Treatment of Atrial Fibrillation: COX IV vs Lesser Surgical Ablations

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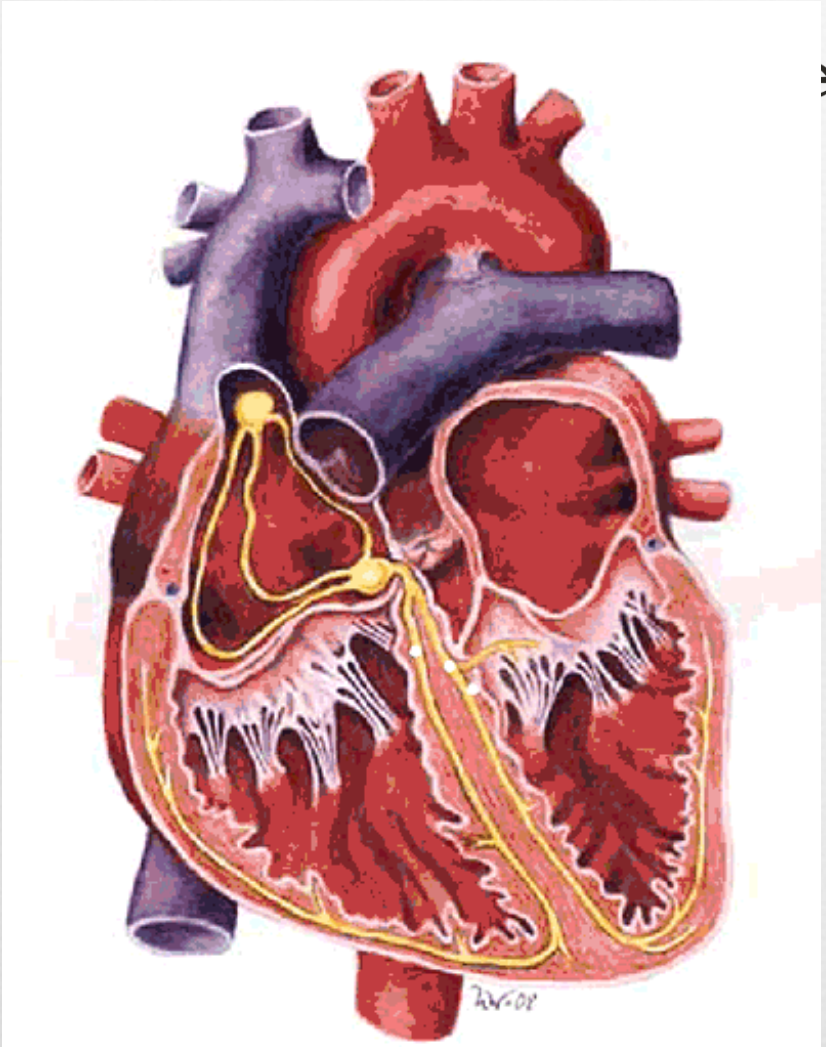
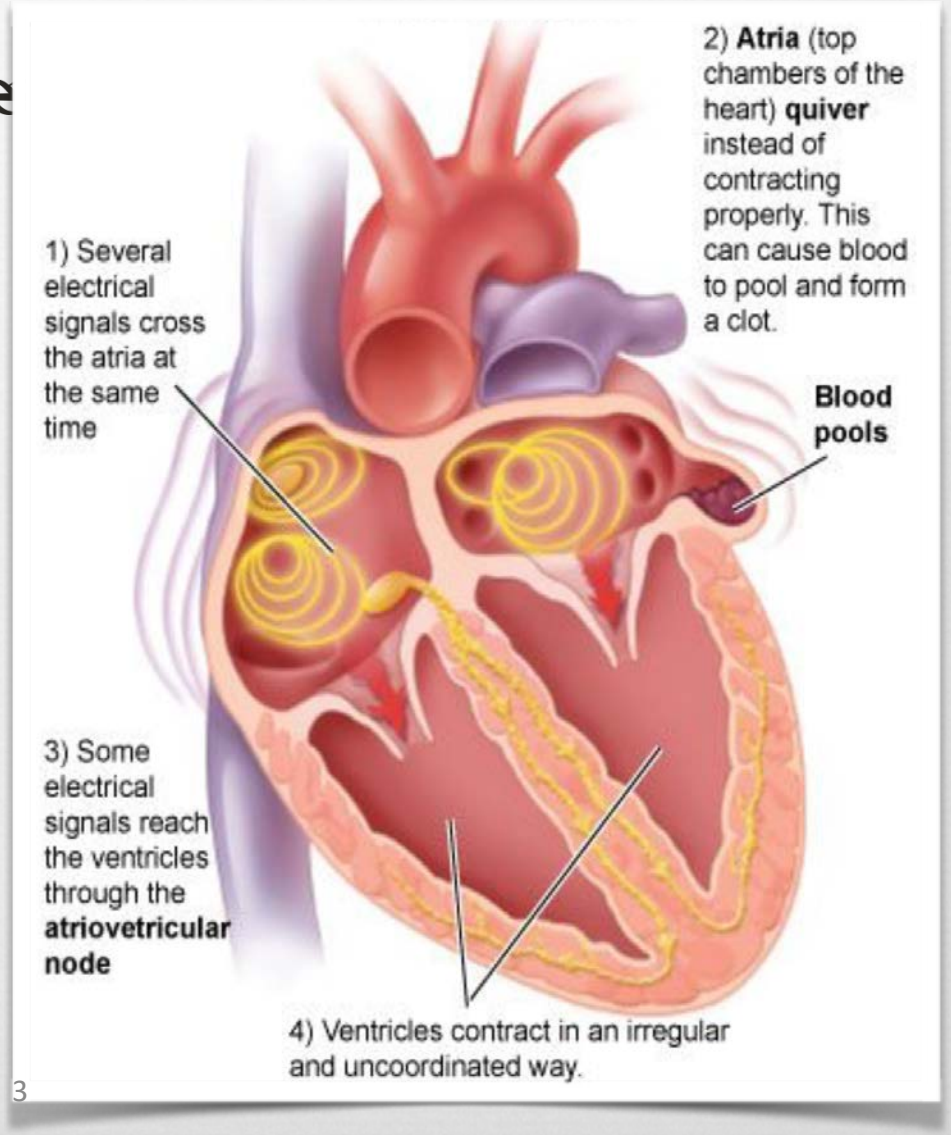
Objectives

- Understand the impact atrial fibrillation has on the medical community
- Discuss the principles of a surgical ablation compared with a transcatheter ablation.
- Describe the ablation lesions in a biatrial Cox Maze IV, a left sided limited Maze, and a pulmonary vein isolation.
- Discuss the positive and negative outcomes associated with the biatrial Cox Maze IV, and compare these outcomes to less extensive surgical ablations
- Identify which patients qualify for different types of surgical ablations based on the concomitant surgery being performed, the type of a-fib, and the individual patient risk factors

