



PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

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PACING NEWS: CORE PROBLEMS

SLEEP APNEA: NUOVE PROSPETTIVE DI DIAGNOSI E DI TRATTAMENTO

Andrea Mazza, MD, FESC, FEHRA

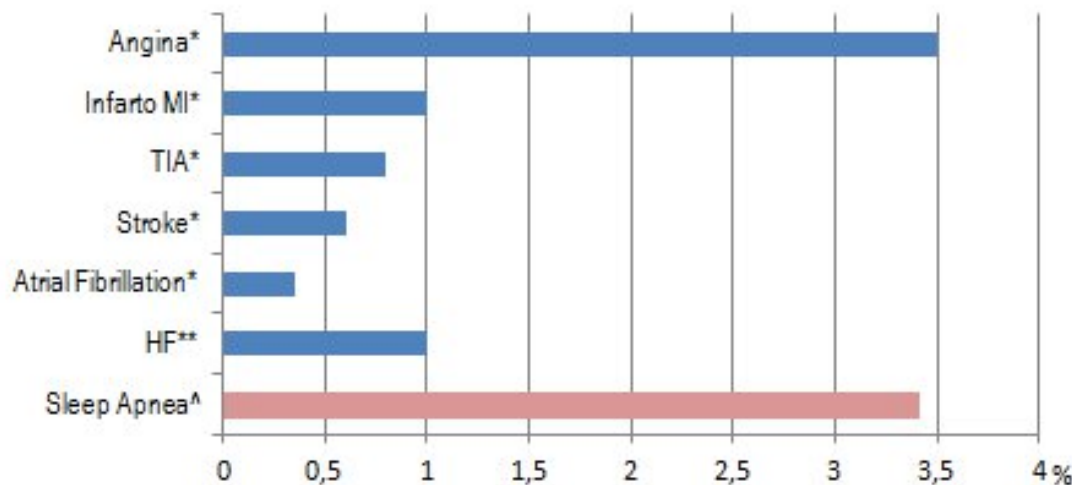
Direttore S.C. Cardiologia

S. Maria della Stella Hospital,

Orvieto, Italy



Prevalenza OSAS vs altre patologie cardiovascolari



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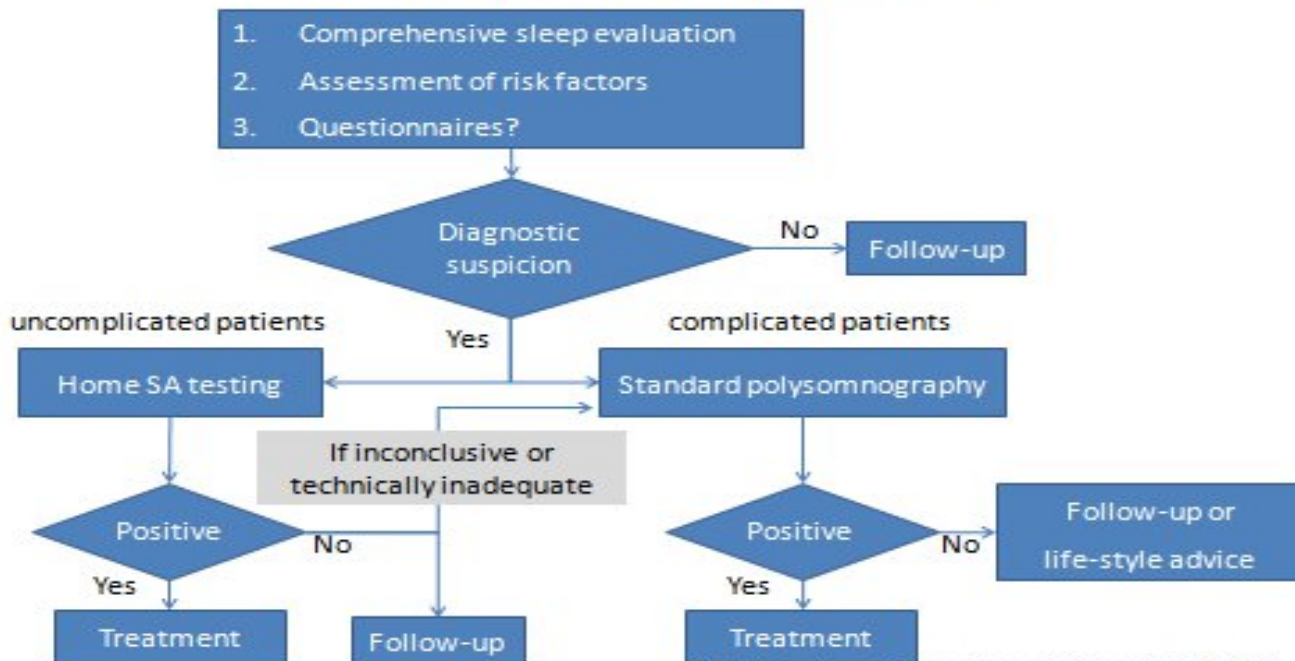
*Osservatorio Epidemiologico Cardiovascolare - anni 2008/2012 (pop. generale età 35-74)

