

Role of Pacing with High Frequency Shock in Reversion of Acute Episodes of Atrial Fibrillation and Atypical Atrial Flutter

Results of the controlled randomized study

Nikolay Shlevkov¹, Sergei Golitsyn¹, Thorsten Lewalter²,
Berndt Luederitz ²

1 – Department of clinical electrophysiology, Russian Cardiology Research Center, Moscow, Russia

2 – Department of medicine-cardiology, University of Bonn, Germany

Introduction

Atrial fibrillation (AF) and atypical atrial flutter (AFI) may appear during the electrophysiological study (EPS) in the following manners:

- Spontaneously, after administering adrenergic or anticholinergic drugs;
- Spontaneously, during the paroxysms of other supraventricular tachycardias (nodal reentry, orthodromic tachycardia, atrial tachycardia among others);
- As a consequence of programmed atrial pacing;
- During attempts of reversion from other paroxysmal tachycardias (nodal reentry, orthodromic tachycardia, atrial tachycardia among others);
- Due to the manipulation of intracavitary catheters.

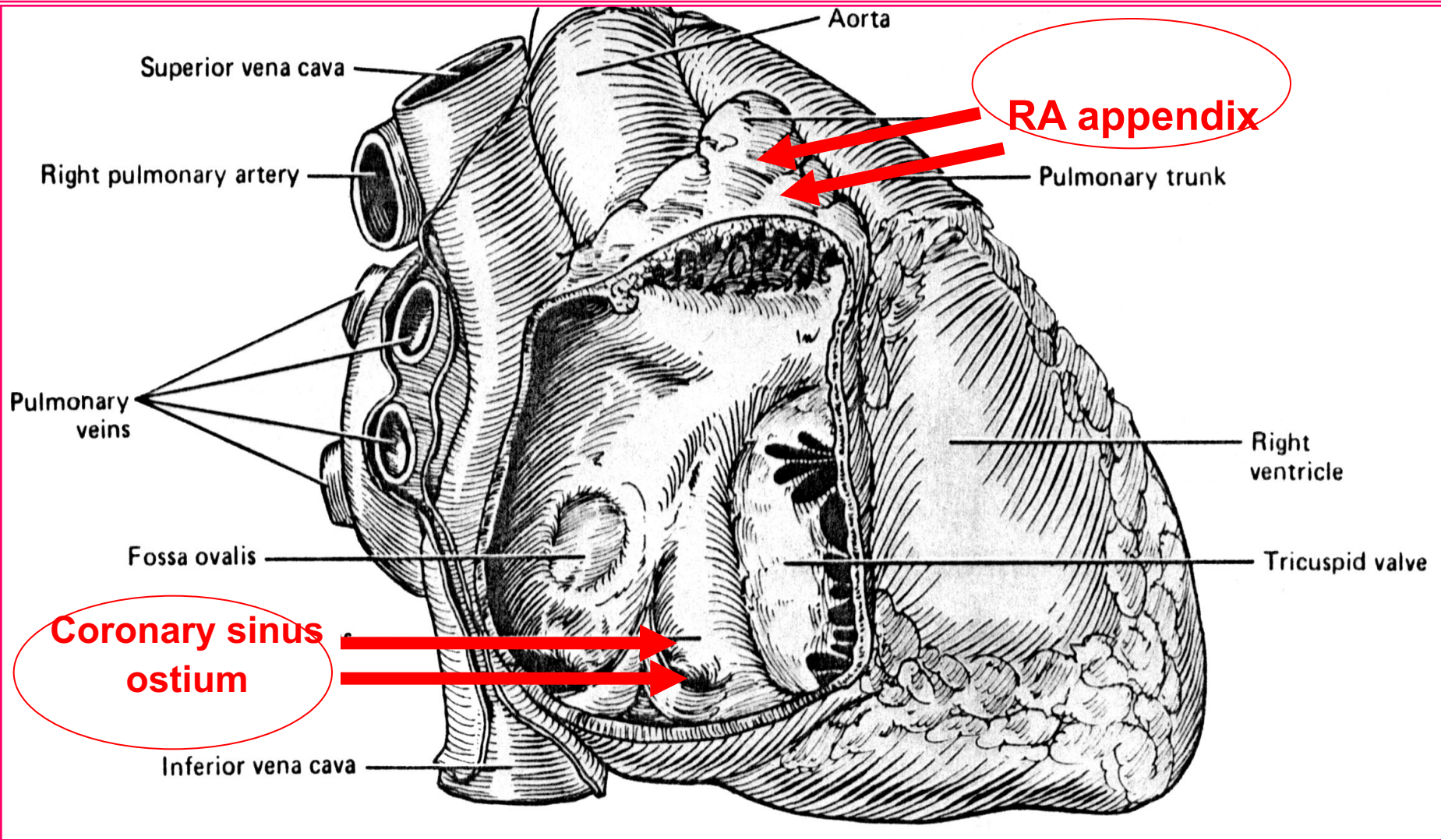
Usual Management of an Electrophysiologist before an Episode of AF or Atypical AFI during EPS

1. Expectant management during 5, 15, 30 or more minutes.
2. Endovenous administration of antiarrhythmic drugs (AAD).
3. Electrical cardioversion.
4. Attempt of reversion with atrial pacing with high frequency shocks?

