Apnea del sueño y enfermedad cardiovascular

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Algunas definiciones...

Apnea : Cese del flujo aereo > 10 sec.

Apnea obstructiva: Obstruccion perfiferica del flujo aereo
central: Daño cerebral: El cerebro no da la orden de respirar

Hipopnea : Disminución del flujo aereo > 30%
y durante mas de 10 sec.

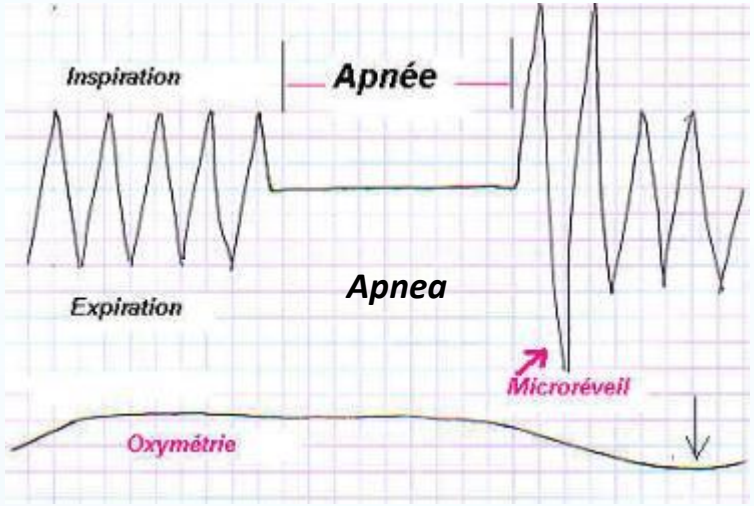
SAHS : lo define el indice de apnea–hipopnea index [AHI]

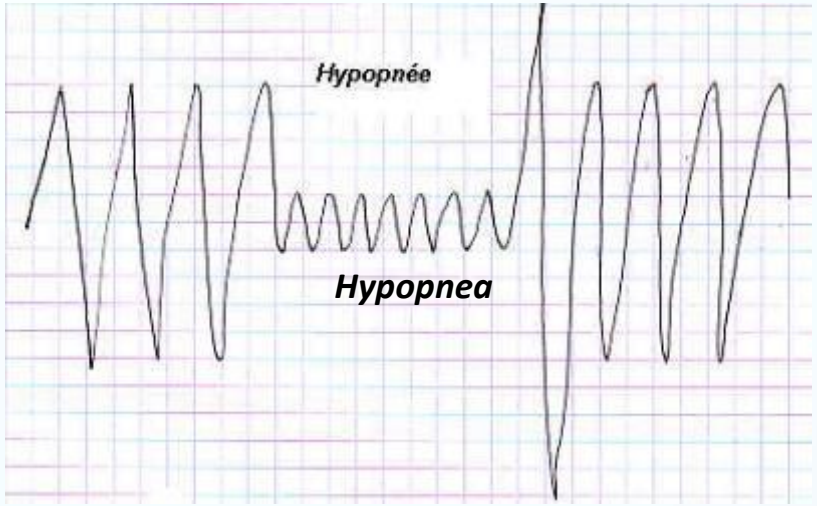
1) Nº de apnea-hipopnea ≥ 5-15/h (leve)
2) Nº de apnea-hipopnea 15-30/h (moderado)
3) Nº de Apnea-hipopnea > 30 (grave)

El diagnostico se hace mediante polisomnografia

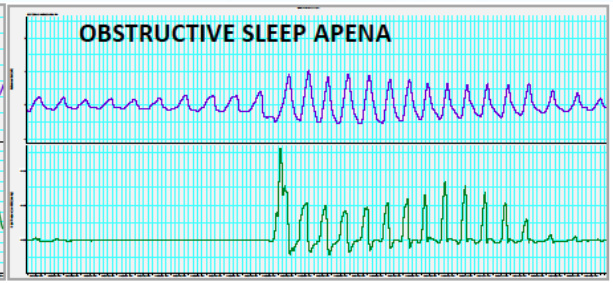
Tratamiento Obstructiva: Continuous Positive Airway Pressure (CPAP)
Nº. de apnea-hipopnea ≥ 30/h
Tratamiento Central: tratar las causas que la provocan

Apnea e Hipopnea

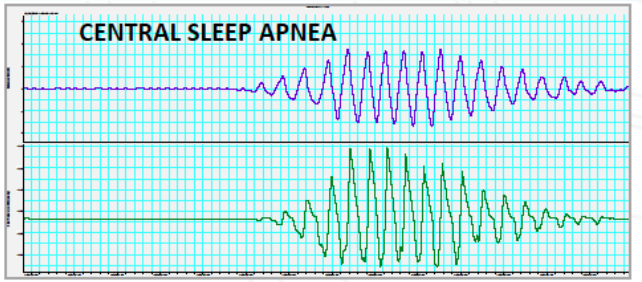




Constant air movement in and out of lungs indicates regular sleep



Abdominal and chest movement without airflow indicates obstructive apnea



Lack of abdominal and chest movement indicates central apnea

Public Health problem?

prevalence

Prevalence 6 - 9% global population

men: 5-9%; Women 2-3%

Prevalence increase with age!! > 50Y

men: 17%; women: 8%

Risk traffic accident x7.2

divorce/independent beds x8.5

morning« irritability »x4.5

Relationship with CV disease

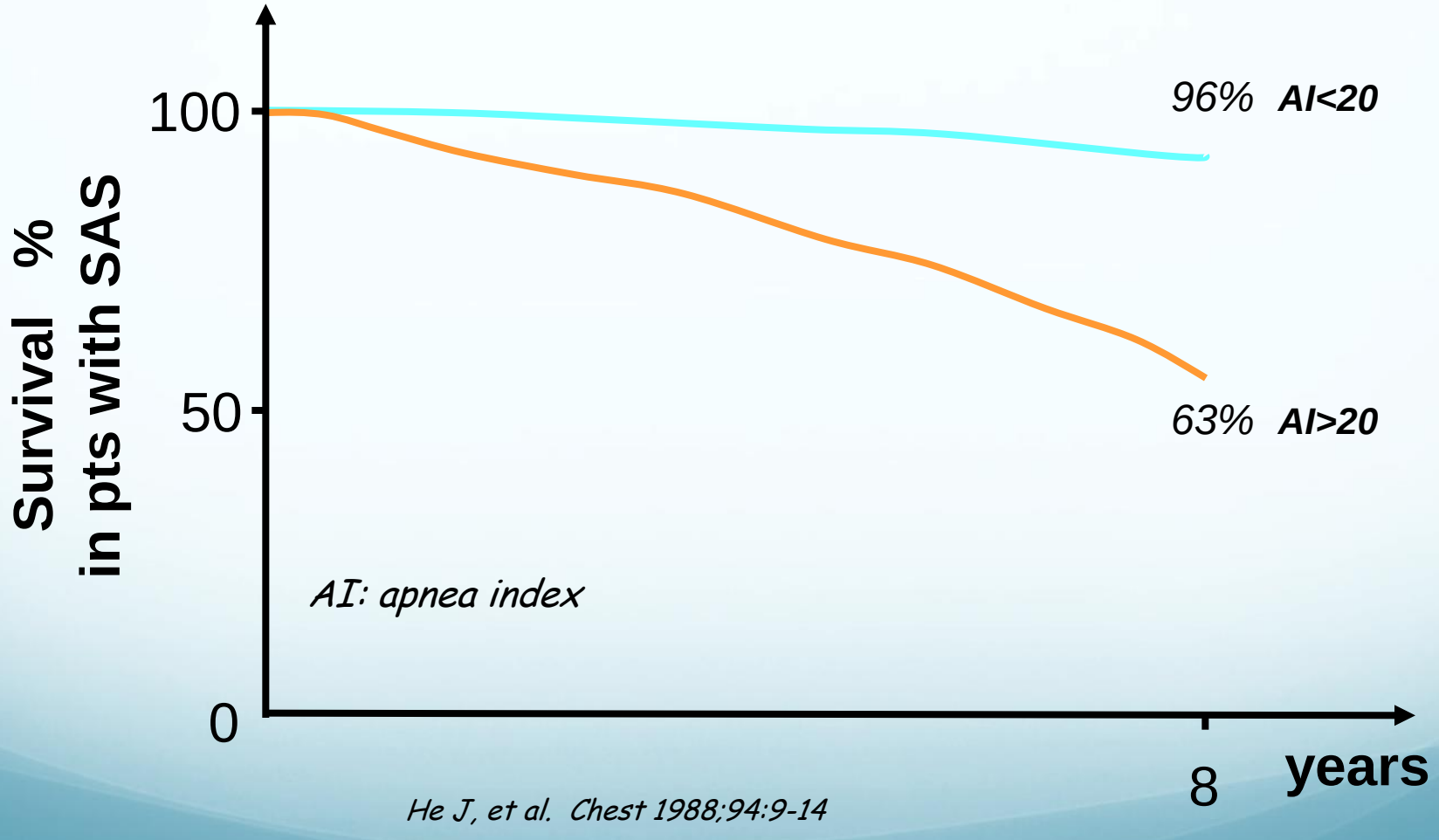
- Resistant Hypertension: 80%
- Hypertension: 45%
- Stroke: 60%
- Aorta aneurysm 60%
- Atrial fibrillation 60%
- Heart Failure 30-50%
- Coronary disease 30%

Philip P. Bull Acad Natl Med 2011;195:1635-43

Parish JM. J Clin Sleep Med. 2010;6:227-8

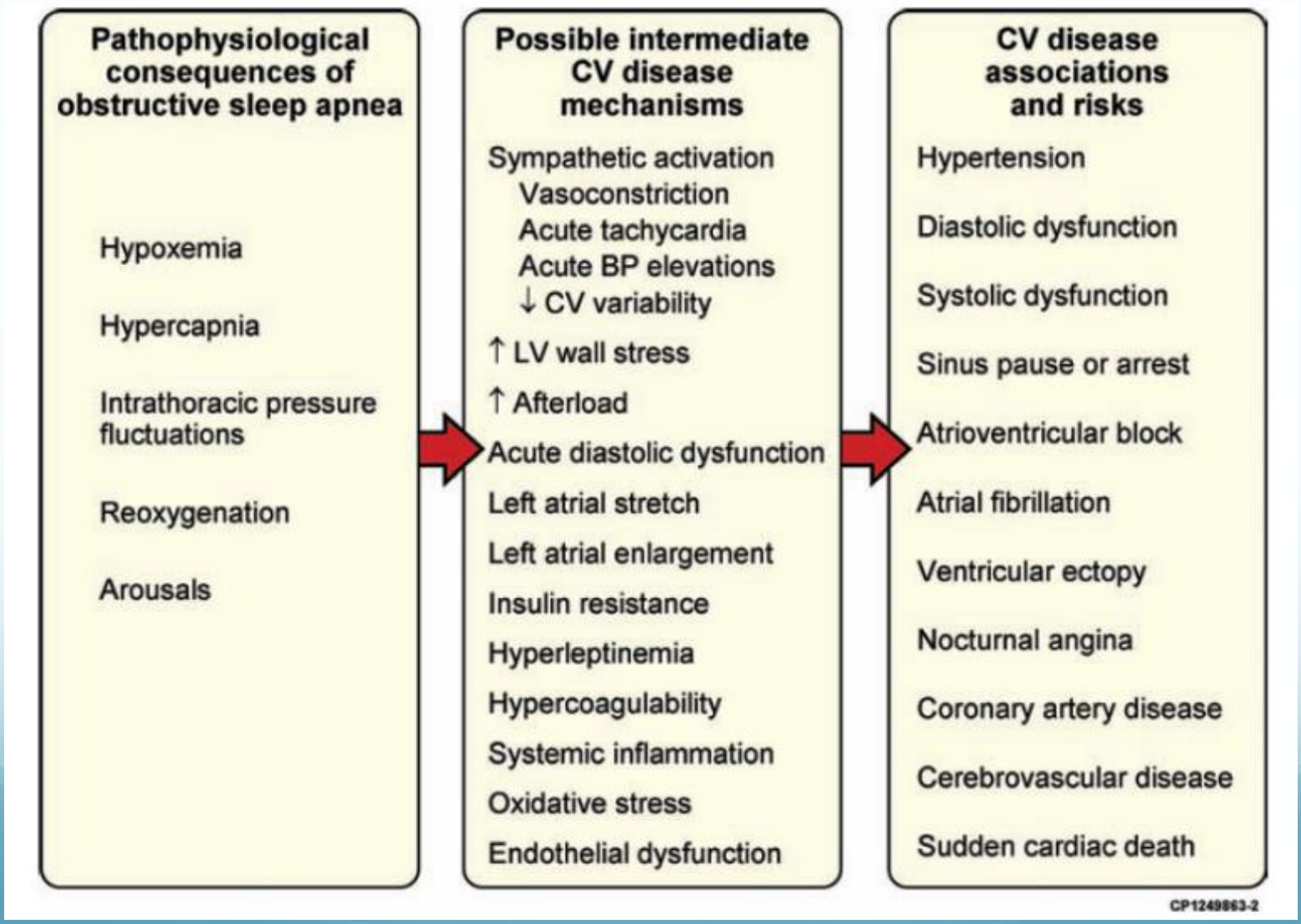
De Roquefeuil F. Heart.org February 2011

SAS and Mortality



He J, et al. Chest 1988;94:9-14

Pathophysiological consequences



Association of Atrial Fibrillation and Obstructive Sleep Apnea

Apoor S. Gami, MD; Gregg Pressman, MD; Sean M. Caples, MD; Ravi Kanagala, MD; Joseph J. Gard, BS; Diane E. Davison, RN, MA; Joseph F. Malouf, MD; Naser M. Ammash, MD; Paul A. Friedman, MD; Virend K. Somers, MD, PhD

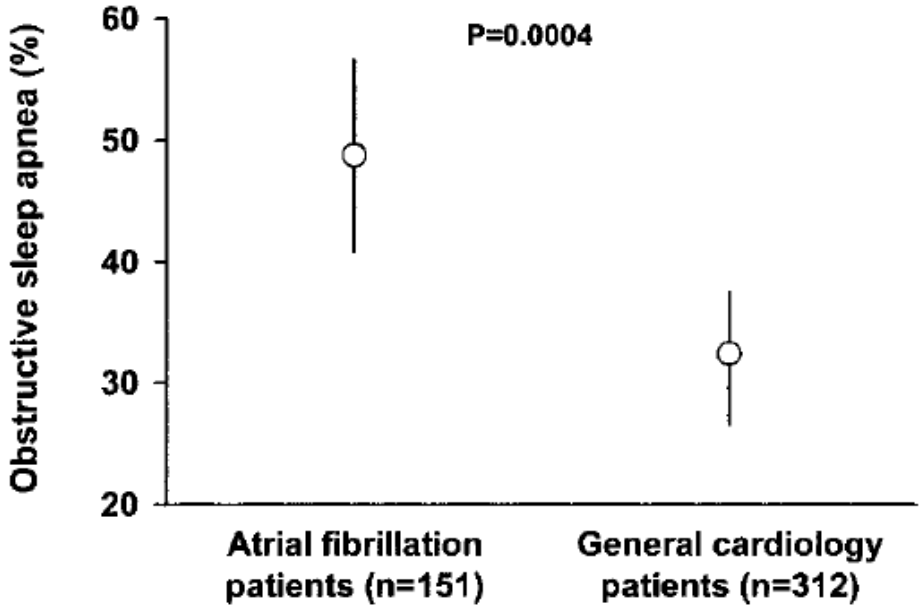


Figure 1. Proportion and 95% CI of patients with OSA. Prevalence of OSA is significantly higher in patients with AF than in patients without past or current AF in general cardiology practice (49% [95% CI 41% to 57%] vs 32% [95% CI 27% to 37%], $P=0.0004$).

