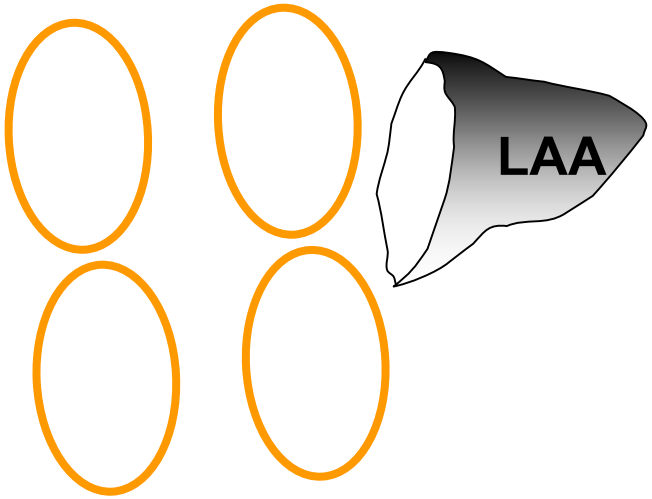
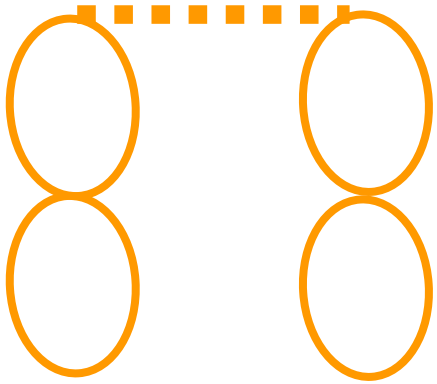
ABLATION DES FA CHRONIQUES

1. VP



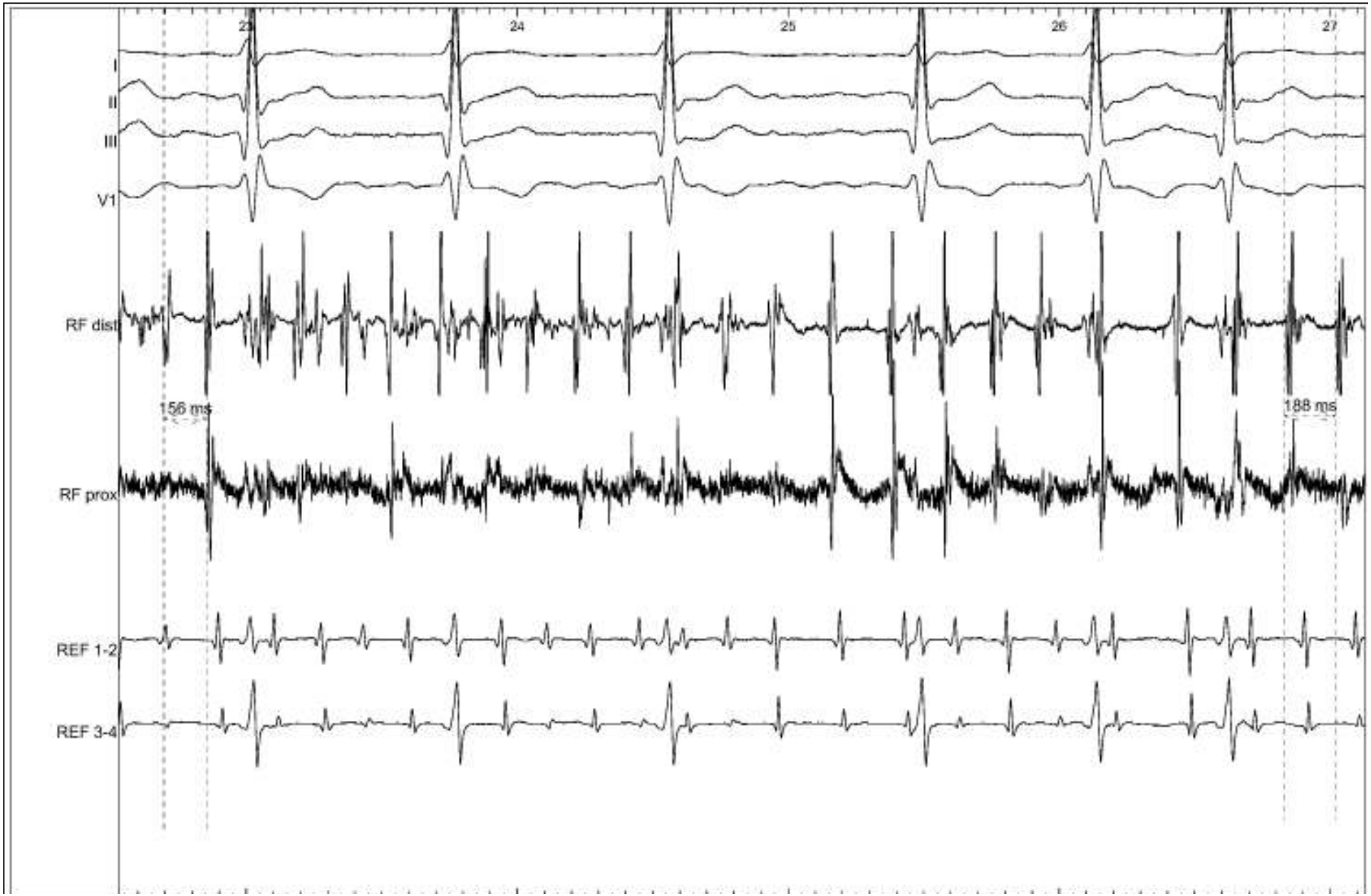
2. Organiser l'activité atriale

3. TOIT



4. Ligne mitrale chez 90% (dont 70% en seconde intention)

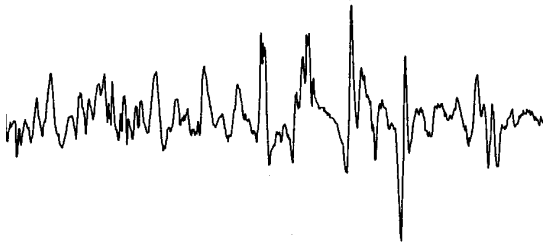
Organisation locale de l'activité



Organisation locale et régionale de l'activi

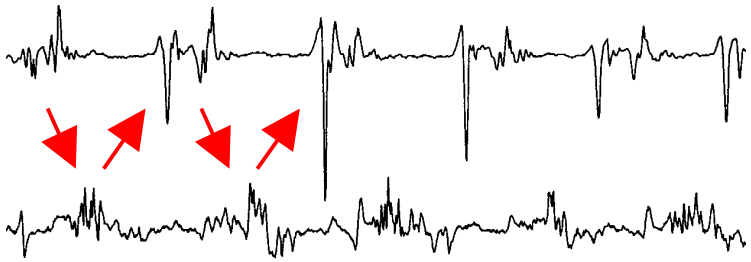
Activation inhomogène en cours de FA

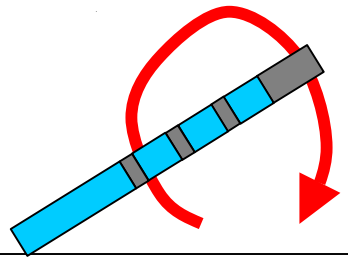
Fractionation



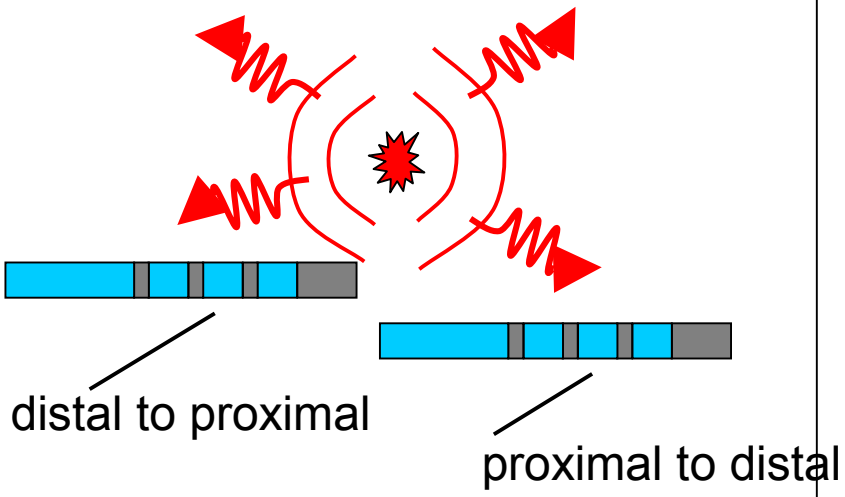
Shorter Cycle Length

Activation Gradient

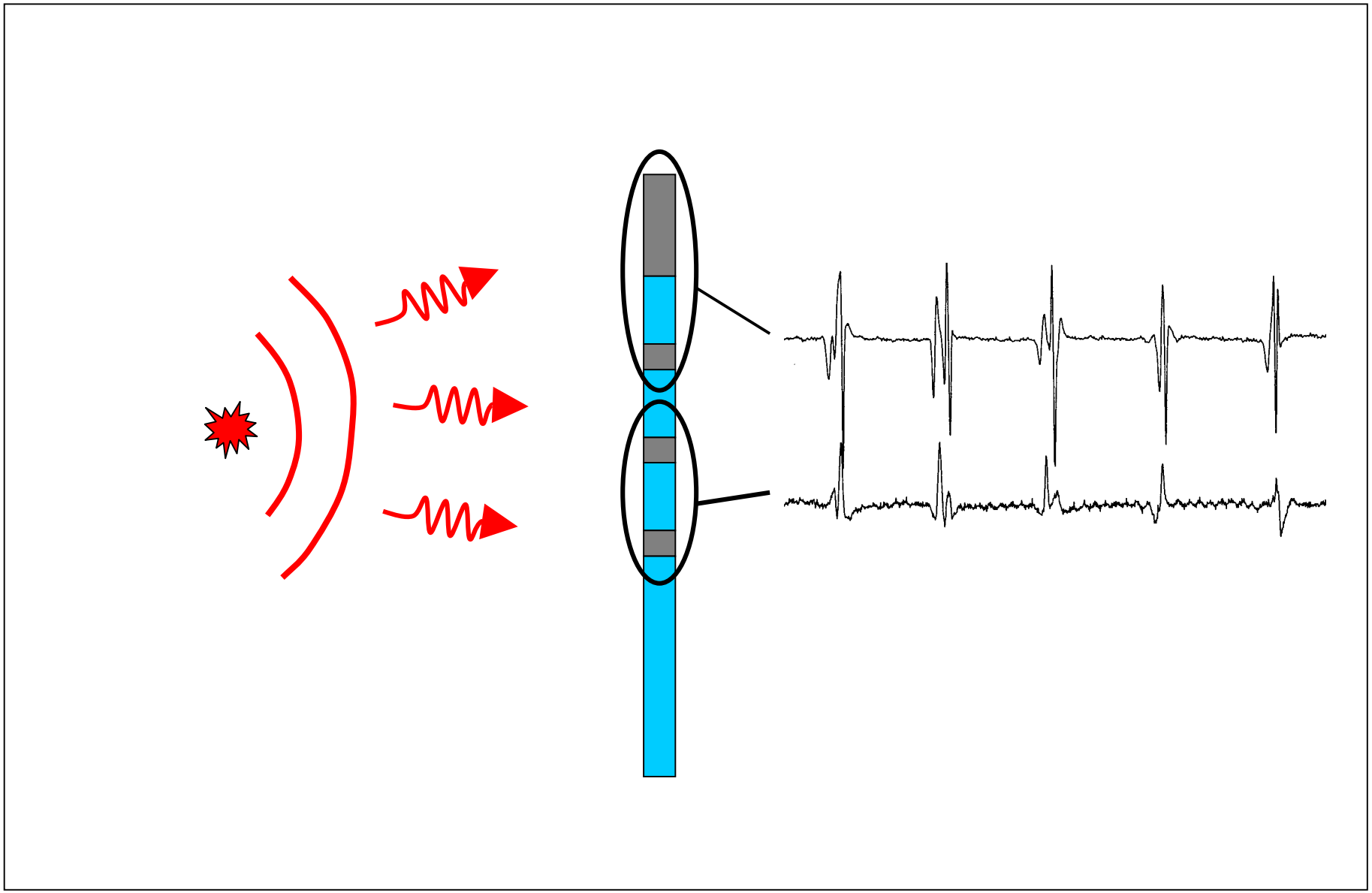




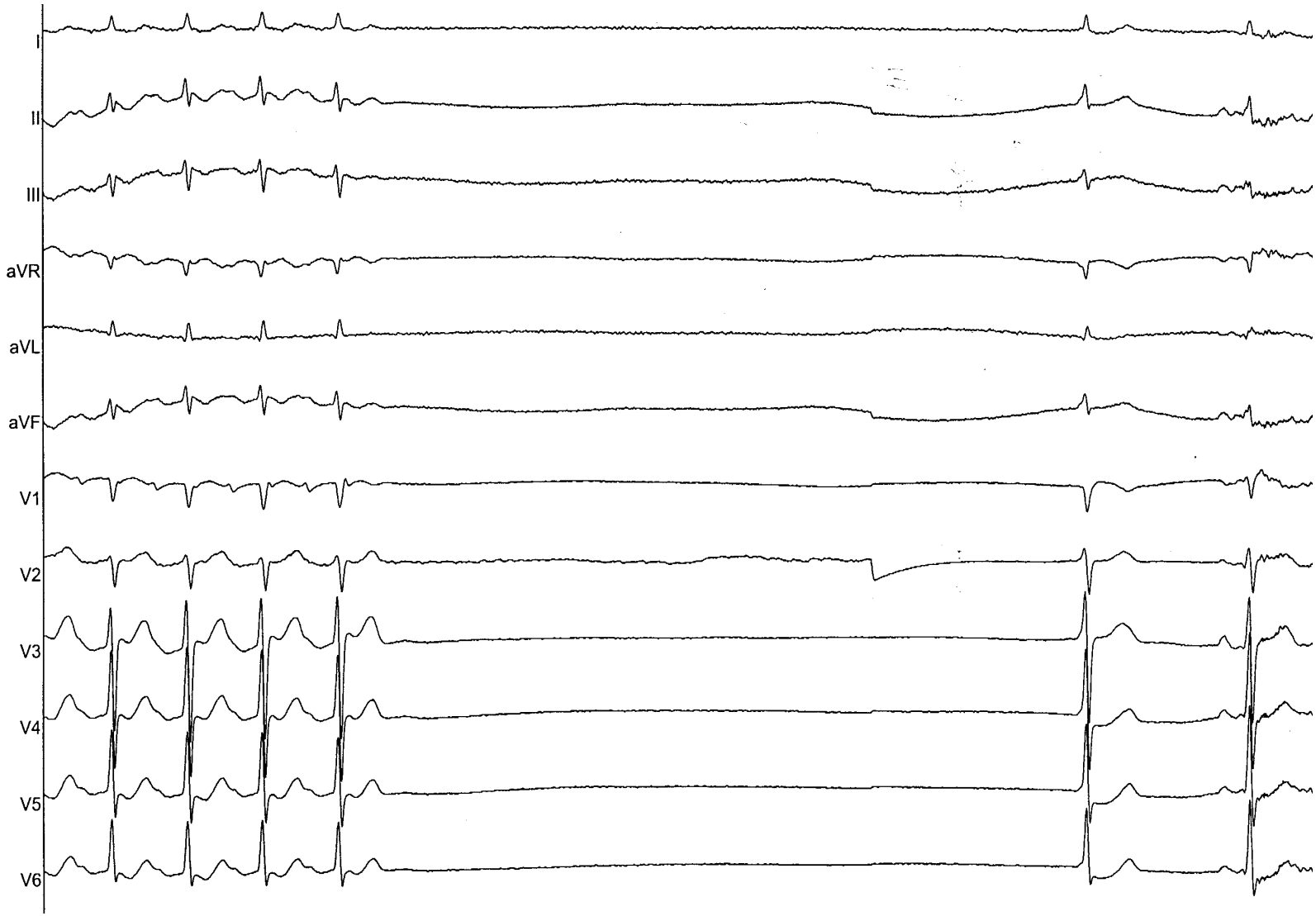
Centrifugal Activation



Activité homogène en cours de FA



FA chronique de 18 mois transformée en flutter perimitral terminé par l'ablation de l'isthme mitral



