Catheter Ablation of Atrial Fibrillation in the Elderly

Burr Hall, MD*
Wojciech Zareba, MD, PhD*
Scott McNitt, MS*
Darren Traub, DO**
James Daubert, MD***

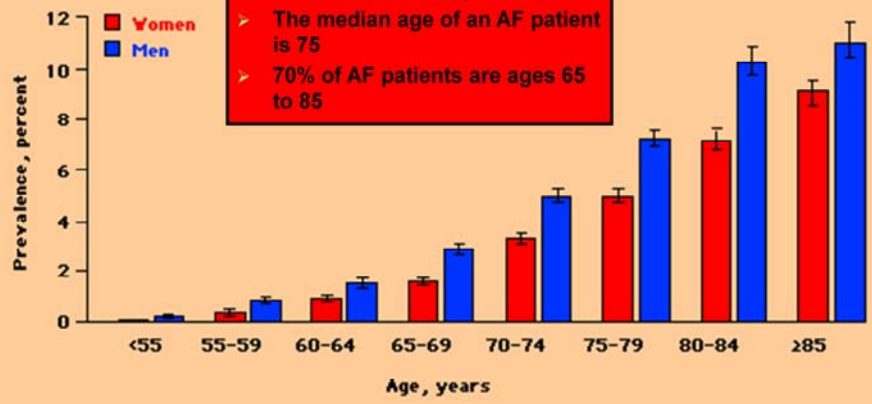
*University of Rochester Medical Center: Rochester, NY
**St. Luke's Hospital and Health Network: Bethlehem, PA
***Corresponding author. Duke University Health System: Durham, NC

- Epidemiology of atrial fibrillation (AF)
  - AF is the most common arrhythmia in clinical practice
  - Approximately 2.2 million people in US have paroxysmal or persistent AF
  - 4.5 million in the European Union[1,2]
  - *This may be an underestimate of the current AF burden*
  - *Population demographics predict a substantial growth of the AF population over the next 30-40 yrs*

1) Arch Intern Med. 1995;155:469-473
2) Fuster et al. J Am Coll Cardiol, 2006; 48:149-246

AF is a disease of the elderly

- AF affects
  - 0.4 – 1% of general population
  - 8% of those >80 years old
- The median age of an AF patient is 75
- 70% of AF patients are ages 65 to 85



Go et al. *JAMA* 285: 2370-2375, 2001

Fuster et al. J Am Coll Cardiol, 2006; 48:149-246

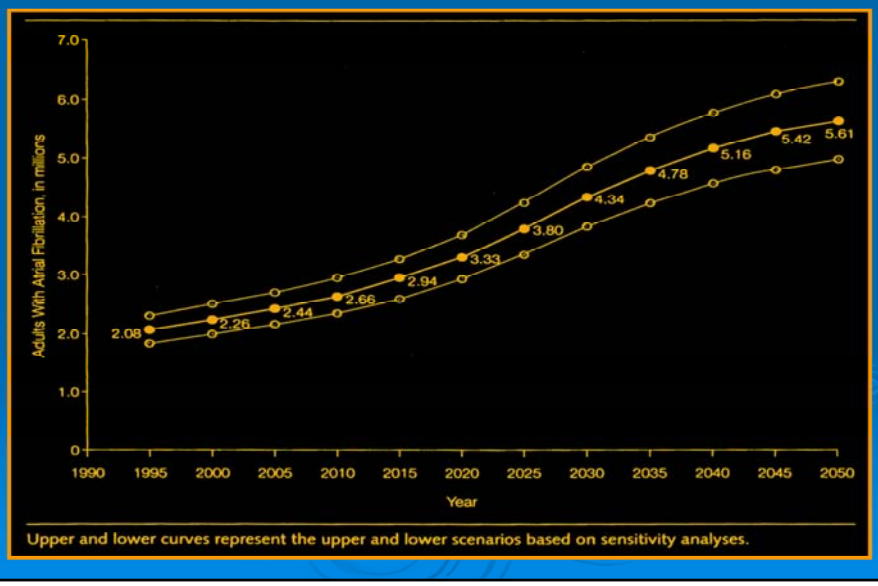
Between 1960 and 1990, the US population aged 65 and older grew by 88%; compared to 34% among those less than 65 years old.

Source: U.S. Bureau of the Census.

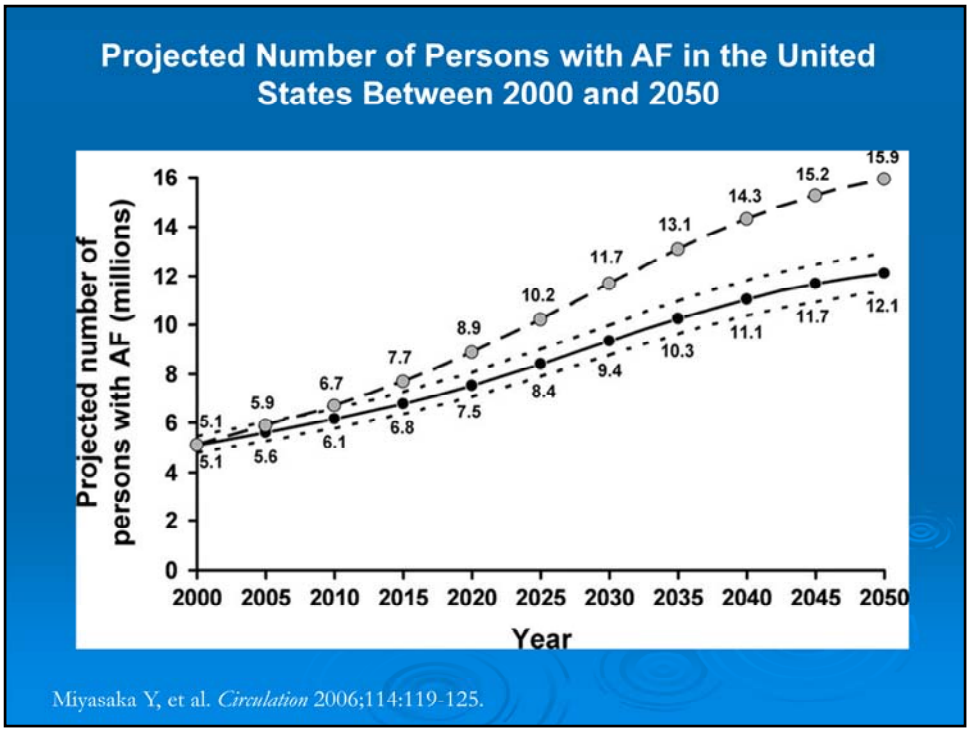
Age and Projected Prevalence of AF

Atria Study

Go et al; JAMA; 2001

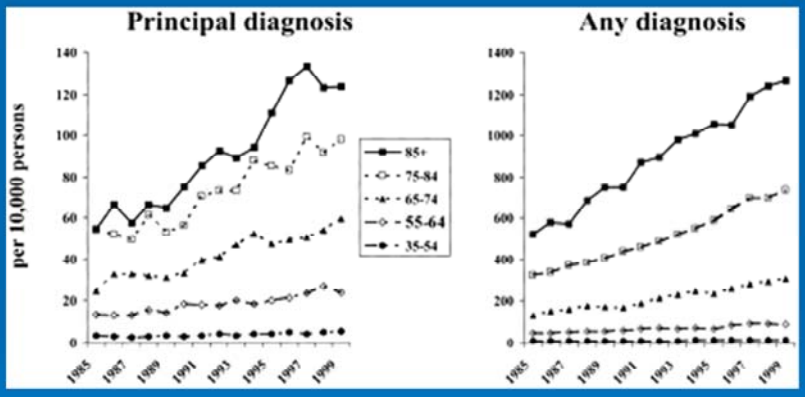


Upper and lower curves represent the upper and lower scenarios based on sensitivity analyses.



Projected number of persons with AF in the US assuming no further increase in age adjusted AF incidence and assuming a continued increase in incidence rate as evident in 1980 to 2000 (dotted curve) Study assessed community based trends in AF incidence from 1980-2000 and provided prevalence projections to 2050 (in Olmstead county)

Hospitalizations for Atrial Fibrillation

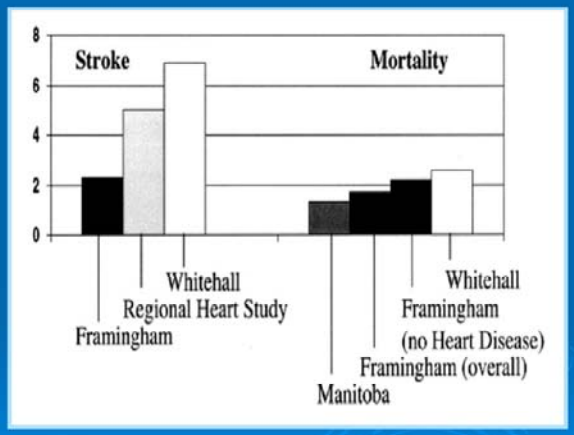


- Hospitalizations with AF as 1° diagnosis ↑ 34% from 1996 to 2001
- In past 20 years admissions with AF listed in the diagnoses ↑66%

Wattigney et al. *Circulation*, 108 (6): 711, 2003

What is wrong with having AF?

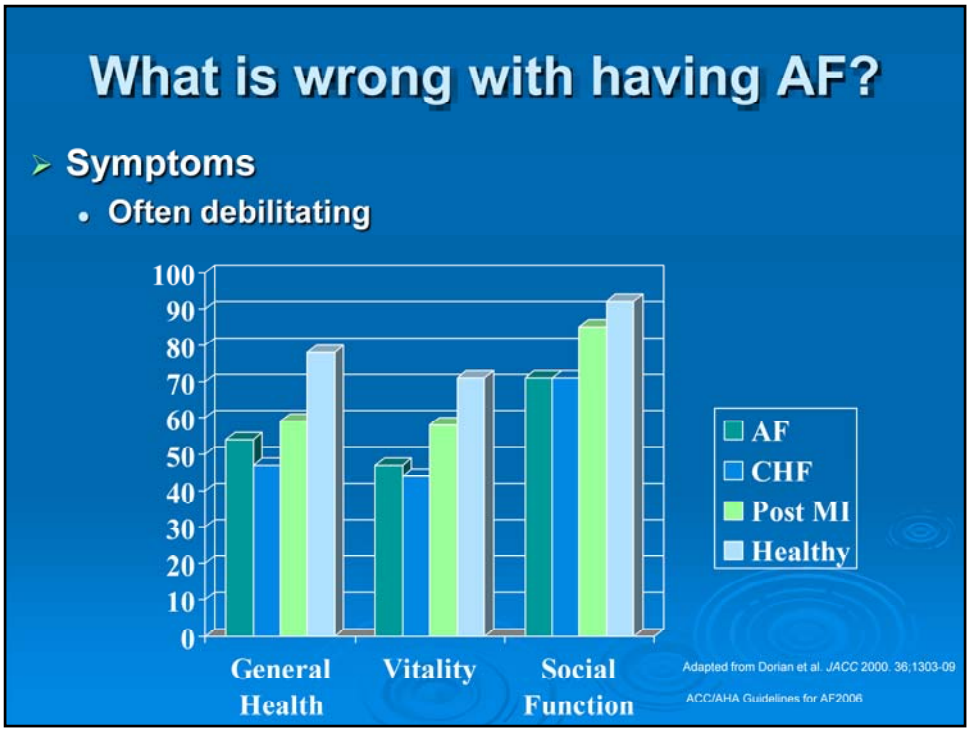
- Stroke risk
  - Four to six times the general population
- Associated with a doubling of all cause mortality
- CHF exacerbation
  - Systolic heart failure
  - Diastolic heart Failure
- Tachycardia-induced cardiomyopathy
- Economic burden
  - $3,600 year/patient
  - 6.7 billion cost burden to US



