

# Maze Procedure in Patients Undergoing Mechanical Valve Replacement

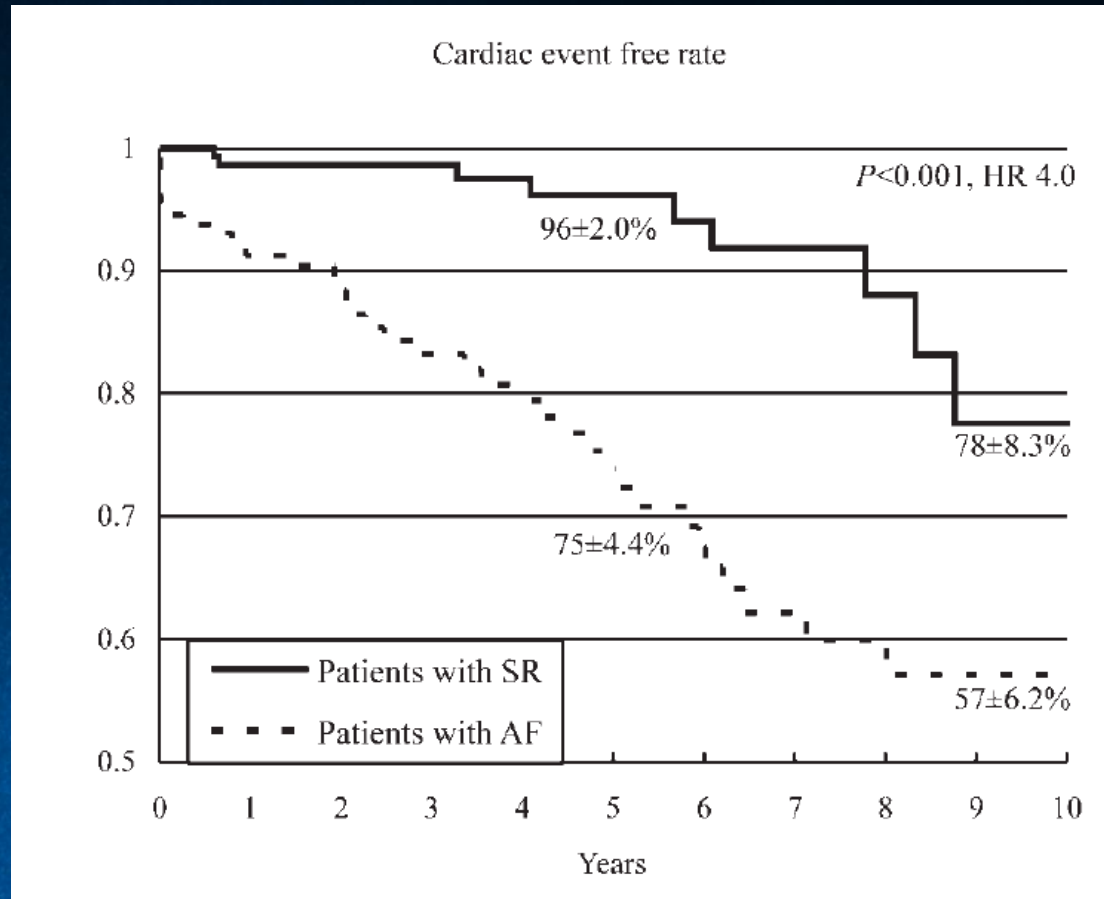
2013년 순환기관련학회 춘계통합학술대회  
The 5<sup>th</sup> Pulse of Asia

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# Impact of AF in Patients Undergoing MV Surgery



*Pre-operative AF in MV repair. Eur Heart J 2005*

# **Clinical Benefits of The Maze Procedure?**

# Left Atrial Radiofrequency Ablation During Mitral Valve Surgery for Continuous Atrial Fibrillation

## A Randomized Controlled Trial

*JAMA. 2005;294:2323-2329*

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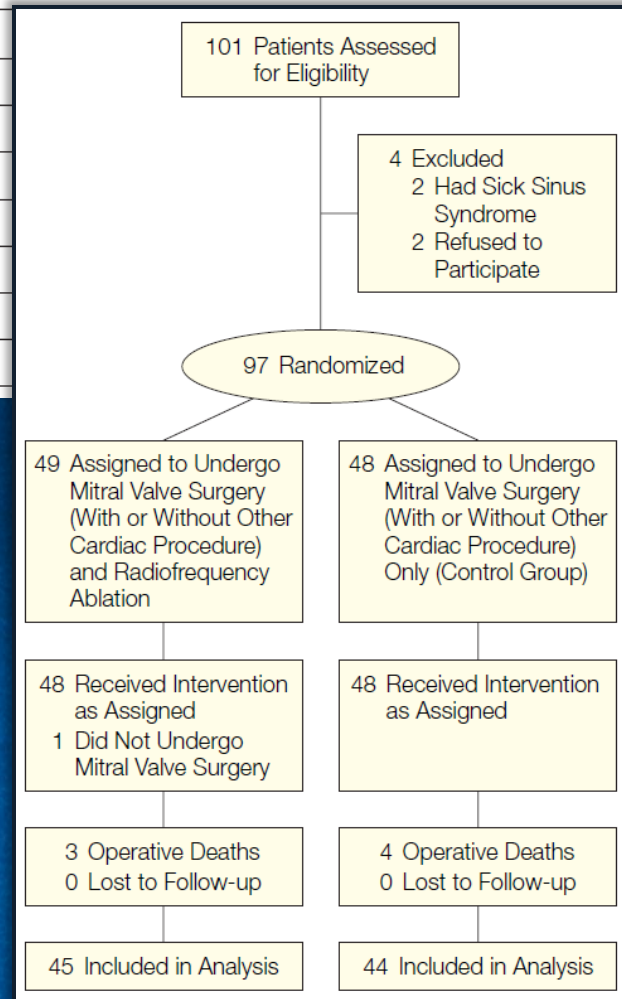
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Radiofrequency ablation (RFA) is increasingly used for atrial fibrillation during mitral valve surgery, its efficacy to improve long-term benefits have not been examined in the controlled trial.

Preoperative RFA of the left atrium increases the efficacy and improves exercise capacity.

