Severe	788 (35)	171 (40)	247 (33)	370 (34)	
Unknown	238 (10)	35 (8)	71 (9)	132 (12)	
Primary indication for surgery					<0.001
Aortic stenosis	1,256 (55)	172 (40)	441 (59)	643 (59)	
Aortic insufficiency/mixed disease	959 (42)	218 (51)	300 (40)	441 (40)	
Unknown	53 (2)	35 (8)	8 (1)	10 (1)	
Urgency					<0.001
Elective	1,972 (87)	305 (72)	672 (90)	995 (91)	
Nonelective	296 (13)	120 (28)	77 (10)	99 (9)	
Previous cardiac surgery	381 (17)	76 (18)	120 (16)	185 (17)	0.70
STS PROM, %	0.7 (0.5-1.0)	0.7 (0.5-1.3)	0.6 (0.5-1.0)	0.6 (0.5-1.0)	<0.001

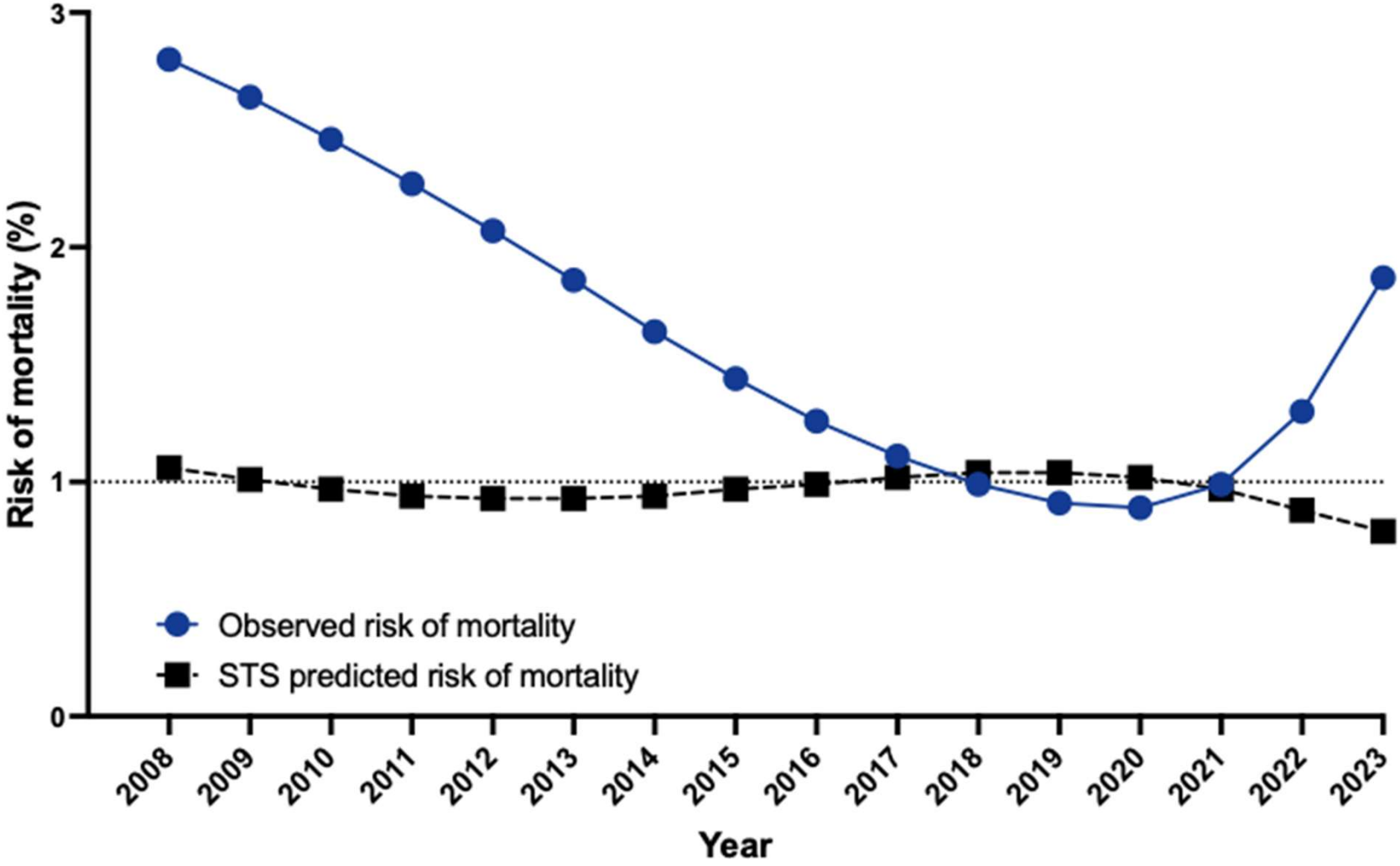
Operative details and early outcomes

TABLE 2 Operative Details and Postoperative Outcomes

	Overall (N = 2,268)	Low Volume (1 or 2 per Year) (n = 425)	Medium Volume (3-10 per Year) (n = 749)	High Volume (>10 per Year) (n = 1094)	*P* Value