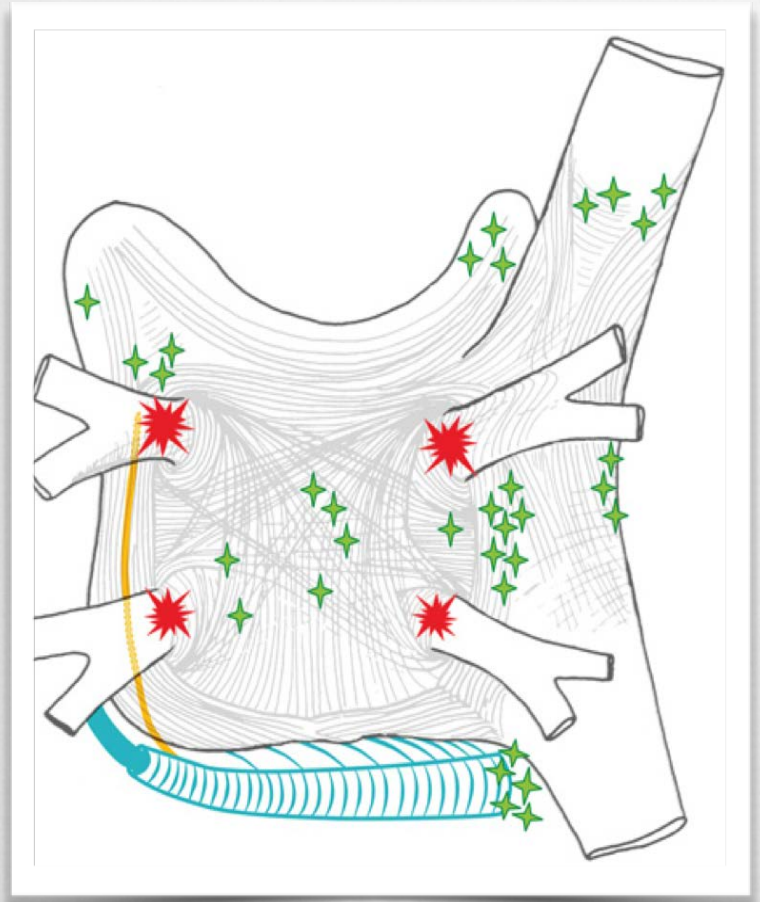
Normal Sinus Rhythm

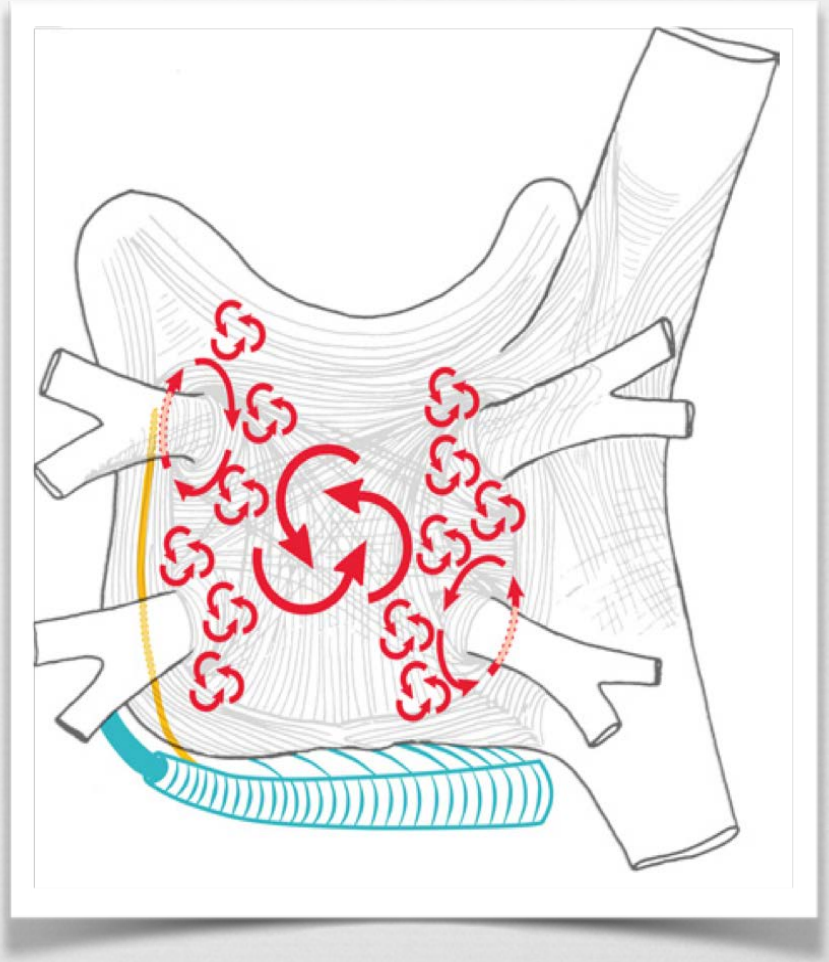


Atrial Fibrillation

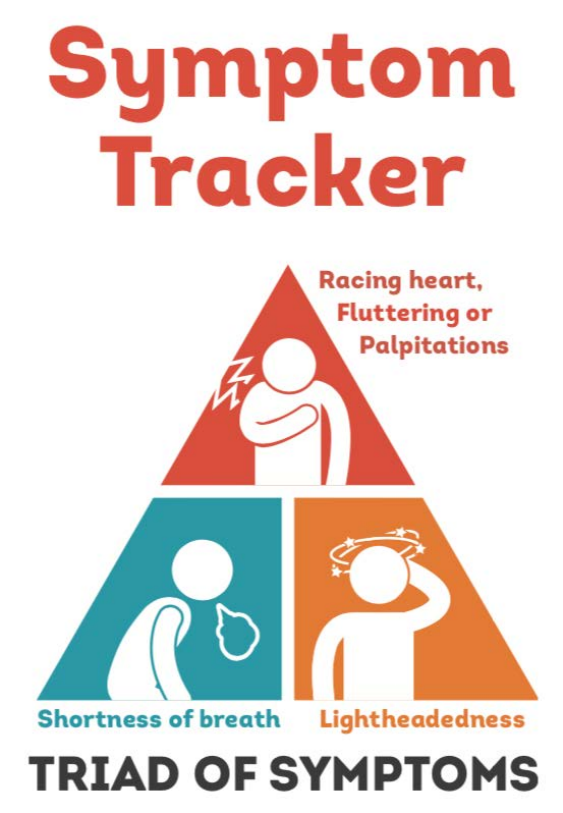


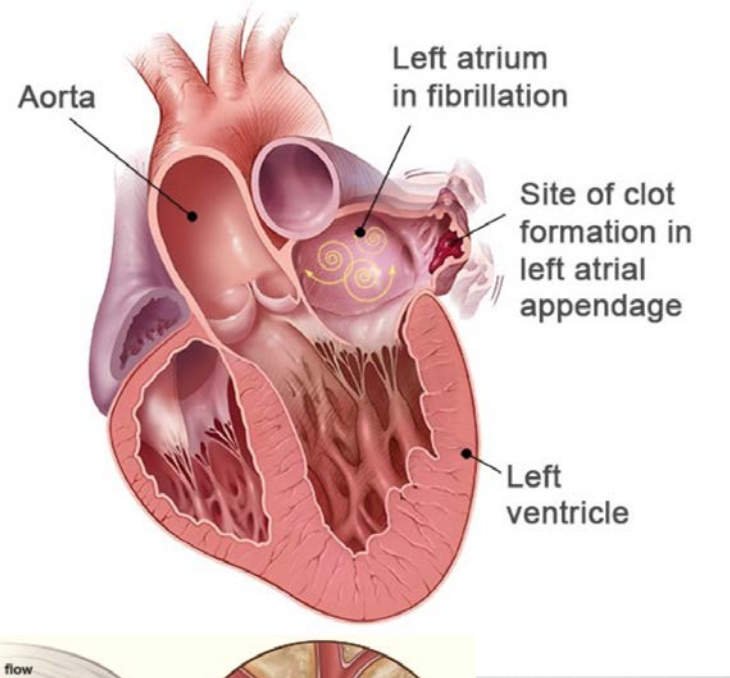
Atrial Fibrillation

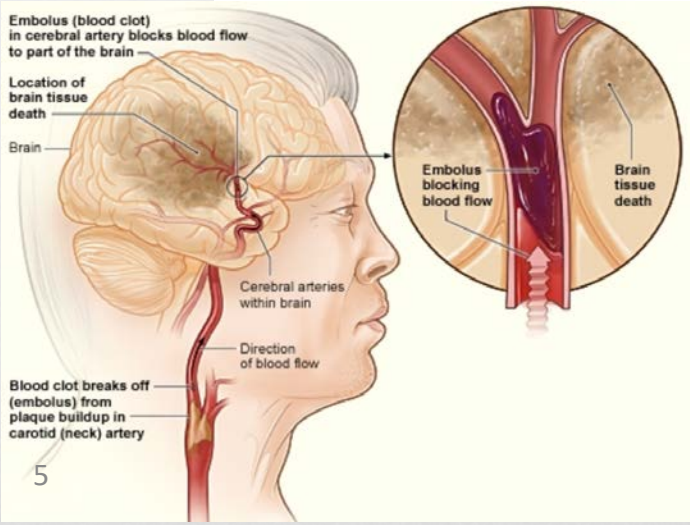




Clinical Relevance

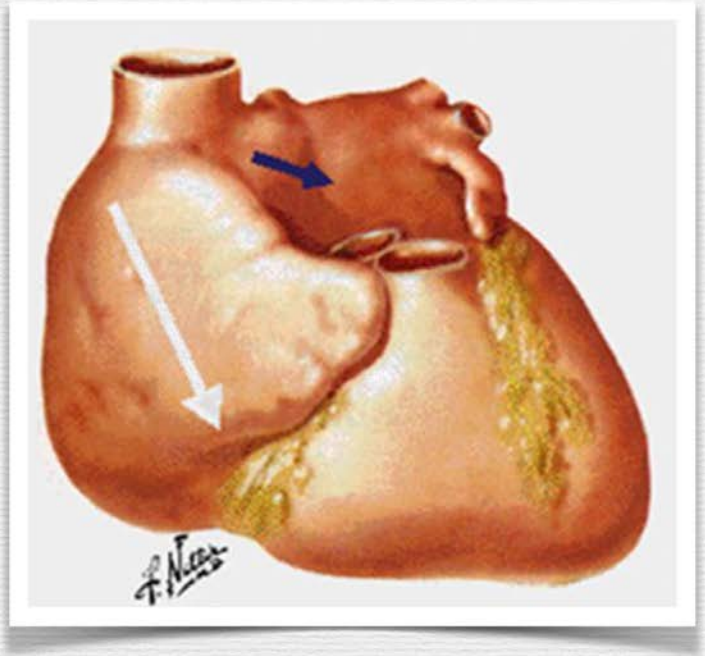




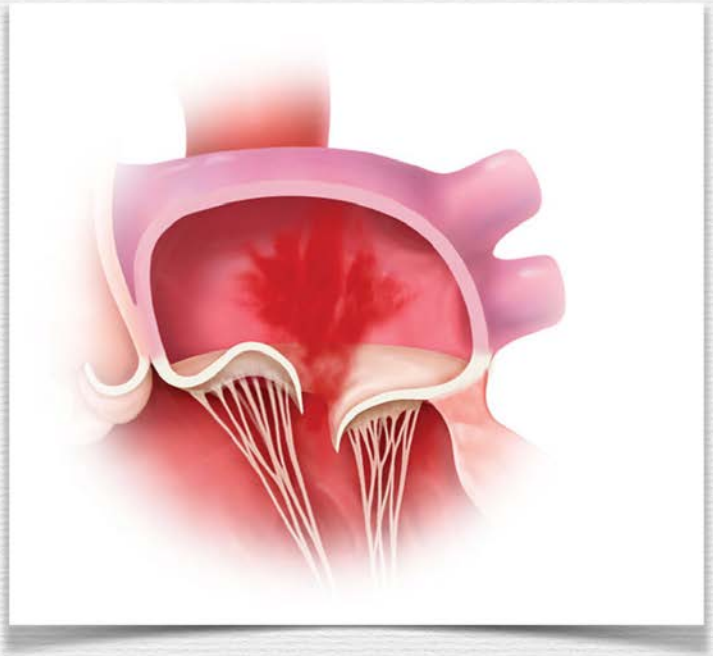


Clinical Relevance

Structural Change



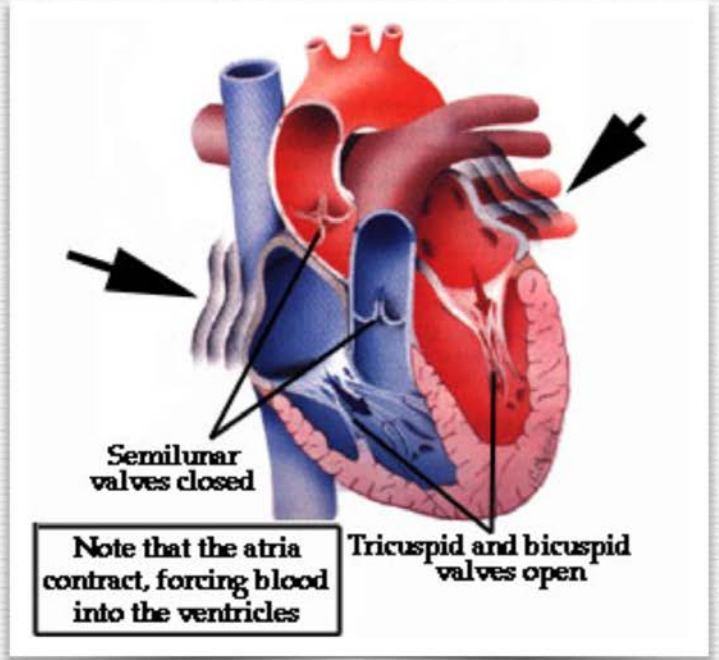
Stretching of the atrium causes irregular scar tissue and worsened a-fib



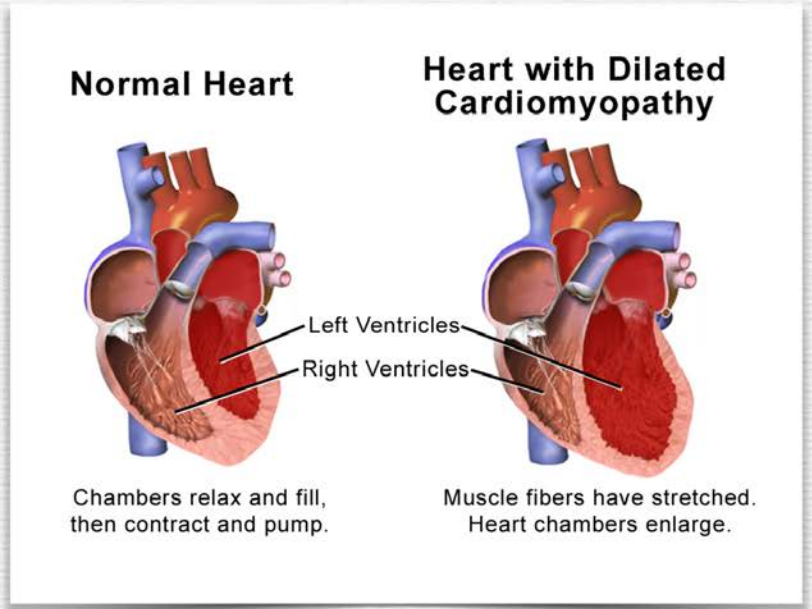
Stretching of the heart can also cause valve stretching and leakage

Clinical Relevance

Heart Failure

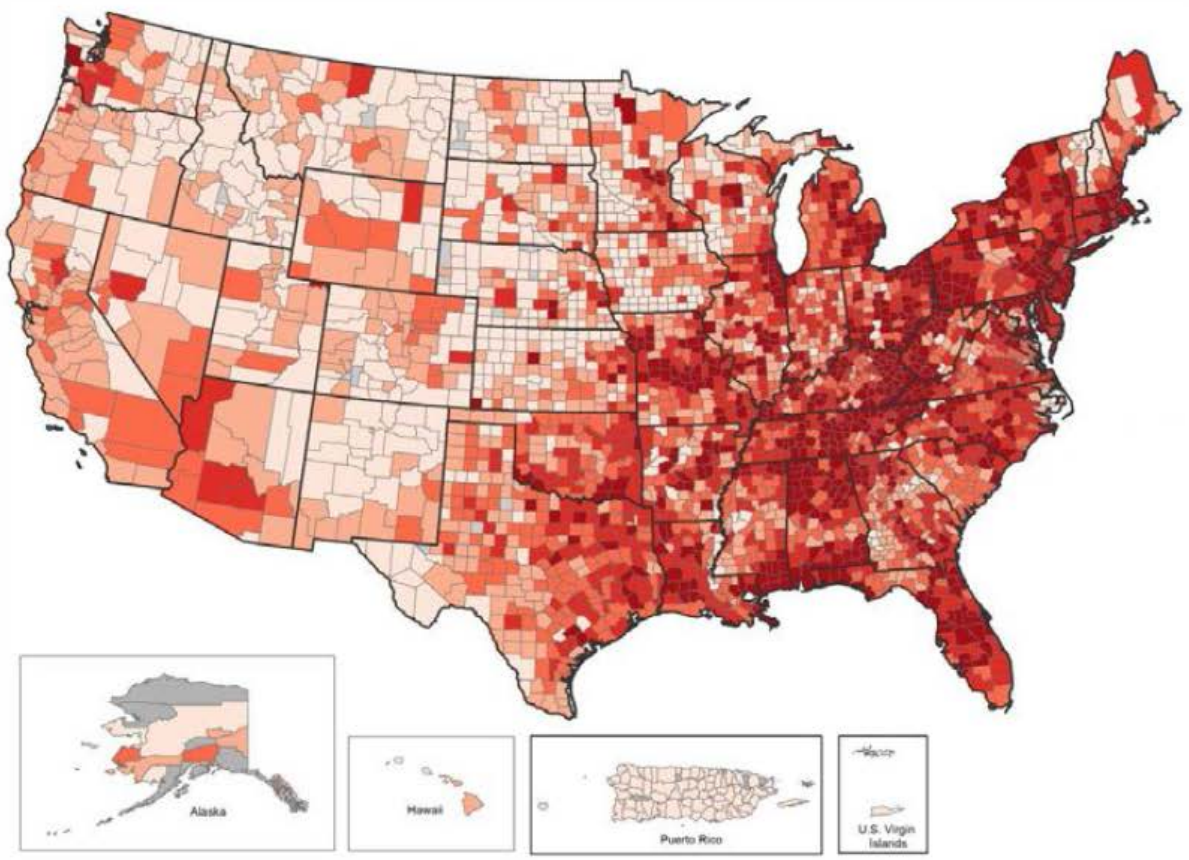


Loss of atrial kick = less blood squeezes into the ventricle to get pumped to the body



Inefficient muscle squeezing leads to weakened heart muscles over time

Impact of AF on the Medical Community



U.S. atrial fibrillation hospitalization rates, Medicare beneficiaries aged 65+ years, 2007–2012

Age-adjusted Rates per 1,000 (Counties)

2.59 - 42.95	(638)
42.96 - 57.51	(638)
57.52 - 67.46	(637)
67.47 - 77.12	(637)
77.13 - 141.27	(638)
Insufficient Data	(33)

Data Source: Centers for Medicare & Medicaid Services, Medicare Provider Analysis and Review (MEDPAR) file, Part A

Refresher on Nomenclature

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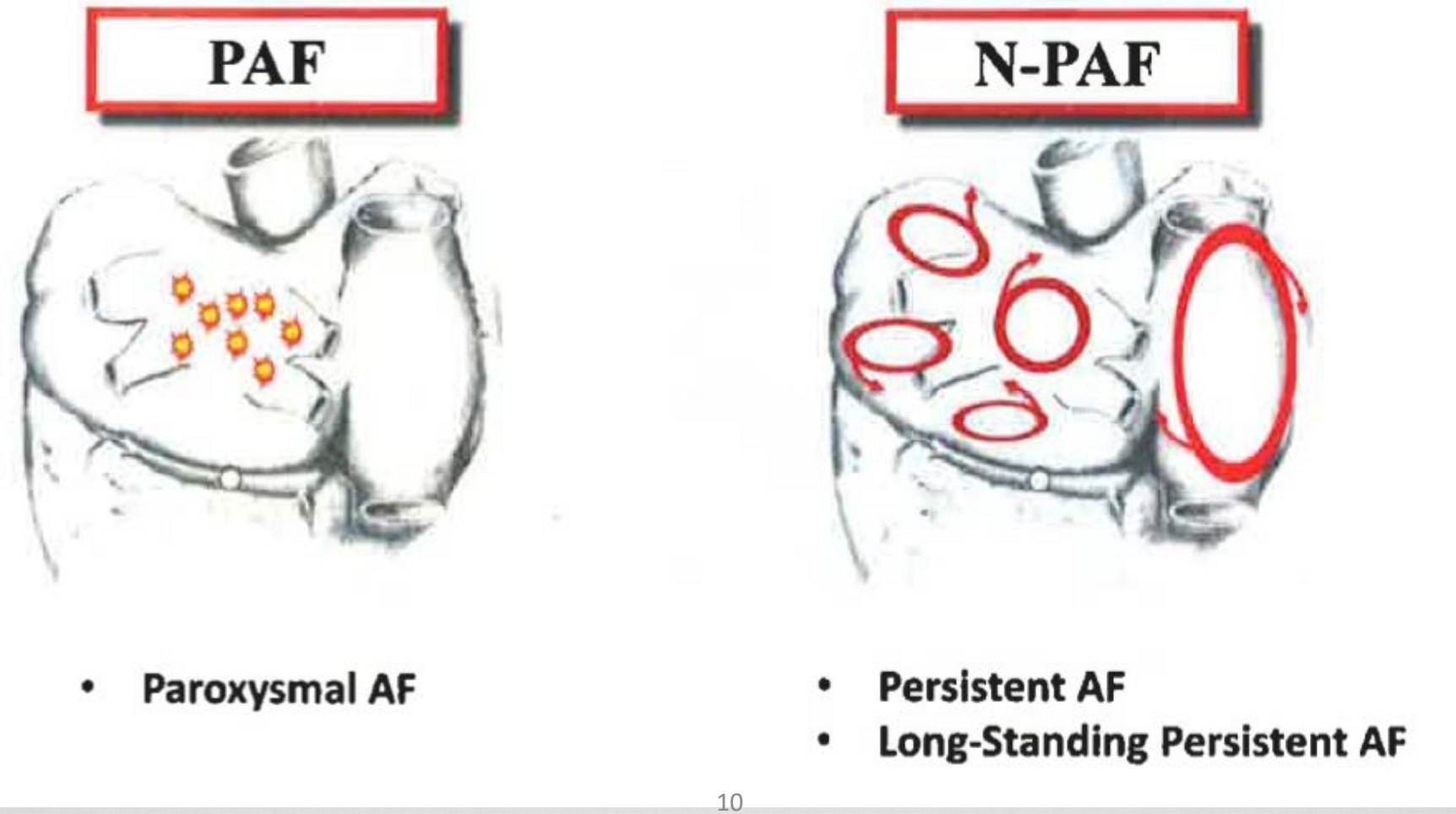
DECEMBER 2, 2014:2246–80

TABLE 3 Definitions of AF: A Simplified Scheme

Term	Definition
Paroxysmal AF	• AF that terminates spontaneously or with intervention within 7 d of onset. • Episodes may recur with variable frequency.
Persistent AF	• Continuous AF that is sustained >7 d.
Long-standing persistent AF	• Continuous AF >12 mo in duration.
Permanent AF	• The term "permanent AF" is used when the patient and clinician make a joint decision to stop further attempts to restore and/or maintain sinus rhythm. • Acceptance of AF represents a therapeutic attitude on the part of the patient and clinician rather than an inherent pathophysiological attribute of AF. • Acceptance of AF may change as symptoms, efficacy of therapeutic interventions, and patient and clinician preferences evolve.
Nonvalvular AF	• AF in the absence of rheumatic mitral stenosis, a mechanical or bioprosthetic heart valve, or mitral valve repair.

AF indicates atrial fibrillation.