Adapted from Dorian et al. *JACC* 2000. 36;1303-09

ACC/AHA Guidelines for AF2006

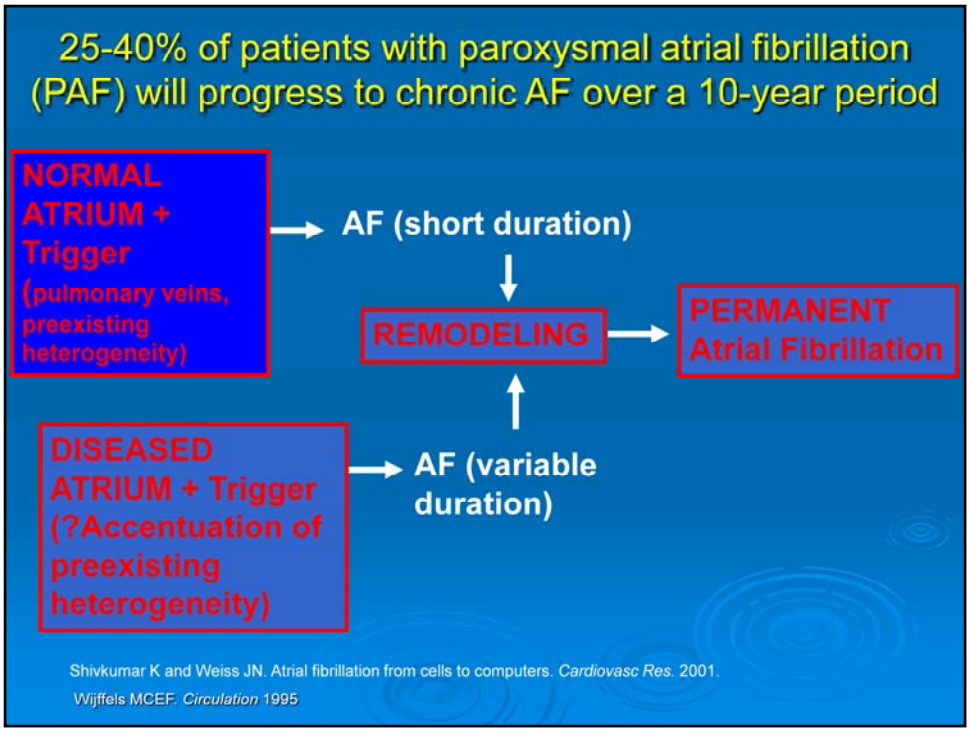
Current Prob Cardiol, May 06 references 1 – 4, economic burden reference 5



Current Prob Cardiol, May 06 references 1 – 4, economic burden reference 5

AF begets AF

- Animal models have demonstrated that the more frequently AF is induced and the longer it lasts, the more easily inducible and more permanent AF becomes (Wijffels MCEF. *Circulation* 1995)
- 25-40% of patients with PAF will progress to chronic AF over a 10-year period

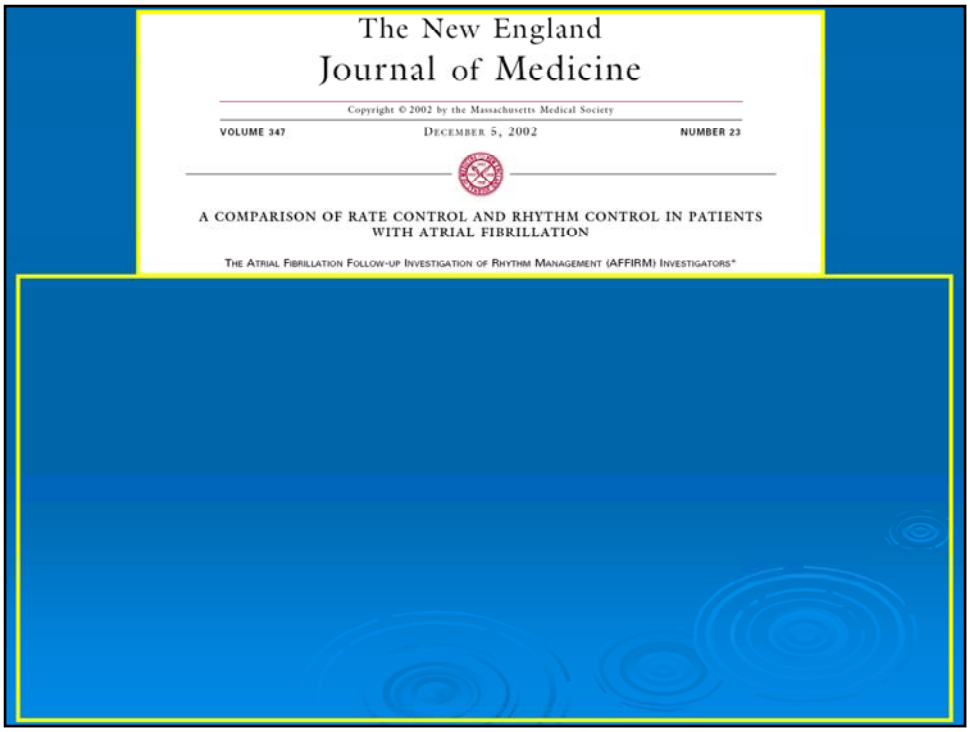


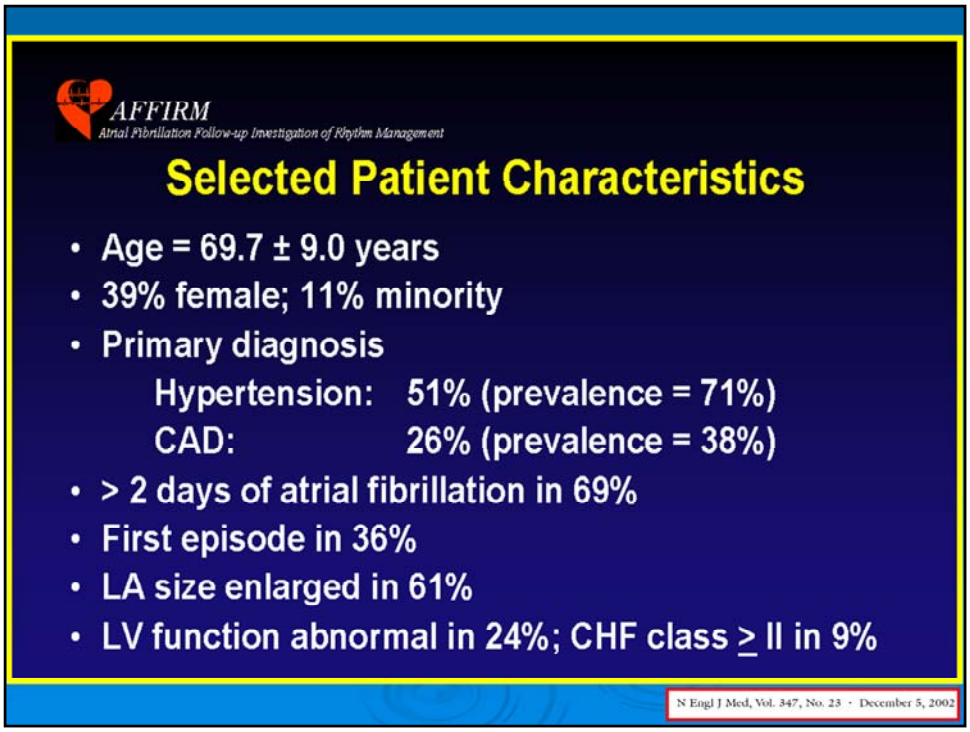
Animal models have demonstrated that the more frequently AF is induced and the longer it lasts, the more easily inducible and more permanent AF becomes (Wijffels MCEF. *Circulation* 1995)

25-40% of patients with PAF will progress to chronic AF over a 10-year period

Management of Atrial Fibrillation

- 1) Rate control and anti-coagulation
- 2) Rhythm control with anti-arrhythmic agents (AADs) and anti-coagulation
- 3) AVJ ablation and pacemaker placement
- 4) Atrial fibrillation ablation


The New England
Journal of Medicine
Copyright © 2002 by the Massachusetts Medical Society
VOLUME 347
DECEMBER 5, 2002
NUMBER 23
A COMPARISON OF RATE CONTROL AND RHYTHM CONTROL IN PATIENTS WITH ATRIAL FIBRILLATION
THE ATRIAL FIBRILLATION FOLLOW-UP INVESTIGATION OF RHYTHM MANAGEMENT (AFFIRM) INVESTIGATORS*


AFFIRM
Atrial Fibrillation Follow-up Investigation of Rhythm Management
Selected Patient Characteristics
• Age = 69.7 ± 9.0 years
• 39% female; 11% minority
• Primary diagnosis
Hypertension: 51% (prevalence = 71%)
CAD: 26% (prevalence = 38%)
• > 2 days of atrial fibrillation in 69%
• First episode in 36%
• LA size enlarged in 61%
• LV function abnormal in 24%; CHF class ≥ II in 9%
N Engl J Med, Vol. 347, No. 23 · December 5, 2002

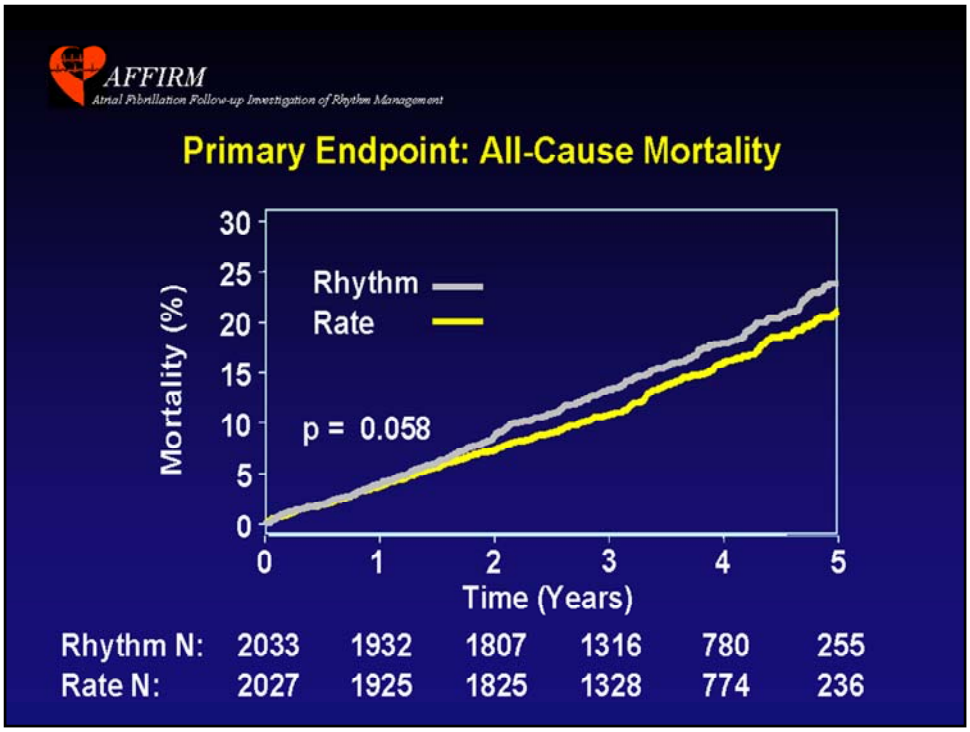
AFFIRM

TABLE 1. BASE-LINE CHARACTERISTICS OF THE PATIENTS.*

CHARACTERISTIC	OVERALL (N=4060)	RATE-CONTROL GROUP (N=2027)	RHYTHM-CONTROL GROUP (N=2033)	P VALUE
Age — yr	69.7±9.0	69.8±8.9	69.7±9.0	0.82
Female sex — no. (%)	1594 (39.3)	823 (40.6)	771 (37.9)	0.08
Ethnic minority group — no. (%)	461 (11.4)	241 (11.9)	220 (10.8)	0.28
Predominant cardiac diagnosis — no. (%)				0.29
Coronary artery disease	1059 (26.1)	497 (24.5)	562 (27.6)	
Cardiomyopathy	194 (4.8)	99 (4.9)	95 (4.7)	
Hypertension	2063 (50.8)	1045 (51.6)	1018 (50.1)	
Valvular disease	198 (4.9)	98 (4.8)	100 (4.9)	
Other	42 (1.0)	23 (1.1)	19 (0.9)	
No apparent heart disease	504 (12.4)	265 (13.1)	239 (11.8)	
History of congestive heart failure — no. (%)	939 (23.1)	475 (23.4)	464 (22.8)	0.64
Duration of qualifying atrial fibrillation ≥2 days — no. (%)	2808 (69.2)	1406 (69.4)	1402 (69.0)	0.80
First episode of atrial fibrillation (vs. recurrent episode) — no. (%)†	1391 (35.5)	700 (35.8)	691 (35.3)	0.74
Any prerandomization failure of an antiarrhythmic drug — no. (%)	713 (17.6)	364 (18.0)	349 (17.2)	0.51
Size of left atrium normal — no. (%)‡	1103 (35.3)	549 (35.3)	554 (35.3)	0.98
Left ventricular ejection fraction — %§	54.7±13.5	54.9±13.1	54.6±13.8	0.74
Normal left ventricular ejection fraction — no. (%)‡	2244 (74.0)	1131 (74.9)	1113 (73.2)	0.29

*Plus–minus values are means ±SD.

