Severe TR with AF:
I DO NOT maze operation

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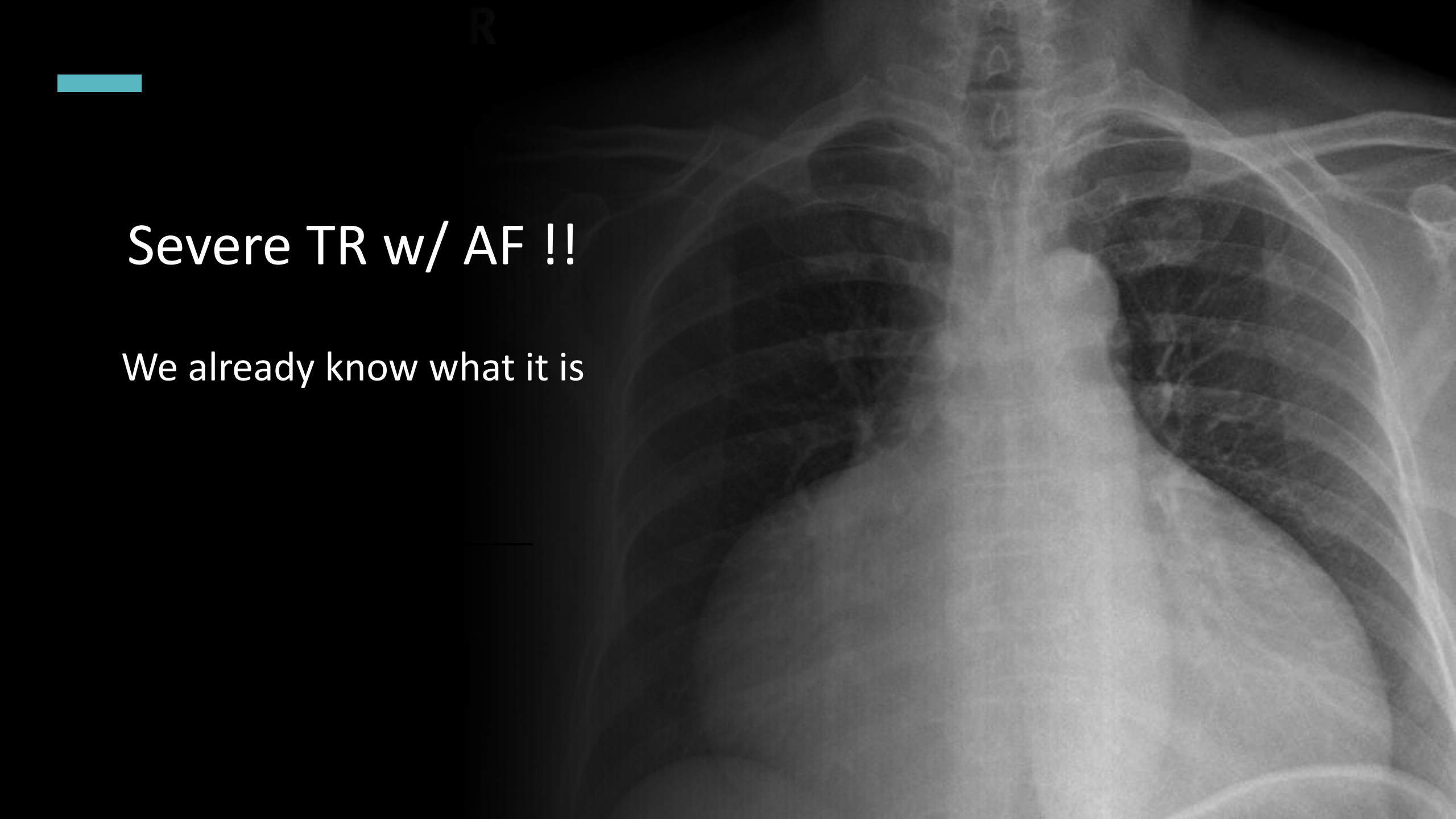
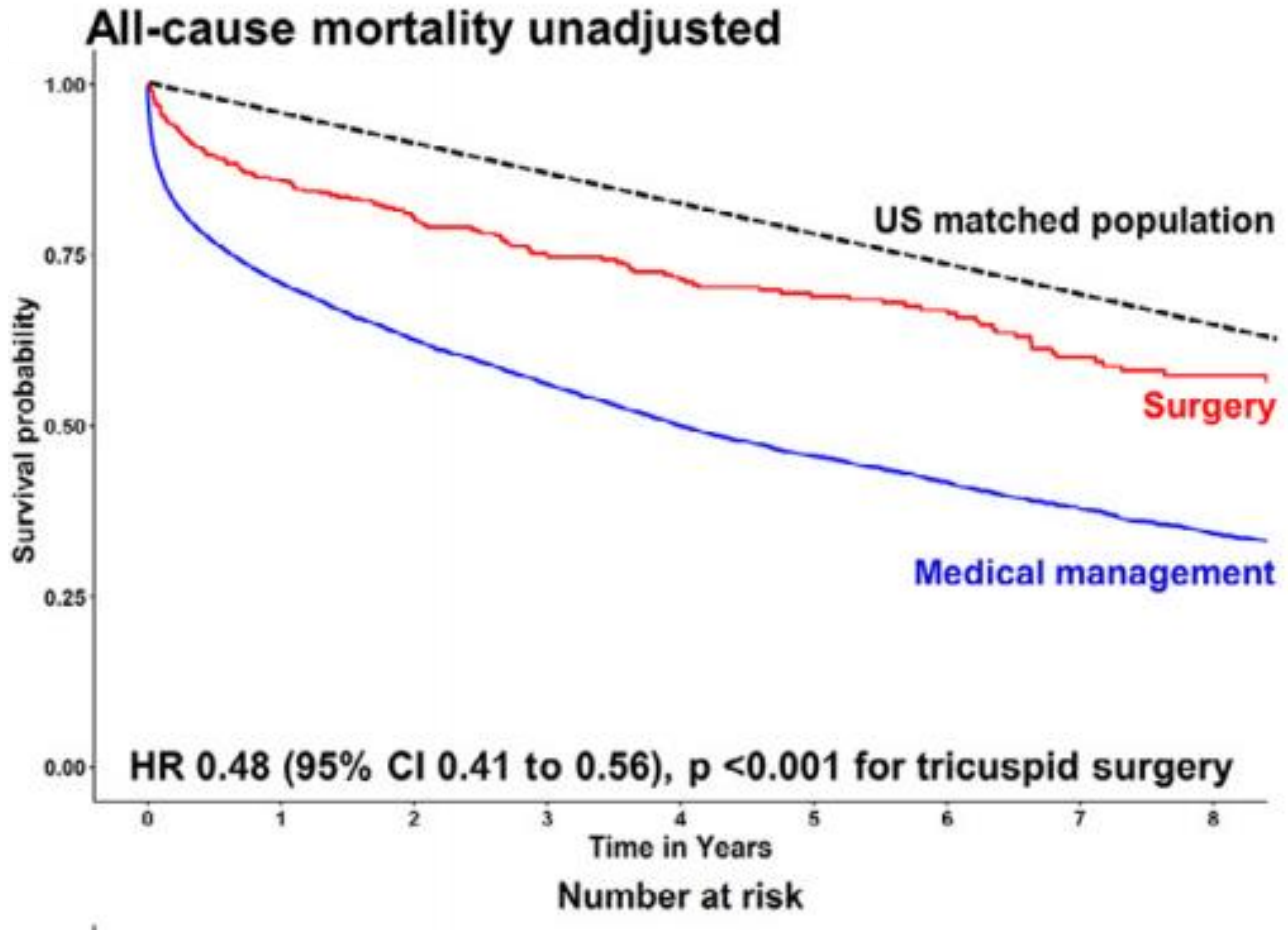
Severe TR w/ AF !!

We already know what it is



TV op.
You'd go for it ?