**Ministero salute (popolazione generale);

^^ Croce et al. Economia e Management, 2006 (pop. generale età >30)



Test diagnostici per OSA



Adapted from Journal of Clinical Sleep Medicine 2017;13:479-504



Severità della sleep apnea valutata mediante monitoraggio notturno

Apnea/Hypopnea Index (events/hour):

- **MILD:** 5 to 15
- **MODERATE:** 15 to 30
- **SEVERE:** > 30

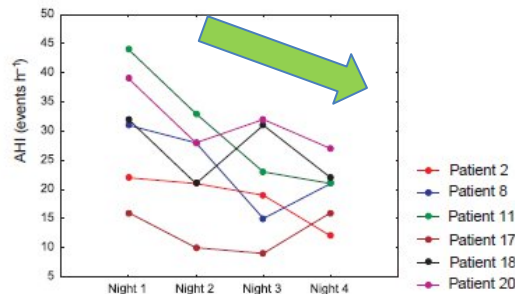
The Report of an American Academy of Sleep Medicine Task Force. Sleep 1999; 22: 667-698.



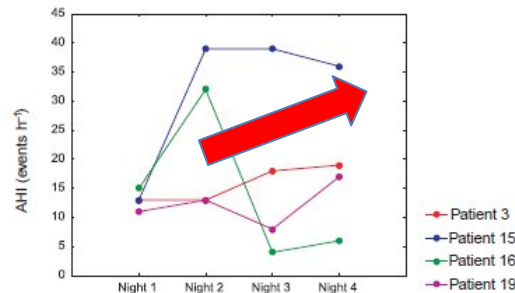
The variability of the apnoea-hypopnoea index

The AHI was evaluated in 20 patients with OSAS on four consecutive nights:

- 50% of patients changed the classification of OSAS severity from the first to the subsequent nights.
- 65% of patients presented a variation in the AHI value ≥ 10 events/h