N Engl J Med, Vol. 347, No. 23 · December 5, 2002


AFFIRM
Atrial Fibrillation Follow-up Investigation of Rhythm Management
Primary Endpoint: All-Cause Mortality
Mortality (%)
30
25
20
15
10
5
0
Rhythm
Rate
p = 0.058
0
1
2
3
4
5
Time (Years)
Rhythm N: 2033 1932 1807 1316 780 255
Rate N: 2027 1925 1825 1328 774 236

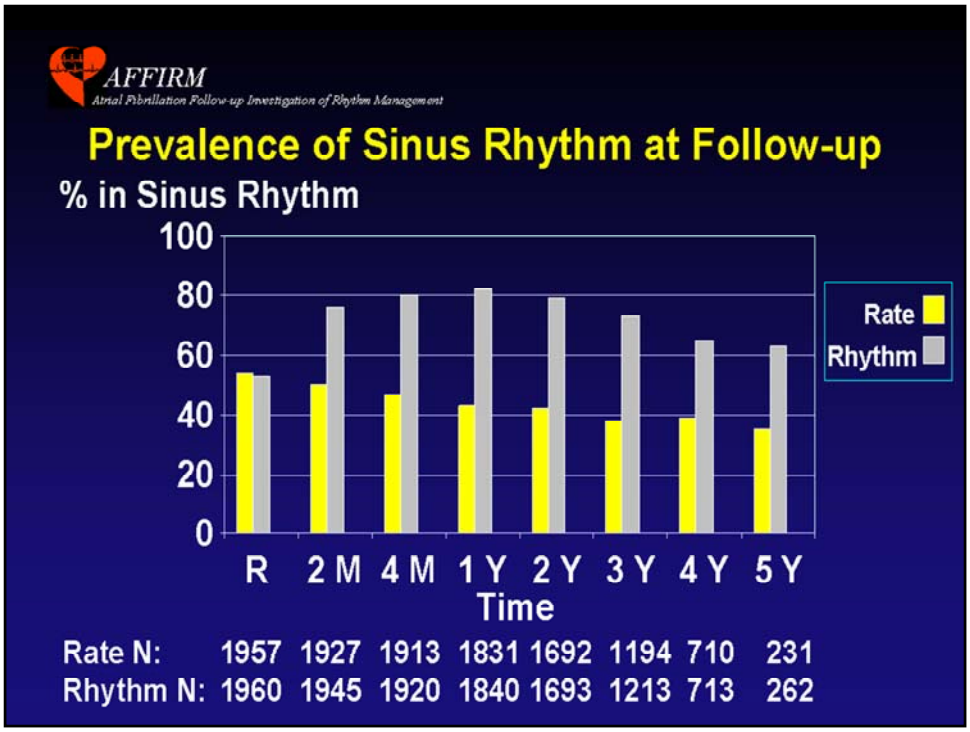
- Did AFFIRM actually study rate control versus rhythm control in an elderly population?
- Was there truly equivalence between the two strategies?

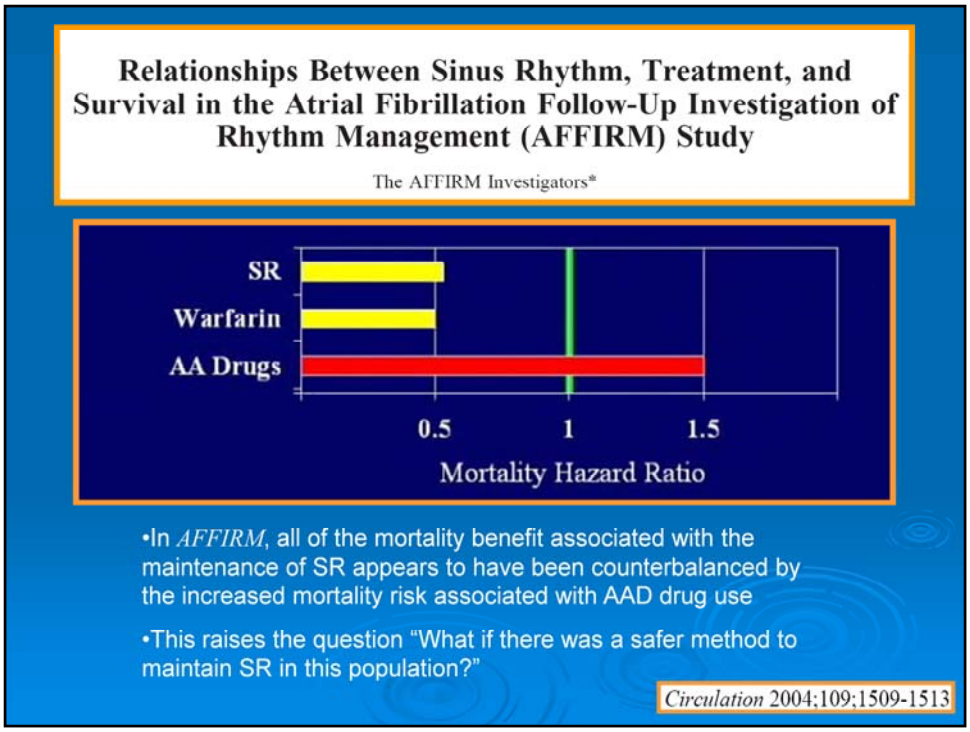
rate control. Radiofrequency ablation to modify or eliminate atrioventricular conduction was used in 105 (5.2 percent) of the patients in the rate-control group after drug failure. During the course of the study, 248 patients crossed over from the rate-control group to the rhythm-control group (actuarial rate of crossover, 7.8 percent, 11.6 percent, and 14.9 percent after one, three, and five years, respectively). Eighty-six of these patients had crossed back to the rate-control group by the end of the study. Uncontrolled symptoms due to atrial fibrillation and congestive heart failure were the most common reasons for the initial crossover to rhythm control in this group.

N Engl J Med, Vol. 347, No. 23 · December 5, 2002

The down side of rate control

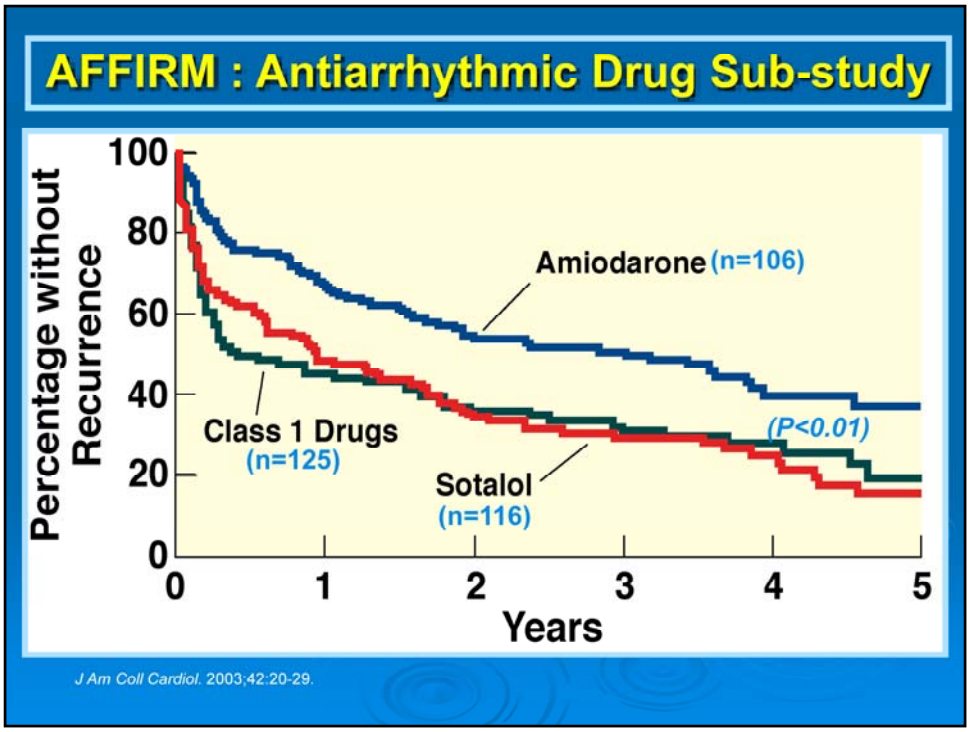
- Rate control with AV nodal blocking agents was not satisfactory in 20% of patients
- 5.2% required AVJ ablation with pacemaker placement
  - Invasive strategy making patients 100% pacemaker dependent
- 14.9% (actuarial) crossover to AAD's at 5 years

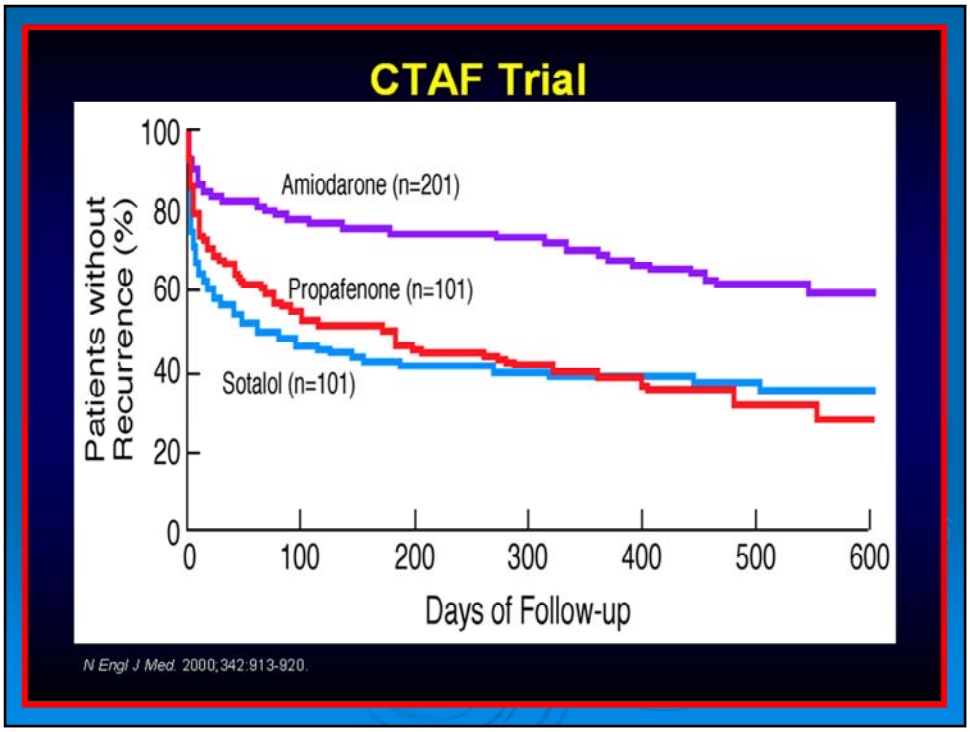

AFFIRM
Atrial Fibrillation Follow-up Investigation of Rhythm Management
Prevalence of Sinus Rhythm at Follow-up
% in Sinus Rhythm
100
80
60
40
20
0
R
2 M
4 M
1 Y
2 Y
3 Y
4 Y
5 Y
Time
Rate
Rhythm
Rate N: 1957 1927 1913 1831 1692 1194 710 231
Rhythm N: 1960 1945 1920 1840 1693 1213 713 262



On treatment analysis which was only published recently, presence of sinus rhythm was one of the most powerful independent predictors of survival along with use of warfarin. Patients in sinus rhythm wee half as likely to die than those with AF. This benefit however was offset by the use of AAD which increased the risk of death.

(Reduction in mortality with sinus rhythm has also been shown in DIAMOND and CHF-STAT trials.


AFFIRM : Antiarrhythmic Drug Sub-study
Percentage without Recurrence
100
80
60
40
20
0
0
1
2
3
4
5
Years
Amiodarone (n=106)
Class 1 Drugs (n=125)
Sotalol (n=116)
(P<0.01)
J Am Coll Cardiol. 2003;42:20-29.