Two Categories of Atrial Fibrillation

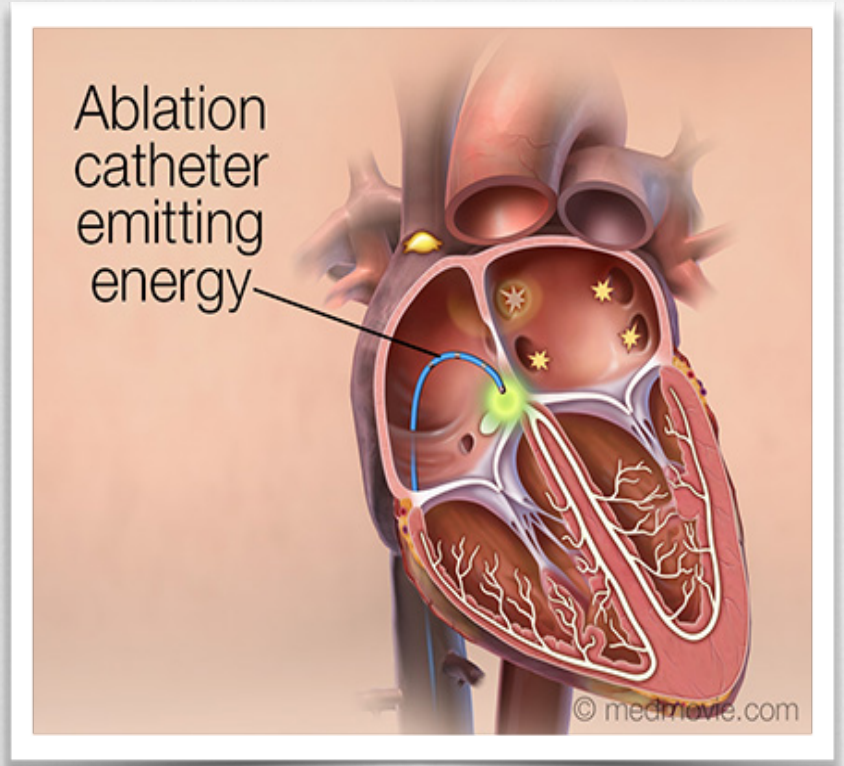


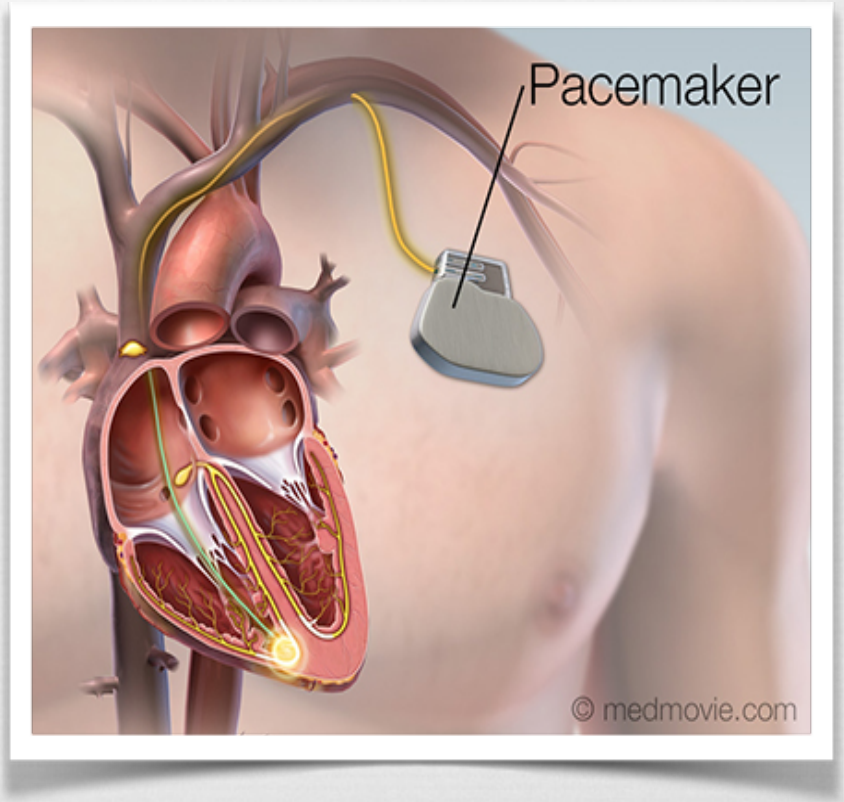
Rate Control

TABLE 8 Summary of Recommendations for Rate Control

Recommendations	COR	LOE	References
Control ventricular rate using a beta blocker or nondihydropyridine calcium channel antagonist for paroxysmal, persistent, or permanent AF	I	B	(93-95)
IV beta blocker or nondihydropyridine calcium channel blocker is recommended to slow ventricular heart rate in the acute setting in patients without pre-excitation. In hemodynamically unstable patients, electrical cardioversion is indicated	I	B	(96-99)
For AF, assess heart rate control during exertion, adjusting pharmacological treatment as necessary	I	C	N/A
A heart rate control (resting heart rate <80 bpm) strategy is reasonable for symptomatic management of AF	IIa	B	(95,100)
IV amiodarone can be useful for rate control in critically ill patients without pre-excitation	IIa	B	(101-103)
AV nodal ablation with permanent ventricular pacing is reasonable when pharmacological therapy is inadequate and rhythm control is not achievable	IIa	B	(104-106)
A lenient rate-control strategy (resting heart rate <110 bpm) may be reasonable when patients remain asymptomatic and LV systolic function is preserved	IIb	B	(100)
Oral amiodarone may be useful for ventricular rate control when other measures are unsuccessful or contraindicated	IIb	C	N/A
AV nodal ablation should not be performed without prior attempts to achieve rate control with medications	III: Harm	C	N/A
Nondihydropyridine calcium channel antagonists should not be used in decompensated HF	III: Harm	C	N/A
With pre-excitation and AF, digoxin, nondihydropyridine calcium channel antagonists, or amiodarone should not be administered	III: Harm	B	(107)
Dronedarone should not be used to control ventricular rate with permanent AF	III: Harm	B	(108,109)

Rate Control – AV Nodal Ablation





Rhythm Control

Pharmacological cardioversion		
Flecainide, dofetilide, propafenone, and IV ibutilide are useful for cardioversion of AF or atrial flutter, provided contraindications to the selected drug are absent	I	A
Amiodarone is reasonable for pharmacological cardioversion of AF	IIa	A
Propafenone or flecainide ("pill-in-the-pocket") to terminate AF out of hospital is reasonable once observed to be safe in a monitored setting	IIa	B
Dofetilide should not be initiated out of hospital	III: Harm	B

AF indicates atrial fibrillation; COR, Class of Recommendation; IV, intravenous; LA, left atrial; LMWH, low-molecular-weight heparin; LOE, Level of Evidence; N/A, not ap
rapid ventricular response; and TEE, transesophageal echocardiography.

Electrocardioversion

Direct-current cardioversion		
Cardioversion is recommended for AF or atrial flutter to restore sinus rhythm. If unsuccessful, cardioversion attempts may be repeated.	I	B
Cardioversion is recommended for AF or atrial flutter with RVR, that does not respond to pharmacological therapies	I	C
Cardioversion is recommended for AF or atrial flutter and pre-excitation with hemodynamic instability	I	C
It is reasonable to repeat cardioversion in persistent AF when sinus rhythm can be maintained for a clinically meaningful time period between procedures	IIa	C

Anticoagulation

TABLE 5 Summary of Recommendations for Risk-Based Antithrombotic Therapy

Recommendations	COR	LOE
Antithrombotic therapy based on shared decision making, discussion of risks of stroke and bleeding, and patient's preferences	I	C
Selection of antithrombotic therapy based on risk of thromboembolism	I	B
CHA_2DS_2-VASc score recommended to assess stroke risk	I	B
Warfarin recommended for mechanical heart valves and target INR intensity based on type and location of prosthesis	I	B
With prior stroke, TIA, or CHA_2DS_2-VASc score ≥2, oral anticoagulants recommended. Options include:		
Warfarin	I	A
Dabigatran, rivaroxaban, or apixaban	I	B
With warfarin, determine INR at least weekly during initiation of therapy and monthly when stable	I	A
Direct thrombin or factor Xa inhibitor recommended if unable to maintain therapeutic INR	I	C
Reevaluate the need for anticoagulation at periodic intervals	I	C
Bridging therapy with UFH or LMWH recommended with a mechanical heart valve if warfarin is interrupted. Bridging therapy should balance risks of stroke and bleeding	I	C
For patients without mechanical heart valves, bridging therapy decisions should balance stroke and bleeding risks against duration of time patient will not be anticoagulated	I	C
Evaluate renal function before initiation of direct thrombin or factor Xa inhibitors, and reevaluate when clinically indicated and at least annually	I	B
For atrial flutter, antithrombotic therapy is recommended as for AF	I	C
With nonvalvular AF and CHA_2DS_2-VASc score of 0, it is reasonable to omit antithrombotic therapy	IIa	B
With CHA_2DS_2-VASc score ≥2 and end-stage CKD (CrCl <15 mL/min) or on hemodialysis, it is reasonable to prescribe warfarin for oral anticoagulation	IIa	B
With nonvalvular AF and a CHA_2DS_2-VASc score of 1, no antithrombotic therapy or treatment with oral anticoagulant or aspirin may be considered	IIb	C
With moderate-to-severe CKD and CHA_2DS_2-VASc scores ≥2, reduced doses of direct thrombin or factor Xa inhibitors may be considered	IIb	C
For PCI,* BMS may be considered to minimize duration of DAPT	IIb	C
After coronary revascularization in patients with CHA_2DS_2-VASc score ≥2, it may be reasonable to use clopidogrel concurrently with oral anticoagulants but without aspirin	IIb	B
Direct thrombin dabigatran and factor Xa inhibitor rivaroxaban are not recommended in patients with AF and end-stage CKD or on dialysis because of a lack of evidence from clinical trials regarding the balance of risks and benefits	III: No Benefit	C
Direct thrombin inhibitor dabigatran should not be used with a mechanical heart valve	III: Harm	B

Risk of Anticoagulation

TABLE 6 Comparison of the $CHADS_2$ and CHA_2DS_2-VASc Risk Stratification Scores for Subjects With Nonvalvular AF

Definition and Scores for $CHADS_2$ and CHA_2DS_2-VASc		Stroke Risk Stratification With the $CHADS_2$ and CHA_2DS_2-VASc Scores	
	Score		Adjusted Stroke Rate (% per y)
$CHADS_2$		$CHADS_2$*	
Congestive HF	1	0	1.9
Hypertension	1	1	2.8
Age ≥75 y	1	2	4.0
Diabetes mellitus	1	3	5.9
Stroke/TIA/TE	2	4	8.5
Maximum score	6	5	12.5
		6	18.2
CHA_2DS_2-VASc		CHA_2DS_2-VASc†	
Congestive HF	1	0	0
Hypertension	1	1	1.3
Age ≥75 y	2	2	2.2
Diabetes mellitus	1	3	3.2
Stroke/TIA/TE	2	4	4.0
Vascular disease (prior MI, PAD, or aortic plaque)	1	5	6.7
Age 65–74 y	1	6	9.8
Sex category (i.e., female sex)	1	7	9.6
Maximum score	9	8	6.7
		9	15.20

HAS-BLED score

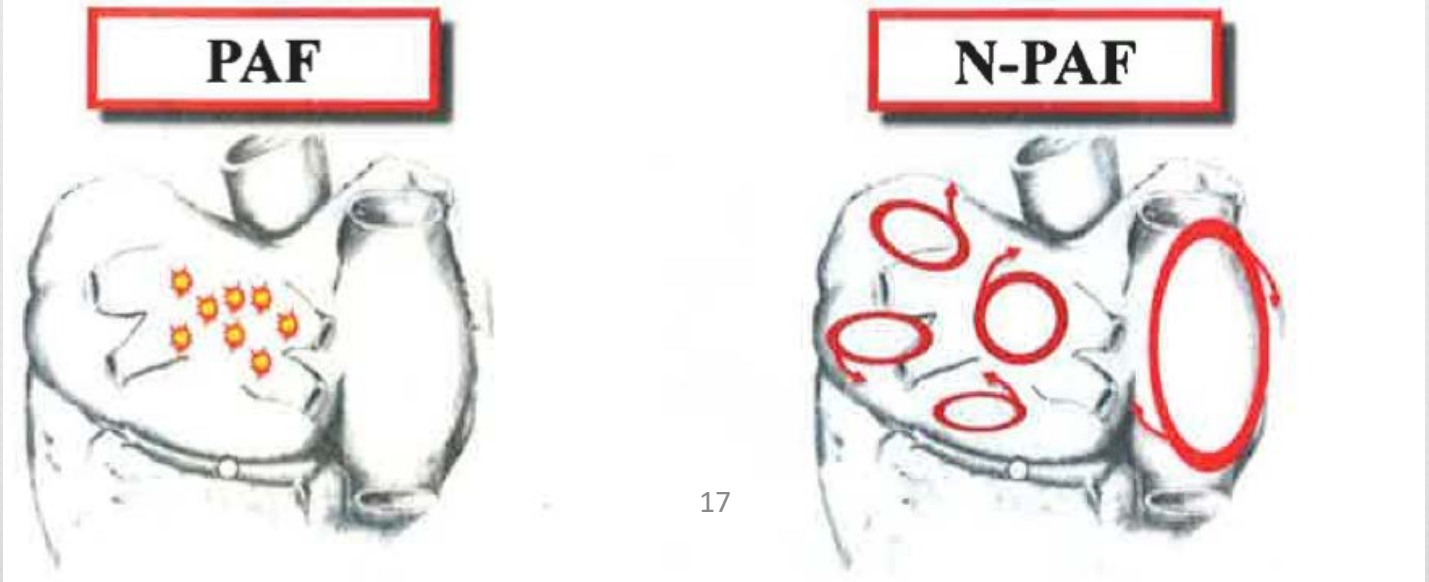
Condition	Points
H - Hypertension	1
A - Abnormal renal or liver function (1 point each)	1 or 2
S - Stroke	1
B - Bleeding	1
L - Labile INRs	1
E - Elderly (> 65 years)	1
D - Drugs or alcohol (1 point each)	1 or 2

HAS-BLED score	Bleeds per 100 patient-years
0	1.13
1	1.02
2	1.88
3	3.74
4	8.70
5	12.5

Catheter Ablation

Table 2 Consensus indications for catheter and surgical ablation of AF

Indications for catheter ablation of AF	Class	Level
Symptomatic AF refractory or intolerant to at least one Class 1 or 3 antiarrhythmic medication		
Paroxysmal: Catheter ablation is recommended*	I	A
Persistent: Catheter ablation is reasonable	IIa	B
Longstanding Persistent: Catheter ablation may be considered	IIb	B
Symptomatic AF prior to initiation of antiarrhythmic drug therapy with a Class 1 or 3 antiarrhythmic agent		
Paroxysmal: Catheter ablation is reasonable	IIa	B
Persistent: Catheter ablation may be considered	IIb	C
Longstanding Persistent: Catheter ablation may be considered	IIb	C



Surgical Ablation

The Society of Thoracic Surgeons 2017 Clinical Practice Guidelines for the Surgical Treatment of Atrial Fibrillation[1]

Vinay Badhwar, MD, J. Scott Rankin, MD, Ralph J. Damiano, Jr., MD, A. Marc Gillinov, MD, Faisal G. Bakaeen, MD, James R. Edgerton, MD, Jonathan M. Philpott, MD, Patrick M. McCarthy, MD, Steven F. Bolling, MD, Harold G. Roberts, MD, Vinod H. Thourani, MD, Richard J. Shemin, MD, Scott Firestone, MS, Niv Ad, MD.

CLASS OF RECOMMENDATION – I

MVR AVR CABG AVR + CABG Heart Team

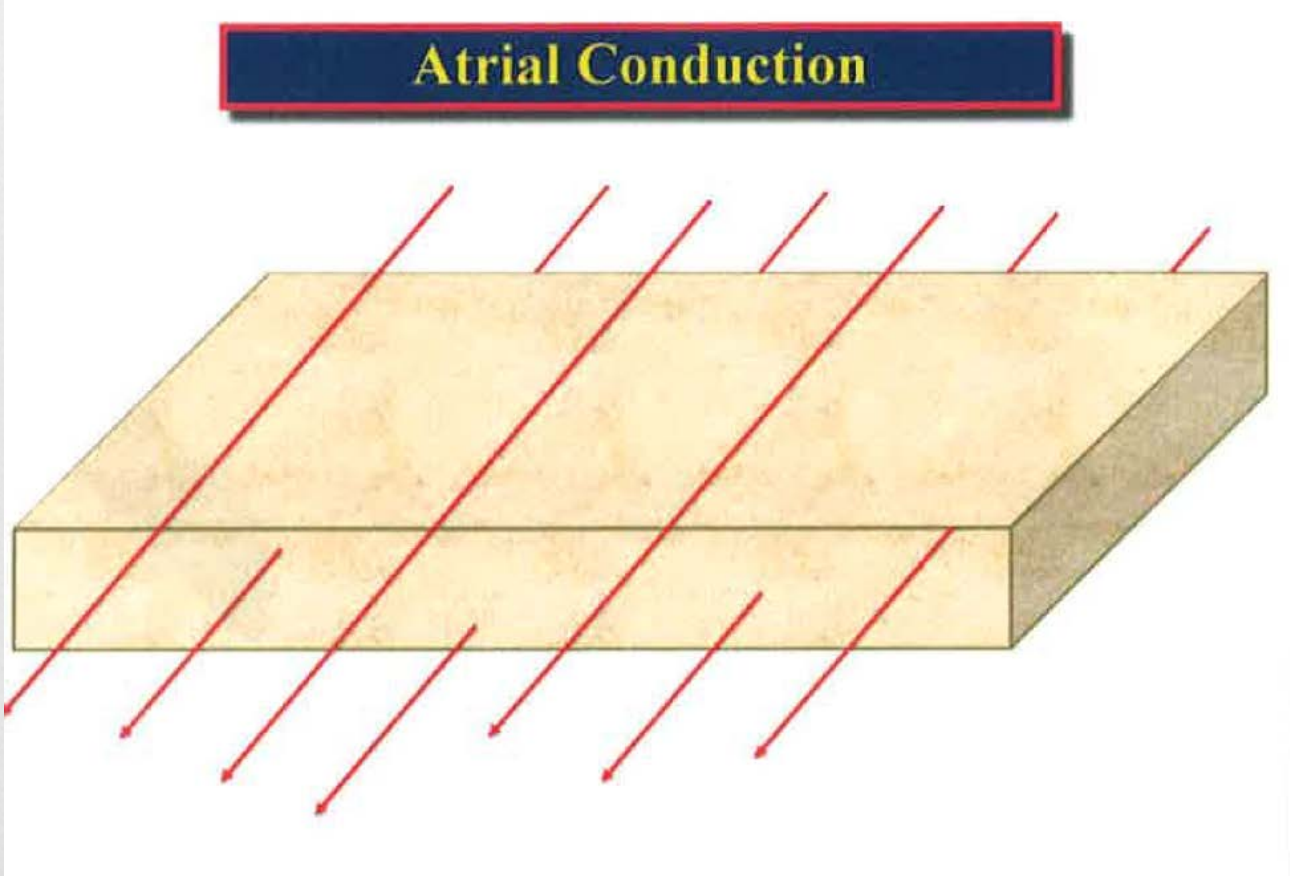
- Surgical ablation for AF can be performed without additional risk of operative mortality or major morbidity, and is **RECOMMENDED** at the time of **concomitant mitral operations** to restore sinus rhythm. (Class I, Level A)
- Surgical ablation for AF can be performed without additional operative risk of mortality or major morbidity, and is **RECOMMENDED** at the time of concomitant **isolated aortic valve replacement, isolated coronary artery bypass graft surgery, and aortic valve replacement plus coronary artery bypass graft operations** to restore sinus rhythm. (Class I, Level B nonrandomized)
- In the treatment of AF, **multidisciplinary heart team** assessment, treatment planning, and long-term follow-up can be **USEFUL AND BENEFICIAL** to optimize patient outcomes. (Class I, Level C expert opinion)