6 patients changed to a lower AHI classification



4 patients changed to a higher AHI classification

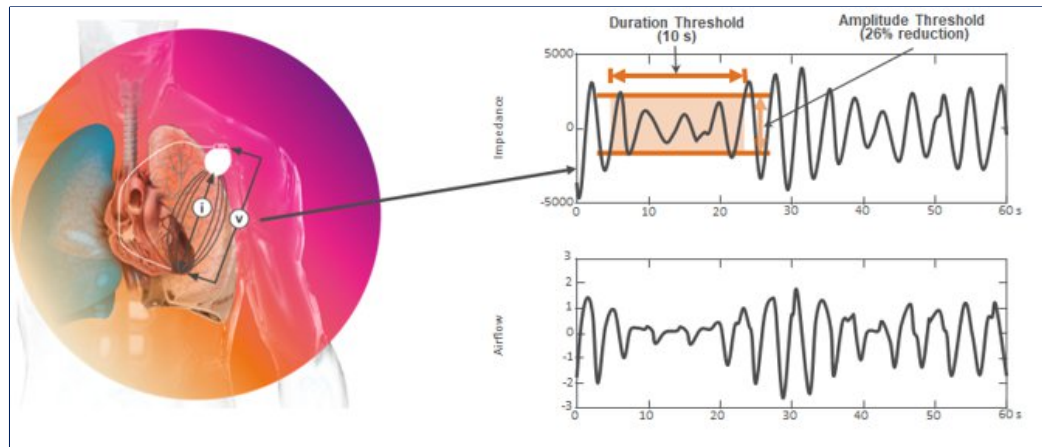


ICD-detected Sleep Apnea

The ApneaScan™ algorithm continuously measures thoracic impedance changes in order to count respiration. It defines:

- Apnea episode as 2 consecutive deep breaths with an interval of >10 s between breaths
- Hypopnea episode as an interval >10 s between deep breaths which additionally contains consecutive small breaths

The **RDI** is calculated by dividing the total number of apnea and hypopnea events by the programmed sleep duration.



ApneaScan™ Algorithm (Boston Scientific)



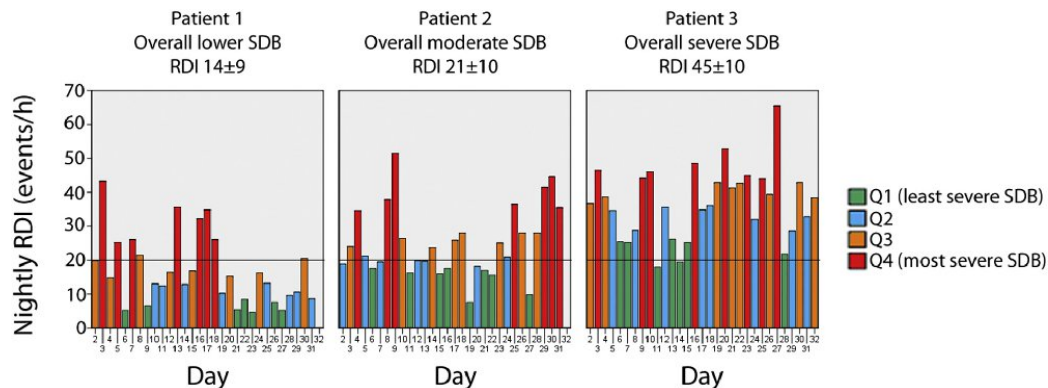
VARIOSA-AF Study

Variability of Sleep Apnea Severity and Risk of Atrial Fibrillation

The VARIOS-AF Study

Dominik Linz, MD, PhD,^a Anthony G. Brooks, PhD,^b Adrian D. Elliott, PhD,^a Chrishan J. Nalliah, MBBS,^c Jeroen M.L. Hendriks, PhD,^a Melissa E. Middeldorp, PhD,^a Celine Gallagher, RN,^a Rajiv Mahajan, MD, PhD,^a Jonathan M. Kalman, MBBS, PhD,^c R. Doug McEvoy, MD,^a Dennis H. Lau, MBBS, PhD,^a Prashanthan Sanders, MBBS, PhD^a

The individual mean night-to-night RDI coefficient of variation was $41 \pm 16\%$



Sleep-disordered breathing severity is not stable over time but exhibits considerable night-to-night variability which cannot be detected by 1 overnight sleep study