Concomitant procedures[a]					
Ascending aortic/hemiarch replacement	952 (42)	100 (24)	263 (35)	589 (54)	<0.001
CABG	36 (2)	8 (2)	6 (1)	22 (2)	0.089
Mitral	44 (2)	4 (1)	9 (1)	31 (3)	0.013
Tricuspid	25 (1)	5 (1)	3 (0)	17 (2)	0.051
Other	7 (0)	1 (0)	4 (1)	2 (0)	0.36
Aortic cross-clamp time, min	174 (142-209)	163 (123-205)	165 (129-205)	181 (157-211)	<0.001
CPB time, min	209 (172-254)	207 (162-266)	201 (160-245)	216 (183-255)	<0.001
Complication[a,b]					
Operative mortality	46 (2)	17 (5)	17 (2)	12 (1)	–
Reoperation	115 (5)	28 (7)	43 (6)	44 (4)	–
Stroke	30 (1)	11 (3)	8 (1)	11 (1)	–
Dialysis	44 (2)	14 (3)	18 (2)	12 (1)	–
Prolonged ventilation	196 (9)	65 (16)	65 (9)	66 (6)	–
Hospital length of stay, d[b]	6 (5-8)	6 (5-10)	6 (5-8)	6 (5-8)	–

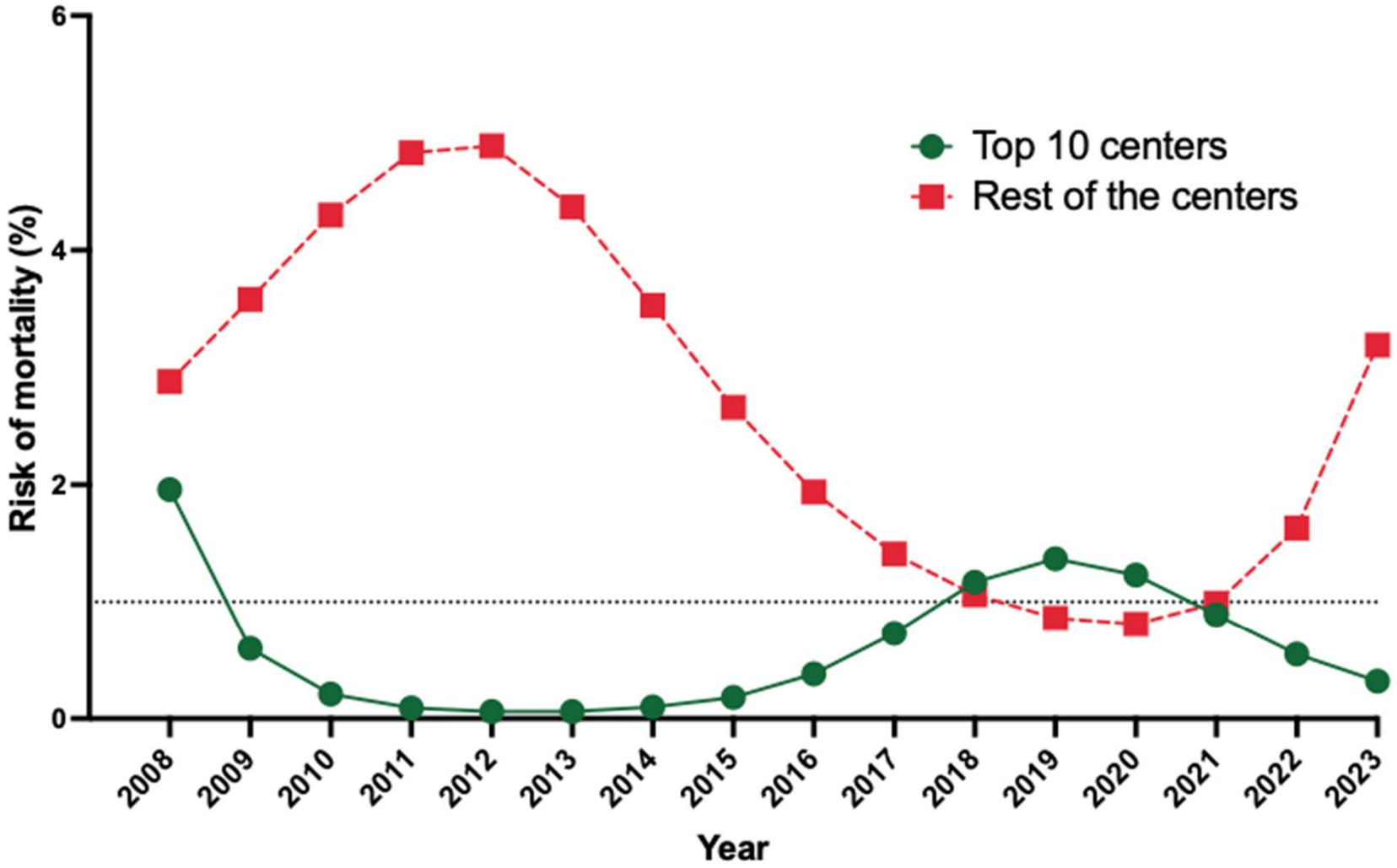
Mazine A….Ouzounian M J Am Coll Cardiol 2026