CTAF Trial
Patients without Recurrence (%)
100
80
60
40
20
0
Amiodarone (n=201)
Propafenone (n=101)
Sotalol (n=101)
0
100
200
300
400
500
600
Days of Follow-up
N Engl J Med. 2000;342:913-920.

Pharmacologic Approaches to Maintain Sinus Rhythm

- Low success rate
  - 1-year AF recurrence of approximately 50%
    - Regardless of anti-arrhythmic agent
    - Amiodarone best agent ~ 65% SR at 16 months
  - Side effects common
    - Amiodarone
      - Attrition rate of therapy due to many side effects
        - 18% at 16 months in CTAF trial
        - 11% at one year AFFIRM trial
  - Risk of pro-arrhythmia

Am J Cardiol 1991;68:335-41
NEJM 2000,342:913-20
Am J Geriatr Cardiol, 2002; 11: 370–375
Heart Rhythm, 2007; 4: 1577–1599.

The Elderly patient and AAD's

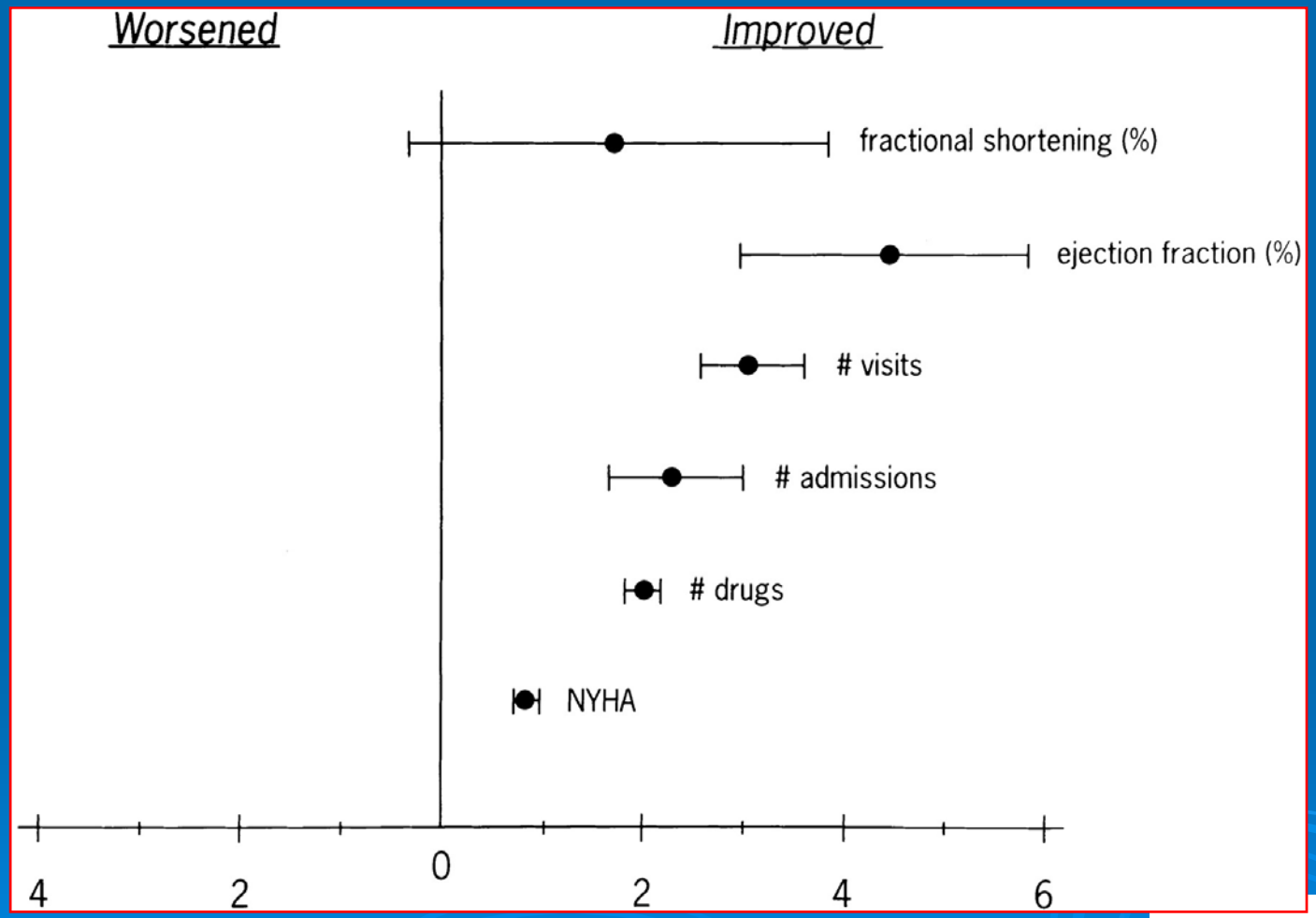
- Age related senescence alters the pharmacokinetics of AADs
  - metabolism less predictable
  - increased predilection for side effects
  - Increased risk of pro-arrhythmias

Dayer MB, Hardman SMC. Special problems with antiarrhythmic drugs in the elderly: Safety, tolerability, and efficacy. Am JGeriatr Cardiol, 2002; 11: 370–375.

Curtis AB, Rich MW. Atrial fibrillation in the elderly: Mechanisms and management. Heart Rhythm, 2007; 4: 1577–1599.

Fang MC, Chen J, Rich MW. Atrial fibrillation in the elderly. AmJ Med, 2007; 120: 481–487.

Meta-analysis of 1100 patients after AV junctional ablation and pacemaker placement for medically refractory atrial fibrillation, atrial flutter or atrial tachycardia: left ventricular function, healthcare use, and New York Heart Association (NYHA) functional classification



Circulation

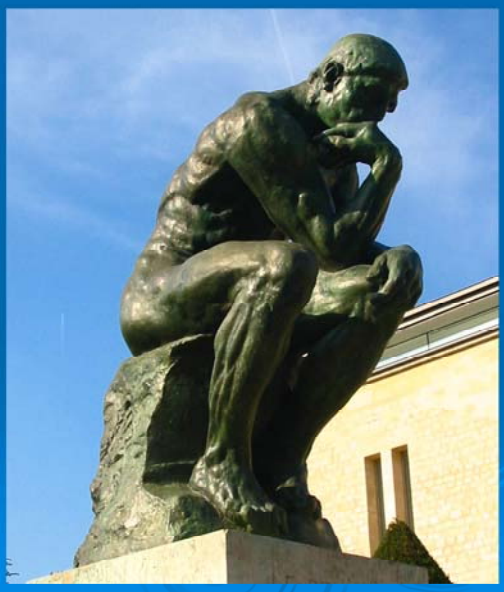
Wood, M. A. et al. Circulation 2000;101:1138-1144

American Heart Association®
Learn and Live℠

Catheter Ablation of the AV Junction

- Advantages
  - Improved rate control
  - Improved QOL
  - Improved LVEF
  - No AADs
  - Less hospitalizations
- Disadvantages
  - Pacemaker dependence
  - Procedure complications
  - Continued embolic risk
  - Progression of AF to more permanent

What about AF ablation?



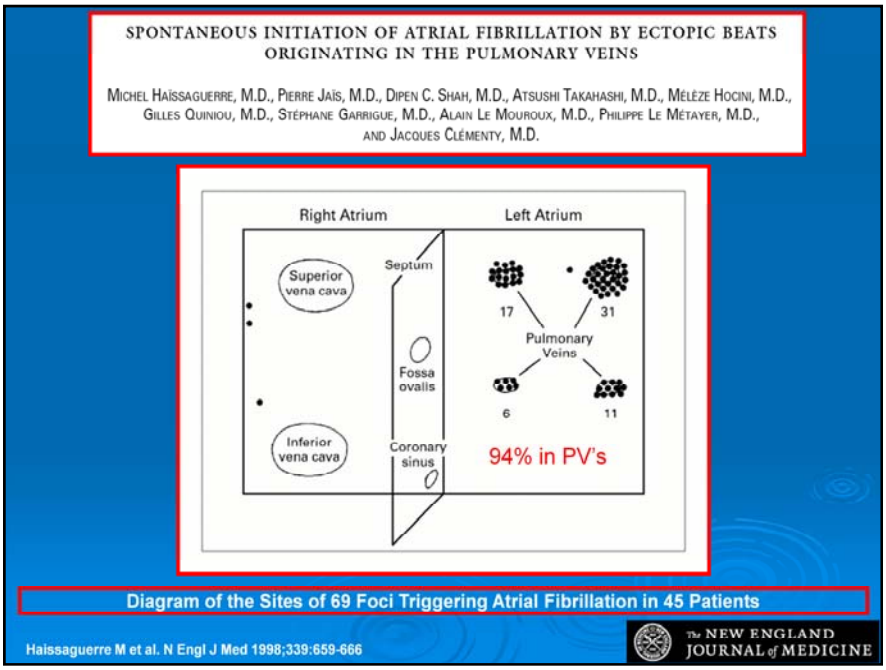
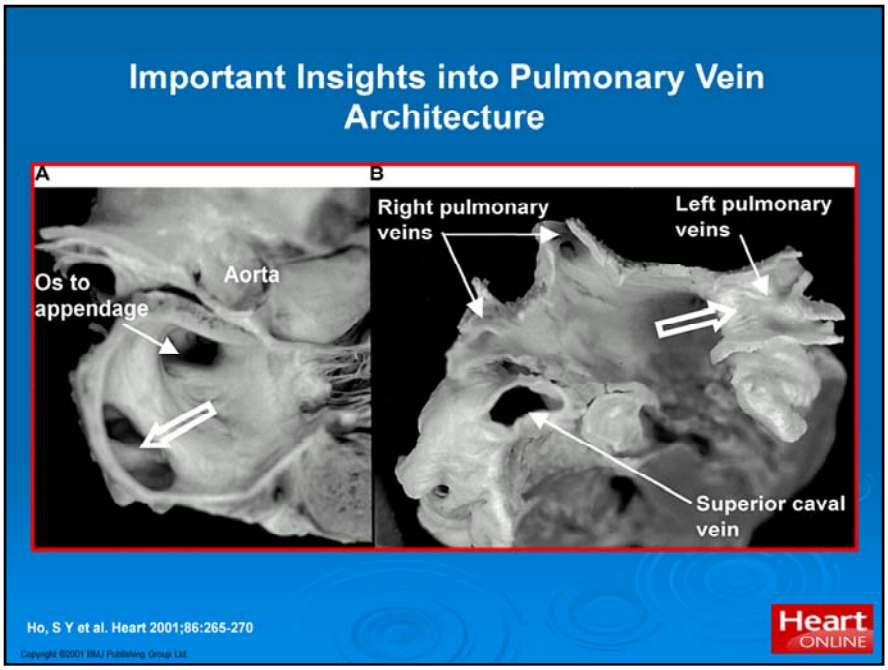
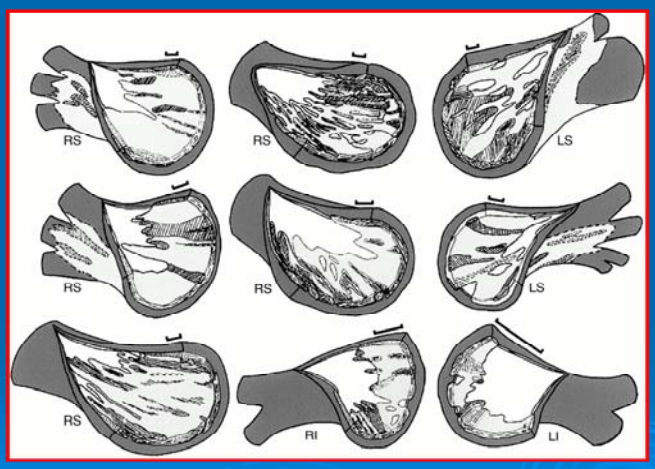


Figure 1. Diagram of the Sites of 69 Foci Triggering Atrial Fibrillation in 45 Patients. Note the clustering in the pulmonary veins, particularly in both superior pulmonary veins. Numbers indicate the distribution of foci in the pulmonary veins.

A single point of origin of ectopic beats was identified in 29 patients, two were identified in 9 patients, three were identified in 6 paitents and four in 1 patient. The venous confirmation of earliest ectopic activity was demonstrated in 23 patients by the radiographic position of the mapping catheter, which was superimposed on the lungs and was outside the cardiac silhouette and by confirationtory angiographic visuatlzation. The conduction time from the venous spike to the activation of the left atrium increased progressively as the coupling interval of the spike spontaneously shortened and when there were repetitive spike discharges.

