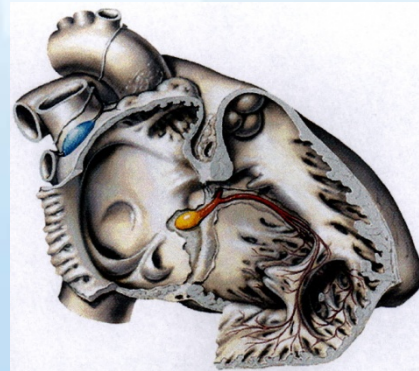


Surgical thermoablation of atrial fibrillation: Epicardial

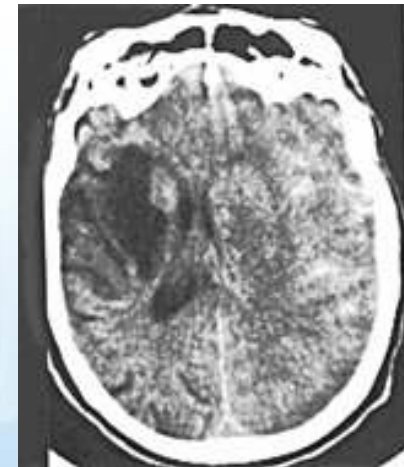


Nicolas Bonnet

*Centre Cardiologique du Nord – CCN
Saint-Denis FRANCE*

Place of Surgery in AF treatment

- Historical
 - Models and concepts
 - Treatments
- Actual
 - Combined with cardiac surgery
 - Lone AF
- Futur
 - Mini-invasive
 - Nodes
 - Left atrial appendage...

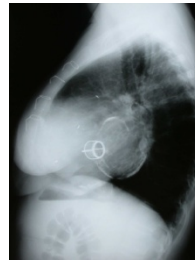


Surgery has landmarks in history of treatments for cardiac rhythm disorders



- Thyroidectomy
- Stellectomy
- Kent ablation
- Ventriculotomy
- Atrial fibrillation

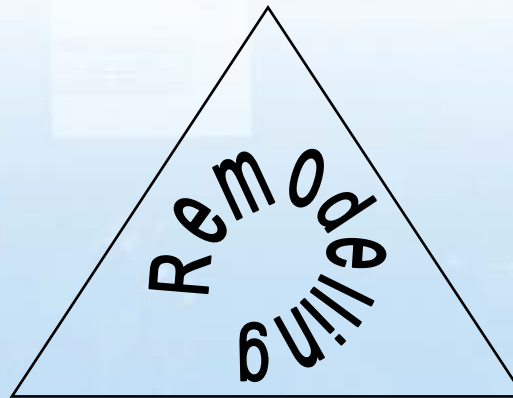
Surgery of Coumel's triangle



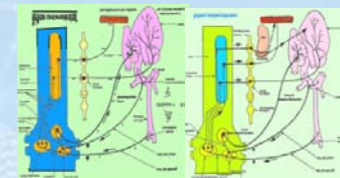
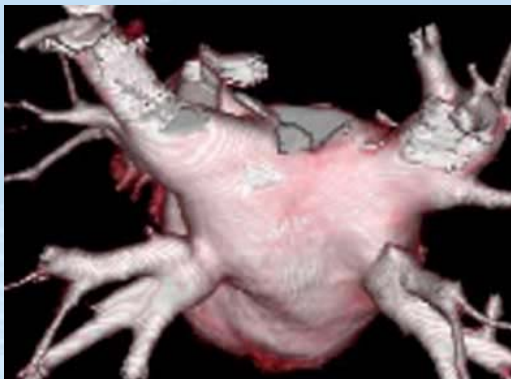
Substratum
(Cardiac surgery / Maze)



Trigger
(minimaze)



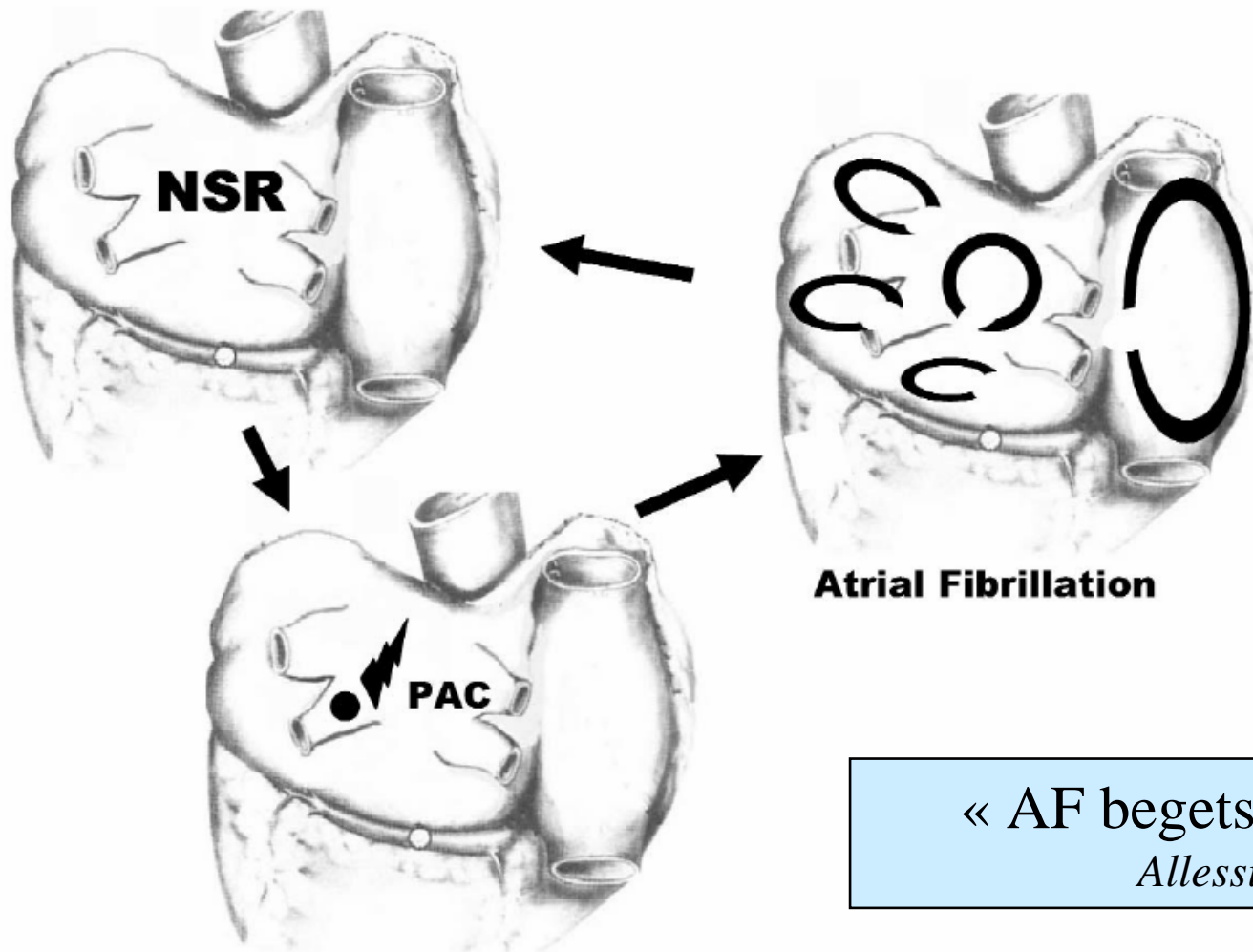
Autonomic nervous system
(stelletomy)
(cardiac nodes ablation)



AF: paroxysmic / continuous

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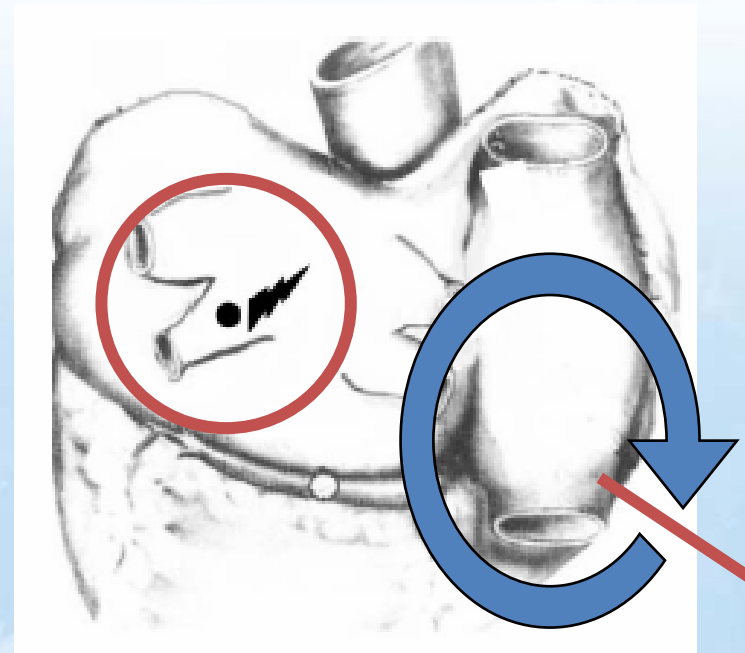
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« AF begets to AF »
Allessie