CLINICAL INVESTIGATIONS

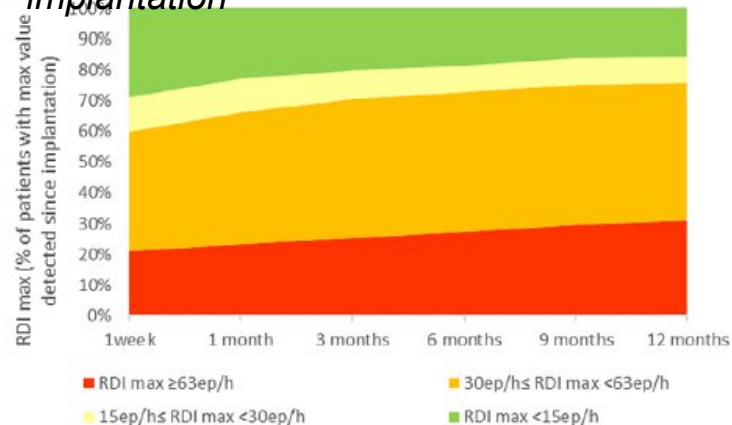
**CLINICAL
CARDIOLOGY** WILEY

Continuous monitoring of sleep-disordered breathing with pacemakers: Indexes for risk stratification of atrial fibrillation and risk of stroke

 Andrea Mazza¹ | Maria Grazia Bendini¹ | Massimo Leggio² |
 Raffaele De Cristofaro¹ | Sergio Valsecchi³ | Giuseppe Boriani⁴

- The individual mean night-to-night RDI coefficient of variation was $34 \pm 17\%$
- The proportion of patients achieving RDI maximum values ≥ 30 ep/h increased from the first observation to the 12-month visit

Time to reach the maximum RDI value during the first 12 months after implantation



Mazza A, et al. Clin Cardiol. 2020;43:1609-1615.

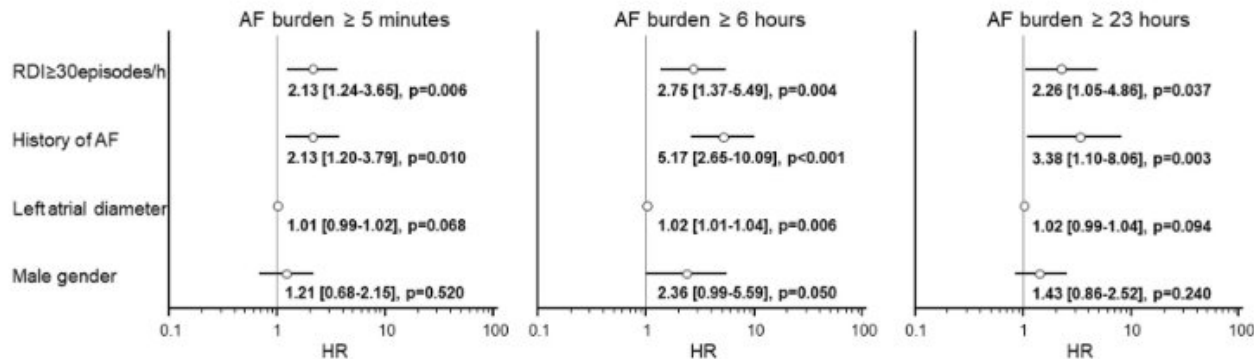


DASAP-HF Study

Association between implantable defibrillator-detected sleep apnea and atrial fibrillation: The DASAP-HF study

Giuseppe Boriani MD, PhD¹ | Igor Diemberger MD, PhD² |
 Ennio C. L. Pisanò MD³ | Paolo Pieragnoli MD⁴ | Alessandro Locatelli MD⁵ |
 Alessandro Capucci MD⁶ | Antonello Talarico MD⁷ | Massimo Zecchin MD⁸ |
 Antonio Rapacciuolo MD, PhD⁹ | Marcello Piacenti MD¹⁰ |
 Ciro Indolfi MD, PhD^{11,12} | Miguel A. Arias MD¹³ | Catia Checchinato MD¹⁴ |
 Maria T. La Rovere MD¹⁵ | Gianfranco Sinagra MD, PhD⁸ |
 Michele Emdin MD, PhD¹⁰ | Renato P. Ricci MD¹⁶ | Antonio D'Onofrio MD¹⁷

- The verification of severe SA at the time of the polysomnographic study did not predict the occurrence of AF during a follow-up of more than 2 years
- But AF was associated with the continuously measured weekly RDI values, using a time-dependent model



Boriani G, et al. J Cardiovasc Electrophysiol. 2022;33:1472-1479.