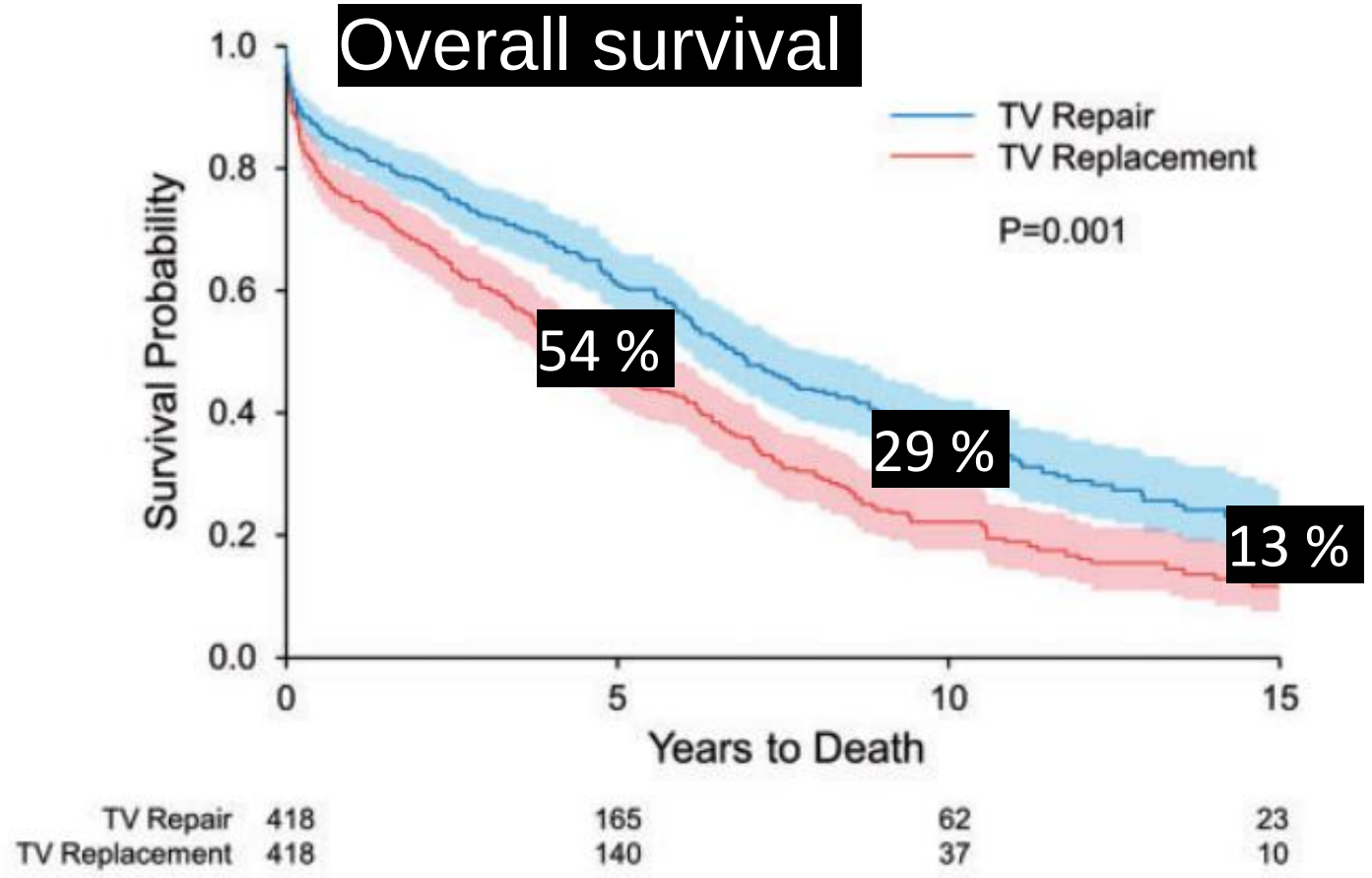
- 632 TV op / 9,301 pts w/ isolated TR > m-s



(Am J Cardiol 2022;162:163-9)

TVR vs TVP ?

- n=2541, first time TV surgery



(Eur J Cardiothorac Surg 2019;56(5):950-8)

Maze ?

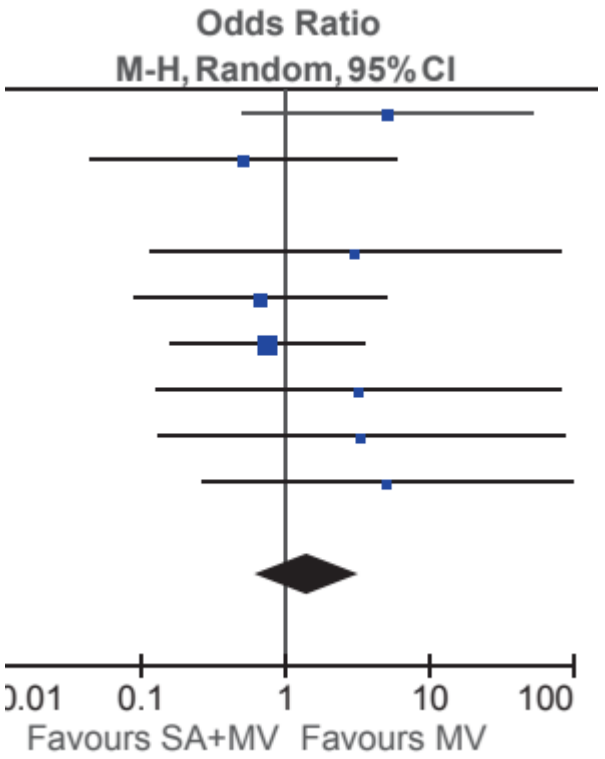
- SR & Meta-analysis
  - **9 RCT , 496 pts MVS**
  - 23 RCT, 1,965 pts OHS

Systematic Review

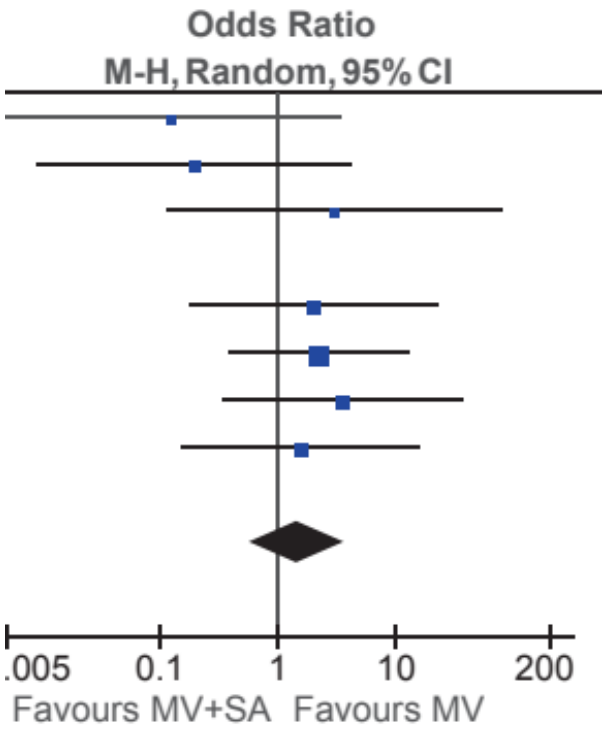
Systematic review and meta-analysis of surgical ablation for atrial fibrillation during mitral valve surgery

Kevin Phan[1], Ashleigh Xie[1], David H. Tian[1], Kasra Shaikhrezai[1,2], Tristan D. Yan[1,3]

All-cause mortality



Stroke & TE



30-D mortality

Bleeding

MI

차이 없음 !

(Ann Cardiothorac Surg 2014;3(1):3-14)

Maze ?

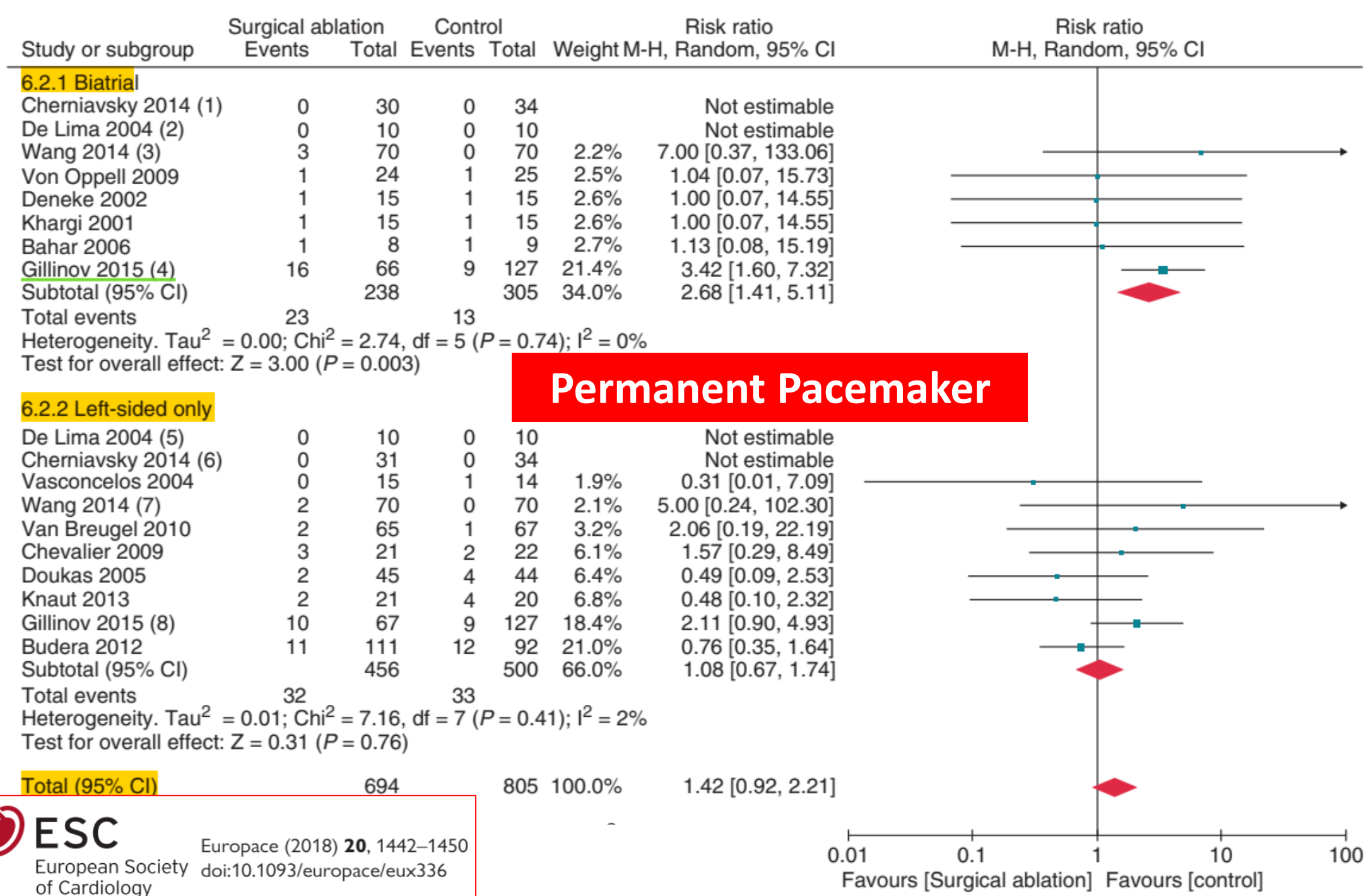
- SR & Meta-analysis
  - 9 RCT , 496 pts MVS
  - **23 RCT, 1,965 pts OHS**