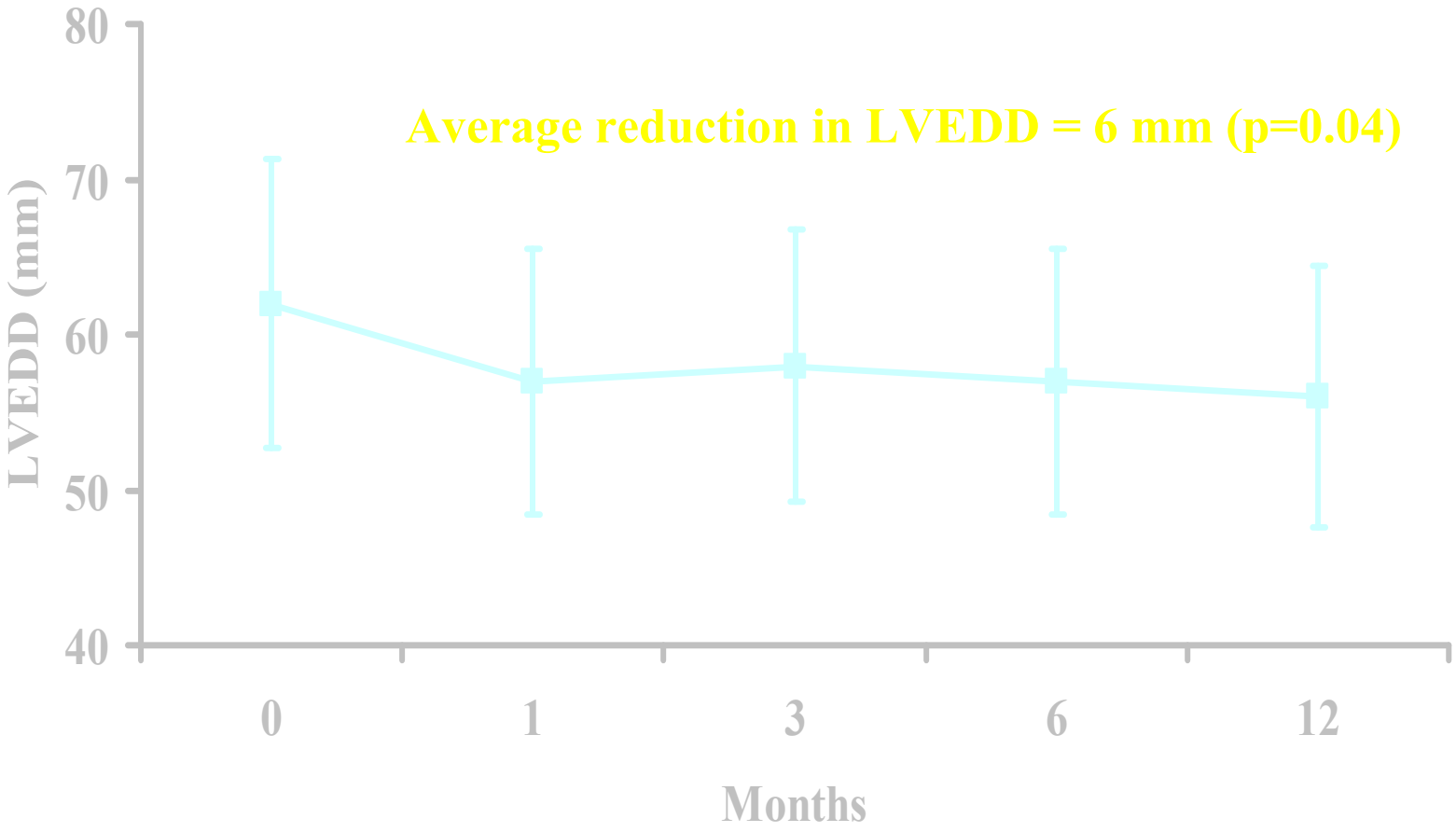
AF and HF , n=74

Male	65 (89%)
Age (years)	56±10
Persistent/Permanent AF	67 (92%)
Duration of AF (months)	80±46
Coexisting heart disease	32 (44%)
• Ischemic	16
• Valvular	10
• Congenital	2
• Hypertrophic CMP	4

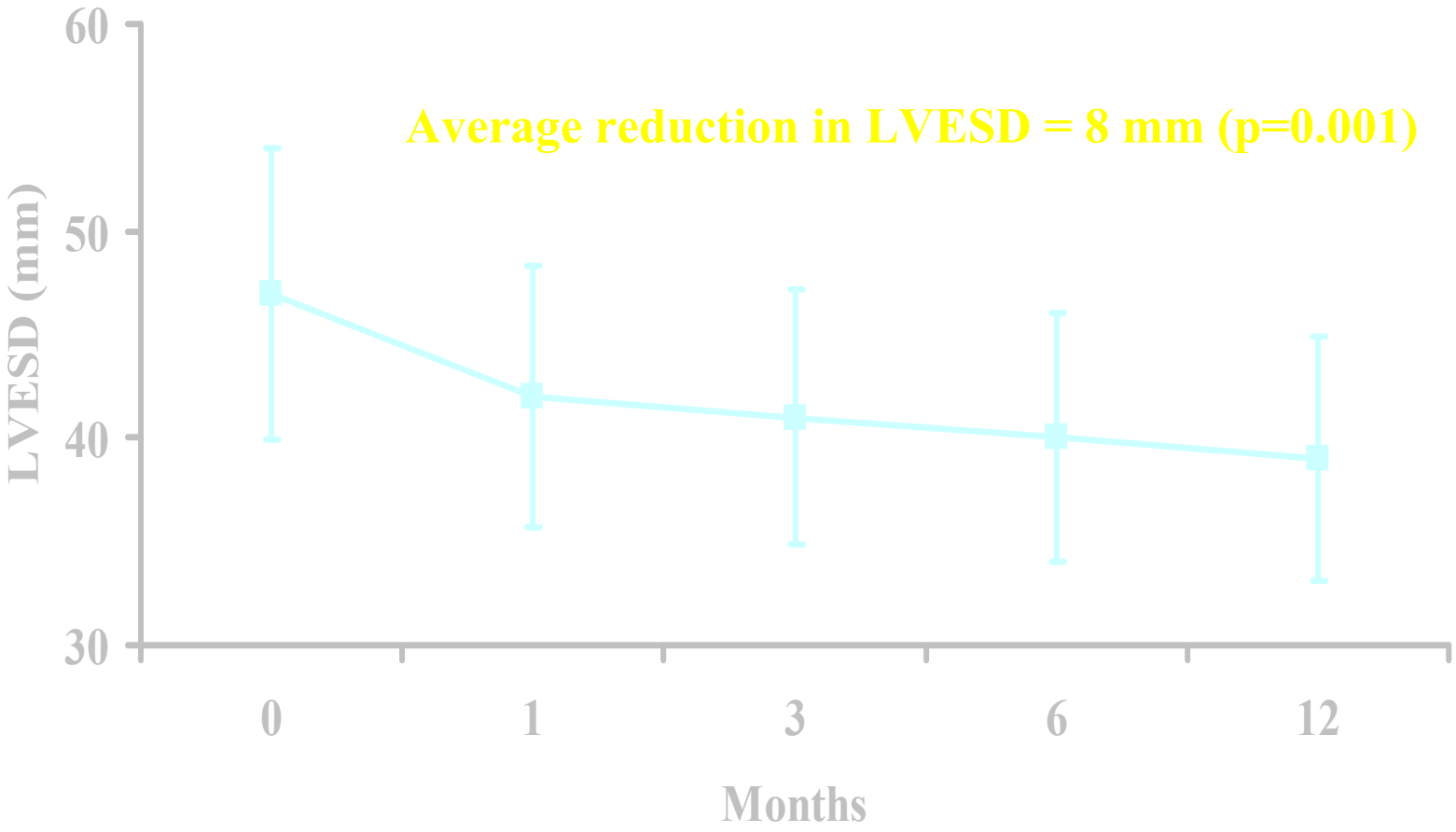
Procedural Outcome

Redo Procedures	35 (48%)
Sinus rhythm (overall)	59 (81%)
Sinus rhythm without drugs	52 (71%)
Duration of follow-up (months)	11±7
Major complications • Tamponade • Stroke	4 (5%) 2 2

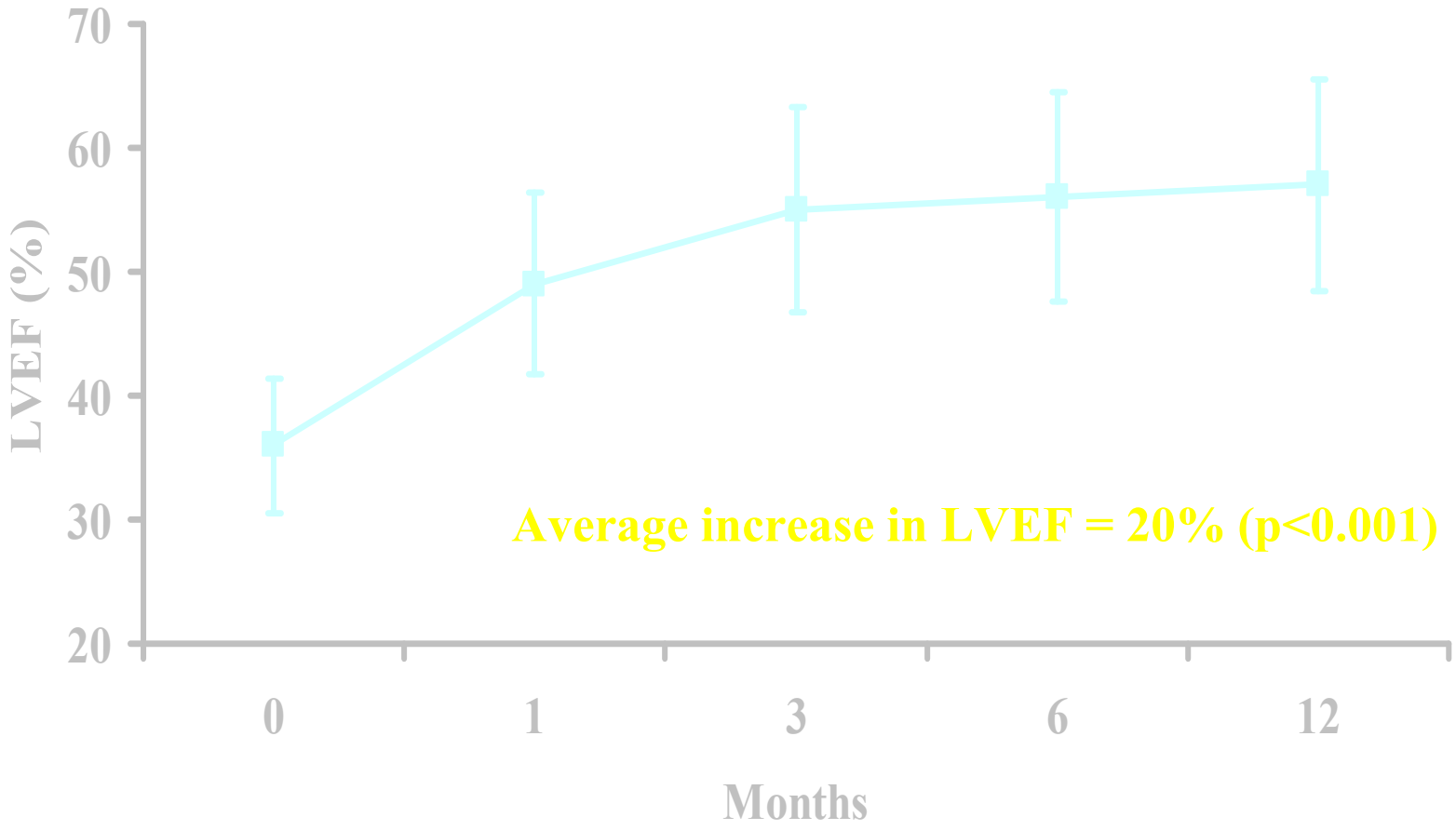
LV End-Diastolic Diameter



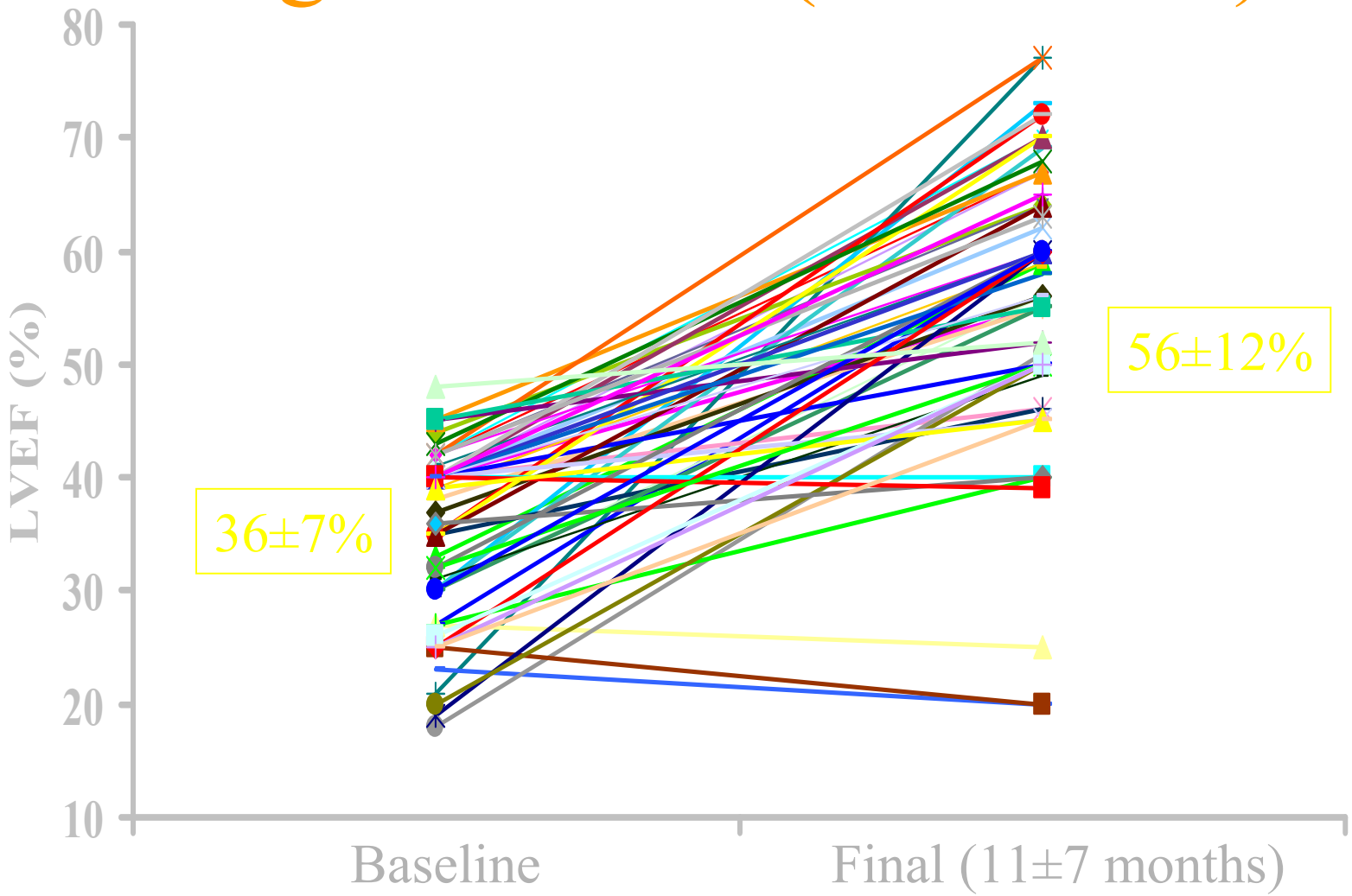
LV End-Systolic Diameter



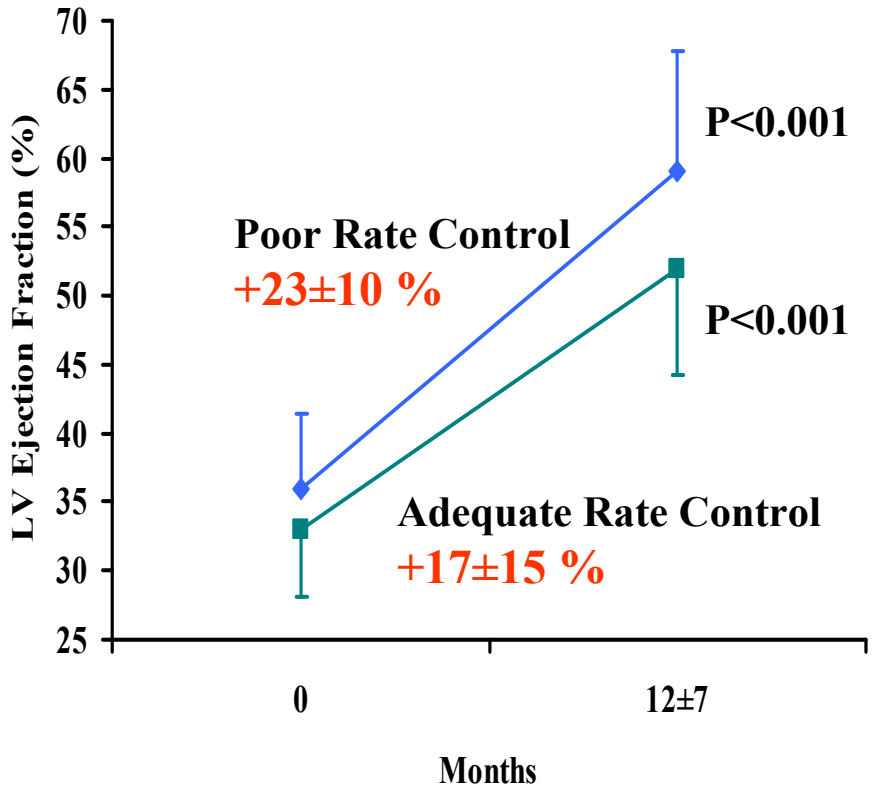
LV Ejection Fraction



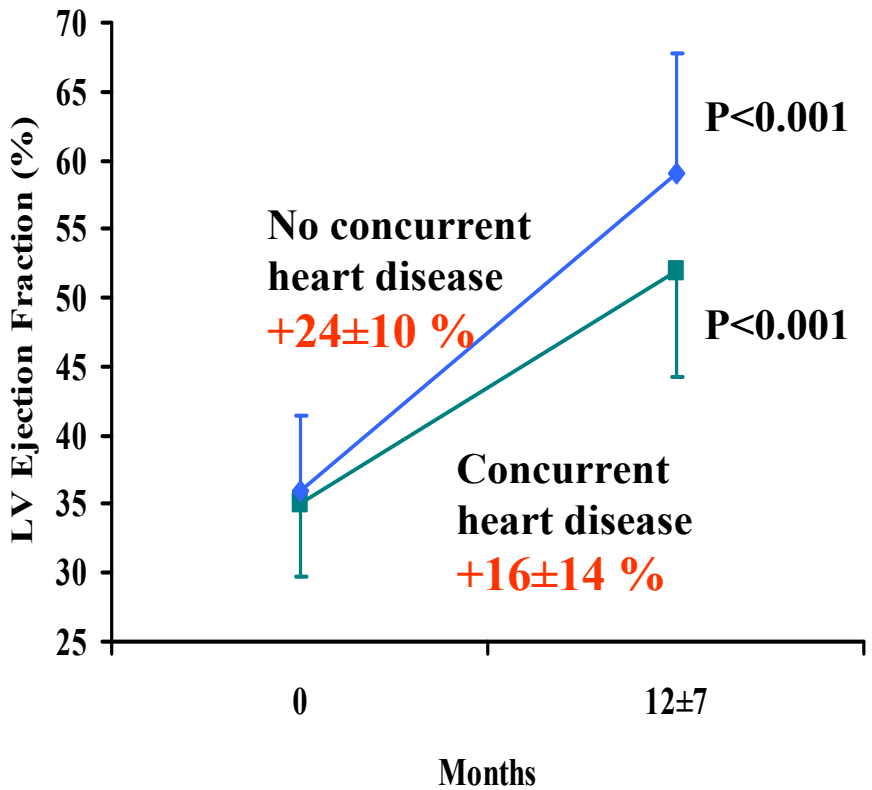
Change in LVEF (Individual)



