

AF & HEART FAILURE:

AF Ablation or Device plus AV node ablation

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Declaration of Interest

Consulting: Bard EP, Biosense Webster, St. Jude Medical, Philips Medical,

Research: Hansen, St. Jude Medical, Biosense Webster

Honoraria & Travel: Biosense Webster, St. Jude Medical, Bard EP, Philips

DSMB: Voyage Medical

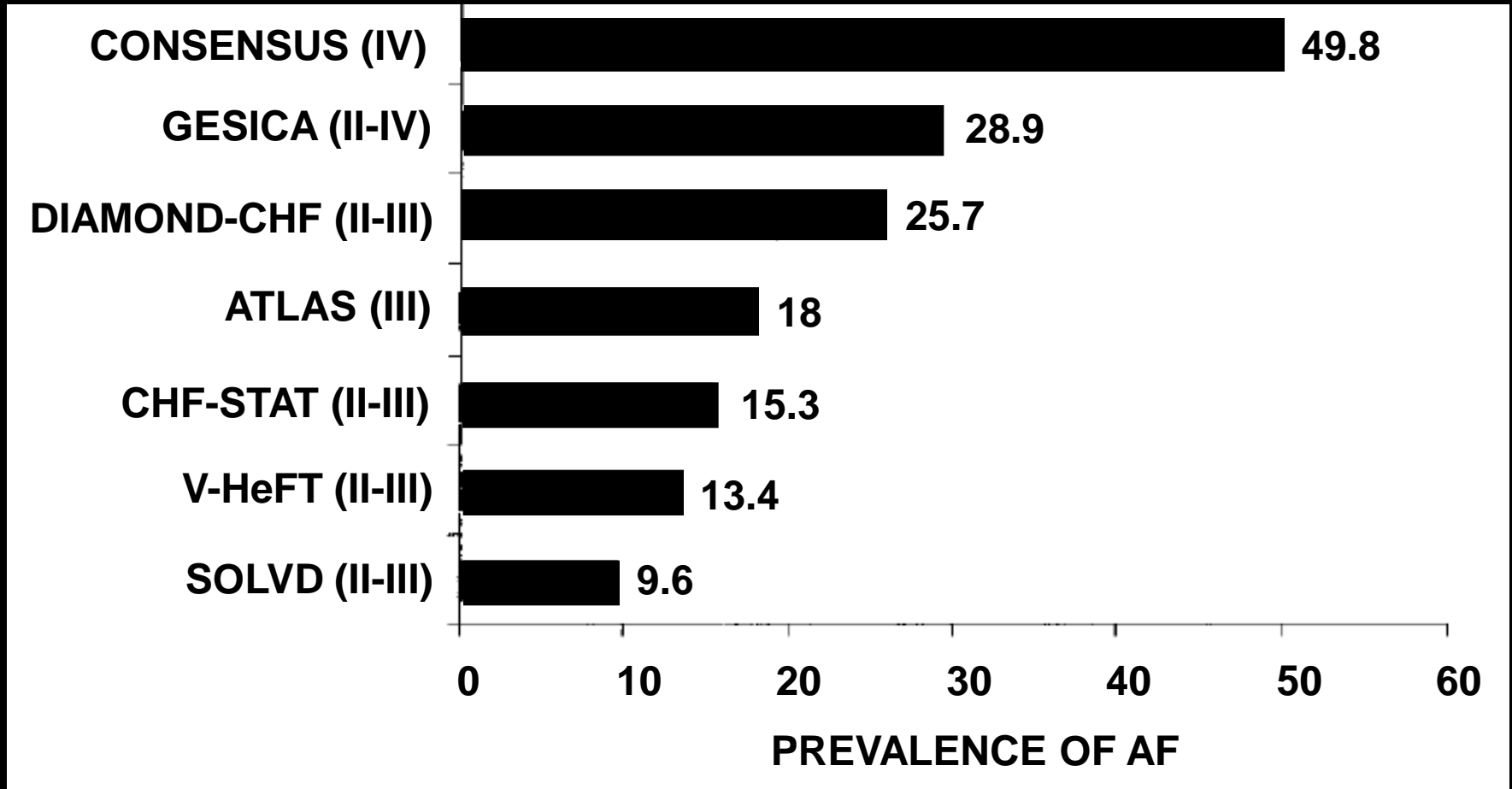
The questions

1. Is it better to be in AF with a regular ventricular rate and synchronous ventricular activation?
2. Is it better to be in sinus rhythm?
3. Can CRT and AVJ ablation guarantee the former?
4. Can AF ablation guarantee the latter?

OUTLINE

- AF and Heart Failure
- AF ablation and CHF
- AF, CHF, CRT and AVJ ablation
- Head to Head
- Summary

Prevalence of AF in Heart Failure Trials



Prognostic significance of AF in CHF

Study	Year	NYHA	No. of Pts.	Pts. in AF	Mean Follow-Up (months)	Mortality			P Value
						Overall	SR	AF	
Middlekauf (6)*	*1991	III-IV	390	75	19	32%	29%	48%	0.0013
Carson (4)†	1993	II-III	795	107	24	25%	21%	20%	0.18
Bourassa (1)*	*1993	II-III	6273	731	12	18%	NA	NA	<0.0001
Dries (16)*	*1998	II-III	6517	419	30	27%	23%	34%	<0.001
Opasich (18)†	*1998	I-IV	3327	755	12	16%	NA	NA	NS
Mahoney (15)†	1999	II-IV	234	62	13	19%	16%	23%	0.21
Crijns (83)*	*2000	III-IV	427	84	40	50%	47%	60%	0.04
Mathew (84)*	*2000	I-IV	7788	866	37	34%	32%	43%	0.0001

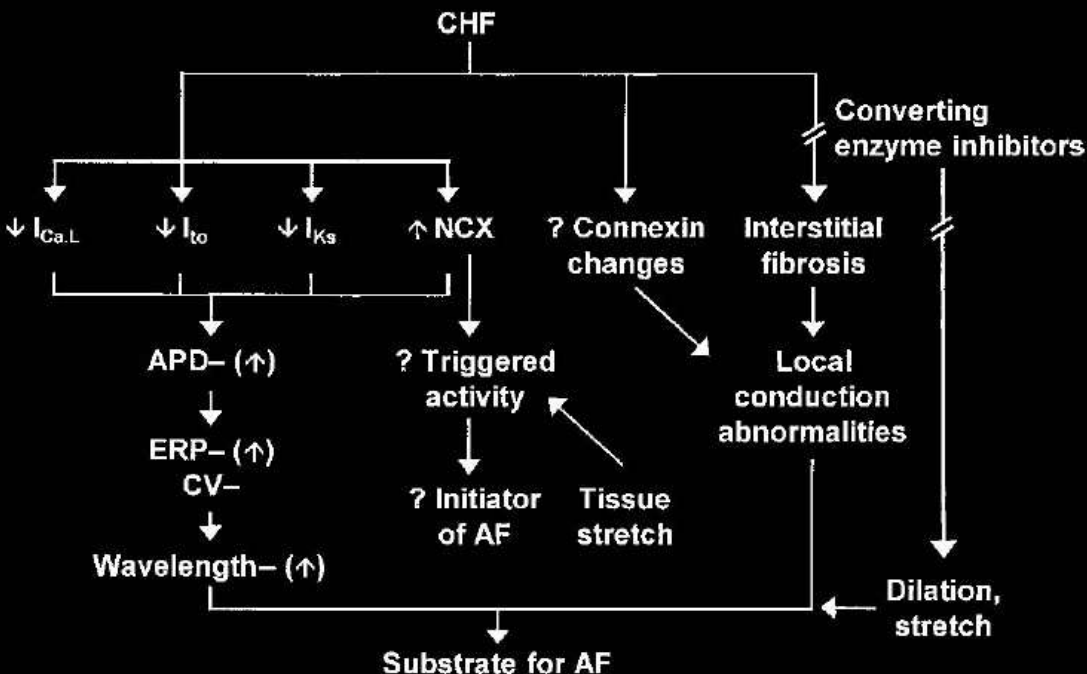
*Studies suggesting significantly increased mortality associated with atrial fibrillation (AF) in patients with congestive heart failure.
 †Studies in which atrial fibrillation did not significantly increase mortality.

AF: 2x risk of death compared with matched controls

AF & HF: 4 to 8-fold increased mortality compared with age-matched population

Atrial Fibrillation and Congestive Heart Failure: Specific Considerations at the Intersection of Two Common and Important Cardiac Disease Sets