Objectives of the Investigation

To evaluate the chance of reversion of acute episodes of AF and atypical AFI with a pacing algorithm with high frequency shocks (1200 impulses/min or 20 Gz) from 2 sites in the right atrium: the right atrial appendage (RAA) and the coronary sinus ostium (CSO).

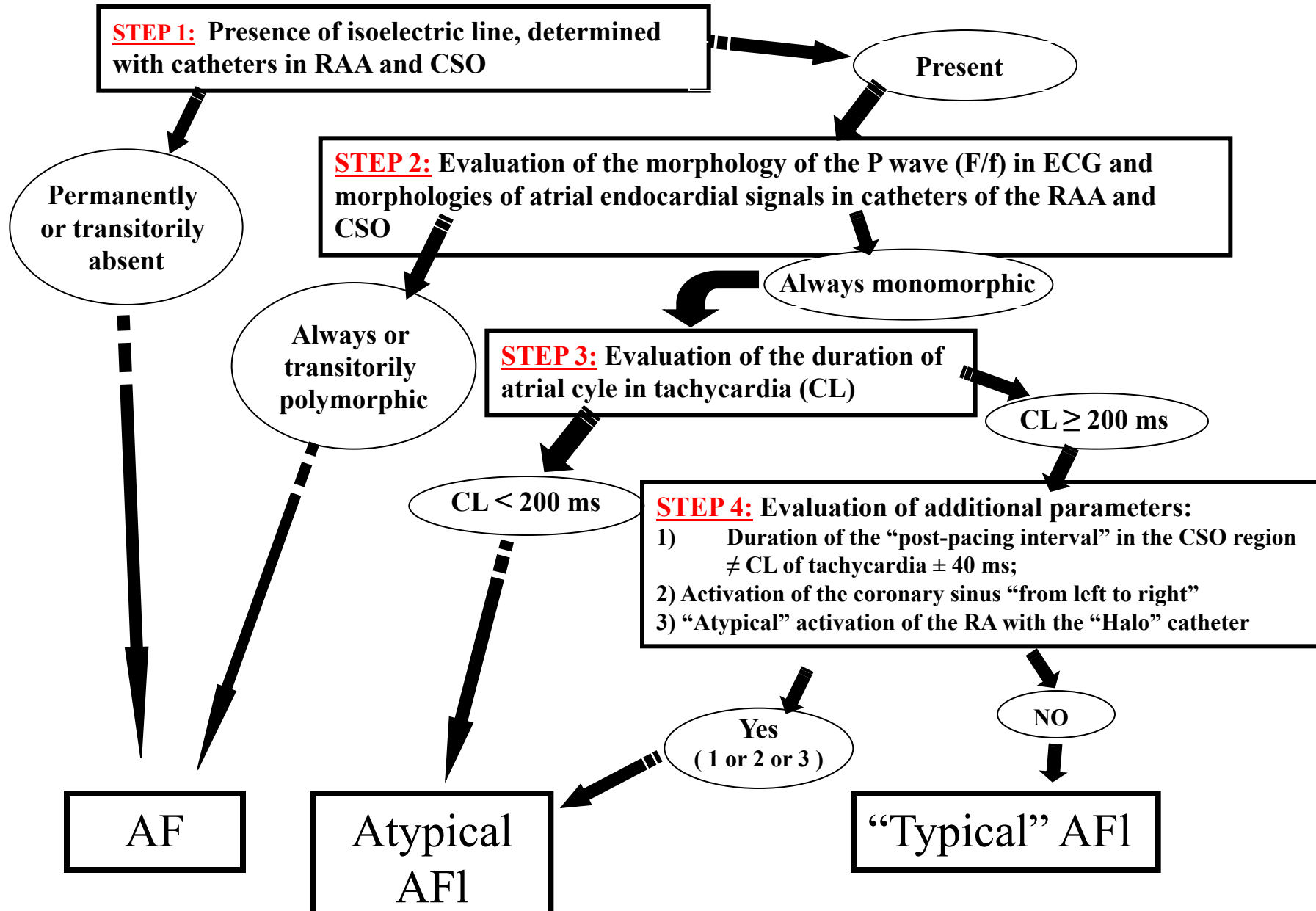
Pacing Sites from RA



Inclusion Criteria for the Study

1. Episodes of AF and atypical AFI of more than 30 sec of duration;
2. Location of 2 catheters (for diagnosis or ablation) in the right cavities of the heart at the time of the onset of the episode.
3. Chance for atrial overdrive pacing during the first 5 minutes since the onset of AF or atypical AFI;
4. The patient should not have received antiarrhythmic drugs previously;
5. Consent of the patient for atrial pacing with high frequencies.

Algorithm of Differential Diagnosis of Atrial Arrhythmias: AF, Atypical or Typical AF1



Definitions

Atrial fibrillation (AF)

Characterized by irregular atrial rhythm with polymorphic P waves (f), irregular RR intervals in ECG, permanent or transitory absence of isoelectric line in electrograms of atrial electrodes, and also by polymorphic atrial signals, permanent or periodical, of intracardiac electrograms.

Atypical atrial flutter (atypical AFI)

Characterized by regular atrial rhythm (with a rate higher than 240/min) with monomorphic P waves (F) in ECG, the permanent presence of the isoelectric line in electrograms of atrial electrodes, and also, by permanent monomorphic atrial signals of intracardiac electrograms. Further, this arrhythmia should not meet the electrocardiographic and electrophysiologic criteria of “typical” AFI.