ESC European Society of Cardiology
Europace (2018) **20**, 1442–1450
doi:10.1093/europace/eux336

Surgical ablation of atrial fibrillation: a systematic review and meta-analysis of randomized controlled trials

Outcomes	Studies	Participants	Effect estimate	*P*-value
Freedom from AF at 3 months	13	870	1.97 (0.83 to 4.68)[a]	0.12
Freedom from AF at 6 months	15	1096	2.31 (1.82 to 2.93)[a]	<0.00001
Freedom from AF at 12 months	20	1407	2.32 (1.92 to 2.80)[a]	<0.00001
All-cause mortality	23	1869	1.07 (0.75 to 1.52)[a]	0.88
Stroke	14	1326	1.19 (0.59 to 2.39)[a]	0.63
Readmission for cardiovascular causes	2	478	1.21 (0.79 to 1.84)[a]	0.38
ER visits postoperatively	0	0	n/a	n/a
All-cause ICU mortality during index hospitalization	7	414	2.44 (0.41 to 14.55)[a]	0.34
All-cause hospital mortality during index hospitalization	15	1030	1.12 (0.56 to 2.22)[a]	0.88
Pacemaker implantation at latest follow up	15	1485	1.27 (0.85 to 1.95)[a]	0.24
Myocardial infarction	5	675	1.01 (0.32 to 3.15)[a]	0.99
Hospital length of stay during index hospitalization	11	930	1.67 (0.22 to 3.12)[c]	0.02

(Europace (2018) 20, 1442–1450)



ESC European Society of Cardiology
Europace (2018) **20**, 1442–1450
doi:10.1093/europace/eux336


SEVER
MAZE

Severe TR : RAE & Fibrosis

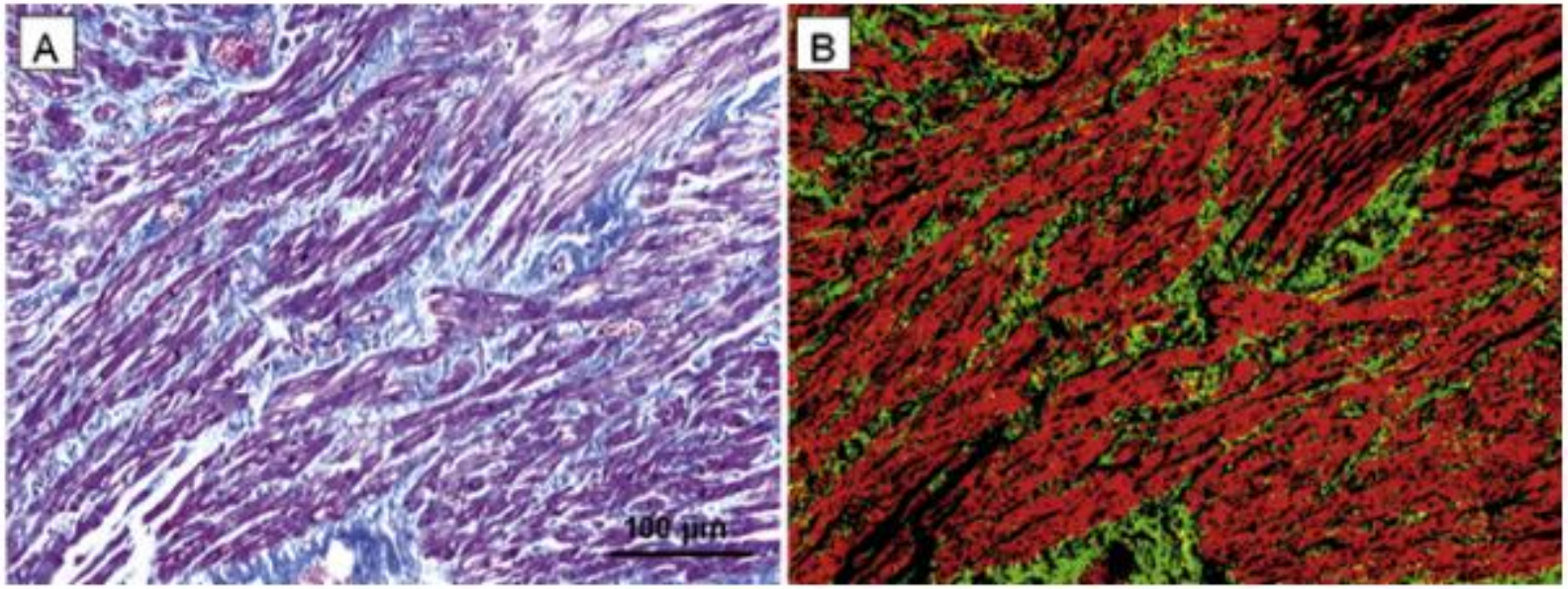


Fig. 1. The fibrotic area appeared as blue when stained with Masson trichrome stain (A). Quantitative measurement of fibrosis area was performed by summing the amount of areas stained in blue (B), with the assistance of an image analyzer: IPAP (Image Processor for Analytical Pathology, Sumika Technoservice Co., Hyogo, Japan). In this example, % fibrosis area was calculated as 14.8%.

(Eur J Cardiothorac Surg. 2011;40:61-9)

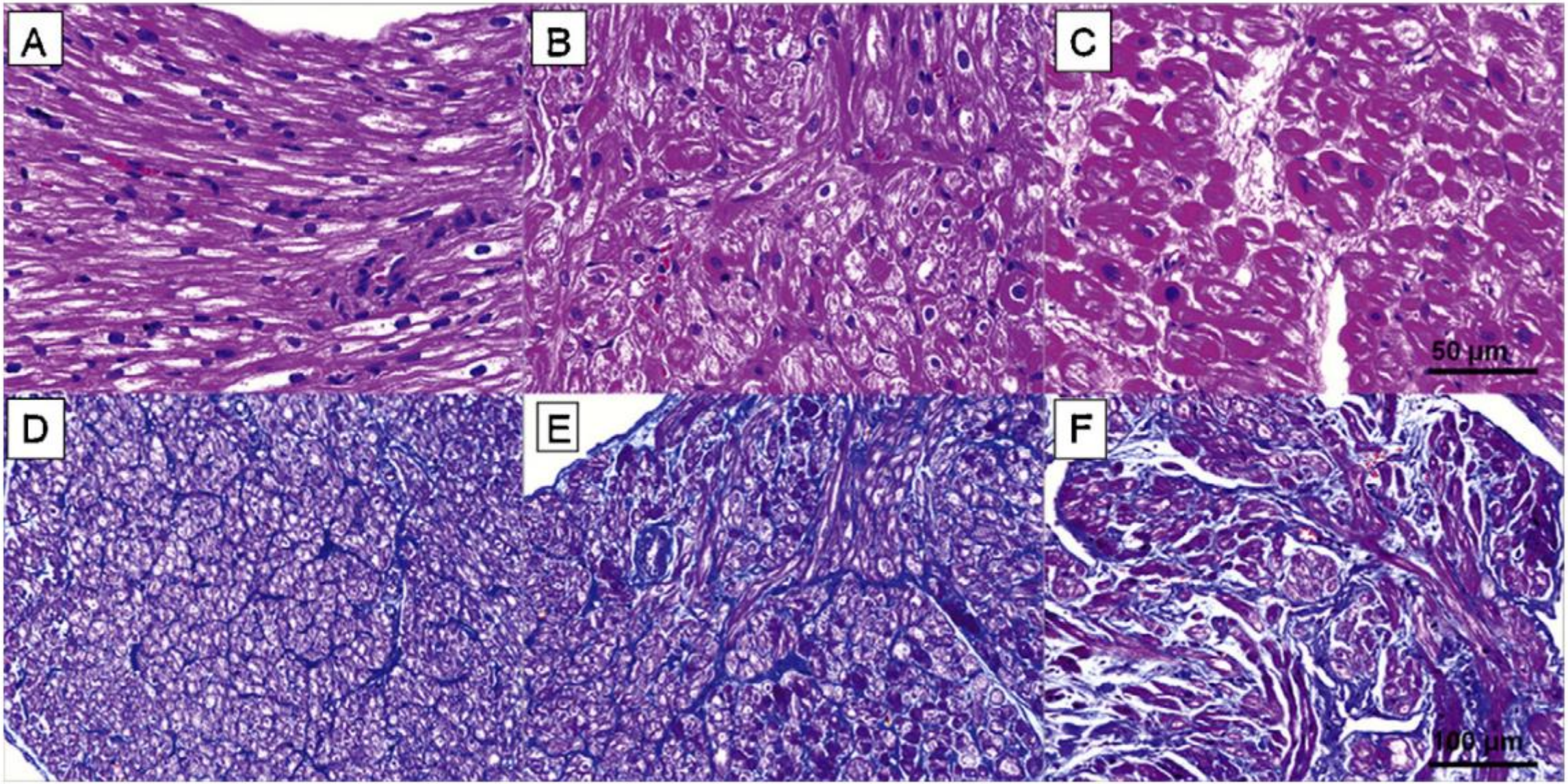


Fig. 2. Microscopic findings of cellular hypertrophy from patients with MVS and sinus rhythm (A), MVS and AF in successful maze group (B), and MVS and AF in unsuccessful maze group (C). Microscopic findings of atrial intercellular fibrosis from patients with MVS and sinus rhythm (D), MVS and AF in successful maze group (E), and MVS and AF in unsuccessful maze group (F). MVS: mitral valve surgery; and AF: atrial fibrillation.