Association Between Device-Detected SA and ICD Therapy in Patients With HF

Association Between Device-Detected Sleep-Disordered Breathing and Implantable Defibrillator Therapy in Patients With Heart Failure

Andrea Mazza, MD,³ Maria Grazia Bendini, MD,³ Valter Bianchi, MD,^b Cristina Esposito, MD,^c Leonardo Calò, MD,^d Chiara Andreoli, MD,^e Vincenzo Ezio Santobuono, MD,^f Antonio Dello Russo, MD,^g Miguel Viscusi, MD,^h Carmelo La Greca, MD,ⁱ Claudia Baiocchi, MD,^j Antonello Talarico, MD,^k Raimondo Albanese, MD,^l Giuseppe Arena, MD,^m Giovanna Giubilato, MD,ⁿ Matteo Ziacchi, MD,^o Antonio Rapacciolo, MD,^p Monica Campari, MSc,^q Sergio Valsecchi, PhD,^q Giuseppe Boriani, MD, PhD^r

- **Purpose:** We evaluated the association between ICD-detected SA and the incidence of appropriate ICD therapies in patients with HF
- **Methods:** Prospective, non-randomized multicenter evaluation of patients receiving an ICD or CRT-D endowed with **ApneaScan™** diagnostic feature and enrolled in the LATITUDE remote monitoring platform.
- **Study endpoints:**
 1. 1st appropriate ICD shock therapy
 2. 1st ICD therapy (ATP or shock) for VT or VF



Association Between Device-Detected SA and ICD Therapy in Patients With HF

411 patients received an ICD or CRT-D and were enrolled in the study

All devices were programmed to two detection zones:

❖ **1st Zone:**

- ❖ **≥ 170 beats/minute** for ventricular tachycardia: **87%** of patients
- ❖ **≥5-second delay** before delivery of ATP/shock: **93%** of patients

❖ **2nd Zone:**

- ❖ **≥ 200 beats/minute** for faster tachycardia: **93%** of patients
- ❖ **≤2.5-second delay**: **85%** of patients

	Total (N=411)
Age, years	69±10
Male, n (%)	317 (77)
Ischemic Heart Disease, n (%)	193 (47)
NYHA Class	
• I, n (%)	19 (5)
• II, n (%)	250 (61)
• III, n (%)	134 (33)
• IV, n (%)	8 (2)
LV Ejection Fraction, %	32±8
History of Atrial Fibrillation, n (%)	136 (33)
Secondary Prevention, n (%)	49 (12)
CRT device, n (%)	297 (72)
Diabetes, n (%)	113 (27)
Chronic Kidney Disease, n (%)	107 (26)
Pulmonary disease, n (%)	70 (17)
Hypertension, n (%)	223 (54)



Association Between Device-Detected SA and ICD Therapy in Patients With HF

During a median follow-up of 26 months [25th-75th percentile: 16-35]:

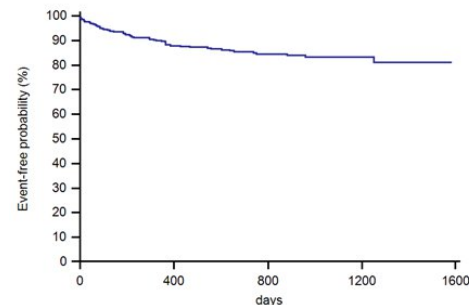
- 58 (**14%**) patients experienced one or more **ICD shocks**
- 100 (**24%**) patients experienced an ICD therapy (**ATP or shock**)