Predicted and observed risk of mortality



Mazine A….Ouzounian M J Am Coll Cardiol 2026

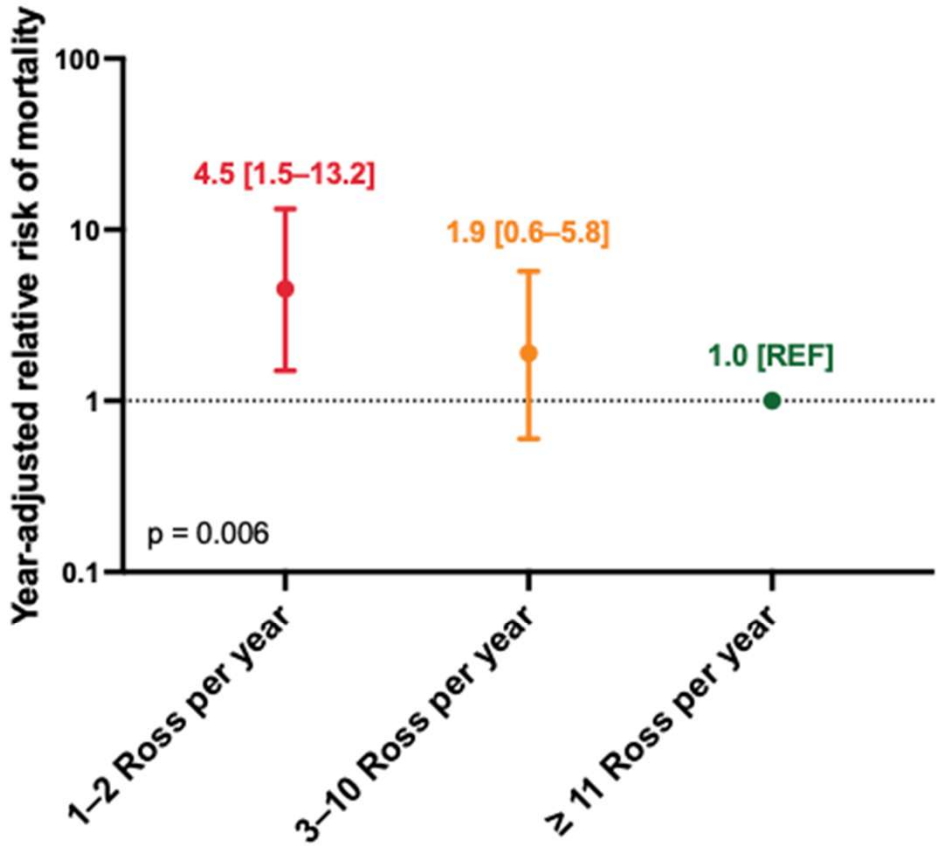
Predicted and observed risk of mortality