This was a randomized, double-blind trial performed in a single center between December 2001 and November 2003. All patients undergoing mitral valve surgery with at least 6 months' history of atrial fibrillation were assessed for eligibility; 97 were en-

**Table 2.** Operative Data and Early Clinical Outcomes\*

Parameters	Radiofrequency Ablation Group (n = 49)	Control Group (n = 48)
Mitral valve repair	38 (77)	34 (71)
Quadrangular resection	15 (39)	13 (38)
Sliding plasty	4 (11)	2 (6)
Edge-to-edge repair	5 (13)	6 (18)
Artificial chordae insertion	3 (8)	1 (3)
Annuloplasty band only	10 (27)	12 (35)
Mitral valve replacement	11 (23)	14 (29)
Coronary artery bypass graft surgery	5 (10.2)	6 (12.5)
Tricuspid valve repair	9 (18.4)	7 (14.6)

*Doukas et al. JAMA 2005*

**Table 3.** Postoperative Cardiac Rhythm at Various Time Intervals\*

Rhythm	Radiofrequency Ablation Group (n = 45)	Control Group (n = 44)	P Value
<b>Monopolar RF Left side Maze only</b>			
Hospital discharge			
Sinus rhythm			<.001
Atrial fibrillation			.004
Atrial flutter			>.99
Nodal rhythm			.16
Pacemaker	2 (4.4)	4 (9.1)	.43
Three months			
Sinus rhythm	21 (46.6)	3 (6.8)	<.001
Atrial fibrillation	18 (40)	33 (75)	.002
Atrial flutter	2 (4.4)	0	.49
Nodal rhythm	2 (4.4)	4 (9.1)	.43
Pacemaker	2 (4.4)	4 (9.1)	.43
Six months			
Sinus rhythm	20 (44.4)	3 (6.8)	<.001
Atrial fibrillation	22 (48.9)	37 (84)	.001
Atrial flutter	1 (2.2)	0	>.99
Nodal rhythm	0	1 (2.3)	>.99
Pacemaker	2 (2.2)	4 (9.1)	.43
Twelve months			
Sinus rhythm	20 (44.4)	2 (4.5)	<.001
Atrial fibrillation	22 (48.9)	37 (84.1)	.001
Atrial flutter	1 (2.2)	0	>.99
Nodal rhythm	0	1 (2.3)	>.99
Pacemaker	2 (4.4)	4 (9.1)	.43

**Table 4. Functional and Biochemical Outcomes\***

Outcomes	RFA Group	Control Group	P Value	RFA, Sinus Rhythm	RFA, Atrial Fibrillation	P Value
Shuttle-walk distance, m						
Baseline	281 (143)	253 (115)	.33	313 (161)	244 (111)	.11
6 mo	331 (136)	297 (114)	.34	381 (128)	271 (121)	.006
12 mo	359 (140)	304 (109)	.02	407 (129)	292 (122)	.002
Change from baseline to 12 mo	78 (9)	51 (7)	.002	94 (8)	48 (82)	.003
NYHA class						
Baseline	2.5 (0.7)	2.5 (0.7)	.99	2.6 (0.7)	2.6 (0.7)	.29
6 mo	1.4 (0.6)	1.4 (0.6)	.99	1.4 (0.6)	1.4 (0.6)	.58
12 mo	1.2 (0.5)	1.3 (0.5)	.34	1.1 (0.4)	1.4 (0.5)	.11
BNP level, median (IQR), fmol/mL						
Baseline	212 (151-319)	185 (96-294)	.30	218 (156-358)	205 (141-317)	.50
6 mo	155 (109-219)	152 (65-243)	.72	169 (101-220)	192 (94-249)	.32
12 mo	160 (103-210)	148 (81-231)	.80	108 (79-173)	168 (125-209)	.08
Change from baseline to 12 mo	76 (125)	30 (71)	.02	-104 (87)	-51 (82)	.03

**Improved  
Functional Outcome**

*Doukas et al. JAMA 2005*

**Table 5.** Echocardiographic Data\*

Parameters	Radiofrequency Ablation Group (n = 45)	Control Group (n = 44)	P Value
Baseline			
Ejection fraction, %	57 (6)	58 (7)	.70
LVESD, cm	4.4 (0.5)	4.5 (0.7)	.39
LVEDD, cm	5.92 (0.4)	5.97 (0.6)	.61
Maximum left atrial area, cm <sup>2</sup>	35 (7)	34 (9)	.49
Minimum left atrial area, cm <sup>2</sup>	28 (7)	26 (8)	.85
Six months			
Ejection fraction, %	51 (6)	51 (6)	.01
LVESD, cm	3.7 (0.7)	3.3 (0.7)	.02
LVEDD, cm	5.7 (0.7)	5.80 (0.7)	.80
Maximum left atrial area, cm <sup>2</sup>	34 (8)	32.4 (9)	.38
Minimum left atrial area, cm <sup>2</sup>	23 (8)	25.6 (8)	.11
Twelve months			
Ejection fraction, %	59 (7)	54.2 (7)	.004
LVESD, cm	3.93 (0.7)	4.26 (0.6)	.03
LVEDD, cm	5.65 (0.6)	5.90 (0.6)	.27
Maximum left atrial area, cm <sup>2</sup>	32 (6)	33.5 (7)	.24
Minimum left atrial area, cm <sup>2</sup>	21 (6)	25 (7)	.14

**Improved  
LV Functions**

*Doukas et al. JAMA 2005*



# Other RCT Series

*Deneke et al.*

*Efficacy of an additional MAZE procedure using RF ablation in patients with chronic AF and MV disease.*

*Eur Heart J 2002*

**Similar Results**

*Abreu Filho et al.*

*Effectiveness of the MAZE procedure using RF ablation in patients with permanent AF and rheumatic MV disease.*

