Sinus Node Dysfunction vs. Atrial Fibrillation

45 years old man, persistent AF, planned for MVR, LA 69mm, EF 70%: Does he need additional maze surgery?

CON

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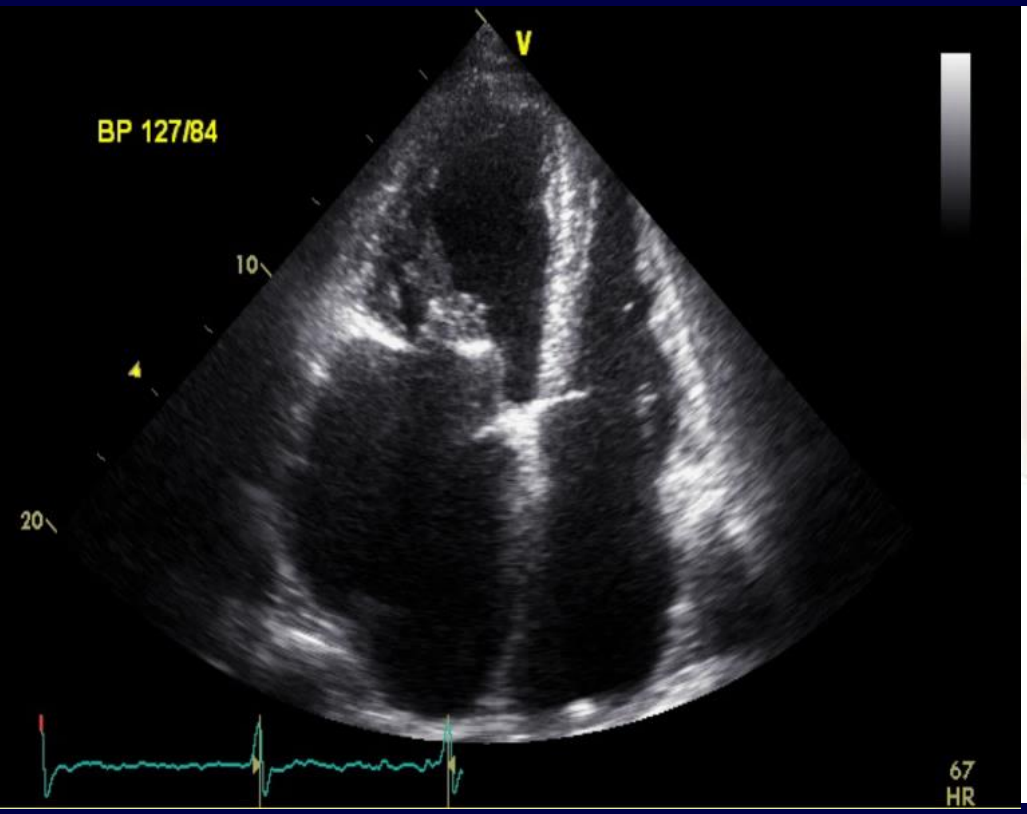
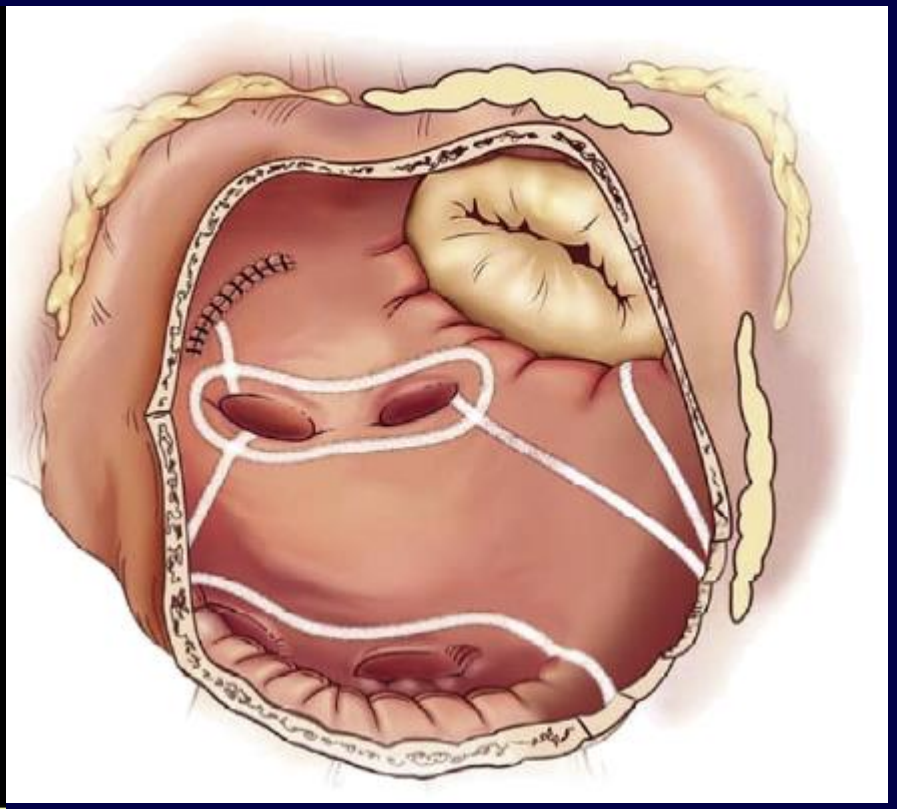
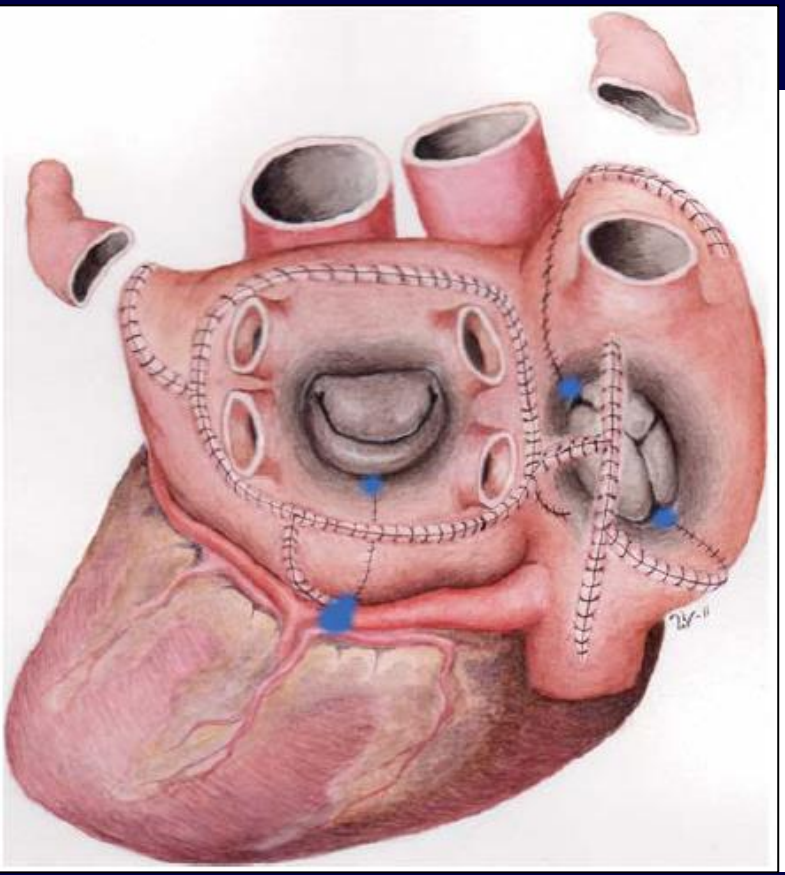
Concomitant Cox Maze IV with MVS

Damiano et al. J Thorac CV Surg . 2011;141:113-21.





Clinical Outcome of Maze Operation



Prasad et al. J Thorac CV Surg . 2003;126:1822-27.

TABLE 2. Patient demographics

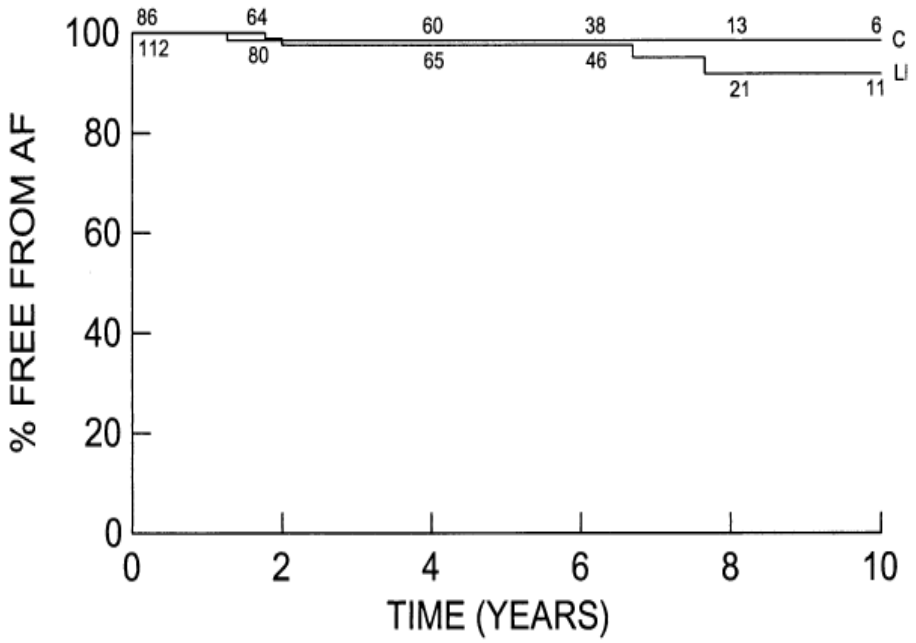
	Lone Maze procedure	Concomitant maze procedure	*P* value
Age (y)	51.3 ± 10.5	58.8 ± 9.9	<.001
Sex (M:F)	90:22	53:33	.003
PAF:PTAF	72:40	45:41	.08
Pump time (min)	162 ± 35	201 ± 42	<.001
Crossclamp time (min)	93 ± 34	122 ± 37	<.001
Mortality	2/112, 1.8%	1/86, 1.2%	.99
Median ICU stay (d)	2	3	.007
Median LOS (d)	9	12	.01

PAF, Paroxysmal atrial fibrillation; *PTAF,* persistent atrial fibrillation; *LOS,* length of stay.