Severe TR : RAE & Fibrosis : Maze

Table 3. Histopathological changes in left and right atria.

Parameters	MVS and SR (n = 23)	MVS and AF (successful maze) (n = 16)	MVS and AF (unsuccessful maze) (n = 8)
Left atrium			
% fibrosis (%)	6.9 ± 2.4	11.2 ± 4.7*	25.0 ± 7.8*,†
Cell size (μm)	13.9 ± 3.5	16.8 ± 3.8*	23.6 ± 4.1*,†
Right atrium			
% fibrosis (%)	6.2 ± 2.9	13.7 ± 6.2*	18.4 ± 5.4*
Cell size (μm)	12.3 ± 2.8	16.2 ± 4.9*	18.7 ± 4.4*

MVS: mitral valve surgery; SR: sinus rhythm; and AF: atrial fibrillatio

* $p < 0.05$ versus values in patients with MVS and SR.

† $p < 0.05$ versus values in patients with successful maze group.

Table 4. Clinical or histological factors correlated with unsuccessful maze operation for valvular AF.

Variables	Univariate	Multivariate	
	p value	OR (95% CI)	p value
Left-atrial dimension (mm)	0.033		NS
Cardiothoracic ratio (%)	NS		
Fibrosis in left atrium (>15%)	0.006	25.2 (1.1-567)	0.042
Cell size in left atrium (μm)	0.014		NS

Severe TR : RAE & Fibrosis : Maze

Table 5. Histopathological changes according to the grade of TR.

Parameters	Trivial TR (n = 16)	Mild TR (n = 20)	Moderate TR (n = 8)	Severe TR (n = 3)	p value
Left atrium					
% fibrosis (%)	9.2 ± 6.1	12.0 ± 9.5	11.8 ± 3.8	18.7 ± 10.2	NS
Cell size (μm)	15.0 ± 4.4	16.8 ± 5.6	17.7 ± 4.7	19.7 ± 4.6	NS
Right atrium					
% fibrosis (%)	9.1 ± 6.7*	9.2 ± 6.6*	16.0 ± 3.6	16.7 ± 2.9	0.02
Cell size (μm)	13.7 ± 3.4*	13.7 ± 3.5*	16.6 ± 6.4	22.1 ± 4.7	<0.01

Impact of maze procedure in patients with severe tricuspid regurgitation and persistent atrial fibrillation

Ilkun Park, MD, MS,[a] Dong Seop Jeong, MD, PhD,[a] Sung-Ji Park, MD, PhD,[b] Joong Hyun Ahn, MS,[c] Jihoon Kim, MD, PhD,[b] Eun Kyoung Kim, MD, PhD,[b] Kiick Sung, MD, PhD,[a] Wook Sung Kim, MD, PhD,[a] and Pyo Won Park, MD, PhD[d]

(J Thorac Cardiovasc Surg 2023;166:478-88)

Variable	Propensity-matched patients		
	Maze group (n = 118)	Nonmaze group (n = 149)	SMD
Left atrial diameter (mm)	58.95 ± 11.27	60.61 ± 10.93	0.120
Left atrial enlargement	114 (96.6)	148 (99.3)	
Right atrial diameter (mm)	53.91 ± 10.56	60.26 ± 12.48	
Right atrial enlargement	110 (93.2)	140 (93.9)	
Combined valve surgery			
Isolated tricuspid valve surgery	15 (12.7)	18 (12.1)	
Combined left-sided valve surgery	103 (87.3)	131 (87.9)	

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(J Thorac Cardiovasc Surg 2023;166:478-88)

TABLE 3. Univariable and multivariable analysis for failure to sinus rhythm conversion in the total cohort

Variable	Univariable analysis			Multivariable analysis		
	Odds ratio	95% CI	*P* value	Odds ratio	95% CI	*P* value
Echocardiographic						
Preoperative EF	1.003	0.991-1.015	.645			
Preoperative LA diameter	1.024	1.014-1.034	<.001	1.022	1.012-1.033	<.001
Preoperative RA diameter	1.022	1.012-1.031	<.001	1.012	1.003-1.022	.013
Surgery						
Maze operation	0.304	0.233-0.396	<.001	0.397	0.290-0.543	<.001
Epicardial coronary sinus ablation	0.413	0.058-2.945	.378			
Tricuspid valve surgery			<.001			
Replacement	1					
Repair	0.593	0.462-0.760				

Impact of maze procedure in patients with severe tricuspid regurgitation and persistent atrial fibrillation

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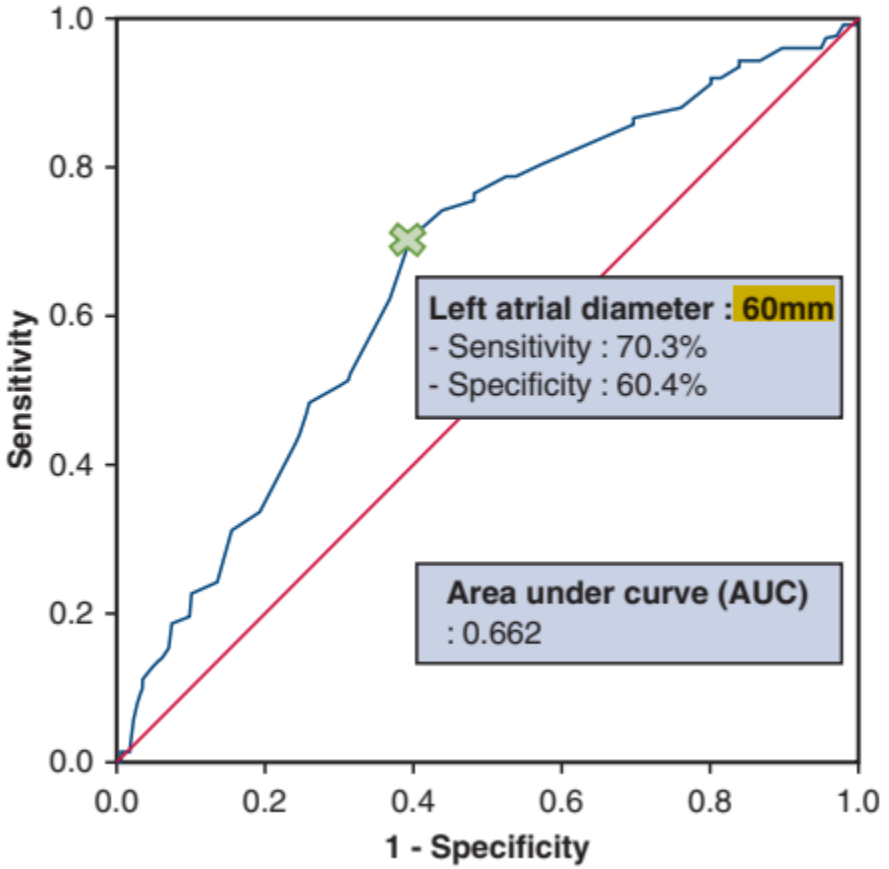
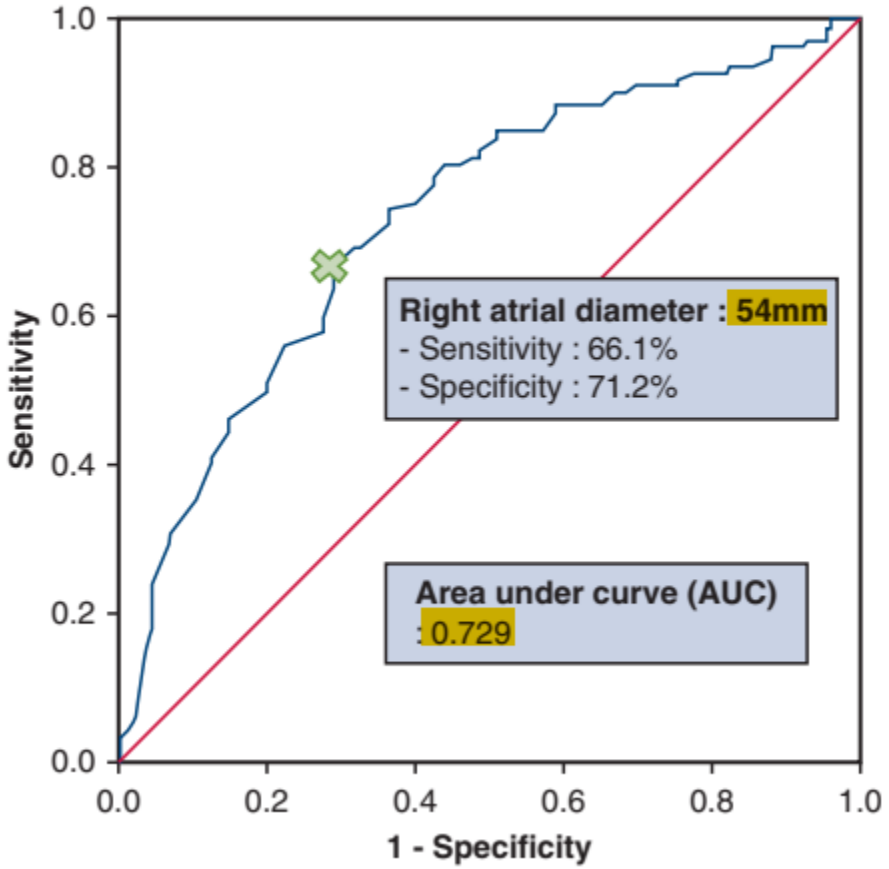
(J Thorac Cardiovasc Surg 2023;166:478-88)