	No shock (N=353)	Shock (N=58)	p
Age, years	70±10	66±13	0.038
Secondary Prevention, n (%)	37 (10)	12 (21)	0.026

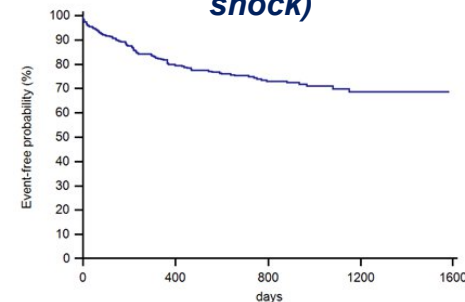
Patients with shocks were:

- **younger**
- **more frequently implanted for secondary prevention**

Time to first ICD shock



Time to first ICD therapy (ATP or shock)

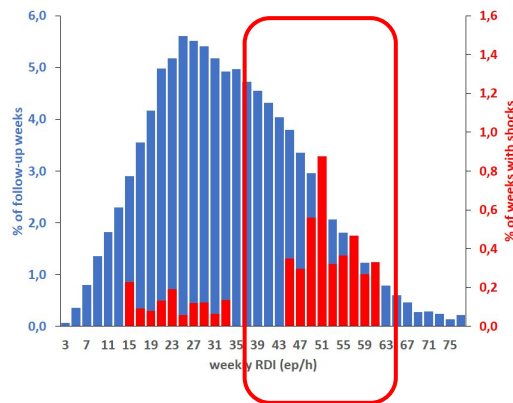




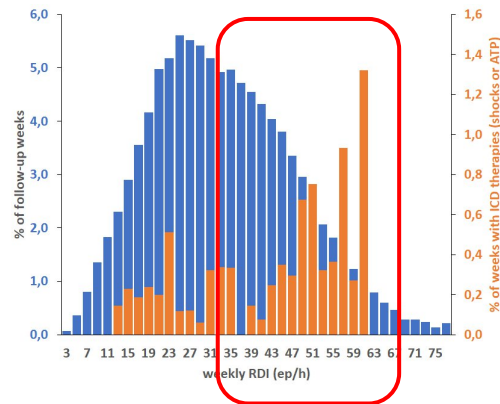
Association Between Device-Detected SA and ICD Therapy in Patients With HF

- The RDI showed **considerable variability** during follow-up in the overall population and in individual patients
- The maximum RDI value did not differ between patients with and without shocks (55 ± 15 ep/h versus 54 ± 14 ep/h, $p=0.539$)
- The weeks during which the ICDs delivered shocks or any therapy for VT or VF were **most frequently those in which the device detected higher RDI values**