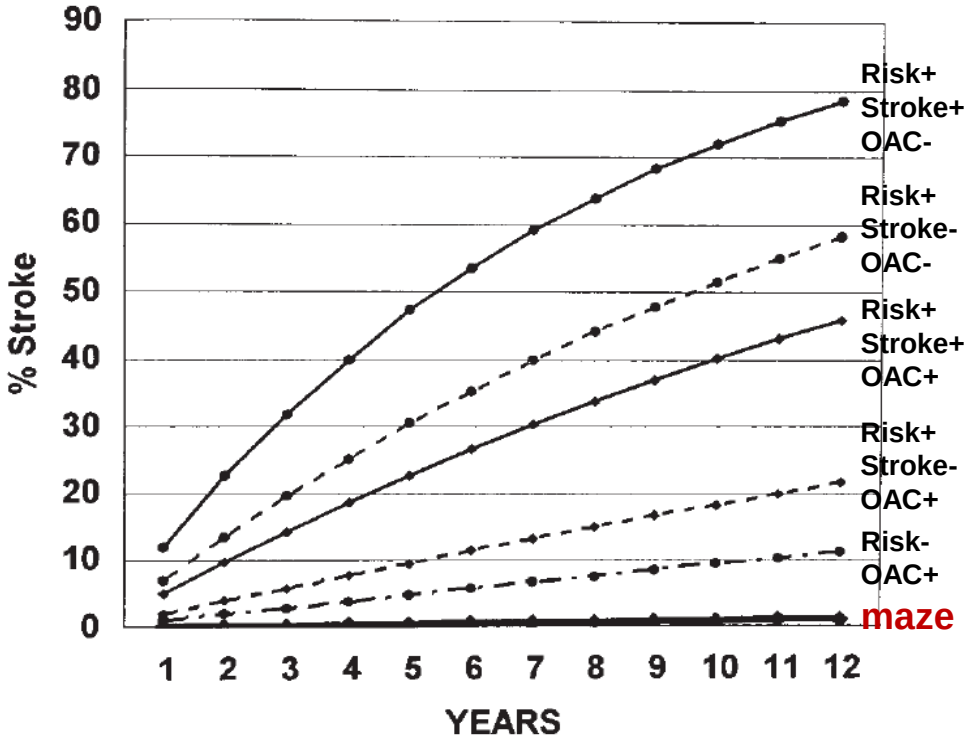
Ahlsson et al. Scand Cardiovasc J. 2012;46:212-8.

Clinical Outcome of Maze Operation

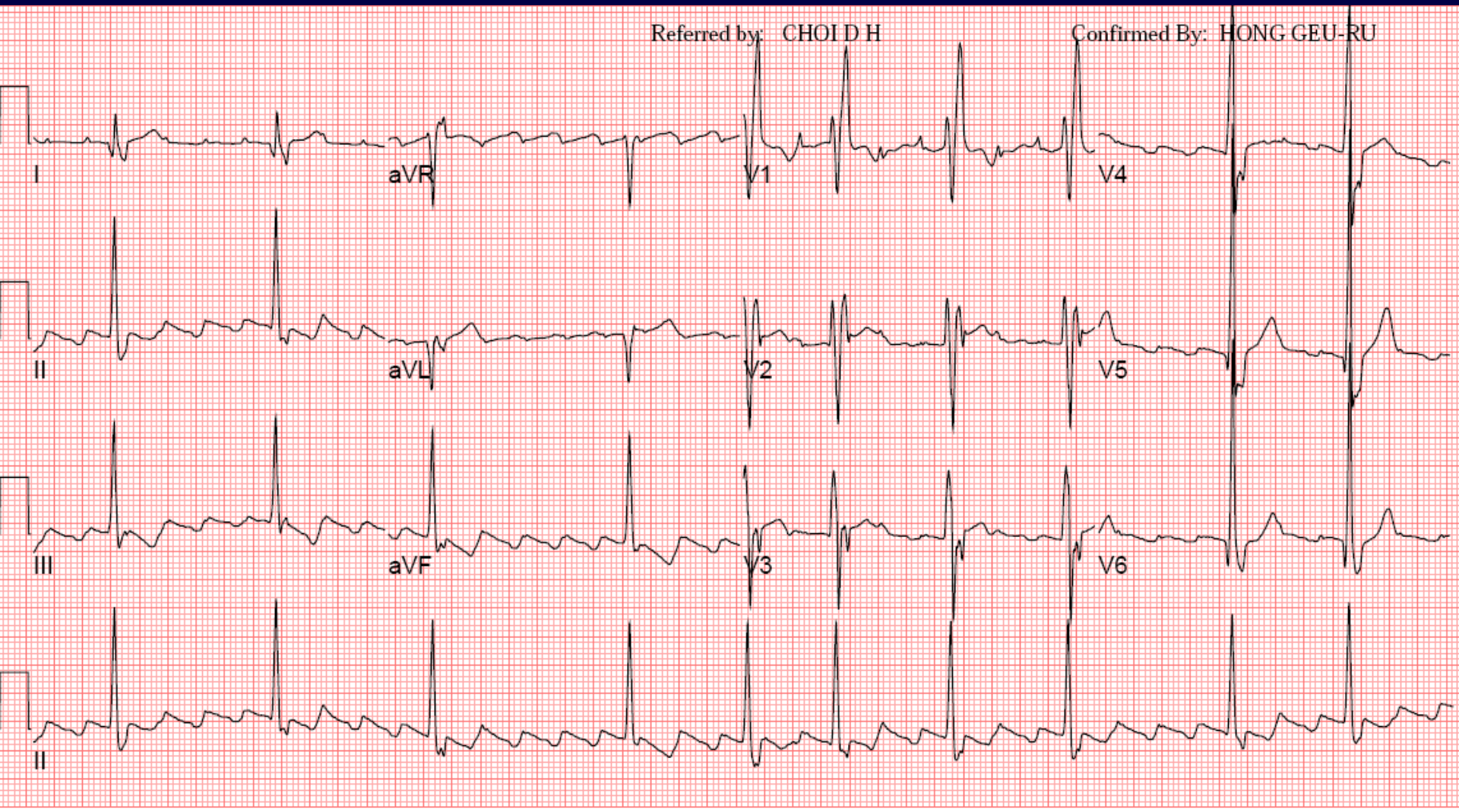
Prasad et al. J Thorac CV Surg . 2003;126:1822-27.



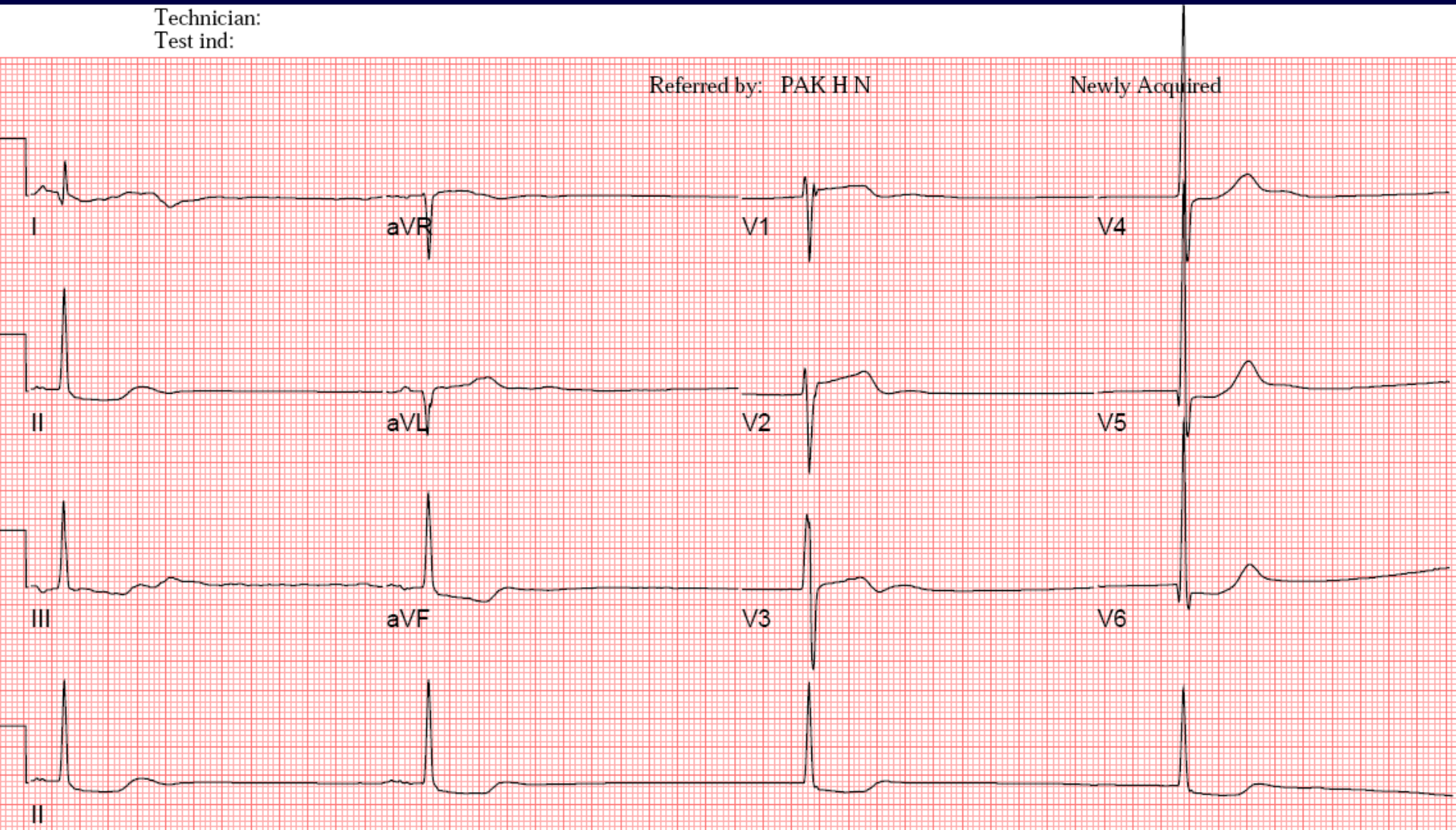
Cox J et al. J Thorac CV Surg . 1999;118:833-40.