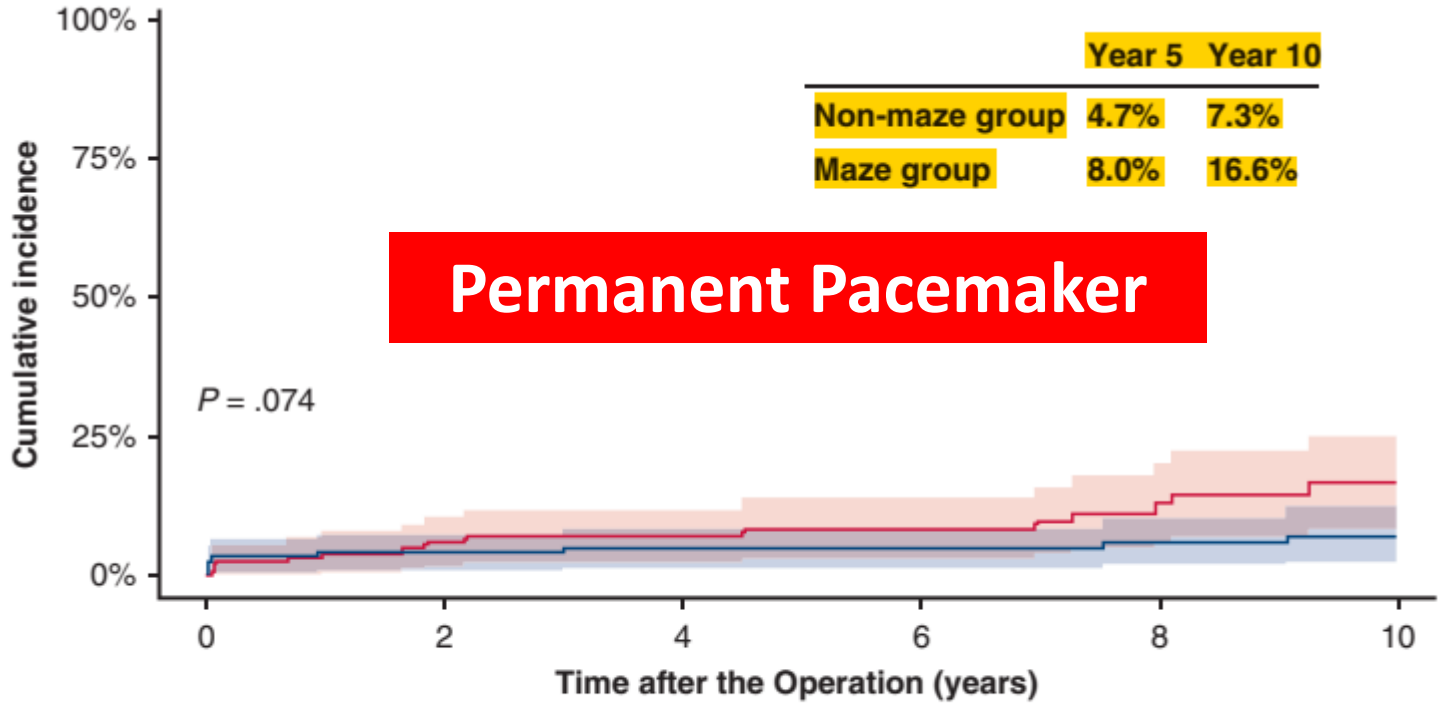




Postoperative clinical outcomes

(J Thorac Cardiovasc Surg 2023;166:478-88)

Propensity-matched patients



	Year 5	Year 10
Non-maze group	4.7%	7.3%
Maze group	8.0%	16.6%

Permanent Pacemaker

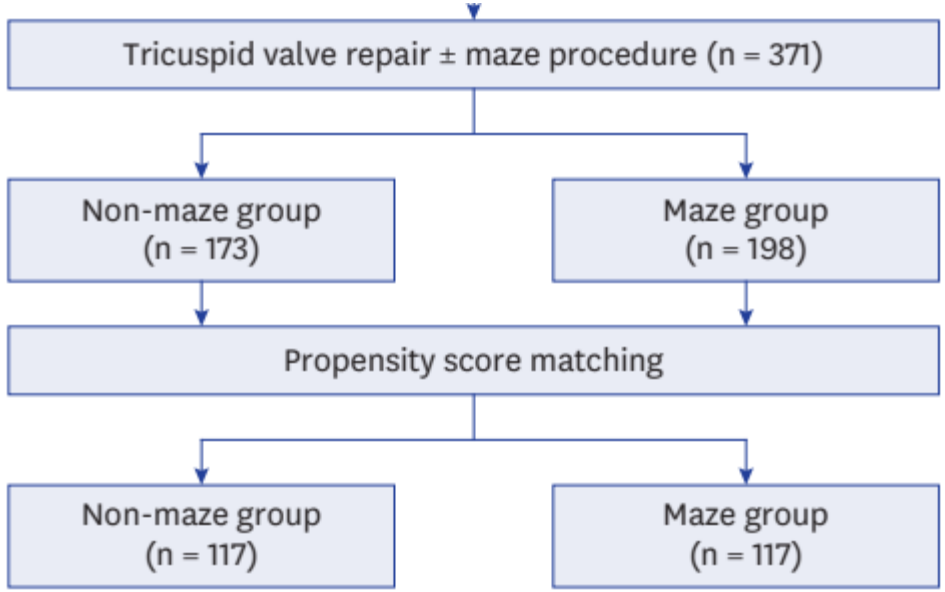
5 y	9 (8.0)	7 (4.7)	.572‡
10 y	14 (16.6)	9 (7.3)	.074‡

JKMS

Outcomes of Concomitant Maze Procedure in Tricuspid Repair for Severe Tricuspid Regurgitation

Ilkun Park,[1] Suryeun Chung,[1] Yang Hyun Cho,[1] Kiick Sung,[1] Wook Sung Kim,[1] Kyungsub Song,[2] Joong Hyun Ahn,[3] Chang Seok Jeon, Pyo Won Park,[4] and Dong Seop Jeong [1]