Mechanisms of AF in CHF



- Experimental CHF

- Ionic remodeling
- Interstitial fibrosis
- No shortening of ARP
- ↑NCX, DADs

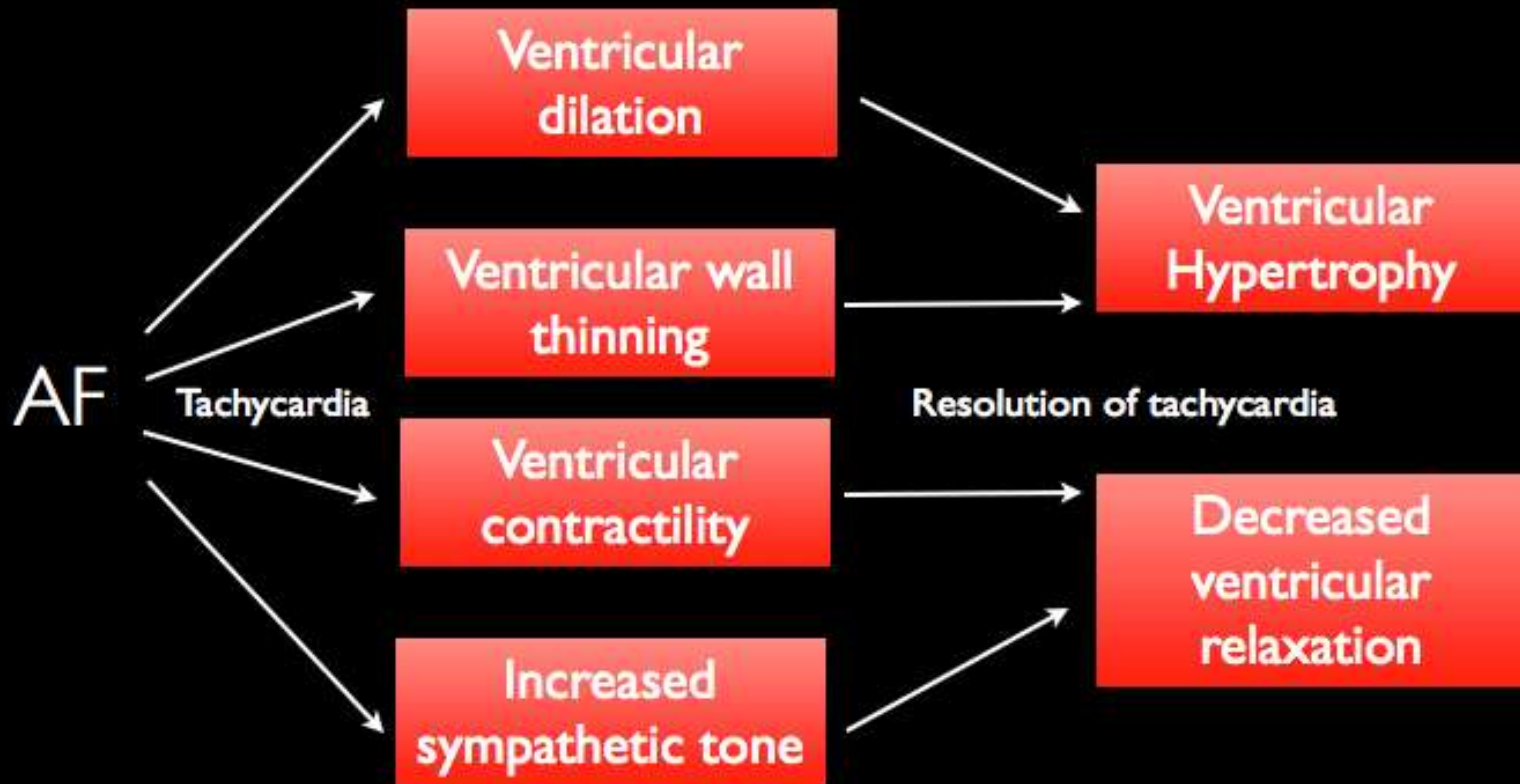
- AF-promoting AT remodeling

- ↓ I_{to} & I_{CaL} by ~65%
- ↓APD, ↓ARP
- Promotes intra-atrial reentry

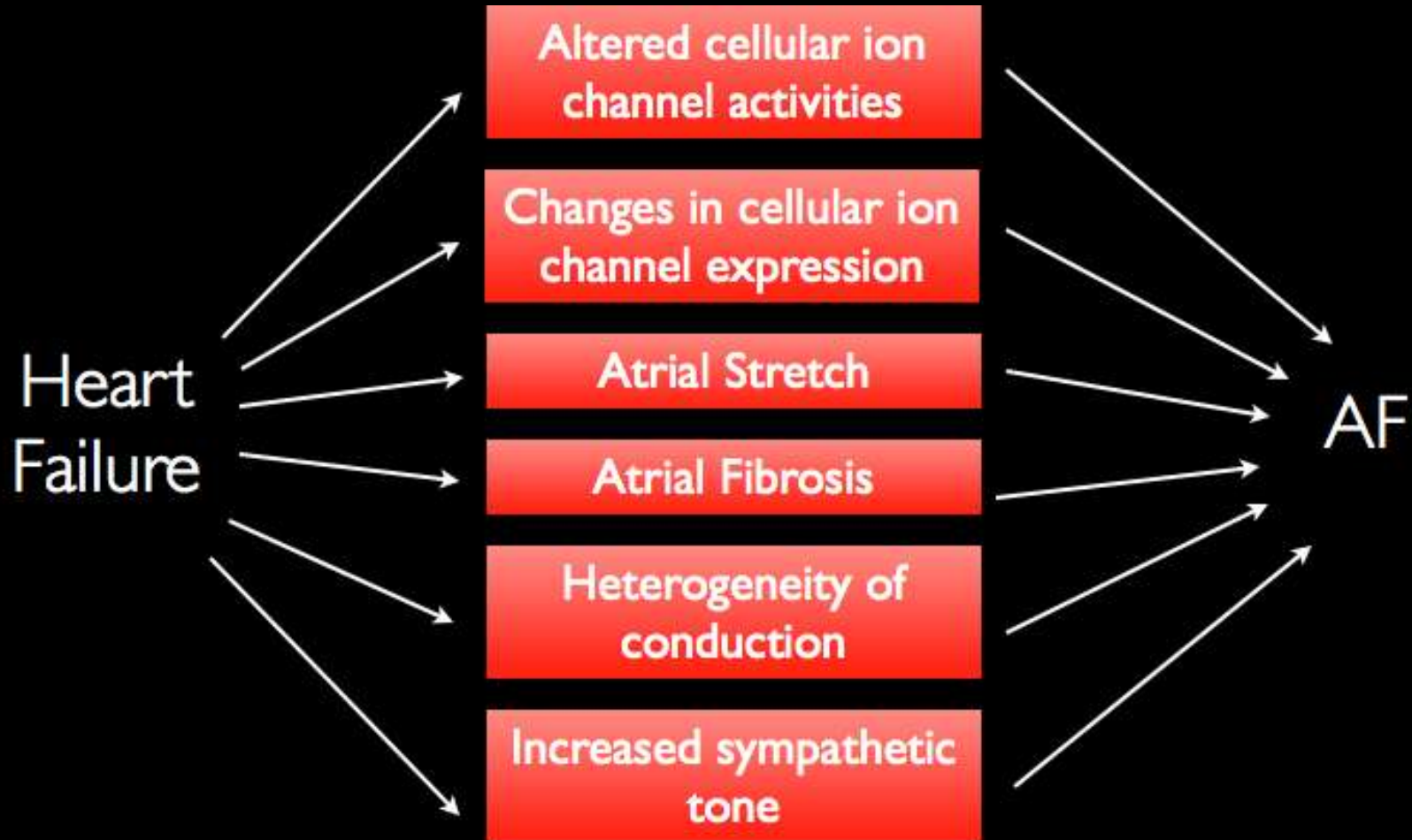
Mechanisms of AF-induced heart failure

Systolic heart failure

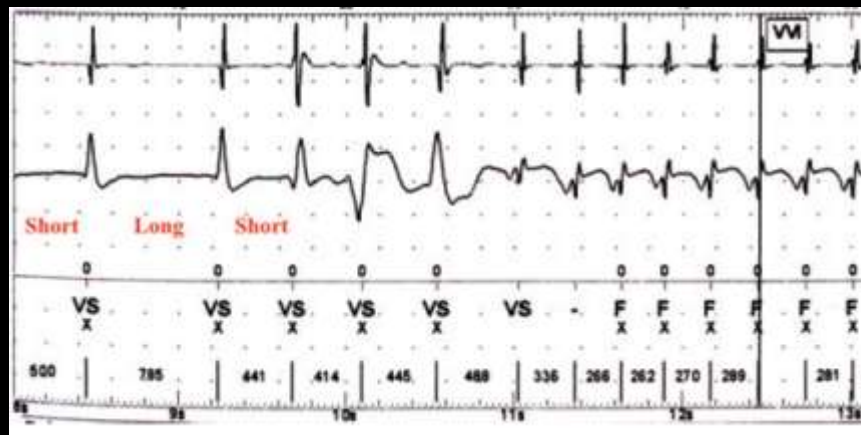
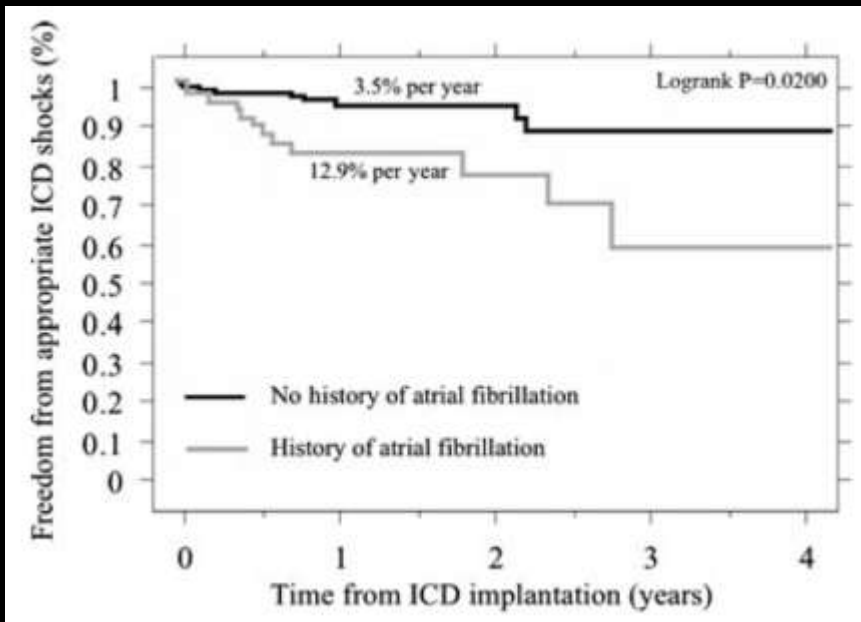
Diastolic heart failure



Mechanisms of heart failure-induced AF

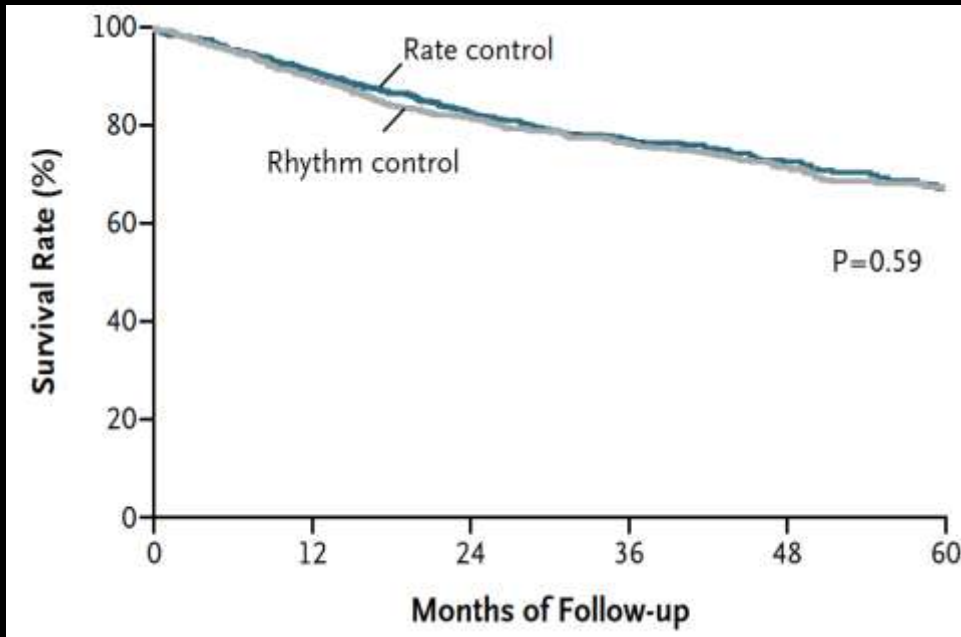


Ventricular Proarrhythmic Effects of Atrial Fibrillation are Modulated by Depolarization and Repolarization Anomalies in Patients with Left Ventricular Dysfunction



- 215 patients
- *Primary* prevention ICD indication, LVEF<35%
 - 60 (28%) AF
 - 155 (72%) no AF
- 10.2% overall appropriate shock during f/u 1.3±1.1y
- AF 21.7% vs no AF 3.9% appropriate shock
- Annual rate of ICD shock
 - 12.9% vs 3.5%
 - AF & QRS > 130ms: HR 5.4
 - AF & QTc > 440ms: HR 12.7
- Pathophysiological link unclear but multiple candidate mechanisms

Rhythm Control versus Rate Control for Atrial Fibrillation and Heart Failure



- Higher hospitalisation (64v59%)
- Higher AF hospitalisation (14v9%)
- Higher brady hospitalisation (6v3%)

- 1376 patients enrolled, 37m f/u
 - 31% in NYHA III/IV
 - Mean LVEF $27\pm 6\%$
 - Persistent AF in $>2/3$
- Death from cardiovascular causes
 - 27%: rhythm control
 - 25%: rate control
- 36 months
 - 73% of rhythm control on amiodarone
 - 21% (142) crossover to rate control (unable to maintain SR)
 - 10% (66) crossover to rhythm control (worsening HF)

Rhythm Control in Atrial Fibrillation — One Setback after Another

Michael E. Cain, M.D., and Anne B. Curtis, M.D.

Nature has equipped the human heart with a complex electrical system for the purpose of coordinated propulsion of blood under a variety of physiologic conditions. Considerable effort is expended by the heart to maintain sinus rhythm. Cardiac electrophysiologists view atrial fibrillation as a system failure. They are likewise frustrated by the conundrum that atrial fibrillation is associated with increased morbidity and mortality, yet attempts to prove that a strategy to maintain nature's rhythm has a favorable effect on patients have been met with one setback after another.²⁻⁴

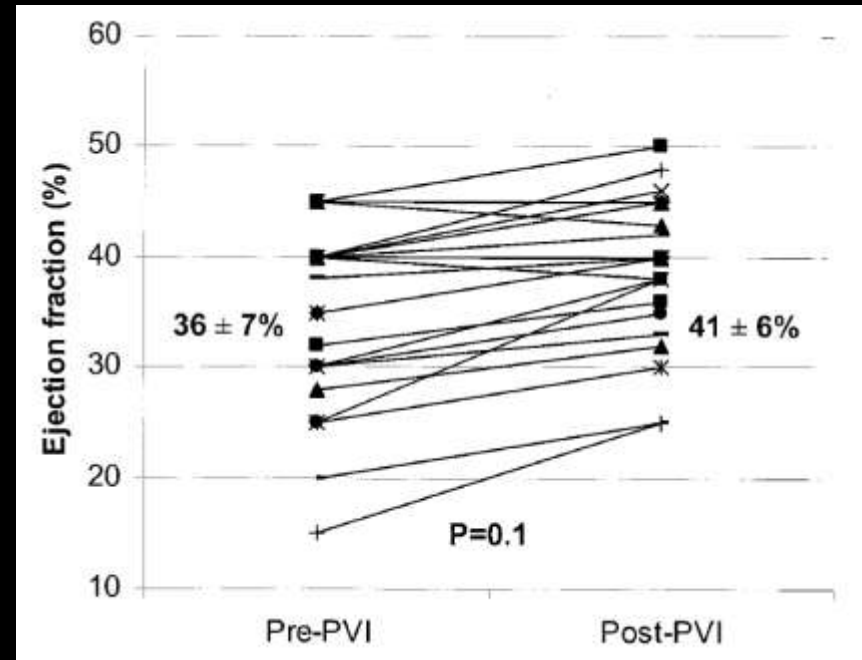
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Pulmonary Vein Isolation for the Treatment of Atrial Fibrillation in Patients With Impaired Systolic Function

- EF < 40% in 94/377 patients undergoing PVI
- Class II 30%; III 68%
- PAF 43%; PsAF 13%; Perm 43%
- Endpoints
 - AF recurrence
 - Change in EF
 - Change in QoL
- Freedom from AF 73% (87% in normal EF)



60% of the study group showed an increase in LVEF after PVI and in these patients, the mean increase in LVEF was 7%.