Obstructive Sleep Apnea, Obesity, and the Risk of Incident Atrial Fibrillation

Apoor S. Gami, MD,*† Dave O. Hodge, MS,‡ Regina M. Herges, BS,‡ Eric J. Olson, MD,†§ Jiri Nykodym, BS,*† Tomas Kara, MD,*† Virend K. Somers, MD, PHD, FACC*†‖

Table 3 Risk of Incident Atrial Fibrillation, Multivariate Models

	HR	95% CI	p Value
<65 yrs old			
Age (per 10 yrs)	2.04	1.48–2.80	<0.001
Male gender	2.66	1.33–5.30	0.006
Coronary artery disease	2.66	1.46–4.83	0.001
Body mass index (per 1 kg/m^2)	1.07	1.05–1.10	<0.001
Decrease in nocturnal oxygen saturation (per −1%)*	3.29	1.35–8.04	0.009
≥65 yrs old			
Heart failure	7.68	4.32–13.66	<0.001

Recurrencies de FA i SAOS

- 106 pacients sotmesos a CVE varen trovar un index de recurrencia al any del 83% en pacients amb SAOS no tractada, en comparació al 53% dels malalts sense SAOS.
- 424 pacients sotmesos a AR de FA varen trovar que la SAOS podia predir la reconducció a les venes pulmonars (OR 2.16).

Tractament de la SAOS

- L'unic tractament es la CPAP, a banda de mesures H-D.
  - La CPAP ha demostrat disminuir o suprimir la presencia de FA nocturna per Holter.
  - El tto amb FAA, la CVE ni la AR han tingut cap paper en la reducció de la SAOS.

Obstructive Sleep Apnea in Patients With Typical Atrial Flutter

Prevalence and Impact on Arrhythmia Control Outcome

Victor Bazan, PhD; Nuria Grau, MD; Ermengol Valles, PhD; Miquel Felez, PhD; Carles Sanjuas, PhD; Miguel Cainzos-Achirica, MD; Begoña Benito, MD; Miguel Jauregui-Abularach, MD; Joaquim Gea, PhD; Jordi Bruguera-Cortada, MD; Julio Marti-Almor PhD

Table 1—*Patient Characteristics*

Characteristics	Overall (n = 56)	AF (n = 30)	AF + AFib (n = 26)	*P* Value[a]
Age, mean (SD), y	66 (11)	67 (10)	64 (11)	.5
Female sex	12 (21)	5 (17)	7 (27)	.1
Hypertension	39 (70)	19 (63)	20 (77)	.38
Smoking	31 (55)	18 (60)	13 (50)	.59
SHD	22 (39)	11 (37)	11 (42)	.79
CAD	6 (11)	3 (10)	3 (12)	1
LVEF, mean (SD), %	61 (8)	62 (7)	60 (9)	.57
LAD, mean (SD), mm	40 (5)	41 (5)	40 (5)	.49
BMI, mean (SD), kg/m^2	31.2 (6)	30.6 (5)	31.9 (7)	.36
AHI, median (IQR)	27 (10.6-47.5)	30.5 (9.5-52)	21.5 (11-39)	.31
CT 90, median (IQR)	2 (0.15-11.7)	6.5 (0.4-19)	1.6 (0.1-5.4)	.33
ESS score, mean (SD)	11 (4)	11 (4)	10 (4)	.42
OSA	46 (82)	23 (77)	23 (88)	.31
Severe OSA	25 (45)	17 (57)	8 (31)	.17
AAD	16 (29)	3 (10)	13 (50)	.001

Data are presented as absolute numbers (%) unless otherwise stated. AAD = antiarrhythmia drug; AFib = atrial fibrillation; AF = atrial flutter; AHI = apnea-hypopnea index; CAD = coronary artery disease; CT 90 = overnight percentage of time with oxygen saturation < 90%; ESS = Epworth sleepiness scale; IQR = interquartile range; LAD = left atrial diameter; LVEF = left ventricular ejection fraction; OSA = obstructive sleep apnea; SHD = structural heart disease.

[a]*P* value comparing each variable in patients with AF vs patients with AF plus AFib at inclusion. $P < .05$ was considered statistically significant.

Association of Sleep-Disordered Breathing and Ventricular Arrhythmias in Patients Without Heart Failure

Yuki Koshino, MD[a,b,*], Makoto Satoh, MD, PhD[b], Yasuko Katayose, MD[b], Kyo Yasuda, MD, PhD[b], Takeshi Tanigawa, MD, PhD[c], Noriyuki Takeyasu, MD, PhD[a], Shigeyuki Watanabe, MD, PhD[a], Iwao Yamaguchi, MD, PhD[a], and Kazutaka Aonuma, MD, PhD[a]

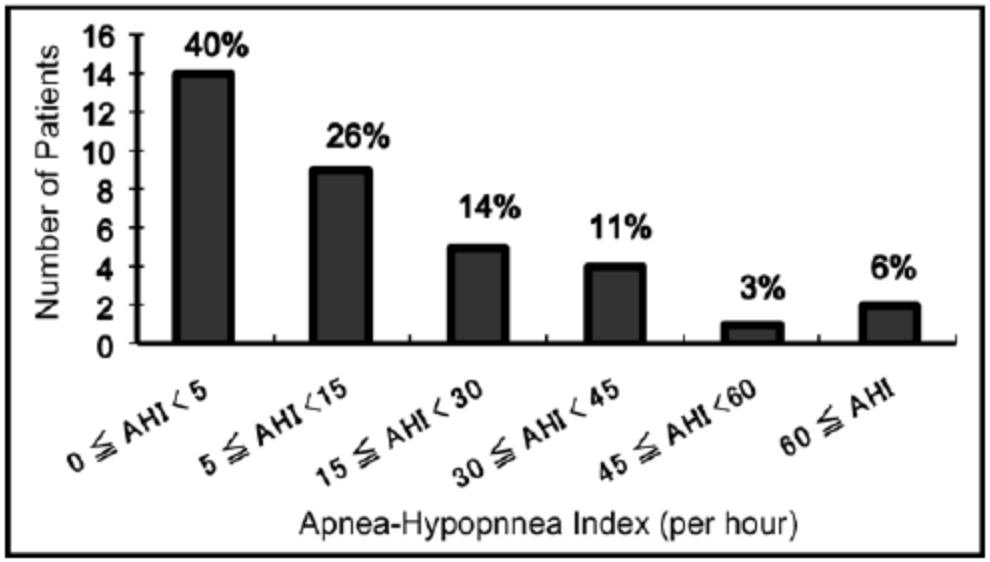
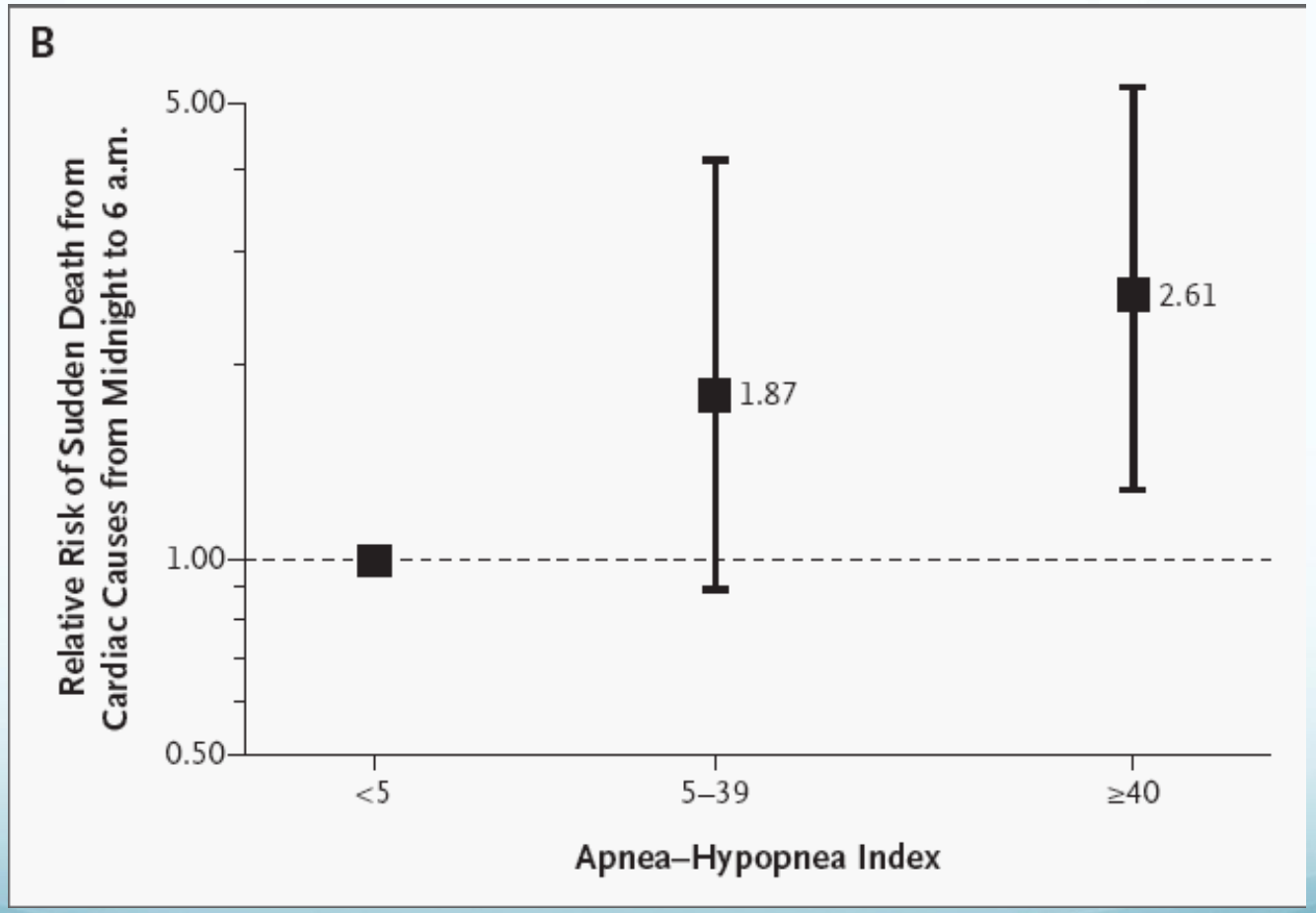


Figure 1. Frequency distribution of AHI in 5/hour- to 15/hour-unit intervals in 35 patients with ventricular arrhythmias. Fourteen patients (40%) showed no evidence of SDB, whereas 21 patients (60%) had SDB with AHIs ≥5/hour.

Day–Night Pattern of Sudden Death in Obstructive Sleep Apnea

Apoor S. Gami, M.D., Daniel E. Howard, B.S., Eric J. Olson, M.D., and Virend K. Somers, M.D., Ph.D.



High Prevalence of Sleep Apnea Syndrome in Patients With Long-Term Pacing

The European Multicenter Polysomnographic Study

Stéphane Garrigue, MD, PhD*; Jean-Louis Pépin, MD, PhD*; Pascal Defaye, MD; Francis Murgatroyd, MD; Yann Poezevara, MS; Jacques Clémenty, MD; Patrick Lévy, MD, PhD

Circulation 2007;115;1703-1709;

TABLE 2. Polysomnographic Data

Variables	Sinus Node Dysfunction (n=36; 37%)	AV Block (n=33; 34%)	Heart Failure (n=29; 29%)
Pacing characteristics			
Nocturnal heart rate, bpm	57±6	66±9	61±6
Atrial pacing, %	20±9	16±7	15±8
Ventricular pacing, %	15±12	97±4*	0*
Sleep parameters			
Total sleep time, min	420±69	350±71	408±67
Sleep time with Sao_2 <90%, %	4.8±9.1	5.3±11.1	4.5±7.2
Arousal index No./h of sleep	22±15	18±27	7±6*
SAS prevalence			
Apnea index/h of sleep	7±11	7±10	6±5
AHI/h of sleep	19±23	24±29	11±7
10≤AHI<15, %	14	18	10
15≤AHI<30, %	17	23	35
AHI ≥30, %	27	27	5*
SAS, %	58	68	50
OSA, % total sleep respiratory events	13±17	15±19	19±23
CSA, % total sleep respiratory events	8±7	7±9	8±12
Hypopnea, % total sleep respiratory events	79±17	78±19	73±25

Values are represented as mean±SD where appropriate.
*P<0.01 by ANOVA.

SSS and OSA

Prevalence of Obstructive Sleep Apnea Syndrome in Patients With Sick Sinus Syndrome

Julio Martí Almor,[a] Miguel Félez Flor,[b] Eva Balcells,[b] Mercedes Cladellas,[a] Joan Broquetas,[b] and Jordi Bruguera[a]

Rev Esp Cardiol. 2006;59(1):28-32

TABLE 1. **Population Characteristics (n=38)***

Age, years, mean±SD	66.6±10
Proportion of men, n (%)	26 (68.4)
BMI, mean±SD	28±4
Overweight patients (BMI=25-29), n (%)	14 (36.8)
Obese patients (BMI>30), n (%)	13 (34.2)
Hypertension (SBP≥140 or DBP≥90 mm Hg), n (%)	22 (57.9)
Epworth sleepiness scale, mean±SD	8.0±3.8
Chronic excessive sleepiness (ESS≥9), n (%)	15 (39.5)

SD indicates standard deviation; ESS, Epworth sleepiness scale; BMI, body mass index; DBP, diastolic blood pressure; SBP, systolic blood pressure.