*Circulation 2005*

*Budera et al.*

*Final results of the PRAGUE-12 randomized multicentre study*

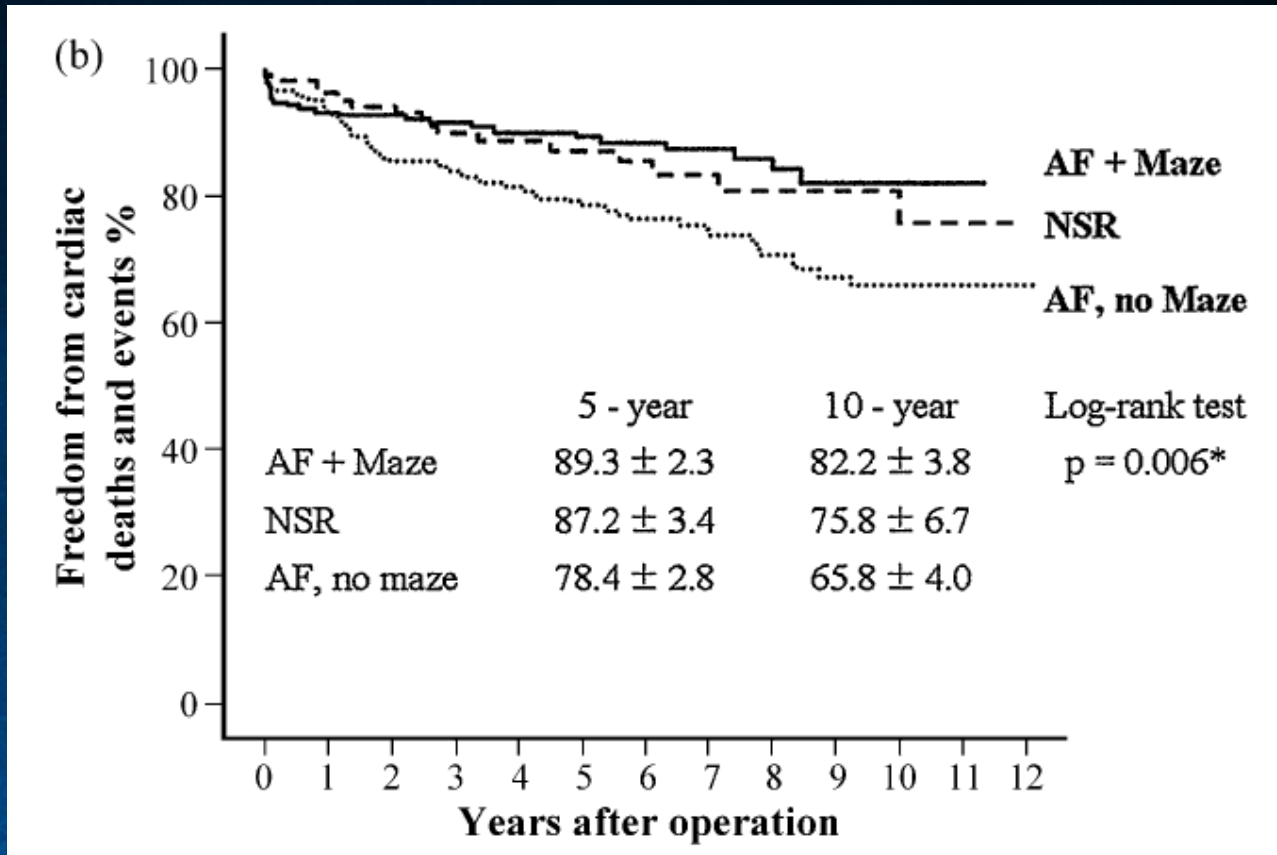
*Eur Heart J 2012*

# Real Clinical Benefits ?

## Death, Stroke, Bleeding

- No data from RCT to date
- Concomitant Maze procedure during elective **MV repair in low-risk patients:**  
“Compelling evidences from observational studies!”

# Real Clinical Benefits ? Death, Stroke, Bleeding



# Impact of Maze Procedure in Different Subsets

- Mechanical valve replacement?
- Elderly patients with tissue valve replacement?
- High-risk subsets?
- Aortic valve replacement? (double incisions)

***Increased cardiac ischemic time (20-40 min)  
+ complexity of the procedure***

# Maze Procedure in Mechanical Valve Replacement?

## Cons and Pros

**Superior hemodynamics**

**Better symptom outcome  
(palpitation ↓)**

**Thromboembolic risk ↓**

**Superior survival (?)**



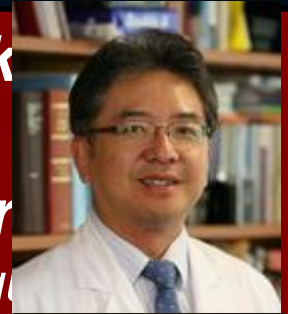
JW Lee

**Surgical risk**

**Unnecessary  
(already on anticoagulation)**

**Rate control may be achieved  
(AFFIRM study)**

**Early mortality / morbidity**



CH Chung



H Song

# Circulation

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## Long-Term Outcomes of Mechanical Valve Replacement in Patients With Atrial Fibrillation

Impact of the Maze Procedure



# Maze Fight!





## Long-Term Outcomes of Mechanical Valve Replacement in Patients With Atrial Fibrillation Impact of the Maze Procedure

Joon Bum Kim, MD; Joon Suk Moon; Sung-Cheol Yun, PhD; Wan Kee Kim, MD;  
Sung-Ho Jung, MD; Suk Jung Choo, MD, PhD; Hyun Song, MD, PhD;  
Cheol Hyun Chung, MD, PhD; Jae Won Lee, MD, PhD

**Background**—The long-term benefits of the maze procedure in patients with chronic atrial fibrillation undergoing mechanical valve replacement who already require lifelong anticoagulation remain unclear.

**Methods and Results**—We evaluated adverse outcomes (death; thromboembolic events; composite of death, heart failure, or valve-related complications) in 569 patients with atrial fibrillation–associated valvular heart disease who underwent mechanical valve replacement with (n=317) or without (n=252) a concomitant maze procedure between 1999 and 2010. After adjustment for differences in baseline risk profiles, patients who had undergone the maze procedure were at similar risks of death (hazard ratio, 1.15; 95% confidence interval, 0.65–2.03;  $P=0.63$ ) and the composite outcomes (hazard ratio, 0.82; 95% confidence interval, 0.50–1.34;  $P=0.42$ ) but a significantly lower risk of thromboembolic events (hazard ratio, 0.29; 95% confidence interval, 0.12–0.73;  $P=0.008$ ) compared with those who underwent valve replacement alone at a median follow-up of 63.6 months (range, 0.2–149.9 months). The effect of superior event-free survival by the concomitant maze procedure was notable in a low-risk EuroSCORE (0–3) subgroup ( $P=0.049$ ), but it was insignificant in a high-risk EuroSCORE ( $\geq 4$ ) subgroup ( $P=0.65$ ). Furthermore, the combination of the maze procedure resulted in superior left ventricular ( $P<0.001$ ) and tricuspid valvular functions ( $P<0.001$ ) compared with valve replacement alone on echocardiographic assessments performed at a median of 52.7 months (range, 6.0–146.8 months) after surgery.

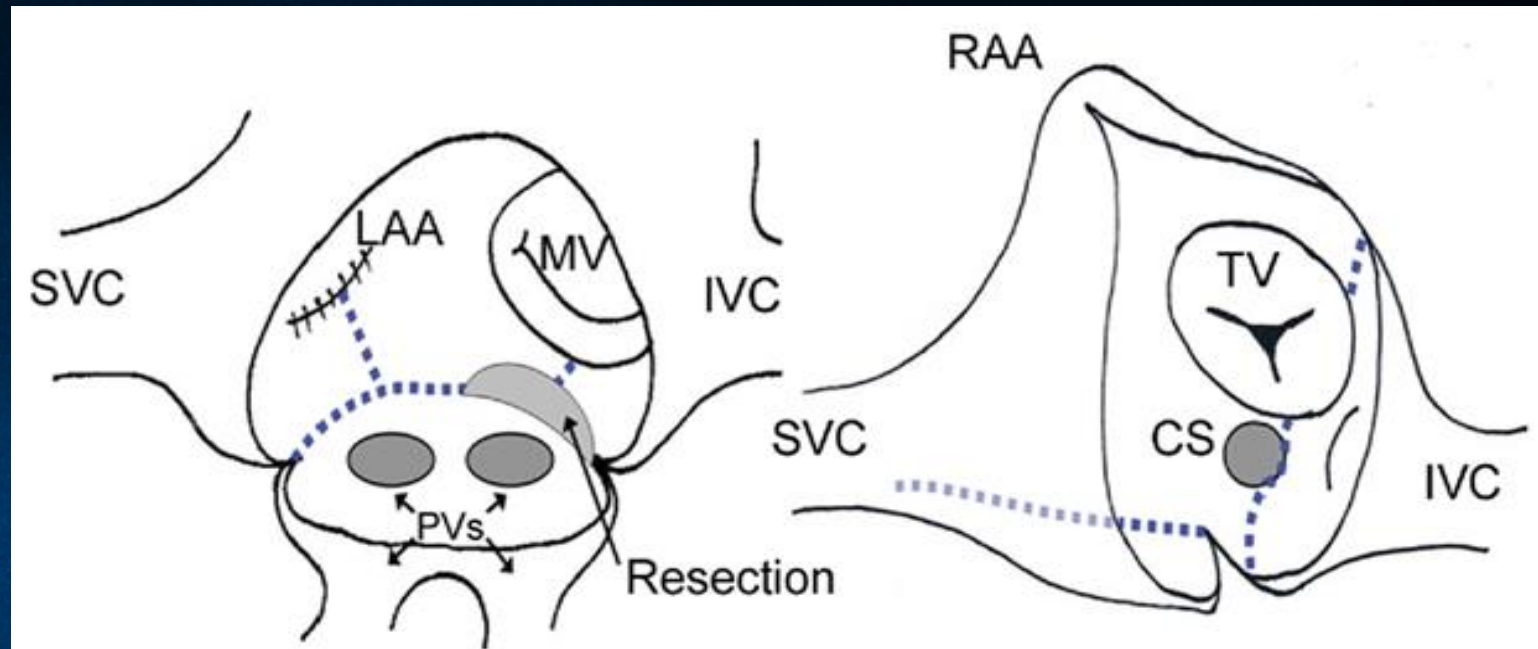
**Conclusion**—Compared with valve replacement alone, the addition of the maze procedure was associated with a reduction in thromboembolic complications and improvements in hemodynamic performance in patients undergoing mechanical valve replacement, particularly in those with low risk of surgery. (*Circulation*. 2012;125:2071–2080.)