Characteristics of Patients

From 1052 patients, in whom EPS was conducted, **110 patients** met the inclusion criteria (45 women and 65 men), i.e. 10.4%.

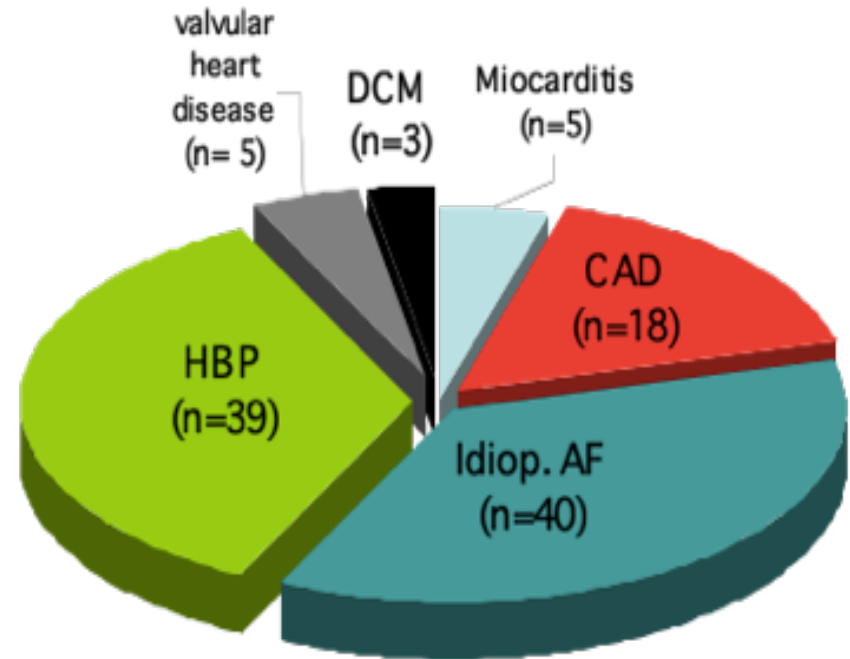
Age = 53 ± 14 years old (from 16 to 82 y.o.)

There were **128 episodes of tachyarrhythmias analyzed: 93 episodes of AF and 35 of atypical AFI.**

In 97 patients (88%) just one episode of AF/atypical AFI was recorded, 13 patients presented several episodes of AF/atypical AFI, which were recorded during 1 EPS (n=9) or several EPS (n=4).

Causes of AF/atypical AFI	n (%)
• Spontaneous appearance	48 (38%)
• Programmed atrial pacing	73 (57%)
• Manipulation with catheter	7 (5%)

Characteristics of diseases associated to arrhythmias (n=110)



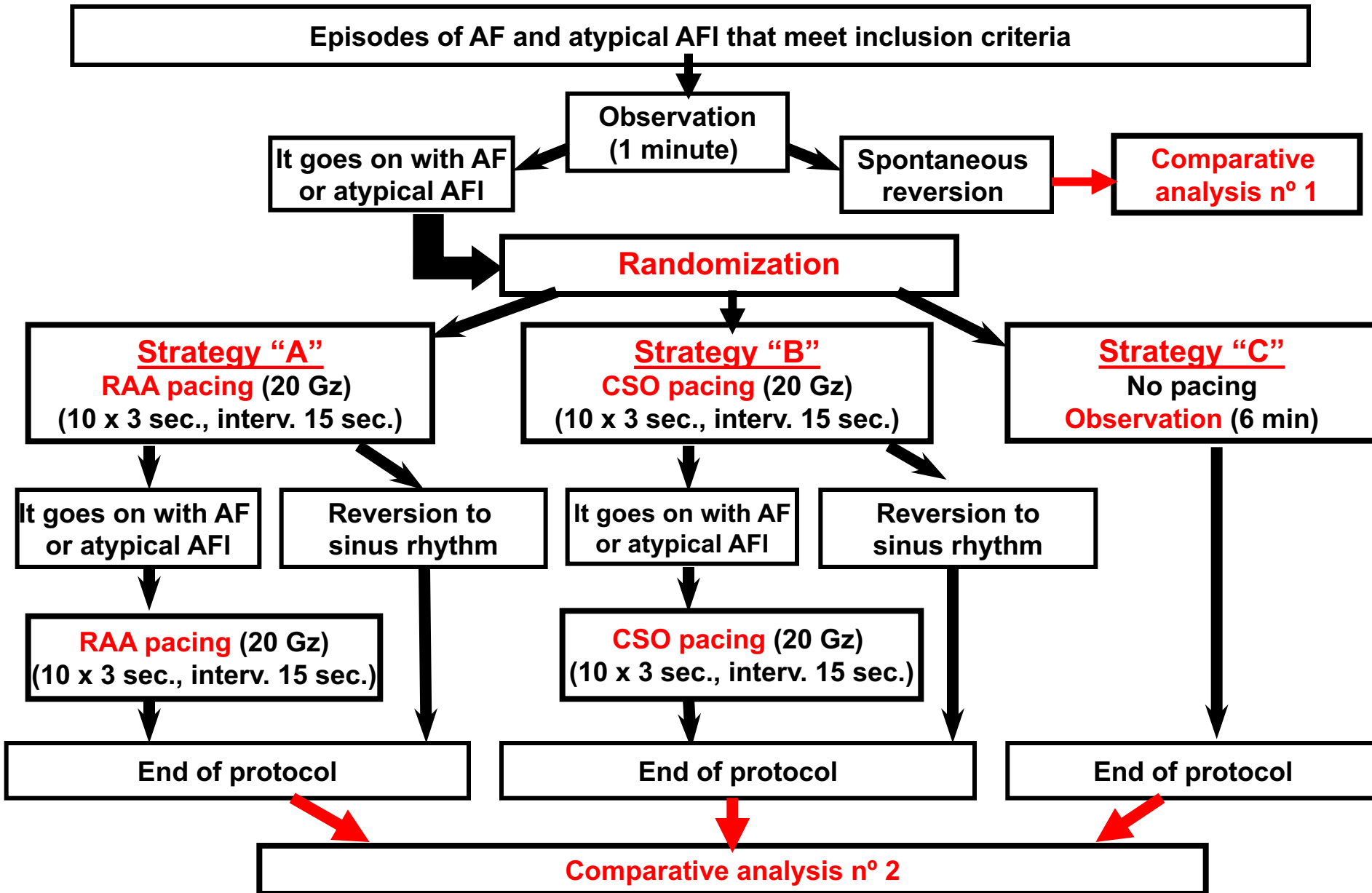
Abbreviations:

CAD – coronary heart disease

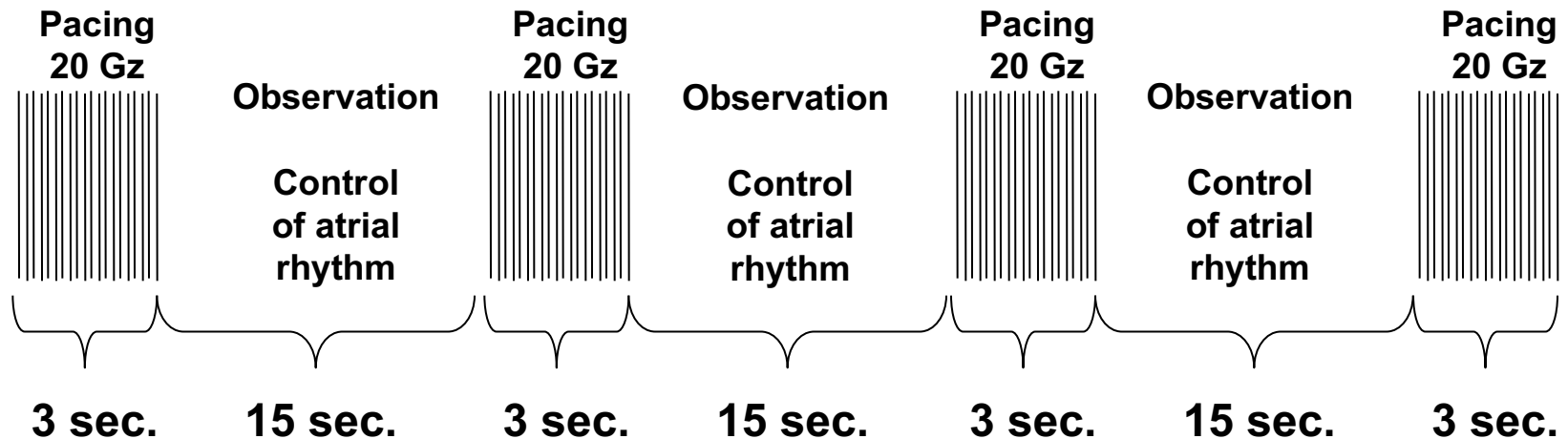
HBP – high blood pressure (history)

DCM – dilated cardiomyopathy

Design of the Study and Randomization Protocol



Protocol of atrial pacing with high frequency shocks

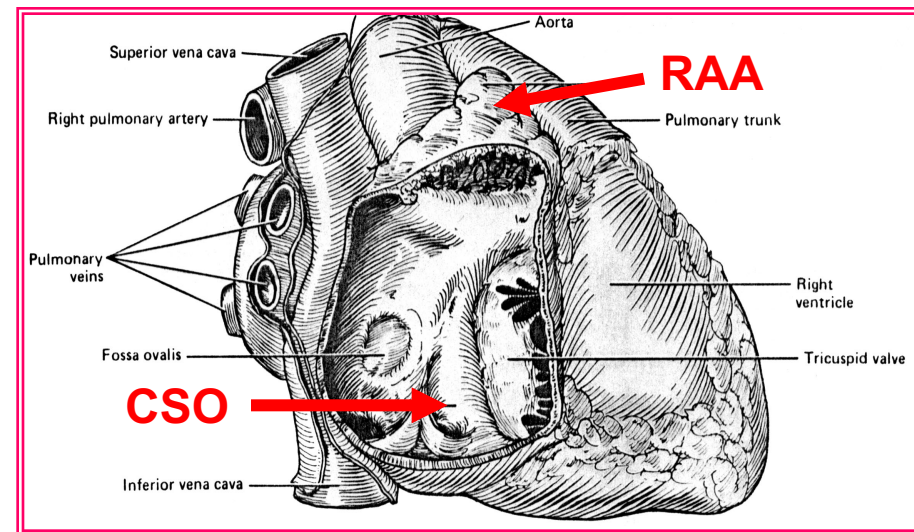


Up to 10 attempts of reversion were made (20 Gz, of 3 sec) in each of the RA sites:

Strategy “A” – RAA, then CSO;

Strategy “B” – CSO, then RAA.