Direct action on the reentrant circuit

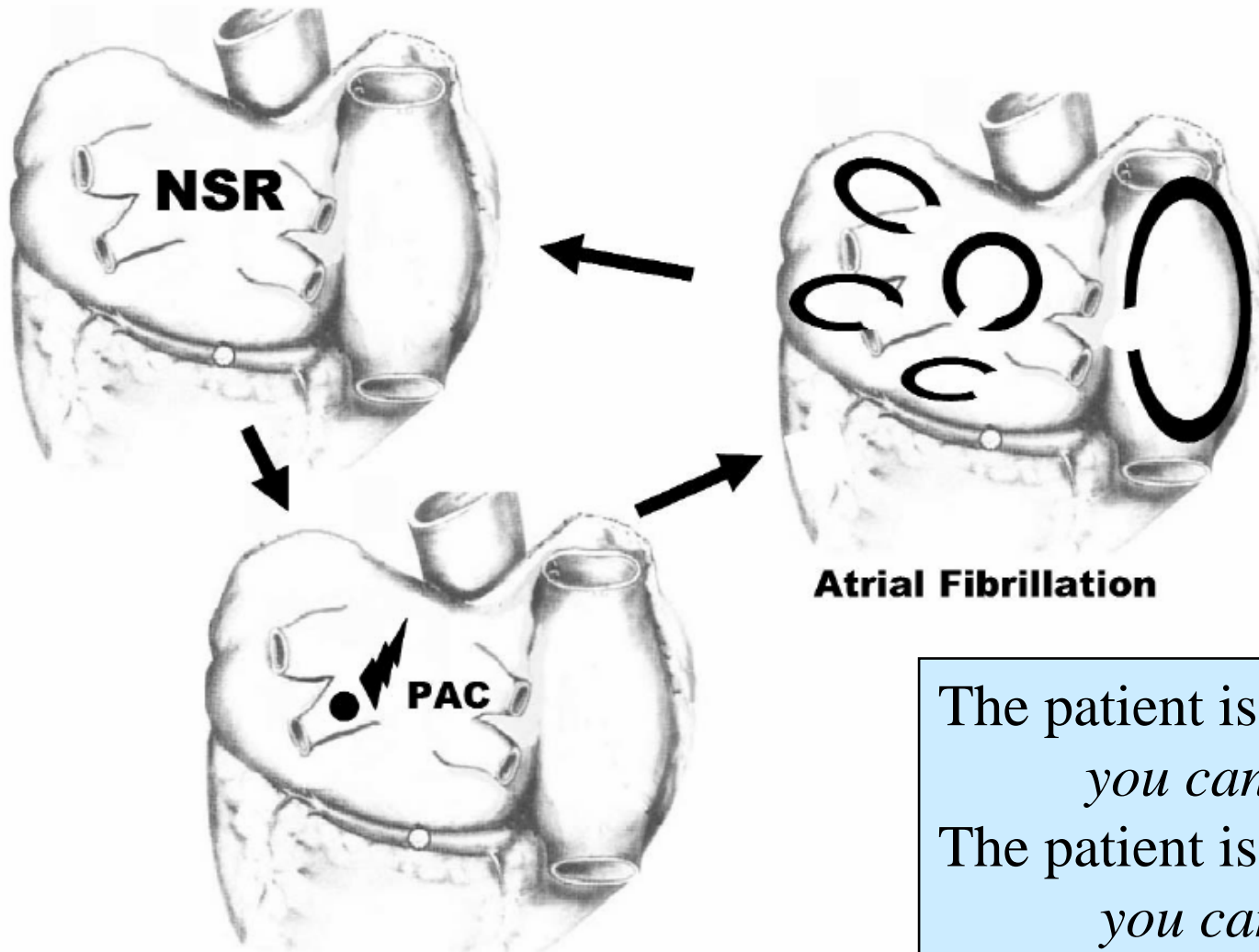
- Trigger
 - Direct ablation
 - exclusion
- Circuit
 - exclusion of circuit
 - Break the circuit
- Need direct identification of the trigger or the reentrant circuit



In Atrial Fibrillation

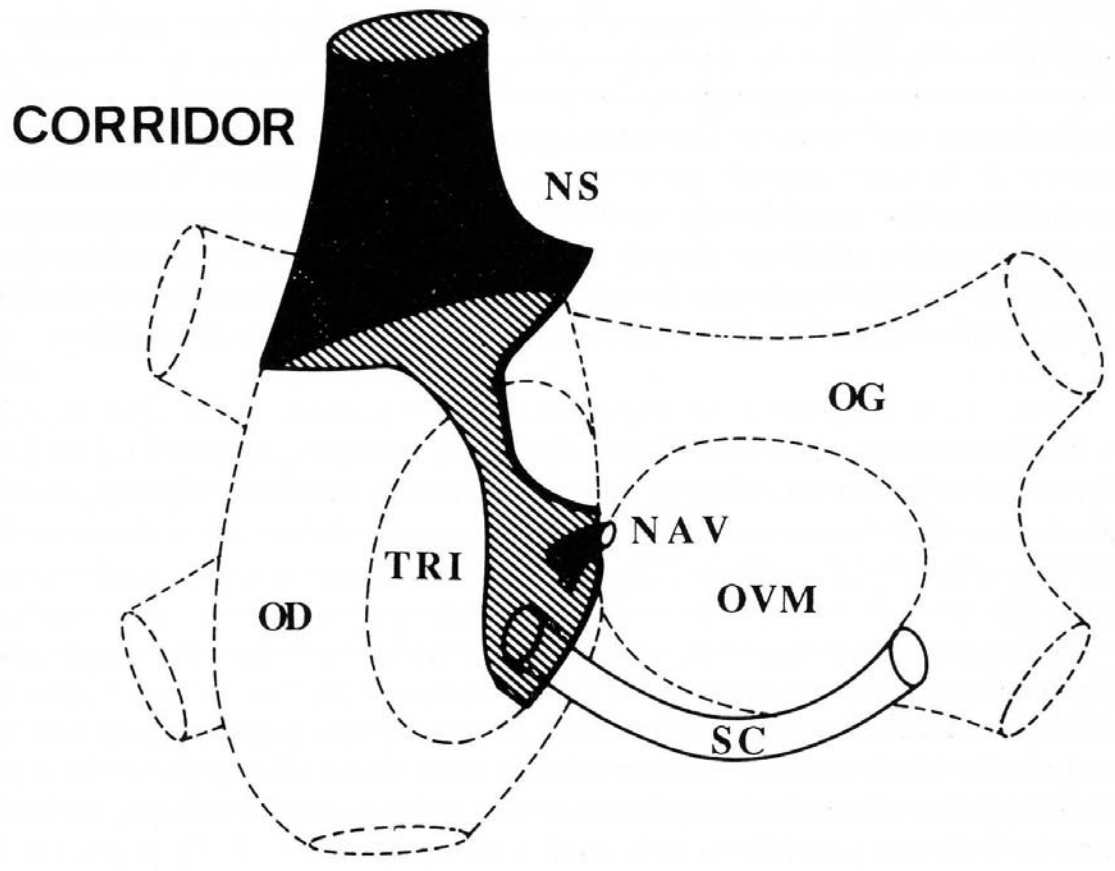
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The patient is in AF,
you can see nothing.
The patient is in SR,
you can see nothing

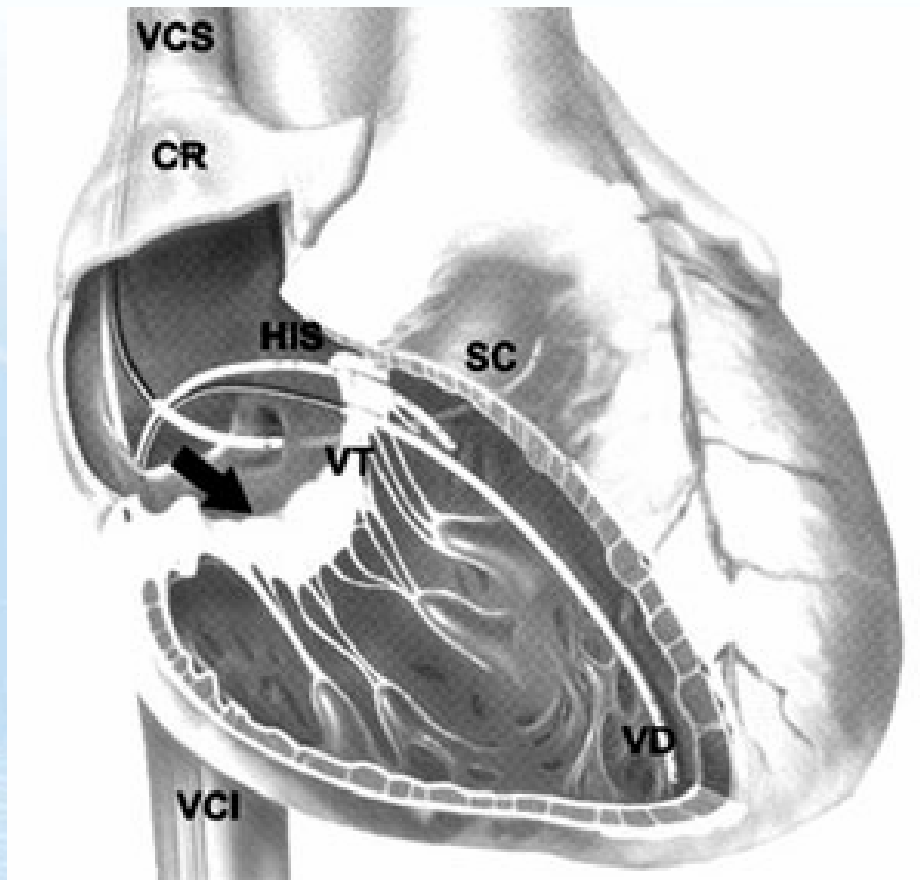
Intervention for isolation of the arrhythmogenic region



Forgotten Interventions

- Corridor (Guiraudon)
- LA isolation (Cox)

Intervention for isolation of the arrhythmogenic region



Actual
intervention
His Bundle
Ablation +
Cardiac
Pacemaker
(AFFIRM)

These interventions have disadvantages

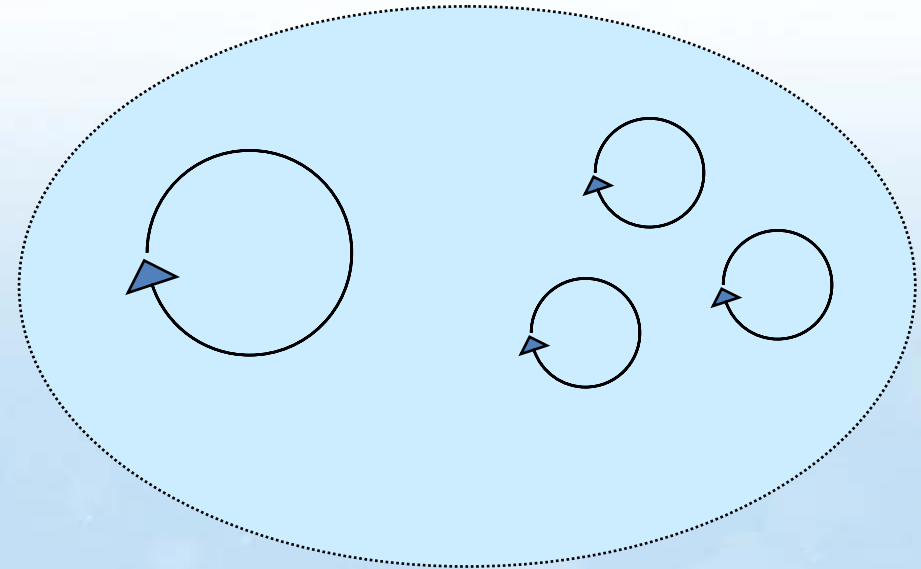
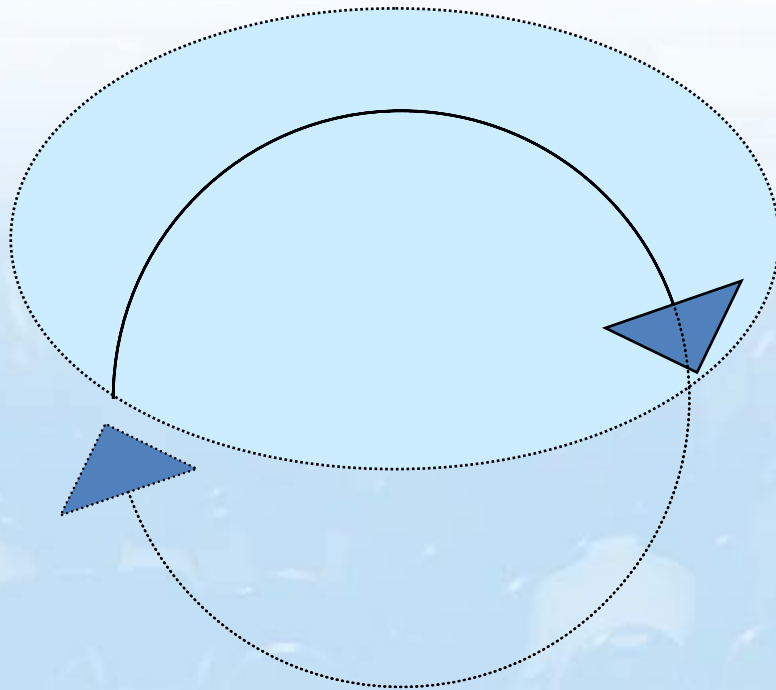