CLASS OF RECOMMENDATION – IIA

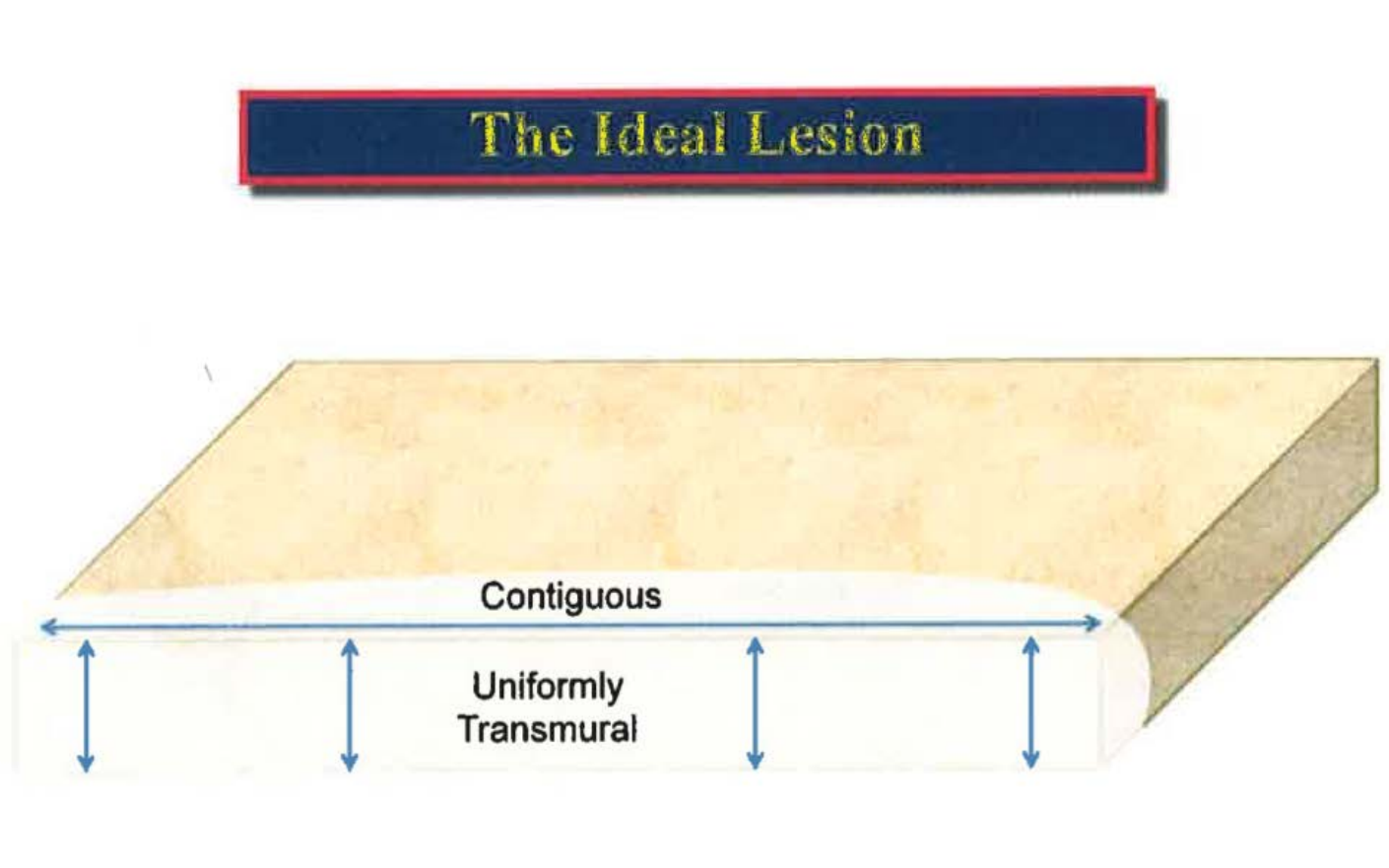
LAAM Stand-Alone Maze

- Surgical ablation for symptomatic AF in the absence of structural heart disease that is refractory to class I/III antiarrhythmic drugs or catheter-based therapy or both is **REASONABLE** as a **primary stand-alone procedure**, to restore sinus rhythm. (Class IIA, Level B randomized)
- Surgical ablation for symptomatic persistent or longstanding persistent AF in the absence of structural heart disease is **REASONABLE**, as a stand-alone procedure using the **Cox-Maze III/IV lesion set** compared with pulmonary vein isolation alone. (Class IIA, Level B nonrandomized)

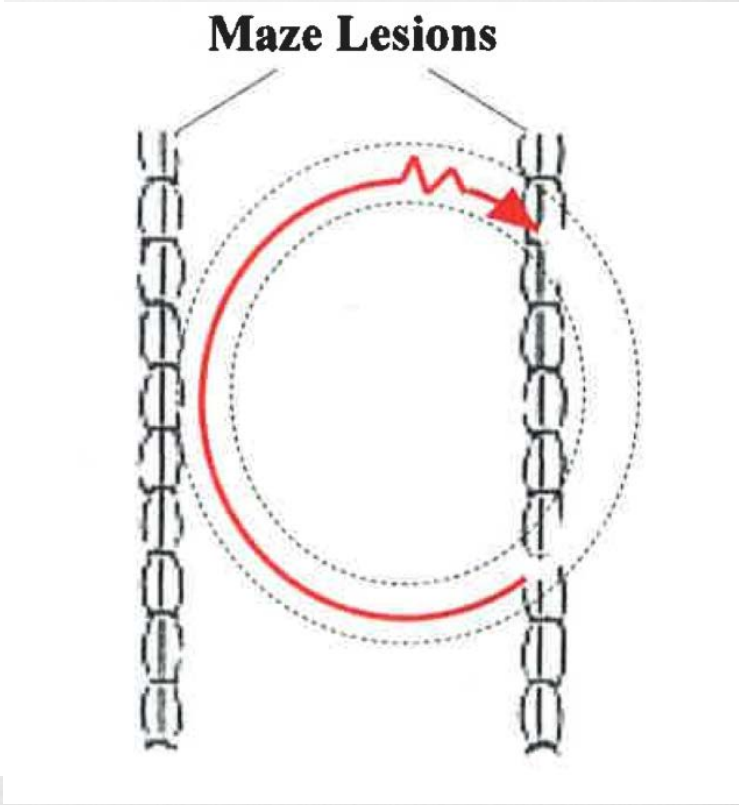
Principles of Surgical Ablation



Principles of Surgical Ablation

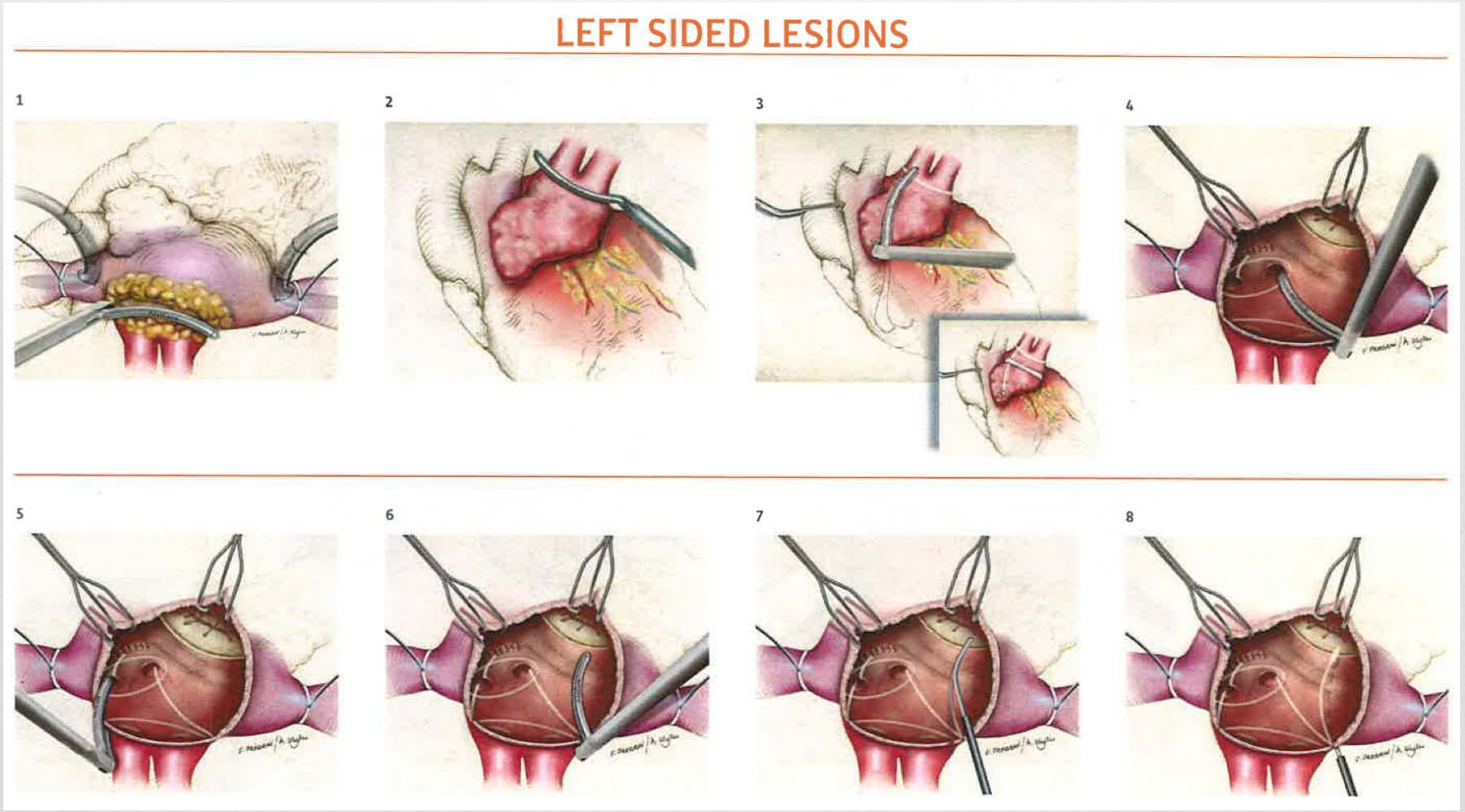


Principles of Surgical Ablation



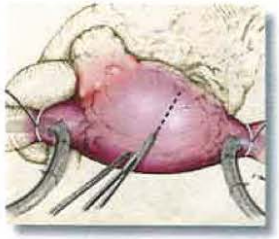
The Cox Maze IV Surgery

The Cox Maze IV Surgery



The Cox Maze IV Surgery

RIGHT SIDED LESIONS



– Initial Step –

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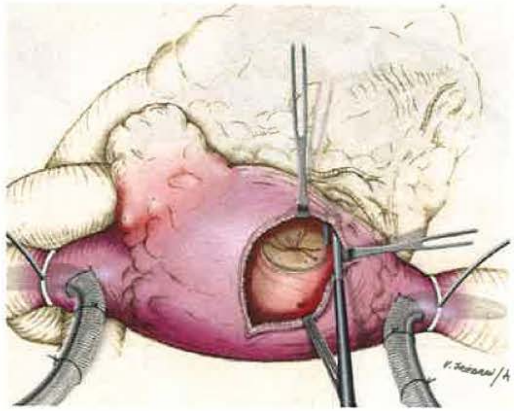

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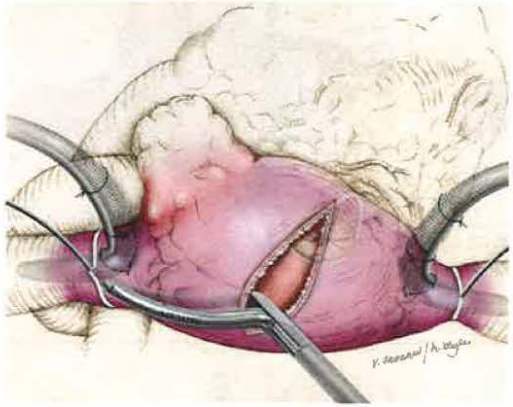

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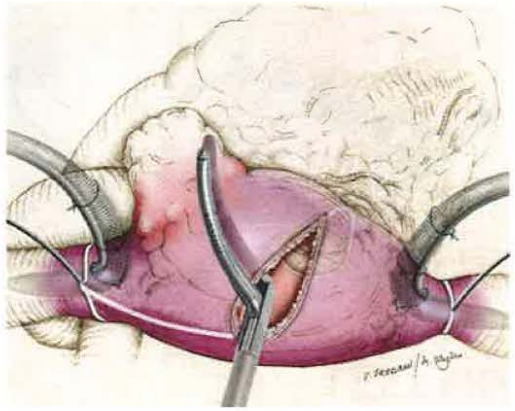

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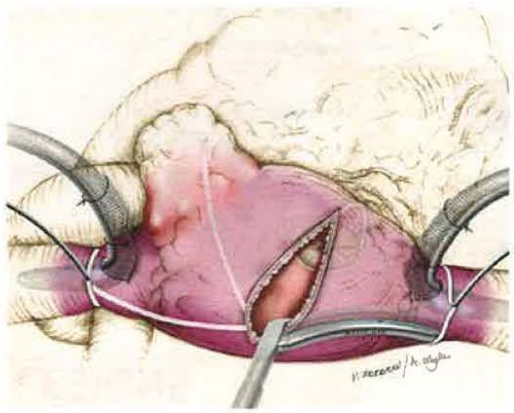