Rate control



Heart Disease



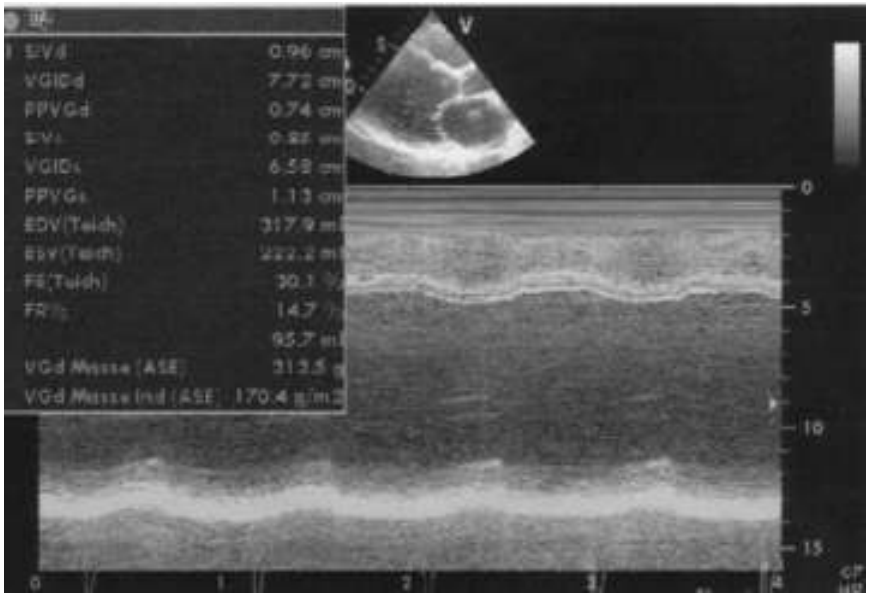
Marked improvement (by 20% or to ≥ 55% EF)

Poor rate control: 86%
Adequate rate control: 54%

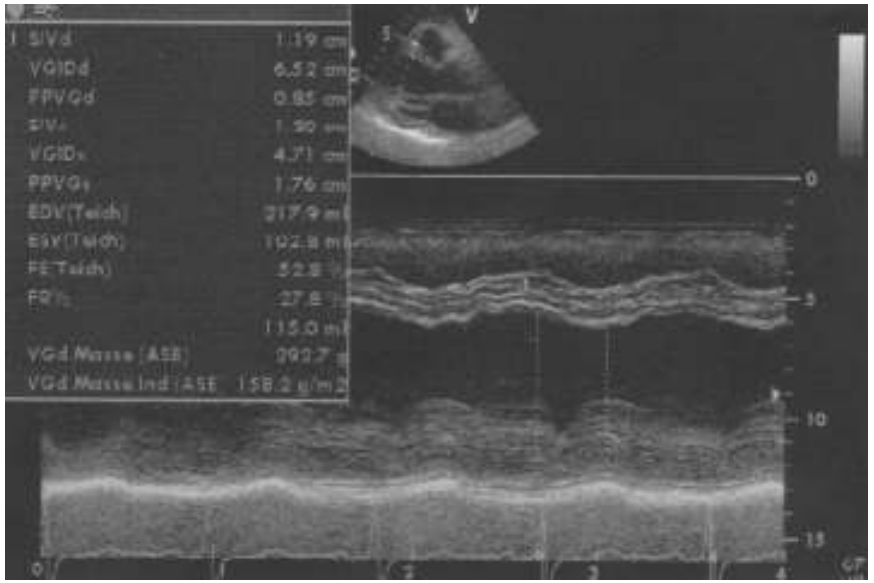
92%

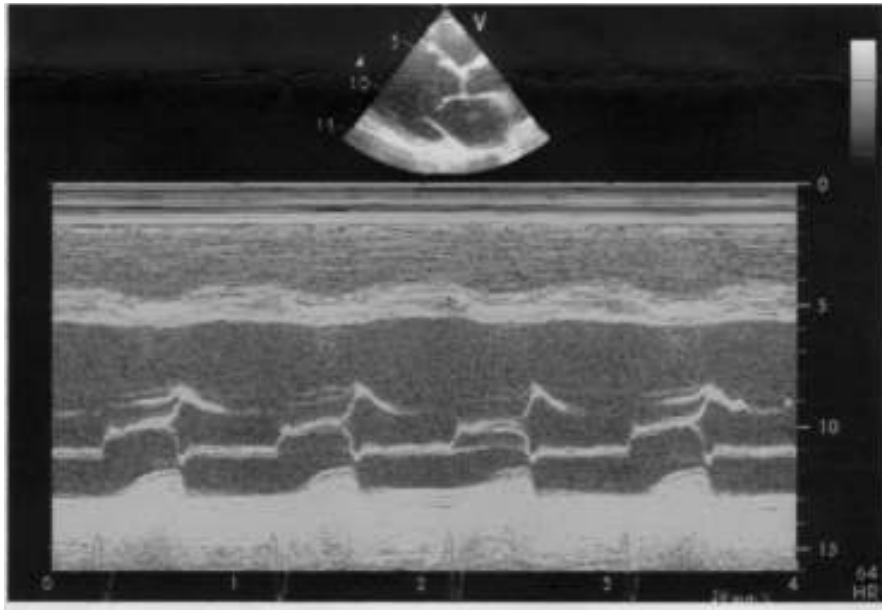
No concurrent HD: 88%
W/ concurrent HD: 54%

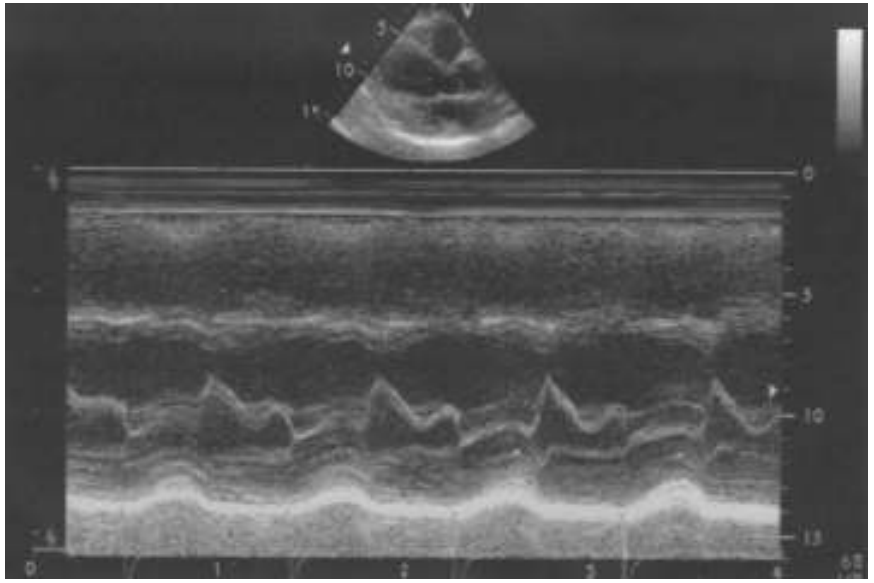
At 1 month



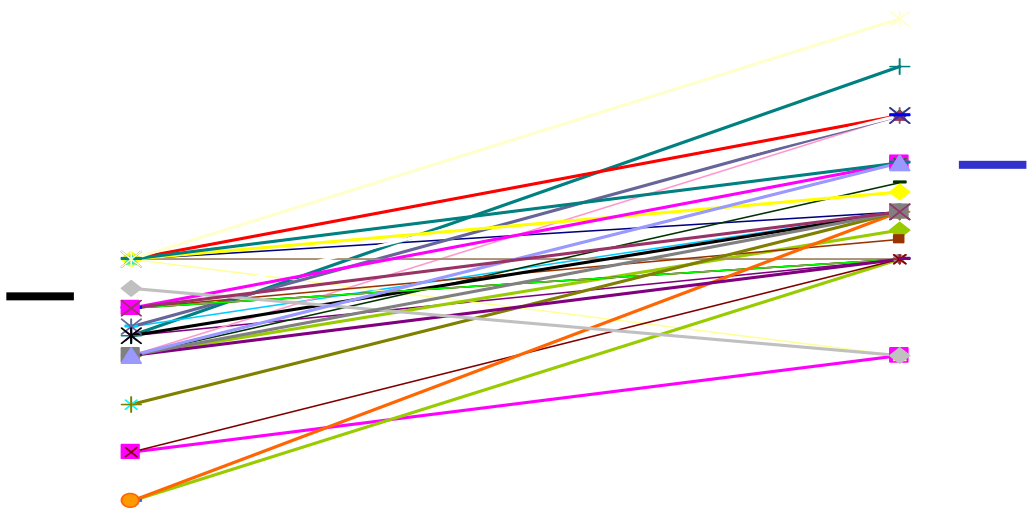
At 3 month







Effect of PVI on LV EF



Penn
University of Pennsylvania

Ablate and pace strategy

TABLE 3. Summary of Findings From the 21 Studies Included in the Meta-Analysis

Author (ref)	No. of Patients	Average Follow-Up	Exercise Duration	Ventricular Function	QOL or Sx	Health Care	Total Mortality, n (%)	Sudden Death, n (%)
Olgin (27)	54	24 mo			↑	↑	4 (7)	2 (4)
Geelen (10)	235	20 mo						6 (2)
Wong (8)	11	3 mo		—				
Jackman (28)	17	8 mo					3 (18)	1 (6)
Heinz (21)	10	48 d		↑				
Bubien (3)	44	6 mo			↑			
Twidale (19)	14	9 mo	—	↑			1 (7)	
Brignole (9)	22	3 mo	↑	—	↑		1 (4)	0 (0)
Darpo (29)	220	31 mo					31 (14)	11 (5)
Natale (22)	14	12 mo		↑	↑			
Kay (6)	156	1 y	—	—	↑	↑	23 (15)	5 (3)
Brignole (5)†	43	6 mo	—	—	↑		0 (0)	0 (0)
Fitzpatrick (25)	107	2.3 y			↑	↑	17 (16)	2 (2)
Jensen (26)	50	17 mo			↑	↑	6 (12)	2 (4)
Morady (30)	20	1 y					0 (0)	0 (0)
Edner (23)	29	216 d		—				
Geelen (24)	11	6 mo		↑	↑		0 (0)	0 (0)
Buys (7)	25	7 mo	—				0 (0)	0 (0)
Lee (11)†	30	6 mo	↑	↑	↑	↑	0 (0)	0 (0)
Twidale (20)	22	14 mo*	↑	↑	↑	↑	2 (23)	2 (9)
Jordaens (31)	47	25 mo						0 (0)

AF ablation vs ablate and pace/resynchronization

Improvement in LV EF: 4.4 ± 0.01 %

Improvement in LV EF 6.9 *% with BiV pacing*

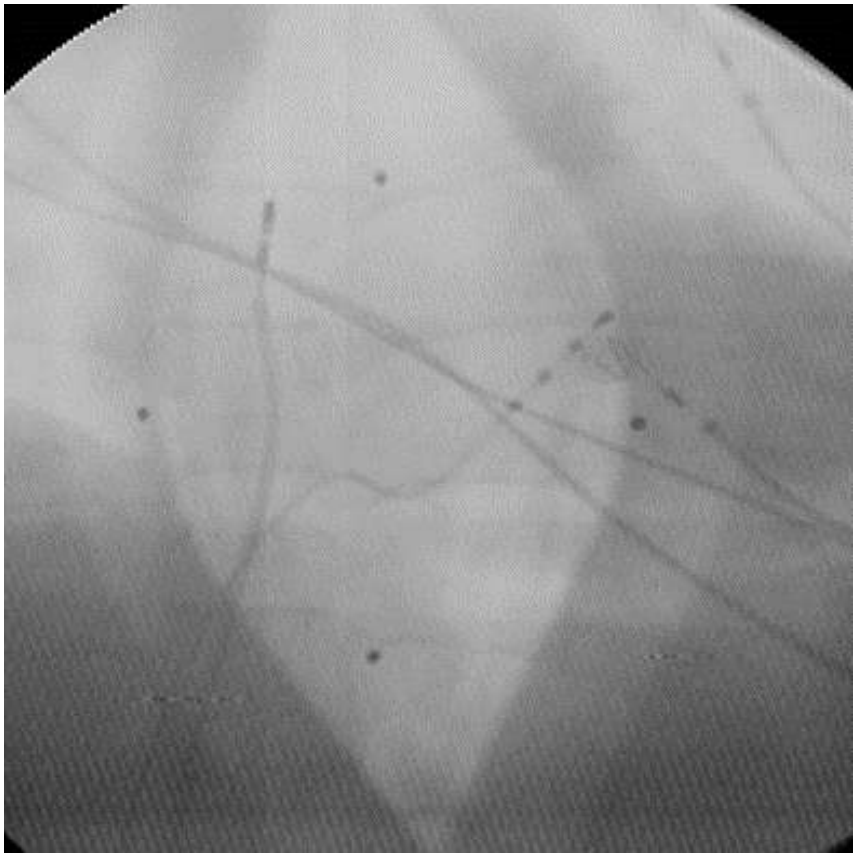
While AF ablation in HF patients results in a marked LV improvement in 75%, with a 20 ± *13 % improvement in LV EF*

Risk of Tamponade associated with PVI: largely unknown!

- At our centre: PVI is associated with ~ 1/1000 tamponade
- WW Survey: 10199 pts; 1.22% (Cappato Circ 2005)
- European registry:

  6759 pts, 1.9%

  (Jais HRS 2004)



Risk associated with linear lesions: Tamponade

Year: 2002	2003
Procedures: 348	398
PVI in all	PVI in all
Tamponades: 9 (2.6%)	3 (0.8%; $p<0.05$)
During linear lesions: 9	3
At mitral isthmus: 5	2
At cavotricuspid Isthmus: 2	0
Mechanical perforation: 2	1

Iatrogenic Flutters

- Atypical atrial flutter of new onset (iatrogenic) in 340 patients (3.9%)
- More frequently observed (*P*0.001) in centers using exclusively 3Dguided compartmentalization strategies (8.4%) than in centers exclusively performing ablation of the triggering substrate or PV electrical disconnection (0.8%).