- Atria are still in AF:
 - Stroke risk
 - No mechanical activity
- Cardiac pacemaker is needed
- ...
- Normal Sinusal Rythm should be better
 - Lower risk for stroke
 - Mechanical activity of atria
 - Chronotropic function of sinus node
 - Normal AV conduction with narrow QRS and less ventricular dyssynchrony...

Whence the development of other interventions with indirect action on reentrant circuits

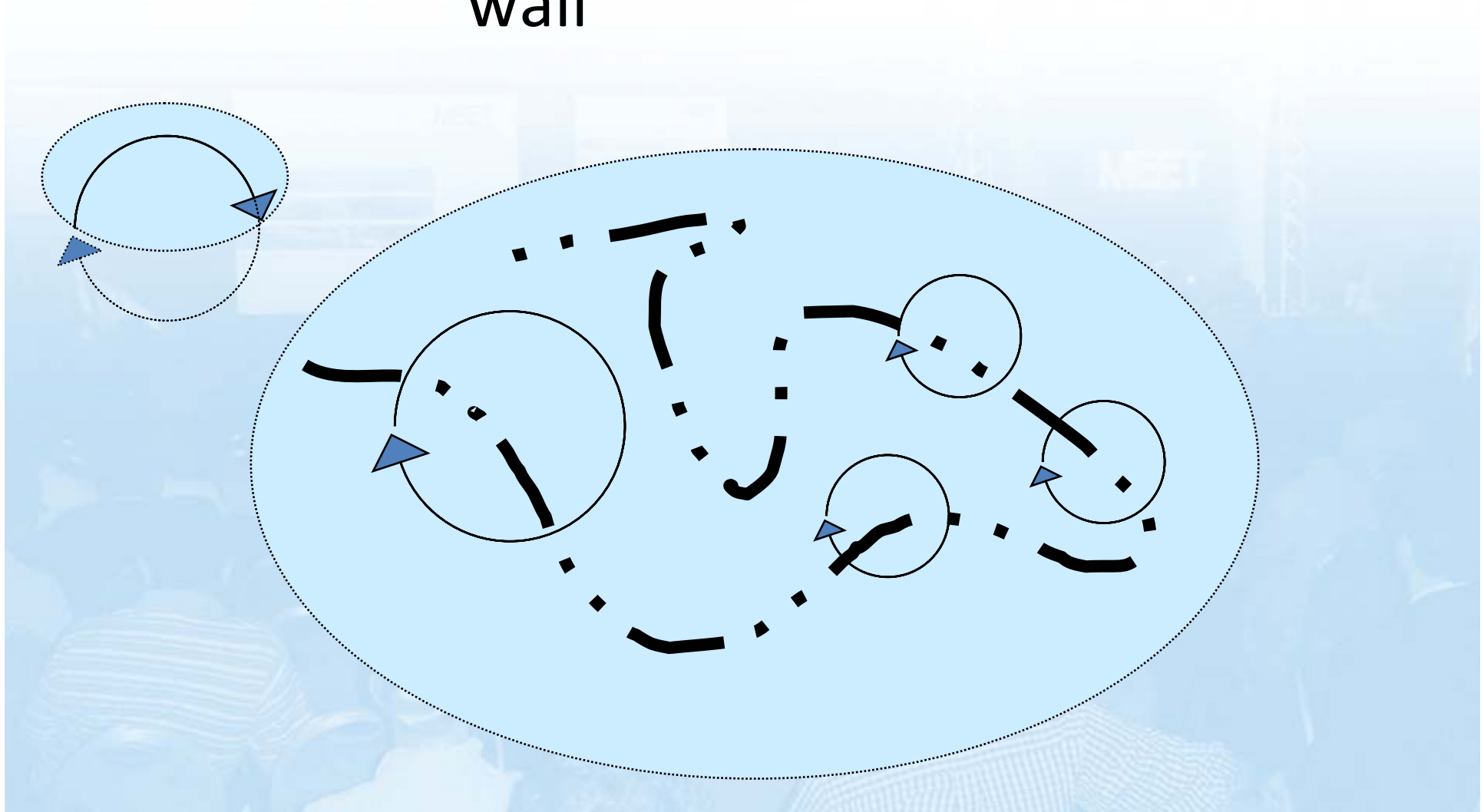
$$\lambda = ERP \times CS$$

wave length = Effective Refractory Period x Conduction Speed



Whence the concepts of depolarization ways and the MAZE

The electrical wave is conducted
in a designed way (maze) of atrial
wall



The Spiral *Guiraudon*

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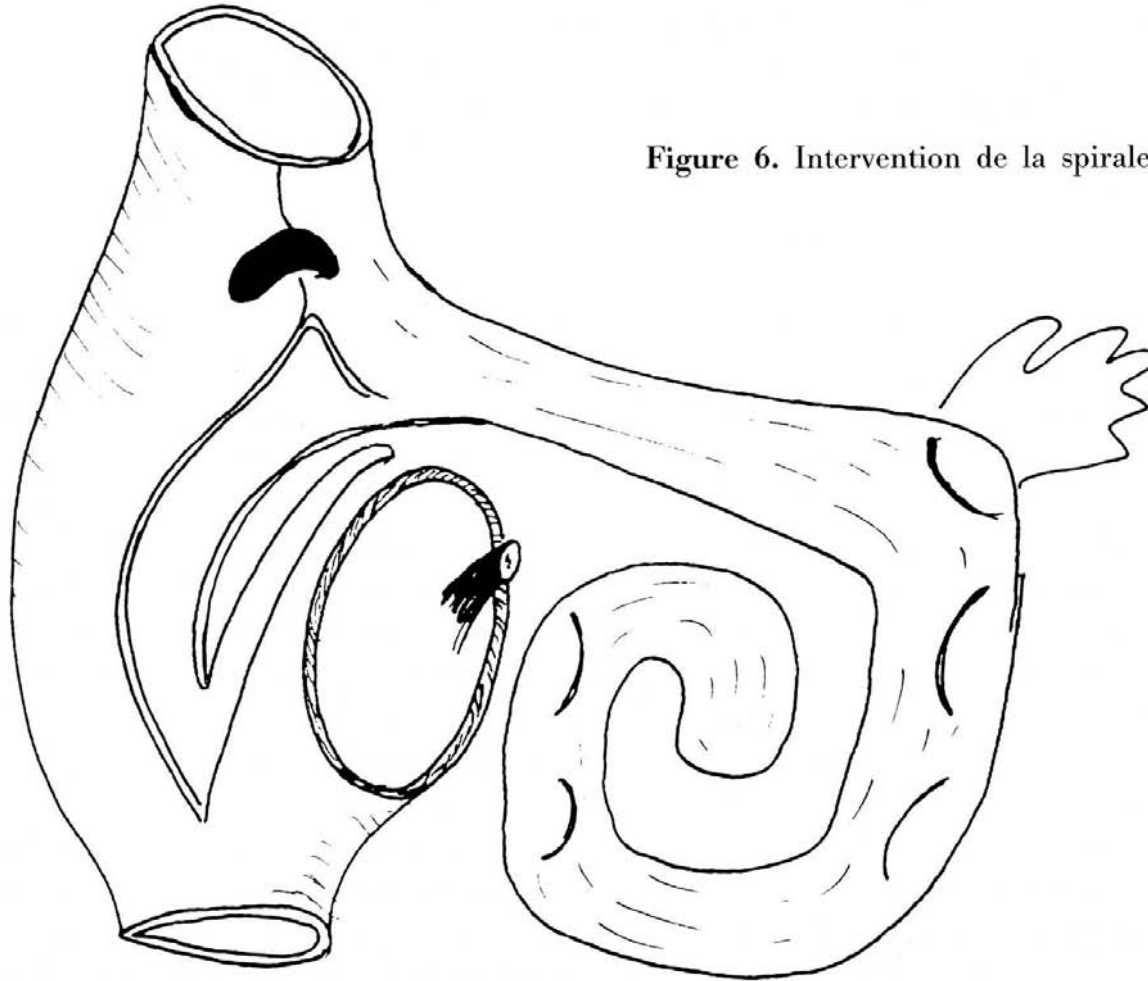
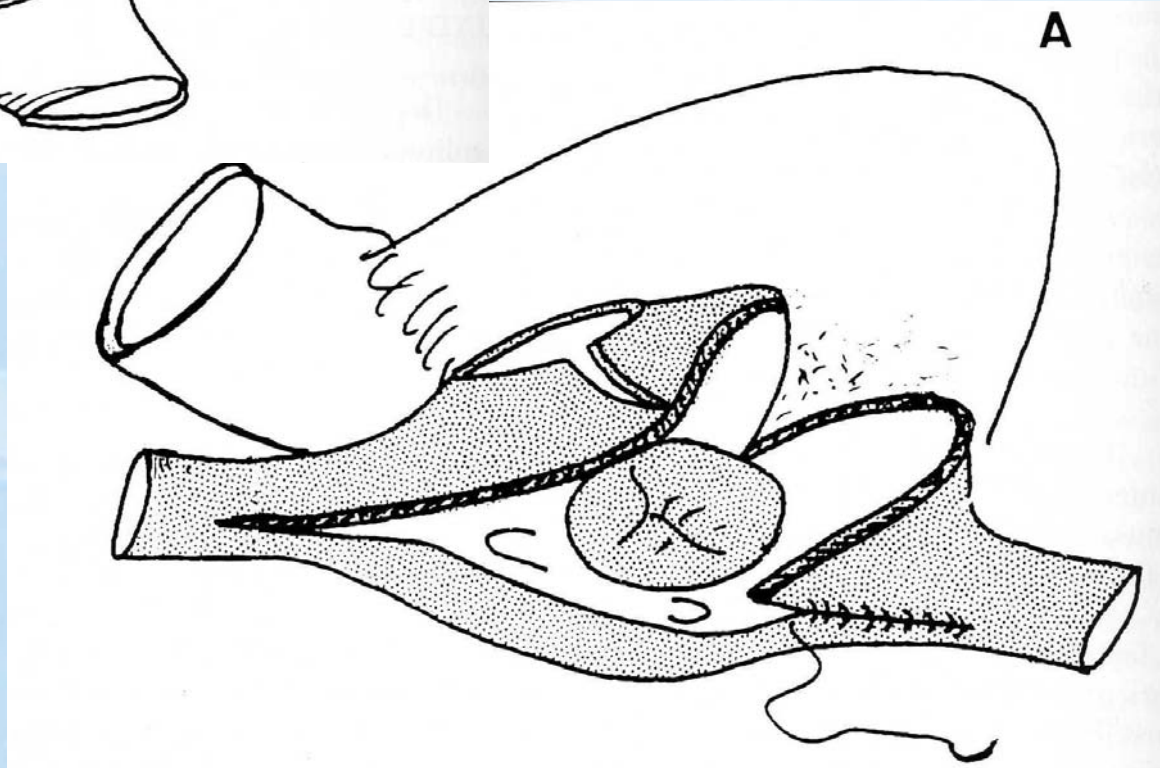
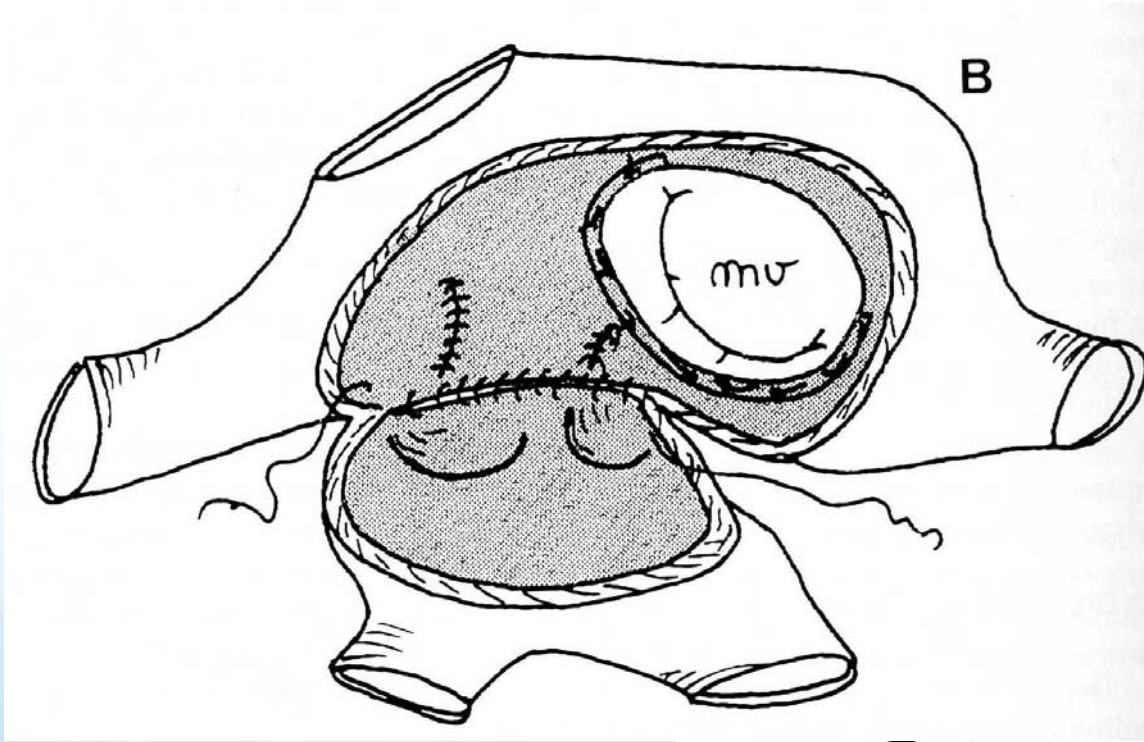