Distribution of follow-up weeks with ICD shocks



Distribution of follow-up weeks with any ICD therapy

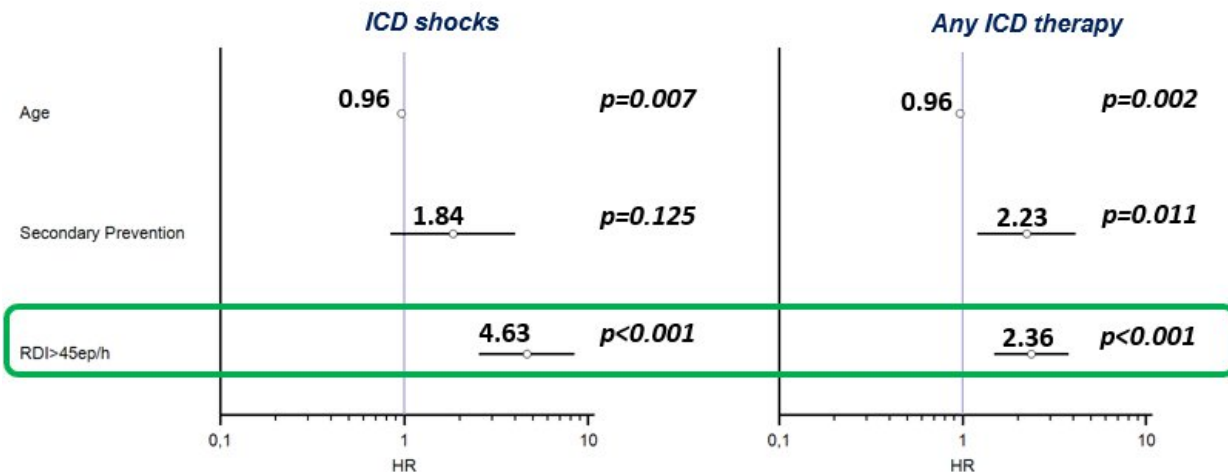


Blue bars: Distribution of all weekly RDI values



Association Between Device-Detected SA and ICD Therapy in Patients With HF

- The maximum RDI was not associated with the occurrence of shocks (Cox regression model)
- A continuously measured weekly **RDI >45 episodes/h** was independently associated with the **occurrence of shock and any ICD therapy**



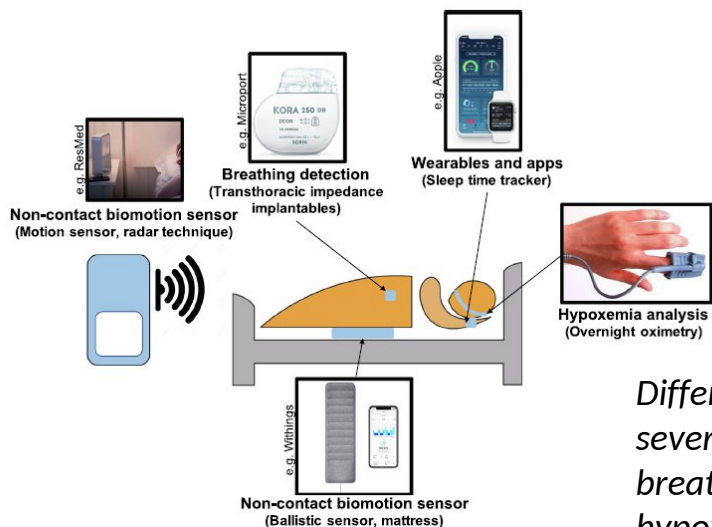
The continuous and automatic assessment of sleep-disordered breathing allows to identify patients during periods of significantly increased risk of ventricular tachyarrhythmias



Nightly sleep apnea severity in patients with atrial fibrillation: Potential applications of long-term sleep apnea monitoring



Dominik Linz^{a,b,c,d,*}, Mathias Baumert^c, Lien Desteghe^{f,g}, Kadhim Kadhim^a, Kevin Vernoooy^{b,c,d}, Jonathan M. Kalman^h, Dobromir Dobrevⁱ, Michael Arzt^j, Manu Sastry^k, Harry J.G.M. Crijns^{b,d}, Ulrich Schotten^{b,d}, Martin R. Cowie^l, R. Doug McEvoy^m, Hein Heidbuchel^{f,g,n}, Jeroen Hendriks^a, Prashanthan Sanders^a, Dennis H. Lau^a