TABLE 3. **Results of the Polysomnographic Study***

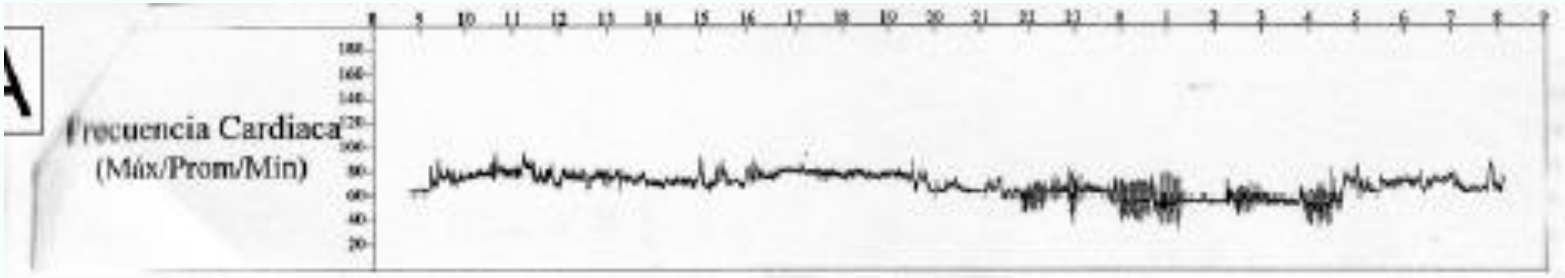
Nocturnal Respiratory Disorder (n=38)	Mean±SD	95% CI
AHI	24.9±15.4	20.07-30.33
Obstructive apneas	13.7±11.6	9.89-17.51
Hypopneas	10.8±9.0	7.84-13.76
Central apneas	0.4±0.8	0.14-0.66
Stratification by AHI (n=38)		
Normal (AHI<9.9)	5 (13.2)	0.024-0.239
Mild (AHI, 10-19.9)	12 (31.5)	0.168-0.464
Moderate (AHI, 20-29.9)	9 (23.7)	0.102-0.372
Severe (AHI>30)	12 (31.6)	0.168-0.464
CT90% (n=38)	5.6 ±13	1.33-9.87
Proportion of patients with SAHS (AHI>10+ESS≥9)	12 (31.6%)	16.8-46.4

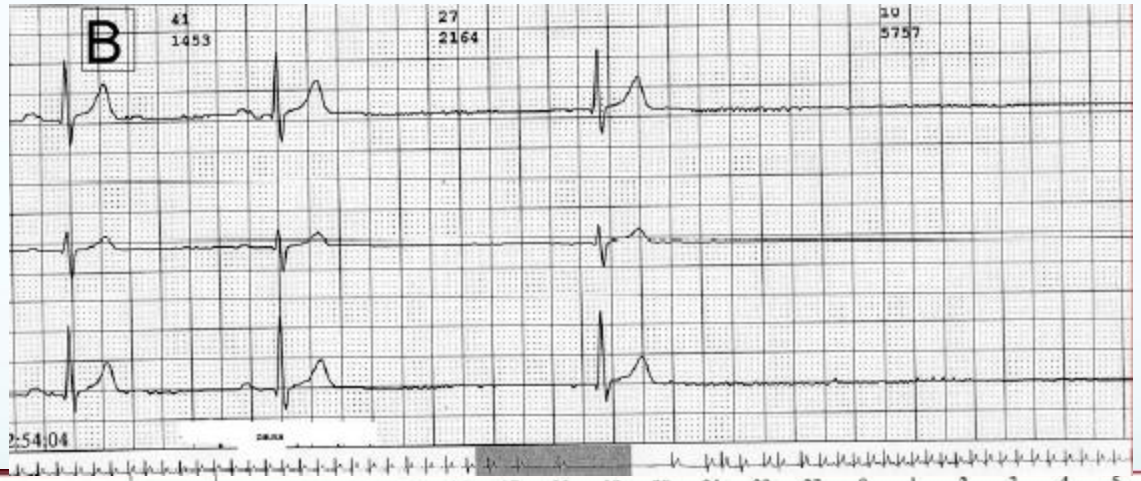
*SD indicates standard deviation; ESS, Epworth sleepiness scale; CI, confidence interval; AHI, apnea-hypopnea index (per hour); $CT_{90\%}$, mean percentage time with oxygen saturation <90%.

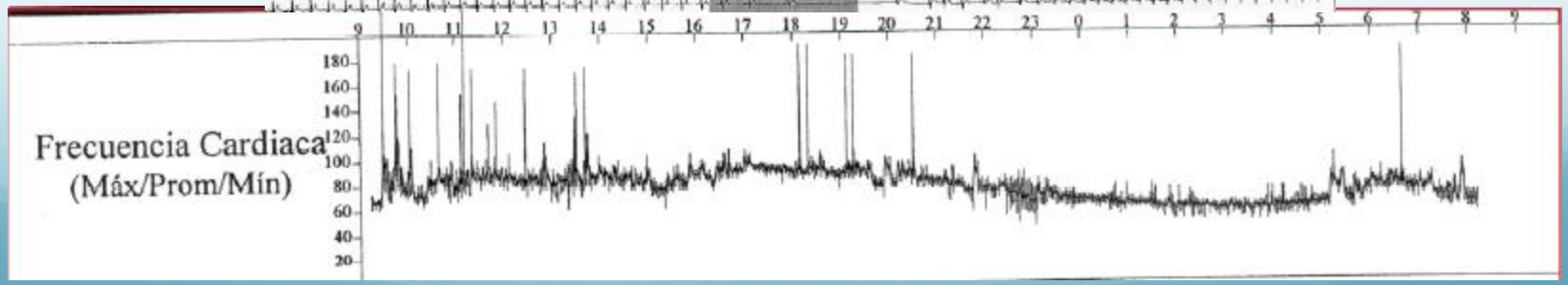
Regression of Sick Sinus Syndrome After Treatment of Sleep Apnea Syndrome

Julio Martí-Almor[a], Miguel Félez-Flor[b] y Jorge Bruguera-Cortada[a]

Rev Esp Cardiol. 2007;60(2)



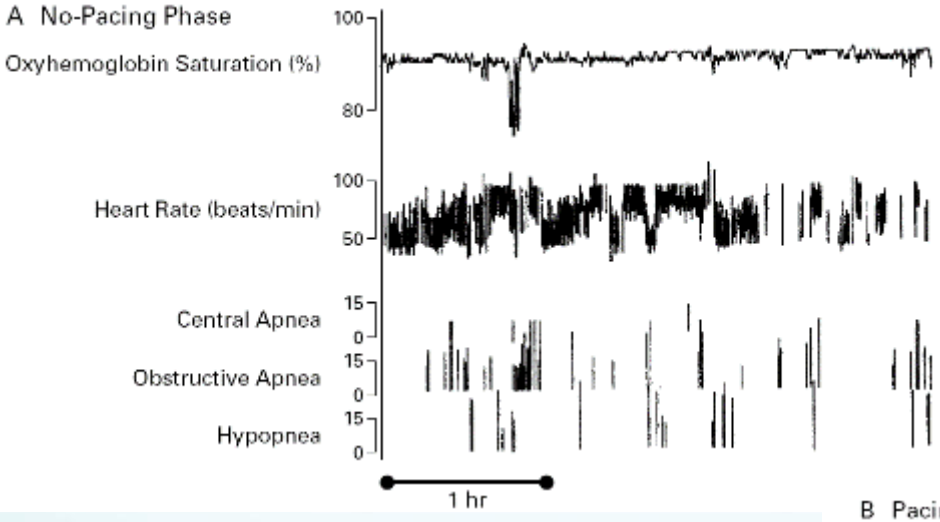


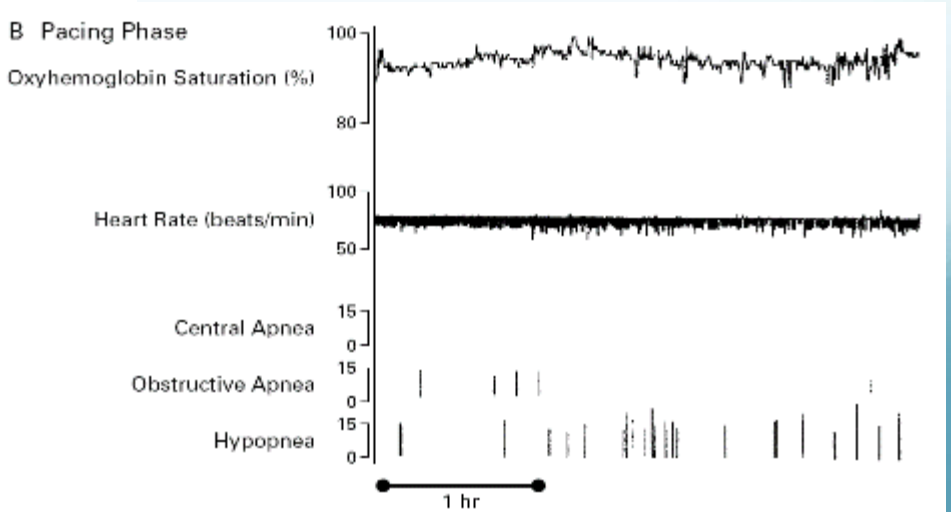


Pacing and SAS

BENEFIT OF ATRIAL PACING IN SLEEP APNEA SYNDROME

STEPHANE GARRIGUE, M.D., PHILIPPE BORDIER, M.D., PIERRE JAÏS, M.D., DIPEN C. SHAH, M.D., MELEZE HOCINI, M.D., CHANTAL RAHERISSON, M.D., MANUEL TUNON DE LARA, M.D., MICHEL HAÏSSAGUERRE, M.D., AND JACQUES CLEMENTY, M.D.

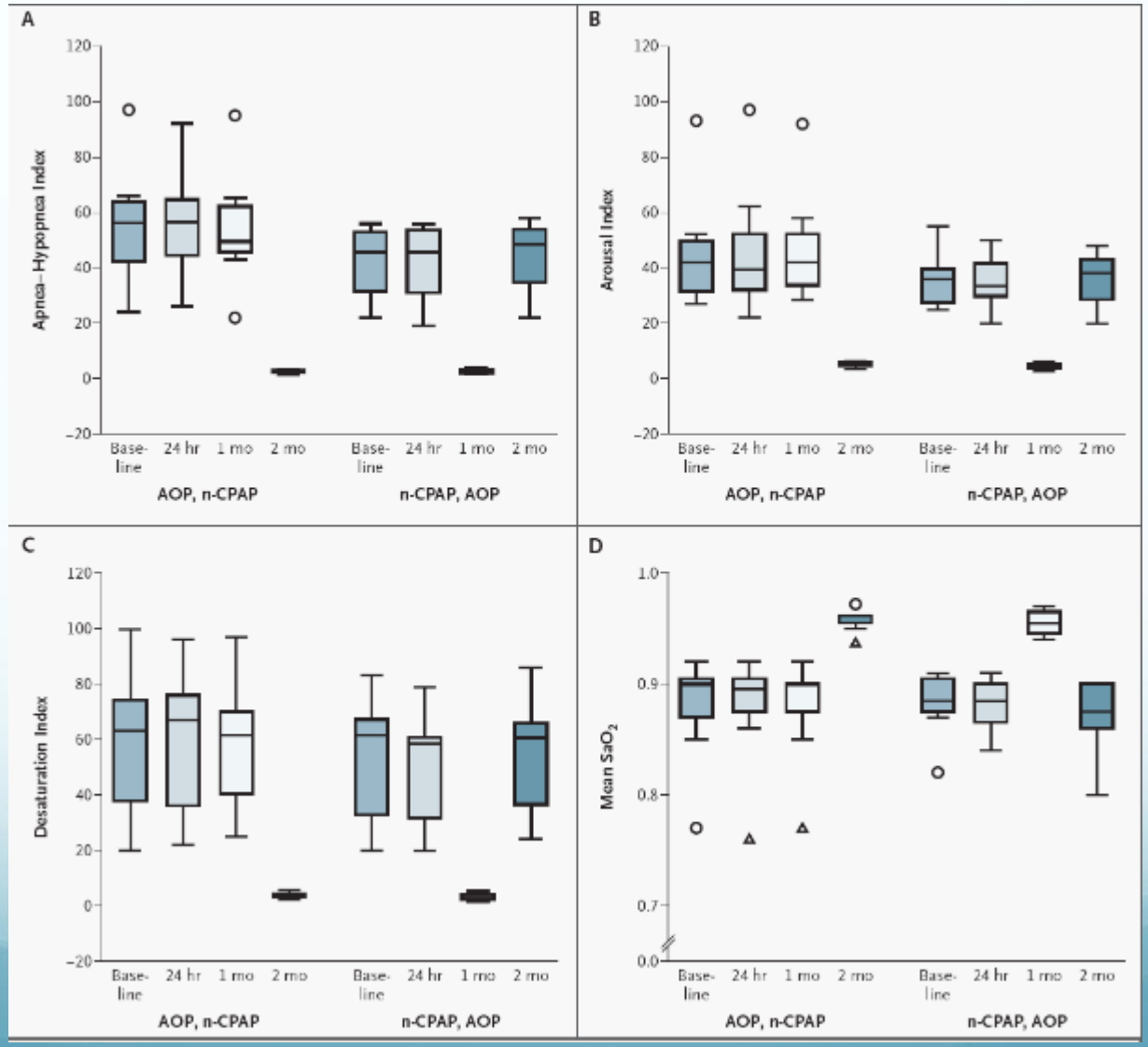




N Engl J Med, Vol. 346, No. 6 · February 7, 20

Atrial Overdrive Pacing for the Obstructive Sleep Apnea–Hypopnea Syndrome

Emmanuel N. Simantirakis, M.D., Sophia E. Schiza, M.D., Stavros I. Chrysostomakis, M.D., Gregory I. Chlouverakis, Ph.D., Nikolaos C. Klapsinos, M.D., Nikolaos M. Siafakas, M.D., Ph.D., and Panos E. Vardas, M.D., Ph.D.