Pulmonary Vein Vestibule Ablation for the Control of Atrial Fibrillation in Patients with Impaired Left Ventricular Function

EF < 40%

- EAM-guided
- PVI + MI linear lesion
- CTI linear ablation
- Follow-up 14±2 months

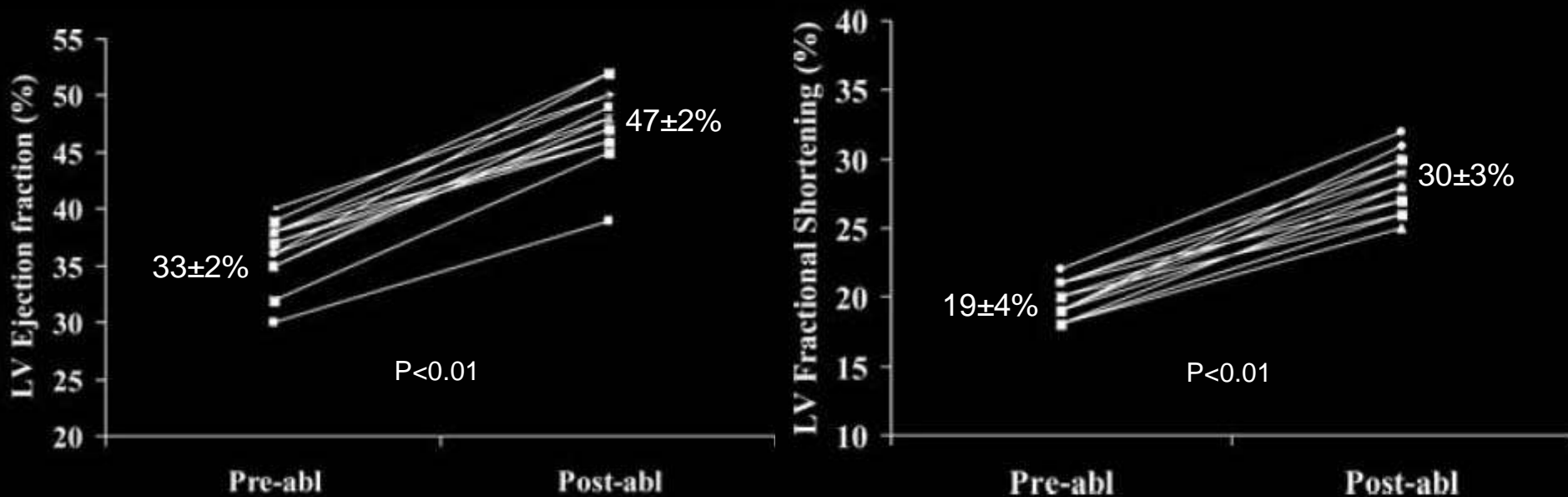
	Patients with CHF (n = 40)	Patients with no CHF (n = 65)	P-Value
Age	57 ± 10	56 ± 8	NS
Males gender, no. (%)	28 (70%)	58 (89%)	NS
Type of AF			
Paroxysmal	10 (25%)	15 (23%)	NS
Persistent	30 (75%)	50 (76%)	NS
Valvular disease	10 (25%)	12 (18%)	NS
Hypertrophic cardiomyopathy	2 (5%)	0	<0.05
Ischemic, hypertensive	10 (25%)	19 (29%)	NS
Dilated cardiomyopathy	18 (45%)	2 (3%)	<0.001
NYHA	2.8 ± 0.1	1.4 ± 0.3	<0.001
Previous electrical cardioversion	35 (87%)	45 (64%)	<0.01
Amiodarone therapy	40 (100%)	43 (66%)	<0.01
Number of AAD tried before ablation	3 ± 1	3 ± 1	NS
Duration of AF (years)	3 ± 1	4 ± 1	NS
Mean EF (%)	33 ± 2	64 ± 6	<0.001
LV fractional shortening (%)	17 ± 4	36 ± 3	<0.001
LA size (mm)	48 ± 4	44 ± 3	NS
LV end-diastolic dimension (mm)	64 ± 6	52 ± 4	<0.001
LV end-systolic dimension (mm)	46 ± 7	32 ± 3	<0.001

Pulmonary Vein Vestibule Ablation for the Control of Atrial Fibrillation in Patients with Impaired Left Ventricular Function

- EAM-guided
- PVI + MI linear lesion
- CTI linear ablation
- Follow-up 14±2 months

	Patients with CHF (n = 40)	Patients without CHF (n = 65)	P-Value
All PVs isolated (%)	40 (100%)	65 (100%)	NS
Left isthmus line completed	34 (85%)	56 (86%)	NS
Right isthmus line completed	39 (98%)	65 (100%)	NS
Total duration of ablation (minute)	78 ± 20	72 ± 27	NS
Total fluoroscopy time (minute)	71 ± 16	70 ± 23	NS
Total duration of procedure (minute)	225 ± 48	234 ± 50	NS
Repeated procedure (%)	2 (13%)	11 (16%)	NS
Complications (%)	2 (13%)	4 (6%)	<0.01
Tamponade	0	1 (2%)	NS
AV fistula	2 (13%)	3 (4%)	<0.01
Stroke	0	0	
Acute follow-up			
AF/Atypical atrial flutter	8 (20%)	10 (15%)	NS
Reablation for AFL	3 (8%)	7 (11%)	NS
Reablation for AF	10 (25%)	7 (11%)	
Outcome			
Follow-up (month)	14 ± 2	14 ± 2	NS
Failure-permanent AF (%)	5 (13%)	7 (11%)	NS
Successful on AAD	15 (38%)	15 (23%)	<0.05
Total successful	35 (87%)	60 (92%)	NS
Anticoagulation	65 (100%)	15 (23%)	<0.001

Pulmonary Vein Vestibule Ablation for the Control of Atrial Fibrillation in Patients with Impaired Left Ventricular Function



Plus – improved QoL
improved exercise capacity

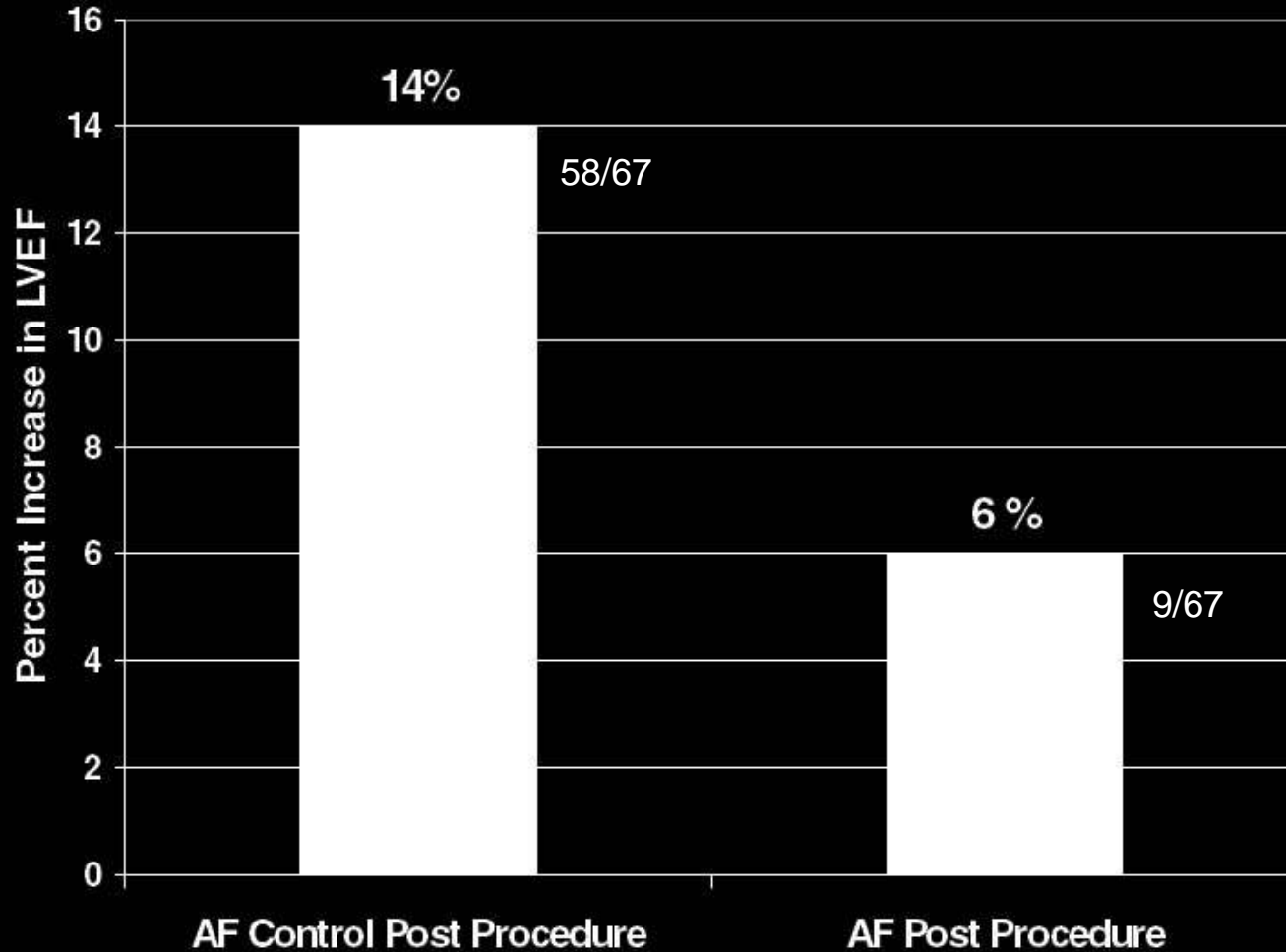
Reversal of Left Ventricular Dysfunction Following Ablation of Atrial Fibrillation

	Patients With Decreased LVEF (n = 67)	Patients With Normal LVEF (n = 299)
Women (%)	5 (7)	71 (23)
Age (years)	54 ± 9	54 ± 11
Left atrial size (cm)	4.4 ± 0.7	4.4 ± 0.6
Mean LVEF (%)	* 42 ± 9	61 ± 6
AF duration (years)	5.6 ± 4.9	5.9 ± 5.7
Paroxysmal AF (%)	* 47 (70)	246 (82)
Persistent AF (%)	20 (30)	53 (18)
Hypertension (%)	21 (31)	133 (44)
Sleep apnea (%)	1 (2)	32 (11)
Coronary artery disease (%)	12 (18)	26 (9)
Valvular artery disease (%)	6 (9)	15 (5)
Mean number of veins isolated	3.4 ± 0.9	3.3 ± 1.0
Mean number of PV isolation procedures	1.6 ± 0.8	1.3 ± 0.5