# Patients

- Patients with AF undergoing mechanical valve replacement between Jan. 1999 and Jan. 2010
- 569 patients
- Maze group: n=317
- Control group: n=252
- Adjustment: Propensity score + IPTW

# Surgical Technique



***Cryoablation (argon-based,  $-120^{\circ}\text{C}$ ), 2 min + LA reduction***

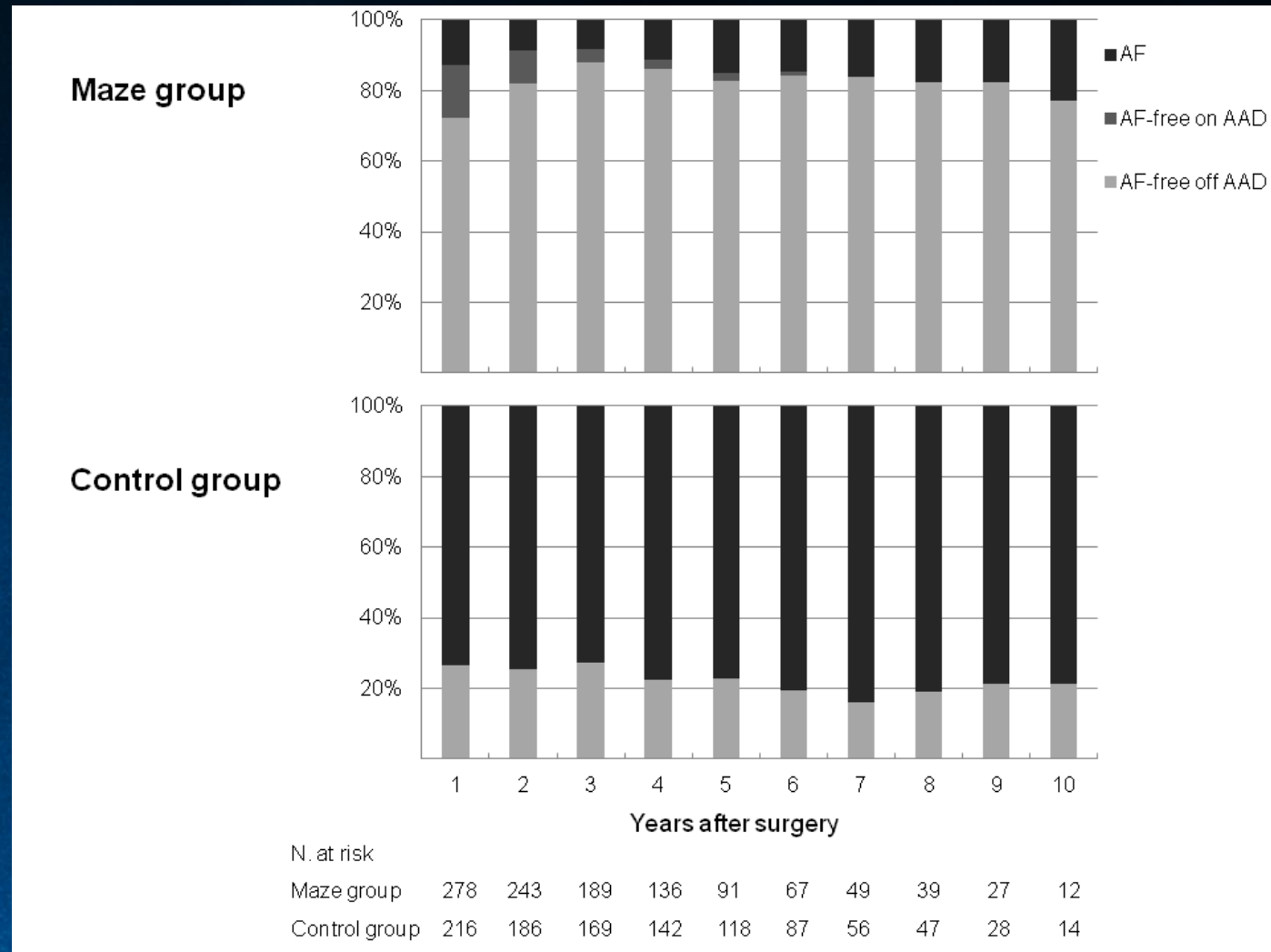
***Kim JB et al. Ann Thorac Surg 2012***