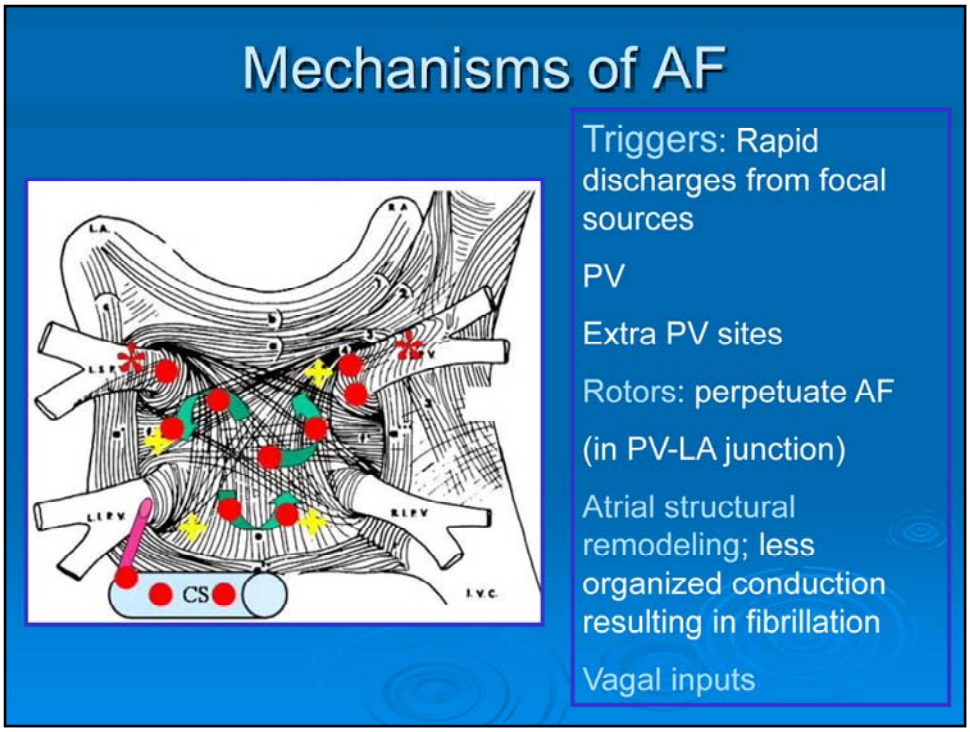

Important Insights into Pulmonary Vein Architecture
A
B
Os to appendage
Aorta
Right pulmonary veins
Left pulmonary veins
Superior caval vein
Ho, S Y et al. Heart 2001;86:265-270
Heart ONLINE

Muscular Sleeves with Gaps of Fatty Tissue and Fibrosis



Ho, S Y et al. Heart 2001;86:265-270

Heart ONLINE



AF is initiated by rapid discharges from one or several focal sources within the atria. 94% arise from PV. Extra PV sites may trigger AF in 6 – 10%. Rotors are high frequency micro reentrant circuits that perpetuate AF. Conduction becomes slower and less organized with increasing distance from rotors because of atrial structural remodeling resulting in fibrillatory conduction.. Interestingly the dominant rotors in AF are localized primarily in the junction between LA and PVs. Further vagal inputs may be important in both triggering and maintaining AF. We will discuss this later.

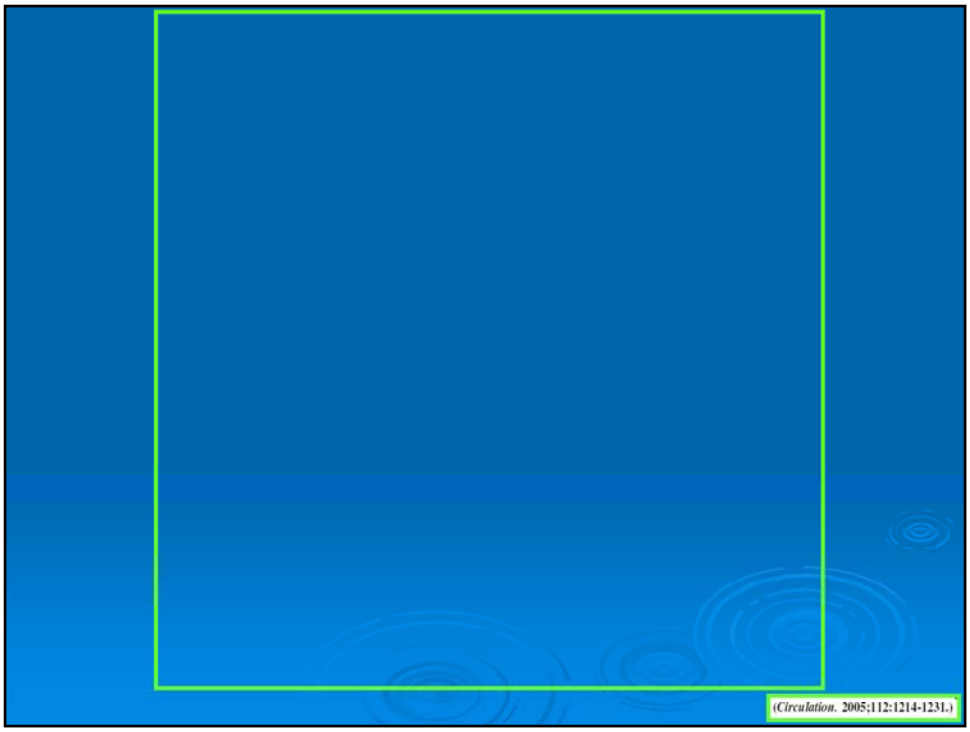
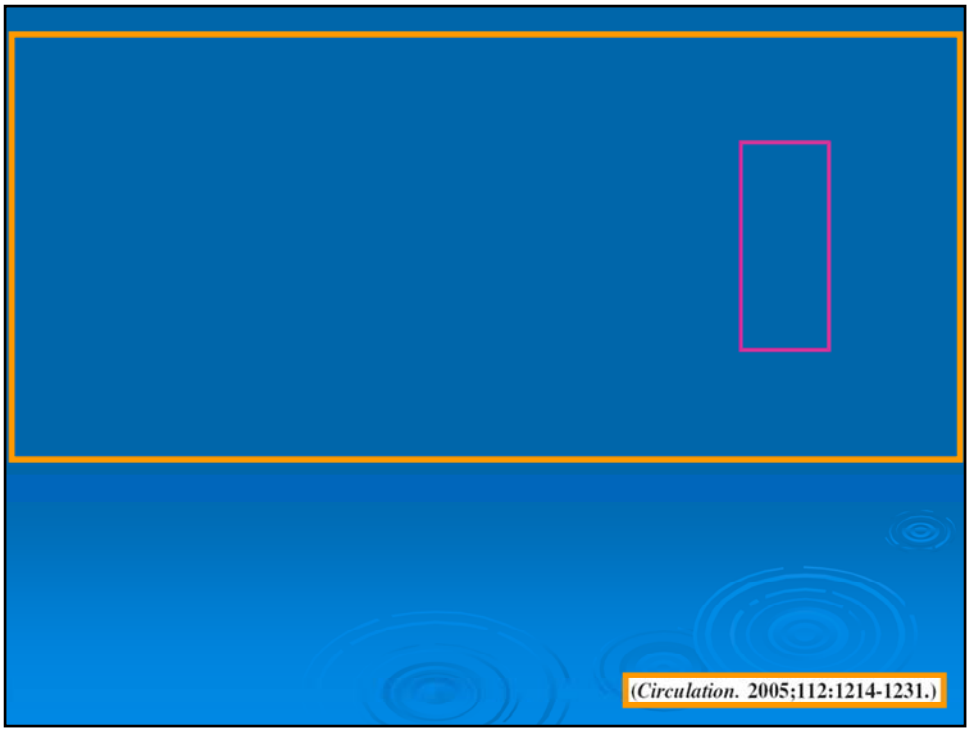
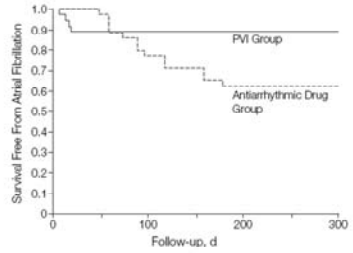


Figure 4. Similarity in location of the radiofrequency lesions produced by various groups' approaches to AF ablation. Top left, An outer view of a patient's LA as seen from the posterior aspect using 3D, multislice CT. Seen clearly are the tubular portions of each of the 4 PVs (individually labeled). The borders between the antra of the PVs and the posterior wall of the LA are indicated by small white arrows. Bottom left, A 3D electroanatomic map (CARTO, Biosense Webster Inc) of the LA (same patient as panel above) acquired during AF ablation guided by ICE. With ICE, the borders of the pulmonary venous antra can be accurately defined, and lesions can be placed to completely surround and electrically isolate the antra. Red dots represent the anatomic locations of these lesions produced by ICE-guided ablation. Top left, Location of lesions produced with a CARTO-guided approach described by Morady and colleagues. Reproduced from Oral et al,40 with permission. Bottom left, Location of lesions produced using another CARTO-guided approach described by Pappone and colleagues. Reproduced from Pappone et al,29 with permission. In all 3 cases, the location of the lesion sets is similar, encompassing the anterior and posterior borders of all 4 pulmonary venous antra. LSPV indicates left superior PV; LIPV, left inferior PV; RSPV, right superior PV; and RIPV, right inferior PV.


(*Circulation.* 2005;112:1214-1231.)

PVI vs AAD as 1st line therapy for PAF

Figure 2. Kaplan-Meier Curve of Survival Free From Atrial Fibrillation



No. at Risk							
PVI Group	32	28	28	28	28	28	28
Antiarrhythmic Drug Group	35	34	23	19	13	13	13

- Significant reduction in AF recurrence at 1-year with PVI
- QOL also significantly improved with PVI compared to AAD's

Table 4. Quality of Life Assessment*

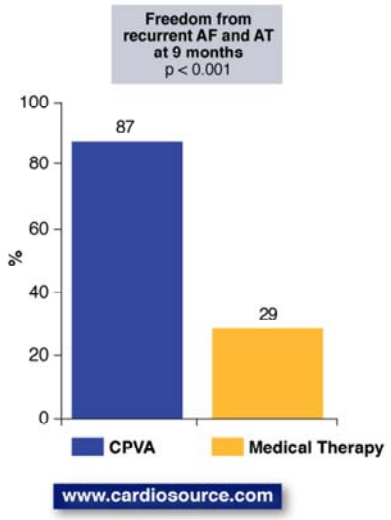
	Mean (SD)					
	Pulmonary Vein Isolation Group (n = 32)		Antiarrhythmic Drug Group (n = 35)			
Short-Form 36 Subscale	Baseline	Follow-up	Baseline	Follow-up	Corrected Difference in Mean Change at 6 mo (95% CI)	*P* Value
General health	57 (2)	9 (1)	57 (2)	68 (2)	11 (8 to 14)	<.001
Physical functioning	71 (3)	97 (3)	69 (2)	75 (7.5)	20 (13.2 to 24.2)	.001
Role physical	73 (5)	71 (2)	51 (5)	53 (3)	14.9 (9.9 to 19.9)	.047
Bodily pain	71 (3)	97 (1)	70 (3)	90 (3)	6 (1.5 to 9.5)	.004
Mental health	65 (4)	65 (2)	64 (2)	68 (3)	−4 (−3.5 to −7.5)	.62
Social functioning	78 (3)	93 (3)	76 (3)	82 (2)	9 (7.5 to 11.5)	.004
Role emotional	70 (1)	76 (1)	70 (1)	75 (1)	1 (−4.0 to 4.3)	.90
Vitality	52 (4)	65 (1)	51 (1)	60 (2)	4 (1.7 to 5.7)	.21

Abbreviation: CI, confidence interval.
*Quality of life was assessed using the Medical Outcomes Study 36-item Short-Form health survey (Short-Form 36) and was measured at enrollmen

JAMA. 2005;293:2634-2640

APAF

Trial Design: APAF was a randomized trial circumferential pulmonary vein ablation (CPVA) (n=99) compared with antiarrhythmic medical therapy (n=99) with flecainide (n=33), sotalol (n=33) or amiodarone (n=33) among patients with paroxysmal atrial fibrillation. Primary endpoint was freedom from recurrent atrial arrhythmias at 1 year.