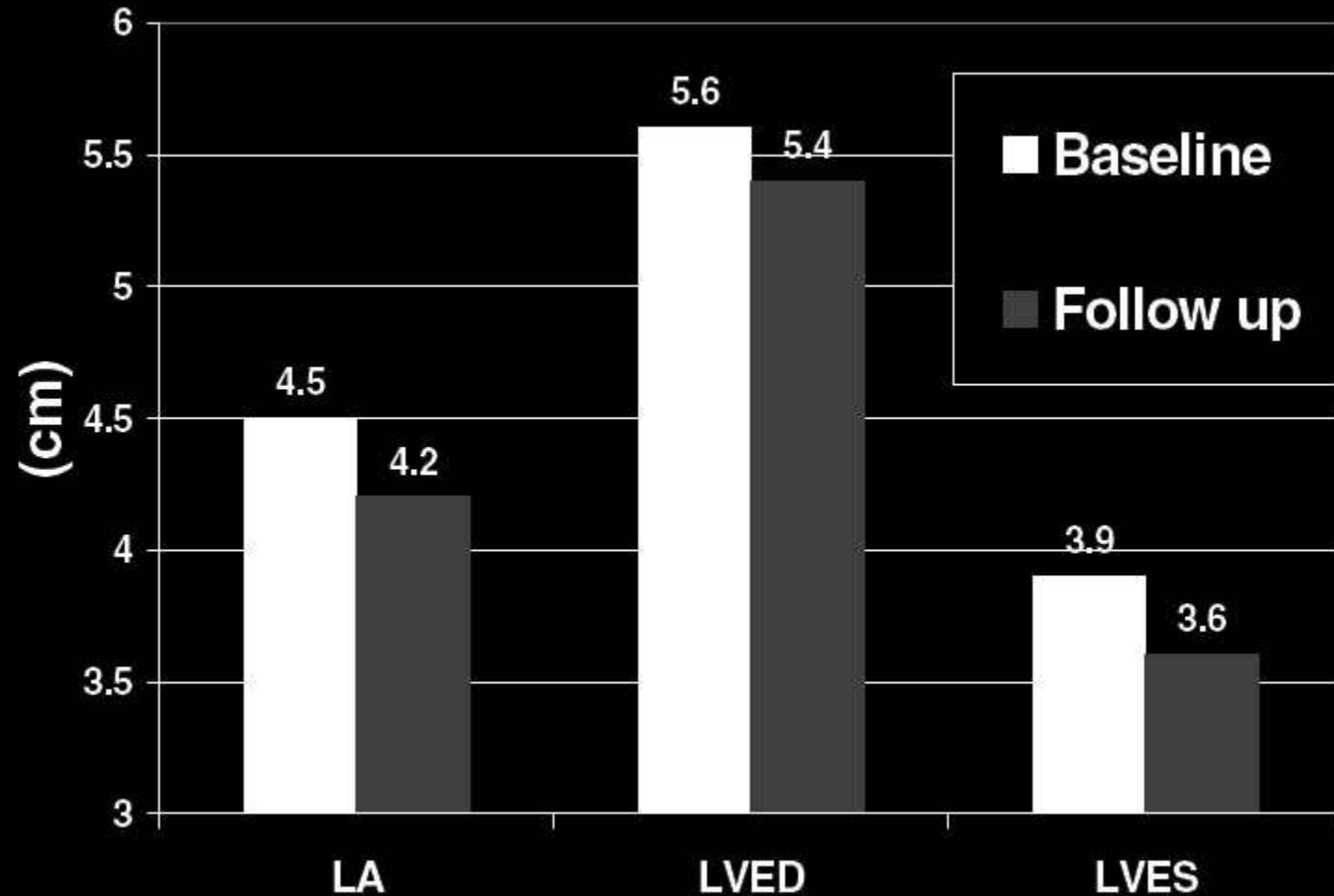
- Graded isoproterenol infusion
- Isolation of arrhythmogenic PVs
- Bidirectional block
- Non-PV triggers targeted
- Redo PVI for recurrences
- Mean follow up 20 ± 9 months

AF control achieved in 87% of patients
 No AADs in 57% of patients
 AF control similar in both groups (86% v 87%)

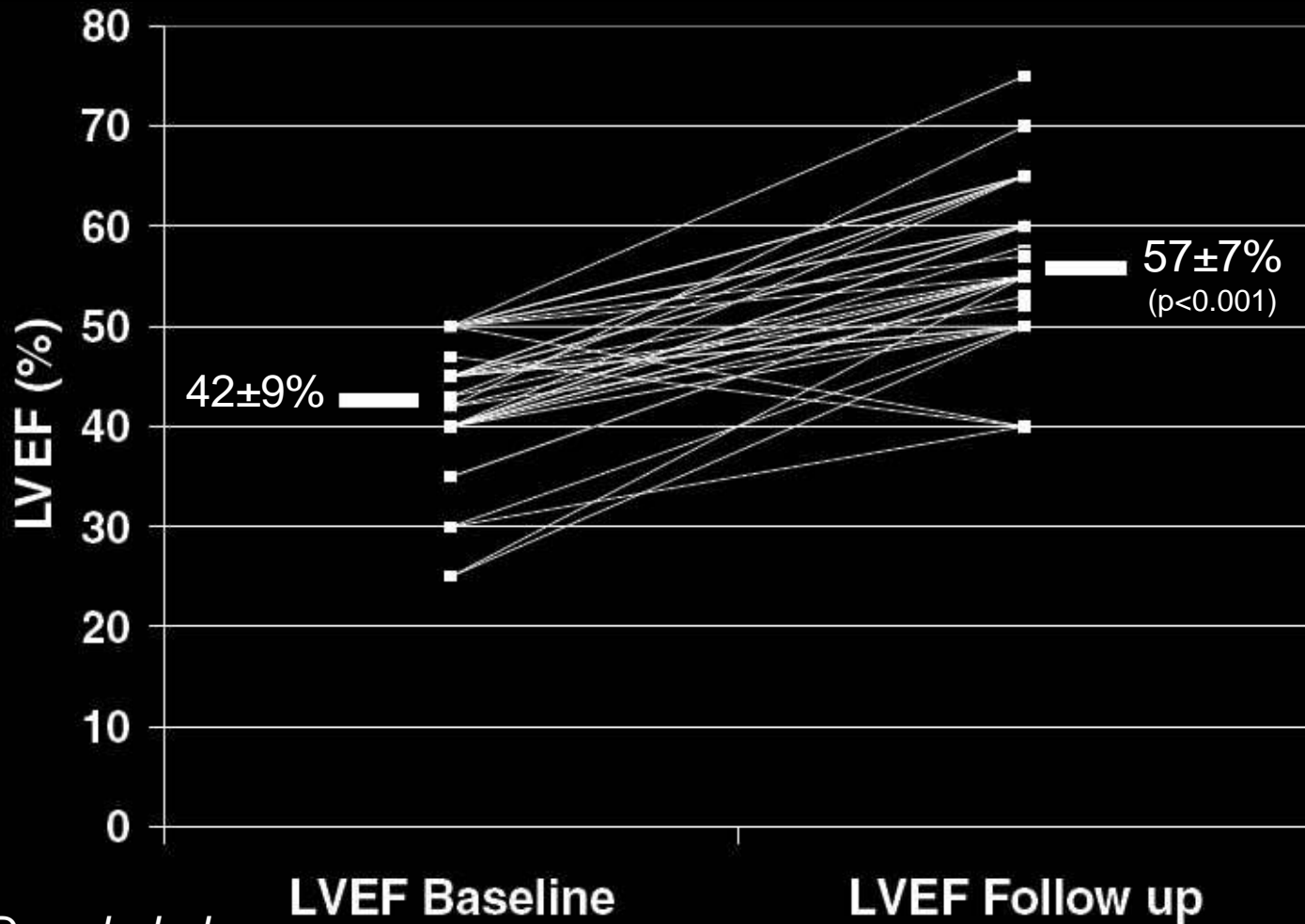
Reversal of Left Ventricular Dysfunction Following Ablation of Atrial Fibrillation



Reversal of Left Ventricular Dysfunction Following Ablation of Atrial Fibrillation



Reversal of Left Ventricular Dysfunction Following Ablation of Atrial Fibrillation



IHD & VHD excluded
"idiopathic" CM ie 50/67

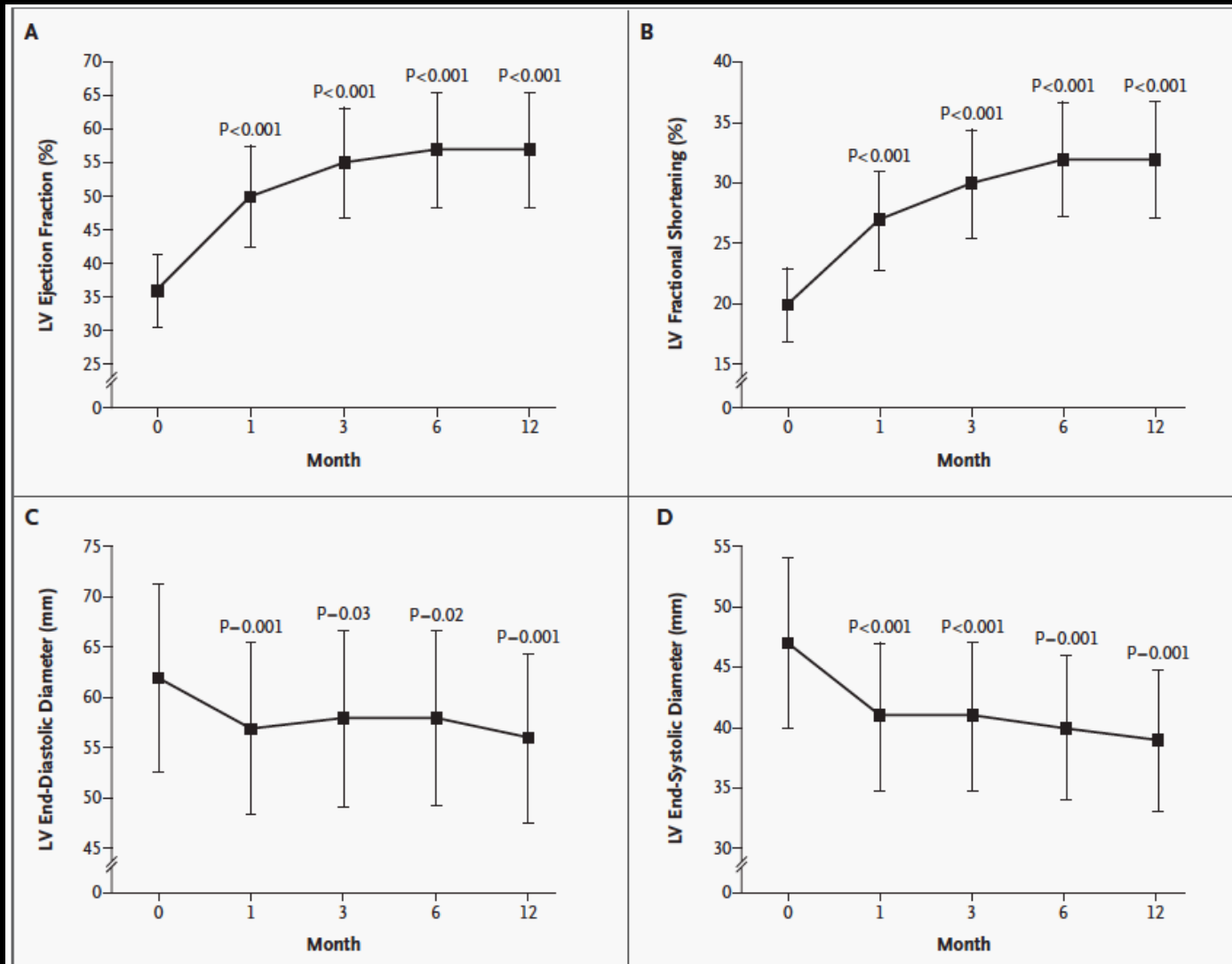
Catheter Ablation for Atrial Fibrillation in Congestive Heart Failure

- 58 consecutive patients with AF and CHF (EF<45%; persistent/permanent AF 91%)
- 58 controls matched for age, sex and AF
- Evaluated for LV function & dimensions, symptom score, exercise capacity, QoL at 1,3,6 and 12 months
- At 12±7m, sinus rhythm:
 - 78% of CHF (69% without drugs)
 - 84% of controls (71% without drugs)