Cardiac resynchronization therapy for the treatment of sleep apnoea: a meta-analysis

Jasmine Lamba[1], Christopher S. Simpson[1,2], Damian P. Redfearn[1,2], Kevin A. Michael[1,2], Michael Fitzpatrick[1,2], and Adrian Baranchuk[1,2]*

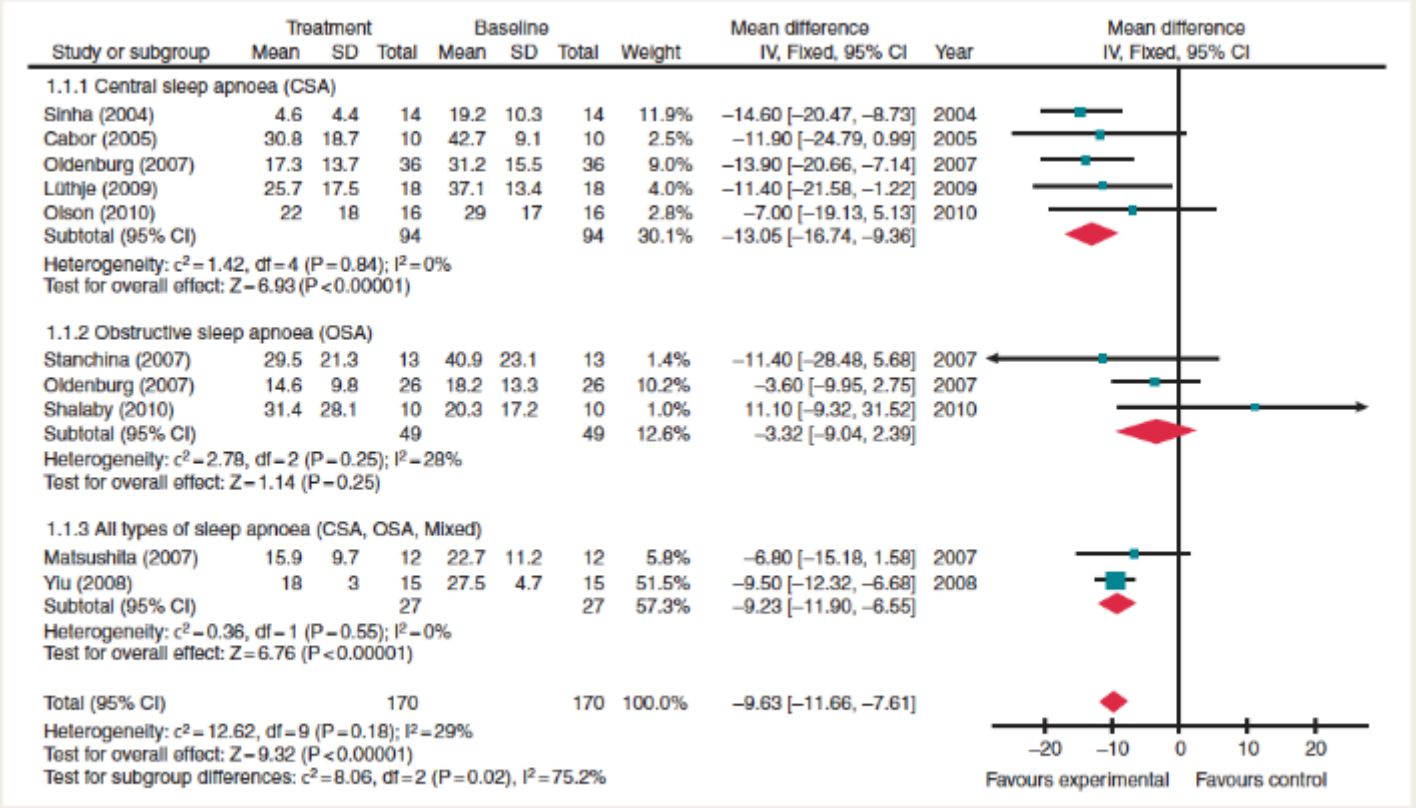


Figure 2 Reduction of sleep apnoea parameters with the use of cardiac resynchronization therapy. CI, confidence intervals; IV, inverse variance; SD, standard deviation.

Table 2 Studies that included a cardiac resynchronization therapy + atrial overdrive pacing arm

Study	Predominant type of SA	Baseline (AHI)	CRT (AHI)	CRT + AOP (AHI)	*P* value[a]
Lüthje *et al.*[14]	CSA	37.1 ± 13.4	25.7 ± 17.5	23.7 ± 17.9	0.07
Shalaby *et al.*[26]	OSA	20.3 ± 17.2[b]	31.4 ± 28.1	17.5 ± 28.8	NS
		22.9 ± 13.9[c]			

Europace (2011) 13, 1174–1179

Utilidad del sensor de apnea de sueño

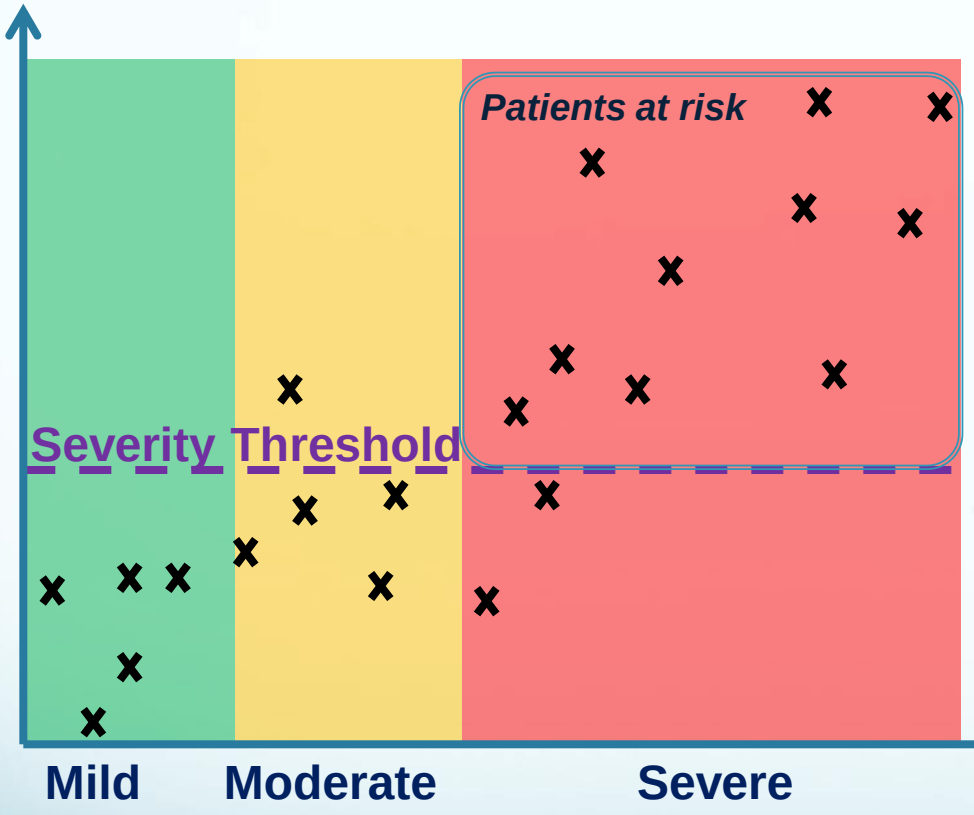
- El sensor V/M de los que dispone el modelo REPLY 200 fue testado en el estudio DREAM
- Existe una excelente correlación entre el RDI (respiratory disturbance Index) y el IAH
- La prevalencia de SAS en el estudio DREAM fue del 75%, en pacientes de una edad media de 73.7 años con 72% de varones, IMC de 28, con indicación de PM del 69% por BAV y 22% por DS y el resto mixto.

A pacemaker transthoracic impedance sensor with an advanced algorithm to identify severe sleep apnea: The DREAM European study

Heart Rhythm, Vol 11, No 5, Month 2014

Pascal Defaye, MD,[*] Ines de la Cruz, MD,[†] Julio Martí-Almor, MD, PhD,[‡]
Roger Villuendas, MD,[§] Paul Bru, MD,[‖] Jérémie Sénéchal, MSc,[¶]
Renaud Tamisier, MD, PhD,[#**] Jean-Louis Pépin, MD, PhD[#**]

DREAM RESULTS



DREAM key learnings

- Good correlation between polysomnography and SAM measurements
- Reply 200 has a good screening capability for severe SAS patients
- DREAM data will allow us to set Severity Threshold to get the best possible Sensitivity and Specificity

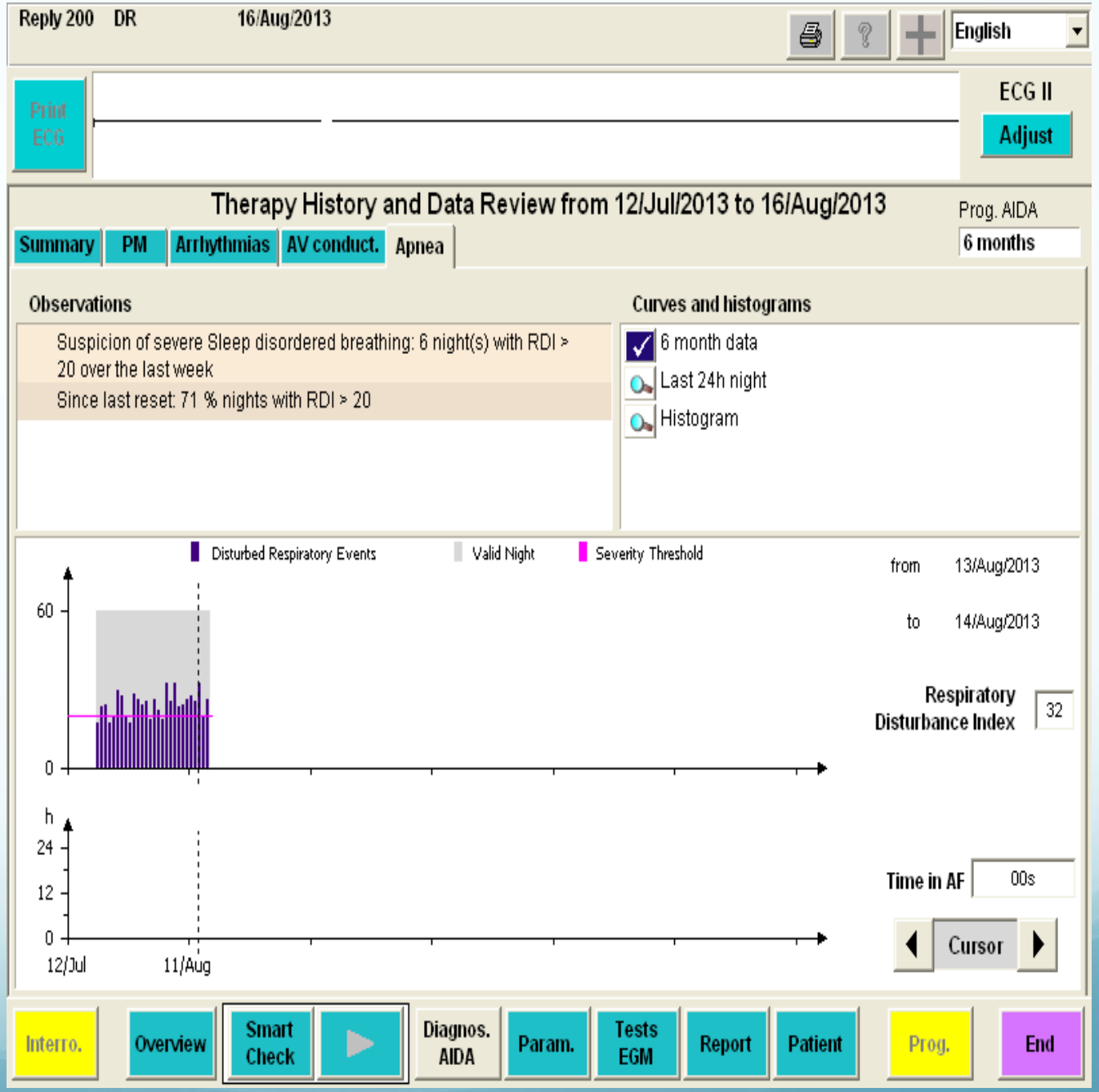
each cross ✗)rresponds to a patient

RDI 20	Sensitivity	Specificity	PPV	NPV
	88.9%	84.6%	88.9%	84.6%

Patient implanted on July, 12th.

SAM activation on July, 19th at first FU.

Second FU with SAM data stored, on August, 16th.



Results from PSG on August 16th

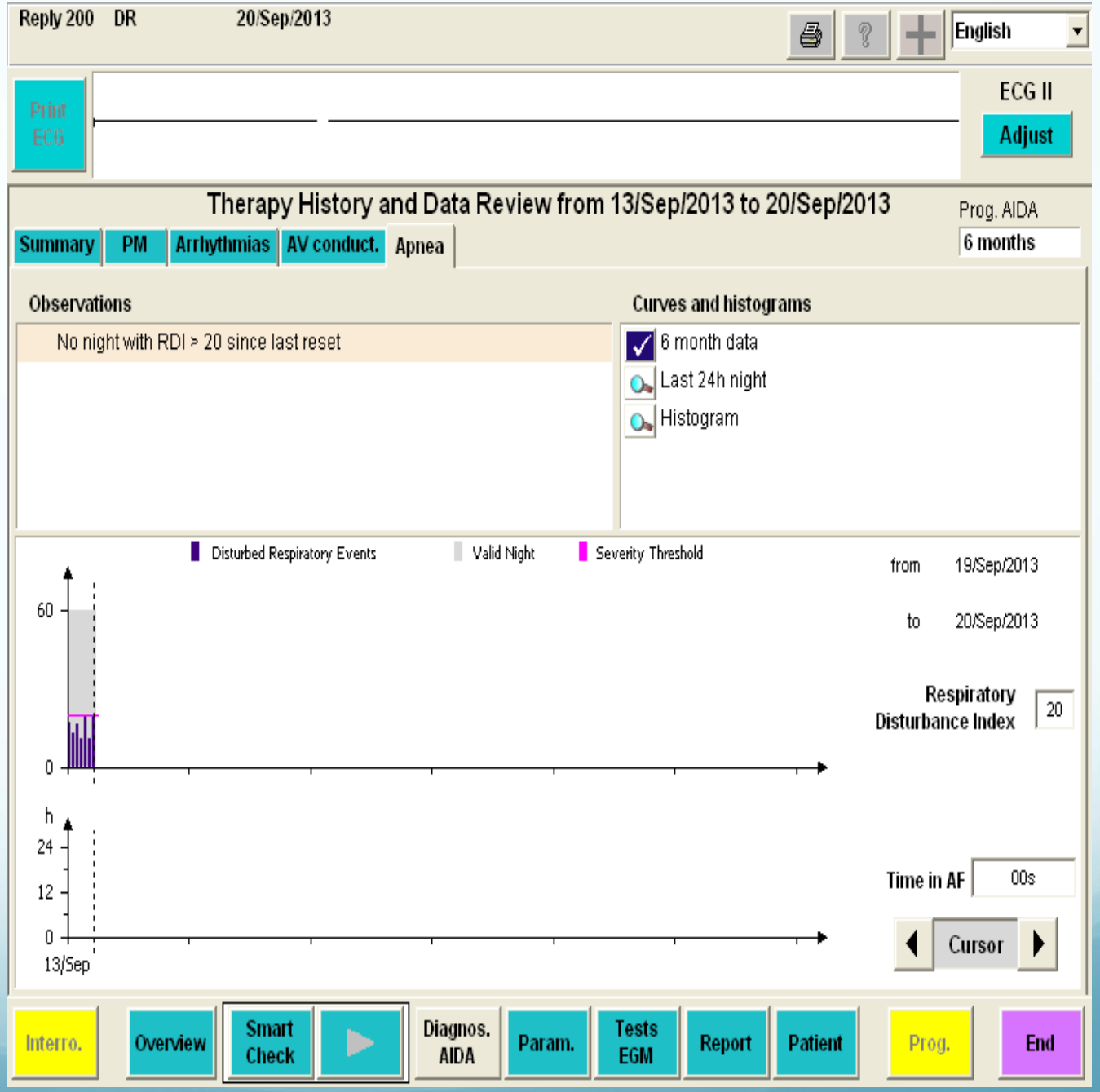
Sleep Summary

Apnea/Hypopnea

Index Time:	450,9 minutes	
Apnea + Hypopnea (A+H):	258	34,3 / h
Supine A+H:	28	29,4 / h
Non-Supine A+H:	230	35,0 / h

CPAP started on September, 3th

Fifth FU on September, 20th.



DREAM Conclusiones

- La monitorizacion de la apnea del sueño con MCP puede detectar pacientes con SAS severo
- Existe una excelente correlacion entre el sensor de apnea del sueño del marcapasos y la polisomnografia
- La monitorización de la apnea del sueño con MCP permite tener información diaria de la evolución del paciente (hace bien la CPAP?)

Que realidad tenemos?