M/64. Severe MSR



s/p MVR, TAP, & maze

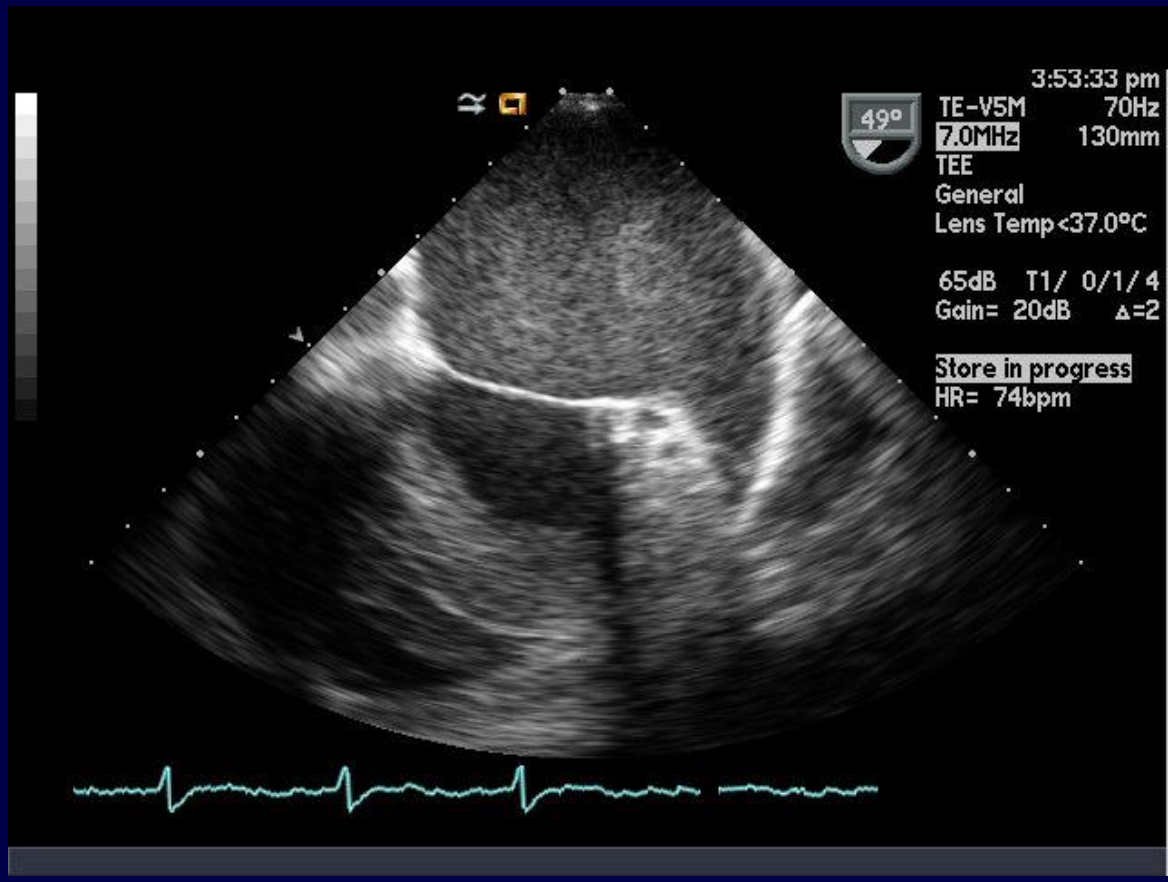


Function of LA

1. Conduit
2. Reservoir
3. Booster Pump

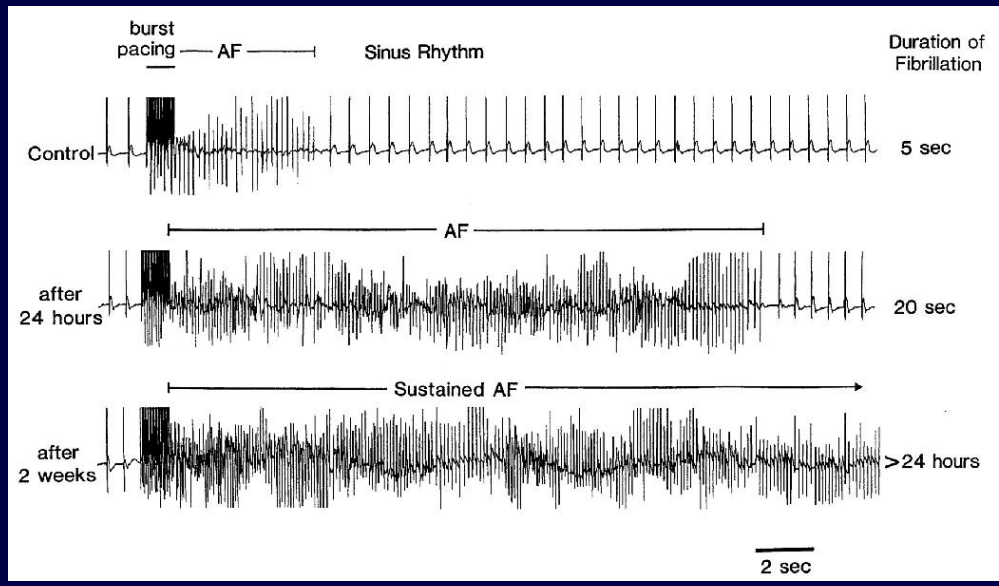
Function of LAA

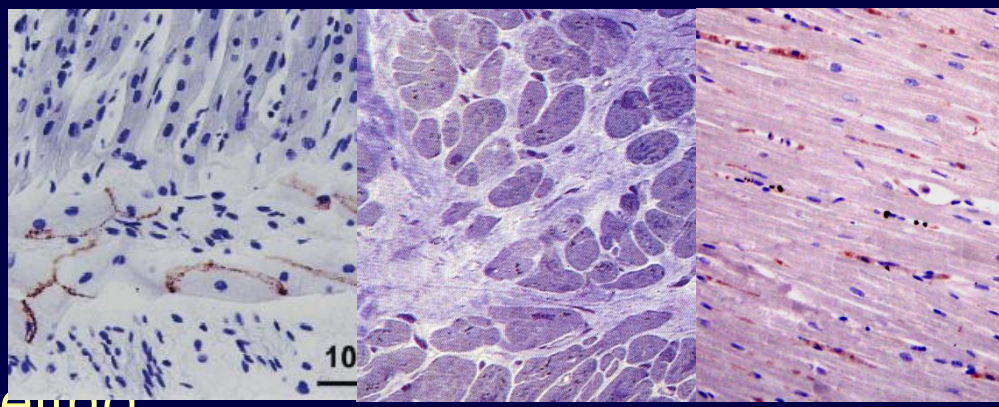
1. Protect coronary artery
2. Reservoir
3. Booster pump
4. Endocrine organ



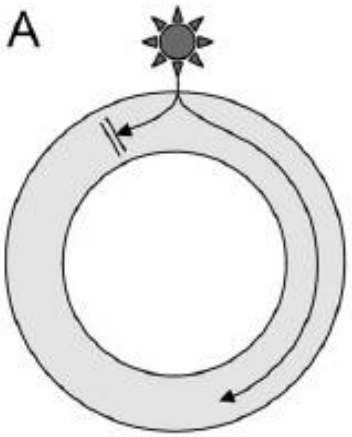
Mechanisms of AF

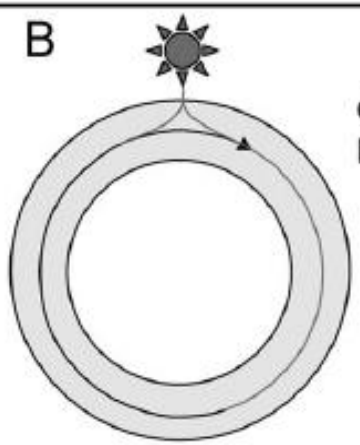
- Electrical Remodeling
  - Ion Channel Remodeling
  - AF beget AF
  - APD & CV
  - AF initiator & AF driver
- Structural Remodeling
  - Atrial dilatation
  - Atrial Fibrosis
  - Gap junctional remodeling
  - Matrix Remodeling
- Autonomic Neural Remodeling





Fundamental determinants of reentry



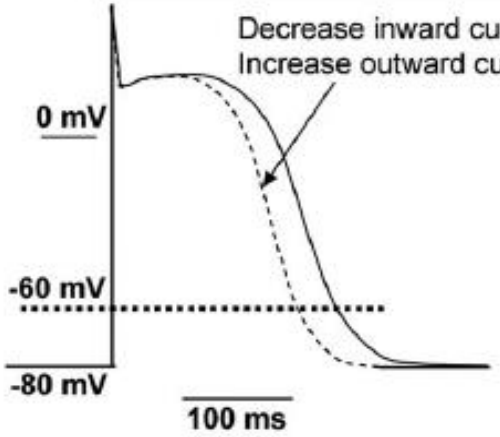


Circuit time: has to be greater than RP.
Favored by: ➢Short refractory periods
➢Slow conduction
➢Long pathways available