J Korean Med Sci. **2024** Apr 22;39(15):e143



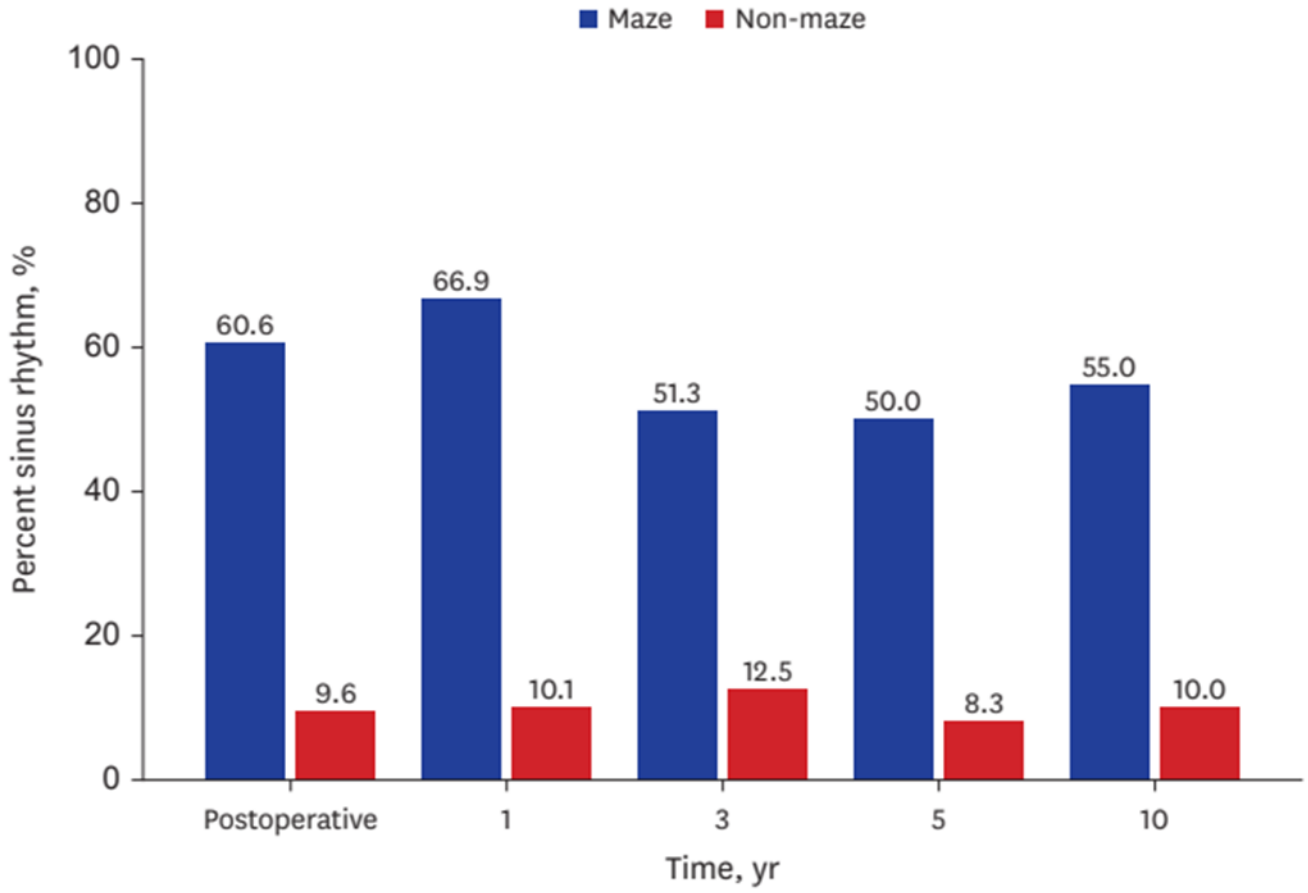
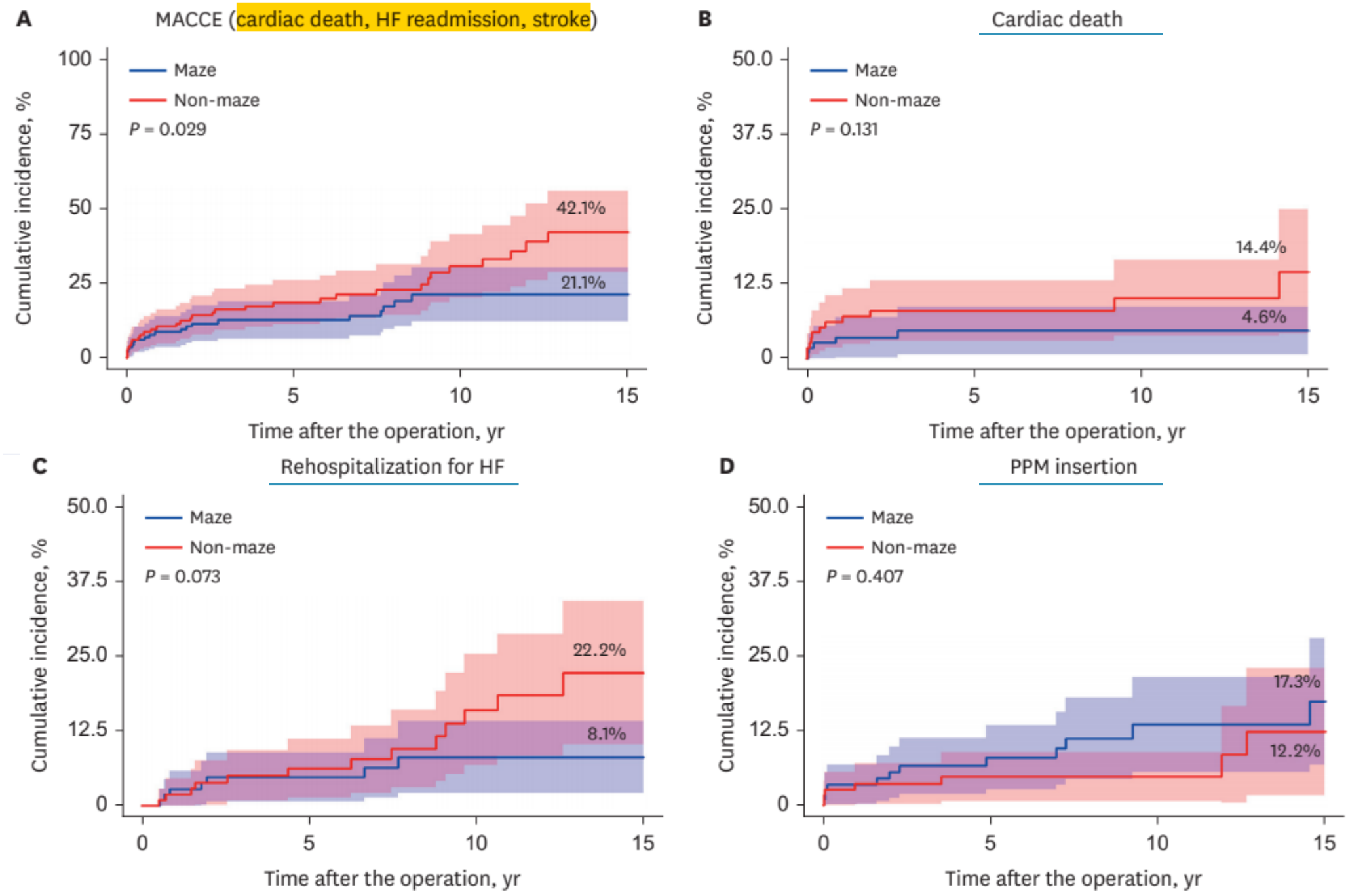


Fig. 3. Sinus rhythm restoration rate between the maze and the non-maze groups in the total patients.


A
MACCE (cardiac death, HF readmission, stroke)
Maze
Non-maze
P = 0.029
42.1%
21.1%
Cumulative incidence, %
Time after the operation, yr
B
Cardiac death
Maze
Non-maze
P = 0.131
14.4%
4.6%
Cumulative incidence, %
Time after the operation, yr
C
Rehospitalization for HF
Maze
Non-maze
P = 0.073
22.2%
8.1%
Cumulative incidence, %
Time after the operation, yr
D
PPM insertion
Maze
Non-maze
P = 0.407
17.3%
12.2%
Cumulative incidence, %
Time after the operation, yr

Check points

- Exclusion of TVR cases
- No definite criteria for decision of the maze procedure
- How many cases of long-lasting persistent AF ?

Table 3. Echocardiographic outcomes in the matched cohort

Variables	Preoperative (n = 291)	5-year follow-up (n = 132)	10-year follow-up (n = 87)	*P* values[a]
LV end-diastolic diameter, mm				0.514
Maze group	49.7 ± 9.3	51.9 ± 5.9	51.2 ± 5.9	
Non-maze group	52.9 ± 10.8	53.7 ± 6.4	52.2 ± 6.2	
LV end-systolic diameter, mm				0.719
Maze group	30.8 ± 6.4	33.4 ± 5.6	32.9 ± 5.7	
Non-maze group	33.4 ± 7.2	35.0 ± 7.9	33.9 ± 6.5	
LV ejection fraction, %				0.212
Maze group	61.3 ± 5.6	59.2 ± 8.4	61.0 ± 4.3	
Non-maze group	60.4 ± 8.5	62.6 ± 7.4	61.9 ± 5.2	
TAPSE, mm				0.160
Maze group	16.7 ± 4.7	11.8 ± 3.2	11.7 ± 2.4	
LAD, mm				0.013
Maze group	59.6 ± 11.4	53.3 ± 8.4	54.9 ± 10.8	
Non-maze group	61.3 ± 10.6	59.6 ± 12.5	58.8 ± 12.3	

[a]Linear mixed model was used to assess the interaction between time and group.

Maze for Atrial TR w/ AF ?

(ventricular vs. atrial TR)

Original Article

Early and mid-term outcomes of tricuspid valve surgery in patients with functional tricuspid regurgitation induced by atrial fibrillation

Eun Chae Kim[#], Nazla Amanda Soehartono[#], Sue Hyun Kim, Yeiwon Lee, Suk Ho Sohn, Ho Young Hwang, Kyung Hwan Kim, Jae Woong Choi

(J Thorac Dis 2024;16(4):2394-2403)

Methods: From 2000 to 2021, a total of 1,301 patients underwent tricuspid valve (TV) surgery. Among them 43 patients who diagnosed as AF induced TR were enrolled. The tricuspid valve-related events (TVRE) included cardiac death, TV reoperation, development of moderate or greater TV disease, congestive heart failure requiring re-admission, and major bleeding or thrombosis. The median follow-up duration was 42.0 months.

Results: The interval from diagnosis of AF to more than moderate TR was 61.2 months, and the interval from initial diagnosis of severe TR to surgery was 2.4 months. Concomitant Cox-maze III procedure was

Outcomes

Table 3 Early postoperative outcomes

Early outcomes	Values (n=43)
Operative mortality	1 (2.3)
Hospital course (days)	15 [6–145]
Low cardiac output syndrome	2 (4.7)
Bleeding reoperation	2 (4.7)
AKI	9 (20.9)
AKI requiring RRT	5 (11.6)
Permanent pacemaker implantation	0
Stroke	2 (4.6)
Respiratory complication	7 (16.3)