- La lista de espera para una PSG es 1-2 años
- El sensor V/M correlaciona con PSG
- Podría el electrofisiólogo indicar CPAP y/o titularla?

Que utilidad practica tiene conocer que hay apneas?

- La presencia de apneas del sueño están relacionadas con peor pronostico cardiovascular.
- En portadores de marcapasos, especialmente bicamerales, pueden correlacionar con la presencia de arritmias auriculares

REgistry of Sleep Apnea monitoring and Atrial Fibrillation in pacemakeR patients RESPIRE

- Objetivos:
  - Evaluate at 12 Months follow-up the association between Atrial Fibrillation (AF) and Sleep Apnea (SA) severity based on data measured and stored in the pacemaker
  - Collect all major serious adverse events as reported by the investigator during the duration of the study corresponding to death, myocardial infarction, stroke and re-intervention.

Rationale for RESPIRE

- La FA no valvular esta ligada a un riesgo mayor de AVC.
- La estratificación del riesgo de embolia se hace en función de la escala CHADSVASC.
- Podria ser el SAHS un nuevo acronimo en esta estratificación de riesgo?
- La regla de las 48 h es falsa. Estudios como el ASSERT demuestran que episodios muy cortos de FA aumentan de forma importante el riesgo de AVC

Table I.

Selected Studies Evaluating the Correlation of AF Burden and Stroke or Systemic Embolism

Author (Year)	Patients (n)	Study Type/ Inclusion Criteria	Monitoring Method/Duration	Outcome
Glotzer et al. (2003)[14]	312	Ancillary analysis of multicenter RCT (MOST)	Dual-chamber PPM for a median of 27 months	• 10 patients (3.2%) developed stroke • Atrial arrhythmia ≥5 minutes: HR 2.8, P = 0.0011 for death or nonfatal stroke
Capucci et al. (2005)[8]	725	Prospective, registry study	Dual-chamber PPM for a median of 22 months	• 14 patients (1.9%) had an arterial thromboembolic event • AF episode lasting >24 hours: HR_{adj} 3.1, P = 0.044 for embolic events • No AF episodes or AF 5 minutes to 24 hours: no difference in embolic events
Glotzer et al. (2009)[9]	2,486	Prospective, observational study (TRENDS)	Dual-chamber PPM or ICD for a mean of 1.4 years	• Daily AT/AF burden <5.5 hours: no difference in rate of thromboembolism compared to no AT/AF (both with 1.1% annual rate) • Daily AT/AF burden ≥5.5 hours: trend toward higher annual rate of thromboembolism (2.2%) compared to no AT/AF, but not statistically significant (P = 0.06) • 30-day cumulative AT/AF burden <10.8 hours: no difference in rate of thromboembolism compared to no AT/AF group (P = 0.96) • 30-day cumulative AT/AF burden ≥10.8 hours: trend toward increased risk of thromboembolism (HR_{adj} 2.2, P = 0.06) compared to no AT/AF
Healey et al. (2012)[10]	2,580	Primary analysis of a multicenter RCT (ASSERT)	Dual-chamber PPM or ICD for a mean of 2.5 years	• Atrial tachyarrhythmia >6 minutes: HR 1.76, P = 0.05 for stroke or systemic embolism compared to patients with no arrhythmia • Atrial tachyarrhythmia <17.7 hours: annual rate of stroke or systemic embolism 1.2% • Atrial tachyarrhythmia >17.7 hours: annual rate of stroke or systemic embolism 4.9%
Shanmugam et al. (2012)[13]	560	Ancillary analysis from two prospective multicenter observational studies of CHF patients with CRT	CRT device for a mean of 1 year	• 11 patients (2%) had a thromboembolic events • Atrial tacharrhythmia ≥3.8 hours a day: HR 9.4; P = 0.006 for stroke or systemic embolism compared to patients with no arrhythmia • No significant increase risk of thromboembolic events in patients with ≥3.8 hours a day versus <3.8 hours a day: HR 2.4; P = 0.23

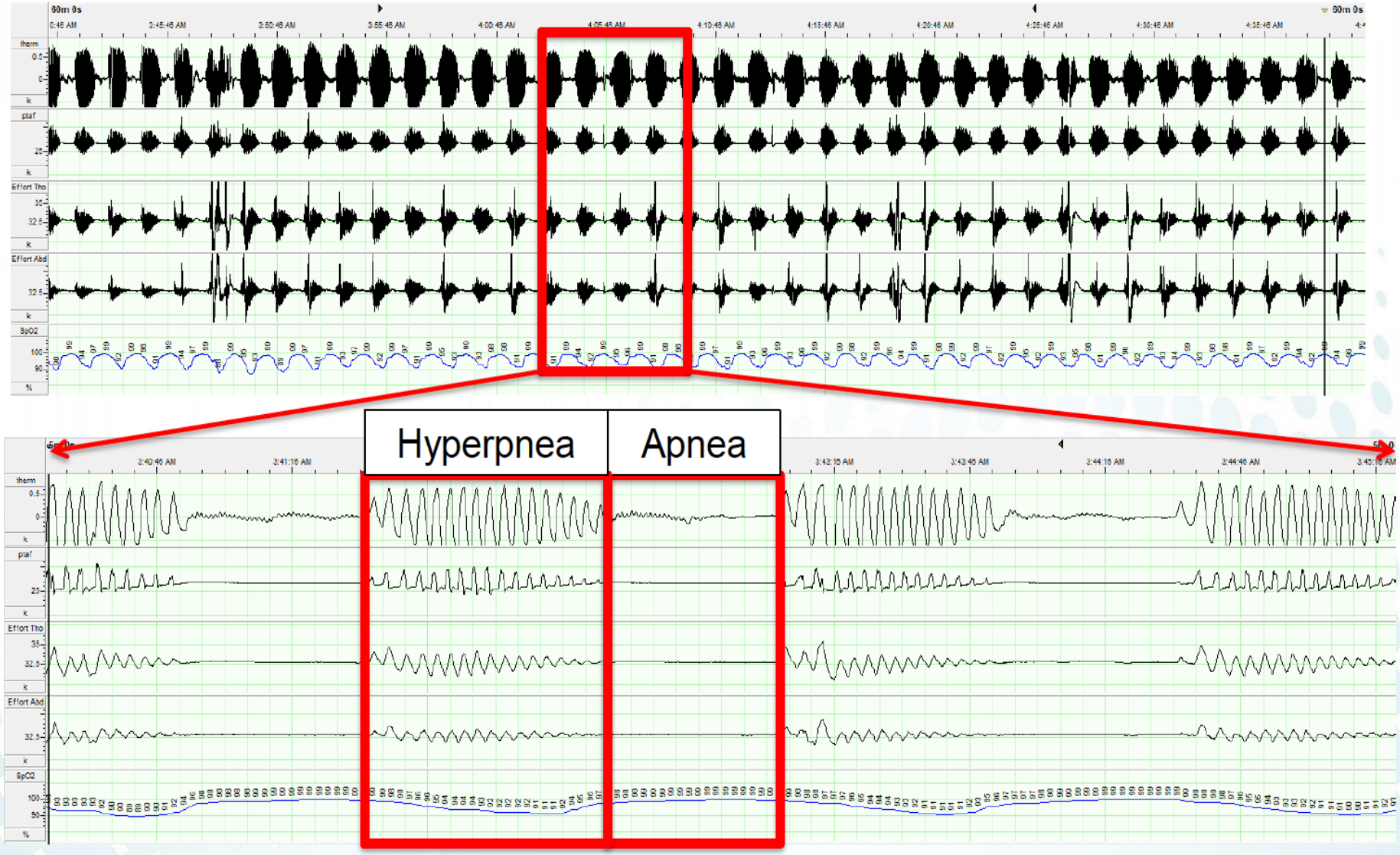
AHRE = atrial high rate episode; AF = atrial fibrillation; AT = atrial tachycardia; CHF = congestive heart failure; CRT = cardiac resynchronization therapy; HR_{adj} = adjusted hazard ratio; ICD = implantable cardioverter defibrillator; PPM = permanent pacemaker; RCT = randomized control trial.

Conclusiones

- El SAS aumenta la morbilidad y mortalidad cardiovascular.
- El SAS esta claramente relacionado con un aumento de las arritmias auriculares potencialmente emboligenas
- Disponer de monitorización continua de apnea del sueño es un plus muy importante.
- Poder correlacionar la severidad del SAS con el aumento de la FA y con el aumento de la incidencia de stroke, puede hacer que la detección de SAS sea un nuevo elemento a añadir a la escala CHADSVASC

Apnea central

- El problema es central: El centro respiratorio se inhibe y no envia la señal para mover el diafragma.
- Causas:
  - Idiopatica
  - Ligada a insuficiencia cardiaca
  - Ligada a toma de neurolepticos
  - Por enfermedad del propio SNC (AVC)

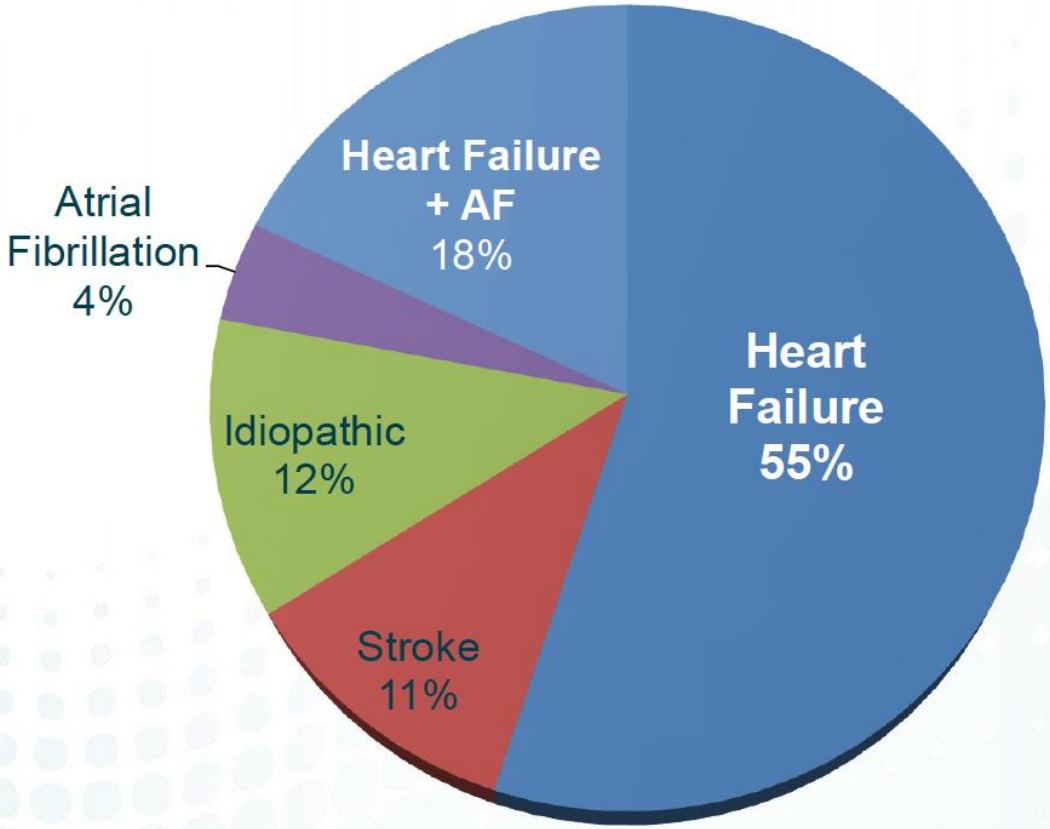


- Apneas of similar lengths
- Crescendo and decrescendo pattern

Respicardia
Improving Heart Health™

CR1060_A

Etiología



Javaheri and Dempsey, Comprehensive Physiology 2013;3:141-163
Dymedex, 2014.

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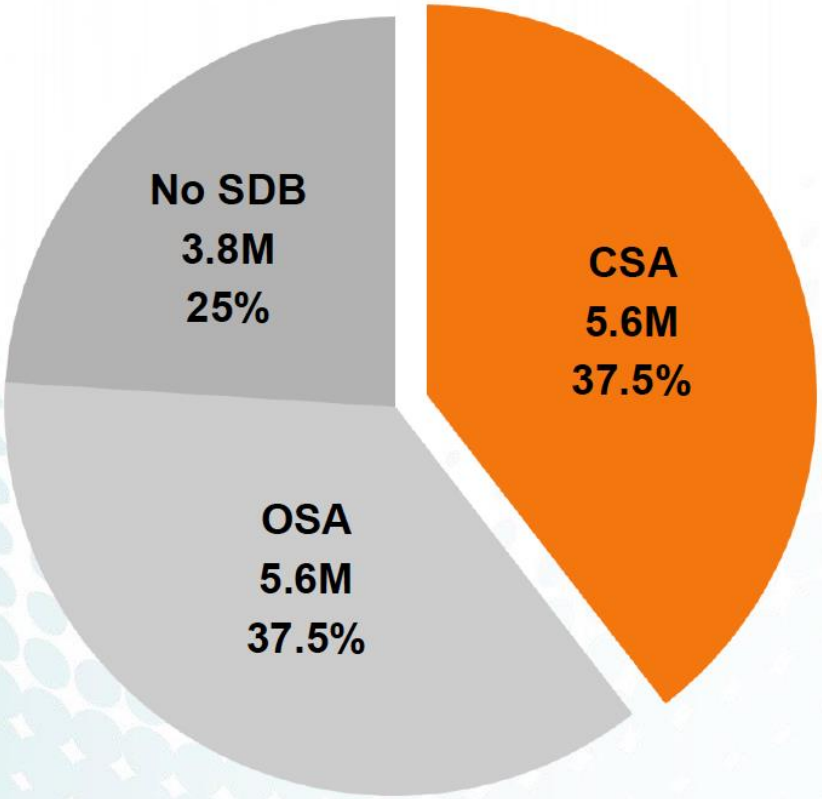
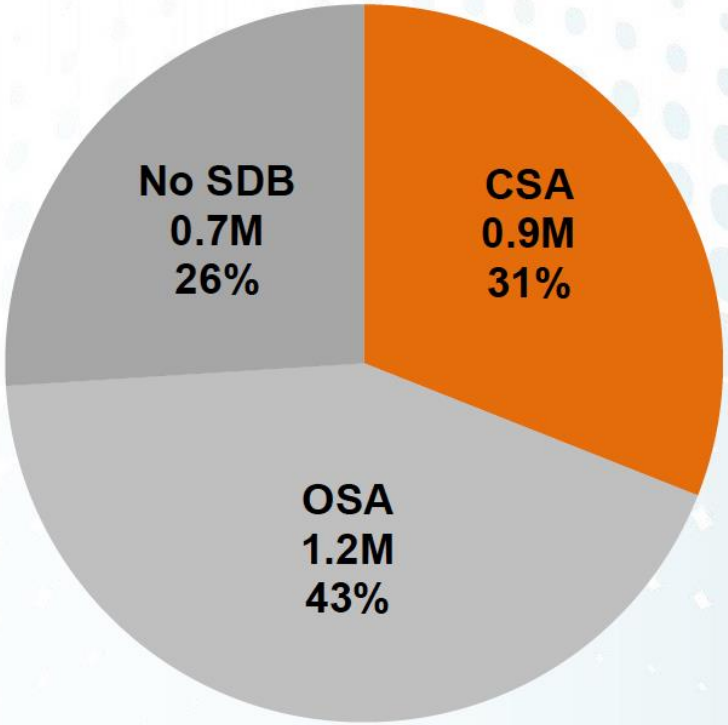
European Heart Failure Population
15.0 Million