How remodeling promotes reentry

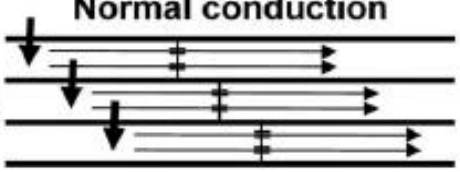
C

Shortened refractory periods

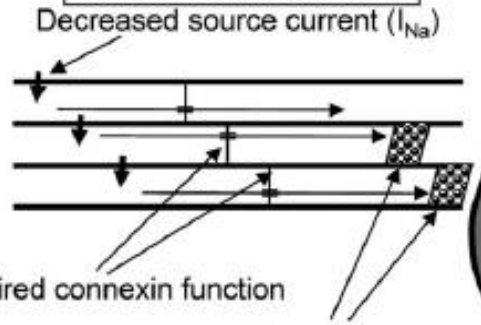


D

Normal conduction

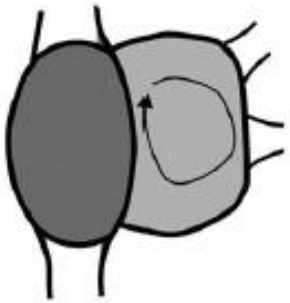


Slowed conduction

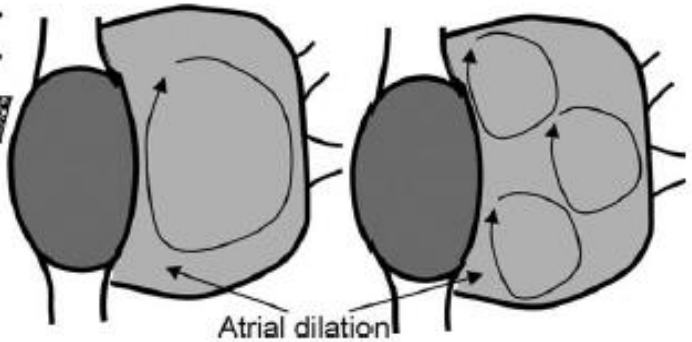


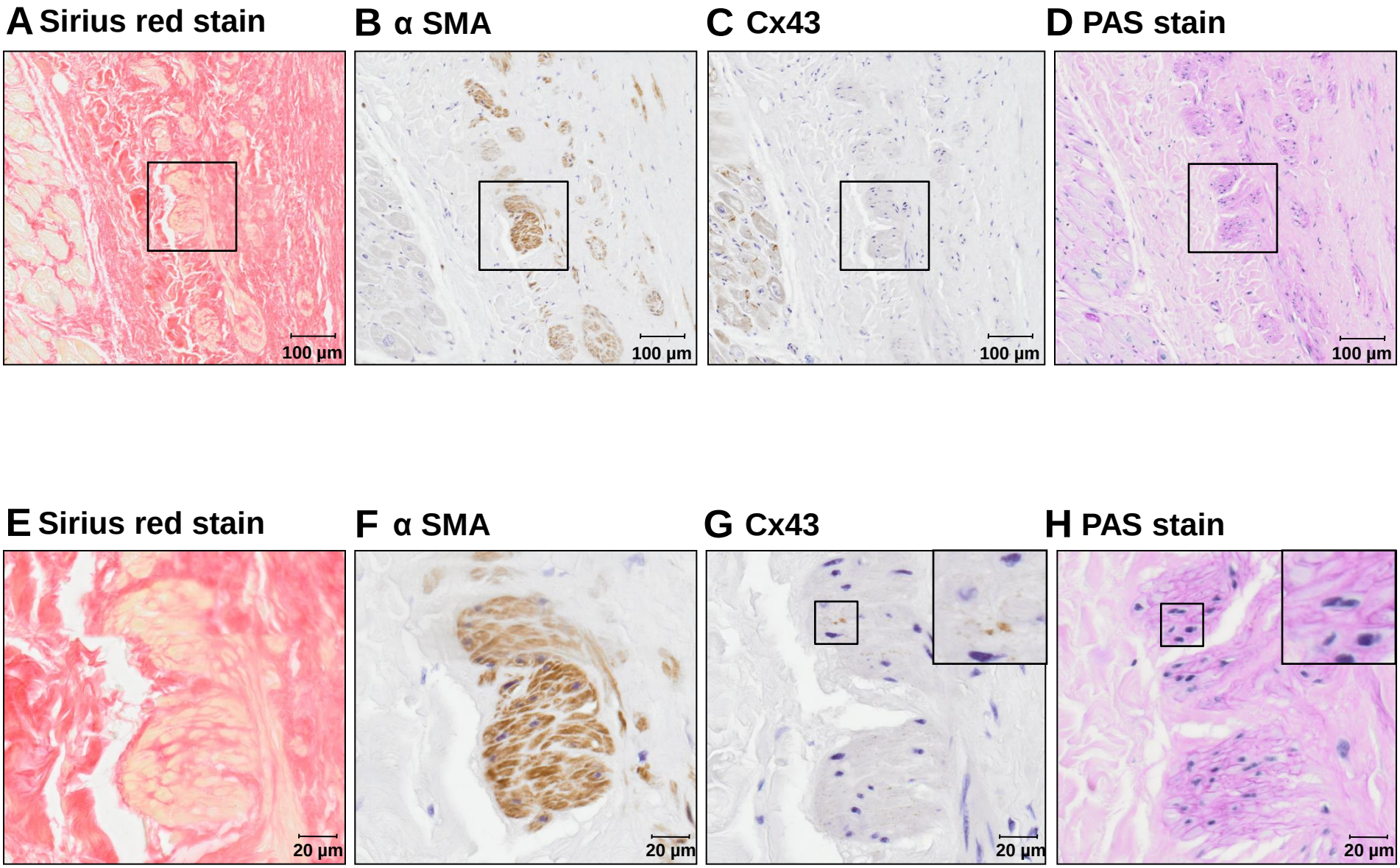
E

Normal atrial size



Increased circuit path-space





Park JH, Pak HN, et al. Cardiovasc Pathol. 2012;110(3):373-7.

HRS-EHRA-ECAS Expert Consensus Documents for Concomitant Surgical AF Ablation

Calkins et al. Europace 2012

INDICATIONS FOR CONCOMITANT SURGICAL ABLATION of AF		
Symptomatic AF refractory or intolerant to at least one Class 1 or 3 antiarrhythmic medication		
Paroxysmal: Surgical ablation is reasonable for patients undergoing surgery for other indications	IIa	C
Persistent: Surgical ablation is reasonable for patients undergoing surgery for other indications	IIa	C
Longstanding Persistent: Surgical ablation is reasonable for patients undergoing surgery for other indications	IIa	C
Symptomatic AF prior to initiation of antiarrhythmic drug therapy with a Class 1 or 3 antiarrhythmic agent		
Paroxysmal: Surgical ablation is reasonable for patients undergoing surgery for other indications	IIa	C
Persistent: Surgical ablation is reasonable for patients undergoing surgery for other indications	IIa	C
Longstanding Persistent: Surgical ablation may be considered for patients undergoing surgery for other indications	IIb	C

IIb: Usefulness/ efficacy is less well established by evidence/ opinion.
"Maybe considered"

Six RCTs for Maze in Mitral Surgery

- Deneke et al. Eur Heart J. 2002;23:558-66.
- Schuetz et al. Eur J Cardiothorac Surg. 2003;24:475-80.
- Carols et al. Circulation 2005;112[suppl I]:I-20~25.
- Doukas et al. JAMA. 2005;294:2323-29.
- Blomstrom-Lundqvist et al. Eur Heart J. 2007;28:2902-2908.
- Chevalier et al. Arch Cardiovasc Dis. 2009;102:769-75.

Patient Characteristics

		Patient	Age (yr)		LAD (mm)		EF (%)	
		number	maze+	maze-	maze+	maze-	maze+	maze-
Deneke et al	RF	15 vs 15	64.7	69.7	59.8	57.8	64	61
Shuetz et al	MW	23 vs 19	64.6	70.2	54.9	53.9	62.8	54.3
Carols et al	RF	42 vs 28	55.4	50.7	61.1	58.8	62.8	66.1
Duokas et al	RF	45 vs 44	67.2	67	58	60	NA	NA
Blomstrom et al	Cryo	30 vs 35	69.5	65.6	61	58	53.5	57
Chenvalier et al	RF	22 vs 21	69.1	66.3	54.6	52.6	59.8	61.3
mean		56.3	65.1	64.9	58.2	56.0	60.6	59.9
SD		5.2	5.2	7.2	2.9	2.9	4.2	4.5

MVS Outcomes

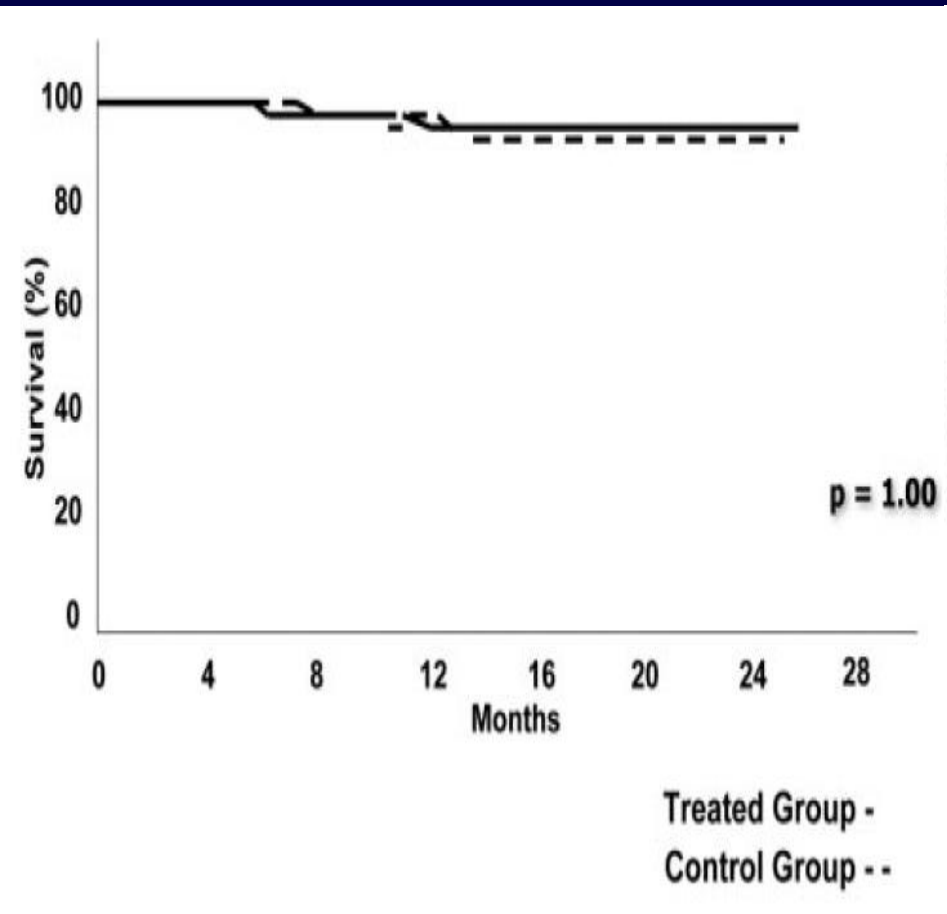
	MVR		ACC (min)		Complication (%)	
	maze+	maze-	maze+	maze-	maze+	maze-
Deneke et al	100	100	NA	NA	NA	NA
Shuetz et al	66.67	36.8	99.6	74	NA	NA
Carols et al	69.1	96.5	67.5	47.1	NA	NA
Duokas et al	23	29	70	64	32.7	37.5
Blomstrom et al	30	20	87.4	84.4	38.2	11.4
Chenvalier et al	45.5	80.9	93	74	18.2	14.3
mean	55.7	60.5	83.5	68.7	29.7	21.1
SD	28.6	36.0	14.2	14.1	10.4	14.3

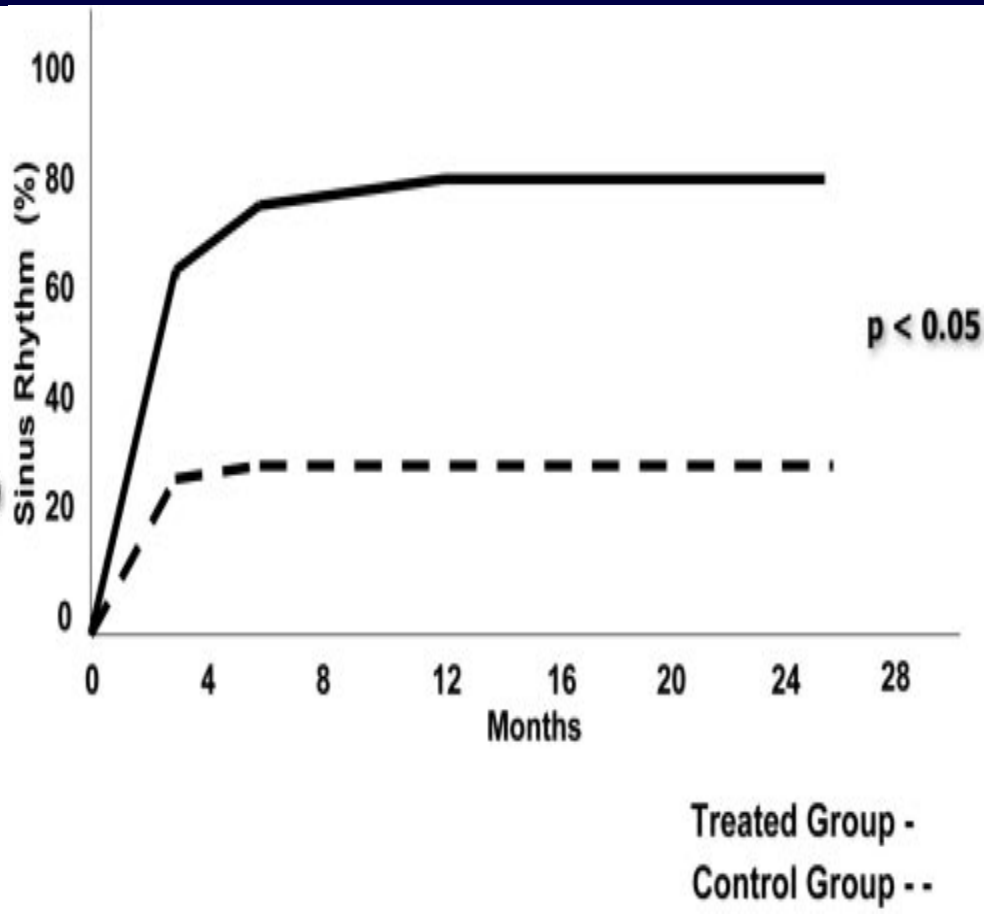
MVS Outcomes

	Pacemaker (%)		Mortality (%)		Maintain SR (%)	
	maze+	maze-	maze+	maze-	maze+	maze-
Deneke et al	6.7	6.7	NA	NA	80	26.7
Shuetz et al	12.5	0	4.2	5.3	80	33.3
Carols et al	2.3	3.5	2.3	0	79.4	26.9
Duokas et al	4.4	9.1	6.1	8.3	44.4	4.5
Blomstrom et al	23.3	17.1	2.9	0	73.3	42.9
Chenvalier et al	22.7	9.5	4.5	0	95.2	33.3
mean	12.0	7.7	4.1	2.7	75.4	27.9
SD	9.2	5.9	1.5	3.9	16.8	12.9

RCT: Irrigation Tip RF Cox maze III in Mitral Surgery

Carols et al. Circulation 2005;112[suppl I]:I-20~25.