The total duration of the protocol was 6 minutes.

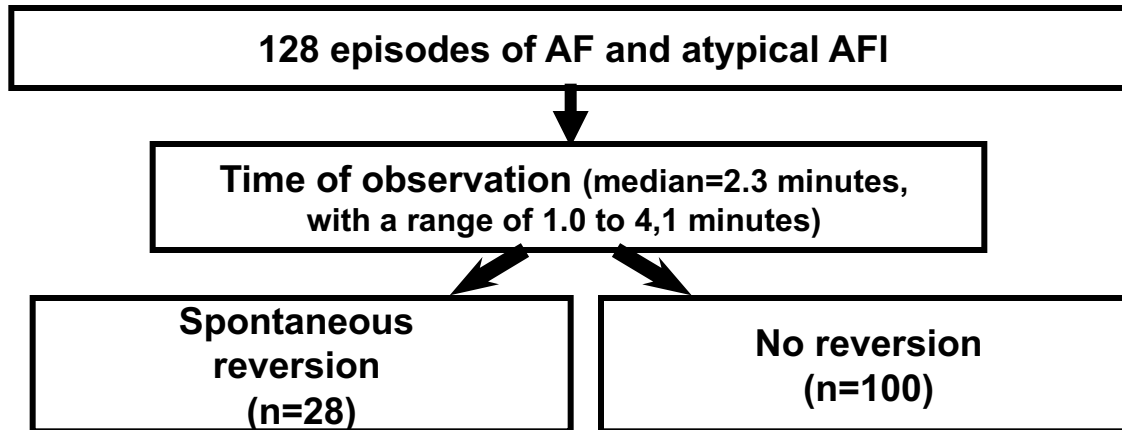


Investigation Methods

Parameters analyzed:

- History of episodes of AF or atypical AFI;
- Etiology of structural heart disease;
- Echocardiographic size of the left atrium;
- Presence of valvular heart diseases in echo;
- Mechanism of appearance of AF or atypical AFI during EPS (spontaneously or induced with programmed atrial pacing);
- Time since the inclusion of the patient up to the onset of the pacing protocol;
- Duration of P wave in ECG (during sinus rhythm).

Results



Parameters analyzed	Nonsustained episodes (n=28)	Sustained episodes (n=100)	P
Age, years	58 (47-65)	52 (40-64)	0.25
Sex (M/F)	13/15	62/38	0.14
History of HBP	13 (52%)	34 (34%)	0.12
History of AF or atypical AFI	11 (44%)	64 (66%)	0.045
Type of arrhythmia: AF or atypical AFI	20/5 (80/20%)	70/30 (70/30%)	0.3
More than 1 episode of AF or atypical AFI	3 (11 %)	27 (27 %)	0.1
Duration of P wave, ms	125 (110 – 140)	130 (116 – 138)	0.39
Size of LA, cm	3.7 (3.4-3.8)	4.1 (3.5-4.5)	0.02
Percentage with LA < 4.0 cm (Echo)	13/16 (81%)	30/73 (41%)	0.005
Mitral insufficiency	5/16 (31%)	42/73 (58%)	0.1

Prior Conclusions

The following factors were markers of sustained episodes of AF or atypical AFl:

- 1) Echocardiographic increase of the size of the left atrium, more than 4.0 cm;
- 2) History of prior episodes of AF or atypical AFl.

Results from Randomization of Sustained Episodes of AF or Atypical AFI (n=100)

Parameters analyzed	STRATEGY ACCORDING TO RANDOMIZATION		
	Strategy "A" RAA/CSO pacing (n=32)	Strategy "B" CSO/RAA pacing (n=34)	Strategy "C" Observation (n=34)
Age, years	50 (38 - 66)	53 (48 – 64)	50 (39 – 61)
Sex (m/f)	22/10	22/14	18/16
Type of arrhythmia: AF/atyp AFI	21/11	24/10	25/9
Structural heart disease	13 (41%)	8 (24%)	12 (35%)
History of HBP	12 (38%)	13 (38%)	9 (27%)
History of AF or atyp AFI	23 (72%)	22 (65%)	21 (62%)
More than 1 episode of AF or atyp AFI	8 (25%)	10 (29%)	10 (29%)
Duration of observation before randomization (in minutes)	2.3 (1.8-2.6)	2.5 (1.7-3.4)	2.2 (1.5-3.0)
Duration of P in ECG (ms)	134 (120-150)	128 (117-136)	125 (116-135)
Size of LA, cm	4.2 (3.8-4.5)	4.1 (3.5-4.5)	4.0 (3.5-4.5)
Percentage of patients with LA < 4.0 cm	11/22 (50%)	17/26 (65%)	14/26 (54%)
Spont appearance of AF or atyp AFI	8 (25%)	13 (38%)	14 (41%)

Effectiveness of reversion to sinus rhythm (SR), according to the therapeutic strategy