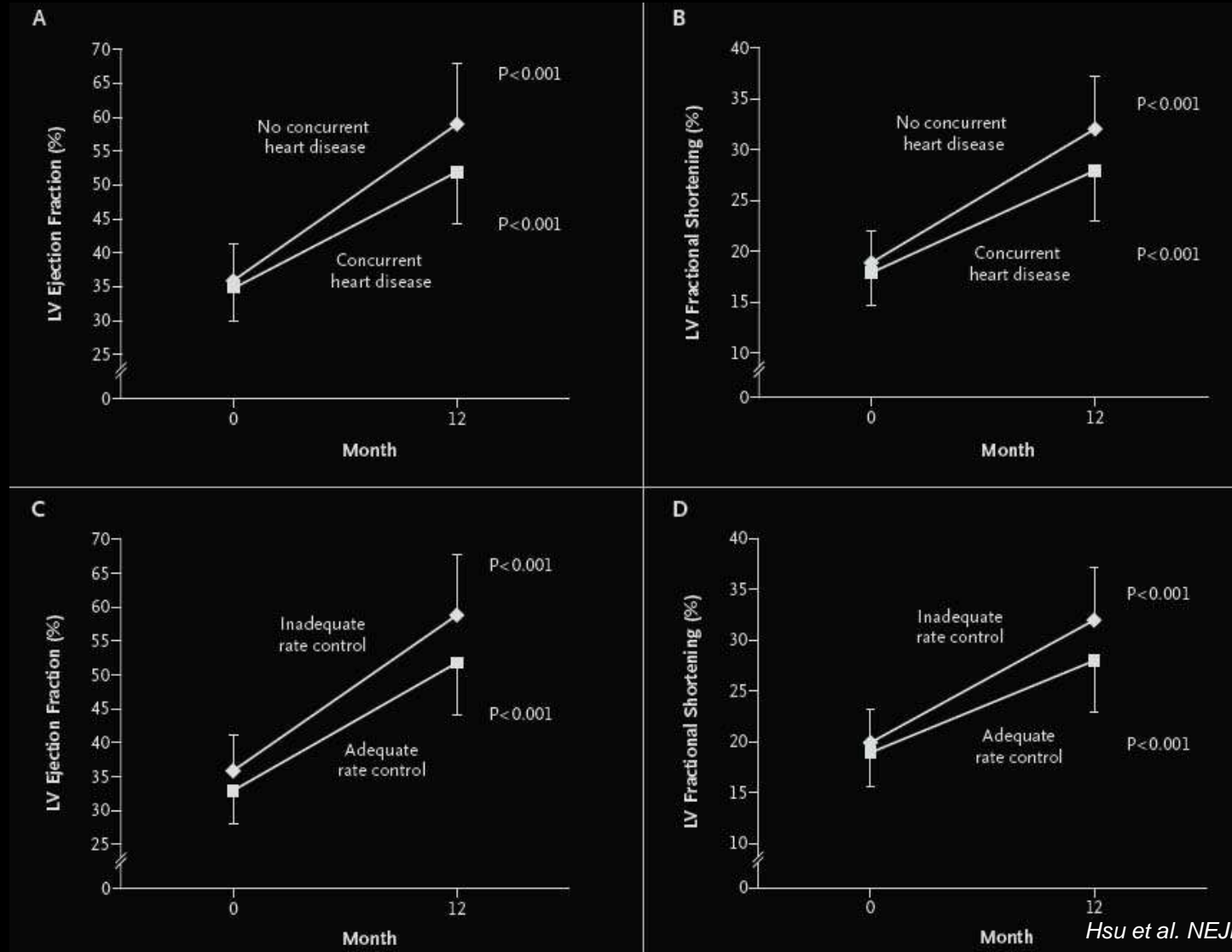
Catheter Ablation for Atrial Fibrillation in Congestive Heart Failure

All <u>pulmonary veins isolated</u> — no. (%)	58 (100)	58 (100)	1.00
Additional <u>left atrial linear ablation</u> — no. (%)	53 (91)	54 (93)	1.00
Total duration of radiofrequency ablation — min	69±27	78±29	0.15
Total duration of fluoroscopy — min	64±24	72±36	0.20
Total duration of procedure — min	218±65	232±90	0.39
Serious complications — no. (%)	2 (3)	1 (2)	0.74
Tamponade	1 (2)	1 (2)	
Stroke	1 (2)	0	
<u>Repeated ablation</u> — no. (%)	29 (50)	27 (47)	0.55
Overall success — no. (%)‡			
Without drugs	40 (69)	41 (71)	0.84
With drugs	45 (78)	49 (84)	0.34
Length of follow-up since last procedure — mo	12±7	12±6	0.98
Permanent	43 (74)	43 (74)	1.00
Persistent	10 (17)	10 (17)	1.00
Paroxysmal	5 (9)	5 (9)	1.00

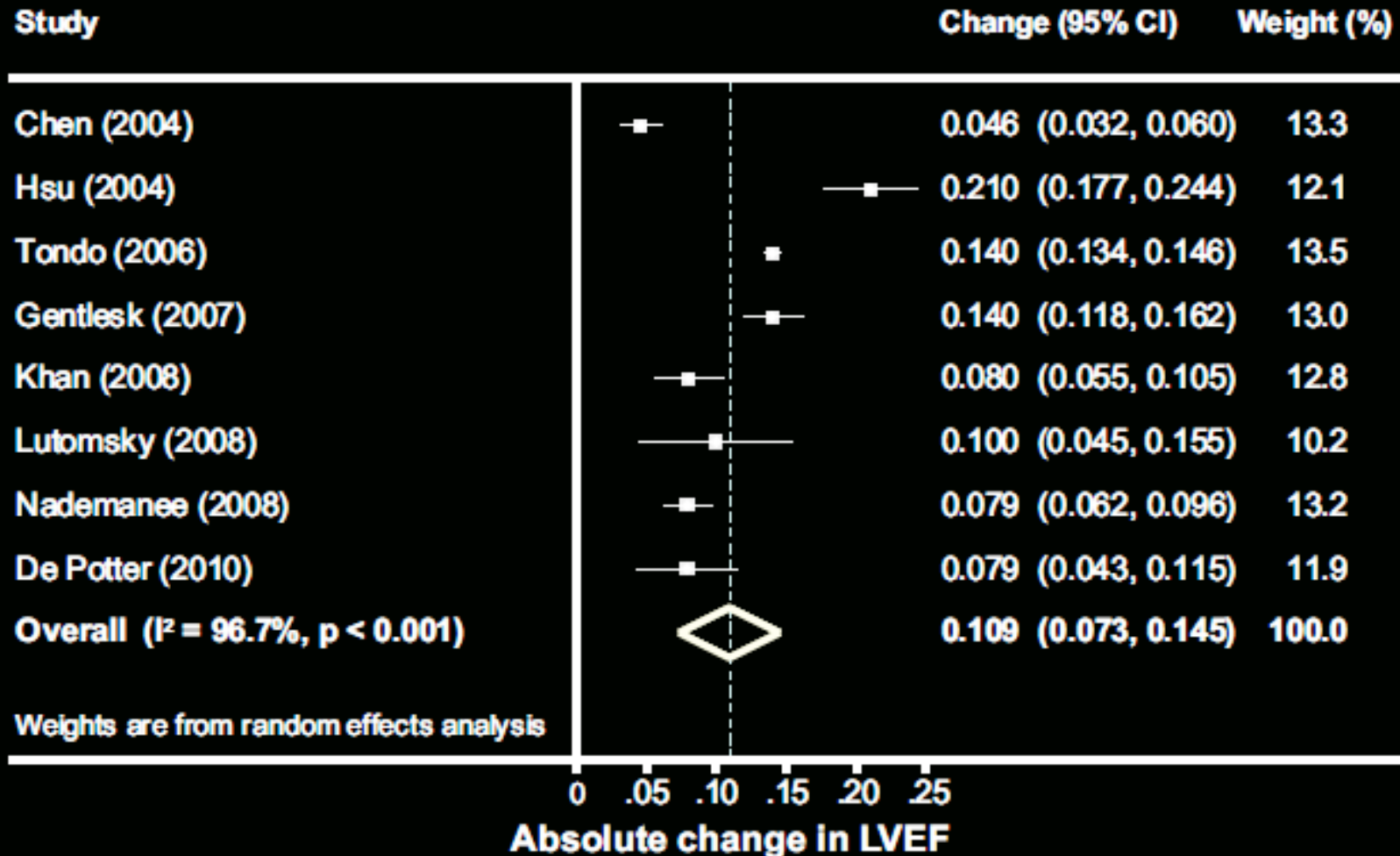
LV function and dimensions after RFA



Concurrent heart disease & rate control



To summarise



Meta-Analysis of the Effectiveness and Safety of Catheter Ablation of Atrial Fibrillation in Patients With Versus Without Left Ventricular Systolic Dysfunction

- Follow up 6-27 months
- AF/AT free after 1 procedure – 28-55%
- AF/AT free after 1.4 procedures – 64-96%
- Complication rate 3.5% in those with versus 2.5% in those without heart failure
- Repeat procedures required more often in LVSD patients

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Comparative effects of permanent biventricular and right-univentricular pacing in heart failure patients with chronic atrial fibrillation

Study Design

- 59 NYHA III patients
 - LV systolic dysfunction
 - Chronic AF
 - Slow V rate requiring PPM
 - Wide QRS (paced>200ms)
- Single blind, randomized, controlled, cross-over
- Two 3 month treatment periods of conventional v BiV pacing
- Primary end point – 6 min walk
- Secondary: peak VO₂, QoL, hospitalisation, patient's preferred mode, mortality

Results

- Very high drop out (42%)
- 37 patients in the “efficacy analysis set”
- % BiV pacing 97-100%
- In those with effective therapy:
 - 9.3% increase in mean walk distance with BiV
 - 13% increase in VO₂max
 - 70% decrease in hospitalisations
 - 85% of patients preferred to be BiV paced
- NOTE: AVN ablation only performed “when required”

Four-Year Efficacy of Cardiac Resynchronization Therapy on Exercise Tolerance and Disease Progression

The Importance of Performing Atrioventricular Junction Ablation in Patients With Atrial Fibrillation

- 673 consecutive HF patients treated with CRT
- 162 in permanent AF, 511 in SR
- Rate slowing medication in all AF
- At 2 months, if %BiV pacing <85%, AVJ ablation was performed
- Measures:
 - NYHA class
 - 6 min walk
 - VO2max
 - Echo
- Response = reduction in LVESV \geq 10% relative to baseline
- Follow up at 6, 12 and every 12 months

Table 1. Baseline Characteristics of SR and AF Patients

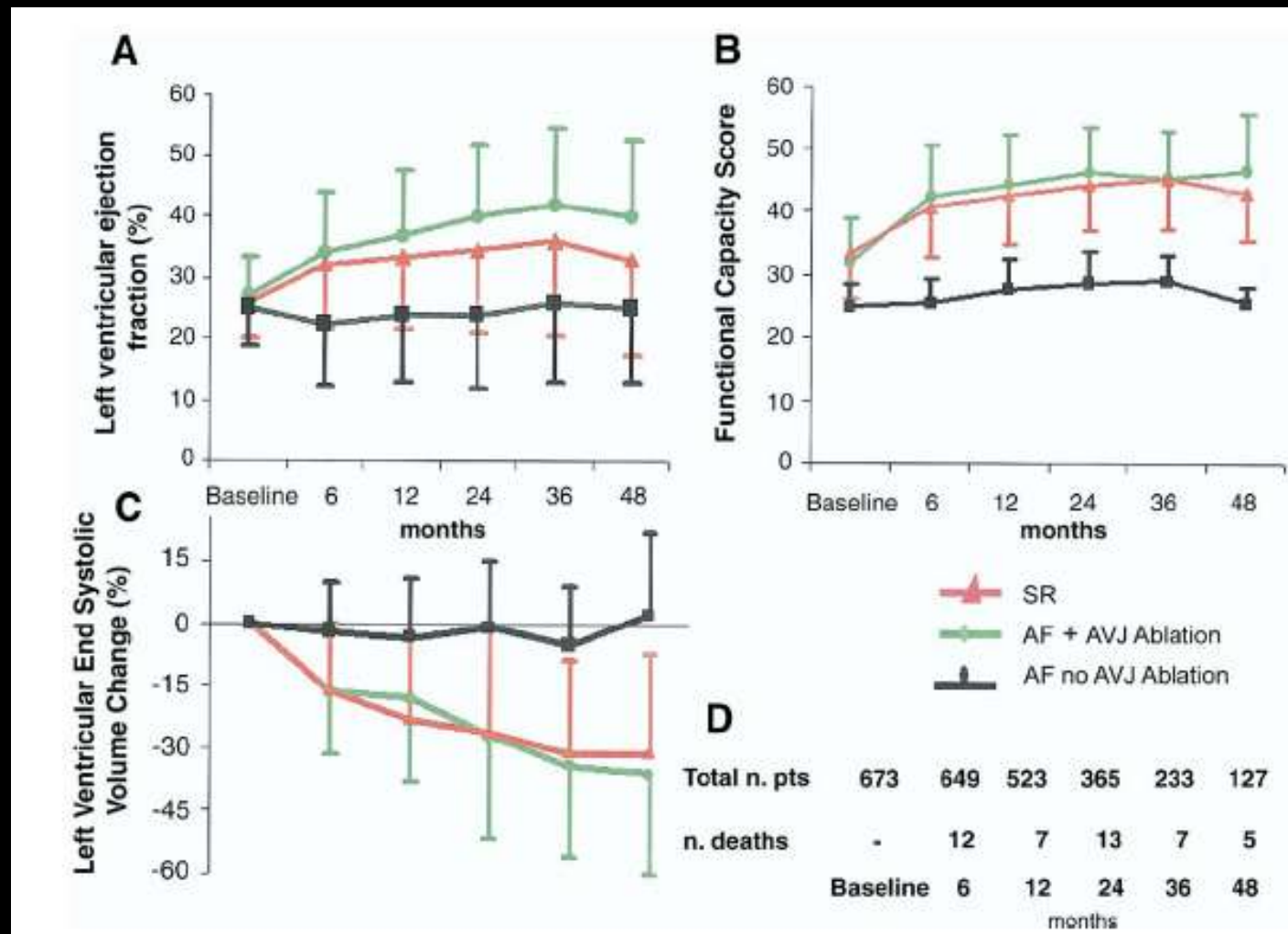
	SR (n = 511)	AF (n = 162)	p Value
Follow-up (months)*	26.1 (12.4–42.2)	24.6 (12.7–42.2)	0.562
Age (yrs)†	63.4 (10.0)	66.0 (8.3)	0.002
Male gender (%)‡	395 (77.3)	139 (85.8)	0.019
Functional NYHA functional class III–IV (%)‡	452 (89.7)	154 (96.9)	0.003
QRS duration (ms)†	165.3 (29.5)	165.0 (35.5)	0.915
Coronary artery disease (%)‡	241 (47.2)	60 (37.1)	0.029
LVEF (%)†	26.0 (7.0)	26.3 (6.7)	0.647
LVEDD (mm)†	67.0 (9.0)	66.0 (8.8)	0.259
LVESV (ml)†	196 (53)	186 (45)	0.062
Peak oxygen consumption (ml/min/kg)†	13.1 (2.8)	12.1 (2.2)	0.005
6-min walking distance (m)†	332 (117)	311 (107)	0.122
Functional capacity score†	33.4 (7.3)	29.6 (6.5)	0.014
CRT with a defibrillator (%)‡	299 (58.5)	79 (48.8)	0.036
Beta-blockers (%)‡	424 (83.1)	135 (83.3)	1.000
ACE inhibitors (%)‡	460 (90.4)	152 (93.8)	0.204
Antialdosteronic agents (%)‡	267 (52.5)	85 (52.5)	1.000
Diuretics (%)‡	449 (88.2)	148 (91.4)	0.314
Negative chronotropic drugs (%)‡	435 (85.1)	160 (98.7)	<0.0001
Lead position: lateral or posterolateral region (%)‡	454 (89)	142 (88)	0.885