Results

- Only preliminary data available in 150 patients
- At 9 months follow-up, freedom from recurrent AF and AT ↑ in CPVA patients vs medical therapy (Figure)
- Of 8 patients who had recurrent AF in CPVA group, repeat ablation procedure performed in 3 patients, 1 of whom still had additional recurrent AF
- Of 52 patients in medical therapy group who had recurrent AF, 38 had CPVA performed, 4 of whom still had additional recurrent AF
- Significant decrease in left atrium diameter at 12 months in CPVA group ($P<0.05$) but no difference in medical therapy group

Conclusions

- Among patients with paroxysmal atrial fibrillation, treatment with circumferential pulmonary vein ablation was associated with reduction in recurrent AF and AT compared with conventional antiarrhythmic medical therapy
- Present trial one of first randomized trials of CPVA in paroxysmal atrial fibrillation
- CPVA recently shown to be beneficial in maintaining sinus rhythm in chronic atrial fibrillation

Presented at ACC 2006


Fuster *et al.*
ACC/AHA/ESC Practice Guidelines
JACC Vol. 48, No. 4, 2006
August 15, 2006:e149–246

Radiofrequency Ablation vs Antiarrhythmic Drugs as First-line Treatment of Symptomatic Atrial Fibrillation

A Randomized Trial

Table 1. Baseline Characteristics*

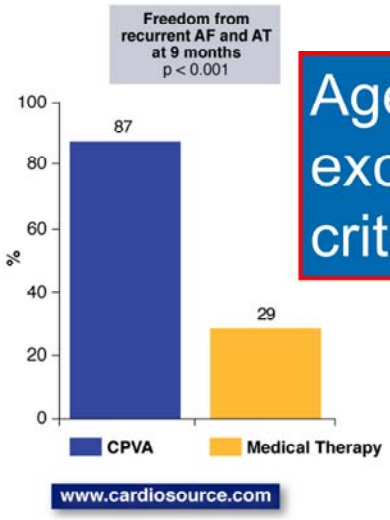
Characteristics	Pulmonary Vein Isolation Group (n = 33)	Antiarrhythmic Drug Group (n = 37)
Age, mean (SD), y	53 (8)	54 (8)
Left atrial size, mean (SD), cm	4.1 (0.8)	4.2 (0.7)
Duration of atrial fibrillation, mean (SD), mo	5 (2.0)	5 (2.5)
Atrial fibrillation		
Paroxysmal	32 (97)	35 (95)
Persistent	1 (3)	2 (5)
Structural heart disease and hypertension	8 (25)	10 (28)
Left ventricular ejection fraction, mean (SD), %	53 (5)	54 (6)
Use of β-blocker therapy	19 (57)	23 (62)

*Data are presented as No. (%) unless otherwise specified.

JAMA. 2005;293:2634-2640

APAF

Trial Design: APAF was a randomized trial circumferential pulmonary vein ablation (CPVA) (n=99) compared with antiarrhythmic medical therapy (n=99) with flecainide (n=33), sotalol (n=33) or amiodarone (n=33) among patients with paroxysmal atrial fibrillation. Primary endpoint was freedom from recurrent atrial arrhythmias at 1 year.



Age > 70 exclusion criteria

Results

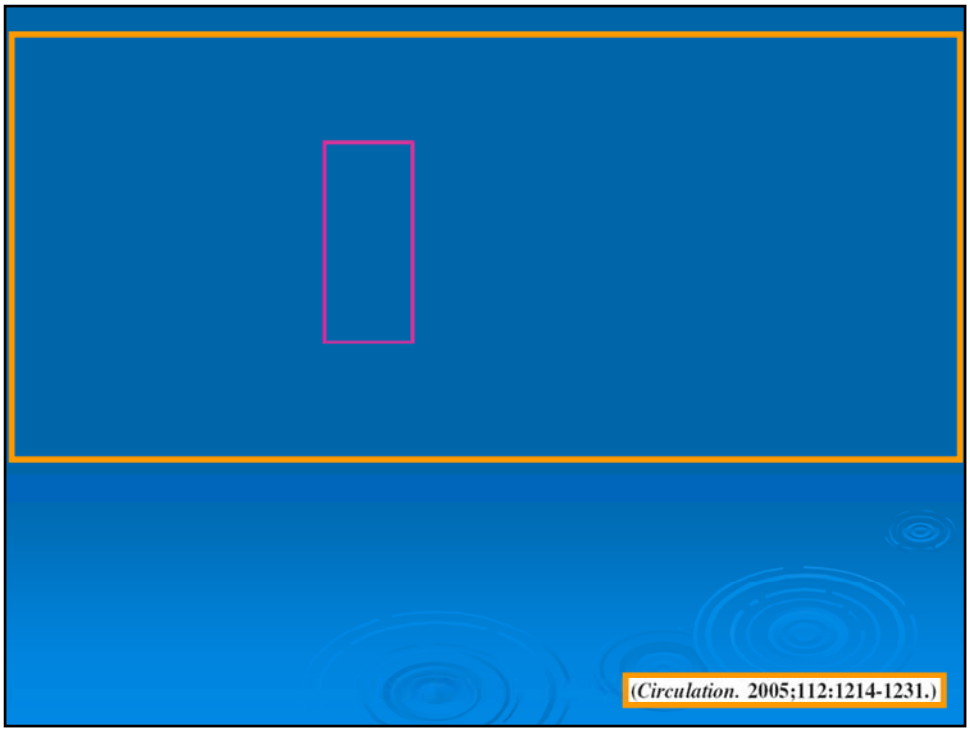
- Only preliminary data available in 150 patients
- At 9 months follow-up, freedom from recurrent AF vs medical therapy
- rrent AF in CPVA group, performed in 3 patients, al recurrent AF
- herapy group who had performed, 4 of whom t AF
- atrium diameter at 12 <0.05) but no difference in

Conclusions

- Among patients with paroxysmal atrial fibrillation, treatment with circumferential pulmonary vein ablation was associated with reduction in recurrent AF and AT compared with conventional antiarrhythmic medical therapy
- Present trial one of first randomized trials of CPVA in paroxysmal atrial fibrillation
- CPVA recently shown to be beneficial in maintaining sinus rhythm in chronic atrial fibrillation

Presented at ACC 2006

www.cardiosource.com


(Circulation. 2005;112:1214-1231.)

There is a disconnect between the AF ablation population and the real AF population!!!

Characteristics of Patients Undergoing Atrial Fibrillation Ablation: Trends Over a Seven-Year Period 1999–2005

EDWARD P. GERSTENFELD, M.D., DAVID CALLANS, M.D., SANJAY DIXIT, M.D., DAVID LIN, M.D., JOSHUA COOPER, M.D., ANDREA M. RUSSO, M.D., RALPH VERDINO, M.D., MARK WEINER, M.D., ERICA ZADO, P.A.C., and FRANCIS E. MARCHLINSKI, M.D.

TABLE 2

Patient Characteristics by Year

Characteristic	1999 (N = 29)	2000 (N = 47)	2001 (N = 109)	2002 (N = 187)	2003 (N = 200)	2004 (N = 221)	2005 (N = 265)	P
Age (years)	**47.1**	**52.4**	**53.5**	**55.1**	**54.8**	**56.8**	**55.7**	**<0.01**
Gender (% male)	90	68	80	77	79	75	77	NS
Prior AF duration (years)	7.6	7.7	5.7	7.6	7.1	6.7	7.4	NS
# Prior AA drugs	**3.9**	**3.6**	**3.3**	**3.0**	**3.1**	**2.6**	**2.0**	**<0.01**
Left atrial size (cm)	**4.0**	**4.2**	**4.1**	**4.5**	**4.4**	**4.5**	**4.4**	**<0.01**
LV ejection fraction (%)	55	54	56	60	59	59	58	NS
Prior stroke/TIA (%)	3.4	2.1	3.6	3.7	6	6.2	10	NS
Prior cardiomyopathy (%)	**0**	**0**	**0.9**	**5.3**	**5.5**	**7.7**	**16**	**<0.05**
Obstructive sleep apnea (%)	10.3	12.8	9.2	7.5	10.5	11.8	12	NS
Body mass index	31.2	29.6	29.1	30.8	29.1	30.7	28.6	NS

J Cardiovasc Electrophysiol, 2007; 18: 23–38

AF ablation in the Elderly Review of the Literature

- There are no prospective randomized controlled trials comparing the safety and efficacy of catheter ablation for paroxysmal or persistent AF in the elderly to best medical therapy or alternative strategies such as AV node ablation plus pacemaker placement

Catheter Ablation of Atrial Fibrillation Versus Atrioventricular Junction Ablation Plus Pacing Therapy for Elderly Patients with Medically Refractory Paroxysmal Atrial Fibrillation

MING-HSIUNG HSIEH, M.D.,*‡ CHING-TAI TAI, M.D.,† SHIH-HUANG LEE, M.D.,†,§ HUAN-MING TSAO, M.D.,† YUNG-KUO LIN, M.D.,† JIN-LONG HUANG, M.D.,†,‡ PAUL CHAN, M.D.,* YI-JEN CHEN, M.D.,* JEN-YUAN KUO, M.D.,*,† TA-CHUAN TUAN, M.D.,† TSUI-LIEH HSU, M.D.,† CHI-WOON KONG, M.D.,† SHIH-LIN CHANG, M.D.,† and SHIH-ANN CHEN, M.D.†

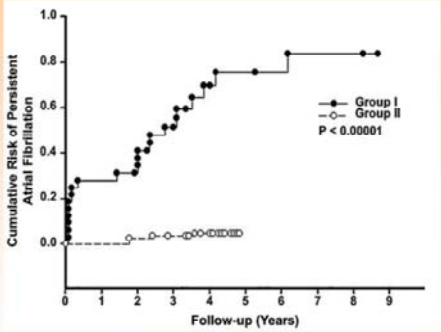
MERITS OF PV ABLATION VS. ABLATE &PACE

TABLE 2

Clinical Outcomes at the End of Follow-Up

	Group 1 (N = 32)	Group 2 (N = 37)	P Value
Free of symptomatic AF, n (%)	32 (100)	30 (81)	0.013
Persistent AF, n (%)	22 (69)	3 (8)	<0.001
Heart failure, n (%)	17 (53)	9 (24)	0.001
NYHA function class	1.7 ± 0.9	1.3 ± 0.6	0.02
Cerebral infarction, n (%)	1 (3)	1 (3)	1.0
Atrial enlargement, n (%)	24 (74)	16 (43)	0.02
Left atrial dimension (mm)	42 ± 9	37 ± 7	0.07
Left ventricular end-diastolic dimension (mm)	53 ± 6	51 ± 8	0.46
Left ventricular ejection fraction (%)	44 ± 8	46 ± 10	0.46
Death, n (%)	5 (16)	3 (8)	0.47
Cardiac causes, n (%)	2 (6)	0	0.21

Data are presented as mean ± 1 SD or number (%).



LESS AF
LESS HEART FAILURE
LESS SYMPTOMS
LESS LA DILATION

J Cardiovasc Electrophysiology 2005; 16: 457-61

Pappone HRS 2009

Efficacy, Safety, and Outcome of Atrial Fibrillation Ablation in Septuagenarians

ANDREA CORRADO, M.D.,*,† DIMPI PATEL, M.D.,* LUCIE RIEDLBAUCHOVA, M.D.,* TAMER S. FAHMY, M.D.,* SAKIS THEMISTOCLAKIS, M.D.,† ALDO BONSO, M.D.,† ANTONIO ROSSILLO,† STEVEN HAO, M.D.,‡ ROBERT A. SCHWEIKERT, M.D.,* JENNIFER E. CUMMINGS, M.D.,* MANDEEP BHARGAVA, M.D.,* DAVID BURKHARDT, M.D.,* WALID SALIBA, M.D.,* ANTONIO RAVIELE, M.D.,† and ANDREA NATALE, M.D.¶,§,#

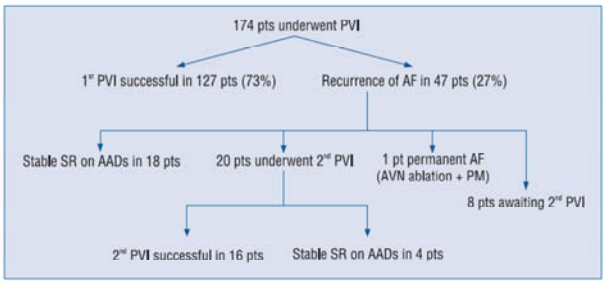


Figure 1. Results from the multicenter experience reported by Corrado et al. [17] for 174 patients over 75 years of age who underwent pulmonary vein isolation (PVI) for atrial fibrillation (AF); PM — pacemaker; AVN — atrioventricular node, SR — sinus rhythm, AADs — antyarrhythmic drugs (reproduced with permission from [17]).