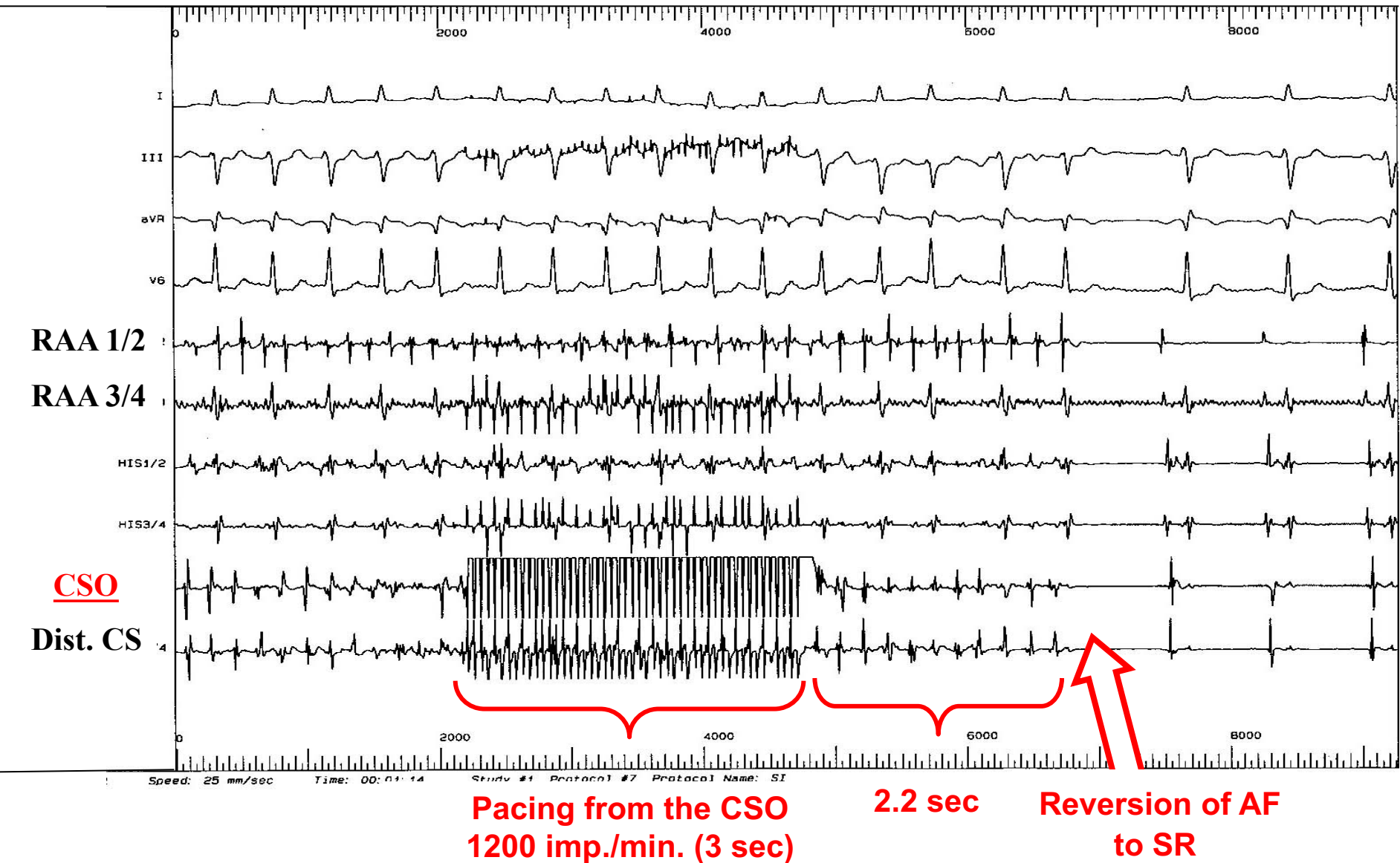
[subset: atrial fibrillation (AF), n=70]

Strategy according to protocol:	Pacing from RAA		Pacing from CSO		Observation	
Number of randomized episodes	n=21		n=24		n=25	
Number of reversions to SR and persistence of AF after pacing in one of the 2 sites (during the first 3 min of observation)	SR n=4 (19%)	AF n=17	SR n=6 (25%)	AF n=18	SR n=2 (8%)	AF n=23
Number of reversions to SR and persistence of AF after pacing in another of the 2 sites (during the last 3 min of observation)	n=18		n=19		n=23	
	SR n=1 (5%)	AF n=17	SR n=3 (12%)	AF n=16	SR n=0 (0%)	AF n=23
Total number of reversions to SR and persistence of AF after the end of the protocol	SR n=5 (24%)	AF n=17	SR n=9 (37%)	AF n=16	SR n=2 (8%)	AF n=23

Example of immediate reverstion of an episode of AF during pacing with shocks of high frequency from the right atrial appendix



Example of late reversion of an episode of AF during pacing with shocks of high frequency from the coronary sinus ostium