Table 3. Baseline Characteristics of AF Patients With and Without AVJ Ablation

	AF No AVJ Ablation (n = 48)	AF + AVJ Ablation (n = 114)	p Value
Age (yrs)*	64.1 (6.3)	66.8 (9.0)	0.054
Male gender (%)†	40 (83.3)	99 (86.8)	0.624
NYHA functional class III–IV (%)†	48 (100)	106 (95.5)	0.323
QRS duration (ms)*	172.1 (32.0)	162.0 (36.5)	0.105
Coronary artery disease (%)†	19 (39.6)	41 (36.0)	0.723
LVEF (%)*	25.1 (5.7)	26.8 (7.1)	0.133
LVEDD (mm)*	67.9 (8.4)	65.3 (8.9)	0.084
LVESV (ml)*	196 (50)	182 (49)	0.101
Peak oxygen consumption (ml/min/kg)*	12.1 (2.2)	12.1 (2.1)	0.892
6-min walking distance (m)*	313 (72)	311 (68)	0.973
Functional capacity score‡	24.6 (6.9)	31.7 (7.1)	0.932
Negative chronotropic drugs (%)†	48 (100)	112 (98)	1.0

Four-Year Efficacy of Cardiac Resynchronization Therapy on Exercise Tolerance and Disease Progression

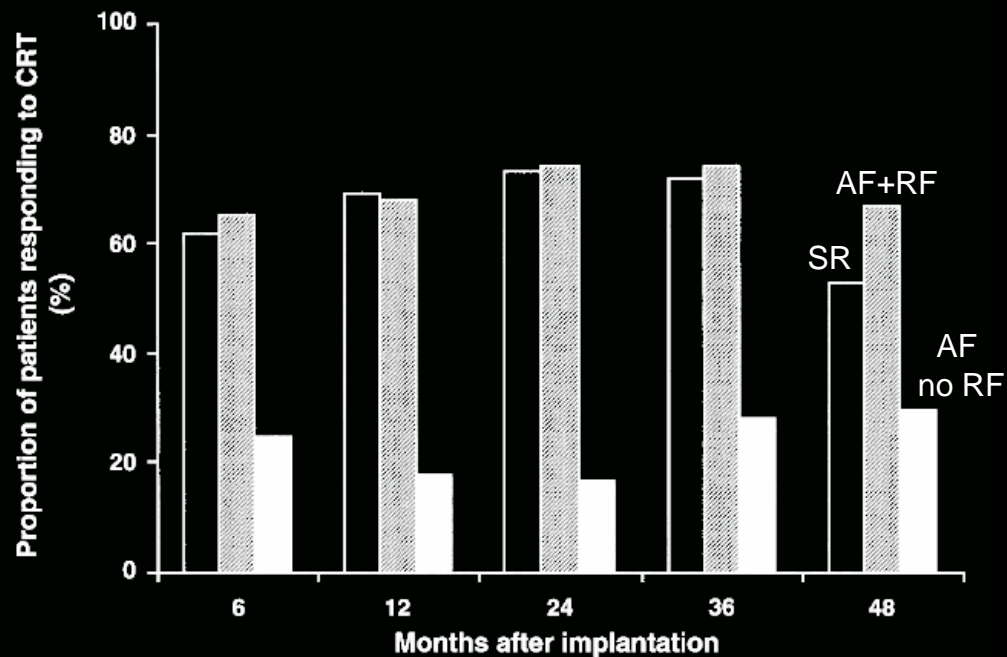
The Importance of Performing Atrioventricular Junction Ablation in Patients With Atrial Fibrillation



Four-Year Efficacy of Cardiac Resynchronization Therapy on Exercise Tolerance and Disease Progression

The Importance of Performing Atrioventricular Junction Ablation in Patients With Atrial Fibrillation

- The effect of BiV pacing, even when >85% of pacing time, is not as effective as 100% BiV pacing time, achievable only by AVJ ablation
- Only 29% of AF patients could achieve >85% BiV pacing with drugs along to limit V rate
- 3X the number of “responders” in the AVJ-ablated group



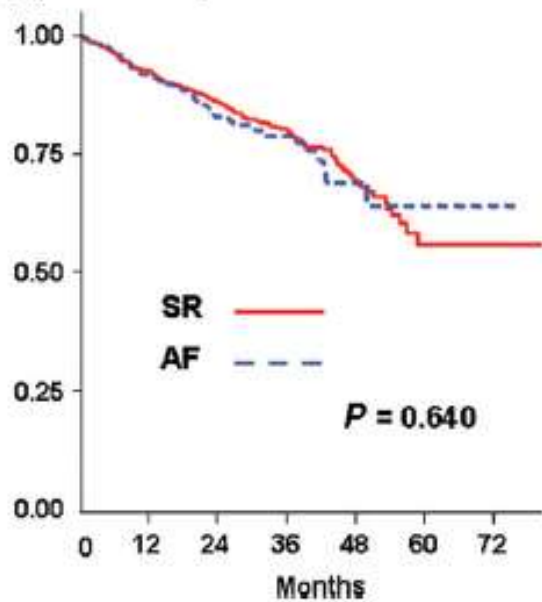
Long-term survival in patients undergoing cardiac resynchronization therapy: the importance of performing atrio-ventricular junction ablation in patients with permanent atrial fibrillation

- 1285 CRT-implanted patients
 - 1042 SR; 243 AF
- Rate control achieved with AVJ RF in 118 and drugs in 125
- Median follow up 34 months
- Mortality similar in both groups
- AF patients
 - 11/118 AVJ RF patients died
 - 28/125 AF drugs patients died
- Conclusion: in AF, AVJ ablation in addition to CRT significantly improves overall survival compared with CRT alone, primarily by reducing HF death

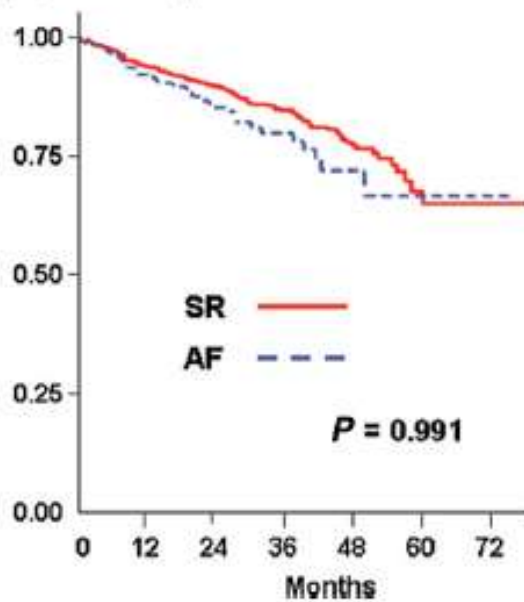
Table 1 Baseline characteristics of global permanent atrial fibrillation patient population compared with sinus rhythm patients

	SR (n = 1042)	AF (n = 243)	P-value
Age (years)	63.4 (9.5)	66.2 (8.9)	<0.001
Female	262 (25.1%)	44 (18.1%)	0.020
Aetiology			
Non-ischaemic	545 (52.3%)	146 (60.0%)	0.032
Ischaemic	497 (47.7%)	97 (40.0%)	
NYHA			
II	60 (5.8%)	10 (4.1%)	0.196
III	826 (79.3%)	193 (79.4%)	
IV	146 (14.9%)	40 (16.5%)	
QRS (ms)	170 (28)	161 (32)	<0.001
Left ventricular EF (%)	24.4 (7.3)	26.0 (8.0)	0.005
Mitral regurgitation (grade 3–4)	594 (57%)	185 (76%)	<0.001
Left atrial diameter (mm)	51 (7)	56 (6)	<0.001
CRT-D	604 (57.8%)	117 (48.2%)	0.006
ACE-inhibitors/ARBs	948 (90.9%)	228 (93.7%)	0.162
Beta-blockers	833 (79.9%)	194 (79.7%)	1.000
Aldosterone antagonists	548 (52.6%)	140 (57.6%)	0.175
Diuretics	938 (90.0%)	224 (92.2%)	0.335
Digitalis	550 (52.9%)	171 (70.3%)	<0.001
Amiodarone	259 (24.9%)	108 (44.4%)	<0.001
Negative chronotropic drugs	907 (87.0%)	236 (97.1%)	<0.001
Intravenous inotropic drugs	12 (1.2%)	5 (2.0%)	0.344