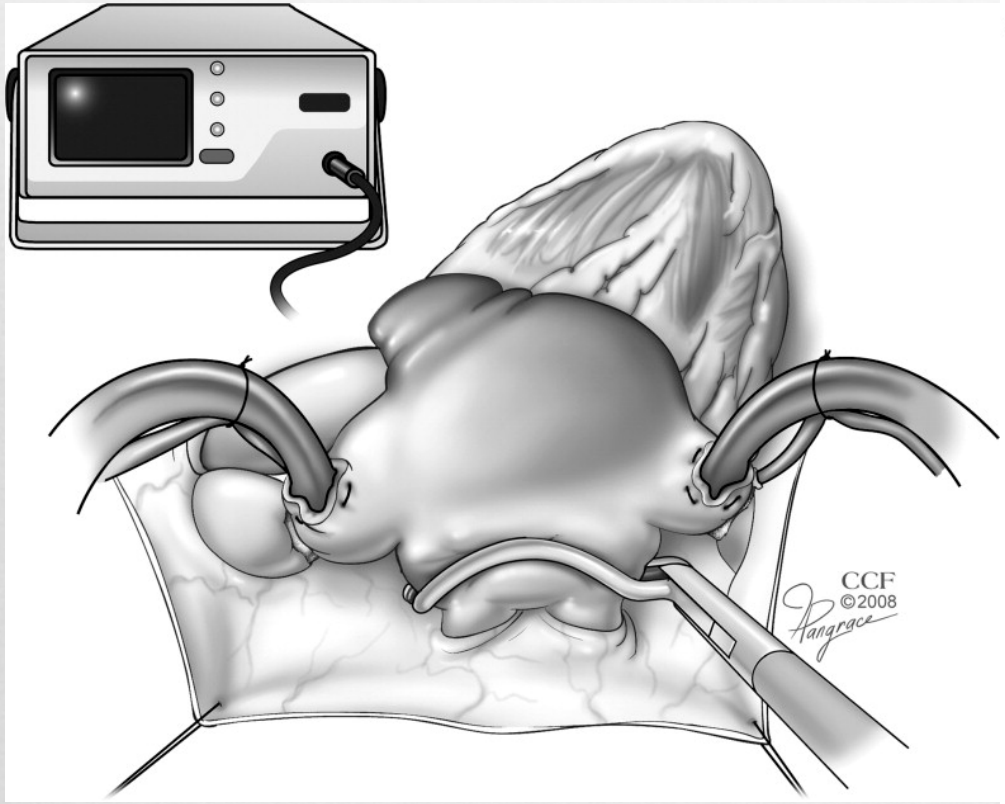
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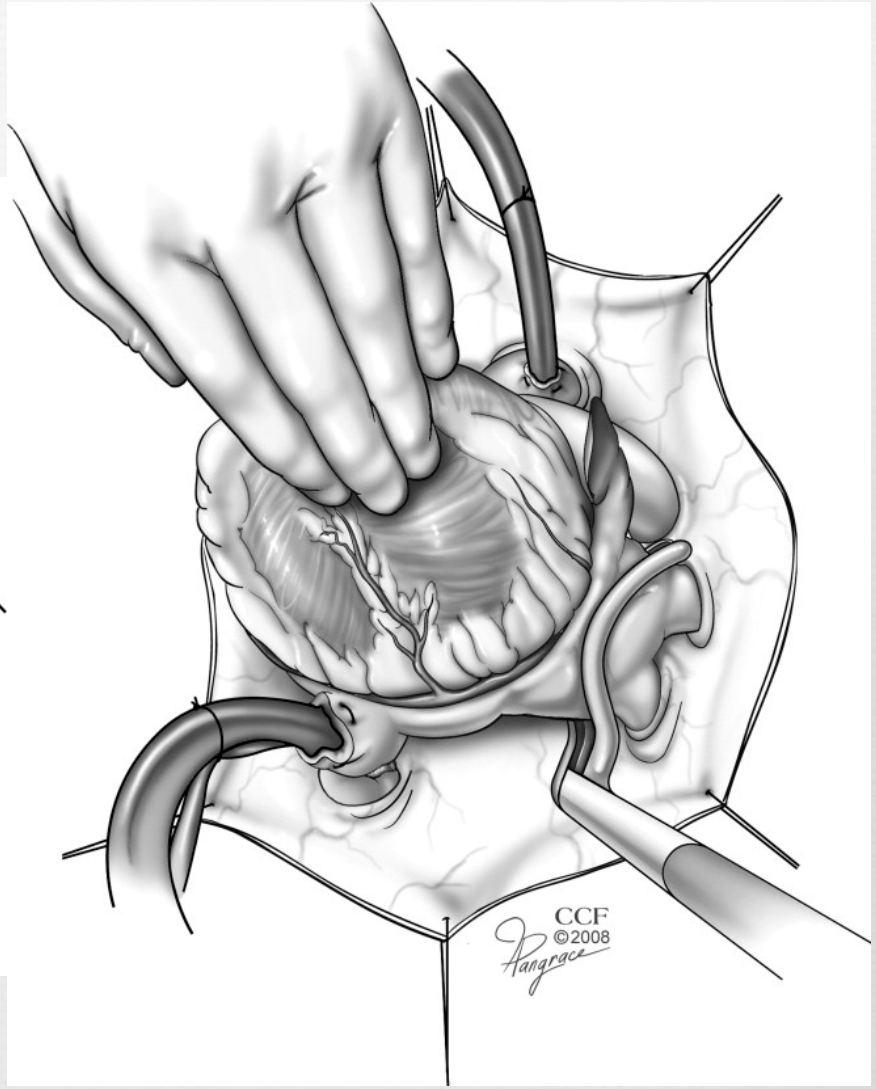
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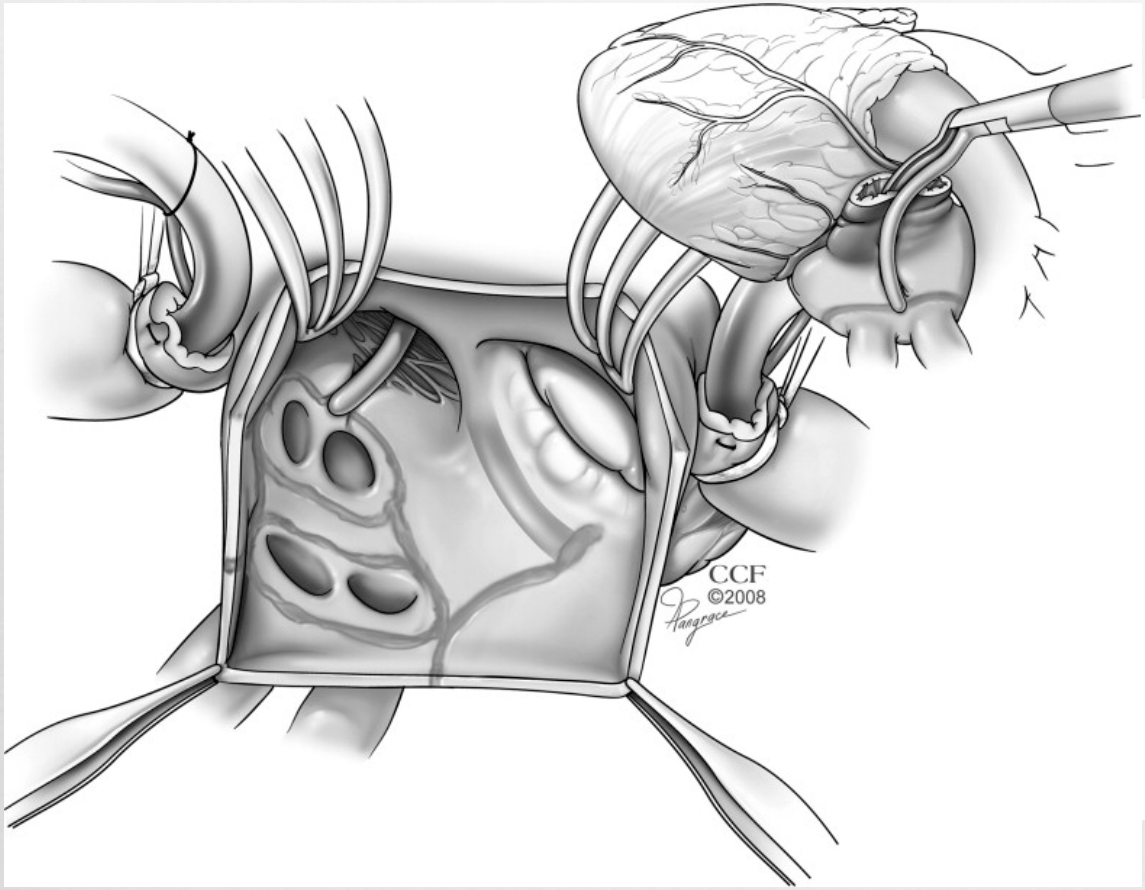
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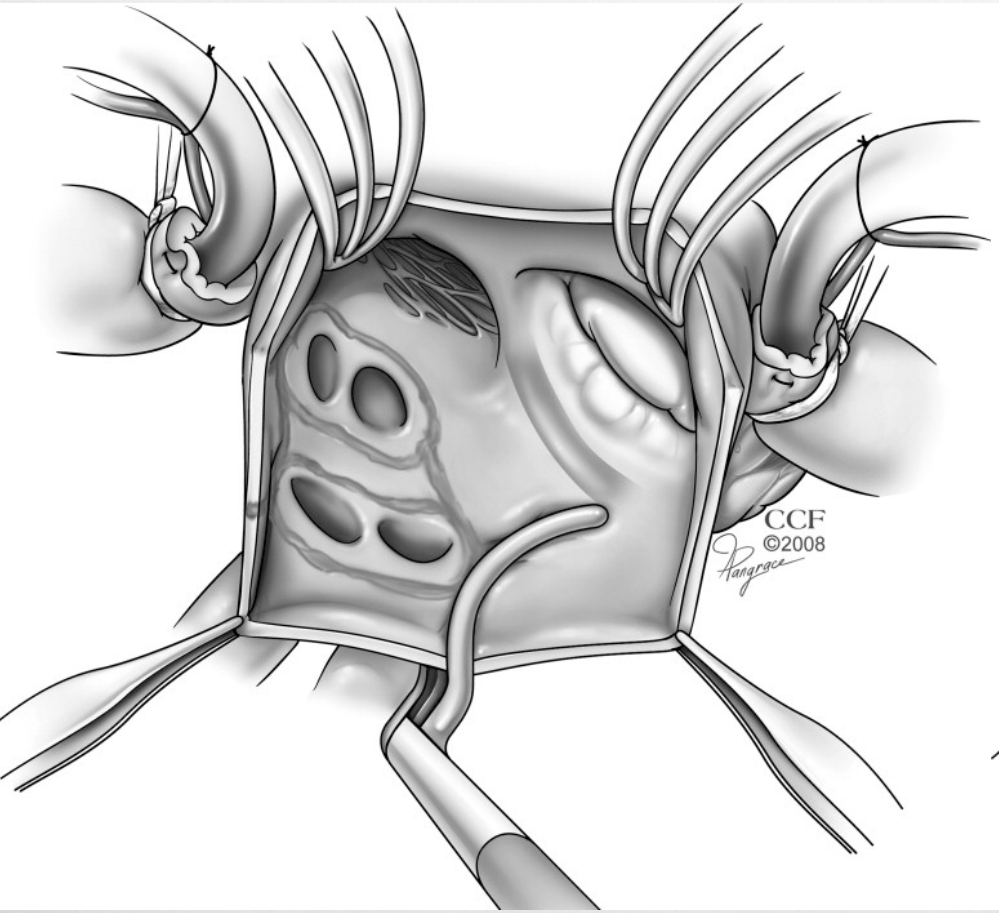
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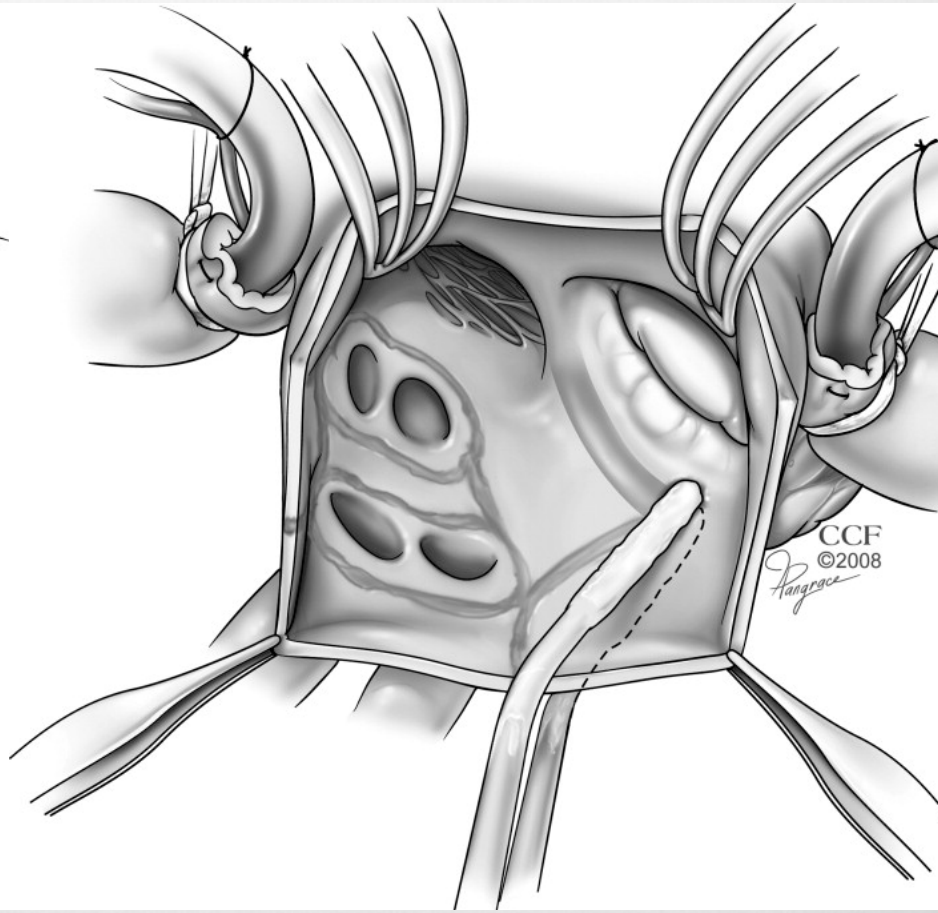
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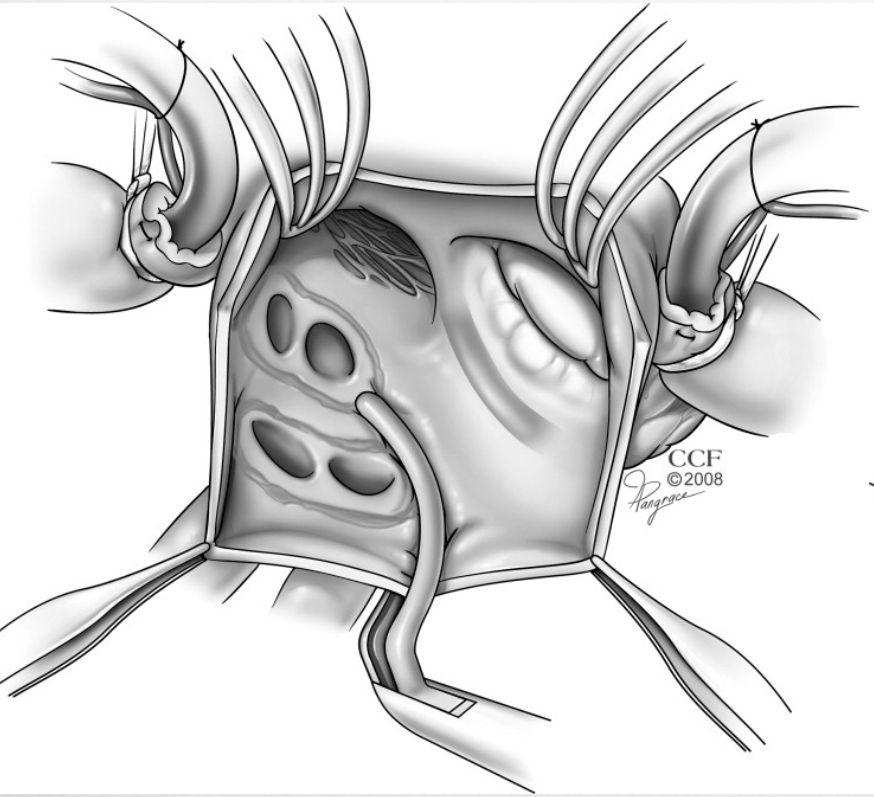