Journal of Cardiovascular Electrophysiology *Vol. 19, No. 8, August 2008*

(Cardiol J 2009; 16, 2: 113–120)

Efficacy, Safety, and Outcome of Atrial Fibrillation Ablation in Septuagenarians

ANDREA CORRADO, M.D.,*,† DIMPI PATEL, M.D.,* LUCIE RIEDLBAUCHOVA, M.D.,* TAMER S. FAHMY, M.D.,* SAKIS THEMISTOCLAKIS, M.D.,† ALDO BONSO, M.D.,† ANTONIO ROSSILLO,† STEVEN HAO, M.D.,‡ ROBERT A. SCHWEIKERT, M.D.,* JENNIFER E. CUMMINGS, M.D.,* MANDEEP BHARGAVA, M.D.,* DAVID BURKHARDT, M.D.,* WALID SALIBA, M.D.,* ANTONIO RAVIELE, M.D.,† and ANDREA NATALE, M.D.¶,§,#

TABLE 2

Procedural Acute Complications

Number of procedures, n	194 (*)
Embolic TIA/stroke, n (%)	1 (0.5%)
Hemothorax, n (%)	1 (0.5%)
Groin hematomas, n (%)	3 (1.5%)

(*) 194 ablations = 174 first ablations + 20 second ablations.
TIA = transient ischemic attack.

Journal of Cardiovascular Electrophysiology *Vol. 19, No. 8, August 2008*

Long-Term Clinical Efficacy and Risk of Catheter Ablation for Atrial Fibrillation in the Elderly

ERICA ZADO, P.A.-C., DAVID J. CALLANS, M.D., MICHAEL RILEY, M.D. PH.D., MATHEW HUTCHINSON, M.D.,FERMIN GARCIA, M.D., RUPA BALA, M.D., DAVID LIN, M.D., JOSHUA COOPER, M.D., RALPH VERDINO, M.D., ANDREA M. RUSSO, M.D., SANJAY DIXIT, M.D., EDWARD GERSTENFELD, M.D., and FRANCIS E. MARCHLINSKI, M.D.

From the Cardiovascular Division, Department of Medicine, Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania, USA

Clinical Characteristics

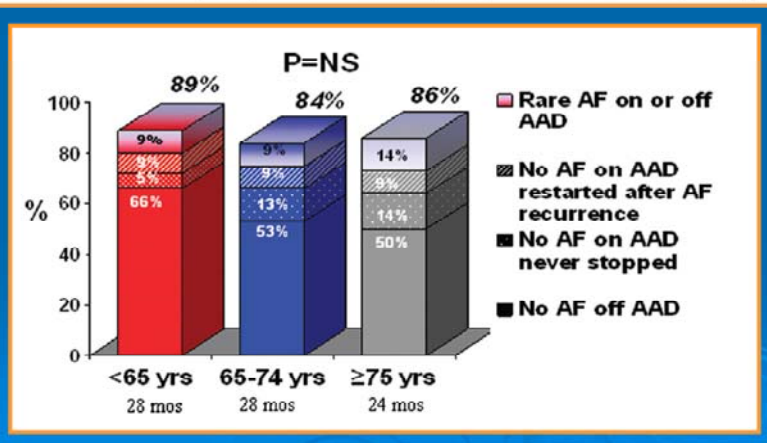
	<65 Years	65–74 Years	≥75 Years	P-Value
Number of patients	948	185	32	NS
Number of procedures	1,244	228	34	NS
Mean procedures/patient	1.3 ± 0.55	1.2 ± 0.47	1.1 ± 0.25	NS
Mean age (yrs)	52 ± 9	68 ± 3	77 ± 2	NS
Age range (yrs)	16 – 64	65 – 74	75 – 82	NS
#Women (%)	185 (20%)	62 (34%)	18 (56%)	<0.001
#PAF (%)	614 (65%)	115 (62%)	17 (53%)	NS
LA size (cm)	4.4 ± 0.7	4.5 ± 0.7	4.4 ± 1.0	NS
#with LVEF <50% (%)	114 (12%)	13 (7%)	5 (16%)	NS
#HTN and/or SHD (%)	533 (56%)	126 (68%)	28 (88%)	<0.001
#CHADS2 score ≥2 (%)	111 (12%)	30 (30%)	23 (72%)	<0.001

LA = left atrial; LVEF = left ventricular ejection fraction; HTN = hypertension; PAF = paroxysmal atrial fibrillation; SHD = structural heart disease; CHADS2 = 1 point each for Congestive heart failure, Hypertension, Age ≥75, Diabetes, and 2 points for Stroke or transient ischemic attack.

Journal of Cardiovascular Electrophysiology *Vol. 19, No. 6, June 2008*

Efficacy, Safety, and Outcome of Atrial Fibrillation Ablation in Septuagenarians

ANDREA CORRADO, M.D.,*,† DIMPI PATEL, M.D.,* LUCIE RIEDLBAUCHOVA, M.D.,* TAMER S. FAHMY, M.D.,* SAKIS THEMISTOCLAKIS, M.D.,† ALDO BONSO, M.D.,† ANTONIO ROSSILLO,† STEVEN HAO, M.D.,‡ ROBERT A. SCHWEIKERT, M.D.,* JENNIFER E. CUMMINGS, M.D.,* MANDEEP BHARGAVA, M.D.,* DAVID BURKHARDT, M.D.,* WALID SALIBA, M.D.,* ANTONIO RAVIELE, M.D.,† and ANDREA NATALE, M.D.¶,§,#



Journal of Cardiovascular Electrophysiology Vol. 19, No. 6, June 2008

Efficacy, Safety, and Outcome of Atrial Fibrillation Ablation in Septuagenarians

ANDREA CORRADO, M.D.,*,† DIMPI PATEL, M.D.,* LUCIE RIEDLBAUCHOVA, M.D.,* TAMER S. FAHMY, M.D.,* SAKIS THEMISTOCLAKIS, M.D.,† ALDO BONSO, M.D.,† ANTONIO ROSSILLO,† STEVEN HAO, M.D.,‡ ROBERT A. SCHWEIKERT, M.D.,* JENNIFER E. CUMMINGS, M.D.,* MANDEEP BHARGAVA, M.D.,* DAVID BURKHARDT, M.D.,* WALID SALIBA, M.D.,* ANTONIO RAVIELE, M.D.,† and ANDREA NATALE, M.D.¶,§,#

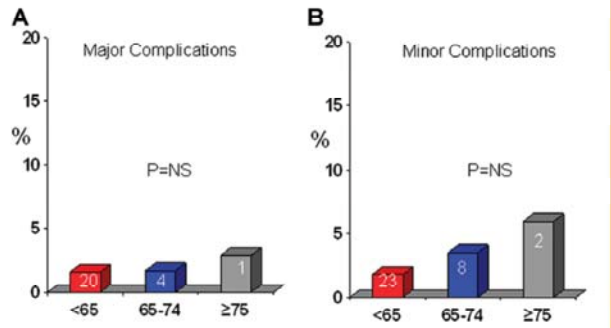


Figure 1. *Incidence and number of complications in the three age groups. Group 1. <65 years in red; group 2. 65 to 74 years in blue; and group 3. ≥75 years in gray. See also Table 2 for characterization of major (A) and other (B) complications.*

Journal of Cardiovascular Electrophysiology Vol. 19, No. 6, June 2008

Catheter ablation of atrial fibrillation in the elderly: Where do we stand?

Darren Traub, James P. Daubert, Scott McNitt, Wojciech Zaręba, Burr Hall

Cardiology Division, University of Rochester Medical Center, Rochester, NY, USA

Table 1. Baseline characteristics of patients undergoing atrial fibbrillation (AF) ablation by age category.

Clinical variables	Age < 70 (n = 45)	Age ≥ 70 (n = 15)	P
Age	52 ± 11	74 ± 2	< 0.001
Female	29%	20%	0.738
Ejection fraction (%)	54 ± 8	57±6	0.105
Ejection fraction ≤ 45%	13%	7%	0.668
Left atrial size [mm]	41 ± 6	43±5	0.151
Left atrial size ≥ 50 mm	4%	13%	0.258
AF duration > 60 months	24%	40%	0.324
Comorbidites			
Coronary artery disease	13%	20%	0.678
Hypertension	42%	40%	1.000
Diabetes	4%	7%	1.000
Medications at baseline			
ACE-inhibitors	27%	40%	0.347
Beta-blockers	40%	87%	0.002
Statins	27%	40%	0.347
Flecainide	24%	13%	0.485
Tikosyn	11%	47%	0.006
Propafenone	33%	20%	0.517
Sotalol	18%	7%	0.427
Amiodarone	9%	0	0.564
None	4%	13%	0.258

(Cardiol J 2009; 16, 2: 113–120)

Catheter ablation of atrial fibrillation in the elderly: Where do we stand?

Darren Traub, James P. Daubert, Scott McNitt, Wojciech Zaręba, Burr Hall

Cardiology Division, University of Rochester Medical Center, Rochester, NY, USA

Table 2. Comparison of atrial fibrillation ablation outcomes at 1 year by age category.

	Age < 70 (n = 45)	Age ≥ 70 (n = 15)	P
NSR in the absence of symptoms at 12 months	36 (80.0%)	9 (60.0%)	0.169
NSR or symptomatic improvement	42 (93.3%)	12 (80.0%)	0.159
Remaining on anti-arrhythmic therapy (%)	7 (15.6%)	9 (60.0%)	0.002
With successful ablations who remained on anti-arrhythmic therapy (%)	3/36 (8%)	3/9 (33%)	< 0.05
Remaining on warfarin (%)	10 (22.2%)	12 (80.0%)	< 0.001
Complications	2 (4.4%)	1 (6.7%)	1.000

NSR — normal sinus rhythm

(Cardiol J 2009; 16, 2: 113–120)

Complications of Catheter Ablation for Atrial Fibrillation: Incidence and Predictors

DAVID D. SPRAGG, M.D.,* DARSHAN DALAL, M.D., M.P.H.,* AAMIR CHEEMA, M.D.,*
DANIEL SCHERR, M.D.,*,† KARUNA CHILUKURI, M.D.,* ALAN CHENG, M.D.,*
CHARLES A. HENRIKSON, M.D.,* JOSEPH E. MARINE, M.D.,*
RONALD D. BERGER, M.D., PH.D.,* JUN DONG, M.D., PH.D.,*
and HUGH CALKINS, M.D.*

From the *Division of Cardiology, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland, USA; and †Division of Cardiology, Department of Medicine, Medical University of Graz, Graz, Austria

TABLE 1

Clinical Characteristics of Patients Undergoing Ablation of AF

Age (y)	57.2 ± 11
Male gender (%)	77.7
AF burden	
Paroxysmal (%)	53.6
Persistent (%)	46.4
Ejection fraction (%)	57.0 ± 9.2
Left atrial diameter (cm)	4.7 ± 0.7
Hypertension (%)	42.0
Prior cardioversions	1.3 ± 2.0
Prior antiarrhythmics	1.6 ± 0.9

TABLE 2

Major Complications in Patients Undergoing Ablation of AF

Stroke	7
Tamponade	8
Vascular injury	11
Pulmonary vein occlusion	1
Hemothorax	2
Heart block	1
Acute lung injury	1
Mitral valve injury	1

(J Cardiovasc Electrophysiol, Vol. 19, pp. 627-631, June 2008.)