Figure 6. Intervention de la spirale.

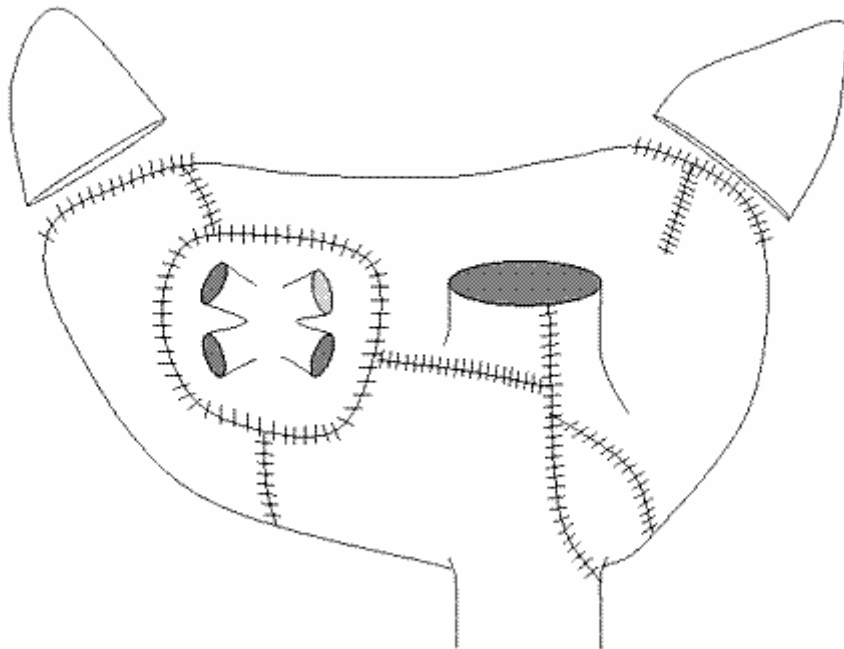


The Maze Cox

Cox Maze



Figure 1.



- Sternotomy
- ECC
- Cut and Sew
- Standard III
- Skill demanding intervention
- Long

Cox STCS 2000

Long term results



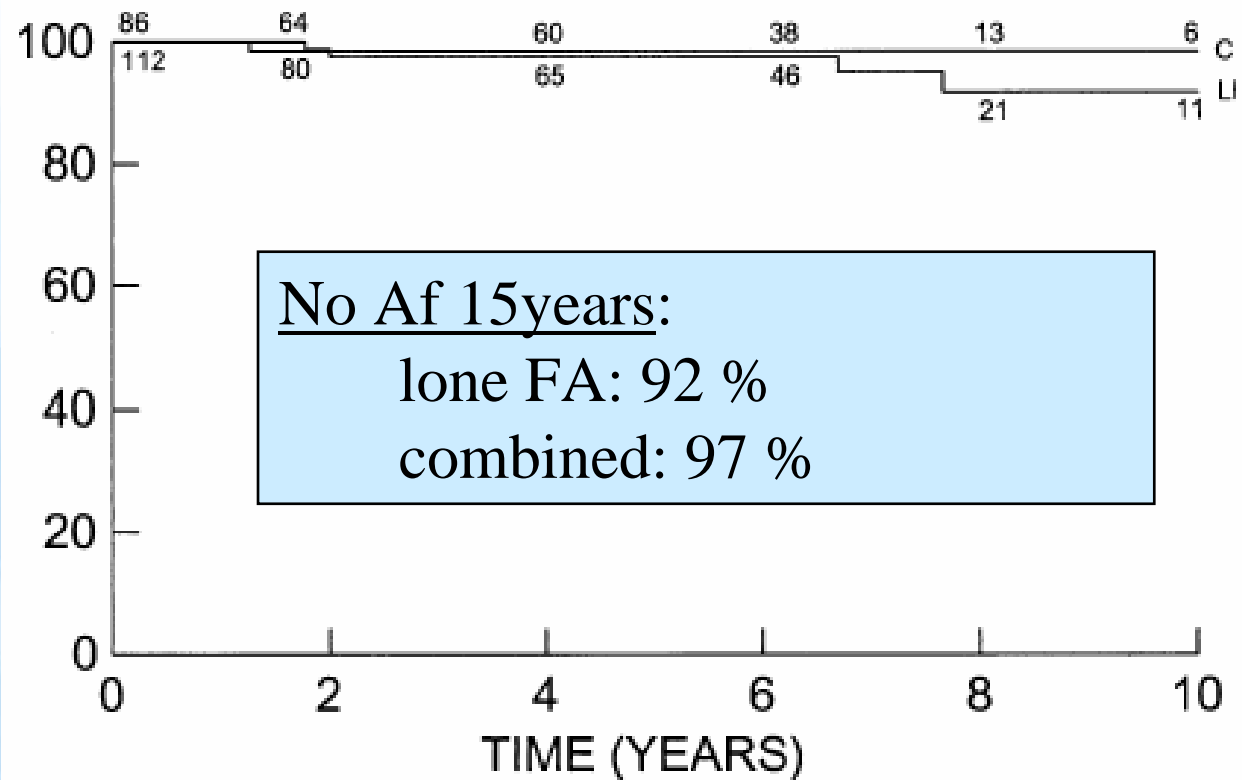
- 346 patients
- All AF
- Operative mortality 2%
- Results:
 - 99 % freeAF 15 years
 - 98 % contraction of Right Atrium
 - 93 % contraction of Left Atrium
 - 15 % Cardiac PM (sinus disease)
- Almost no stroke !