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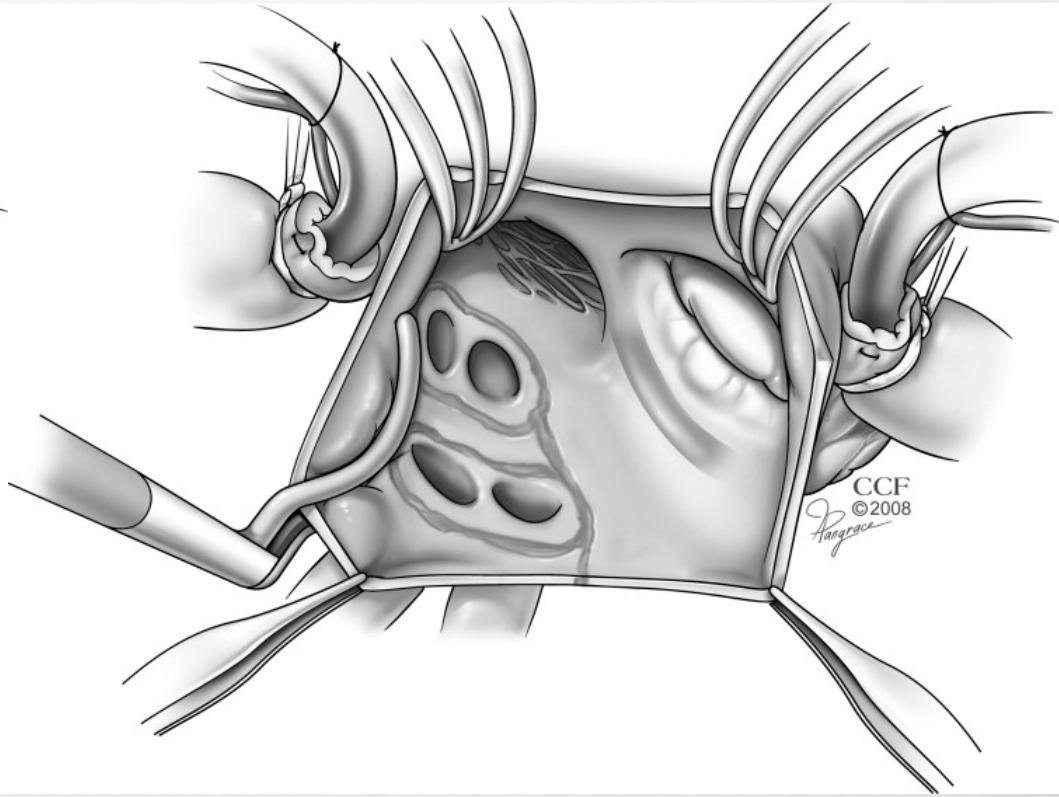
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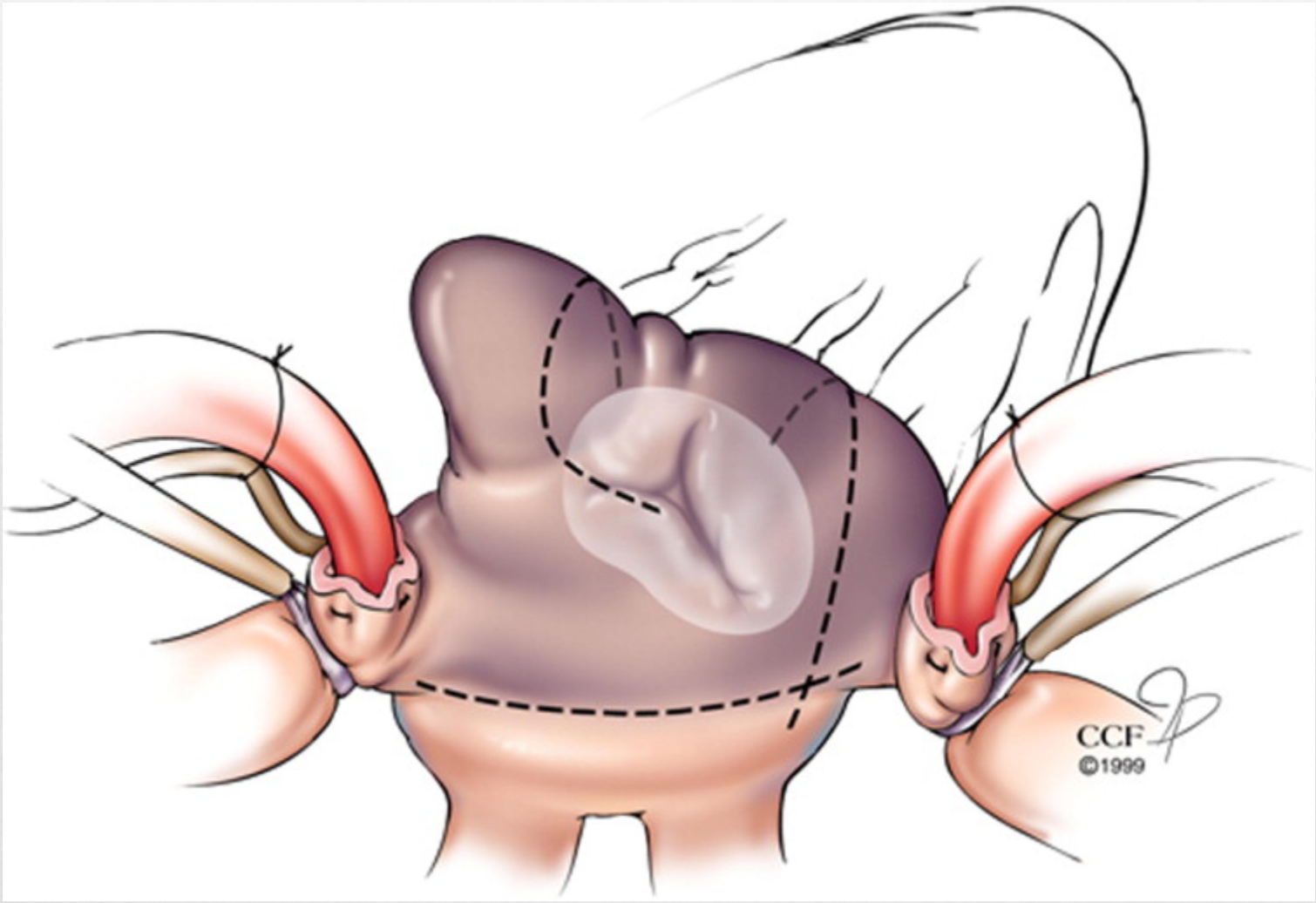
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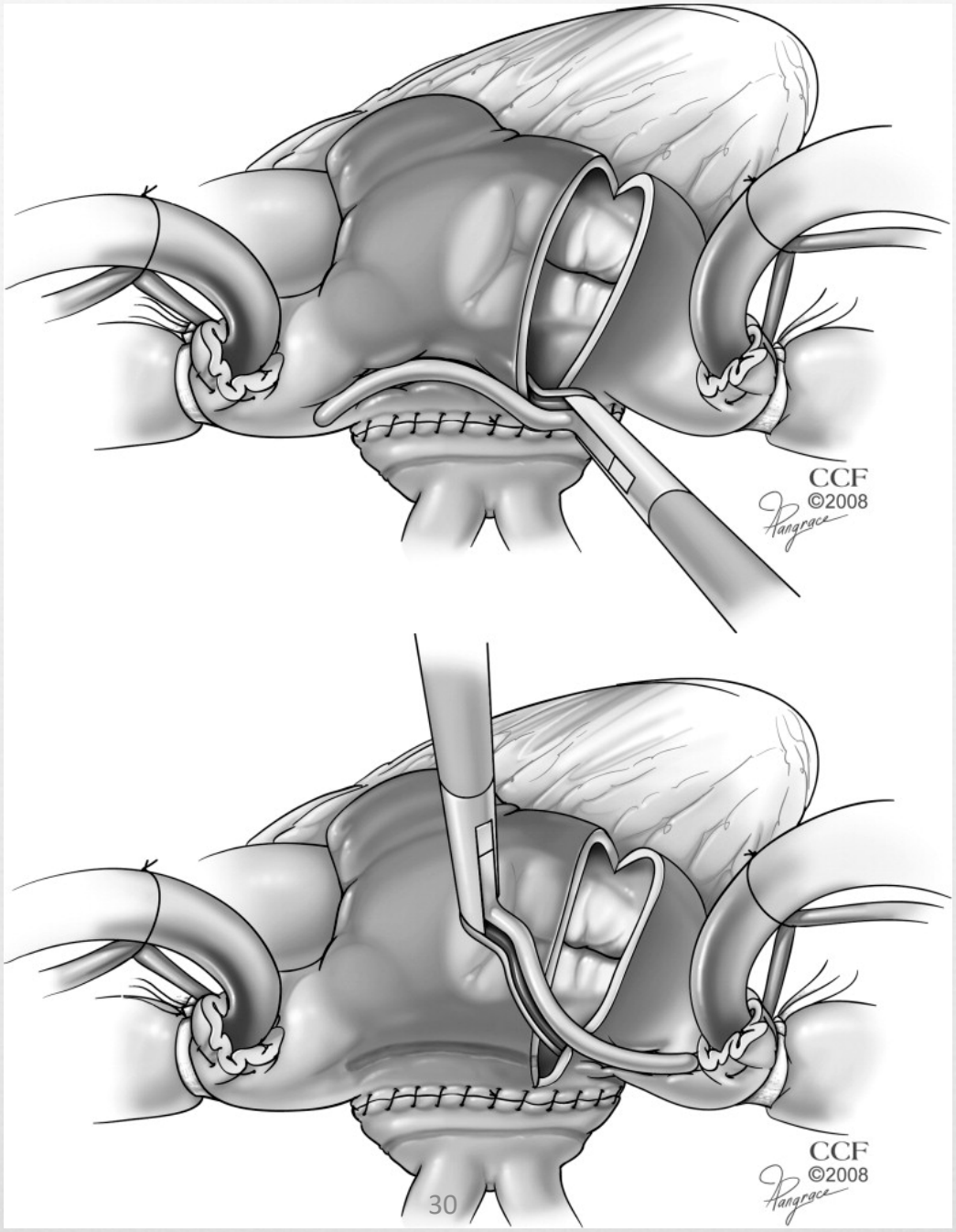
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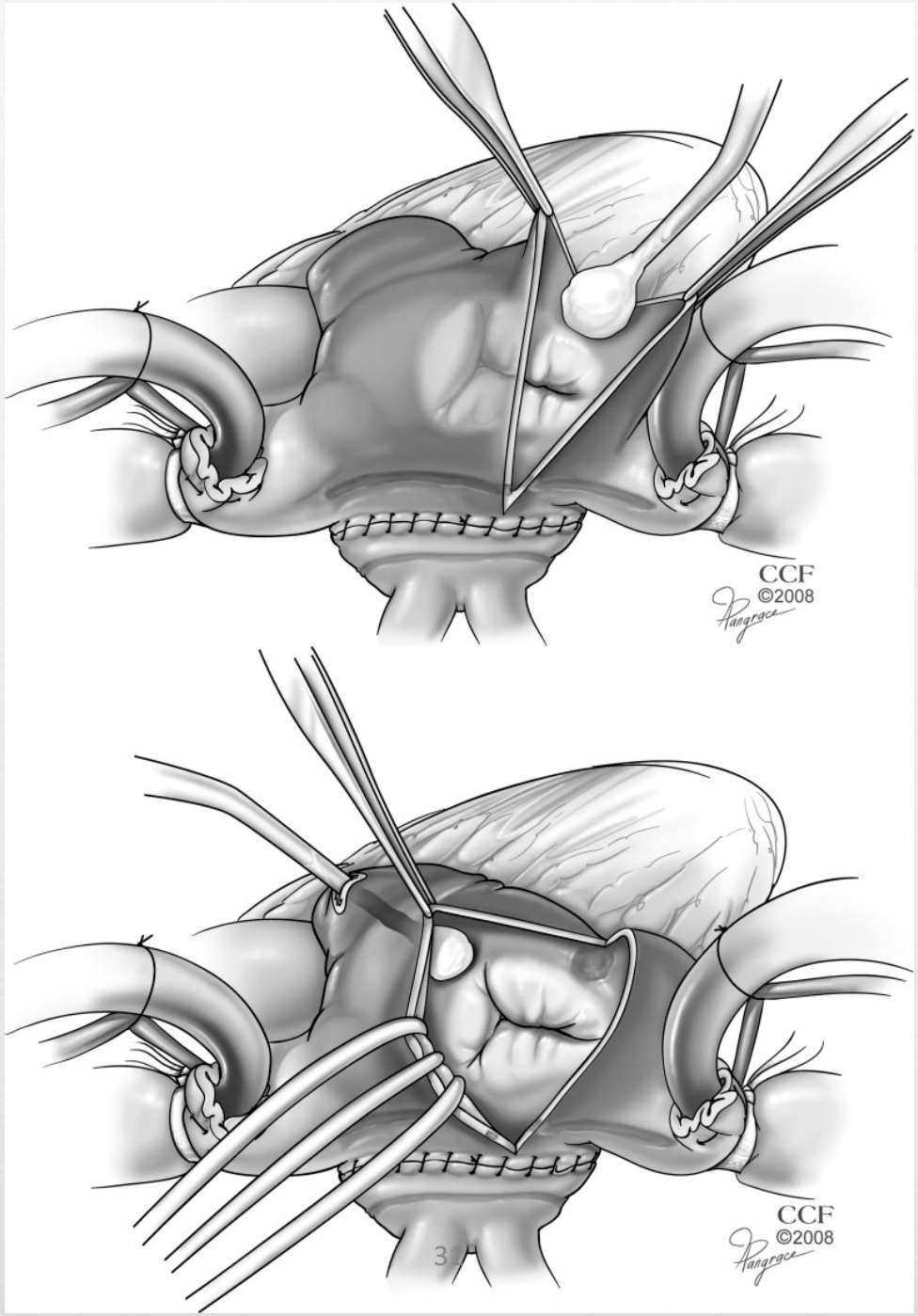
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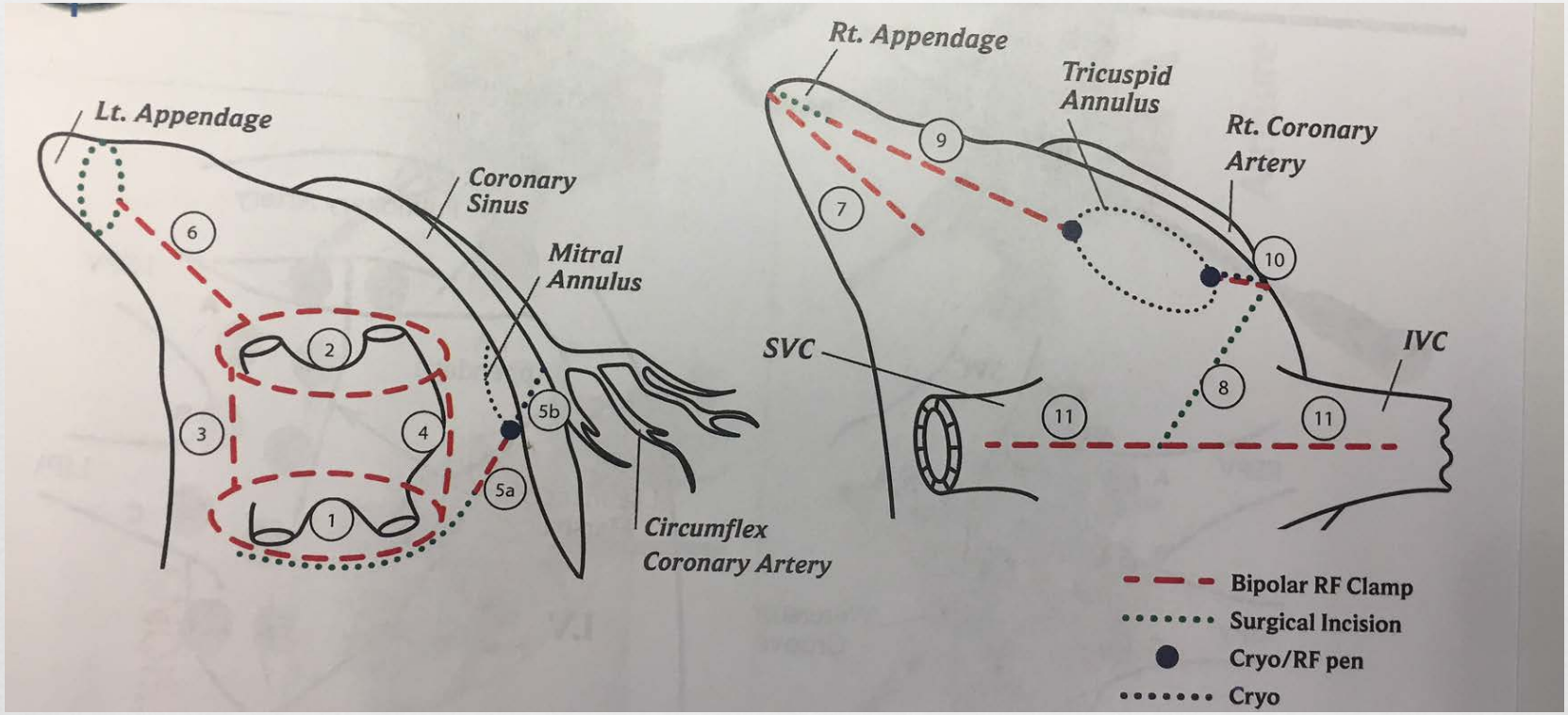
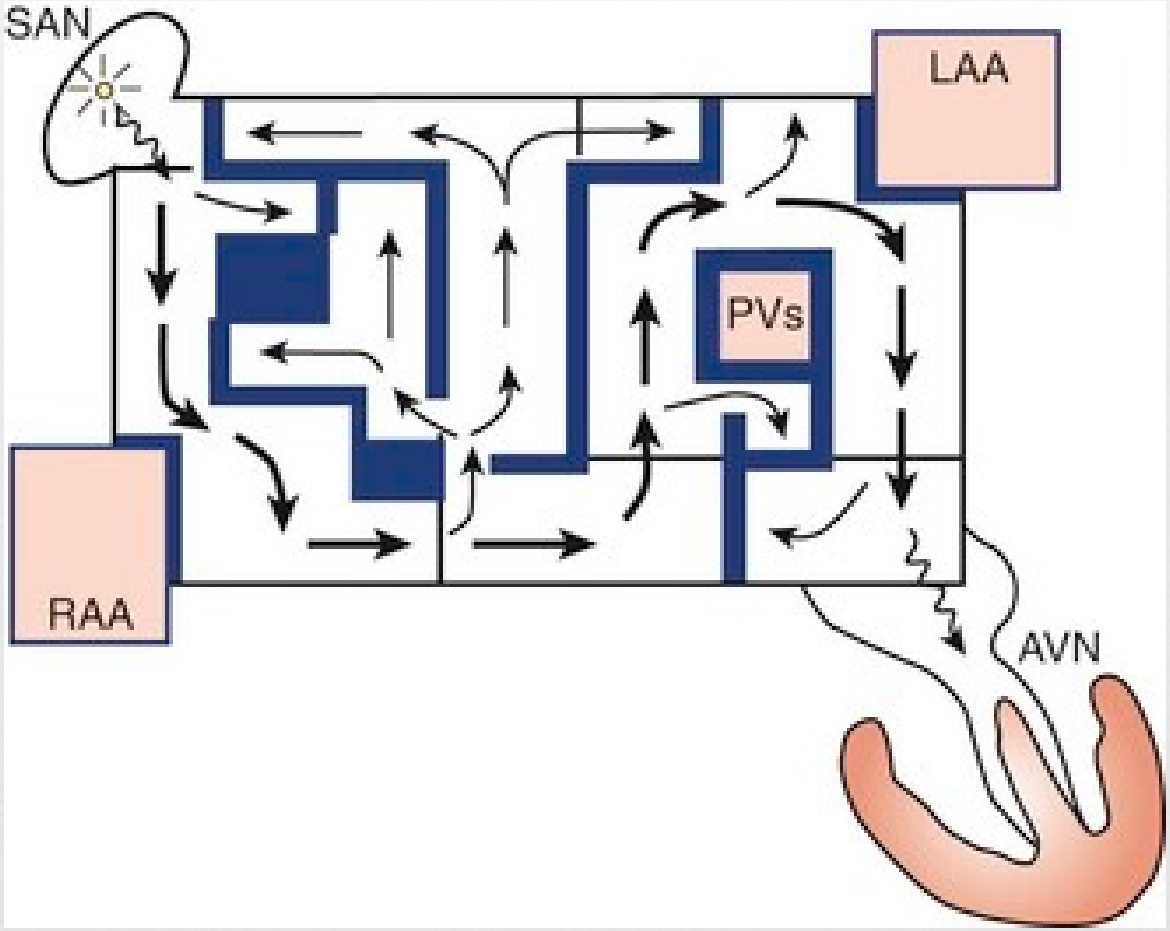
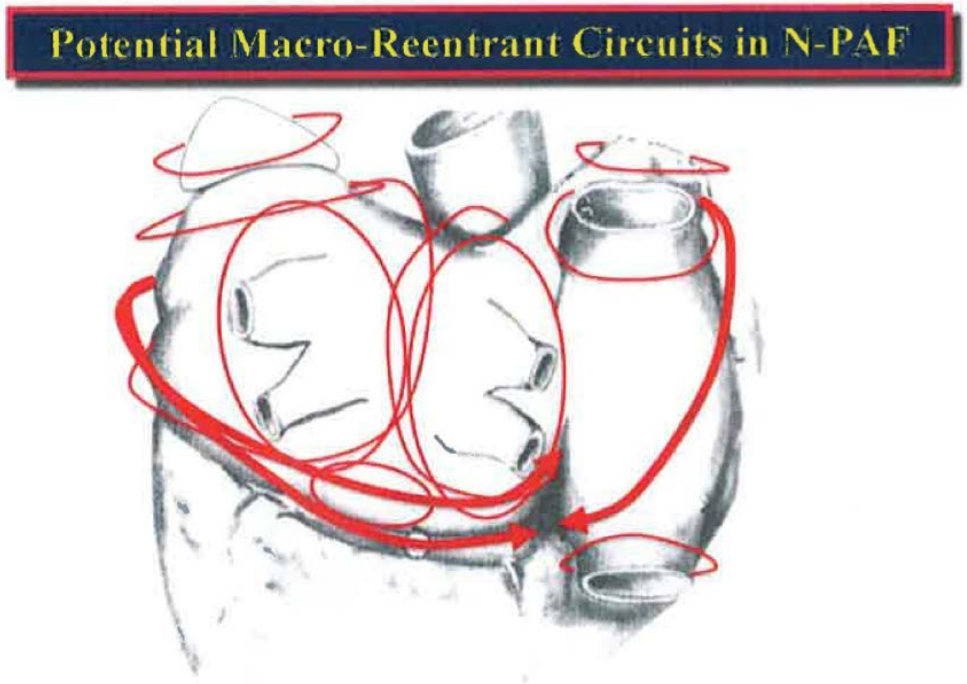
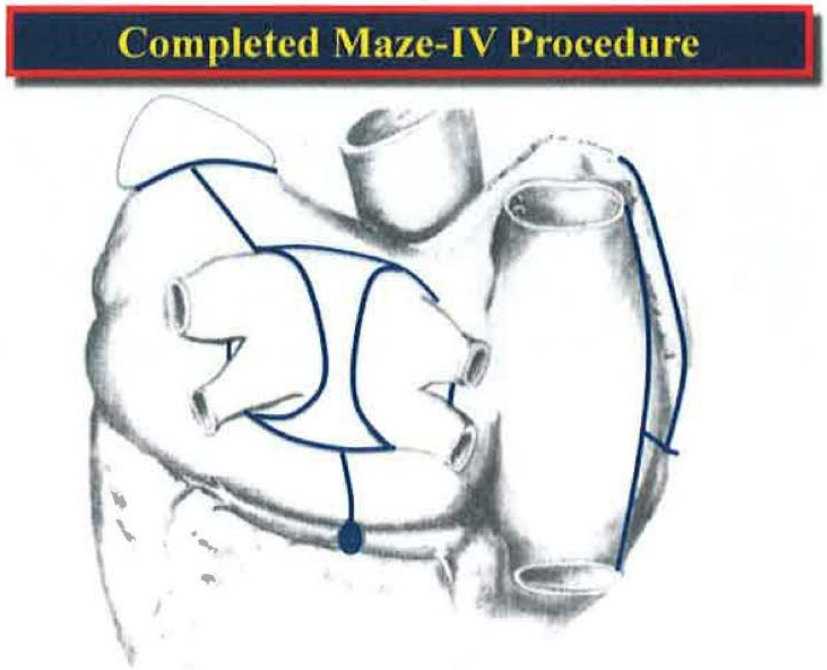