Mazine A….Ouzounian M J Am Coll Cardiol 2026

Center Volume-Outcome relationship

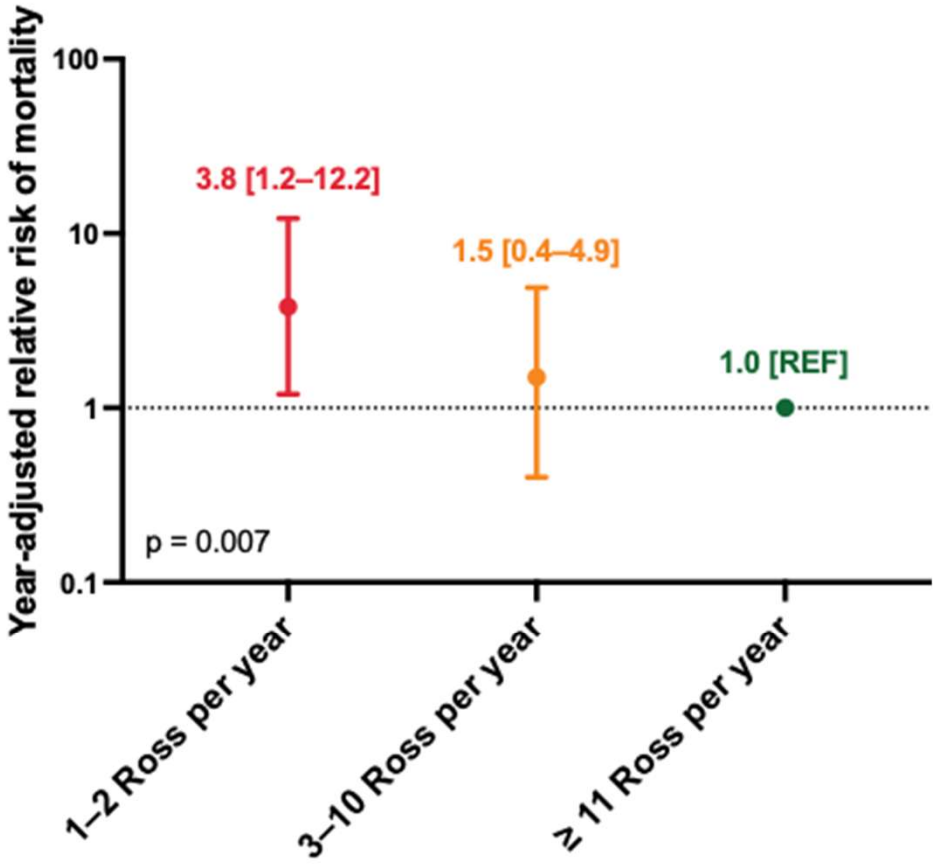
Center Ross volume (per year)	Unadjusted in-hospital mortality
1–2	3.6 %
3–10	1.5 %
≥ 11	0.9 %



Mazine A….Ouzounian M J Am Coll Cardiol 2026

Surgeon Volume-Outcome relationship

Surgeon Ross volume (per year)	Unadjusted in-hospital mortality
1–2	3.0 %
3–10	1.2 %
≥ 11	0.8 %