Other results of Cox-Maze III

Prasad SM, RJ Damiano JTCS 2005



- 276 patients
 - combined 41 %
 - lone 59 %
 - paroxysmic 58 %
 - permanent 42 %
- Results
 - Operative Mort. 1,4 %
 - Early relaps 44,6 %
 - PM 16,7 %
- Long term ($6,0 \pm 3,6$ y)
 - ACFA 7,8 %
 - antiarrhythmics 20 %
- Unsuccess correlated with preoperative duration of AF

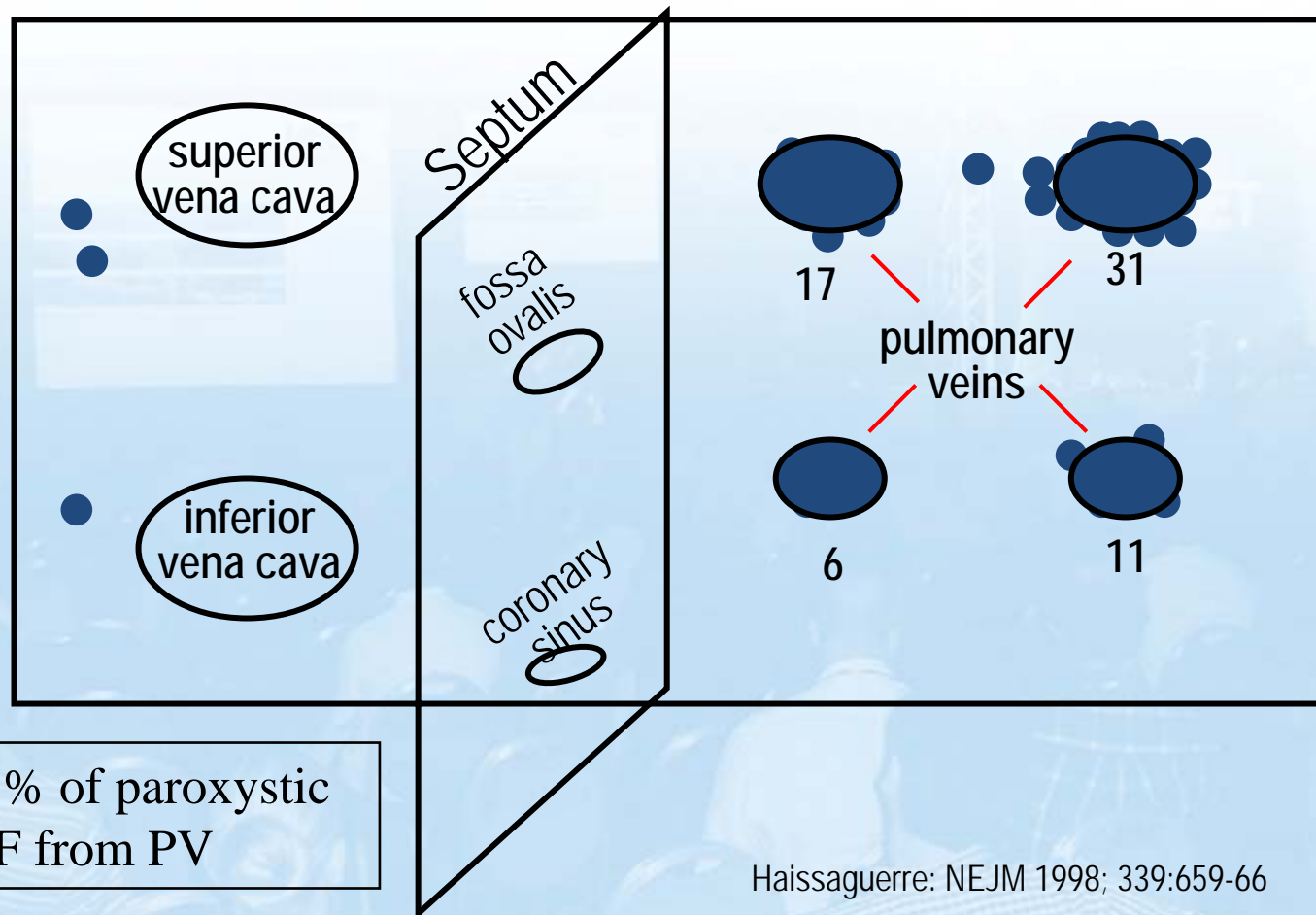


AF, new concepts



Right Atrium

Left Atrium



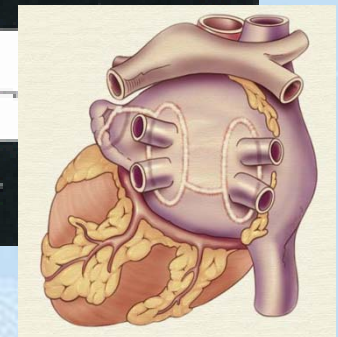
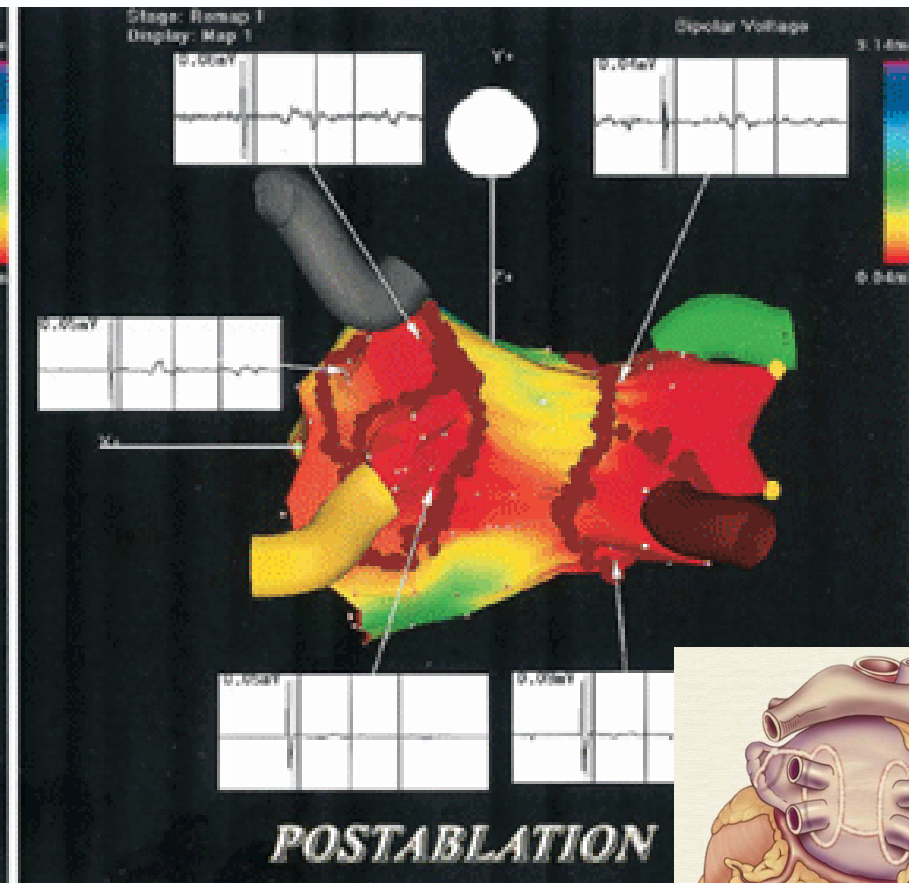
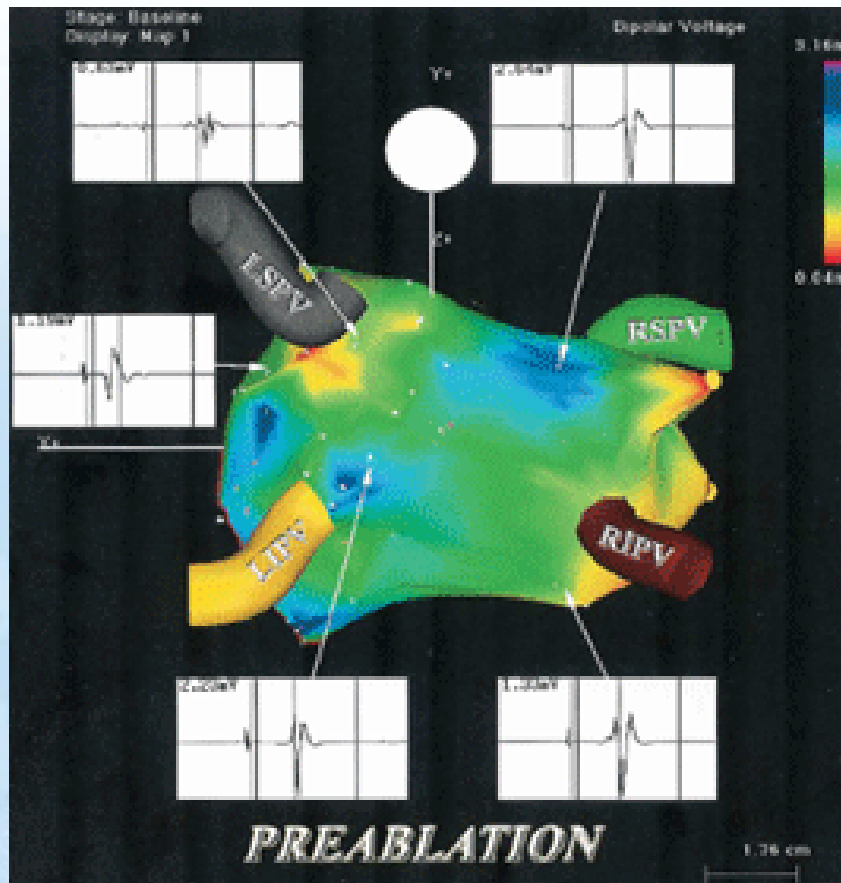
Haissaguerre: NEJM 1998; 339:659-66