# Early Outcomes

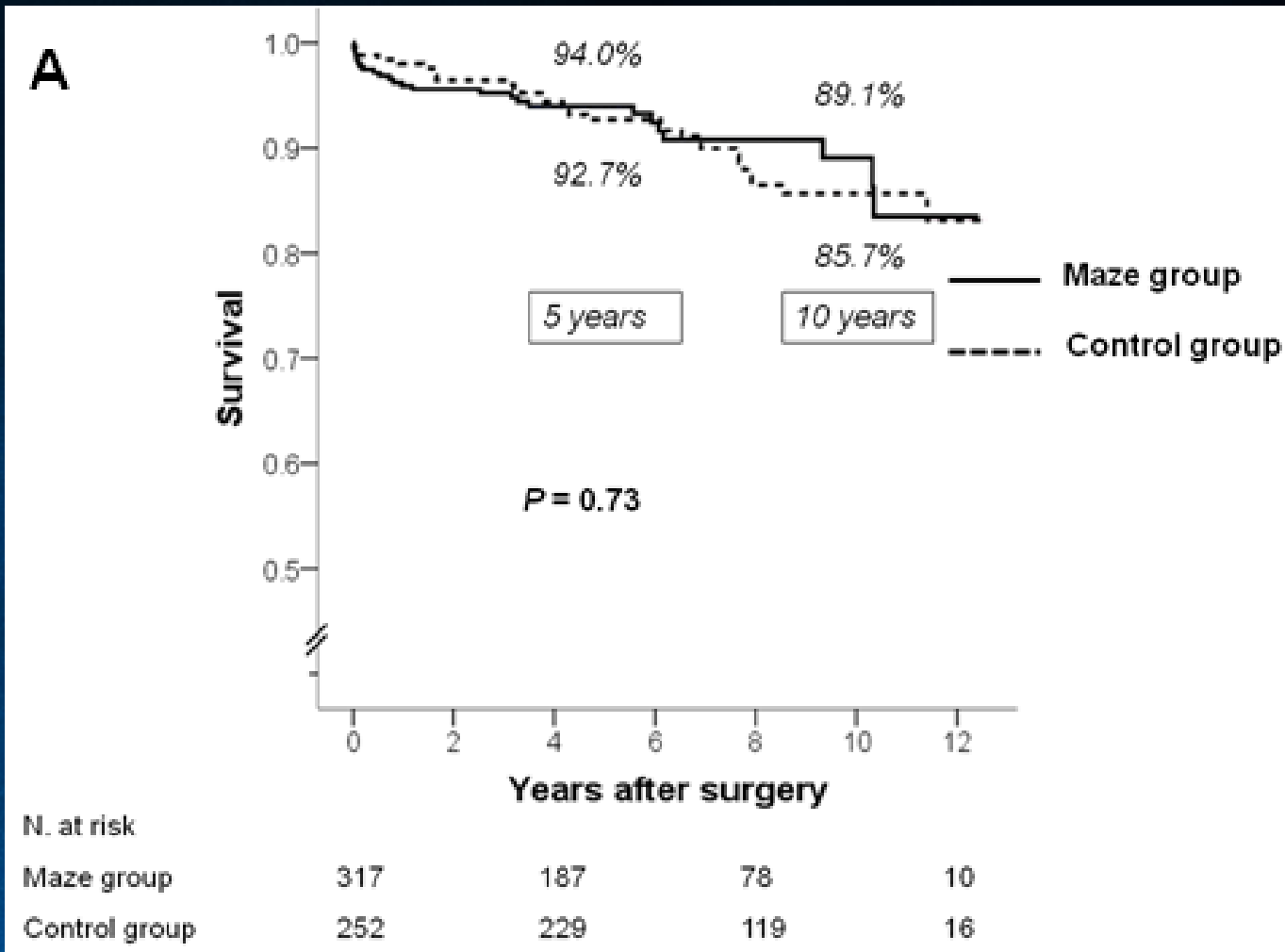
**Table 2. Operative Outcomes**

	Maze Group (n=317)	Control Group (n=252)	<i>P</i>
Early (within 30 d) death, n (%)	5 (1.6)	2 (0.8)	0.47
Patients with early major morbidity, n (%)	44 (13.9)	39 (15.5)	0.59
Low cardiac output syndrome	4 (1.3)	2 (0.8)	0.59
Stroke	1 (0.3)	0	0.37
Ventricular tachycardia/ fibrillation	2 (0.6)	0	0.21
Requirement for new dialysis	6 (1.9)	5 (2.0)	0.94
Surgical bleeding requiring re-exploration	16 (5.0)	16 (6.3)	0.50
Pericardial effusion	18 (5.7)	14 (5.6)	0.95
Mediastinitis	0	1 (0.4)	0.26
Surgical-site wound problem	7 (2.2)	5 (2.0)	0.85
Permanent pacemaker implantation	8 (2.5)	3 (1.2)	0.25