Dickstein et al. Eur J Heart Fail;2008;29:2388-2442
Oldenburg et al. Eur J Heart Fail;20079:251-7

European Atrial Fibrillation Population
2.8 Million



Bitter et al. Dtsch Arztebl Int 2009;106:164–70

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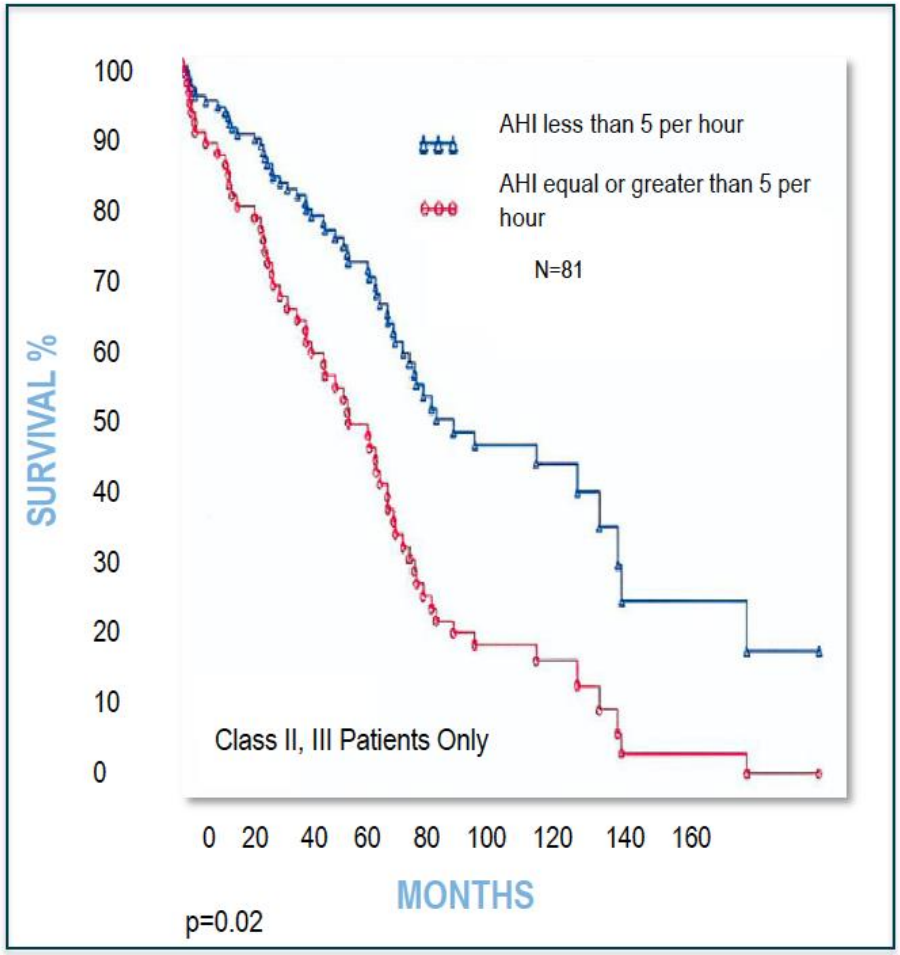
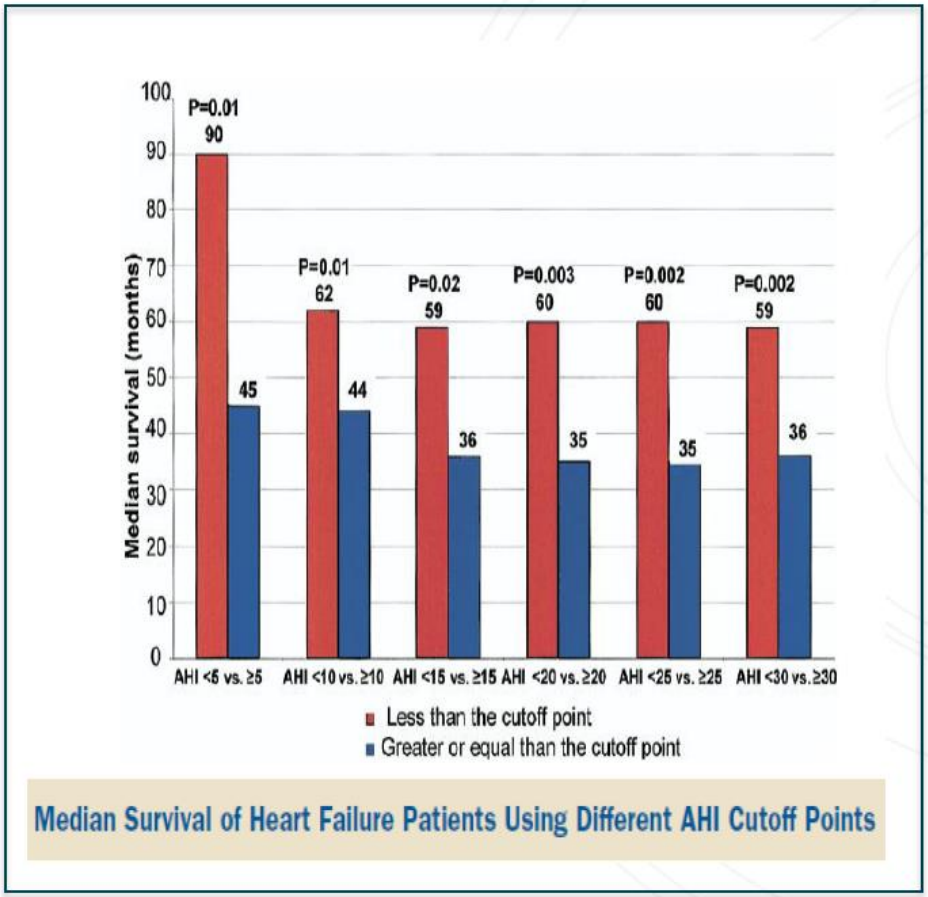
Características clínicas

- Pacientes con IC y /o FA
- No da somnolencia ni otros síntomas
- Se suele asociar a peor pronostico
- Se debe sospechar en pacientes varones, > 60 años, obesos, etc..
- DIAGNOSTICO: PSG, o Holter respiratorio de 6 canales

Central Sleep Apnea Significantly Increases Mortality in Heart Failure Patients





Median Survival of Heart Failure Patients Using Different AHI Cutoff Points

Javaheri, et. al.: JACC 49(20):2028-34, 2007

Tratemos la SACS!!!!

- Tratemos la causa mas frecuente: IC
  - TMO y/o TRC

Otras alternativas

- CPAP
- Servoventilacion adaptativa
- Ventilacion con CO_2

Cardiac resynchronization therapy for the treatment of sleep apnoea: a meta-analysis

Jasmine Lamba[1], Christopher S. Simpson[1,2], Damian P. Redfearn[1,2], Kevin A. Michael[1,2], Michael Fitzpatrick[1,2], and Adrian Baranchuk[1,2]*

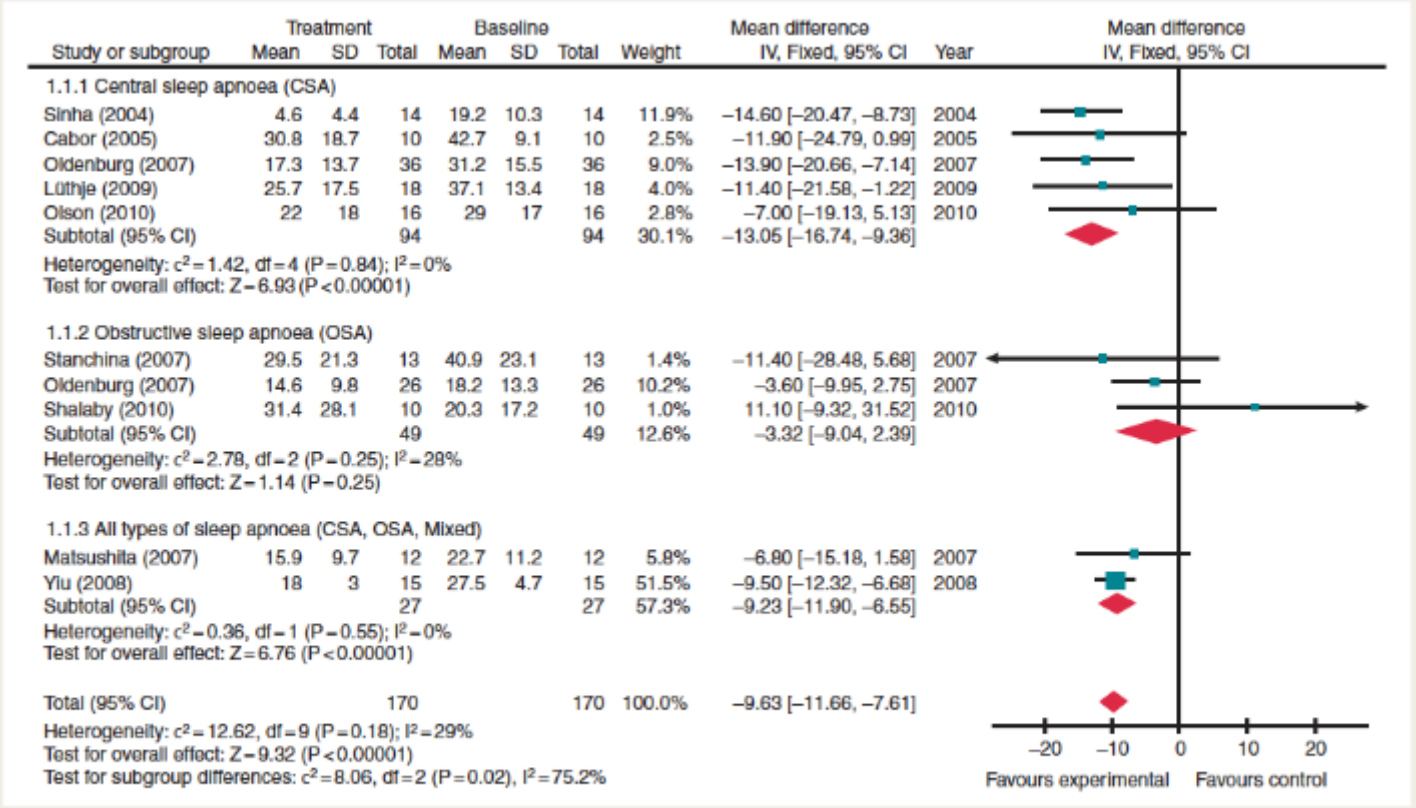


Figure 2 Reduction of sleep apnoea parameters with the use of cardiac resynchronization therapy. CI, confidence intervals; IV, inverse variance; SD, standard deviation.

Table 2 Studies that included a cardiac resynchronization therapy + atrial overdrive pacing arm

Study	Predominant type of SA	Baseline (AHI)	CRT (AHI)	CRT + AOP (AHI)	*P* value[a]
Lüthje *et al.*[14]	CSA	37.1 ± 13.4	25.7 ± 17.5	23.7 ± 17.9	0.07
Shalaby *et al.*[26]	OSA	20.3 ± 17.2[b]	31.4 ± 28.1	17.5 ± 28.8	NS
		22.9 ± 13.9[c]			

Europace (2011) 13, 1174–1179

Tratamiento ventilatorio

- CPAP Asegura una EPAP
  - CANPAP: 258 pacientes con IC randomizados a CPAP o no CPAP. No hubo diferencias en la supervivencia. El estudio fue detenido prematuramente. En un analisis post hoc parecia existir una mejor supervivencia en los pacientes en los que se disminuia el AHÍ por debajo de 15.
- Servoventiladores adaptativos (Asegura una EPAP y una IPAP)
  - Estudio SERVE-HF: La gran esperanza!!

Adaptive Servo-Ventilation for Central Sleep Apnea in Systolic Heart Failure

Martin R. Cowie, M.D., Holger Woehrle, M.D., Karl Wegscheider, Ph.D., Christiane Angermann, M.D., Marie-Pia d'Ortho, M.D., Ph.D., Erland Erdmann, M.D., Patrick Levy, M.D., Ph.D., Anita K. Simonds, M.D., Virend K. Somers, M.D., Ph.D., Faiez Zannad, M.D., Ph.D., and Helmut Teschler, M.D.