RCT: Additional maze in mitral surgery

Deneke et al. Eur Heart J. 2002;23:558-66.

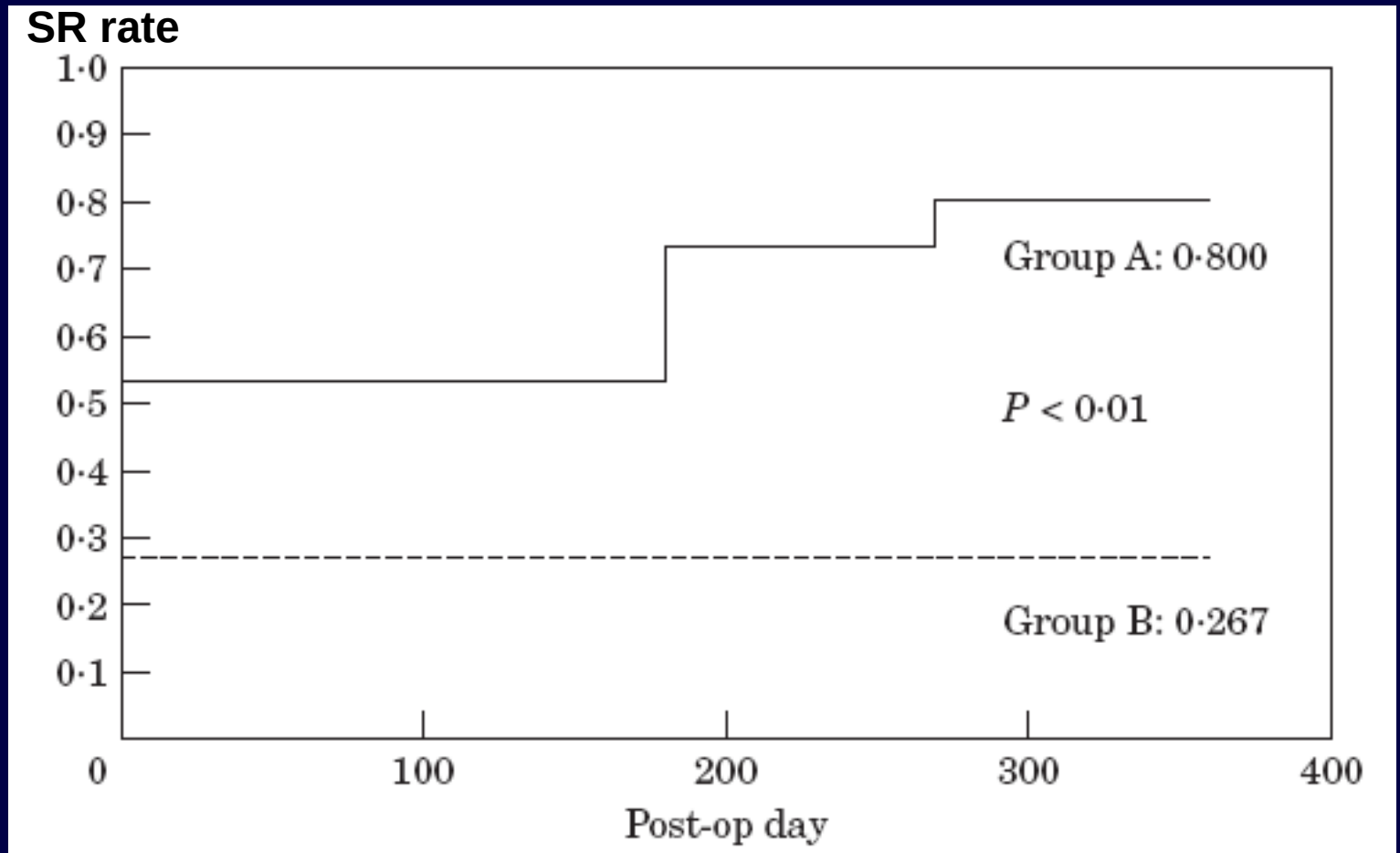
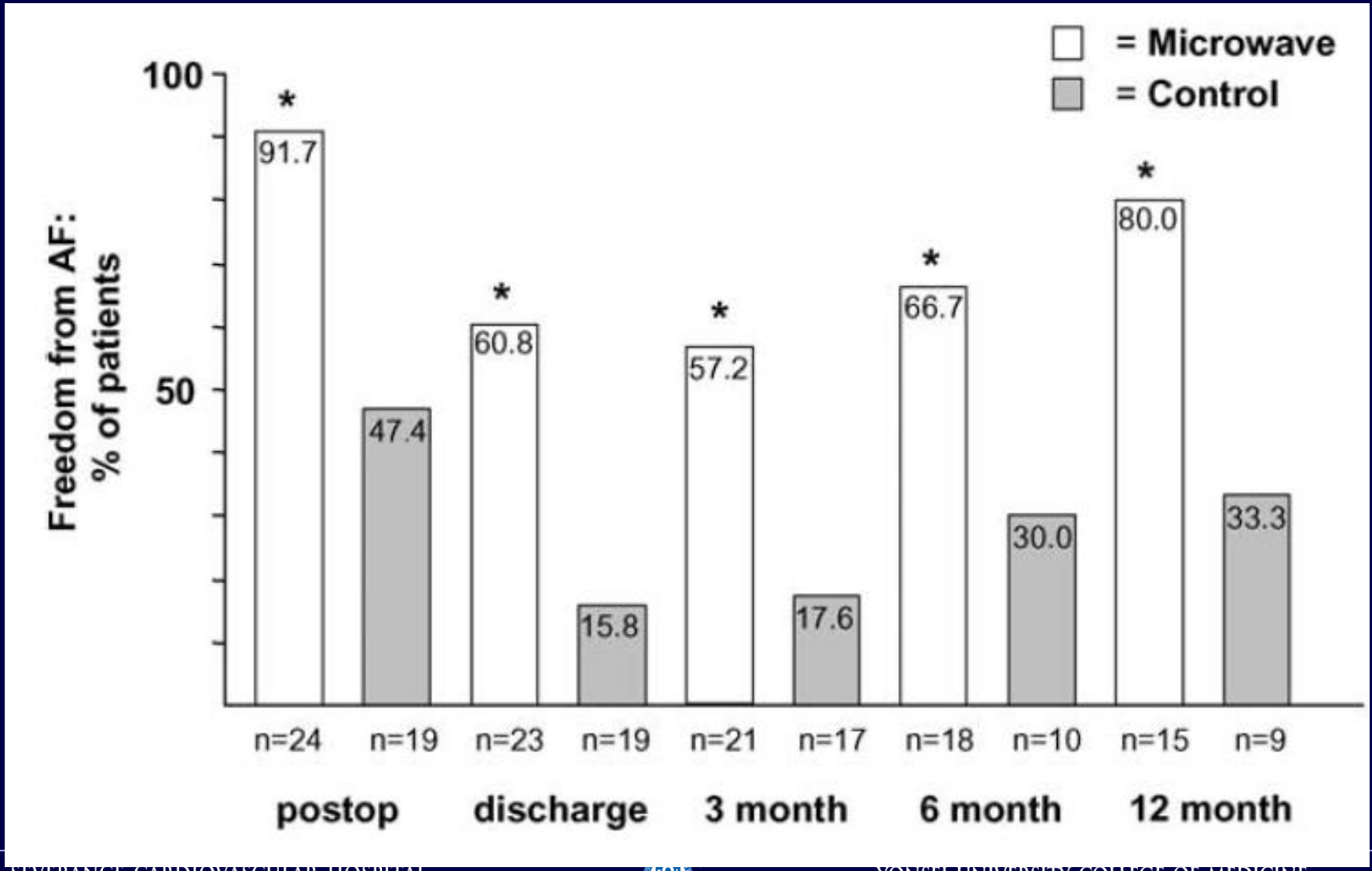


Figure 3 Cumulative frequencies of sinus rhythm after mitral valve replacement and modified radiofrequency MAZE procedure (group A) and without the MAZE procedure (group B).