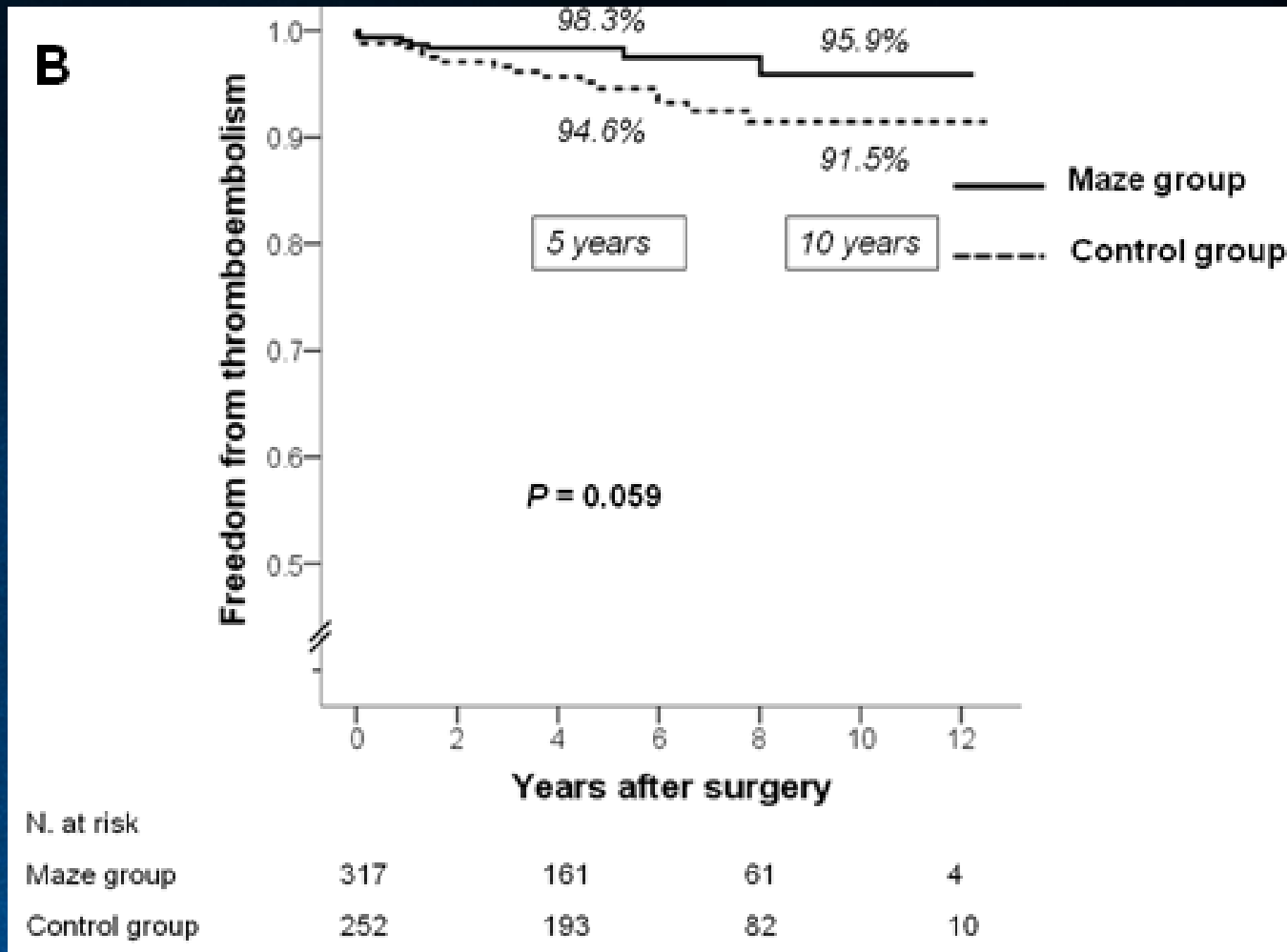
# Postoperative Rhythm Status



# Survival



# Thromboembolism

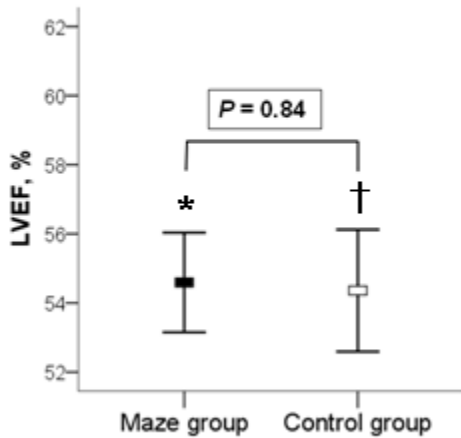


# Adjusted Hazard Ratios for Clinical Outcomes: Maze vs. Control

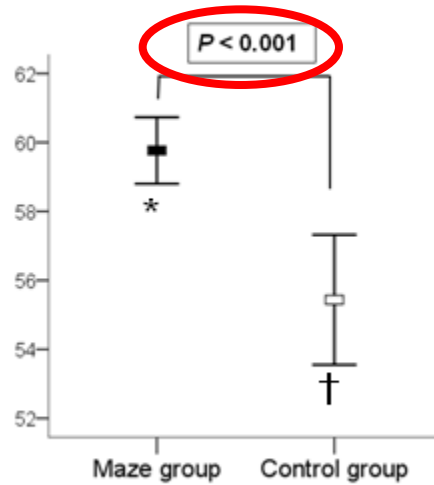
Outcomes		HR	95% CI	P value
Death	Crude	0.91	0.53-1.56	0.73
	Propensity score	1.13	0.63-2.01	0.69
	IPTW	1.15	0.65-2.03	0.63
Thromboembolism	Crude	0.42	0.17-1.03	0.059
	Propensity score	0.28	0.10-0.77	0.014
	IPTW	0.29	0.12-0.73	0.008
Composite outcome	Crude	0.83	0.59-1.16	0.27
	Propensity score	0.80	0.55-1.16	0.24
	IPTW	0.82	0.50-1.34	0.42