Cappato et al,Circulation. 2005;111:1100-5

Study	n	Number proc/pt	Follow-up	Long term success - AAD	Long term success + AAD	Stroke	PV stenosis	Tamponade
Bordeaux	307	1.45	22± 16	72%	82%	0	0.5%	< 1%
SA Chen	79	1.08	6 ± 2	86%	99%	2.5%	42%	1%
T Arentz	51	1.6	24 ± 10	45%	80%	0	19%	6%
C Pappone	251	NA	10 ± 5	75%	80%	0	0	< 1%
B Cauchemez	60	1.55	8 ± 9	60%	75%	3	0	3%

Complications: FA Paroxystique

- STENOSE DES VEINES PULMONAIRES < 1%
- TAMPONADE < 1%
- ACCIDENT EMBOLIQUE < 0,5%
- FISTULE ATRIO-OESOPHAGIENNE (1/1000?)
- DECES ?
- RISQUE SUPERIEUR SI INSUFFISANCE CARDIAQUE

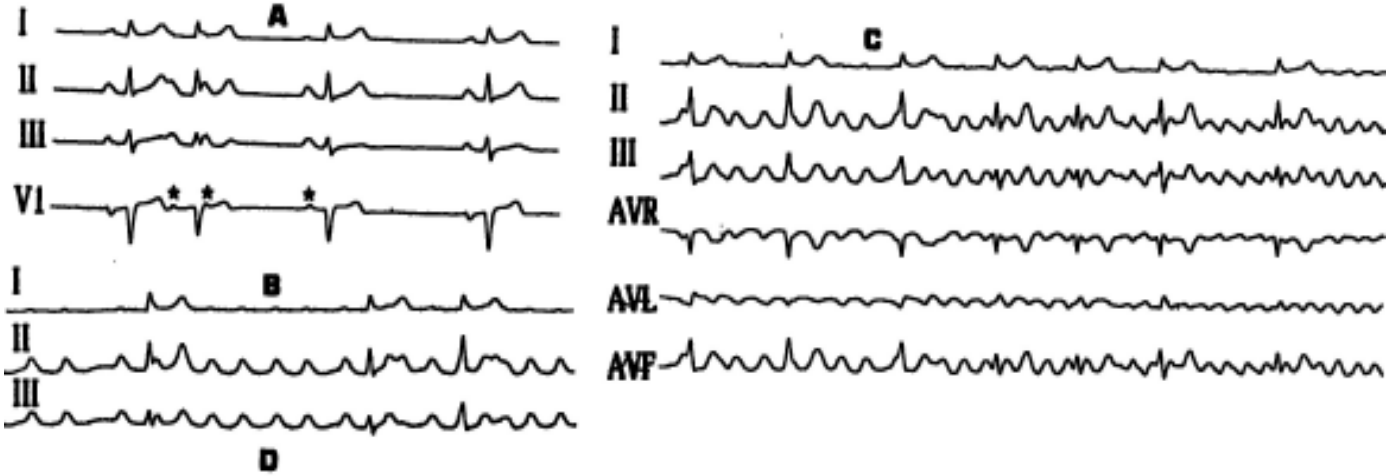
- **<u>FA focales</u>** :

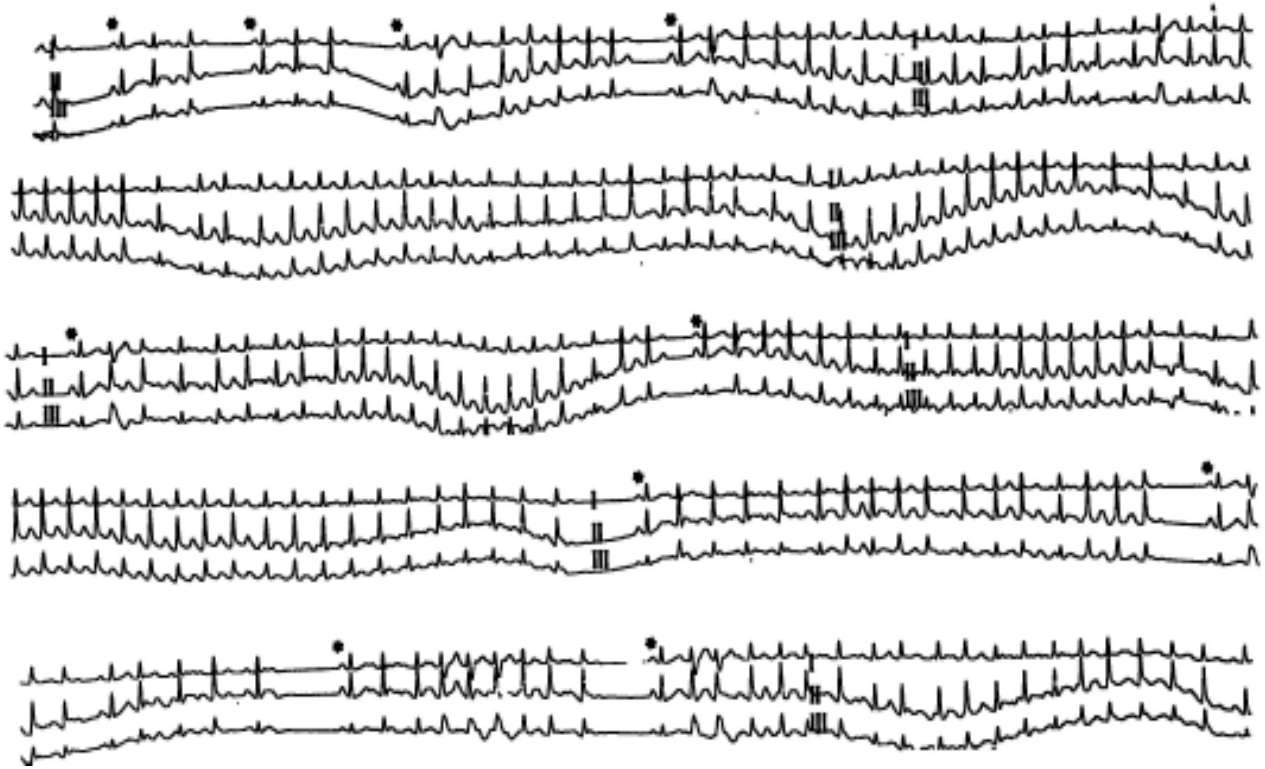
– sujet jeune, sans cardiopathie
– épisodes brefs mais incessants, entrecoupés d'ESA : Superbe indication mais rare ! Guérison > 90 %

FA Focale typique (Circulation 1997)

Aspect typique de
FA Focale avec ESA
Isolées ou en salves
De cycle très variable
Mais de morphologie
Constante. Pour les
Cycles les plus rapides,
l'aspect ECG est celui
d'une FA classique.

Sur le panneau du bas,
L'arythmie est incessante
Mais les épisodes sont
Brefs. Ce comportement
Est typique.





- **<u>FA paroxystiques tout venant</u>** :

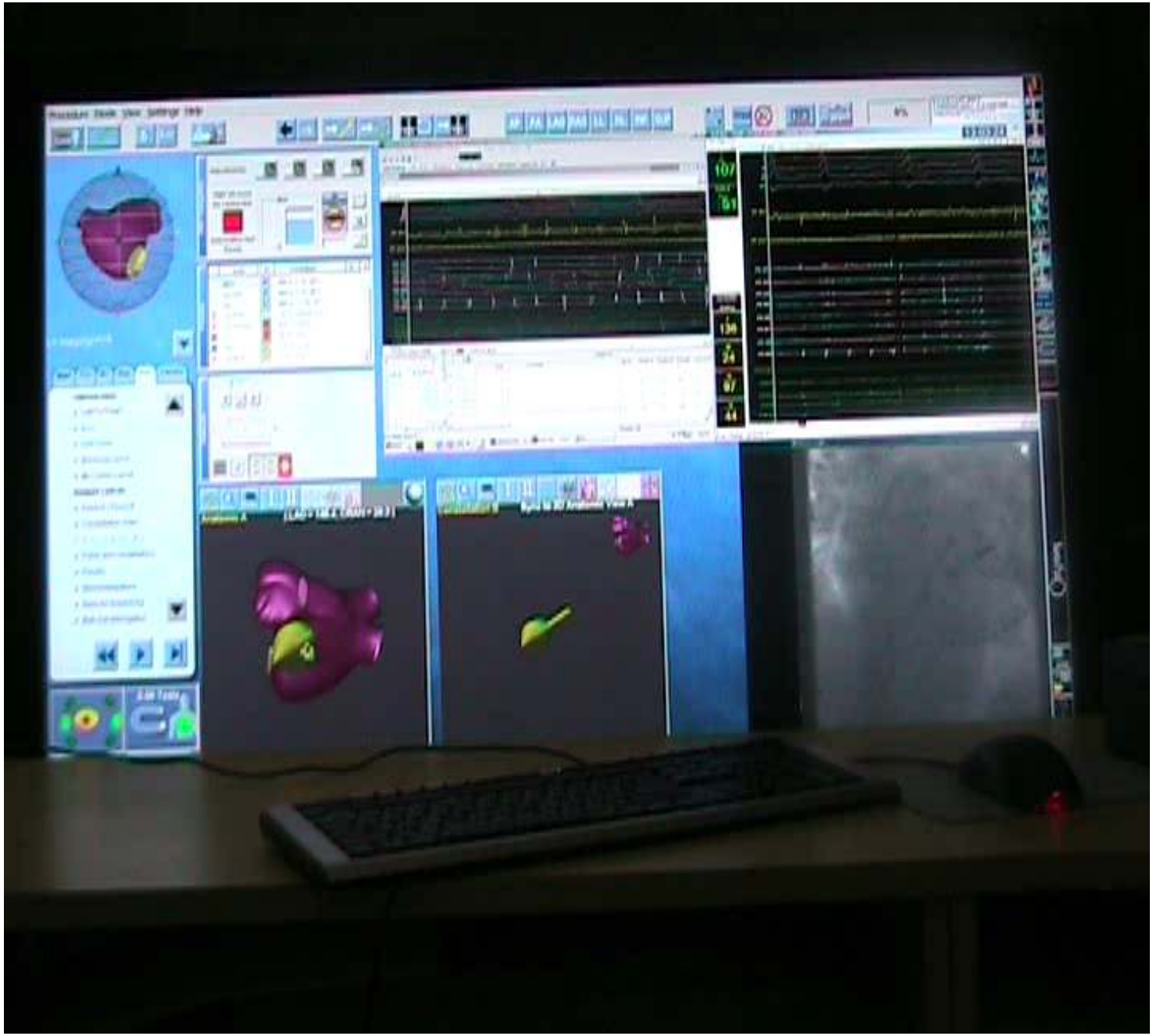
– résistant à au moins 2 antiarythmiques
– symptomatique
– au moins un épisode tous les 10-15 jours
– la présence d'une cardiopathie sous-jacente n'intervient pas dans la sélection mais rend le recours aux lésions linéaires plus fréquent
– guérison : 85 % sans antiarythmique,
1,34 ablations/pt

- **<u>FA chroniques</u>** :

– c'est l'ablation la plus difficile
– Isolation des veines pulmonaires+ lésions linéaires + lesions atriales
– guérison ≈ 80 % sans antiarythmique
  90 % avec IC ± β^- ou Amiodarone
– possible transformation en flutter gauche si lignes incomplètes

- **<u>FA et insuffisance cardiaque</u>** :

– c'est encore plus difficile!
– Les risques sont plus élevés,
– Taux de succès identique 80 % sans antiarythmique
90 % avec IC ± β^- ou Amiodarone
– Ce sont les patients qui bénéficient le plus de l'ablations de la FA
– Certainement à considérer avant l'ablation du His et la pose d'un PM
– Indication à discuter au cas par cas




LAA CL 200 (+10)
RAA CL 206 (+6)
I
II
V1
PV 1/2
PV 2/3
PV 3/4
PV 4/5
PV 5/6
PV 6/7
PV 7/8
PV 8/9
CS1-2
CS3-4
CS 5-6
CS7-8
CS9-10

Hansen Robotic Catheter System™


Flexible Guide Catheter

- Les traitements médicamenteux ne sont pas suffisants pour une proportion importante des patients en FA
- Des traitements non pharmacologiques, seule la chirurgie et l'ablation par RF des FA sont curatifs.
- Ces deux approches seront probablement complémentaires.
  - L'approche chirurgicale étant plus lourde, elle sera légitime en complément d'une intervention cardiaque par ailleurs nécessaire.
  - L'ablation par RF de la FA sera proposée aux patients n'ayant pas besoin d'une chirurgie cardiaque.

- L'ablation des FA focales du sujet jeune, sans cardiopathie sous-jacente, est une excellente indication.
- Les FA paroxystiques tout venant sont une indication très raisonnable d'ablation par RF, surtout avant le 4ème âge.
- L'ablation des FA chroniques reste plus difficile, ce qui en restreint l'indication aux patients les plus atteints et aux patients porteurs d’une myocardiopathie.
- Les indications évolueront en fonction des améliorations des procédures mais cela reste une intervention délicate nécessitant des opérateurs entraînés.

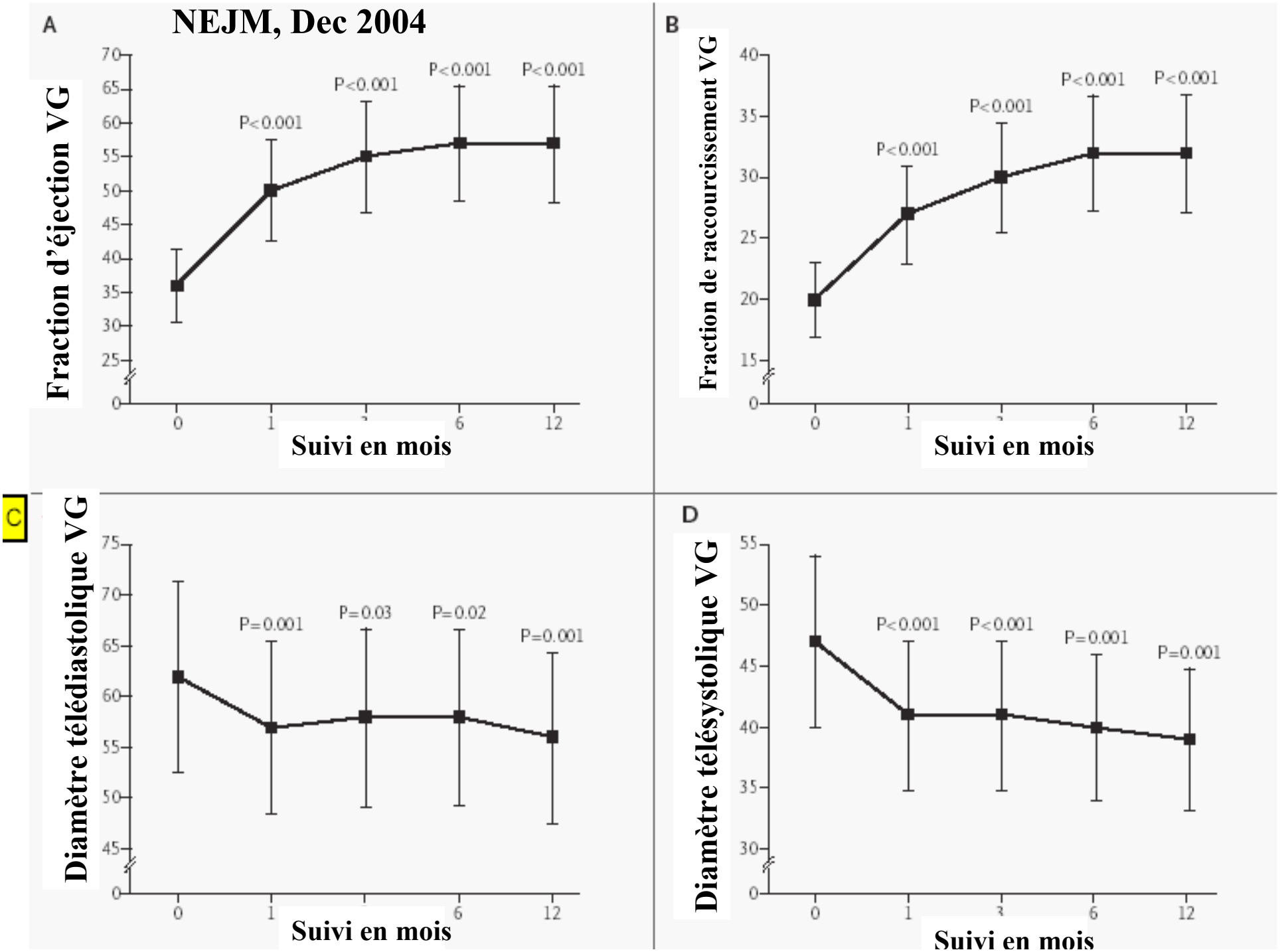
SF-36 in 54 patients successfully treated

SF-36 Scale	Baseline	3 months	12 months
Physical Function	67.4 ± 22.6	79.2 ± 25†	85.8 ± 20.7†
Role Physical	42.6 ± 42.8	66.7 ± 42.9†	87.0 ± 26.8†
Bodily Pain	56.2 ± 41.9	71 ± 41.5†	90.7 ± 22†
Role Emotional	47.1 ± 23	66.9 ± 21.9†	71.6 ± 19.2†
Mental Health	59.6 ± 21.8	75.7 ± 18.4†	80 ± 15†
Social Functioning	64.8 ± 28.1	81.7 ± 21†	89.9 ± 16.1 †
Vitality	68.2 ± 28.1	82.1 ± 21.3†	83.9 ± 21†
General Health	52.5 ± 21.1	66.6 ± 17†	72.4 ± 20.9†