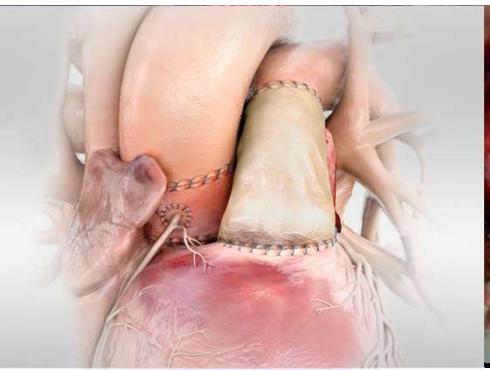
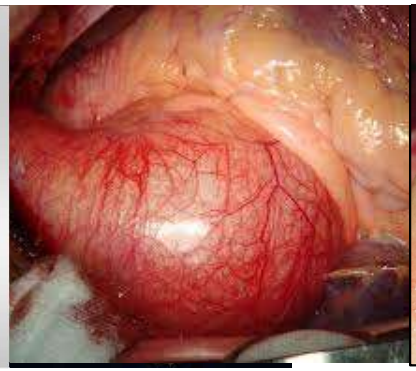
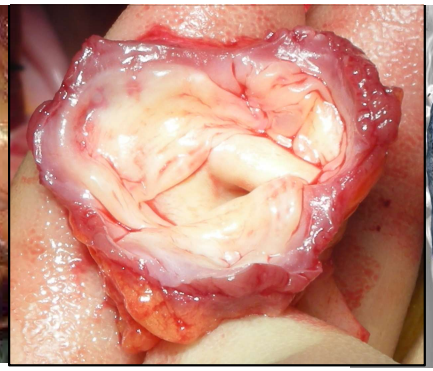
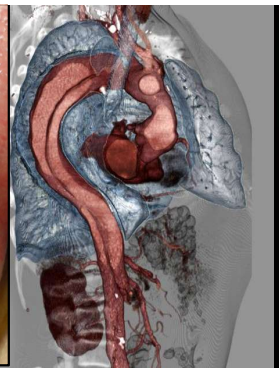
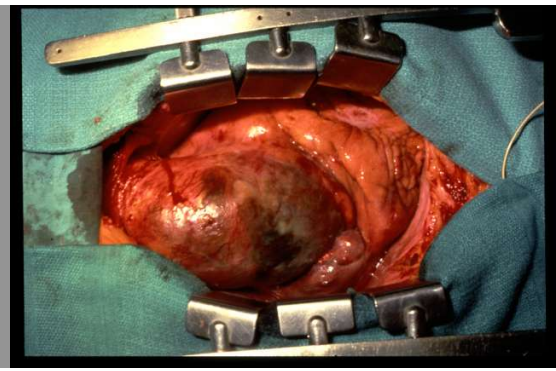


Mazine A….Ouzounian M J Am Coll Cardiol 2026

Other observations

- From 2021 – 2023
  - 79 Ross centers
  - 29 new centers
  - 56 limited experiences (<5 cases from 2008-2020)
- Of the 29 new Ross Centers
  - 16 (55%) remained low volume
  - 10 (34%) reached intermediate volume
  - 3 (10%) reached high volume

Mazine A….Ouzounian M J Am Coll Cardiol 2026

How do we achieve better dissemination?

UHN Peter Munk Cardiac Centre

UNIVERSITY OF TORONTO

Better dissemination requires

Dedicated centers and surgeons
Thoughtful / systematic approach
Objective metrics
Careful program development