# Echocardiographic Outcomes

A. LV ejection fraction



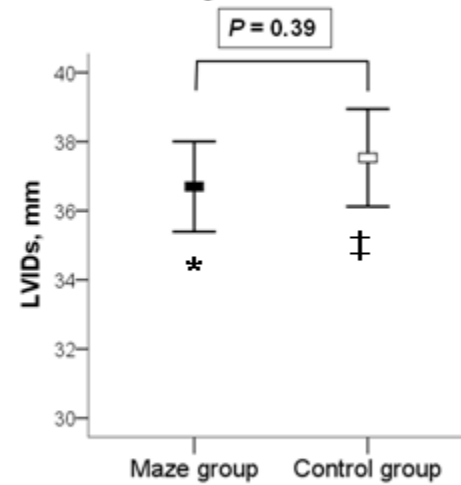
Preoperative



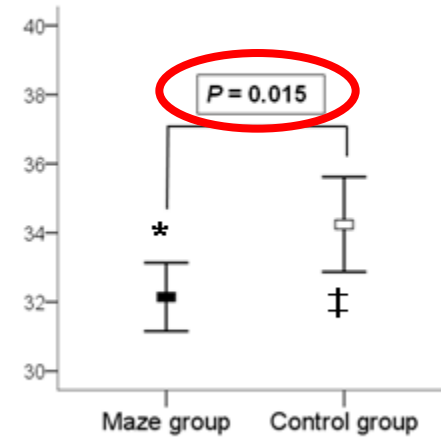
\*  $P < 0.001$ , †  $P = 0.32$

Last follow-up

B. LV systolic dimension



Preoperative

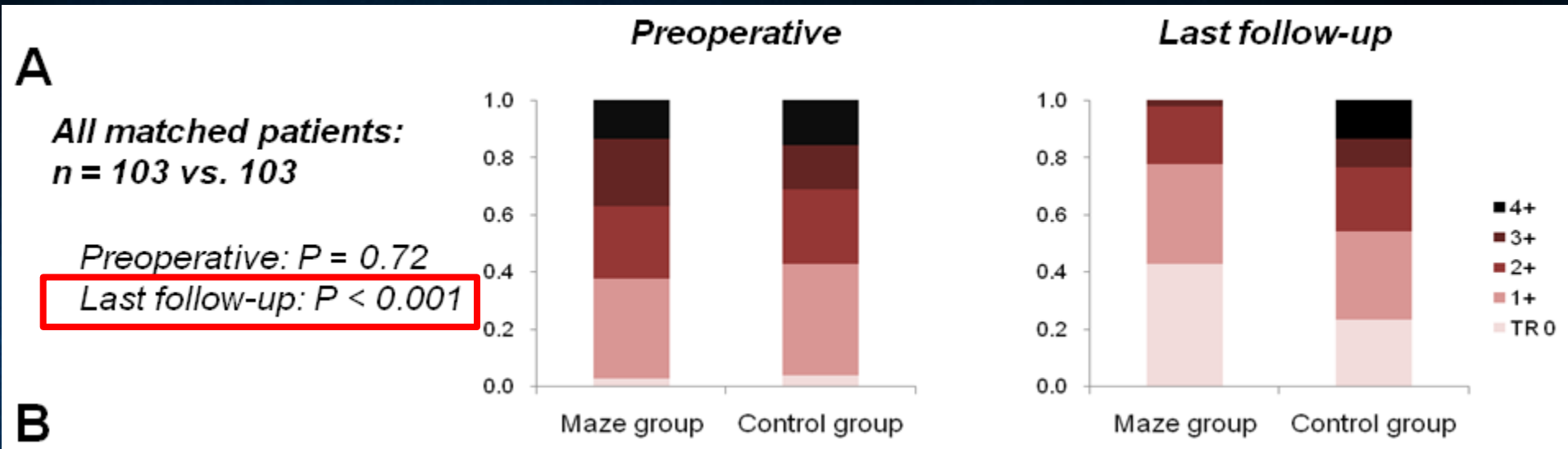


\*  $P < 0.001$ , †  $P < 0.001$

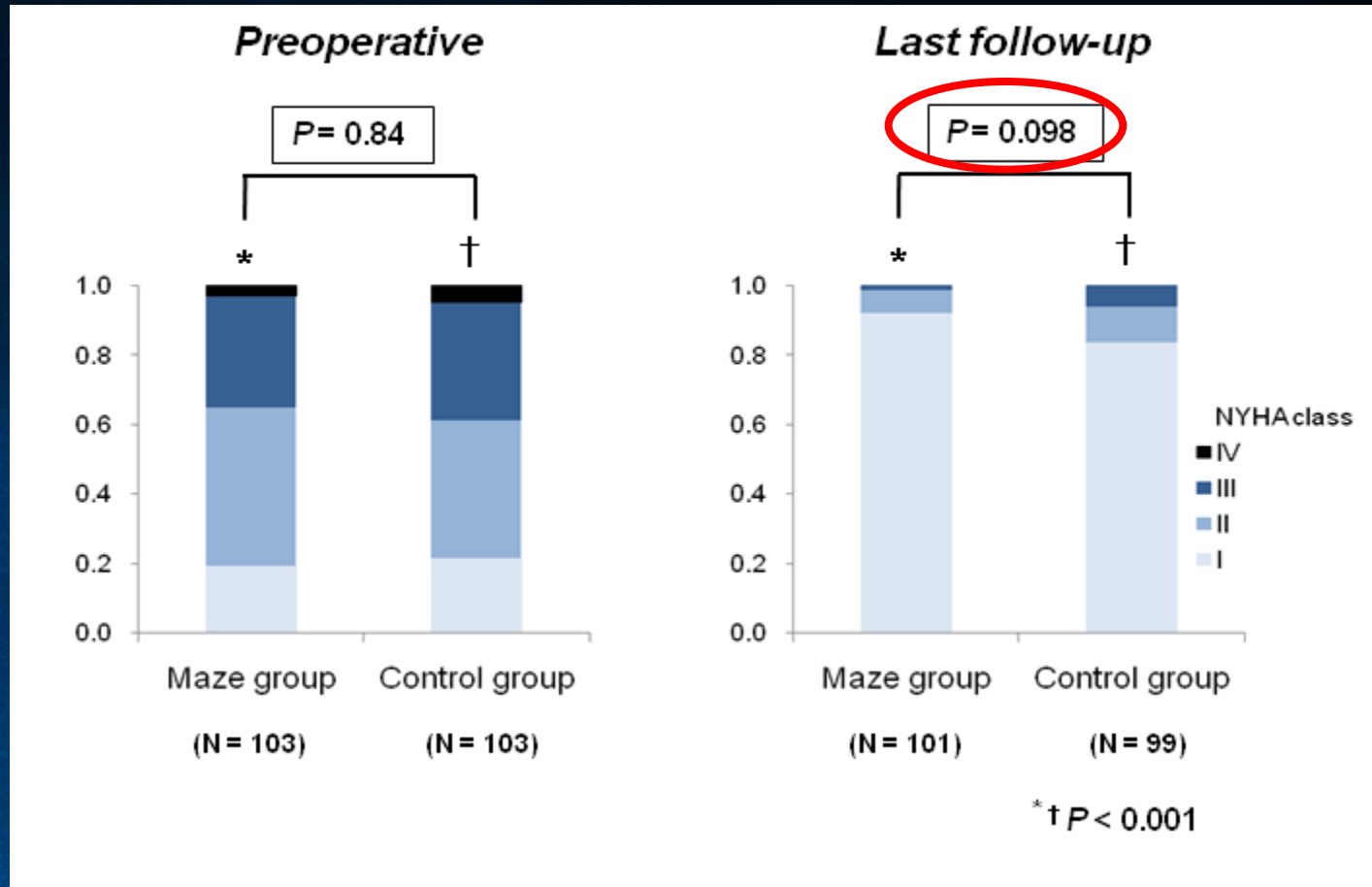
Last follow-up



# Postoperative TV Function



# NYHA Functional Class



# Results Summary

- Concomitant Maze procedure for AF patients undergoing mechanical valve replacement:
  - Similar survival
  - Decreased CVA
  - Superior LV and TV function
  - Improved NYHA class

## After the Match...



## Maze procedure in MVR at AMC since 2012

- MVR in patients with AF : n=101
- Maze procedure: **n=83 (82.2%)**
- Reason for “No-Maze” (n=18)
  - **Serious comorbidity**: n=4
  - **Severe adhesion**: n=10  
( previous Maze in 2)
  - **Giant atrium (70-91mm)**: n=4

## ***45 Years Old Man***

- Persistent AF***
- Mitral Valve Replacement***
- LA 69mm***
- EF 70%***

***Concomitant Maze procedure?***

***Concomitant Maze procedure?***

***Why not?***

***One concern...: Large LA  
(Suboptimal rhythm outcome)***

**Thank you**



# Comparison of cardiac surgery with left atrial surgical ablation vs. cardiac surgery without atrial ablation in patients with coronary and/or valvular heart disease plus atrial fibrillation: final results of the PRAGUE-12 randomized multicentre study<sup>†</sup>

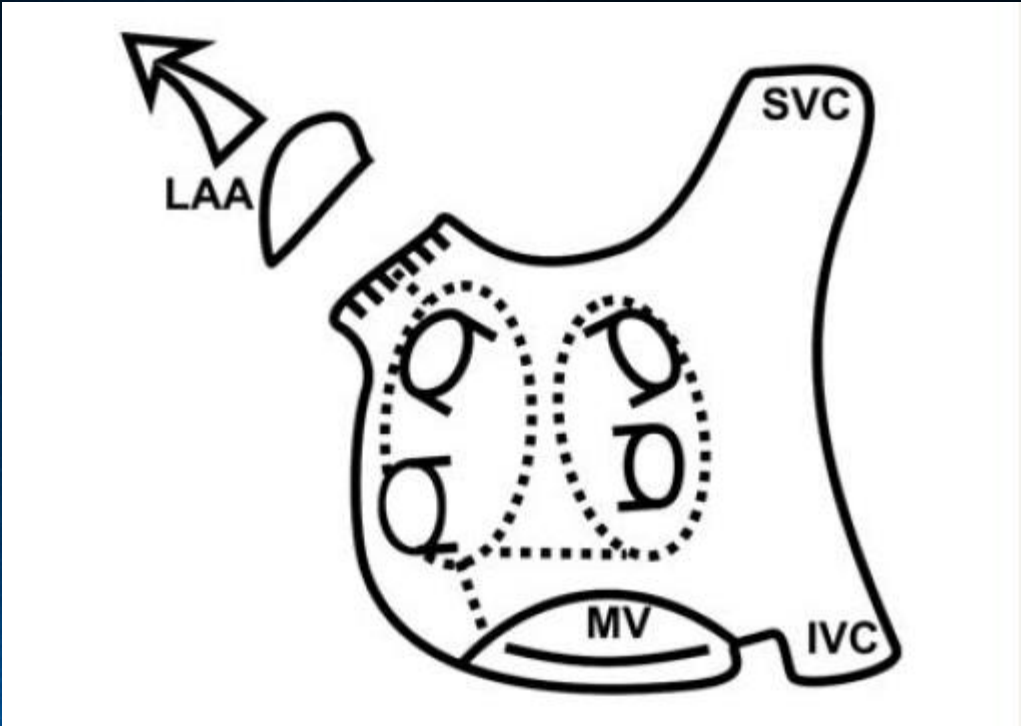
Petr Budera<sup>1\*</sup>, Zbyněk Straka<sup>1</sup>, Pavel Osmančík<sup>1</sup>, Tomáš Vaněk<sup>1</sup>, Štěpán Jelínek<sup>1</sup>, Jan Hlavička<sup>1</sup>, Richard Fojt<sup>1</sup>, Pavel Červinka<sup>2</sup>, Michal Hulman<sup>3</sup>, Michal Šmíd<sup>4</sup>, Marek Malý<sup>5</sup>, and Petr Widimský<sup>1</sup>