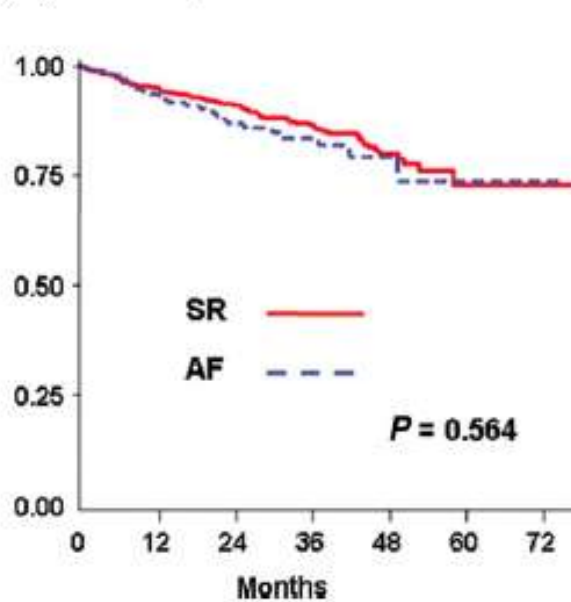
(A) Total Population: Overall Survival



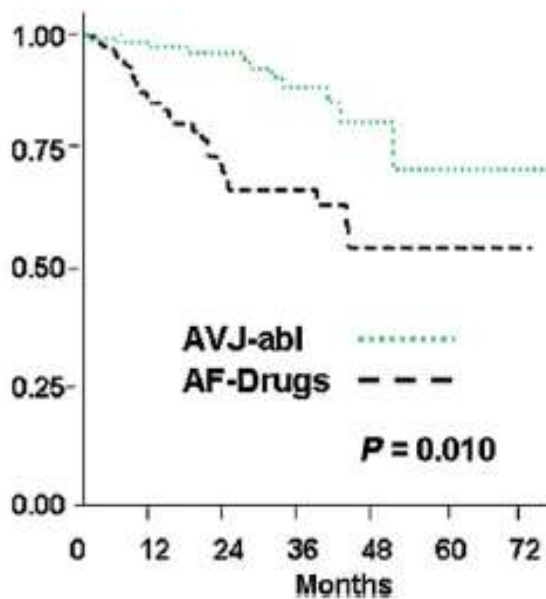
(B) Total Population: Cardiac Survival



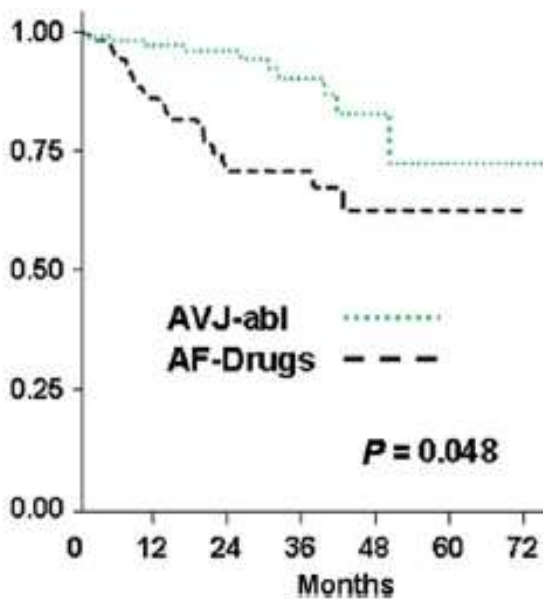
(C) Total Population: HF Survival



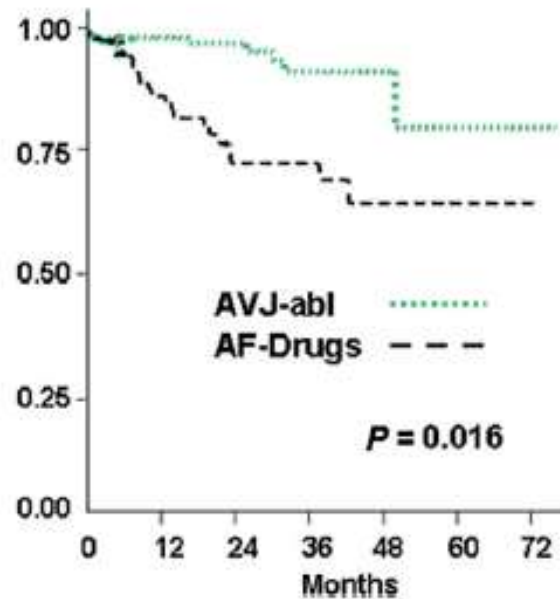
(A) AF Patients: Overall Survival



(B) AF Patients: Cardiac Survival



(C) AF Patients: HF Survival



Comparison of Benefits and Mortality in Cardiac Resynchronization Therapy in Patients With Atrial Fibrillation Versus Patients in Sinus Rhythm (Results of the Spanish Atrial Fibrillation and Resynchronization [SPARE] Study)

- 470 consecutive CRT patients
- 126 with permanent AF
- Baseline and 12 months

Despite the beneficial effects of CRT, death from refractory heart failure at 12 months was higher in patients with AF (17/126, 13.5%) than those in SR (14/344, 4.1%)

AF is an independent risk factor for mortality from heart failure after CRT implantation

Table 2
Improvement at 12 months observed in survivors with atrial fibrillation (AF) and sinus rhythm (SR)

	AF	SR
Δ Minnesota Quality of Life Test (points)	-14 ± 30	-18 ± 21
Δ 6 Minute walking distance (m)	+79 ± 165	+92 ± 134
Δ Left ventricular end-diastolic diameter (mm)	-2 ± 10	-3 ± 7
Δ Left ventricular end-systolic diameter (mm)	-3 ± 9	-5 ± 10
Δ Left ventricular ejection fraction (%)	+6 ± 9	+7 ± 10

Table 4
Improvement at 12 months in survivors with atrial fibrillation with and without atrioventricular junction ablation

	Yes	No
Δ Minnesota Quality of Life Test (points)	-17 ± 31	-13 ± 31
Δ 6 Minute walking distance test (m)	+99 ± 220	+75 ± 140
Δ Left ventricular end-diastolic diameter (mm)	-3 ± 6	-2 ± 7
Δ Left ventricular end-systolic diameter (mm)	-2 ± 8	-3 ± 9
Δ Left ventricular ejection fraction (%)	+6 ± 9	+7 ± 10

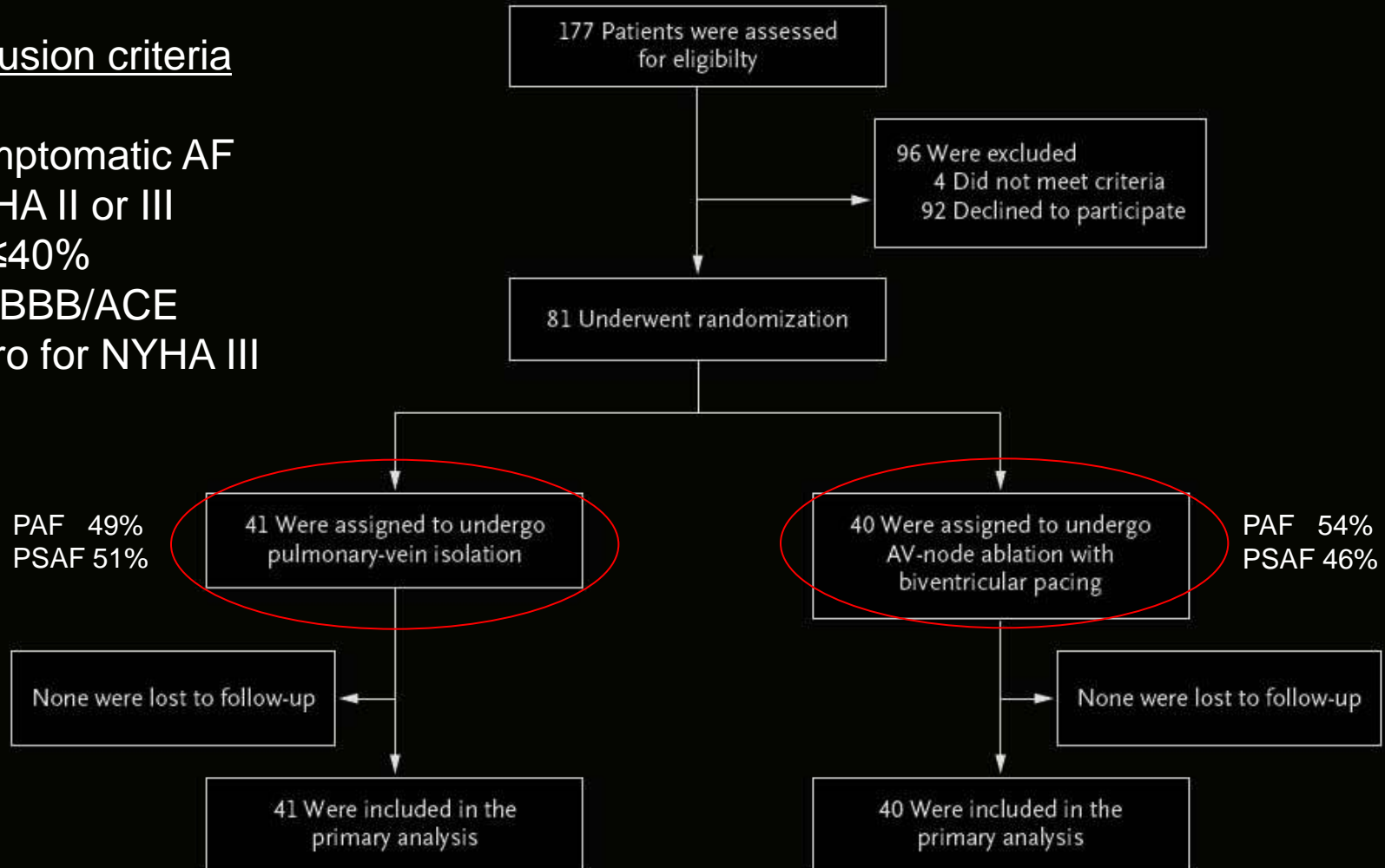
OUTLINE

- AF and Heart Failure
- AF ablation and CHF
- AF, CHF, CRT and AVJ ablation
- Head to Head
- Summary

Pulmonary-Vein Isolation for Atrial Fibrillation in Patients with Heart Failure

Inclusion criteria

Symptomatic AF
NYHA II or III
EF ≤ 40%
On BBB/ACE
Spiro for NYHA III



Pulmonary-Vein Isolation for Atrial Fibrillation in Patients with Heart Failure

- PV antral isolation
- Linear and egm-guided ablation according to centre (15)
- Secondary end point
 - Freedom from AF
 - LA size at 6 months
- Primary end point
 - EF
 - 6 min walk distance
 - MLWHF score

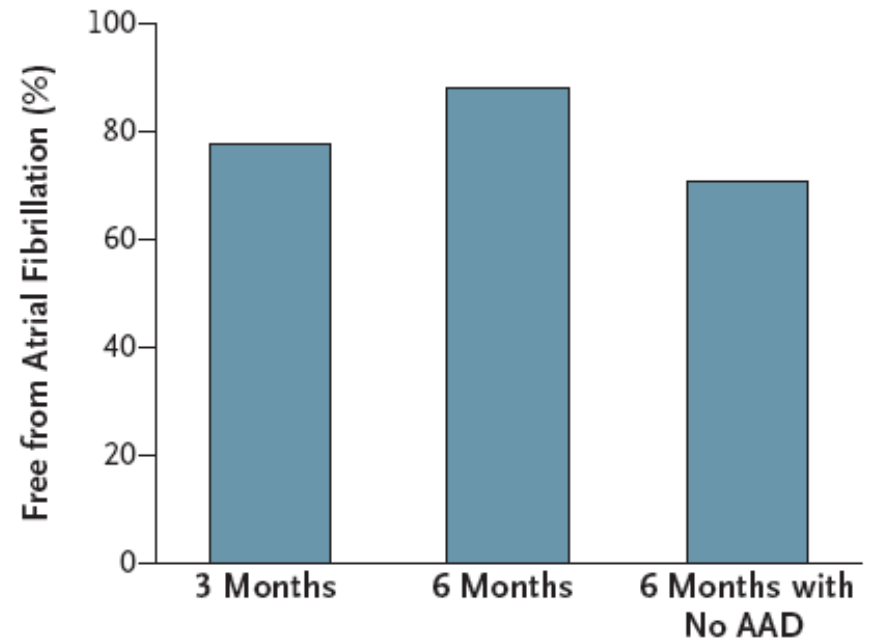
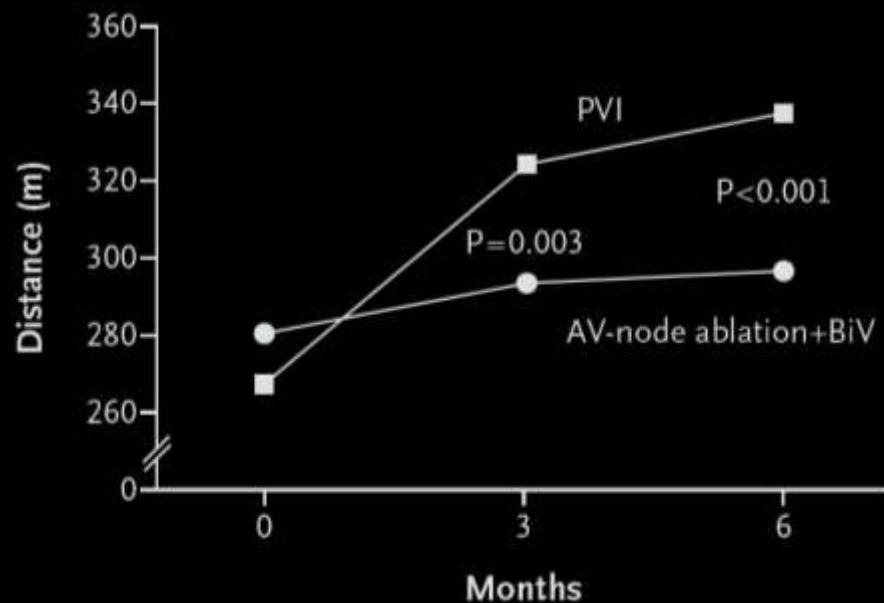
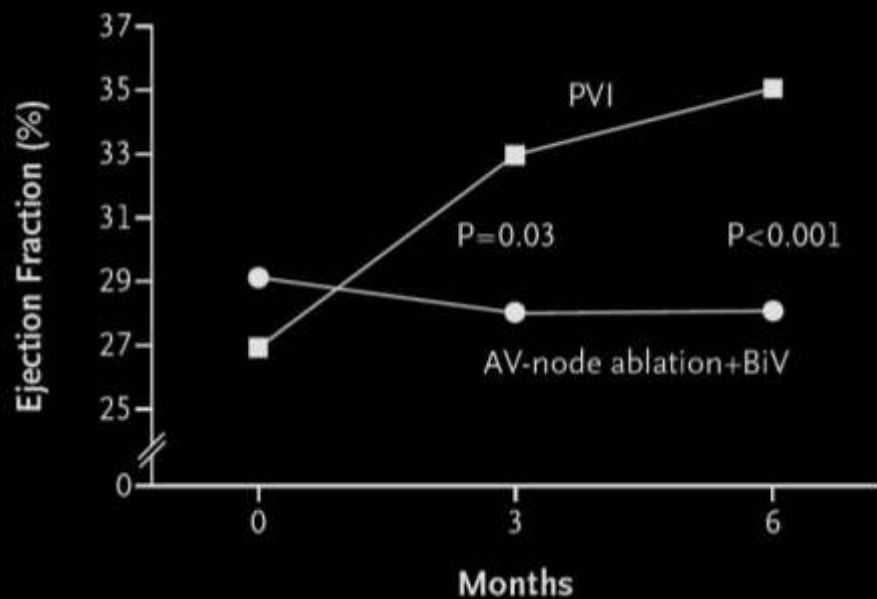


Figure 2. Freedom from Atrial Fibrillation in Patients Undergoing Pulmonary-Vein Isolation with or without Antiarrhythmic Drugs (AAD).