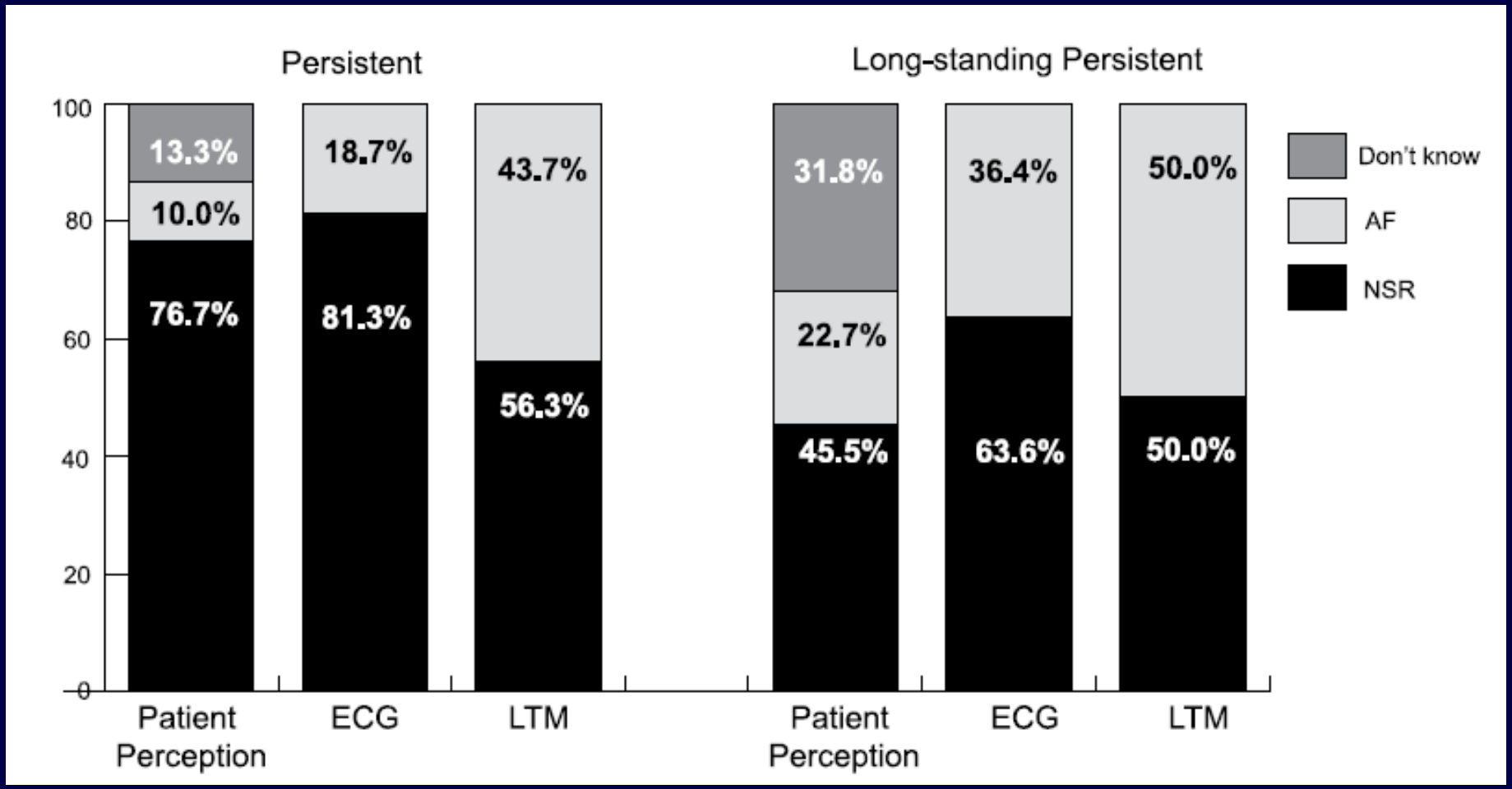
RCT: Microwave in Open Heart Surg

Schuetz et al. Eur J Cardiothorac Surg. 2003;24:475-80.



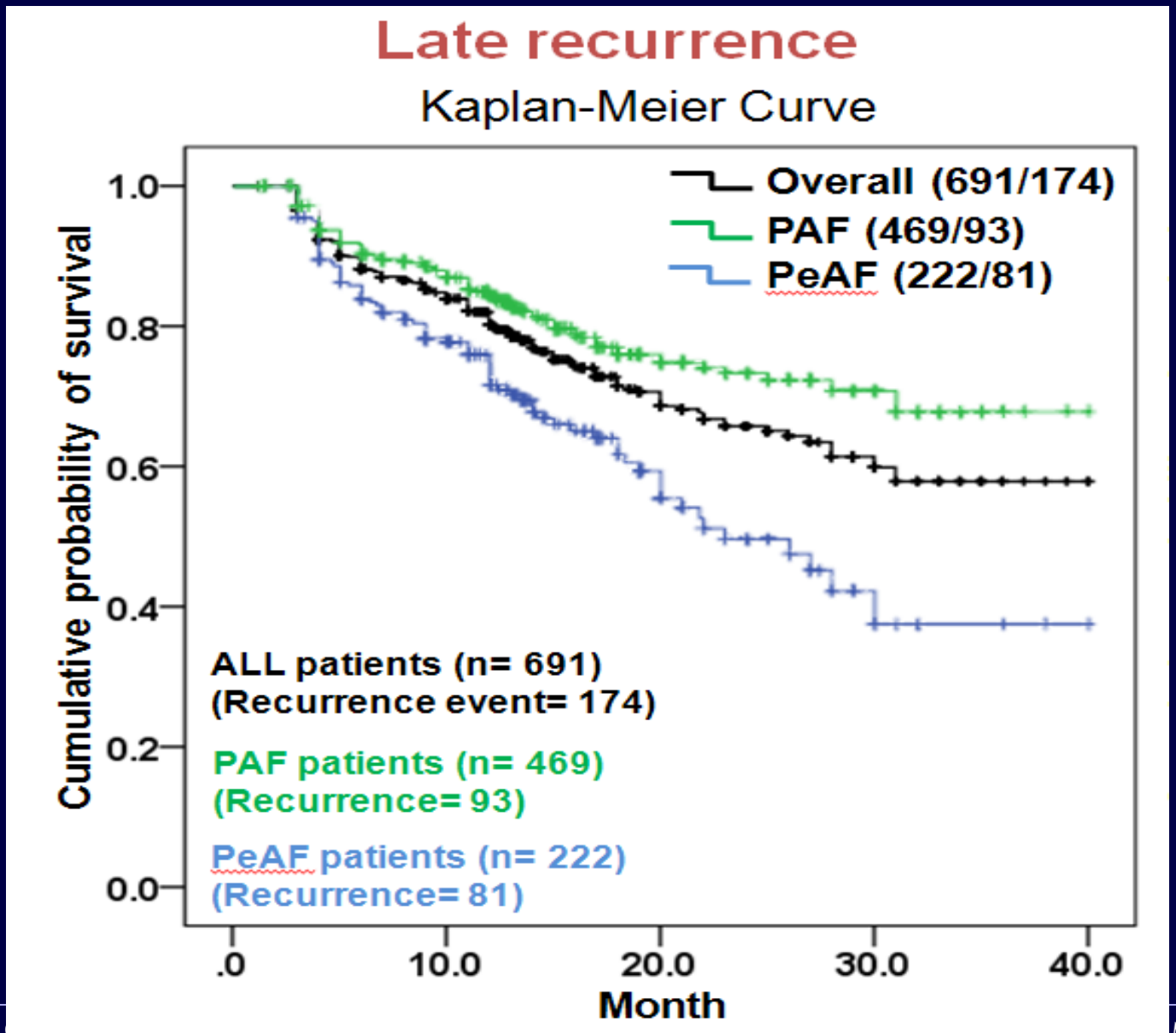
Mini-maze 6mo Outcome

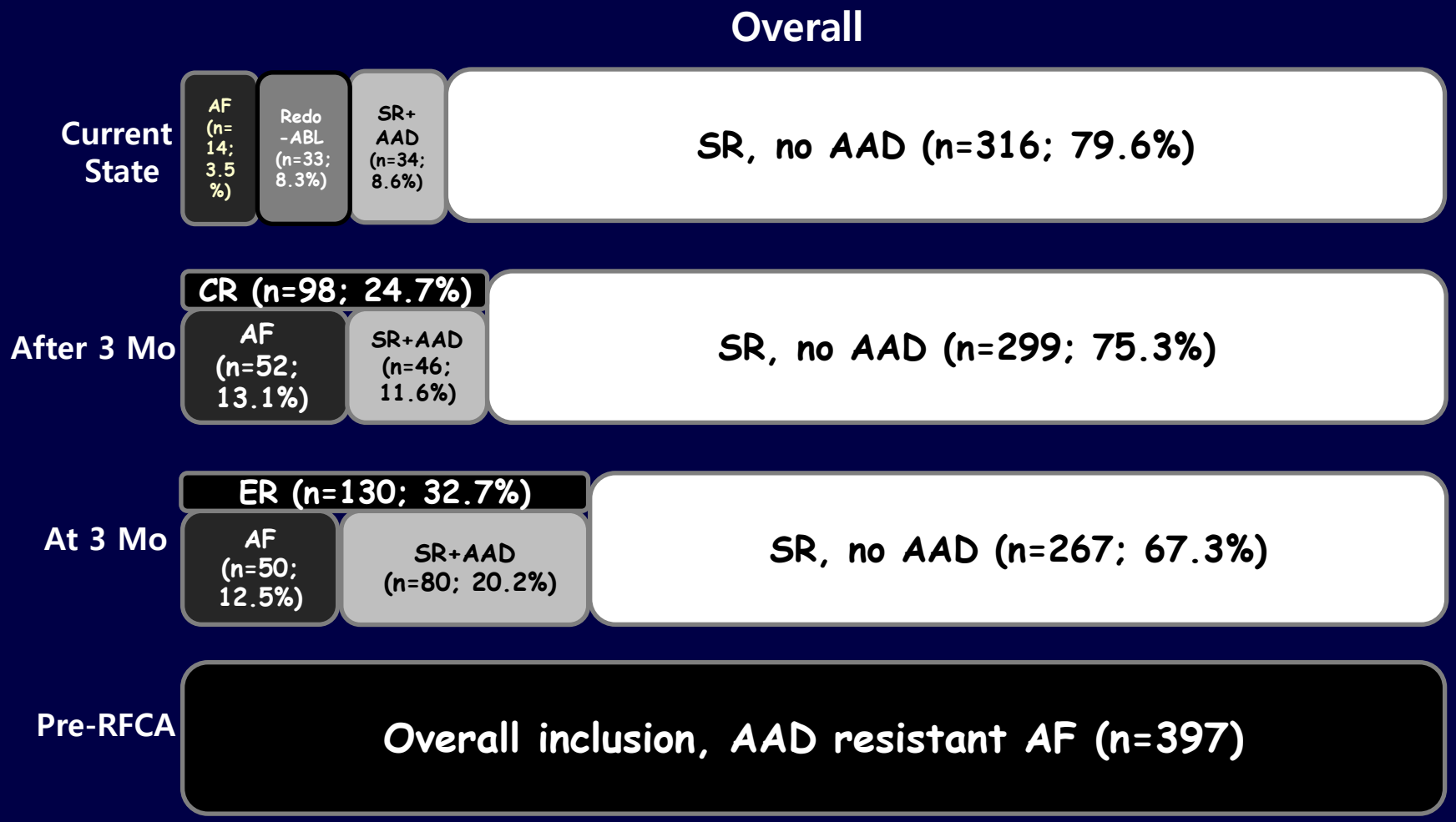
Edgerton et al. J Thorac CV Surg. 2009;138:109-114.



Outcome of Catheter Ablation

Yonsei AF Ablation Cohort





Won HY, Pak HN, et al. Int J Cardiol. 2012;[In Press]

RCT: Additional maze in mitral surgery

Deneke et al. Eur Heart J. 2002;23:558-66.

*Table 4 Functional data on group A and B at 6-month follow-up (*statistically significant)*

		Group A MAZE+ n=11	Group B MAZE − n=11	
NYHA	mean (median)	2·5 (2·5)	2·6 (3)	$P=0·531$
Max heart rate (beats . min^{-1})	mean (SD)	96 (16)	99 (17)	$P=0·666$
Mean heart rate increase (beats . min^{-1})	mean (SD)	21 (11)	31 (20)	$P=0·175$
V_{O2}max (ml . min^{-1} kg^{-1})	mean (SD)	9·3 (3·4)	8·5 (3·2)	$P=0·530$
Maximum workload	mean (SD)	73 (29)	43 (16)	$P=0·008$*
Anaerobic threshold (V_{O2})	mean (SD)	7·2 (1·8)	6·4 (2·3)	$P=0·551$
Transmitral A-wave	mean (SD)	70% (7/10)	100% (4/4)	
Transtricuspid A-wave	mean (SD)	100% (10/10)	100% (4/4)	

RCT: RF in Mitral Surgery

Doukas et al. JAMA. 2005;294:2323-29.