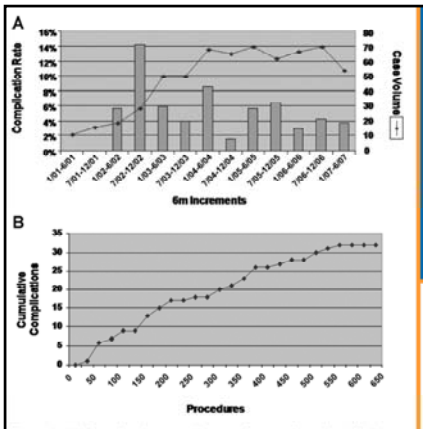


Figure 1. *(A) Complication rates (bars) and case volume (line) during sequential 6-month periods from 2001 to 2007. (B) Cumulative complications versus procedures.*

(J Cardiovasc Electrophysiol, Vol. 19, pp. 627-631, June 2008.)

Complications of Catheter Ablation for Atrial Fibrillation: Incidence and Predictors

DAVID D. SPRAGG, M.D.,* DARSHAN DALAL, M.D., M.P.H.,* AAMIR CHEEMA, M.D.,* DANIEL SCHERR, M.D.,*† KARUNA CHILUKURI, M.D.,* ALAN CHENG, M.D.,* CHARLES A. HENRIKSON, M.D.,* JOSEPH E. MARINE, M.D.,* RONALD D. BERGER, M.D., PH.D.,* JUN DONG, M.D., PH.D.,* and HUGH CALKINS, M.D.*

From the *Division of Cardiology, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland, USA; and †Division of Cardiology, Department of Medicine, Medical University of Graz, Graz, Austria

TABLE 3

Comparison of Patients with and without Major Complications (Univariate Analysis)

Variables	No complication (n = 608)	Complication (n = 32)	P
Patient characteristics			
Age	57.1 ± 10.8	59.2 ± 12.4	0.31
Age > 70 (%)	12.4	25.0	**0.04**
Female gender (%)	21.7	34.4	0.06
Hypertension	42.3	31.3	0.21
Ejection fraction	58.3 ± 28.8	55.2 ± 9.2	0.60
Left atrial diameter	4.7 ± 0.1	4.6 ± 0.2	0.60
AF			
Paroxysmal	53.1	59.3	0.53
Persistent	46.9	40.7	
Procedure times			
Procedure duration	257 ± 61	260 ± 88	0.77
LA access time	167 ± 59	160 ± 67	0.52

Efficacy, Safety, and Outcome of Atrial Fibrillation Ablation in Septuagenarians

ANDREA CORRADO, M.D.,*,† DIMPI PATEL, M.D.,* LUCIE RIEDLBAUCHOVA, M.D.,* TAMER S. FAHMY, M.D.,* SAKIS THEMISTOCLAKIS, M.D.,† ALDO BONSO, M.D.,† ANTONIO ROSSILLO,† STEVEN HAO, M.D.,‡ ROBERT A. SCHWEIKERT, M.D.,* JENNIFER E. CUMMINGS, M.D.,* MANDEEP BHARGAVA, M.D.,* DAVID BURKHARDT, M.D.,* WALID SALIBA, M.D.,* ANTONIO RAVIELE, M.D.,† and ANDREA NATALE, M.D.¶,§,#

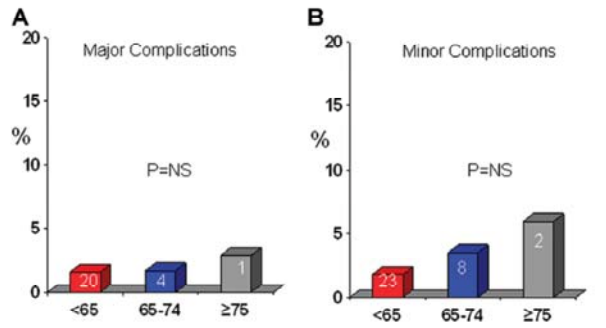
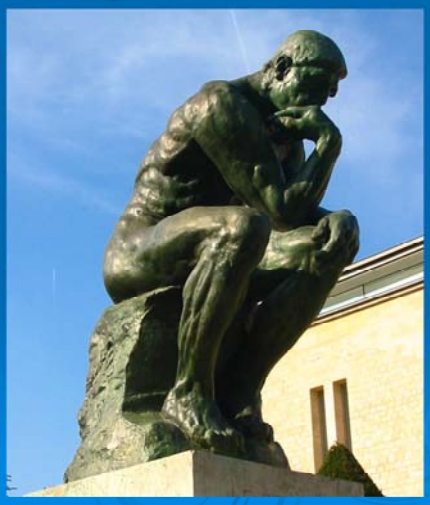


Figure 1. *Incidence and number of complications in the three age groups. Group 1. <65 years in red; group 2. 65 to 74 years in blue; and group 3. ≥75 years in gray. See also Table 2 for characterization of major (A) and other (B) complications.*

Journal of Cardiovascular Electrophysiology Vol. 19, No. 6, June 2008

Can we use the same AF ablation strategies in younger and older patients?



Cellular electrophysiologic properties of old canine atria provide a substrate for arrhythmogenesis

Evgeny P. Anyukhovsky[a], Eugene A. Sosunov[a], Alexei Plotnikov[a], Ravil Z. Gainullin[a], Jeffrey S. Jhang[b], Charles C. Marboe[b], Michael R. Rosen[a,*]

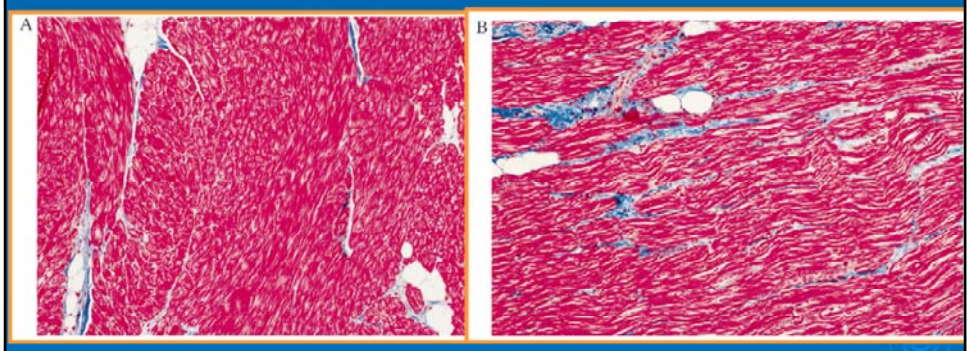
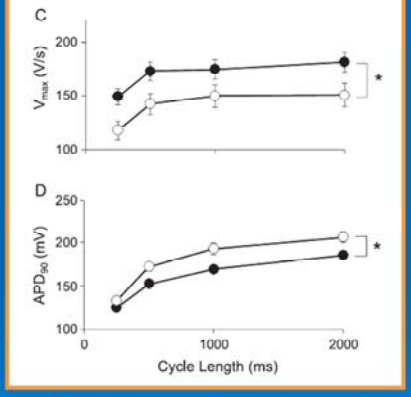


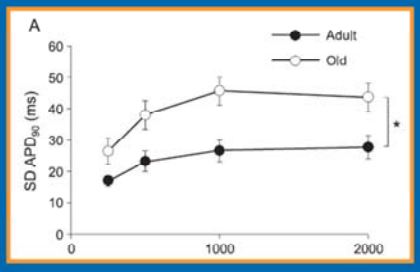
Fig. 5. Representative sections of pectinate muscle bundles from an adult (A) and old (B) dog showing myocytes in red and collagen in blue. The circular, clear spaces are interstitial fat which was excluded from the analysis. Image analysis of these and additional fields showed the amount of fibrosis tissue in adult atrium = 4.5% (A) and the amount of diffuse, interstitial fibrous tissue in old atrium = 17.9% (B) of the amount of myocardium. Masson trichrome stain. Original magnification = 160×.

Age-associated changes in electrophysiologic remodeling: a potential contributor to initiation of atrial fibrillation

Evgeny P. Anyukhovsky, Eugene A. Sosunov, Parag Chandra, Tove S. Rosen, Penelope A. Boyden, Peter Danilo Jr., Michael R. Rosen*



Older dogs in sinus rhythm (white circles) had lower Vmax and longer AP duration compared to adult dogs (black circles)



Older dogs in SR had significantly greater heterogeneity of repolarization than adult dogs (SD APD_{90} = standard deviation of action potential duration to 90% repolarization) as well as a larger interregional dispersion of AP duration. These spatial differences in AP duration and refractoriness likely facilitate re-entry; initiation and perpetuation of AF.

CHANGE OF DEMOGRAPHICS, CLINICAL CHARACTERISTICS AND OUTCOMES IN PATIENTS REFERRED FOR ATRIAL FIBRILLATION ABLATION

Freddy Del-Carpio Munoz, MD, Gregory A. Cogert, MD, Kristi H. Monahan, RN, Janice M. Haroldson, RN, Laura A. Peterson, Yong M. Cha, MD, Paul A. Friedman, MD, Thomas M. Munger, MD, Samuel J. Asirvatham, MD and Douglas L. Packer, MD. Mayo Clinic, Rochester, MN

Difference of demographics over time in patients referred for AF ablation.

	Early Period (1998-2002) n=275	Intermediate Period (2003-2005) n=515	Early Period (2006-2008) n=624	p value
Age (mean ± SD)	52.1 ± 10	55.6 ± 11	58.1 ± 11	0.001
Number of failed AAs	2.5 ± 1.3	1.9 ± 1.3	2.5 ± 1.1	0.001
PAF (n, %)	193 (70%)	261 (51%)	227 (37%)	0.0001
Persistent AF (n, %)	70 (25%)	192 (37%)	318 (52%)	0.0001
Permanent AF (n, %)	12 (5%)	60 (12%)	67 (11%)	0.0002
Organic Heart Disease (n, %)	44 (16%)	126 (25%)	194 (31%)	0.0001
Normal LA size (n, %)	95 (35%)	161 (32%)	88 (16%)	0.0001
Repeat procedure (n, %)	15 (5%)	55 (11%)	80 (13%)	0.003
AF Elimination/Control (%)	48/59%	61/71%	69/82%	0.0001

Heart Rhythm Vol 6, No.5 May Supplement 2009

Catheter ablation of atrial fibrillation in the elderly: Where do we stand?

Darren Traub, James P. Daubert, Scott McNitt, Wojciech Zaręba, Burr Hall

Cardiology Division, University of Rochester Medical Center, Rochester, NY, USA

Table 3. Summary of studies of atrial fibrillation (AF) ablation in the elderly.

Author	Patients (age range in years)	AF type (paroxysmal, persistent, chronic)	Mean-follow (months)	Outcome	Remaining on AAD's	Major complications
Hseih et al.	37 (72 ± 4)	Paroxysmal	52 ± 6	81% in SR	11%	0%
Corrado et al. (see Fig. 1)	174 (> 75)	Paroxysmal 55% Persistent 45%	20 ± 14	88% (127/143) SR off AAD's after 1st procedure 10.8% (16/143) SR off AAD's after 2nd procedure	13%	1%
Zado et al. (see Fig. 2)	635 (< 65) 124 (65–74) 22 (≥ 75)	65% paroxysmal** 62% paroxysmal 53% paroxysmal	27.6 ± 13.8 27.7 ± 13.6 23.8 ± 11.3	89% AF control* 84% AF control* 87% AF control*	20% 29% 37%	1.6% 1.7% 2.9%
Hall et al.	15 (73.6)	100% paroxysmal	56	60% in SR at 12 months 80% in SR or with symptomatic improvement	60%	6.6%
Santinelli et al. (abstract)	172 (> 80, mean age 83 ± 2)	35% paroxysmal 29% persistent 36% paroxysmal	18 ± 5	Overall success rate of 75% 90% paroxysmal 76% persistent 60% permanent	Not reported	5%

AAD — antiarrhythmic drug, SR — sinus rhythm; *defined as 1) no AF episodes on or off anti-arrhythmic therapy or 2) rare AF (≤ 6 AF episodes over the follow-up year and/or > 95% reduction in AF burden when monitoring was compared pre- and post-ablation; **percentage of paroxysmal per age group, other patients in each age group were non-paroxysmal AF

(Cardiol J 2009; 16, 2: 113–120)

Conclusion

- Catheter ablation of AF can be safely performed in an elderly population.
  - There may be a slightly increased risk of peri-procedural complications
- Catheter ablation appears to be efficacious in an elderly population
  - All data based on retrospective analyses
  - More elderly remain on AADs post-ablation
    - This may be an acceptable endpoint for an elderly patient with symptomatic AF
- The next step is to perform large scale, randomized trials like AFFIRM to more definitively establish the role of catheter ablation in treating elderly patients with atrial fibrillation