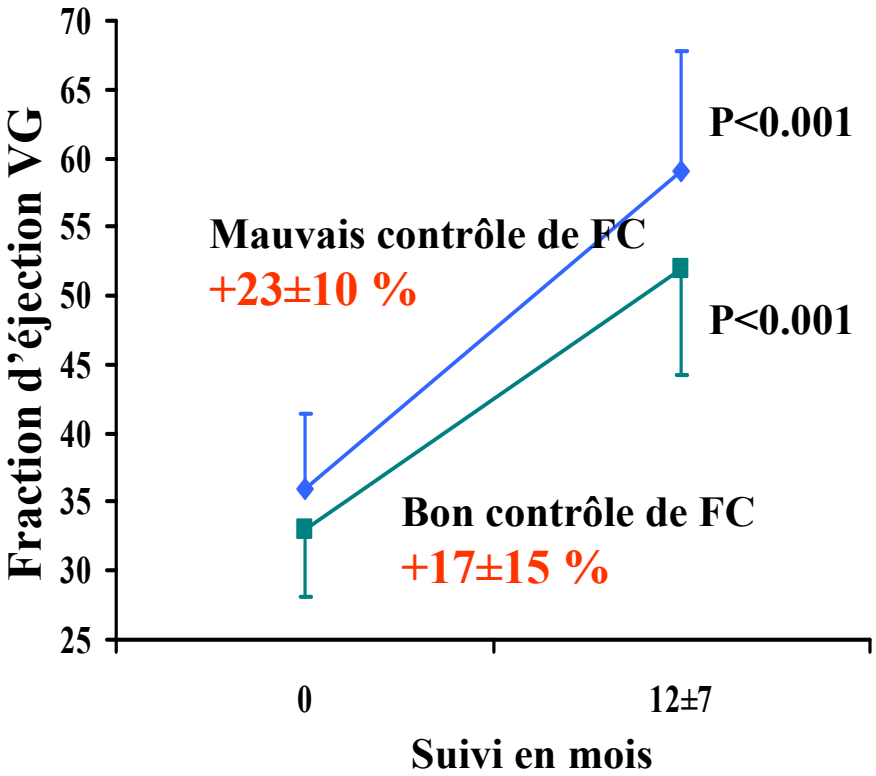
BASELINE CHARACTERISTICS

	CHF (n=48)	Controls (n=48)	P-Value
Men	43 (90%)	43 (90%)	1.0
Age (years)	56±10	56±10	0.94
Duration of AF (months)	79±45	79±57	0.93
Permanent AF	34 (71%)	34 (71%)	1.0
Persistent AF	9 (19%)	9 (19%)	1.0
Paroxysmal AF	5 (10%)	5 (10%)	1.0
Structural Heart Disease	**25 (52%)**	**13 (27%)**	**0.01**
LVEF (%)	**37±8**	**66±7**	**<0.001**
No. of Antiarrhythmics	3±1	3±1	0.65
Amiodarone Used	46 (96%)	44 (92%)	0.68
Electrical Cardioversion Attempted	**39 (81%)**	**27 (56%)**	**0.008**
Follow-up (months)	**11±7**	**11±5**	**0.79**

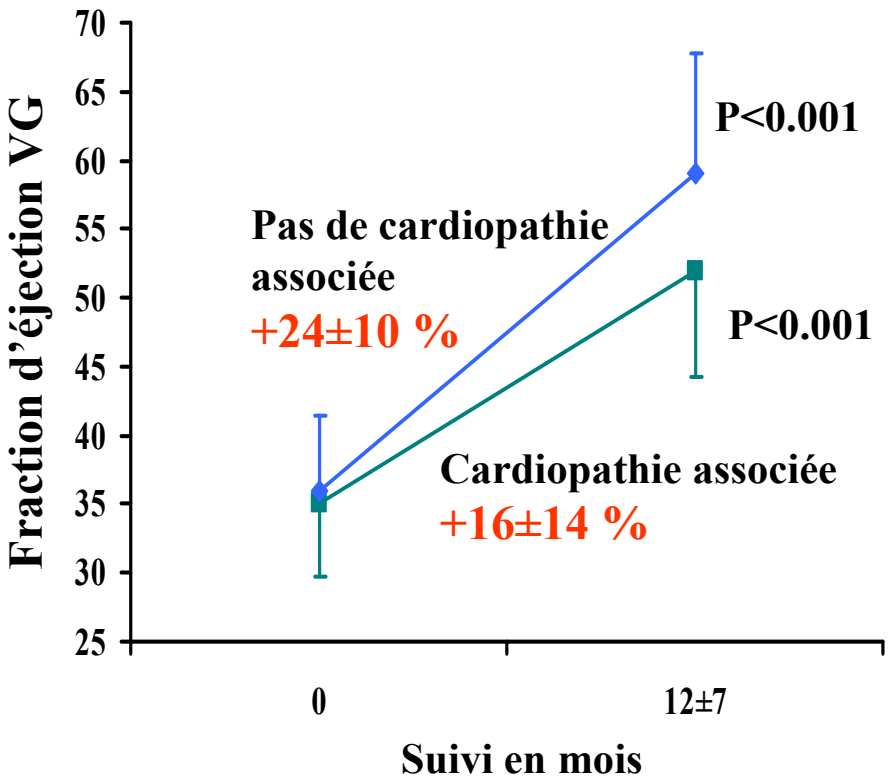
Li-Fern Hsu, Bordeaux


NEJM, Dec 2004
A
Fraction d'éjection VG
P<0.001
P<0.001
P<0.001
P<0.001
Suivi en mois
B
Fraction de raccourcissement VG
P<0.001
P<0.001
P<0.001
P<0.001
Suivi en mois
C
Diamètre télédiastolique VG
P=0.001
P=0.03
P=0.02
P=0.001
Suivi en mois
D
Diamètre télésystolique VG
P<0.001
P<0.001
P=0.001
P=0.001
Suivi en mois

Contrôle de fréquence



Cardiopathie

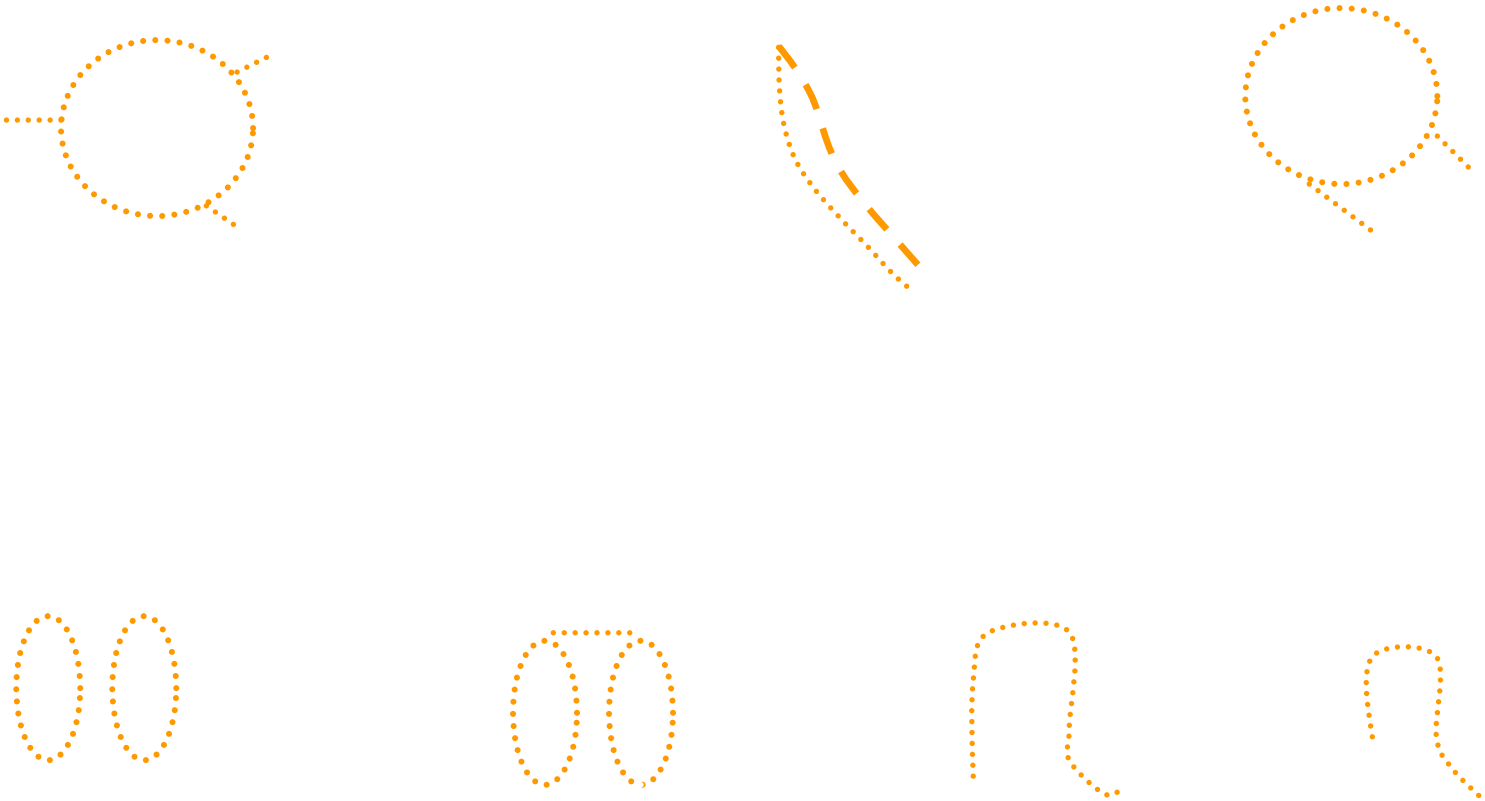


Amélioration majeure (+ 20% ou FE ≥ 55%)

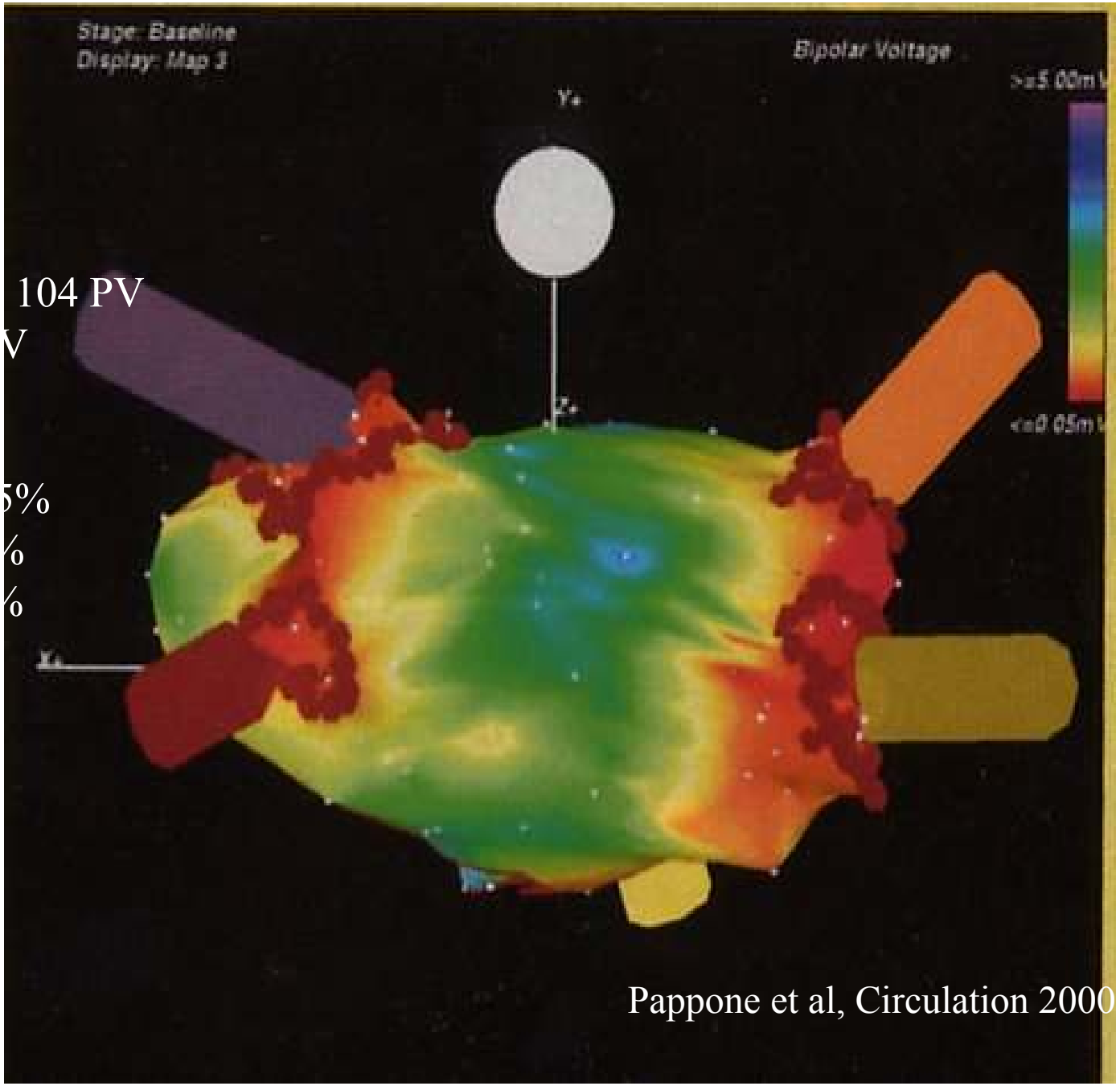
Mauvais contrôle de FC: 86%
Bon contrôle de FC: 54%

92%

Pas de cardiopathie associée: 88%
Cardiopathie associée: 54%



- Experienced lab (learning curve +++)
- Oral anticoagulation prior and after ablation
- Perfused long sheaths in the LA (2-4 cc/min)
- Limited RF power for PV : 20-30 W
- Lasso catheter should not be uncoiled (CCW rotation) or introduced in LV



104 PV
V

5%
%
%

Pappone et al, Circulation 2000

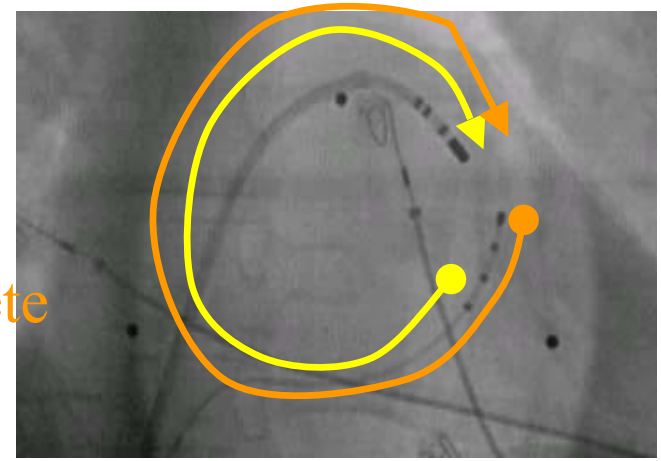
Catheter ablation population (PAF)
PV disconnection + LA isthmus ablation

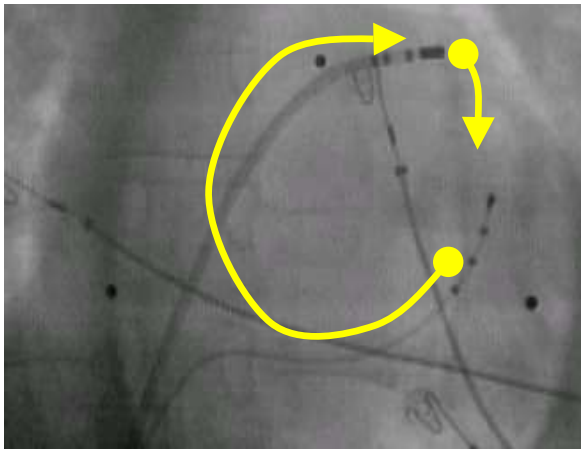
- 159 patients 55 ± 9 years, (24-78)
  - 19 female, 140 male
- previous embolic event : 9%
- Structural heart disease : 25%
  - HTX and/or Hypertrophic CM: 14%
  - valvular : 7%
  - Ischemic heart disease : 4%
  - Dilated CM: 0.5%

Catheter ablation population (CAF)
PV disconnection + LA isthmus ablation

- 53 patients (6 female, 54 ± 10 years, 27-77)
- Chronic AF since 22±23 months
- previous embolic event : 6%
- Structural heart disease : 48%
  - Hypertension : 14%
  - Dilated or hypertrophic CM : 16%
  - Ischemic heart disease : 5%
  - Valvular : 5%
  - Restrictive: 5%
  - ASD: 3%

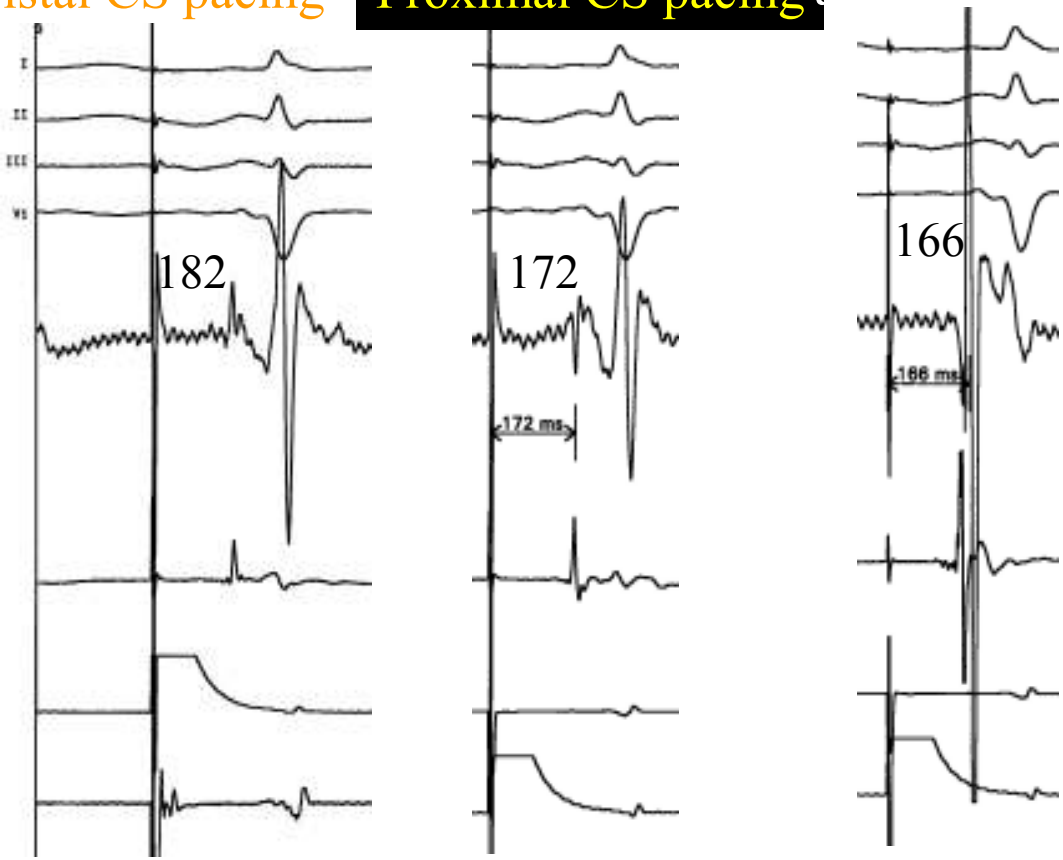
Differential pacing and activation time to demonstrate complete isthmus block