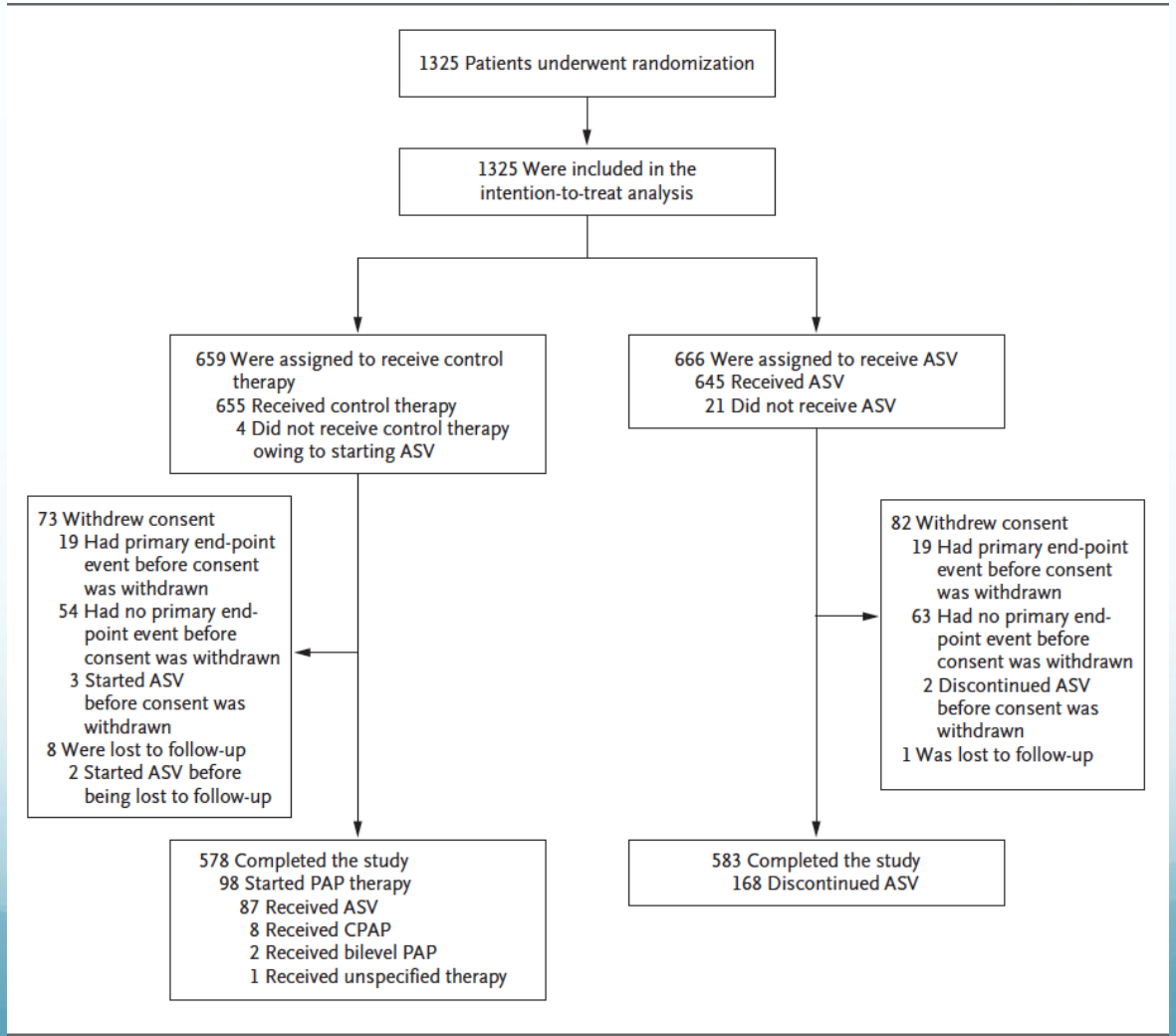


Table 1. Demographic and Clinical Characteristics of the Patients at Baseline.*

Characteristic	Control (N=659)	Adaptive Servo-Ventilation (N=666)
Age — yr	69.3±10.4	69.6±9.5
Male sex — no. (%)	599 (90.9)	599 (89.9)
Body weight — kg	86.1±17.5	85.6±15.8
Body-mass index†	28.6±5.1	28.4±4.7
NYHA class — no./total no. (%)		
II	194/654 (29.7)	195/662 (29.5)
III	454/654 (69.4)	456/662 (68.9)
IV	6/654 (0.9)	11/662 (1.7)
Left ventricular ejection fraction — %‡		
Mean	32.5±8.0	32.2±7.9
Range	9.0–71.0	10.0–54.0
Diabetes mellitus — no./total no. (%)	252/653 (38.6)	254/660 (38.5)
Cause of heart failure — no./total no. (%)		
Ischemic	366/642 (57.0)	390/653 (59.7)
Nonischemic	276/642 (43.0)	263/653 (40.3)
Blood pressure — mm Hg		
Systolic	122.1±19.6	122.3±19.0
Diastolic	73.3±11.5	73.7±11.3
Electrocardiographic finding — no./total no. (%)		
Left bundle-branch block§	65/295 (22.0)	79/304 (26.0)
Sinus rhythm	395/646 (61.1)	372/650 (57.2)
Atrial fibrillation	147/646 (22.8)	178/650 (27.4)
Other	104/646 (16.1)	100/650 (15.4)

Table 1. Demographic and Clinical Characteristics of the Patients at Baseline.*

Characteristic	Control (N=659)	Adaptive Servo-Ventilation (N=666)
Implanted device — no. (%)	364 (55.2)	362 (54.4)
No device	295 (44.8)	304 (45.6)
Non-CRT pacemaker	29 (4.4)	32 (4.8)
ICD	161 (24.4)	163 (24.5)
CRT-P	21 (3.2)	14 (2.1)
CRT-D	153 (23.2)	153 (23.0)
Hemoglobin — g/dl	13.9±1.5	13.8±1.6
Creatinine — mg/dl¶	1.4±0.6	1.4±0.6
Estimated GFR — ml/min/1.73 m^2	59.3±20.8	57.8±21.1
6-Min walk distance — m	337.9±127.5	334.0±126.4
Concomitant cardiac medication — no./total no. (%)		
ACE inhibitor or ARB	603/659 (91.5)	613/666 (92.0)
Beta-blocker	611/659 (92.7)	612/666 (91.9)
Aldosterone antagonist	325/659 (49.3)	316/666 (47.4)
Diuretic	561/659 (85.1)	561/666 (84.2)
Cardiac glycoside	124/657 (18.9)	149/666 (22.4)
Antiarrhythmic drug	89/659 (13.5)	128/666 (19.2)

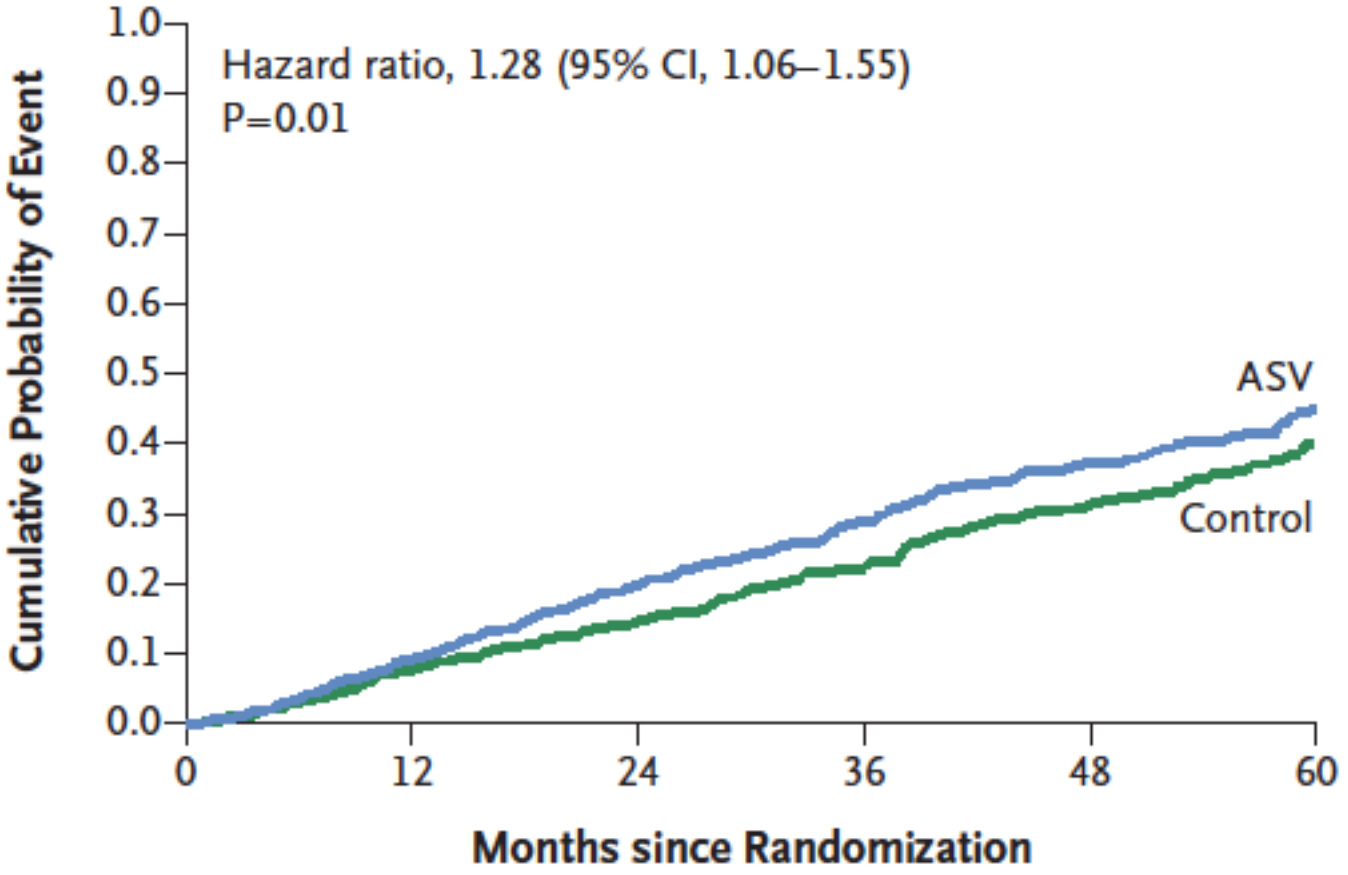
Table 2. Respiratory Characteristics at Baseline.*

Characteristic	Control (N = 659)	Adaptive Servo-Ventilation (N = 666)
Epworth Sleepiness Scale score†	7.1±4.6	7.0±4.3
AHI — no. of events/hr	31.7±13.2	31.2±12.7
Central apnea index/total AHI — %	46.5±30.0	44.6±28.9
Central AHI/total AHI — %	81.8±15.7	80.8±15.5
Oxygen desaturation index — no. of events/hr‡	32.8±19.0	32.1±17.7
Oxygen saturation — %		
Mean	92.8±2.5	92.8±2.3
Minimum	80.3±7.5	80.7±7.0
Time with oxygen saturation <90% — min	55.7±73.9	50.5±68.2

Table 3. Incidence of End-Point Events.*

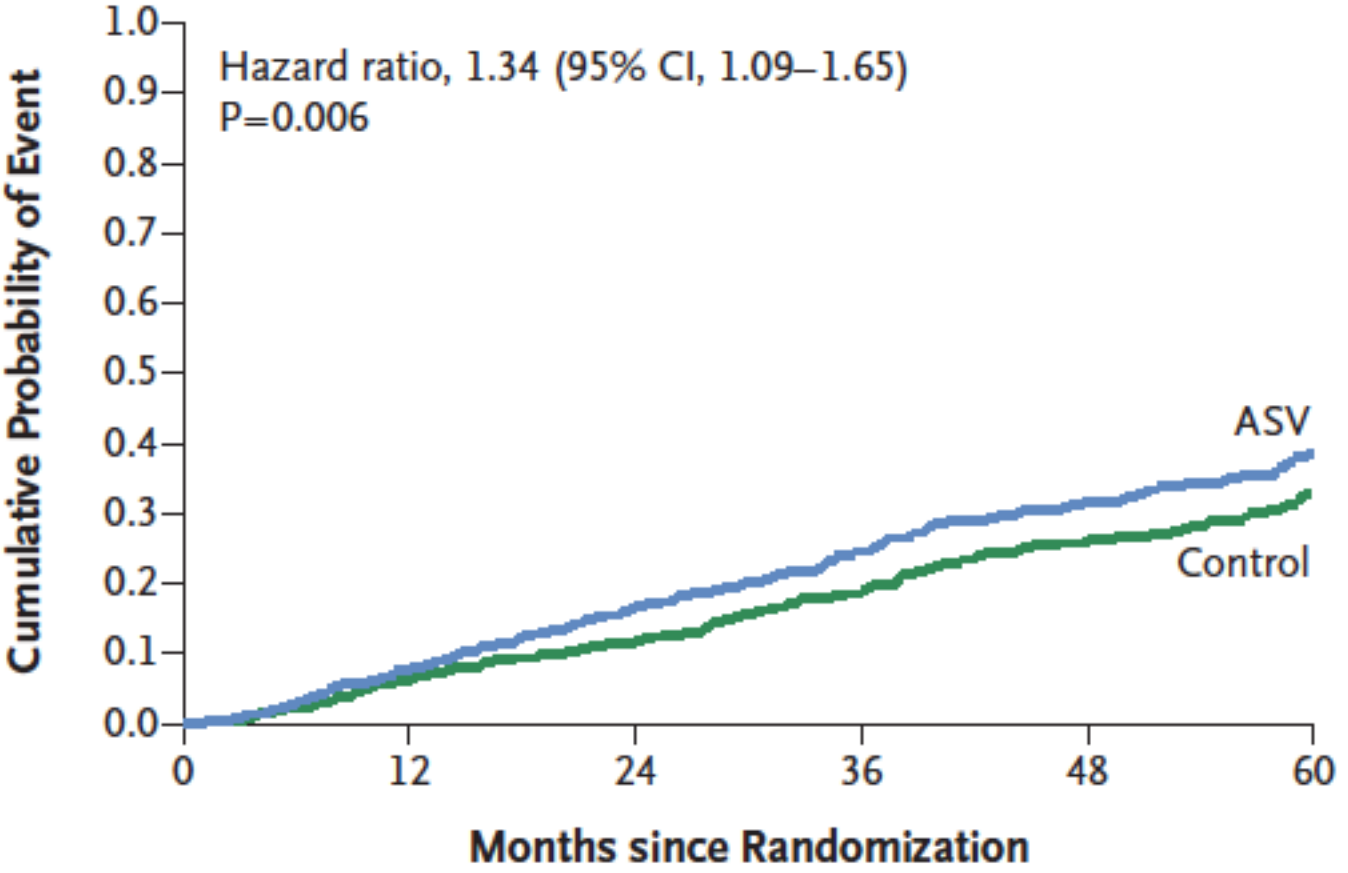
Event	Control (N=659)		Adaptive Servo-Ventilation (N=666)		Hazard Ratio (95% CI)	P Value
	No. of Patients (%)	No. of Events/Yr (95% CI)	No. of Patients (%)	No. of Events/Yr (95% CI)		
Primary end point†	335 (50.8)	0.212 (0.190–0.236)	360 (54.1)	0.245 (0.220–0.272)	1.13 (0.97–1.31)	0.10
First secondary end point†	317 (48.1)	0.200 (0.179–0.224)	345 (51.8)	0.235 (0.211–0.261)	1.15 (0.98–1.34)	0.08
Second secondary end point†	465 (70.6)	0.405 (0.369–0.444)	482 (72.4)	0.441 (0.403–0.483)	1.07 (0.94–1.22)	0.28
Death from any cause	193 (29.3)	0.093 (0.081–0.107)	232 (34.8)	0.119 (0.104–0.135)	1.28 (1.06–1.55)	0.01
Cardiovascular death	158 (24.0)	0.076 (0.065–0.089)	199 (29.9)	0.102 (0.088–0.117)	1.34 (1.09–1.65)	0.006
Hospitalization for any cause	448 (68.0)	0.384 (0.349–0.421)	452 (67.9)	0.411 (0.374–0.451)	1.05 (0.92–1.20)	0.47
Unplanned hospitalization for worsening heart failure	272 (41.3)	0.164 (0.145–0.185)	287 (43.1)	0.190 (0.169–0.214)	1.13 (0.95–1.33)	0.16
Heart transplantation	12 (1.8)	0.006 (0.003–0.010)	8 (1.2)	0.004 (0.002–0.008)	0.70 (0.28–1.70)	0.43
Implantation of long-term VAD	10 (1.5)	0.005 (0.002–0.009)	16 (2.4)	0.008 (0.005–0.013)	1.67 (0.76–3.68)	0.20
Resuscitation	19 (2.9)	0.009 (0.006–0.014)	25 (3.8)	0.013 (0.008–0.019)	1.40 (0.77–2.54)	0.27
Resuscitation for cardiac arrest	16 (2.4)	0.008 (0.004–0.013)	18 (2.7)	0.009 (0.005–0.015)	1.19 (0.61–2.34)	0.61
Appropriate shock	65 (9.9)	0.033 (0.026–0.043)	45 (6.8)	0.024 (0.017–0.032)	0.71 (0.48–1.04)	0.08
Noncardiovascular death	35 (5.3)	0.017 (0.012–0.024)	33 (5.0)	0.017 (0.012–0.024)	1.00 (0.62–1.62)	0.99

B Death from Any Cause



No. at Risk						
Control	659	563	493	334	213	117
ASV	666	555	466	304	189	97

C Death from Cardiovascular Causes



No. at Risk						
Control	659	563	493	334	213	117
ASV	666	555	466	304	189	97

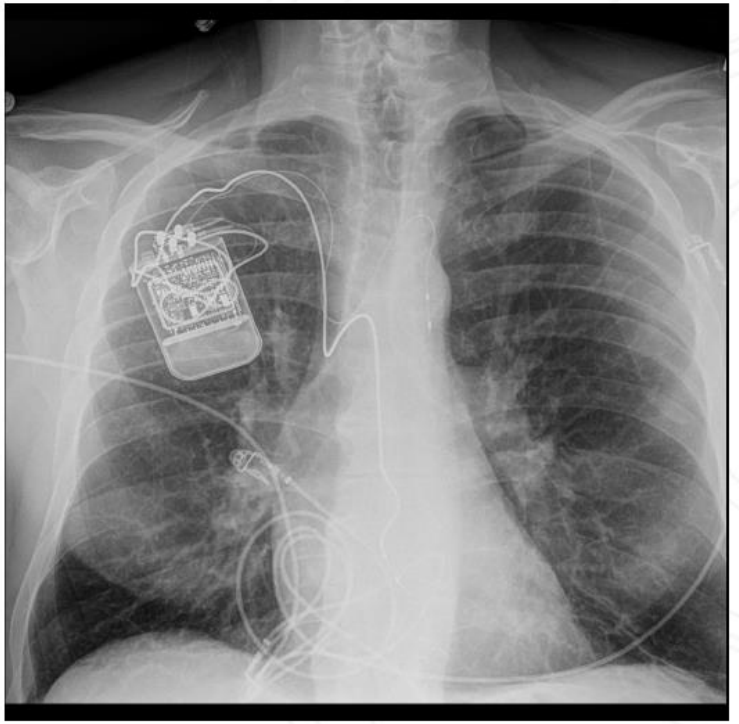
Porque fallo?