Lt. Appendage
Coronary Sinus
Mitral Annulus
Circumflex Coronary Artery
Rt. Appendage
Tricuspid Annulus
Rt. Coronary Artery
SVC
IVC
1
2
3
4
5a
5b
6
7
8
9
10
11
11
Bipolar RF Clamp
Surgical Incision
Cryo/RF pen
Cryo

The Cox Maze IV Surgery

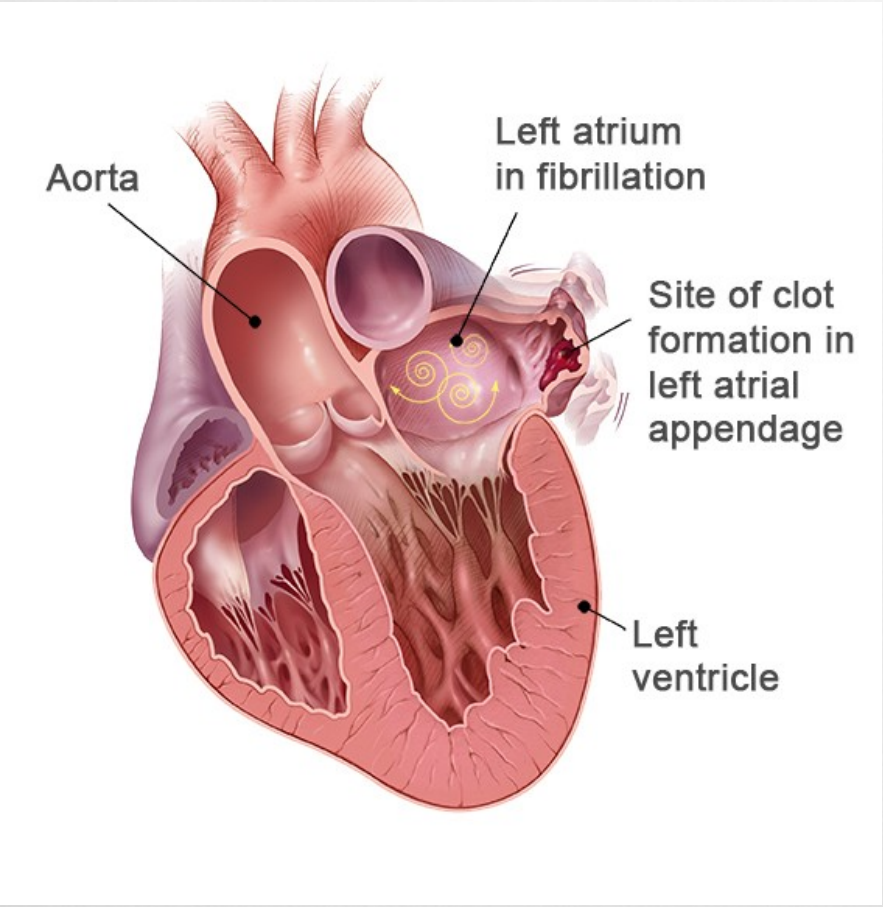


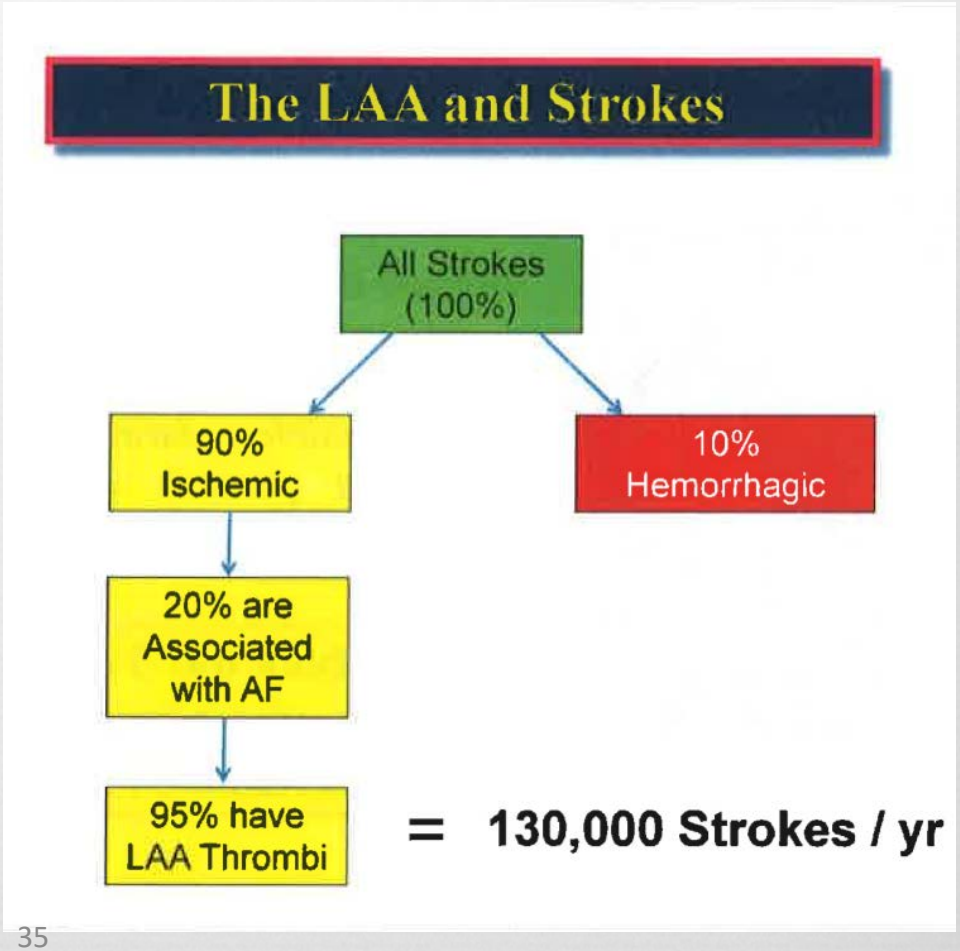
The Cox Maze IV Surgery





Management of the Left Atrial Appendage



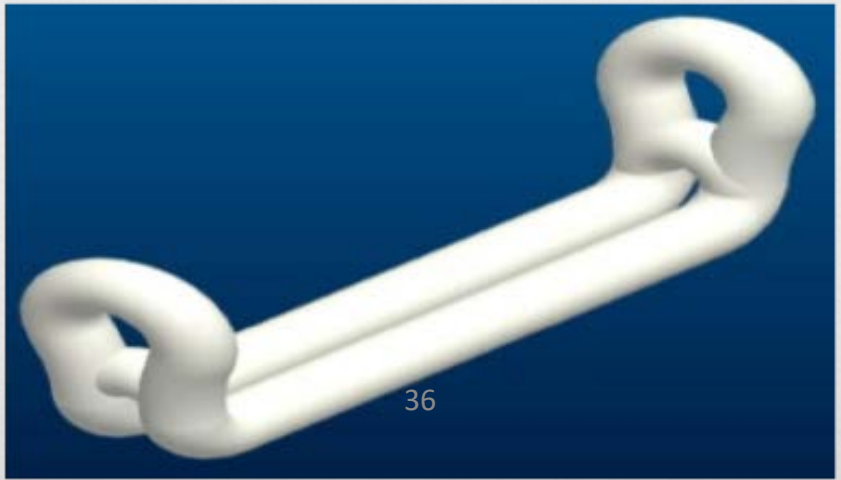


Management of the Left Atrial Appendage

Concomitant Surgical Ablation 2017 Society of Thoracic Surgeons (STS) Guidelines

CLASS OF RECOMMENDATION – IIA *continued*

- It is **REASONABLE** to perform **left atrial appendage excision or exclusion** in conjunction with surgical ablation for AF for longitudinal thromboembolic morbidity prevention. (Class IIA, Level C limited data)
- At the time of concomitant cardiac operations in patients with AF, it is **REASONABLE** to **surgically manage the left atrial appendage** for longitudinal thromboembolic morbidity prevention. (Class IIA, Level C expert opinion)



Cox Maze IV Post-Op Care

Clinical management after surgery for atrial fibrillation focuses on four areas:

1) **Fluid retention** occur in 12-30% of patients. This may be considered as:
   - Early 24-36 hrs: Pulmonary congestion
   - Late: Pleural effusion and weight gain

   Managed as per standard ICU protocol.

2) **Atrial tachyarrhythmias (ATA)**– Over 40% of patients experience ATA (AF, Aflutter, AT, SVT) post operatively.
   - Intraoperative antiarrhythmics/Amiodarone may be administered as per hospital protocol. This may be continued into the postoperative period except for patients with bradycardia or junctional rhythm. Cardioversion may also be considered for these patients as outlined in the previous slide at physician's discretion.

Clinical considerations after surgery : continued

3) **Anticoagulation**—(At Physician's Discretion)
   - Aspirin is usually resumed on POD-1 unless contraindicated.
   - Coumadin is usually started/restarted on postoperative day (POD)-2. Coumadin should be delayed if the patient experiences a bradycardic rhythm requiring a pace maker.
   - An INR range of 2.0-2.5 is the recommended level to maintain for patients.
   - The duration of Coumadin is dependent on physician discretion and may be based upon several factors including, (i) Patient remaining in sinus rhythm (ii) Concomitant procedure performed ie. mechanical valve replacement, and (iii) CHADS2 score.

4) **Perioperative sinus/AV dysfunction**— (At Physician's Discretion)
   - The need for a permanent pacemaker (PPM) is more common in patients with preoperative SA node dysfunction. If the patient develops postoperative bradycardia and/or junctional rhythm, all antiarrhythmics should be discontinued. The patient may be treated conservatively for 7-10 days before a PPM is implanted. Bradycardic rhythms can often resolve within this time period.

Cox Maze IV Post-Op Care

HRS Guidelines for AF Reporting Outcomes

Blanking period

- A blanking period of three months should be employed after ablation when reporting outcomes.

Minimal monitoring

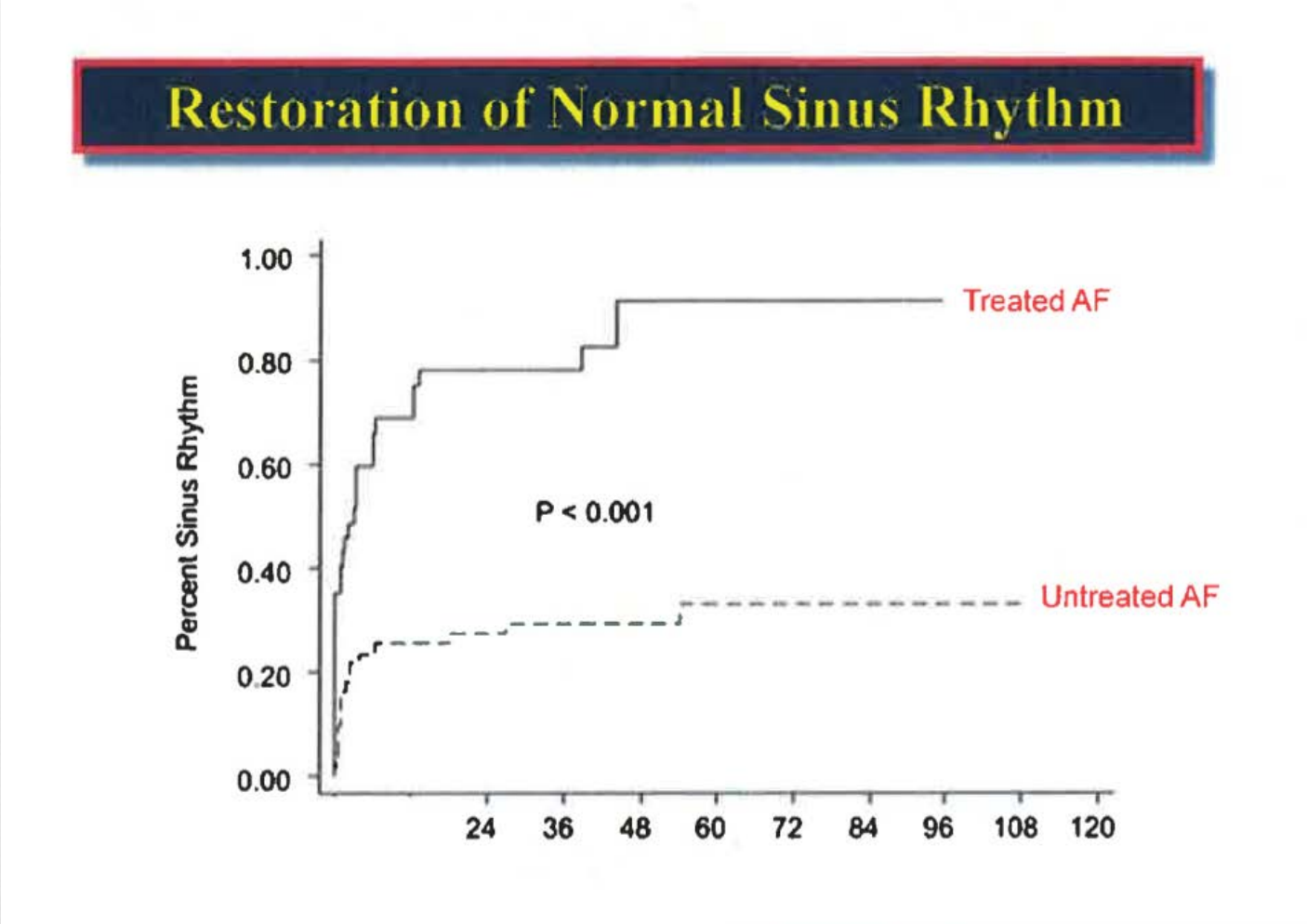
- Patients should be seen in follow-up at a minimum of three months following the ablation procedure and then every six months for at least two years.
- An event monitor should be obtained to screen for recurrent AF/flutter/tachycardia in patients who complain of palpitations during follow-up.
- Patients being evaluated as part of a clinical trial or in whom warfarin may be discontinued should have some type of continuous ECG monitoring performed to screen for asymptomatic AF/flutter/tachycardia.
- 24–hour Holter monitoring is an acceptable minimal monitoring strategy for patients enrolled in a clinical trial and is recommended at three to six months intervals for one to two years following ablation.