Distal CS pacing

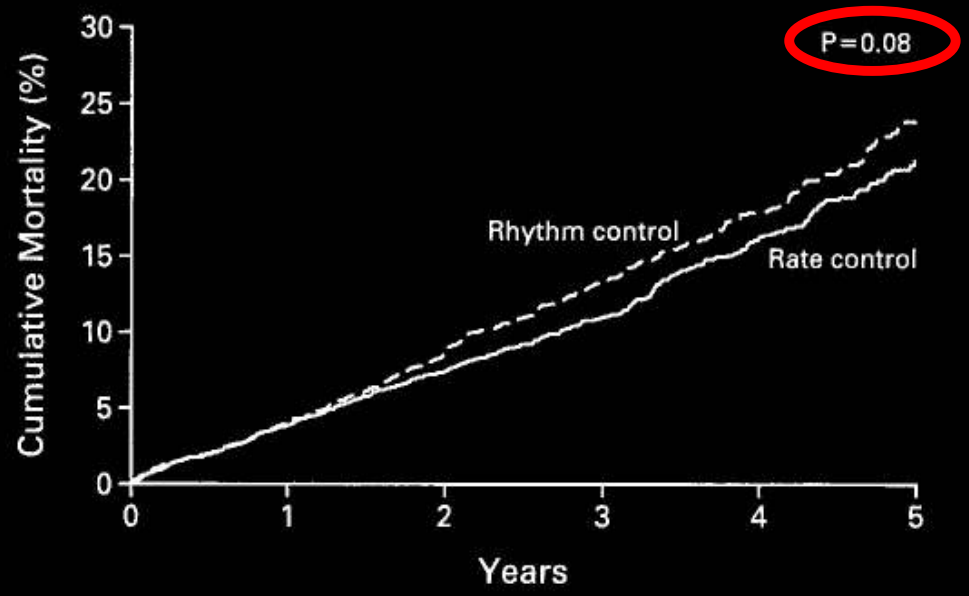
Proximal CS pacing a



A COMPARISON OF RATE CONTROL AND RHYTHM CONTROL IN PATIENTS WITH ATRIAL FIBRILLATION

THE ATRIAL FIBRILLATION FOLLOW-UP INVESTIGATION OF RHYTHM MANAGEMENT (AFFIRM) INVESTIGATORS*

RATE VERSUS RHYTHM CONTROL FOR ATRIAL FIBRILLATION



No. of Deaths						
		number (percent)				
Rhythm control	0	80 (4)	175 (9)	257 (13)	314 (18)	352 (24)
Rate control	0	78 (4)	148 (7)	210 (11)	275 (16)	306 (21)

Figure 1. Cumulative Mortality from Any Cause in the Rhythm-Control Group and the Rate-Control Group.

Time zero is the day of randomization. Data have been truncated at five years.

(N Engl J Med 2002;347:1825-33.)

Ablation par RF de la Fibrillation auriculaire

- Modification du substrat (cathéters irrigués)
  - Lésions linéaires OD : succès < 20%
  - Lésions linéaires OG : succès = 60 % (complications)
- Abolition des foyers initiateurs
  - Guidée par cartographie circulaire (Lasso)
    - 80 à 95 % sont localisés dans les veines pulmonaires (Circulation 1997;95:572 ; NEJ 1998;339:659)
  - Anatomique, guidée par Carto
- Modification du substrat et abolition des foyers initiateurs

- Cas particulier : Réinitiation immédiate après CEE

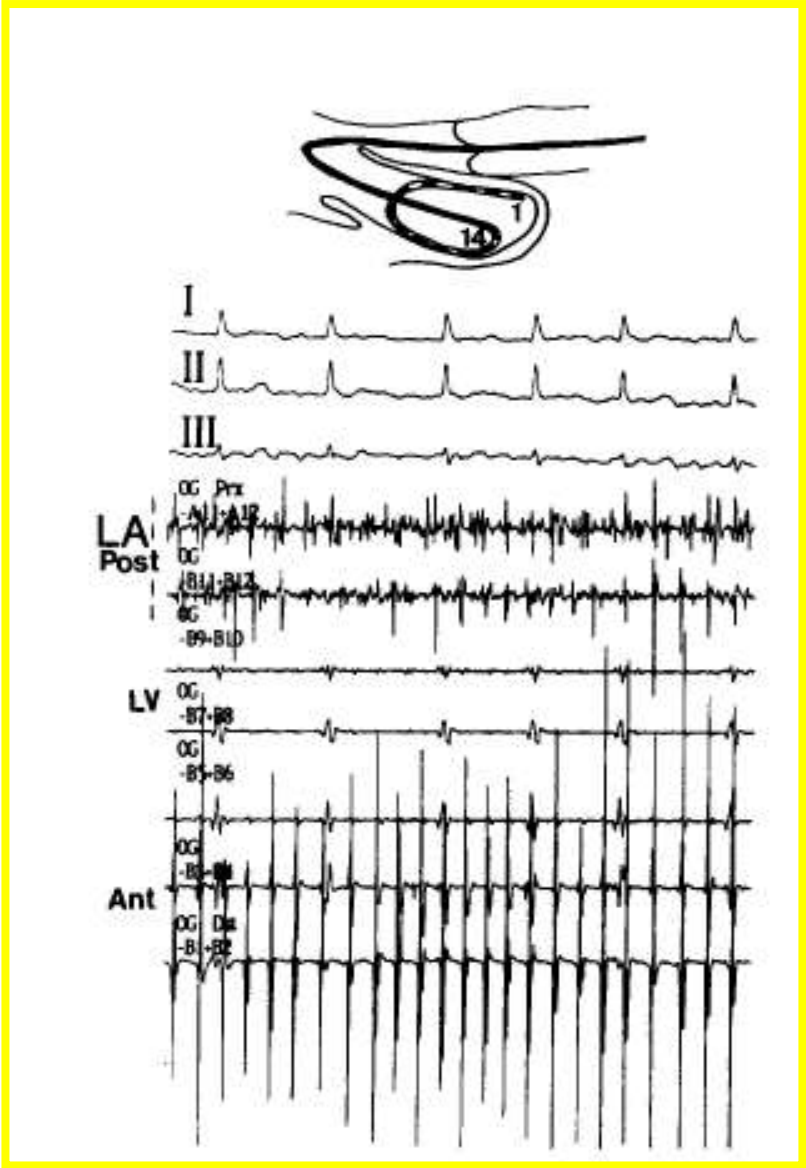
  L'ablation des 4 veines pulmonaires + autres foyers potentiels permet un taux de guérison de 50 %.

- L'ablation est proposée aux patients extrêmement symptomatiques du fait de leur fibrillation chronique, notamment si l'on suspecte une participation rythmique à une éventuelle myocardiopathie.
- L’ablation de la FA semble préférable à celle du faisceau de His avant le quatrième age

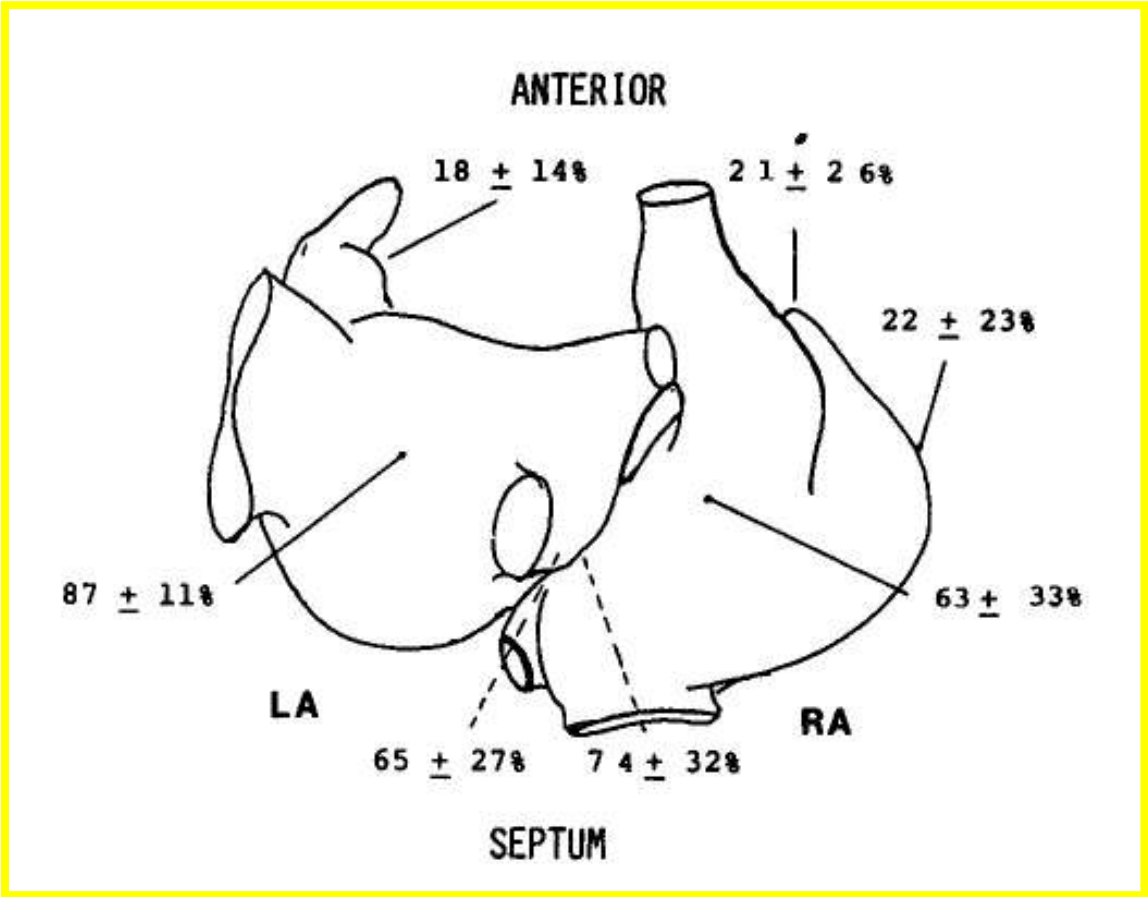
Results : PV disconnection

	LocaLisa group N=26	Control group N=26
RF delivery (min)	34.8 ± 11.4 *P=NS*	38.2 ± 10.5
Time taken for disconnection (min)	46.5 ± 12.0 *P=0.0001*	66.3 ± 18.9
Fluoroscopy time (min)	8.4 ± 4.3 *P<0.0001*	23.7 ± 9.7

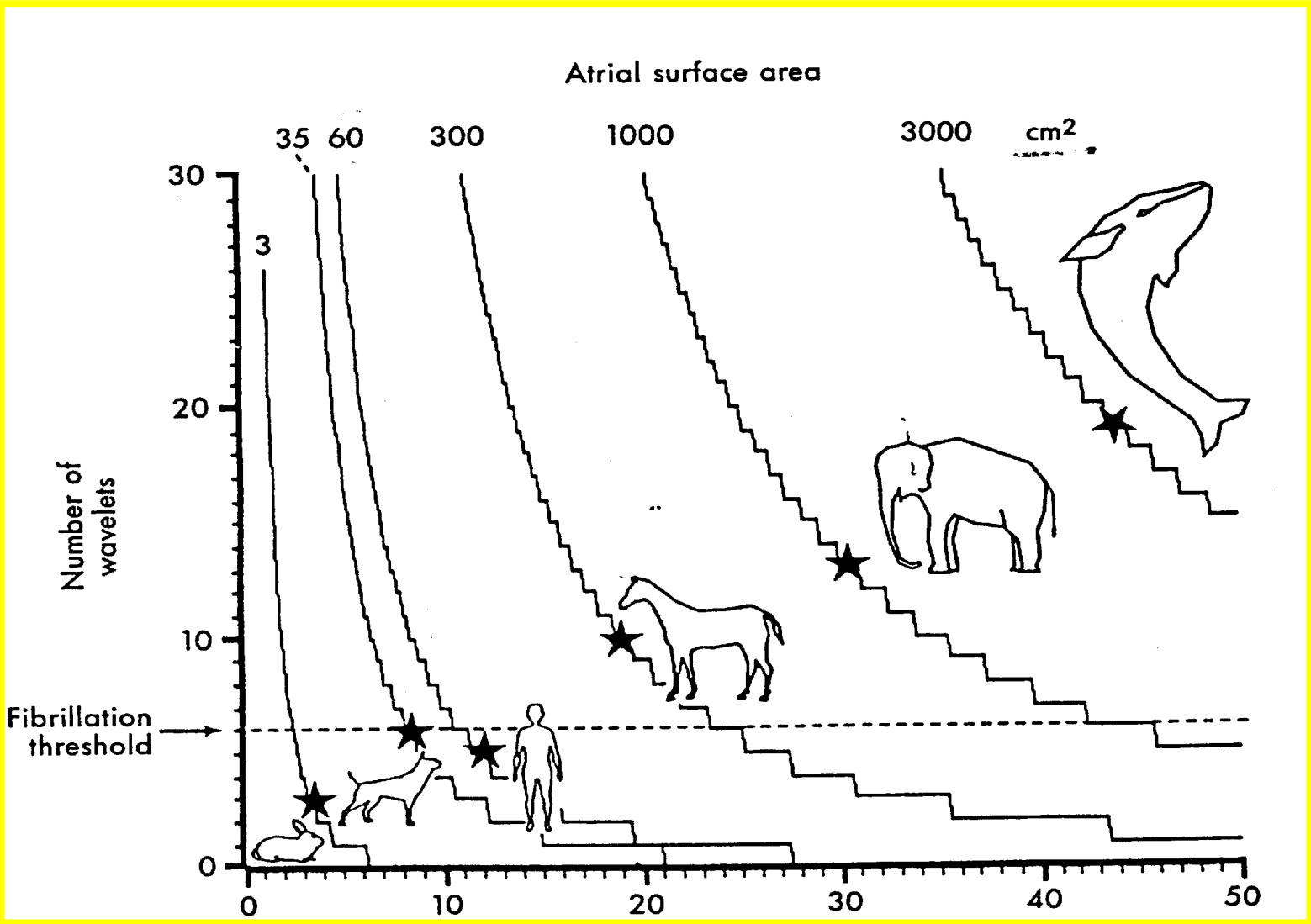
Cartographies spatiales et temporelles



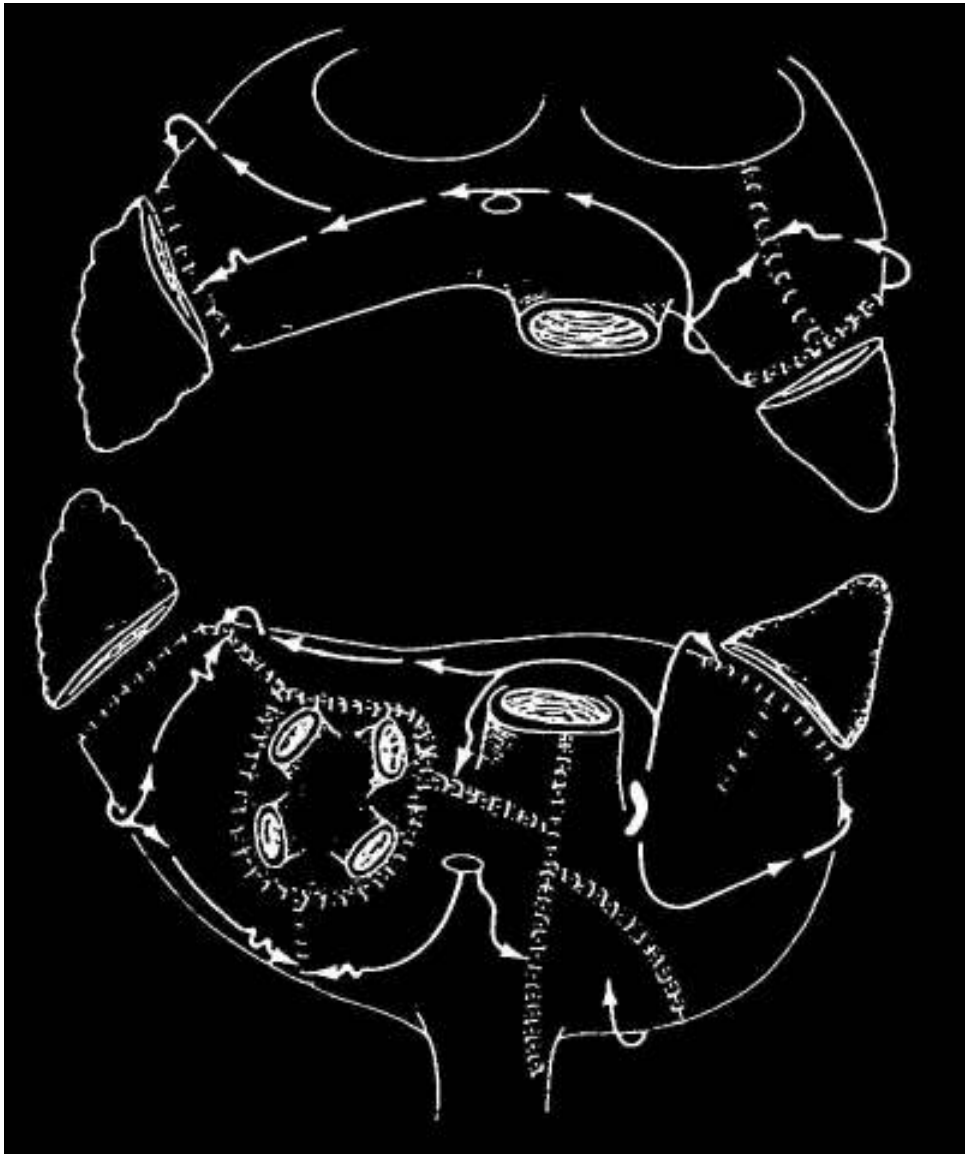
Distribution des activités auriculaires complexes