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 (120)	.02	407 (130)	292 (122)	.002
Change from baseline to 12 mo	78 (94)	49 (97)	.13	94 (102)	48 (82)	.003
NYHA class						
Baseline	2.5 (0.7)	2.4 (0.6)	.90	2.4 (0.7)	2.6 (0.7)	.29
6 mo	1.4 (0.6)	1.5 (0.6)	.67	1.3 (0.5)	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

AF Correction Surgery: STS Natl' Cardiac Database

N=67,389. Gammie et al. Ann Thoracic Surg. 2008;85:909-15.

Operation	Number of Patients (n)	Preoperative AF (n)	Preoperative AF (%)	Among Preoperative AF: AF Correction Surgery (n)	Among Preoperative AF: AF Correction Surgery (%)
Mitral ± CABG	44,874	12,235	27.3	6,415	52.4
Aortic ± CABG	75,821	10,590	14.0	2,965	28.0
Isolated CABG	369,854	22,388	6.1	5,438	24.3

Variable	AF Correction Surgery (n = 6,231)	No AF Correction Surgery (n = 5,244)	*p* Value
Median CPB time (min)	138 (108, 176)	129 (99, 169)	<0.0001
Median cross-clamp time (min)	102 (77, 131)	93 (70, 124)	<0.0001
Concomitant CABG (%)	34.1	38.5	<0.0001
Reoperation for bleeding	4.7	5.8	0.0008
DSWI	0.51	0.42	0.2207
Stroke	1.46	2.44	0.0020
Prolonged ventilation	14.8	20.5	<0.0001
Renal failure[a]	6.5	8.1	0.0004
Permanent pacemaker[b]	6.8	6.3	0.0878
Operative mortality	4.5	6.6	<0.0001
LOS (median, days)	7 (6, 10)	8 (6, 12)	<0.0001

AF Correction Surgery: STS Natl' Cardiac Database

N=67,389. Gammie et al. Ann Thoracic Surg. 2008;85:909-15.

Table 4. Risk-Adjusted Mortality and Morbidities for Patients Having Mitral Valve Surgery With (Versus Without) Concomitant Surgical Treatment of Atrial Fibrillation, Adjusting for Participant Clustering and Other Potential Variables[a]

Outcome	Total N	Adjusted OR	Lower (95% CI for Adjusted OR)	Upper (95% CI for Adjusted OR)	Adjusted *p* Value
Mortality					
Death	11,475	1.00	0.83	1.20	0.975
Complications					
Any reoperation	11,475	0.98	0.87	1.12	0.802
Renal failure/dialysis[b]	10,820	1.03	0.88	1.21	0.689
Prolonged ventilation	11,475	0.98	0.88	1.09	0.715
Need for permanent pacemaker[c]	10,475	1.26	1.07	1.49	0.007
Hospital stay					
Postprocedure LOS > 14 days	11,475	1.00	0.88	1.13	0.949

Questions for maze in MV Surgery

- Survival Benefit? **NO**
- Reduce Stroke? **YES**
- LA size limitation? **Mean LAD 57mm**
- High requirement of pacemaker? **YES**
- Rhythm Follow-up Strategy (ACC/AHA/ESC guidelines)? **NO**
- Cost Benefit? **NO**

- Reasons for Stroke prevention
  - Restoration of LA function?
  - Concomitant appendage resection?
  - Anticoagulation effect?

Pre-existing AF does not Worsen Survival of HF
Framingham Heart Study

Wang et al. Circulation 2003;107:2920-2925.

TABLE 2. Cox Multivariable Proportional Hazards Models Examining the Impact of the Comorbid Condition on Mortality

Models	Men, Adjusted HR (95% CI)	Women, Adjusted HR (95% CI)
Comorbid condition as a time-dependent variable		
(A) Mortality after AF		
Impact of incident CHF	2.7 (1.9 to 3.7)*	3.1 (2.2 to 4.2)*
(B) Mortality after CHF		
Impact of incident AF	1.6 (1.2 to 2.1)†	2.7 (2.0 to 3.6)*
Comorbid condition as a categorical variable		
(C) Mortality after AF		
Impact of prior CHF	2.2 (1.6 to 3.0)*	1.8 (1.3 to 2.3)*
Impact of concurrent CHF‡	2.4 (1.6 to 3.5)*	1.4 (1.0 to 1.9)
(D) Mortality after CHF		
Impact of prior AF	0.8 (0.6 to 1.0)	1.2 (0.9 to 1.6)
Impact of concurrent AF‡	1.0 (0.7 to 1.4)	1.1 (0.8 to 1.5)

*$P \leq 0.0001$, †$P < 0.01$.

Take-Home Message

- Concomitant maze operation during mitral valve surgery might be beneficial in preventing stroke, but increases OP time and cost.
- Rhythm control in significantly dilated LA accompanies high risk of AF recurrence or sinus node dysfunction without restoring atrial function.
- Rate control strategy might be reasonable strategy in patients with longstanding persistent AF and giant atria.

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부정맥 3 Debaste 2. 08:30~10:00: 4회의장 130420

Rebuttal

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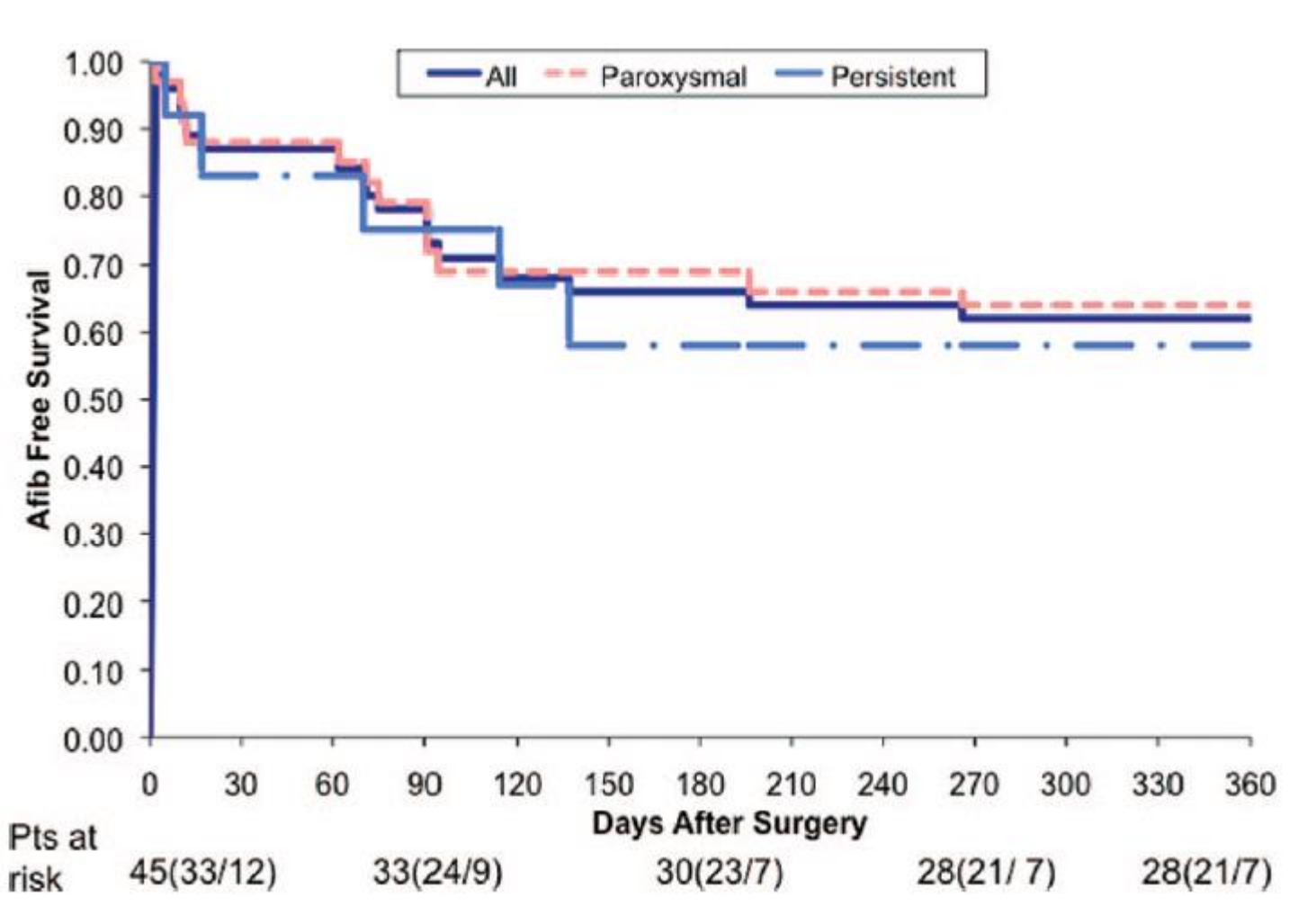
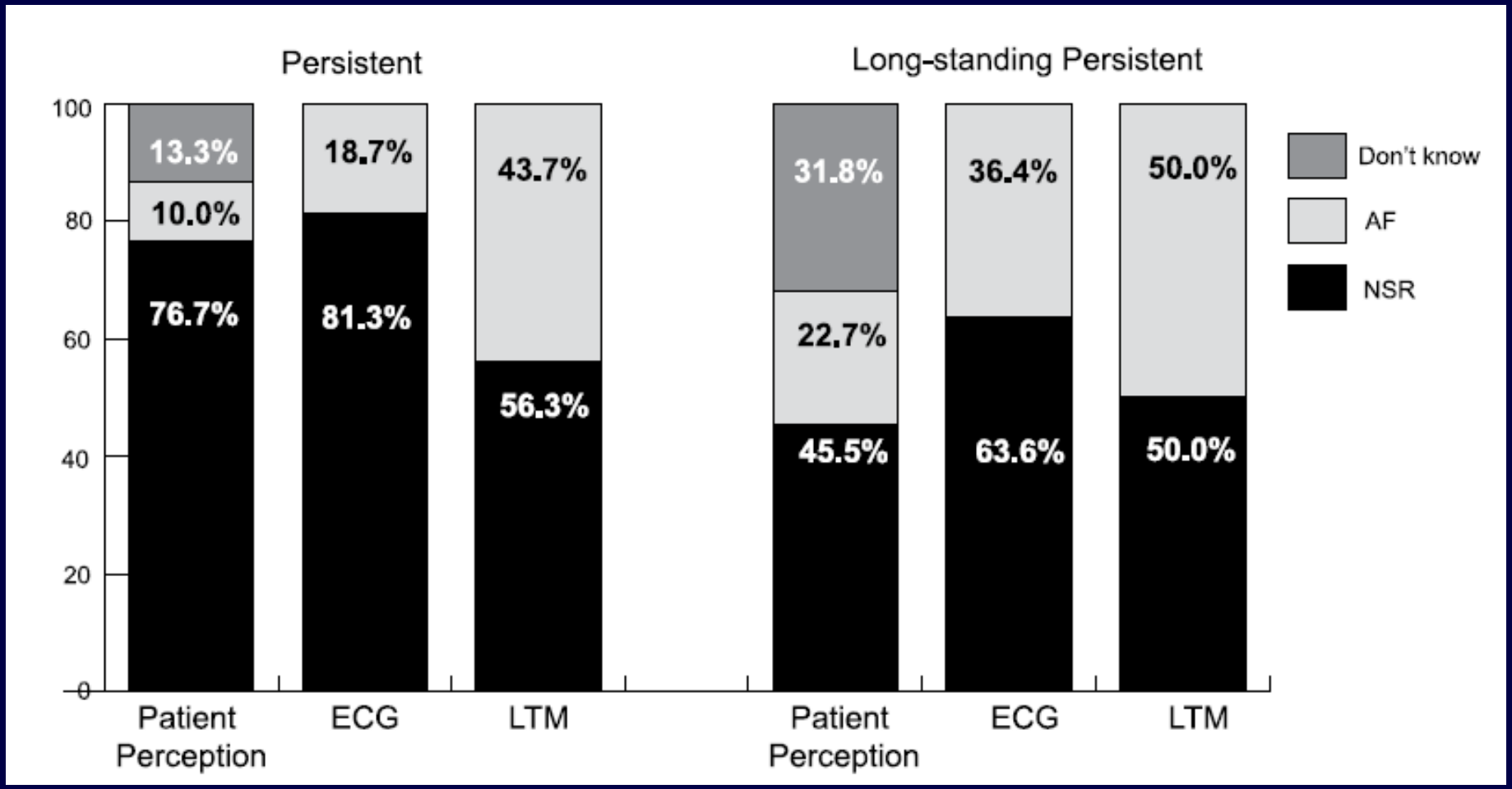
Minimally Invasive Maze Surgery