2007 HRS Guidelines for AF Reporting Outcomes

Definition of success

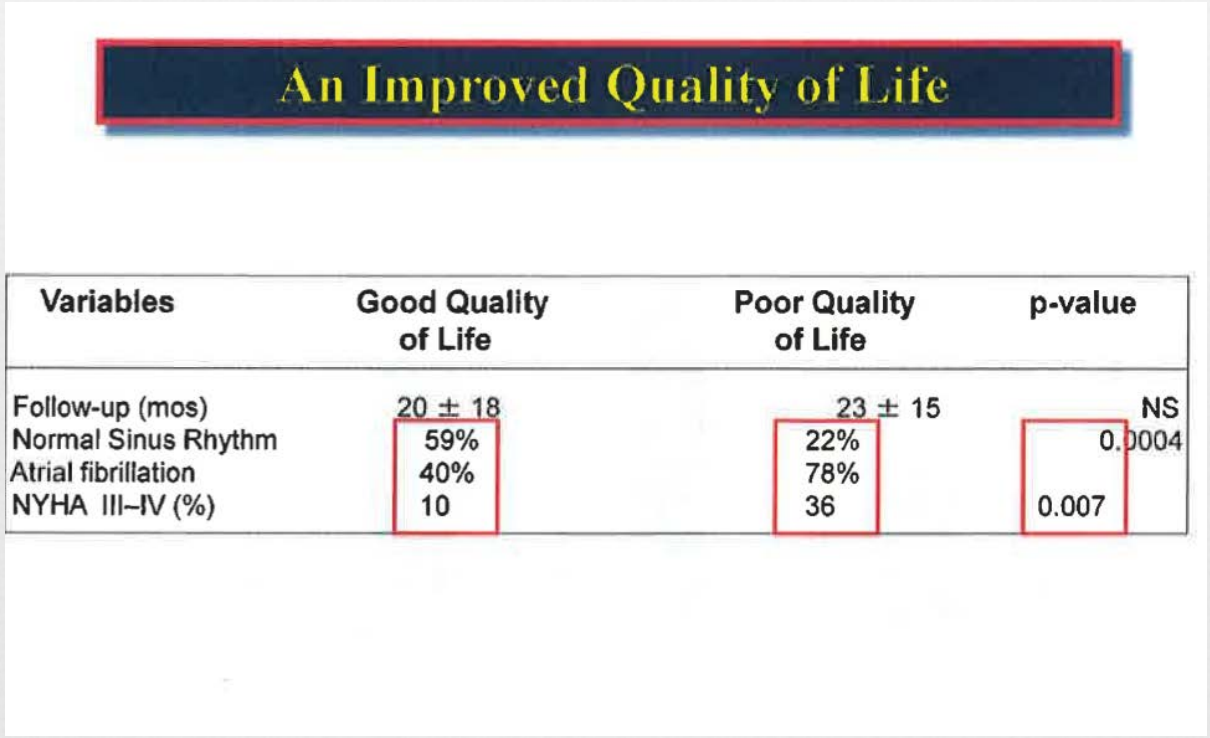
- Freedom from AF/flutter/tachycardia off antiarrhythmic therapy is the primary endpoint of AF ablation.
- Freedom from AF at various points following ablation may be a better marker of true benefit and should be considered as a secondary endpoint of ablation.
- An episode of AF/flutter/tachycardia detected by monitoring should be considered a recurrence if it has a duration of 30 seconds or more.

Cox Maze IV Outcomes



Louagie et al. Ann Thorac Surg 2009.

Cox Maze IV Outcomes

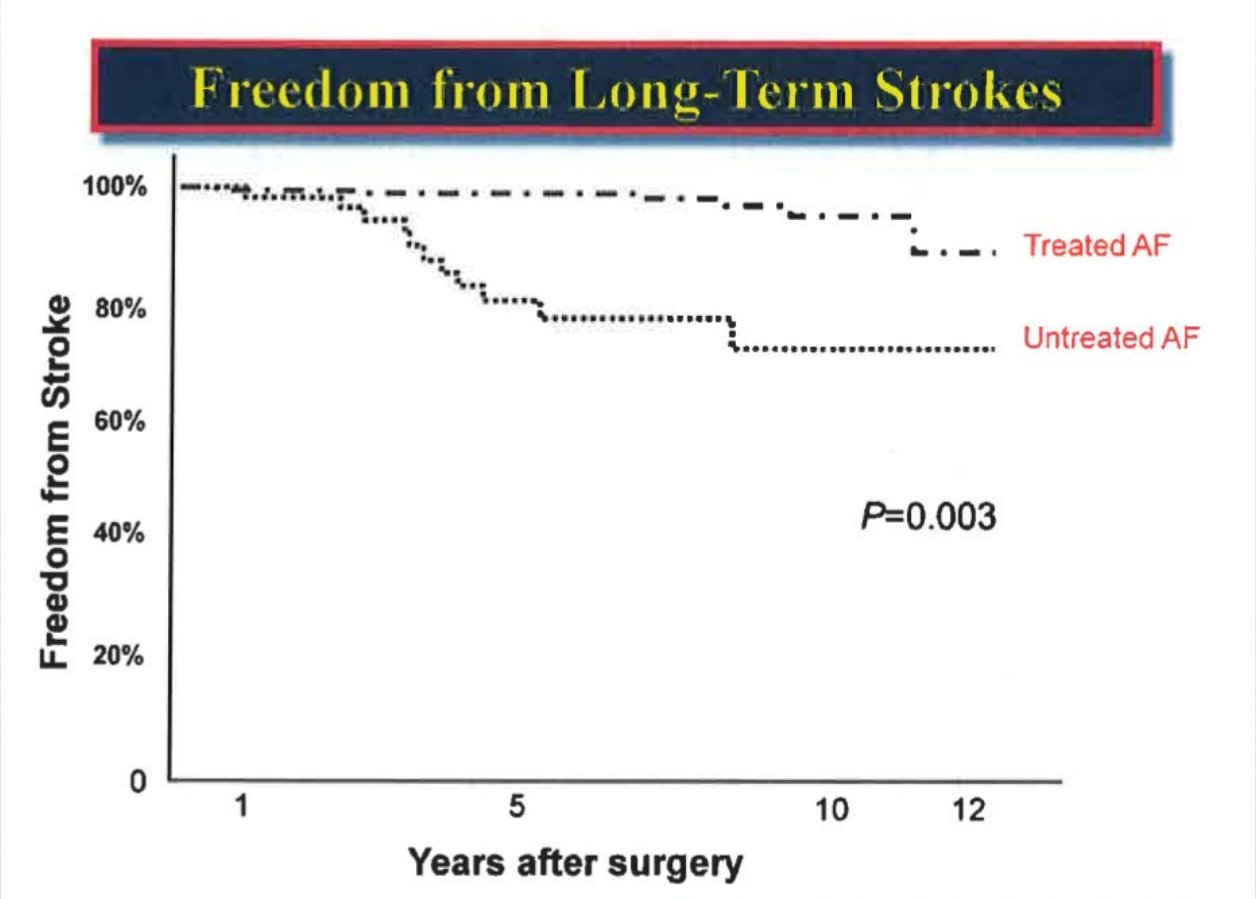


An Improved Quality of Life

Variables	Good Quality of Life	Poor Quality of Life	p-value
Follow-up (mos)	20 ± 18	23 ± 15	NS
Normal Sinus Rhythm	59%	22%	0.0004
Atrial fibrillation	40%	78%	
NYHA III–IV (%)	10	36	0.007

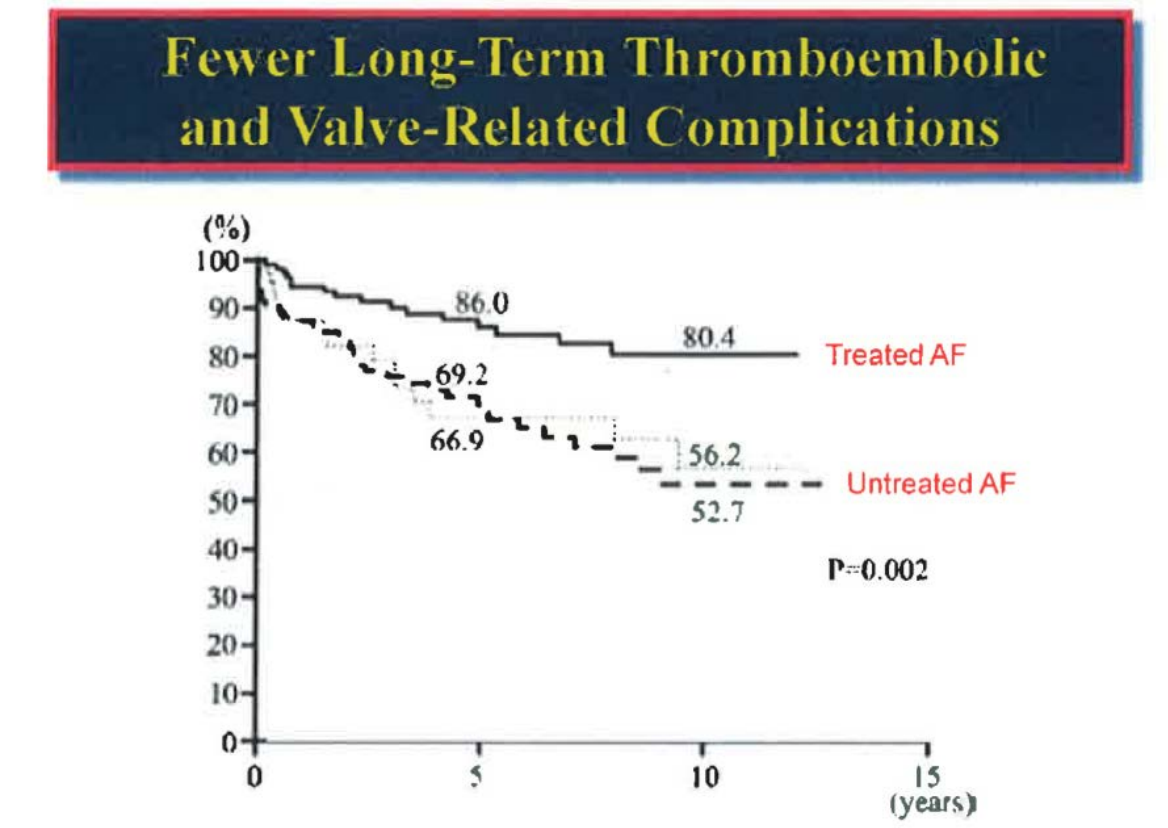
Fortani et al: Ann Thorac Surg 2006

Cox Maze IV Outcomes



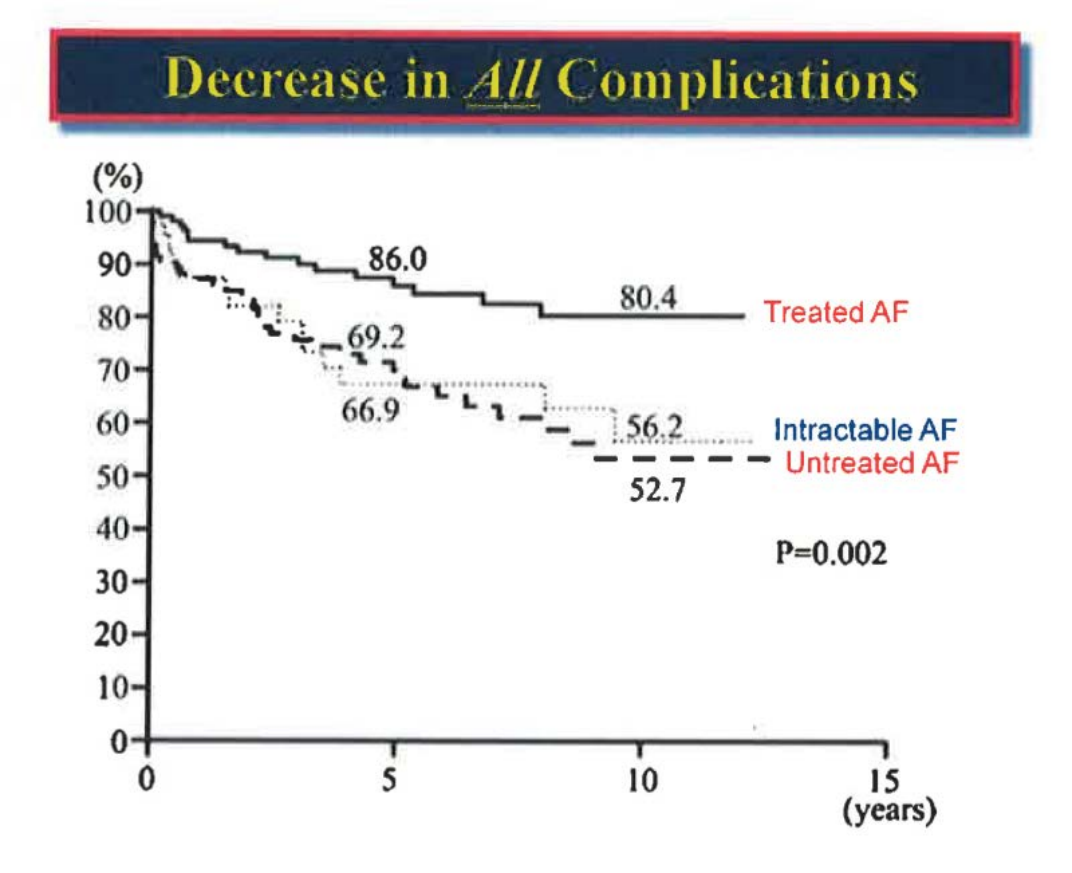
Itoh et al. Eur J. Cardiothorac Surg. 2006.

Cox Maze IV Outcomes



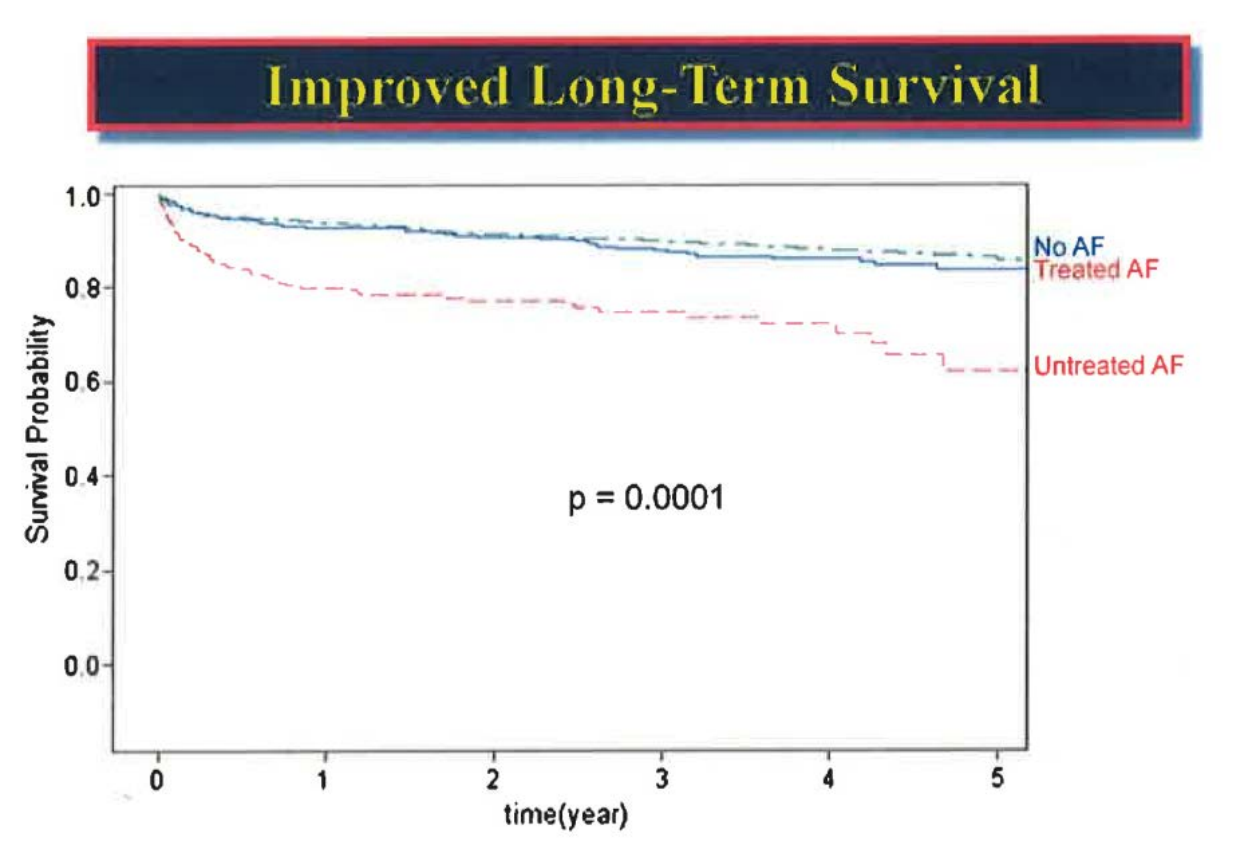
Fukunaga et al. Ann Thorac Surg. 2008.

Cox Maze IV Outcomes



Fukunaga et al. Ann Thorac Surg. 2008.

Cox Maze IV Outcomes



Lee et al. J Thor Cardiovasc Surg. 2012.