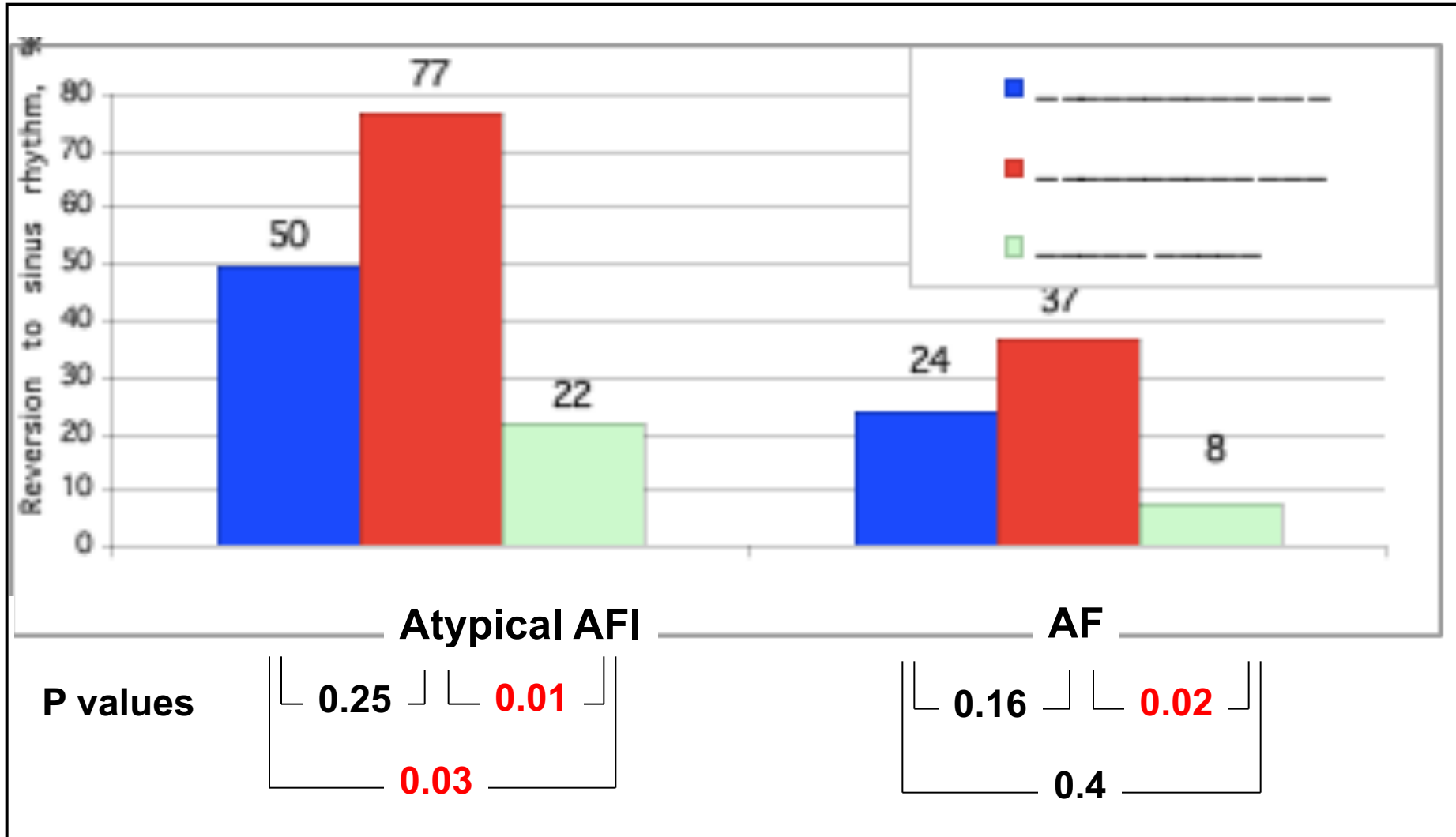


Effectiveness of reversion to sinus rhythm (SR), according to the therapeutic strategy