Théorie de la perpétuation des FA par de multiples vaguelettes réentrantes (Moe, Allessie)



Cox Maze, 1992



Swartz: abstract AHA 1994

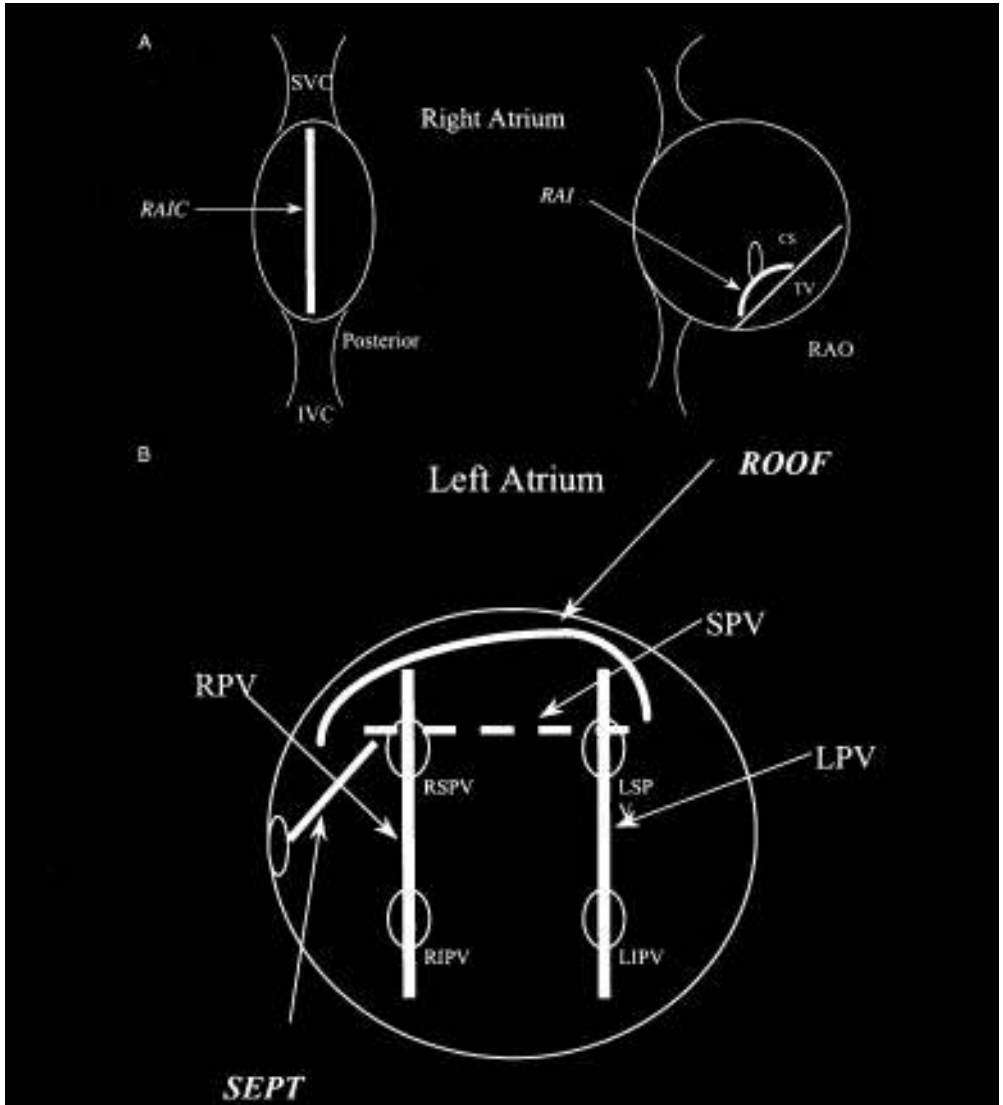
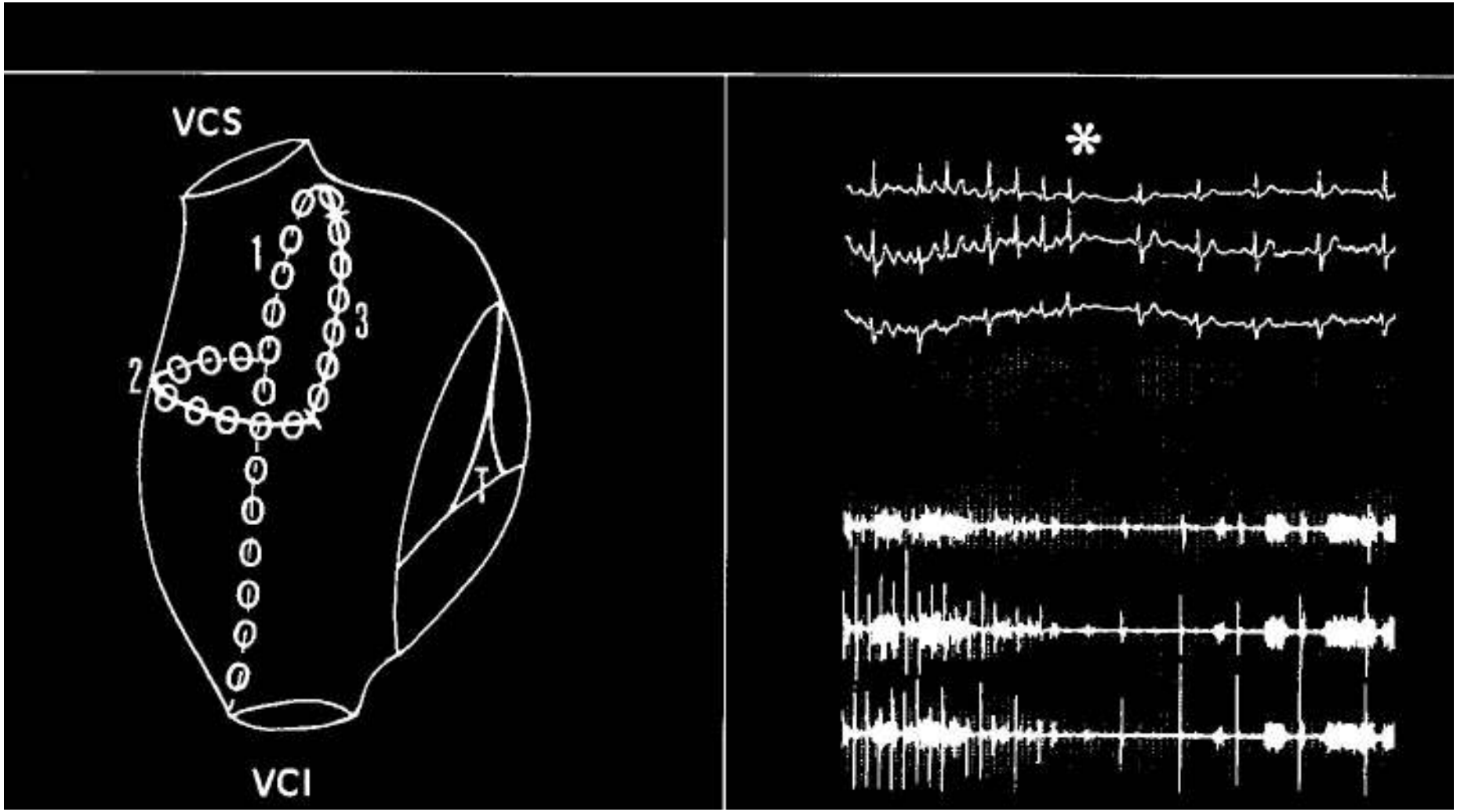


FIGURE 5. Schematic drawing showing the location (arrows) of the 7 linear lesions in the Guidant Heart Rhythm Technologies (HRT) Linear Ablation System clinical trial that are delivered in the right (A) and left (B) atrium. CS = coronary sinus; IC = intercaval; IVC = inferior vena cava; LAR = left atrial roof; LAS = left atrial septum; LIPV = left inferior pulmonary vein; LPV = left pulmonary vein; LSPV = left superior pulmonary vein; RAO = right anterior oblique; RAIC = right atrial intercaval; RIPV = right inferior pulmonary vein; RPV = right pulmonary vein; RSPV = right superior pulmonary vein; SPV = superior pulmonary vein; SVC = superior vena cava; TV = tricuspid valve.

Bordeaux 1994 (JCE 1994, 5;12:1045)



Lésions linéaires de l'OD pour la FA

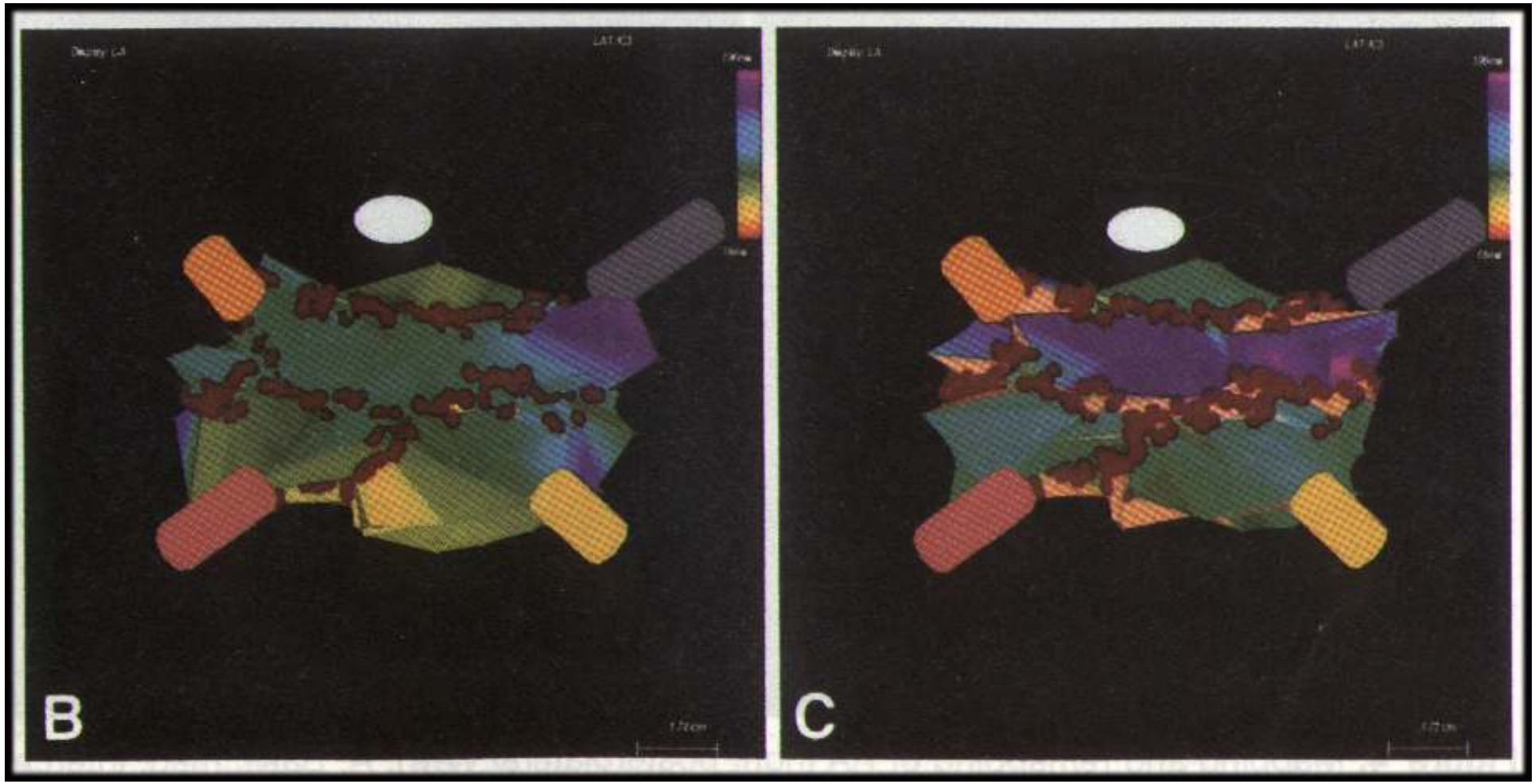
(13 %)
(33 %)

(11 %)
(27 %)

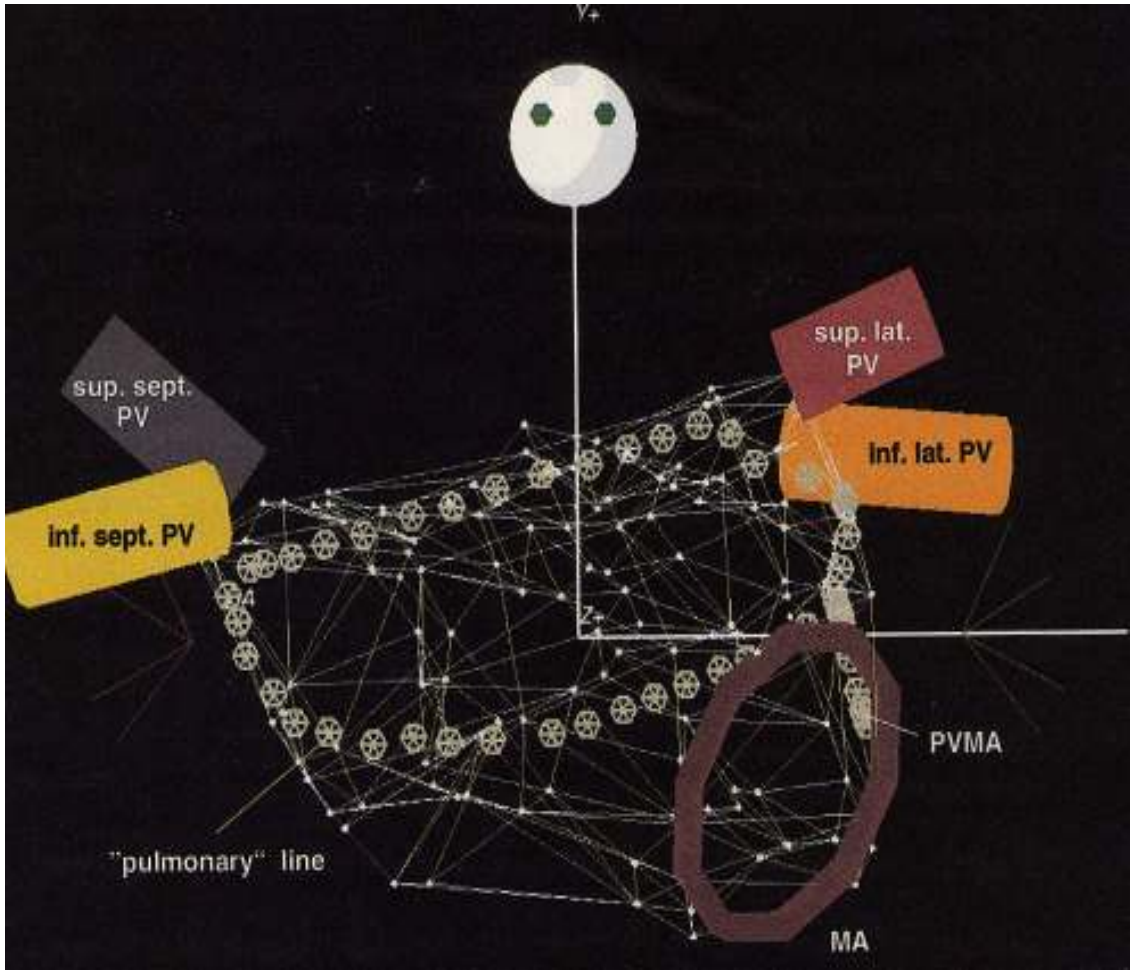
Lésions linéaires du septum D et de l'OG