Han et al. Circ Arrhyth EP. 2009;2:370-77.



Mini-maze 6mo Outcome

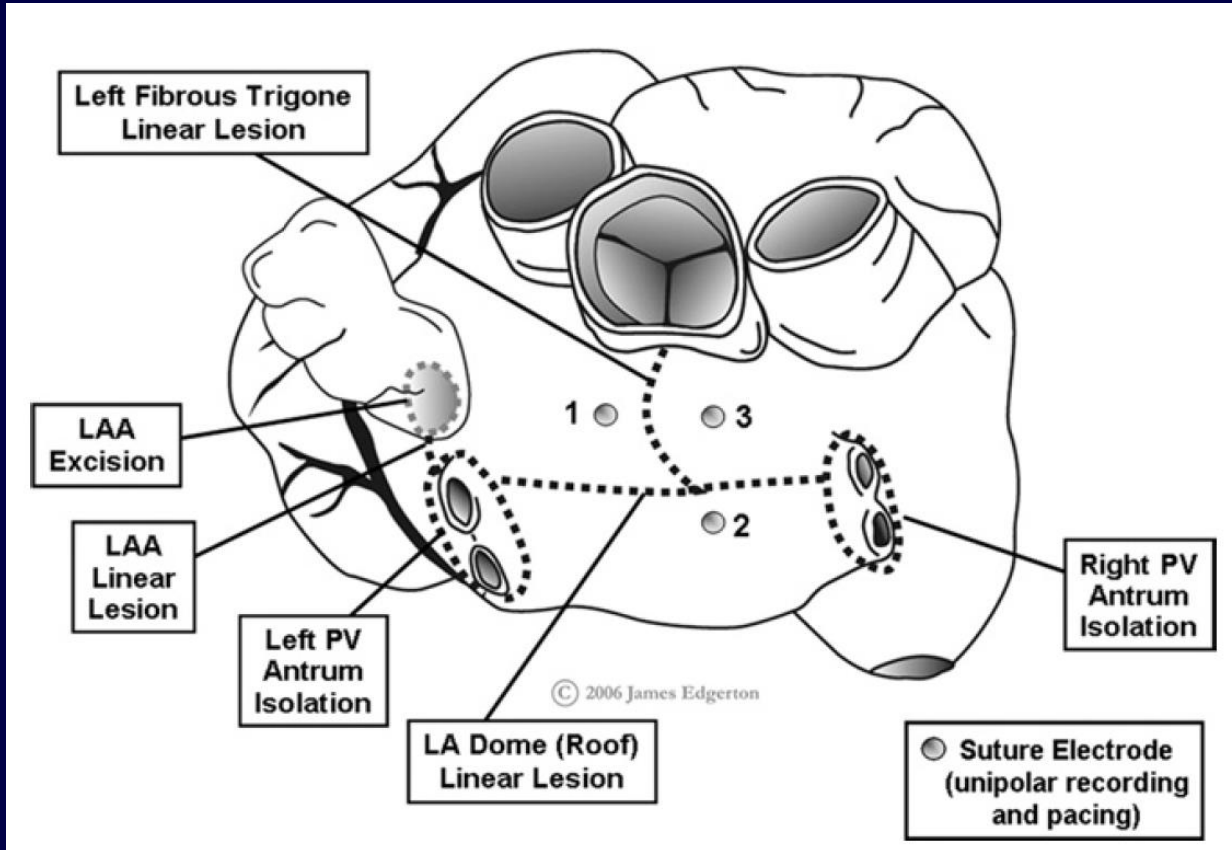
Edgerton et al. J Thorac CV Surg. 2009;138:109-114.



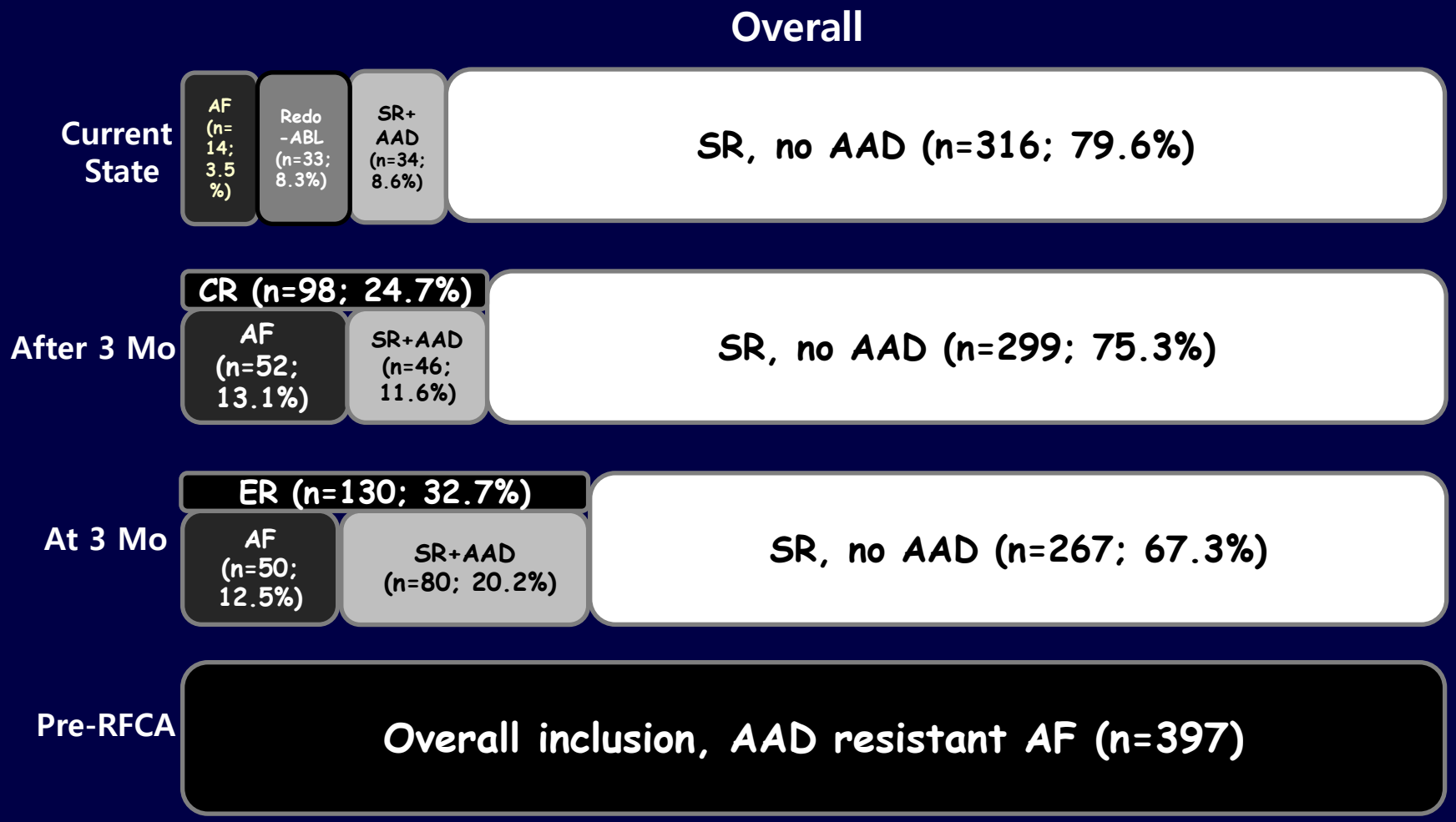
Thoracoscopic Surgical Ablation

Dallas Lesion Set

Edgerton, Jackman et al. Heart Rhythm 2009;6:S64-S70.



	Persistent atrial fibrillation (n = 10)	Long-standing persistent atrial fibrillation (n = 20)
Follow-up	Normal Sinus Rhythm	Normal Sinus Rhythm
Six months	9/10 (90%)	15/20 (75.0%)
Freedom from atrial fibrillation without antiarrhythmic drugs	7/9 (77.8%)	7/15 (46.7%)



Won HY, Pak HN, et al. Int J Cardiol. 2012;[In Press]

HRS-EHRA-ECAS Expert Consensus Documents for Surgical AF Ablation

Calkins et al. Europace 2012

INDICATIONS FOR STAND ALONE SURGICAL ABLATION of AF		
Symptomatic AF refractory or intolerant to at least one Class 1 or 3 antiarrhythmic medication		
Paroxysmal: Stand alone surgical ablation may be considered for patients who have not failed catheter ablation but prefer a surgical approach	IIb	C
Paroxysmal: Stand alone surgical ablation may be considered for patients who have failed one or more attempts at catheter ablation	IIb	C
Persistent: Stand alone surgical ablation may be considered for patients who have not failed catheter ablation but prefer a surgical approach	IIb	C
Persistent: Stand alone surgical ablation may be considered for patients who have failed one or more attempts at catheter ablation	IIb	C
Longstanding Persistent: Stand alone surgical ablation may be considered for patients who have not failed catheter ablation but prefer a surgical approach	IIb	C
Longstanding Persistent: Stand alone surgical ablation may be considered for patients who have failed one or more attempts at catheter ablation	IIb	C
Symptomatic AF prior to initiation of antiarrhythmic drug therapy with a Class 1 or 3 antiarrhythmic agent		
Paroxysmal: Stand alone surgical ablation is not recommended	III	C
Persistent: Stand alone surgical ablation is not recommended	III	C
Longstanding Persistent: Stand alone surgical ablation is not recommended	III	C