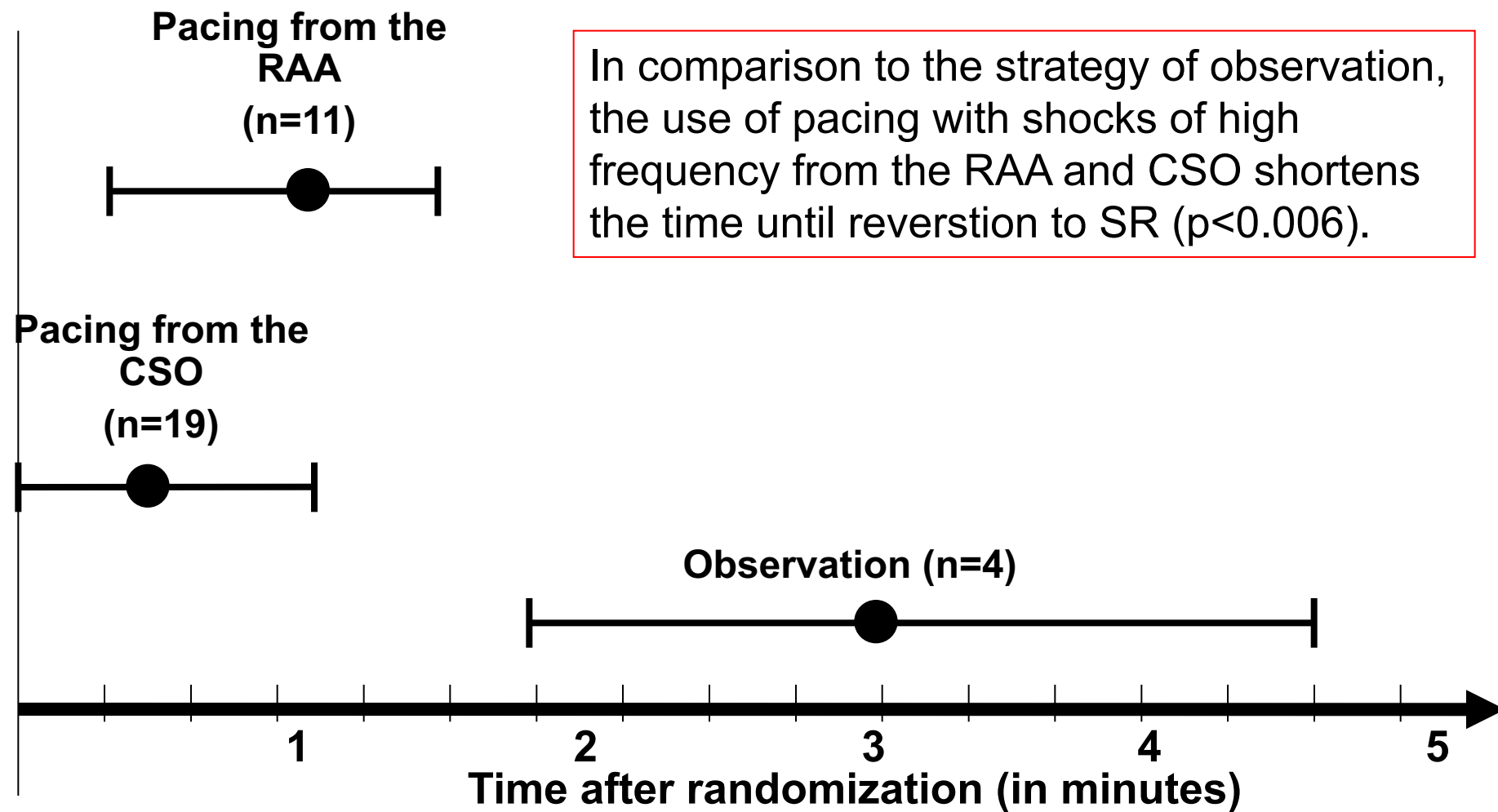
[subset: atypical atrial flutter (AAFI), n=30]

Strategy according to protocol:	Pacing from RAA	Pacing from CSO	Observation
Number of randomized episodes	<div>n=11</div>	<div>n=10</div>	<div>n=9</div>
Number of reversions to SR and persistence of atypical AFI after pacing in one of the 2 sites (during the first 3 min of observation)	<div>SR n=6 (55%)</div> <div>AAFI n=3</div>	<div>SR n=9 (90%)</div> <div>AAFI n=1</div>	<div>SR n=0 (0%)</div> <div>AAFI n=9</div>
Number of reversions to SR and persistence of atypical AFI after pacing in another of the 2 sites (during the last 3 min of observation)	<div>n=1</div> <div>SR n=0 (5%)</div> <div>AAFI n=1</div>	<div>n=3</div> <div>SR n=1 (33%)</div> <div>AAFI n=2</div>	<div>n=9</div> <div>SR n=2 (22%)</div> <div>AAFI n=7</div>
Total number of reversions to SR and persistence of atypical AFI after the end of the protocol	<div>SR n=6 (50%)</div> <div>AAFI n=4</div>	<div>SR n=10 (77%)</div> <div>AAFI n=3</div>	<div>SR n=2 (22%)</div> <div>AAFI n=7</div>

Comparison of effectiveness of pacing with shocks of high frequency from the RA appendix and the CS ostium for reversion of AF or atypical AFI



Comparison of strategies, according to time until reversion to sinus rhythm in patients with AF or atypical AFI



Predictors of effectiveness of pacing with shocks of high frequency for reversion of AF episodes.

Results (Cox regression)

Parameters	Successful reversion of AF (n=14)	No reversion (n=31)	P (analysis of 1 factor)	Regression coefficient (b ⁱ)	P (analysis of several factors)	Hazard ratio
Age, years	52 (33-61)	54 (48-65)	0.32	-	-	-
History of HBP	4 (29%)	17 (55%)	0.12	-	-	-
Struct. disease	5 (36%)	10 (32%)	0.54	-	-	-
Percentage of spontaneous appearance of AF	8/14 (57%)	8/31 (26%)	0.047	1.61	0.03	4.95
Duration of P wave (ms)	122 (118-134)	136 (126-148)	0.08	-	-	-
Duration of P < 125 ms	9/14 (64 %)	9/31 (29 %)	0.04	1.16	0.01	3.71
LA size (cm)	4.4 (4.2-4.6)	4.2 (3.5-4.5)	0.25	-	-	-

Conclusions

- 1. In comparison with the strategy of “observation”, the use of atrial pacing with shocks of high frequency increases in a significant way, the probability of reversion to sinus rhythm in patients with AF or atypical AFI, which helps preventing pharmacological or electrical cardioversion.**
 - 2. The effectiveness of pacing with shocks of high frequency, as to reversion, is higher in patients with atypical AFI (up to 77%), than in patients with AF (around 35%).**
 - 3. The factors that are associated with a better effectiveness of pacing with high frequency shocks as to reversion of AF, are the following: 1) pacing from the coronary sinus ostium; 2) spontaneous appearance of AF; 3) duration of P wave less than 125 ms (during SR).**
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