Anatomical approach, Maze-Like



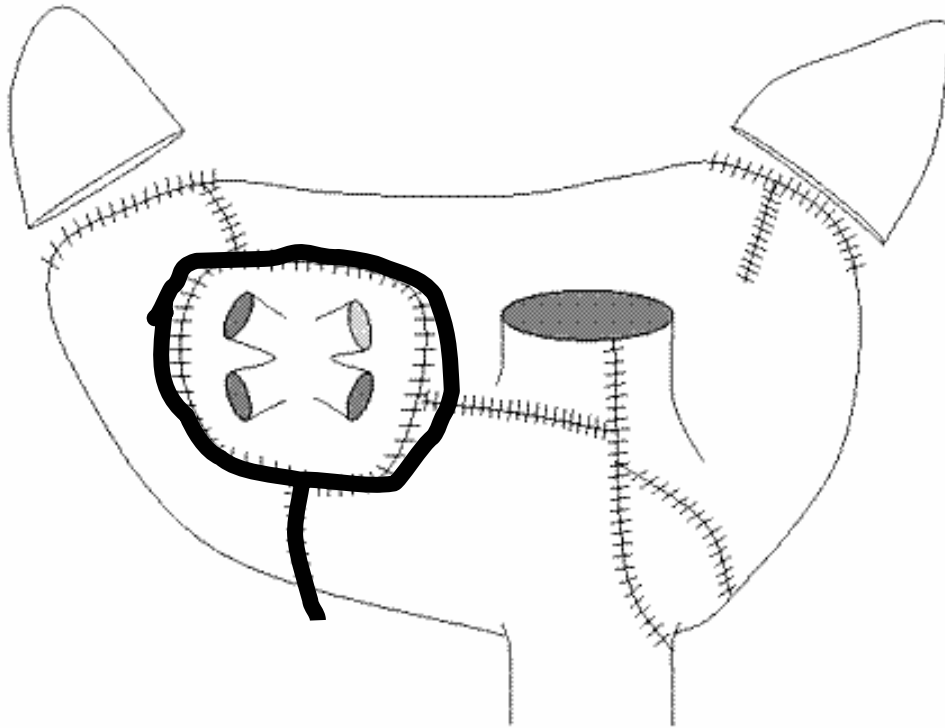
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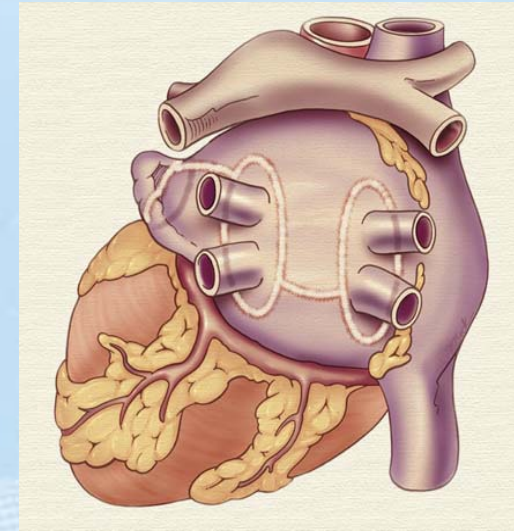


Cox Maze or PVI: Pulmonary Veins Isolation

Figure 1.



- Easier
- Epicardial
- Off Pump
- Miniinvasive

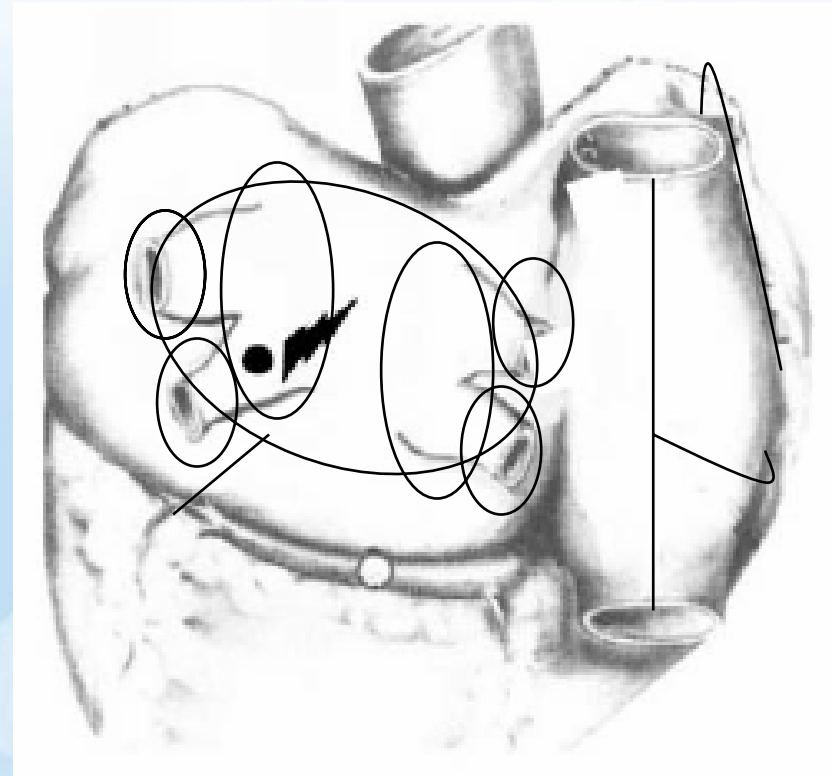


Wich lines: *convergence Pappone -Cox*

- Anatomical approach
 - 4 PV >> 1/2/3 PV
 - Back of LA >> PV
 - Left Isthmus
 - CoxMaze IV

Q

Cox Maze IV



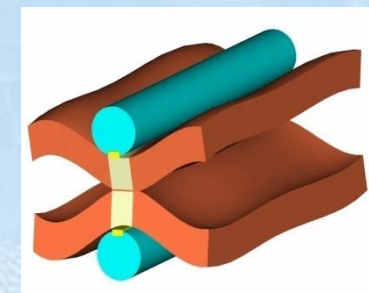
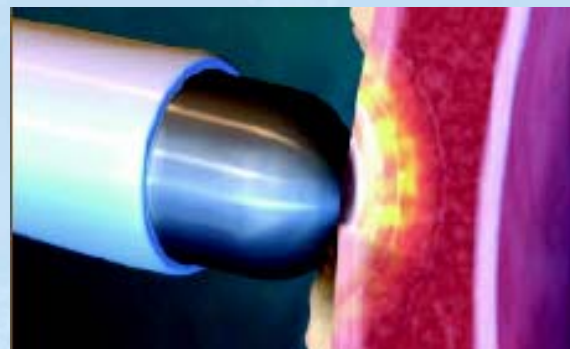
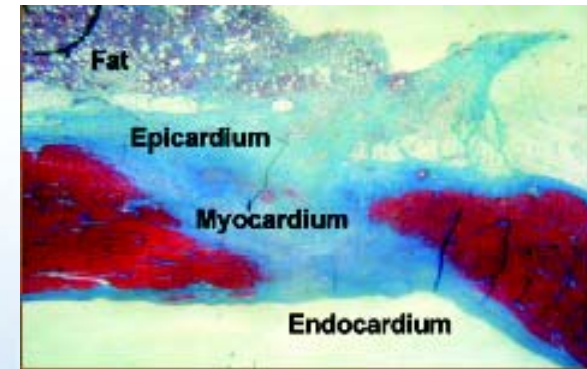
New energies for creation of ablation lines

- How create the fibrous scare of ablation line

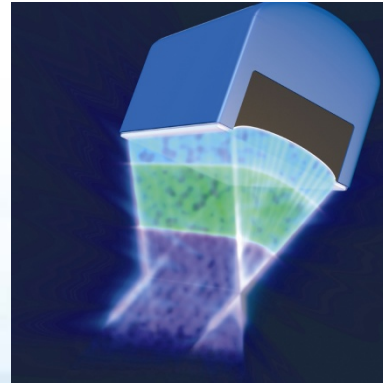
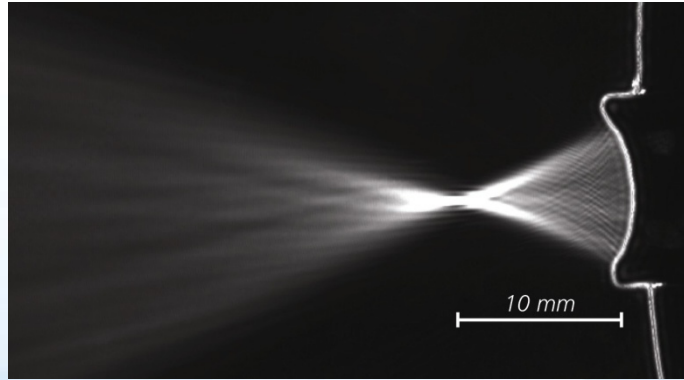
- Cut and Sew
- Warm

- Electrical cautery
- radiofrequency
- Microwaves
- *Laser*
- Ultrasounds HIFU

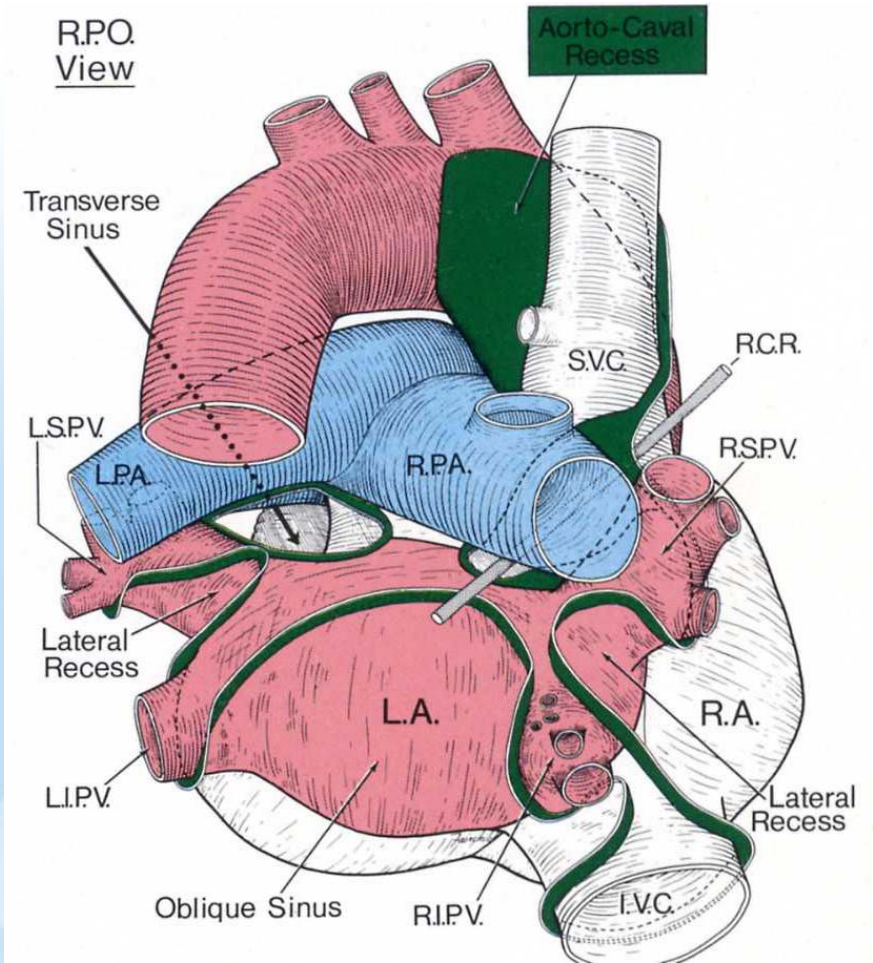
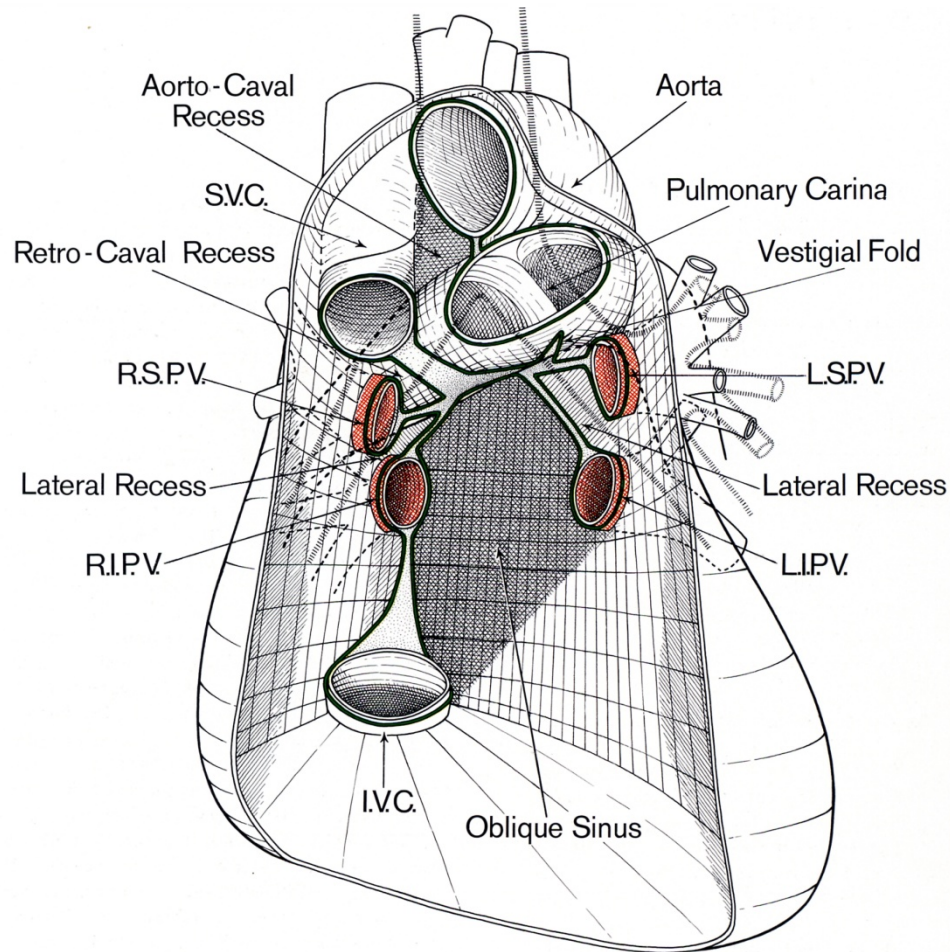
- Cold: cryothérapie