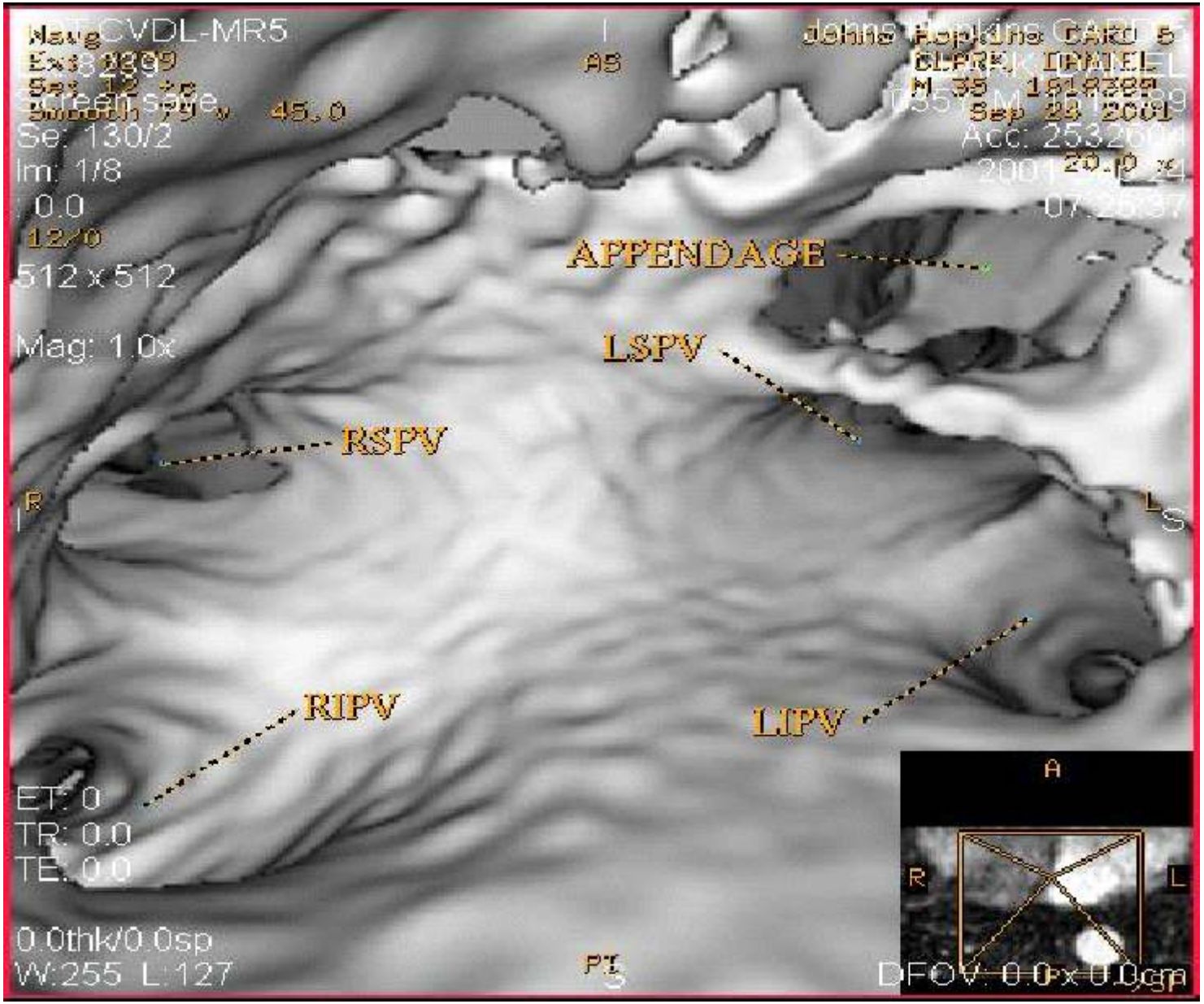
(57 %)
(84 %)

Pappone et al, circulation. 1999;100:1203-08

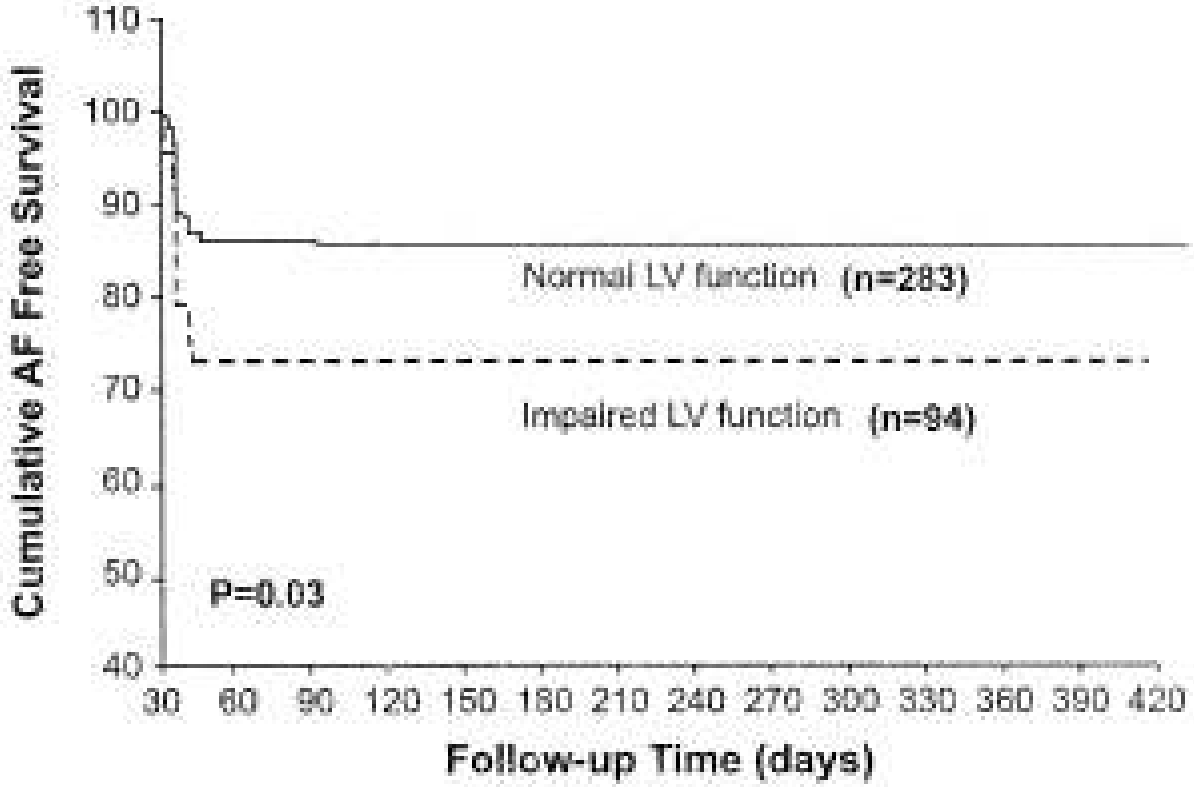


12/27 pts (44%) free of arrhythmias without AA drugs

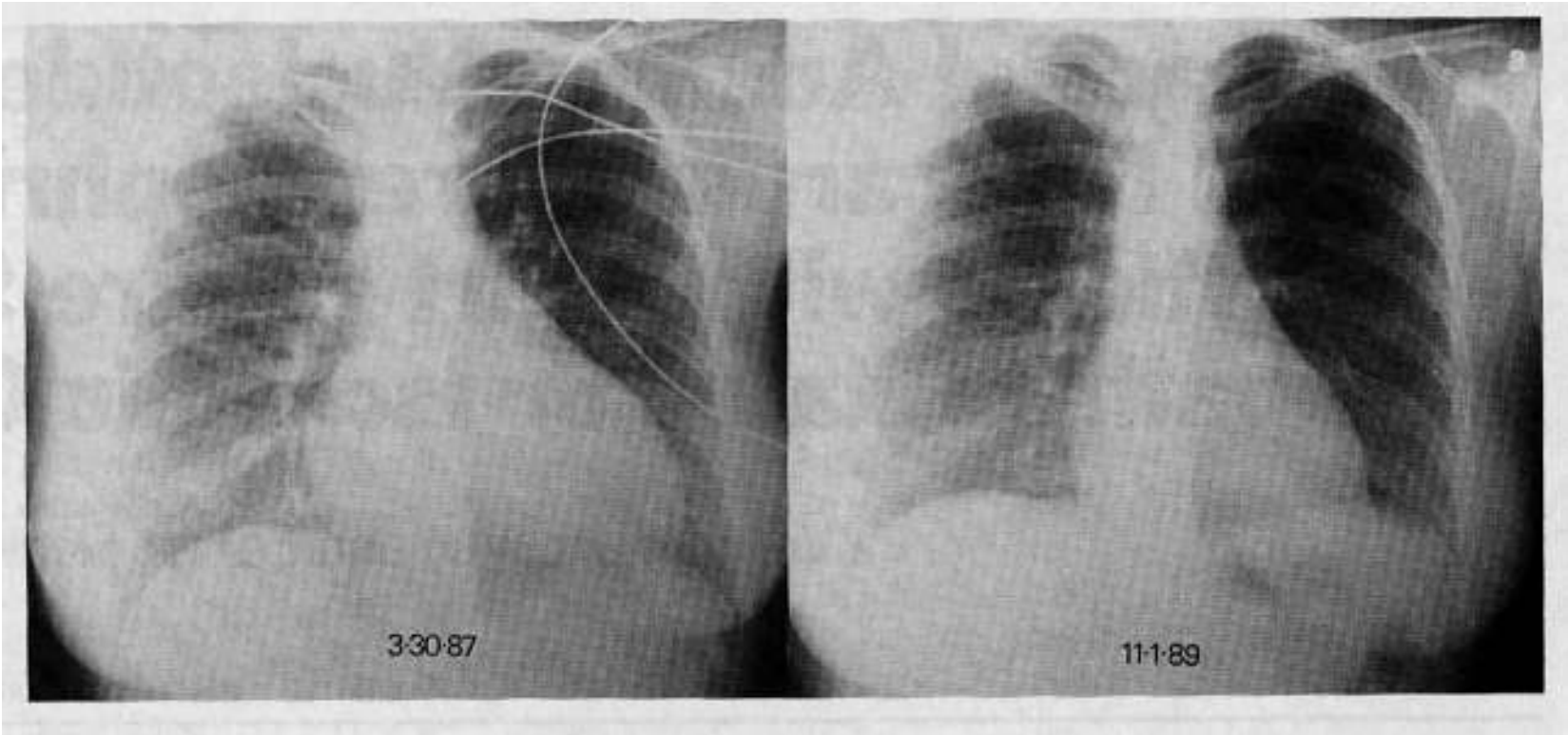

Y+
sup. sept.
PV
sup. lat.
PV
inf. lat. PV
inf. sept. PV
Z+
PVMA
"pulmonary" line
MA



Courtesy: H Calkins


Cumulative AF Free Survival
110
100
90
80
70
60
50
40
Normal LV function (n=283)
Impaired LV function (n=94)
P=0.03
30 60 90 120 150 180 210 240 270 300 330 360 390 420
Follow-up Time (days)

Grogan et al: AJC 1992; 69: 1570



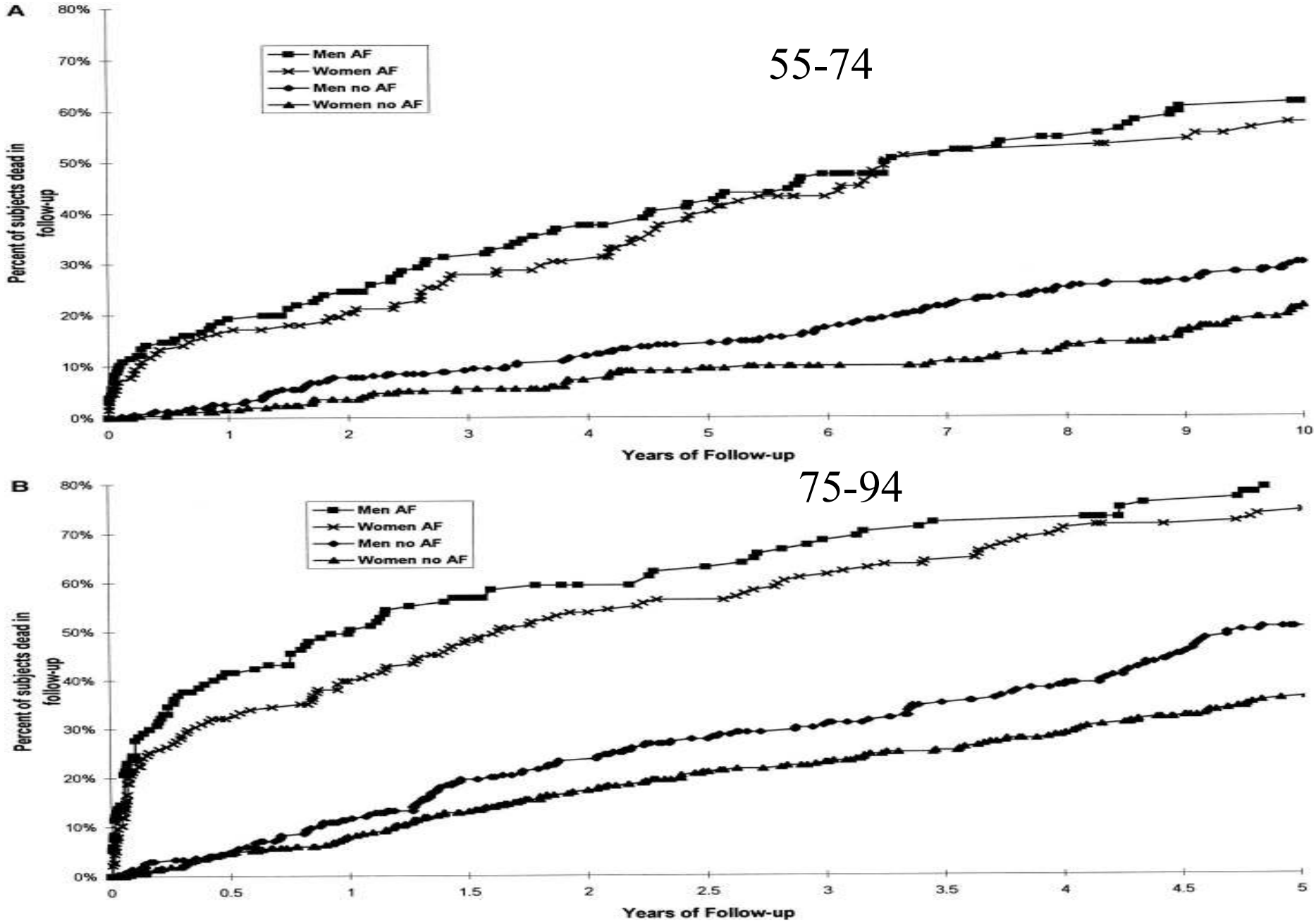

A
55-74
Men AF
Women AF
Men no AF
Women no AF
Percent of subjects dead in follow-up
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
1
2
3
4
5
6
7
8
9
10
Years of Follow-up
B
75-94
Men AF
Women AF
Men no AF
Women no AF
Percent of subjects dead in follow-up
80%
70%
60%
50%
40%
30%
20%
10%
0%
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Years of Follow-up

TABLE 2. Electrophysiological Parameters

PV	n	No. of Sites	PV Threshold, V	S_1-A_1, ms	Longest S_2-A_2, ms	Increment, ms	PV ERP, ms	PV ERP, range	PV FRP, ms	PV-LA FRP, ms	PV-LA ERP, ms	LA ERP, ms	Difference PV/LA ERP, ms
LSPV													
AF	22	34	2.3±1.1	111±22	207±74	96±66†	178±70*†	60–300	212±86†	322±30	212±31	248±40	−71±57
Controls	15	26	2.2±1.2	91±23	125±39	35±32	287±45*	200–360	315±41	333±52	NA	254±42	34±36
RSPV													
AF	19	29	2.7±1.4	79±33	193±76	114±70†	179±76*†	80–300	212±85†	328±36	217±48	252±41	−67±90
Controls	16	28	2.2±1.5	76±22	120±42	53±48	286±33*	220–340	321±43	341±45	NA	259±44	26±37
LIPV													
AF	16	21	2.9±1.2	100±26	207±77	101±64†	184±73*†	80–340	206±52†	327±38	222±40	257±25	−72±70
Controls	16	24	2.8±1.1	70±21	107±43	38±40	277±61	140–340	309±46	332±42	NA	251±40	26±48
RIPV													
AF	6	6	2.9±1.2	75±25	163±61	88±66	233±69	140–320	297±6	323±21	NA	246±19	−23±57
Controls	8	9	2.3±1.5	42±28	82±42	34±15	270±27	240–320	301±40	326±29	NA	257±40	12±33
Total													
AF	63	90	2.6±1.3	...	...	102±65†	185±71*†	...	210±77†	325±33	216±38	253±21	...
Controls	55	87	2.5±1.4	...	...	42±40	282±45*	...	315±43	334±44	NA	253±41	...

*PV vs LA, $P<0.001$; †AF vs controls, $P\leq0.01$; NA, not applicable because no PV-LA block was observed.

(*Circulation*. 2002;106: 2479-2485.)