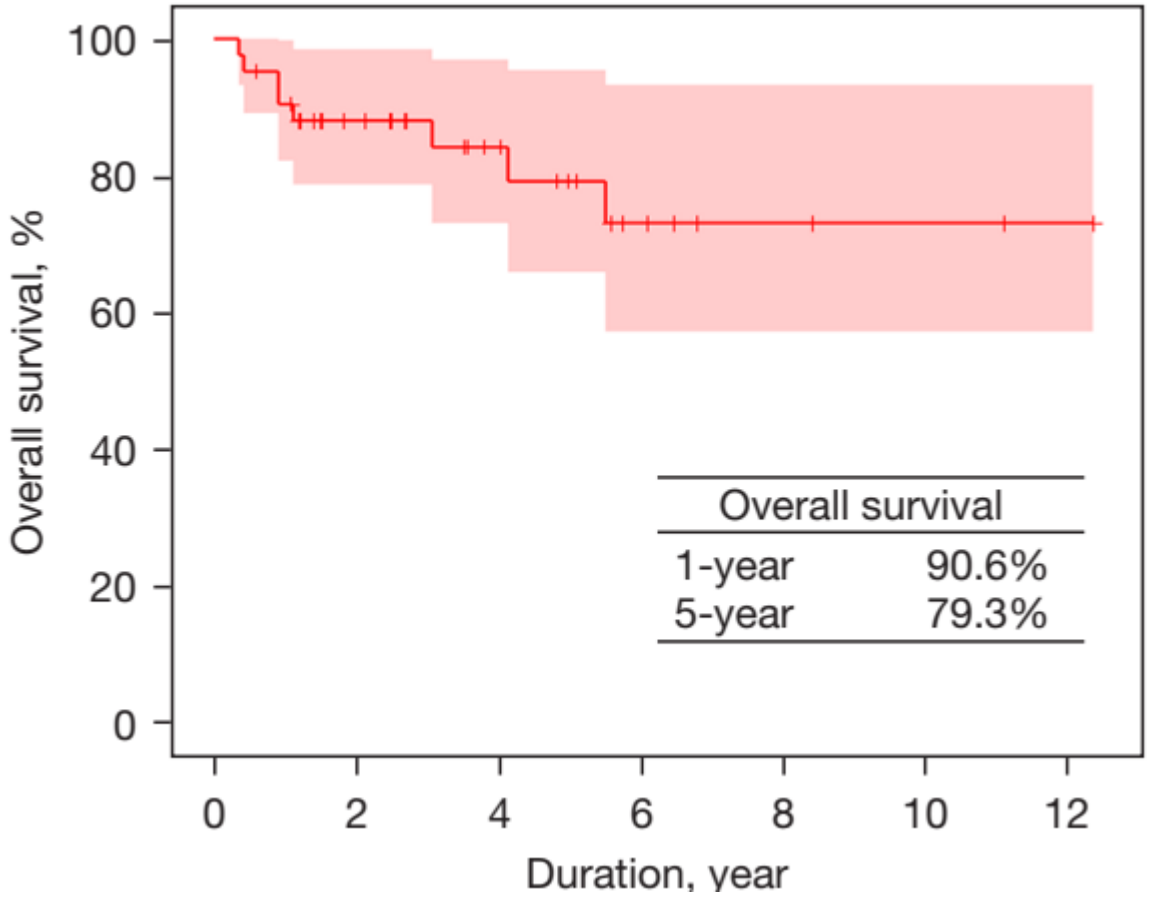
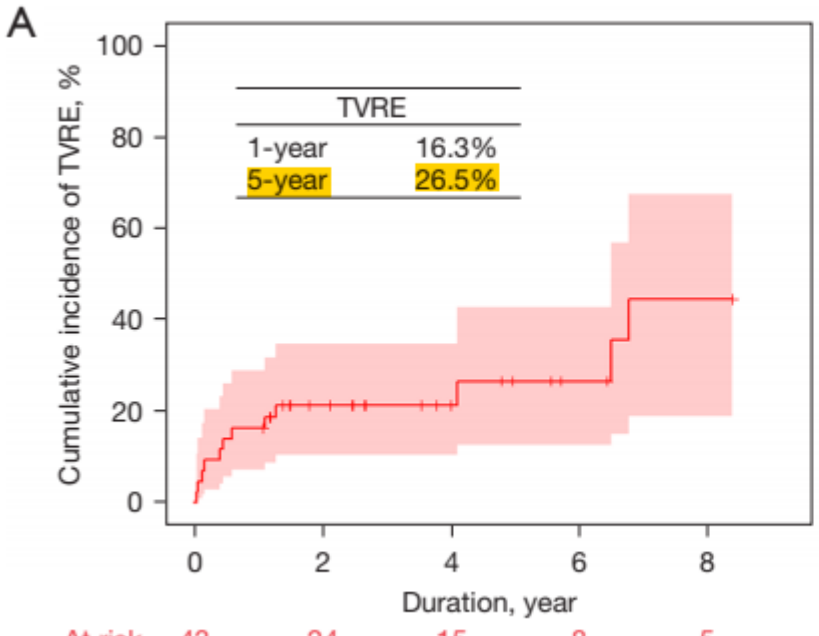


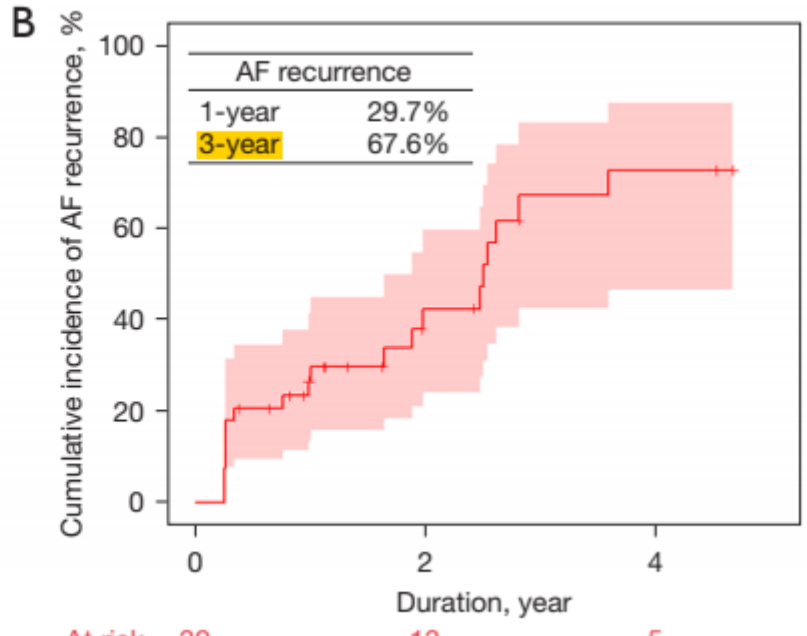
Table 2 Operative data of the study patients

Variables	Values (n=43)
Type of tricuspid valve surgery	
Repair	37 (86.0)
De-Vega annuloplasty	4 (9.3)
Ring annuloplasty	33 (76.7)
Replacement	6 (14.0)
Concomitant Cox-maze III procedure	39 (90.7)
CPB time (min)	160.6±50.7
ACC time (min)	100.4±27.5

Table 4 Mid-term postoperative outcomes

Midterm outcomes	Values (n=42)
Late mortality	7 (16.7)
Cardiac death	2 (4.8)
PPM insertion	6 (14.3)
Recurrence of AF after Cox-maze III procedure (n=39)	20 (51.3)
Recovery to sinus rhythm, free from PPM	15 (38.5)
TV re-operation	3 (7.1)
Development of moderate or severe TV disease	4 (9.5)
Congestive heart failure requiring re-admission	2 (4.8)
Major bleeding or thrombotic events	2 (4.8)





Benefit of maze : Overall survival (5YR)

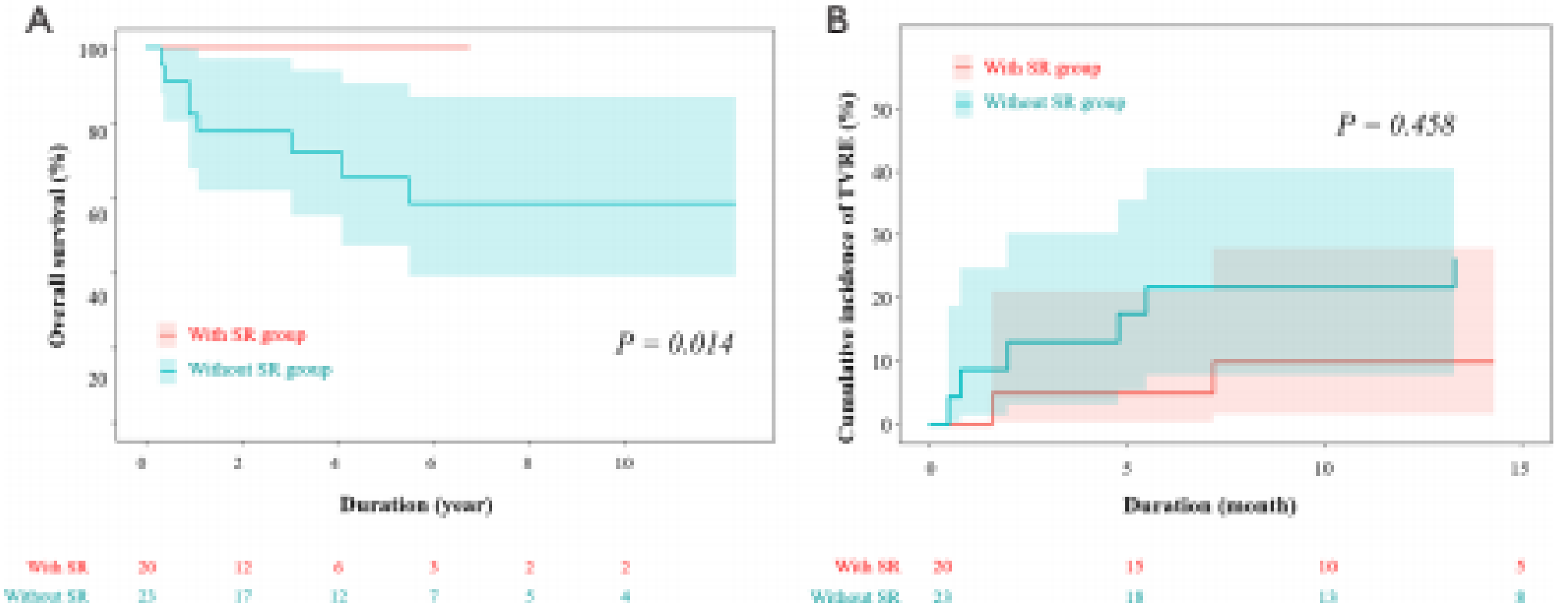
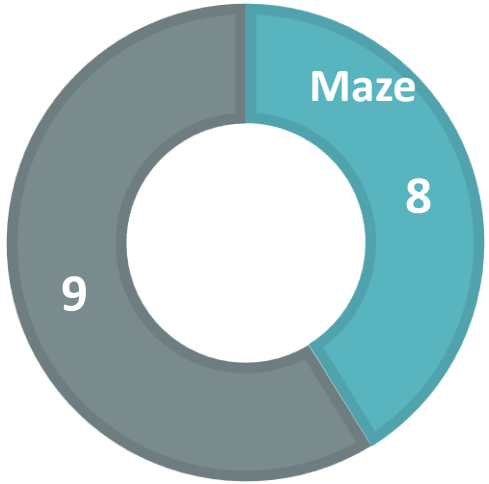