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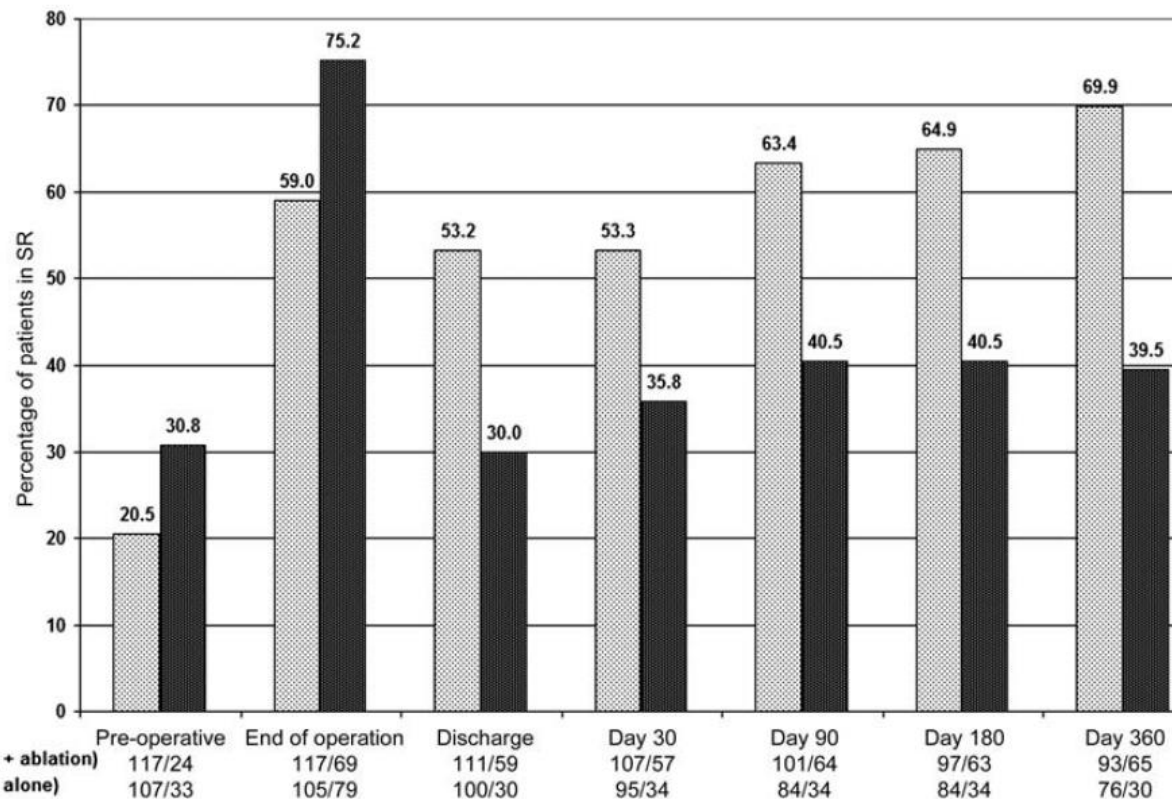
European Heart Journal (2012) **33**, 2644–2652  
doi:10.1093/eurheartj/ehs290





**Table 6** One-year complications

Complications	Group A (with ablation) (n = 111)
Death	18 (16.2%)
Bleeding	11 (9.9%)
Stroke	3 (2.7%)
Heart failure	26 (23.4%)
Combined	45 (40.5%)



**Table 3** Operative characteristics

Characteristics	Group A (with ablation) (n = 117)	Group B (without ablation) (n = 105)
Duration of surgery (min)	220 (180–255)	200 (165–235)
CPB (min)	100 (74–121)	72 (46–100)
Cross-clamp time (min)	78 (46–96)	51 (31.5–70)
End-operation rhythm, n (%)		
SR	69 (59.0%)	79 (75.2%)
AF	12 (10.3%)	16 (15.2%)
Epicardial stimulation	36 (30.8%)	10 (9.5%)
Blood loss (mL)	680 (450–1115)	705 (445–1115)
Hospital stay (days)	8 (7–12)	8 (6–11)

**Table 4** Other 30 days' complications

Complications	Group A (with ablation) (n = 116)	Group B (without ablation) (n = 102)	P-value
Operative revision for bleeding	10 (8.6%)	9 (8.8%)	1.000
Other bleeding complication	5 (4.3%)	6 (5.9%)	0.759
Pneumothorax	4 (3.4%)	3 (2.9%)	1.000
Pleural effusion with puncture	16 (13.8%)	16 (15.7%)	0.706
Pneumonia	3 (2.6%)	4 (3.9%)	0.708
Respiratory insufficiency with re-intubation	3 (2.6%)	8 (7.8%)	0.119
Sternal wound infection	2 (1.7%)	0 (0.0%)	0.500
Heart failure with rehospitalization	14 (12.1%)	14 (13.7%)	0.840
Multi-organ failure	5 (4.3%)	4 (3.9%)	1.000
PM implantation	7 (6.0%)	1 (1.0%)	0.070

**Table 2** Types of operations

Characteristics	Group A (with ablation) ( <i>n</i> = 117)
Without mitral surgery, <i>n</i>	59
CABG	23
AVR	19
TVP	1
AVR + CABG	9
AVR + TVP	4
TVP + CABG	0
AVR + TVP + CABG	3

Characteristics	Group A (with ablation) ( <i>n</i> = 117)	Group B (without ablation) ( <i>n</i> = 105)
With mitral surgery, <i>n</i>	58	45
MVP	3	1
MVR	4	3
MVP + CABG	2	5
MVR + CABG	1	1
AVR + MVP	1	0
AVR + MVR	1	0
MVP + TVP	19	13
MVR + TVP	7	3
AVR + MVP + CABG	2	1
AVR + MVR + CABG	0	1
MVP + TVP + CABG	9	9
MVR + TVP + CABG	2	1
AVR + MVP + TVP	1	6
AVR + MVR + TVP	2	0
AVR + MVP + TVP + CABG	4	1

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## Long-Term Outcomes of Mechanical Valve Replacement in Patients With Atrial Fibrillation

Impact of the Maze Procedure