Saint-Jude Epicor



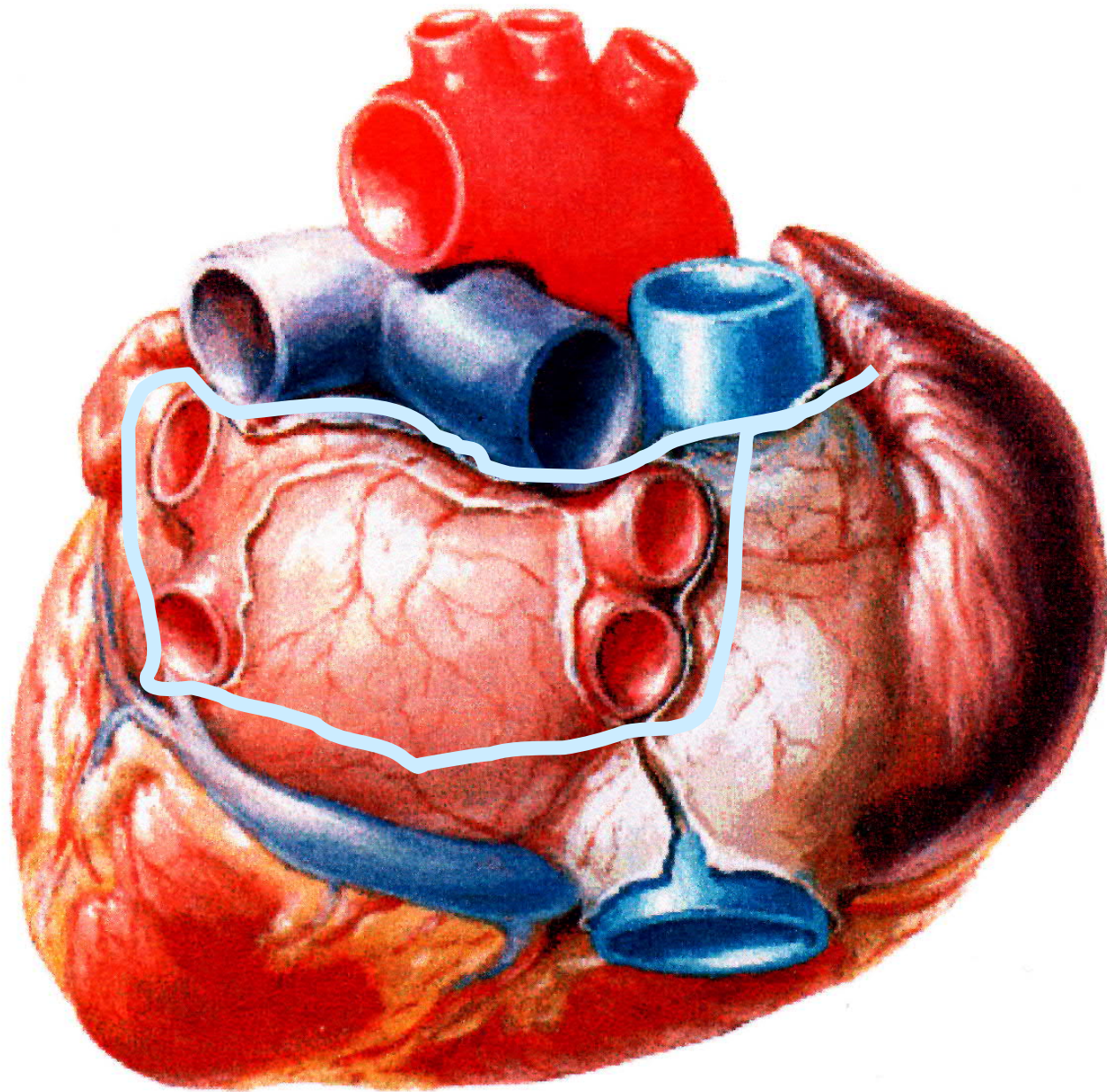
Encircling the 4 PV



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Saint-Jude Epicor

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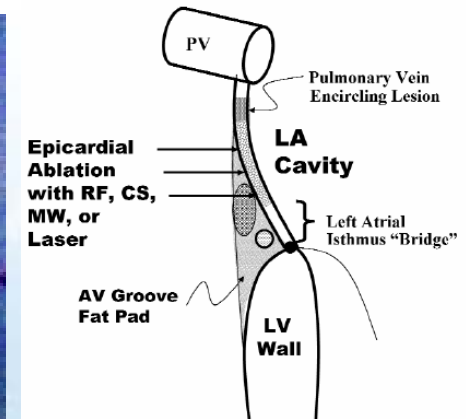


HIFU Epicor Saint-Jude *epicardial mitral line*

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- Wand
- No coronary lesions
- Advantages
 - Left Flutter
 - Better results
- Epicardial
 - Off Pump
 - Mini-invasive



Epicor

Combined surgery



Comparisons between published series of surgical Maze and variants

Author	No. of patients	Surgery type	Concomitant surgery	6-mo freedom from AF
Prasad et al ⁷	299	Cox III	28%	95%
Schaff et al ²⁵	173	Cox III	66%	80%
McCarthy et al ²⁴	83	Cox III	72%	90.4%
Sie et al ¹⁵	122	Hybrid, R&L	100%	77%
Gaynor et al ²⁷	40	Hybrid, R&L	53%	91% (21/23)
Raman et al ²⁶	132	Isolated, R&L	100%	90% (45/50)
Pasic et al ¹¹	48	Isolated L	100%	92%
Mohr et al ¹³	234	Isolated L	68%	81% (99/122)
Williams et al ¹²	48	Isolated L	100%	80%
Benussi et al ¹⁴	132	Isolated L	100%	80.5%
Knaut et al ¹⁶	249	Isolated L	100%	65%-80%
Epicor	103	Isolated L	100%	85%-88%

R, Right-sided lesions; L, left-sided lesions.

Cox - Maze IV

Melby, Damiano Annals of Surgery 2006



- Results (>200 pts)
 - mortality 4 %
 - hospitalisation 11 days
 - complications
 - bleeding id: 10 %
 - stroke id: Cox 1 % / PVI 13 %
 - PaceMaker: Cox 10 % / PVI 0 %
 - post-op AF: 60 à 70 %
 - Cross Clamping time lower in CM IV than CM III (lone FA 42 vs 96 minutes)

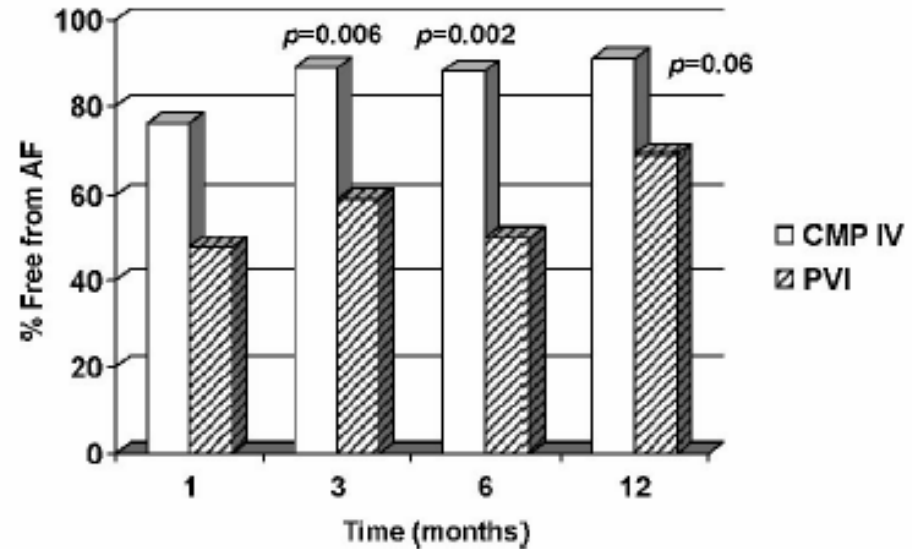


TABLE 4. Freedom From Atrial Fibrillation at 12-Month Follow-up and at Last Follow-up

	CMP IV [n (%)]	PVI [n (%)]
Paroxysmal AF		
12-mo follow-up	18/20 (80)	6/8 (75)
Last follow-up	37/40 (93)	7/10 (70)
Permanent/persistent AF		
12-mo follow-up	32/34 (94)	3/5 (60)
Last follow-up	57/59 (96)	3/7 (43)

Choice of technology ?