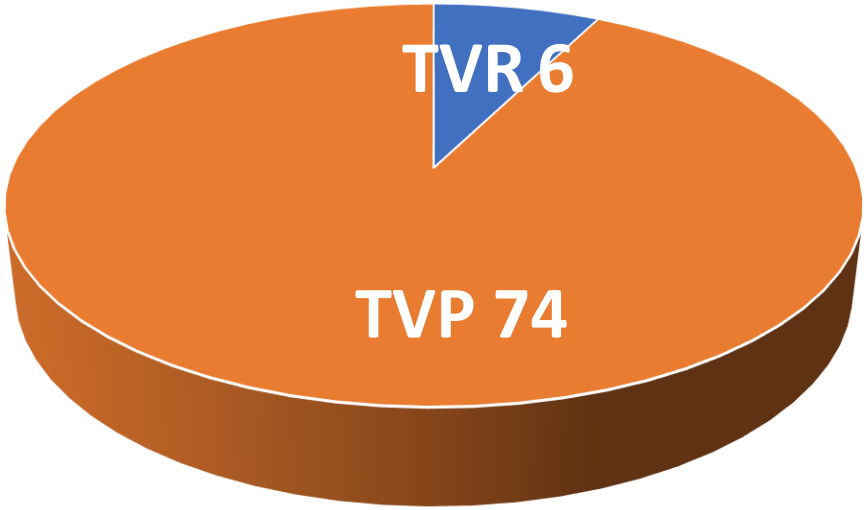
Figure S1 Overall survival (A) and cumulative incidences of TVRE (B) in the patients with sinus rhythm (with SR group) and the patients without sinus rhythm (without SR group). TVRE, tricuspid valve related events.

SNUH 서울대학교병원운영 서울특별시보라매병원

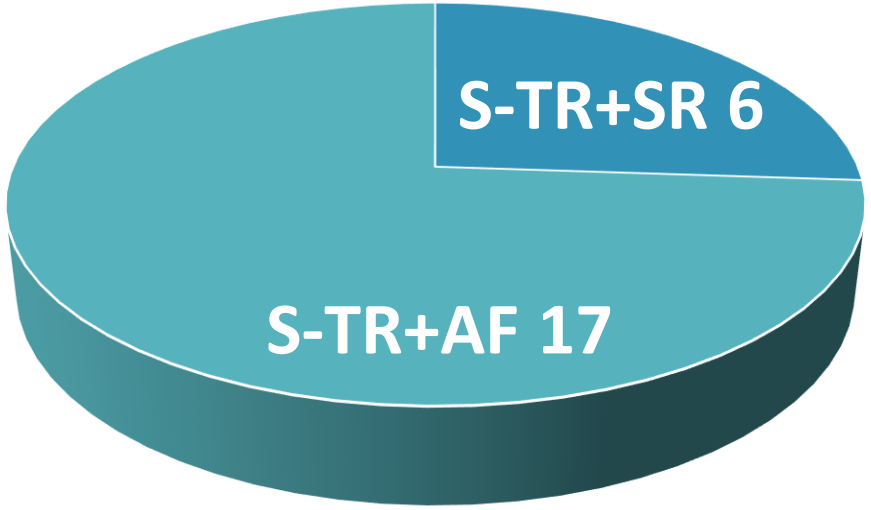
(2010 – 2023)



TV operation
(N=80)



Severe TR
(N=23)



Outcomes
(mean F/U = 26 months)

	Maze (n=8)	N-Maze (n=9)	P
Age	65.3±6.7	73.4±8.0	0.068
Male	3	2	
DM	0	2	
HT	4	5	
CKD	1	2	
Stroke	0	0	
LVEF	55.4±8.1	64.4±9.9	0.059
LA	58.9±7.6	55.4±9.9	
PASP	44.4±9.7	55.0±37.0	
Redo	0	2	
Combined	6	8	
Isolated	1	2	

	Maze (n=8)	N-Maze (n=9)	P
CPB	233.1±90.5	195.7±75.5	
ACC	132.2±44.9	139.8±44.5	
TVR	0	2	
TVP	8	7	
Early mortality	1	2	
AF at discharge	2	7	
AF on last F/U	1	7	
Late mortality	0	1	

A case of ventricular TR, F/80

S-TR, M-MR,
Persistent AF,
RV dysfx (FAC=29%),
PASP=49 mmHg, BAE

→

1차: MVP(ACR X2, post. commissural closure), MAP, TVP(clover technique, TAP w/ MC3), Maze X => **IntraOP TEE**, Gr1 TR, MR => **TTE**, S-TR, M-MR, FAC=21%, PASP=70 mmHg

→

2차: MVP(A2 chordal shortening, commissural overlapping closure), TVP(release tethering by 2nd chordal resection, PM splitting, clover technique), TAP w/ DeVega => **IntraOP TEE**, no TR, no MR => **TTE**, t-MR, mM-TR, FAC=23%, PASP=48 mmHg

↓

1 mo later :
NIC of echoCG findings

→

4 mo later :
no-MR, S-TR,
EF 48%,FAC=26.3%,
PASP=58 mmHg

→

6 mo later :
no-MR, S-TR (ERO 증가),
EF 61%, FAC=20%,
PASP=70 mmHg

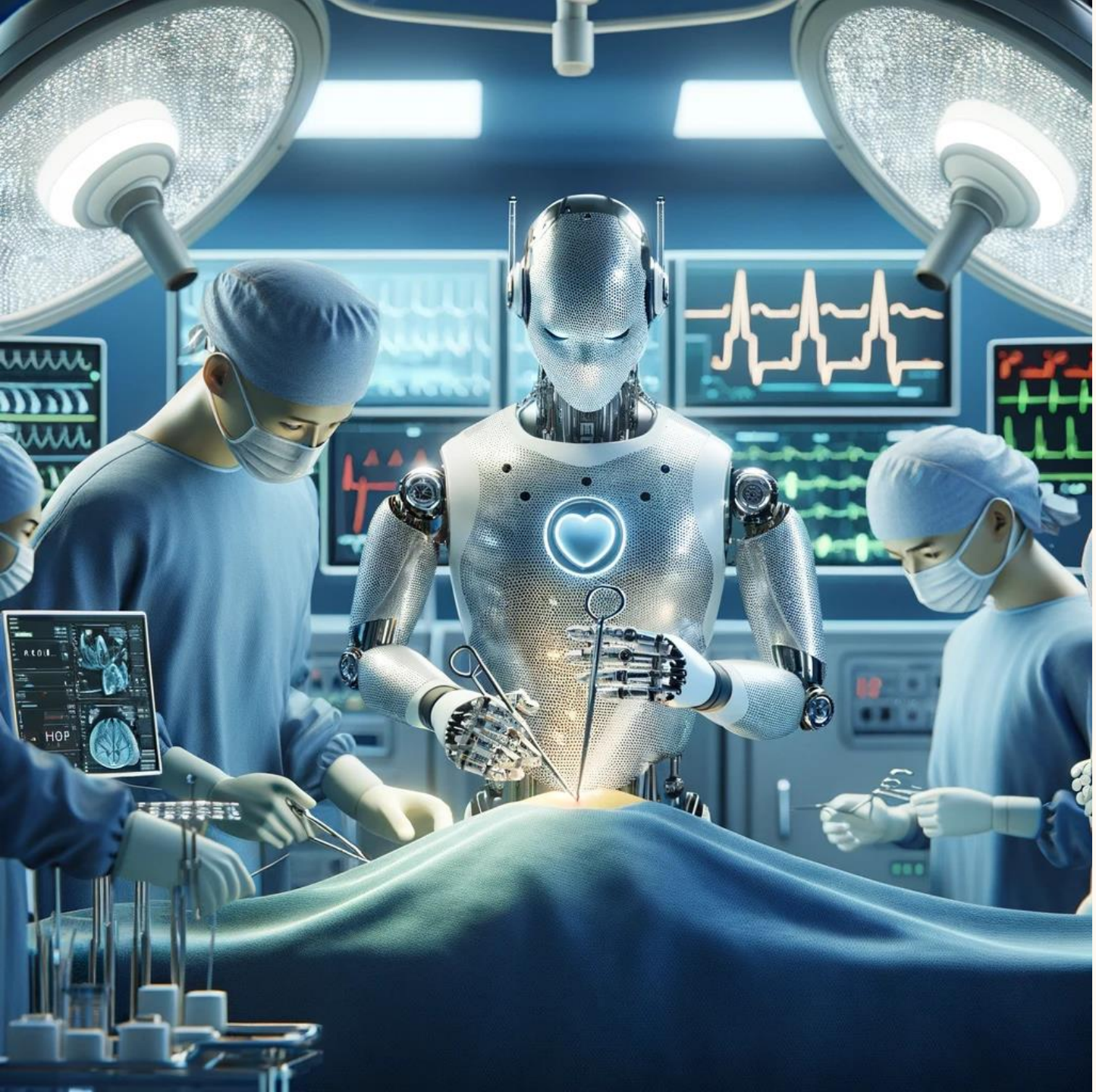
Take-home message

about maze op for severe TR w/ AF

Patient selection is needed. TR repair is more important than maze.

Atrial TR w/ AF would be one of the targets gaining benefit

Careful decision for the pts w/ high risk factors of maze failure



감사합니다 !

A humanoid robot performing heart surgery in an operating room, alongside several human assistants.

Is this possible in the future?