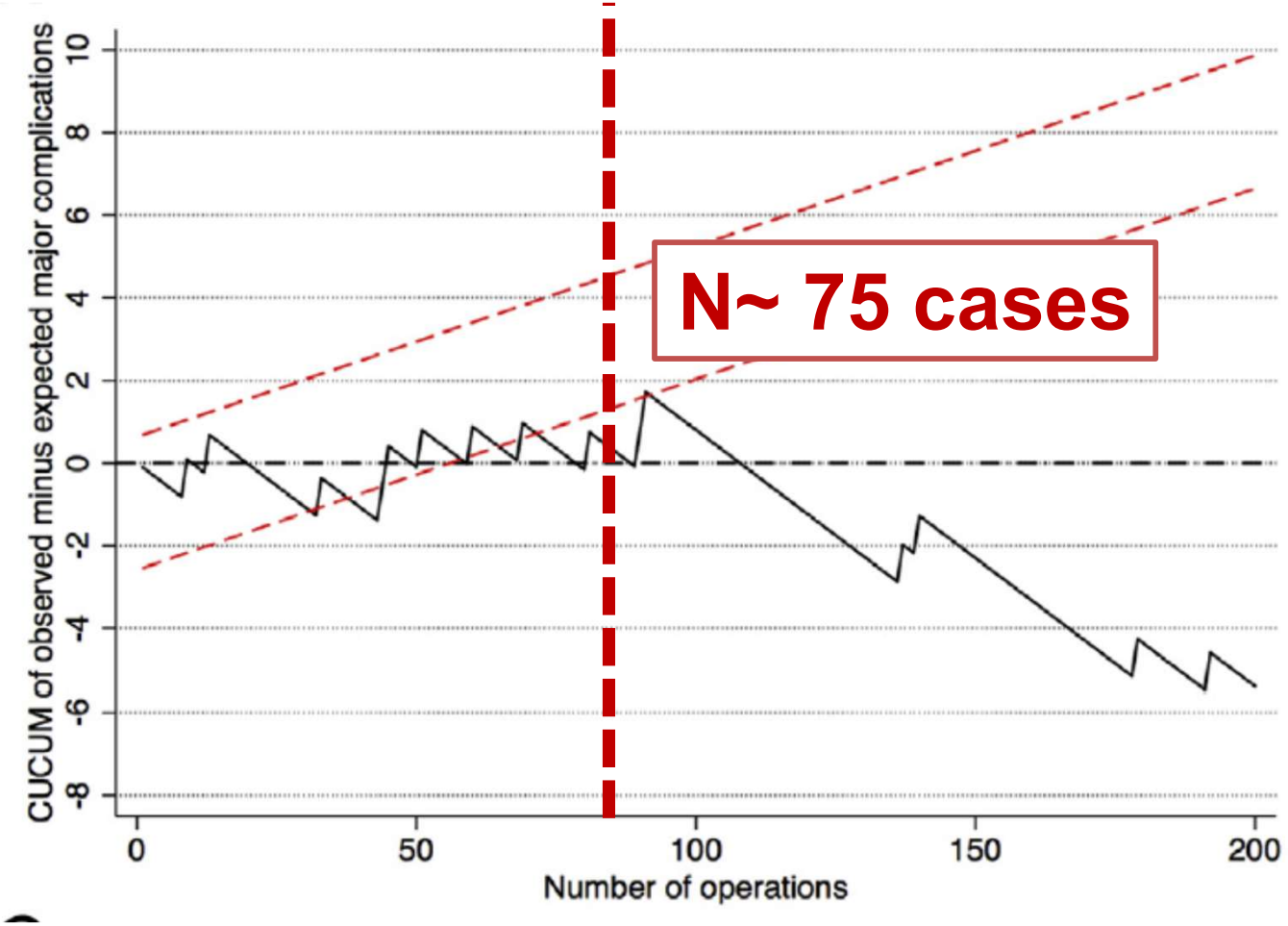
1. Volume
2. Safety
3. Efficacy

UNIVERSITY OF TORONTO

Clinical Research

Impact of the Learning Curve on Early Outcomes Following the Ross Procedure

Ismail Bouhout, MD, Aly Ghoneim, MD, Nancy Poirier, MD, Raymond Cartier, MD, Philippe Demers, MD, Louis P. Perrault, MD, PhD, and Ismail El-Hamamsy, MD PhD



Bouhout I et al. Can J Cardiol 2017

How do we achieve wider dissemination?

1. **Standardized, reproducible procedure**
2. **Dedicated surgeons / centers**
3. **Training / mentorship / proctorship**
4. **Prospective critical evaluation**
5. **Transparency**
6. **Accessibility**

UHN Peter Munk Cardiac Centre

UNIVERSITY OF TORONTO

Summary: Ross procedure

- Ross procedure
- Specialized skill set
  - Excellent early and late outcomes
  - Dependent on volume, patient selection, and evolving techniques
- Evidence suggests need for better dissemination
- Dissemination must be done thoughtfully and safely

UHN Peter Munk Cardiac Centre

UNIVERSITY OF TORONTO

The Houston Aortic Symposium 2026

March 5-7, 2026

The Westin Oaks, Houston, Texas

UHN Peter Munk Cardiac Centre

UNIVERSITY OF TORONTO