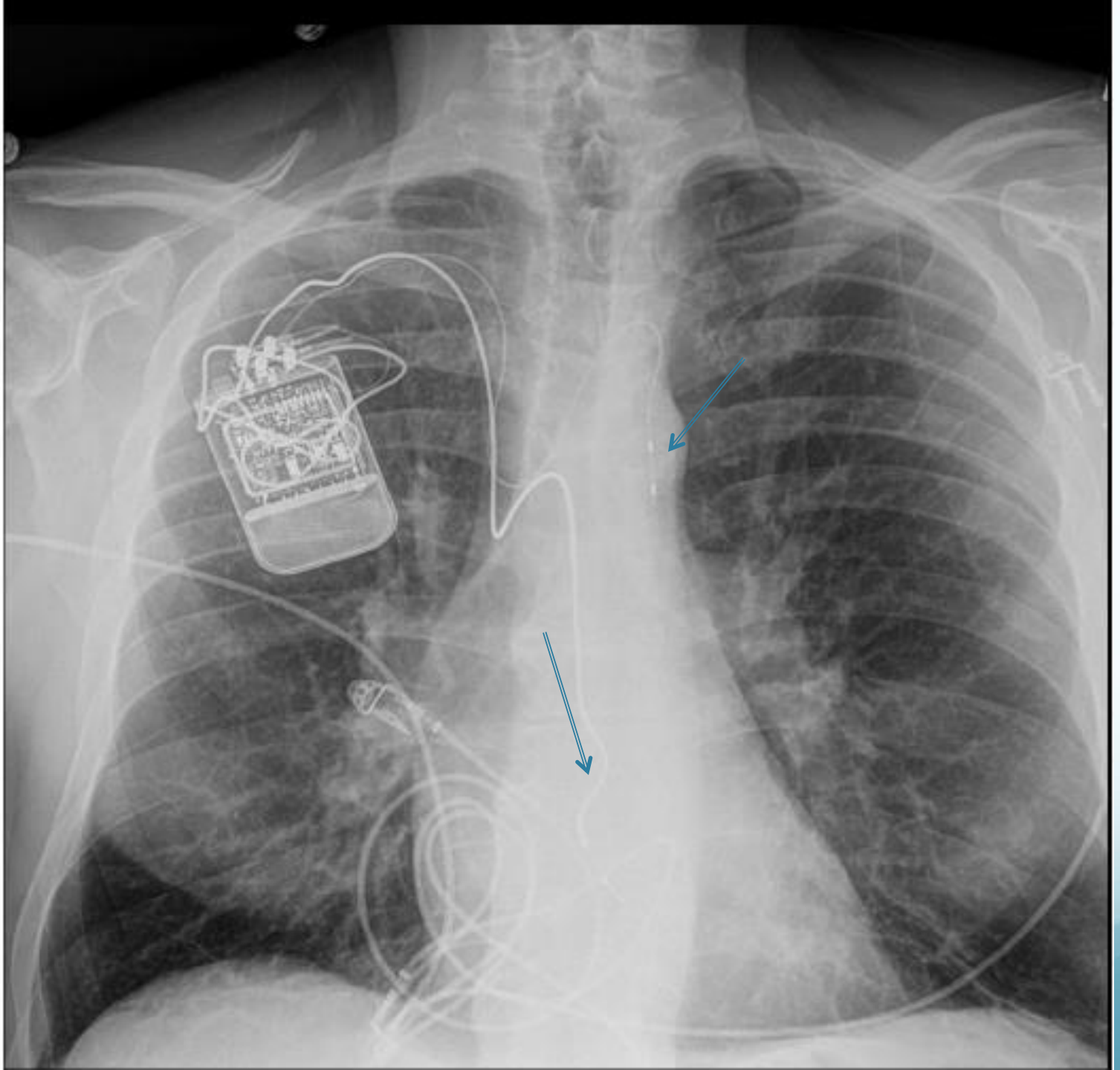
- ACS Puede ser una forma fisiológica de normalizar la PCO2. Mantener un flujo aéreo constante puede ser deletéreo.
- Mantener una presión inspiratoria y espiratoria de forma constante puede tener efectos hemodinámicos nefastos en la precarga.

Alternativa: Estimulación del nervio frénico

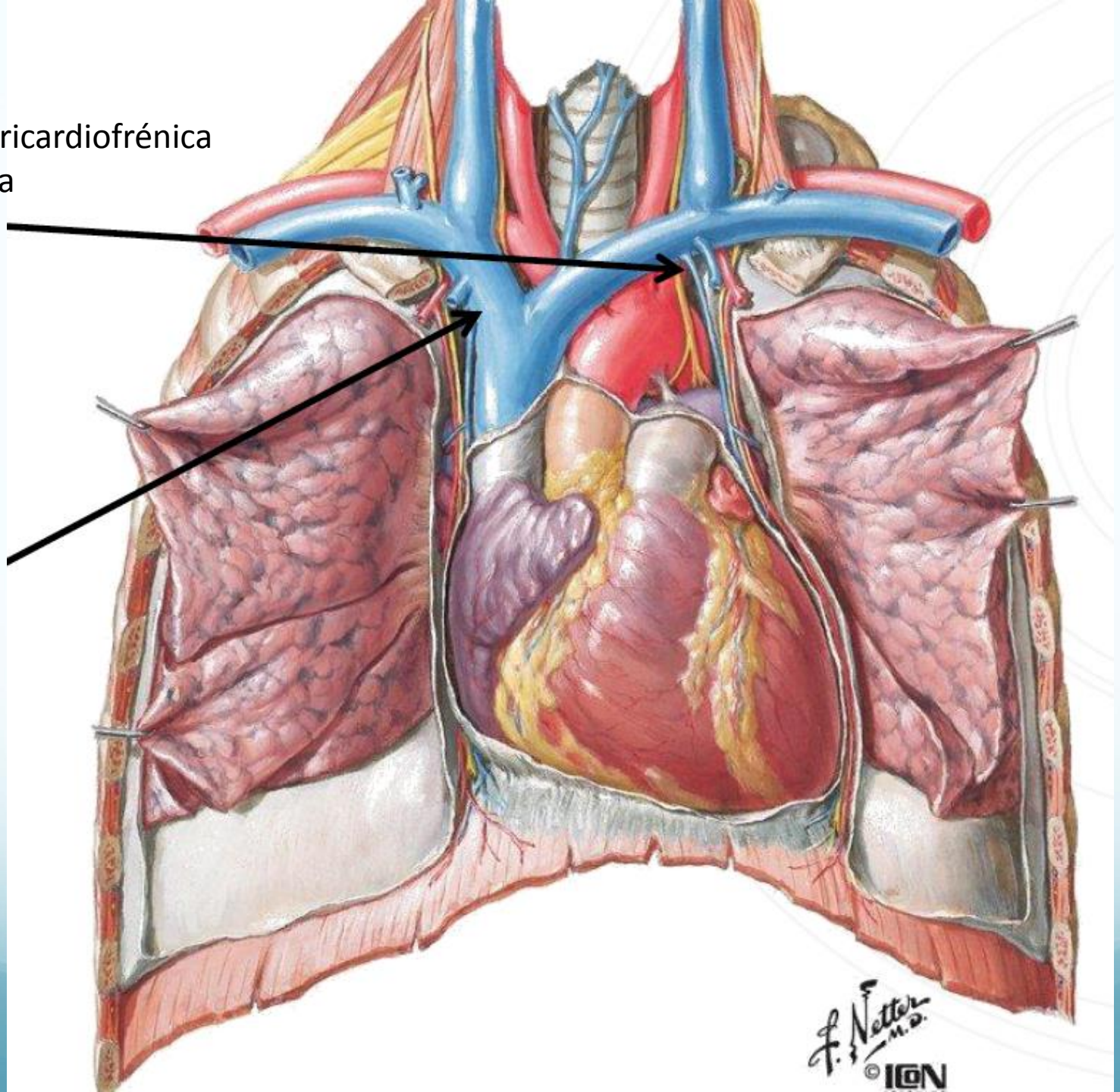
How is the remedē® System Implanted?

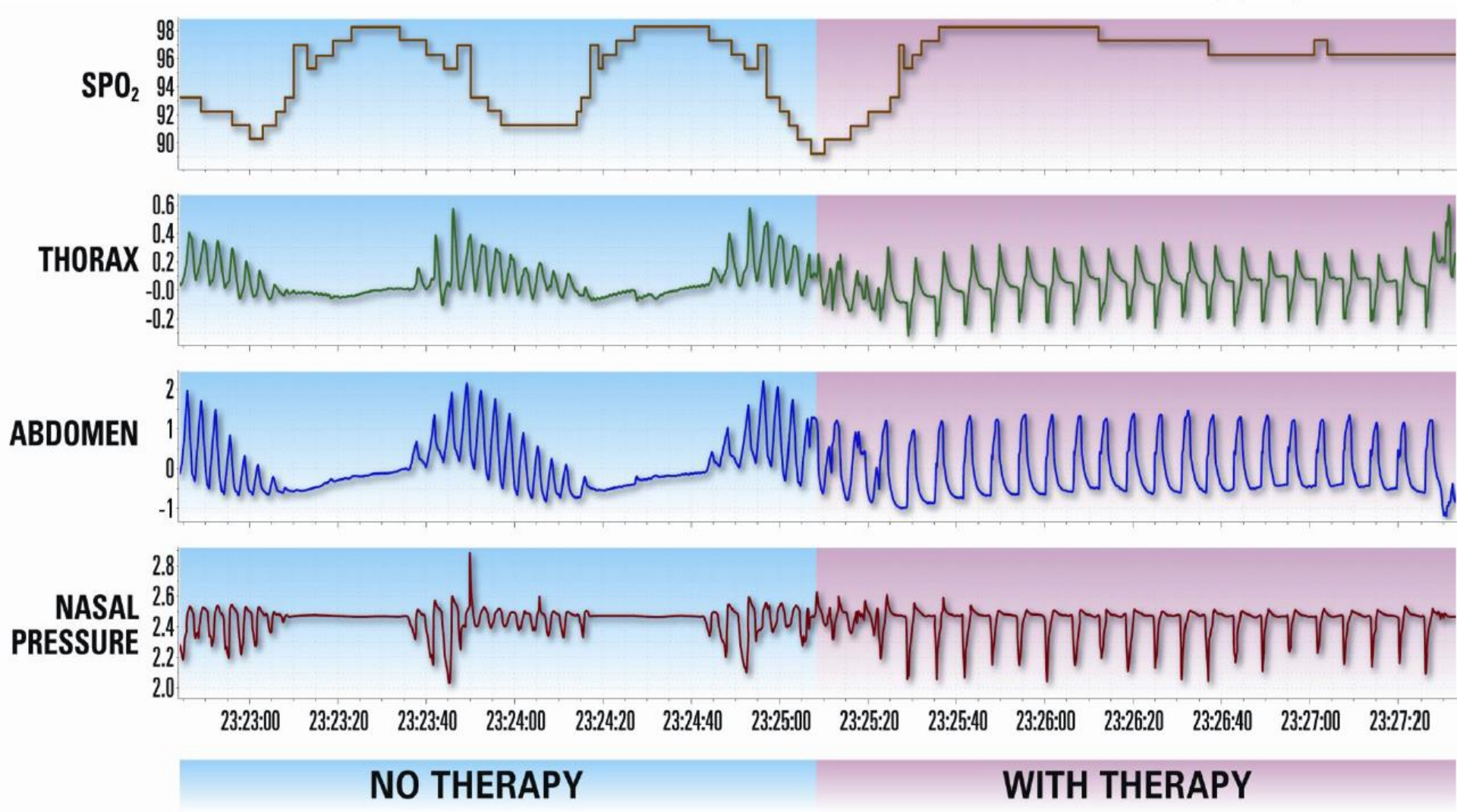
- The **rem**edē® System implant takes place in the **EP laboratory** by cardiologists experienced with CRT
- **Light sedation** is used to keep patients comfortable
- The device is placed **under the skin** in either the right or left chest
- A **stimulation lead** is placed either in the left pericardiophrenic or right brachiocephalic vein
- A second lead to **sense respiration** is placed in the azygos vein





Vena pericardiofrénica izquierda





Eur Heart J (2012) 33(7): 889-894

Que evidencia científica tenemos?

- Escasa: The Remede Pivotal study (pocos pacientes)
- Mejora de parámetros respiratorios pero no hay end-points duros
- La mitad de los pacientes van a llevar además un TRC. Dificultad técnica al implante.
- Abre una puerta a la esperanza en este tipo de pacientes???

Conclusiones

- El SBD es una entidad de la que empezamos a ser conscientes.
- Es especialmente prevalente en insuficiencia cardiaca.
- La CPAP es el único tratamiento útil en la obstructiva.
- La terapia ventilatoria no parece demasiado util.
- La estimulación frénica puede convertirse en una herramienta terapeútica útil en paciente con apnea central pero este beneficio esta por demostrar.

MUCHAS GRACIAS