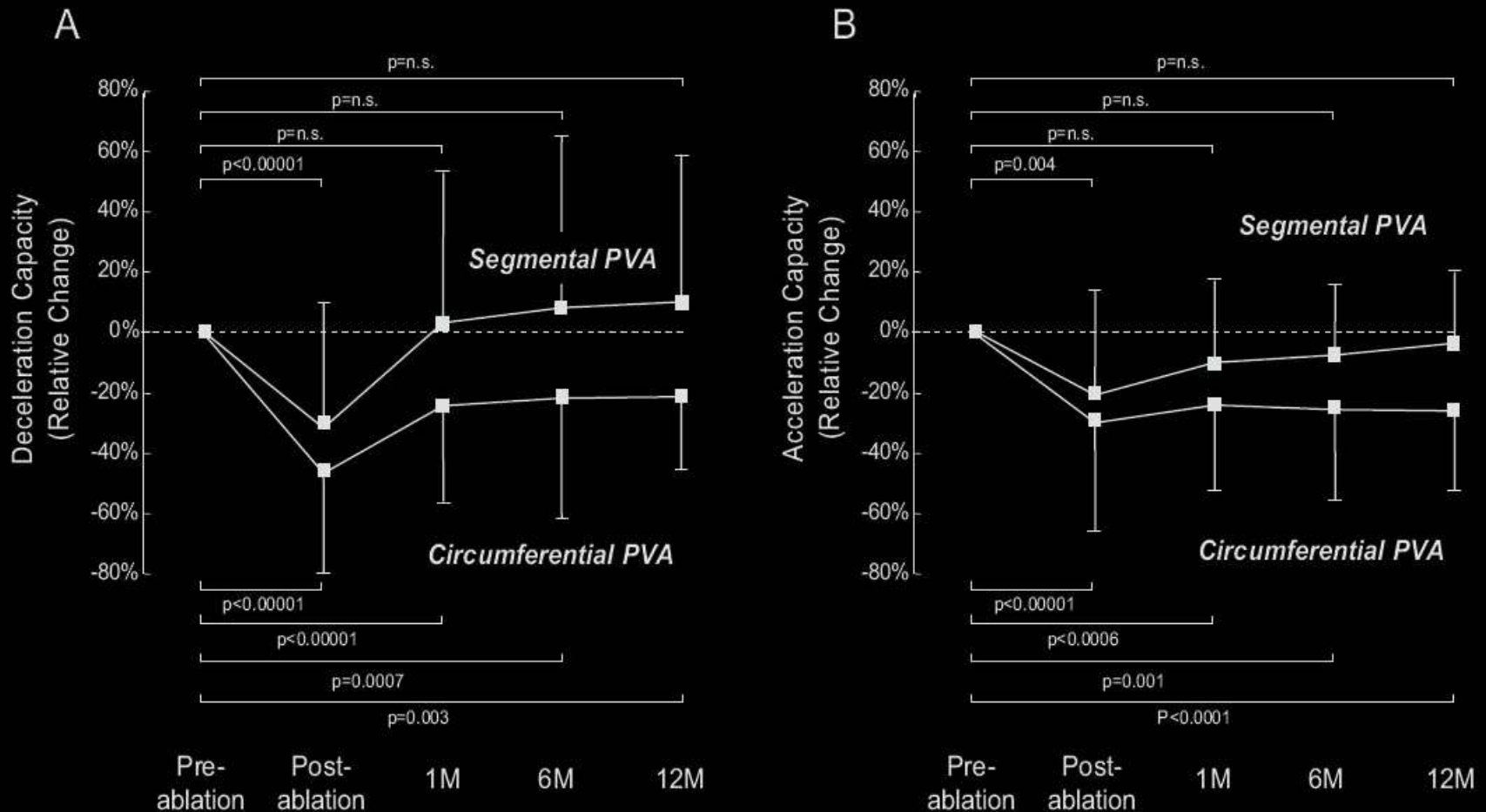
Pulmonary-Vein Isolation for Atrial Fibrillation in Patients with Heart Failure



Type of AF & Progression

- Progression in none of the PVI group but in 30% of the AVN ablation & CRT group
- Regression from nonparoxysmal to paroxysmal or SR in 100% of PVI group vs 5% of the AVN ablation & CRT group
- Decreased AAD burden in PVI group (10 patients vs 15 patients)
- In non-paroxysmal group, greater *increases* in EF ($12\pm 10\%$), 6 min walk and MLWHF score than in the paroxysmal group (EF $3\pm 3\%$)

Effects of circumferential or segmental pulmonary vein ablation for paroxysmal atrial fibrillation on cardiac autonomic function

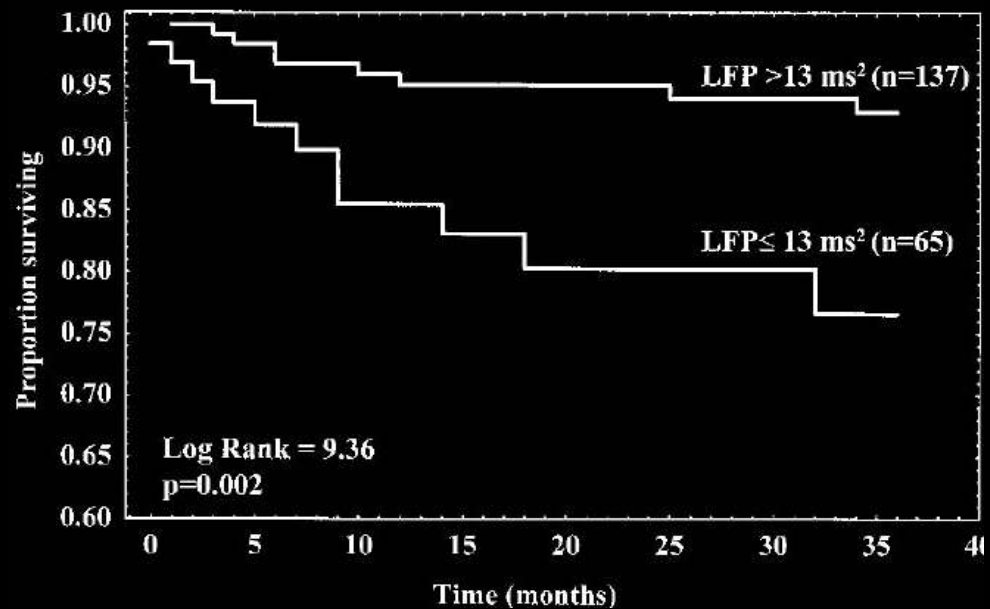


Short-Term Heart Rate Variability Strongly Predicts Sudden Cardiac Death in Chronic Heart Failure Patients

- 242 patients
- Mod-severe CHF
- EF $27 \pm 11\%$
- Peak VO_2 $15 \pm 6 \text{ ml/kg/min}$
- NYHA II/III = 88%

TABLE 5. Multivariate Prognostic Model for Sudden Death in the Validation Sample

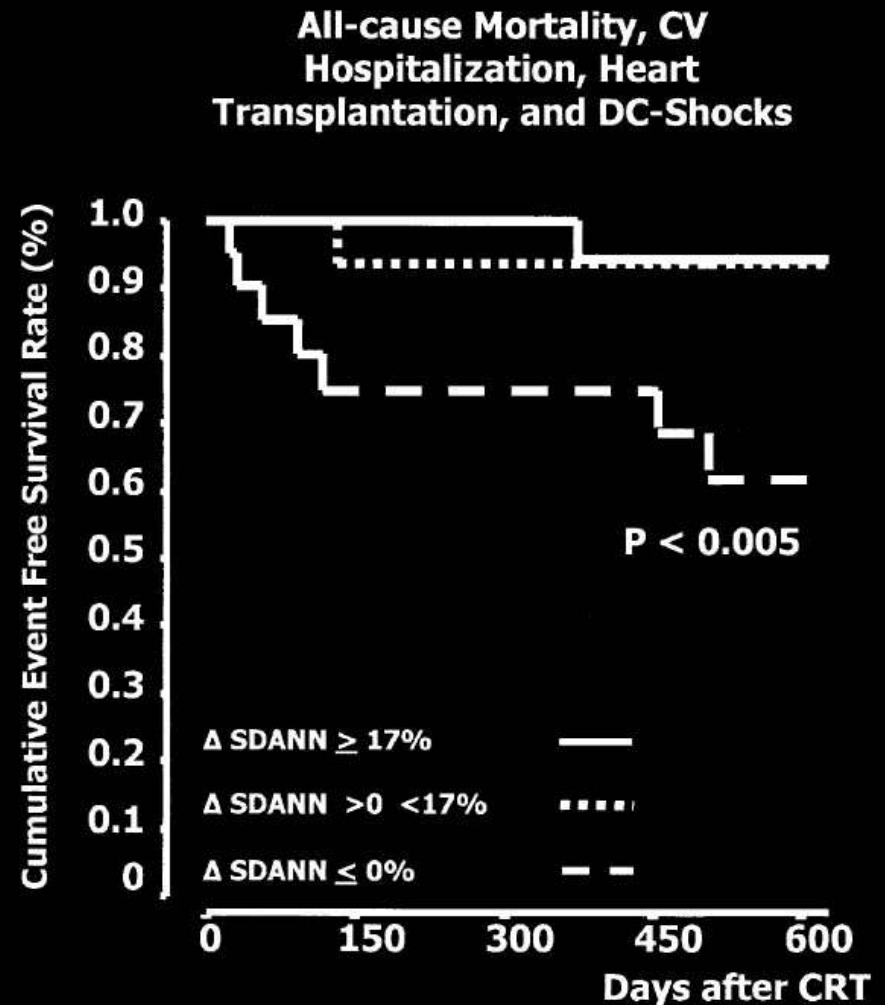
Variables (Cutoff Value)	χ^2	P	RR (95% CI)
VPCs/h (≥ 83)	7.9	0.005	3.7 (1.5–9.0)
Controlled-breathing LF power ($\leq 11 \text{ ms}^2$)	5.7	0.017	3.0 (1.2–7.6)



Cardiac Resynchronization Therapy Improves Heart Rate Profile and Heart Rate Variability of Patients With Moderate to Severe Heart Failure

- 113 HF patients
- NYHA III/IV 106/7
- EF $21 \pm 6\%$
- Peak VO₂ 14.3 ± 3.5
- Beta blockers 96%
- CRT-D 82%

- Lack of HRV improvement at 4 weeks identified patients at higher risk for major cardiovascular events



Do you choose the treatment with

1. The greatest chance of benefit
2. The most sustained effect
3. The lowest complication rate
4. The lowest cost
5. The widest availability

Conclusions

- Catheter ablation for AF in CHF improves
 - Symptoms
 - Exercise capacity
 - LV ejection fraction
- Catheter ablation is superior to AV node ablation and biventricular pacing in systolic heart failure one study at 6 months with no mortality benefit demonstrated
- Biventricular pacing plus (or even without) AVJ ablation has a sustained effect out to 4 years, with a demonstrated mortality benefit in patients with AF

Conclusions

- Autonomic modification may have unpredictable and potentially deleterious effects on ventricular electrophysiology
- Conversely, earlier intervention for AF in CHF may retard CHF-induced atrial fibrosis and thereby retard or ultimately prevent substrate development
- BUT (and it's a big but):

DATA DEMONSTRATING A SURVIVAL BENEFIT OF
THE CLINICAL STRATEGY OF RHYTHM
CONTROL TO MAINTAIN SINUS RHYTHM OVER
A RATE CONTROL STRATEGY ARE STILL
LACKING!

I have yet to see any problem,
however complicated, which,
when you looked at it in the right way,
did not become still more complicated.

Poul Anderson (1926-2001)
American science fiction writer