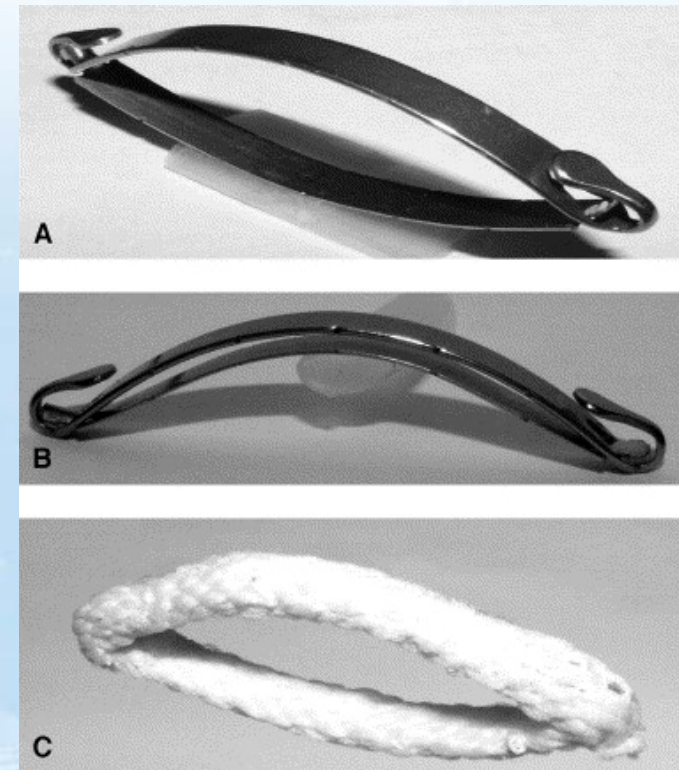
- No randomised study
- Transmurality
 - Commercial arguments
 - Efficiency
 - EPICOR
 - bipolar RF (Atricure ? Medtronic)
 - ?
- Duration of ablation
 - Epicor: slow (10 min) but less dissection
 - bipolar RF fast but more dissection
- Protection of neighbour organs
- Purely epicardial
 - Epicor: one line and mitral line
 - Bipolar RF
- Cox Maze IV
 - Ripolar RF better
- Mini-invasives
 - In progress

Schematic surgical options

- Sternotomy + ECC: Cox Maze III ou IV
 - > 90 % free of FA at 15 years
- Mininvasive: PVI + mitral line
 - 70 % free of FA at 5 years

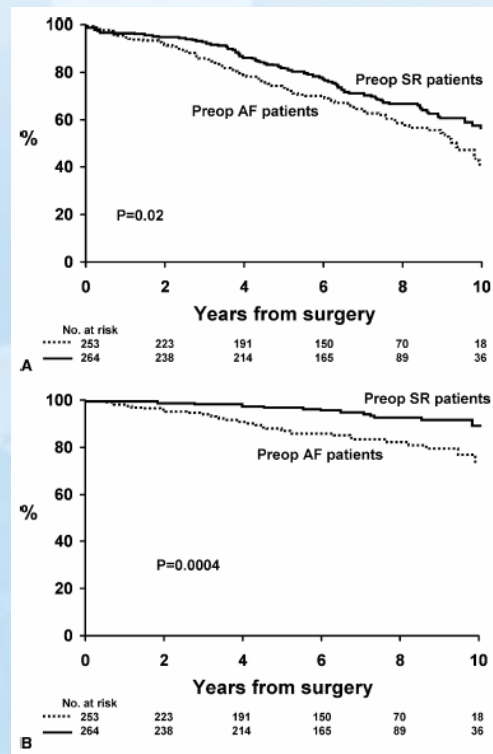
Ideal surgery

- Mini-invasive
 - mini-incisions
 - no ECC
 - fast
 - Day surgery
- Epicardial
- Mini Maze
- LAA exclusion
- Transmural



Epidemiology of AF in combined surgery

- Prevalence
 - MR 46 % Eguchi EHJ 2005
 - AS 15% Ngaage ATS 2006
 - CABG 8.7% Ngaage JTCS 2007
- Pragmatic
 - mitral 15 %
 - aortic 10 %
 - coronary 5 %



- Atrial fibrillation correction surgery: lessons from the Society of Thoracic Surgeons National Cardiac Database (Gammie ATS 2008)
 - 40 % of patients are treated
 - 52 % mitral
 - 28 % aortic
 - 24 % coronary

Advocacy for surgical treatment of AF



- Efficient Cox Maze III:
 - 90 % Affree at 15 years
 - Damiano JTCS 2003 & Annals Surgery 2006
 - Ishii Circulation 2004
 - Gammie ATS 2005
 - Schaff (Mayo Clinic) STCS 2000
- Low morbimortality
 - Fast
 - No PV stenosis
 - No oesophageal lesions with bipolar or HIFU
 - No complications from endovascular approach
- Less stroke with LAA exclusion
- Mechanical activity of atria
- Surgery in progress
 - Mini-invasive
 - Faster
 - ...

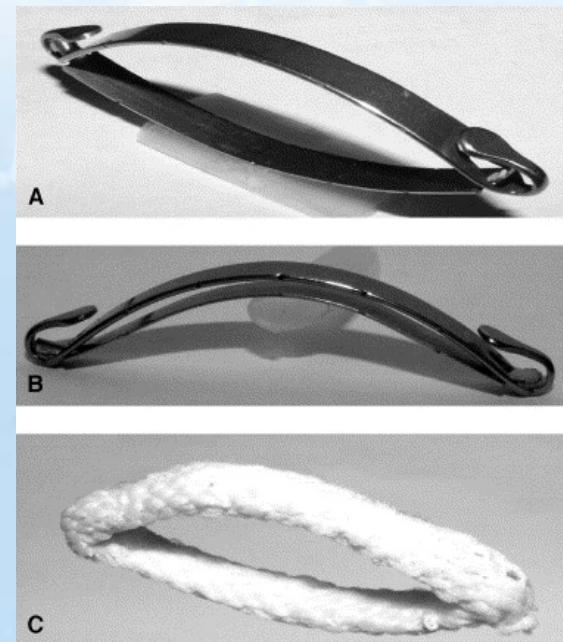
Near Futur or present

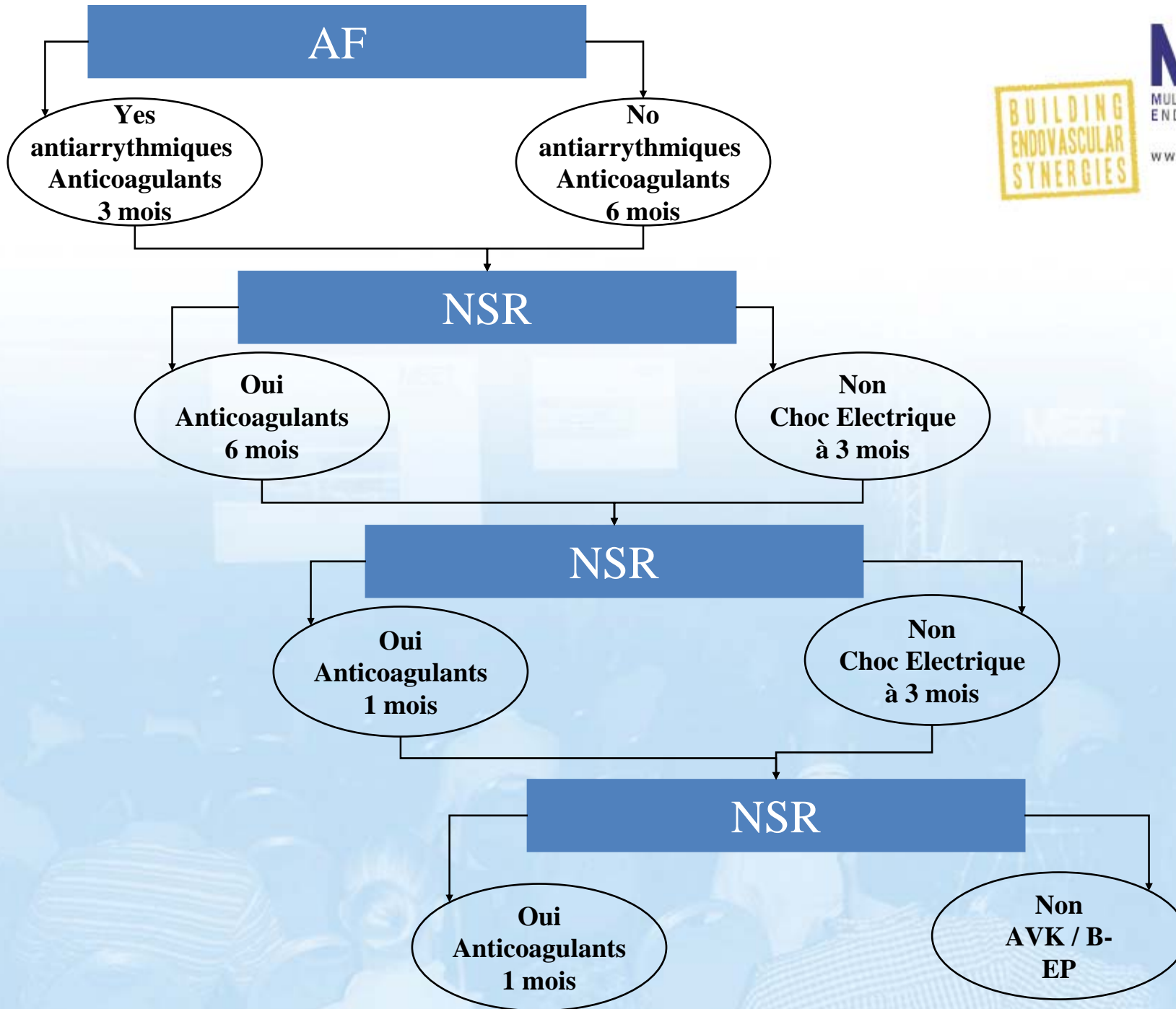
- Better surgery
 - LAA exclusion
 - Cardiac nodes ablation...
- Better medical – surgical collaboration
 - Patient selection
 - Follow-up
 - Anticoagulation
 - Rythm and rate control
 - Successfull strategy: combination of endo and epicardial approach
 - Epi then endo
 - Endo then epi...

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Cardiological saying to
meditate.



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If the patient is dying of his ventricles, the
cardiologist is living of his atria.