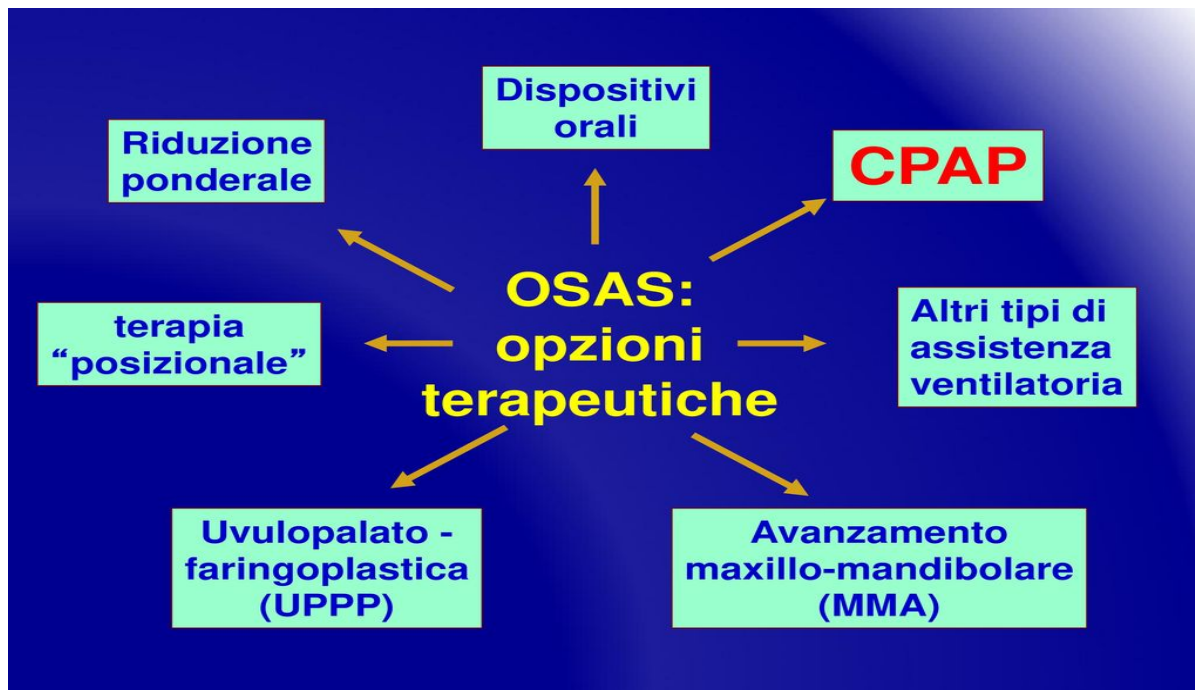
Nightly SDB-severity assessment rather than the single-night diagnosis by one over-night sleep study may better reflect the exposure to SDB-related factors and yield a superior metric to determine SDB-severity in the management of AF.

Different approaches to assess nightly SDB severity: Non-contact biomotion sensors; breathing detection; wearables and apps; hypoxia analysis.

Linz D, et al. Int J Cardiol Heart Vasc. 2019;24:100424.



OSAS: opzioni terapeutiche





Multidisciplinary Approaches to Sleep Apnea Management

REVIEW ARTICLES

Multidisciplinary Approaches to Sleep Apnea Management: Historical Review and Future Recommendations

Authors

Carl Stepnowsky, PhD ^{1,2}

A comprehensive individualized assessment, either recommending targeted specific therapy, or combinations of multiple therapies, appears to be an ideal approach to OSA management. But for this approach to work well, multiple specialists with both knowledge of their own and other's disciplines will need to work collaboratively with an individual patient.



Obstructive Sleep Apnea in Cardiovascular Disease: A Review of the Literature and Proposed Multidisciplinary Clinical Management Strategy

Jeremy R. Tietjens, MD; David Claman, MD; Eric J. Kezirian, MD, MPH; Teresa De Marco, MD; Armen Mirzayan, DDS; Bijan Sadroonri, MD; Andrew N. Goldberg, MD; Carlin Long, MD; Edward P. Gerstenfeld, MD; Yerem Yeghiazarians, MD

We suggest diagnostic testing for patients with established or at risk for CVD in whom sleep apnea is suspected following a comprehensive sleep assessment:

1. Symptomatic HF (New York Heart Association Class II-IV) or asymptomatic (New York Heart Association Class I) left ventricular dysfunction (ejection fraction <40%).
2. AF, particularly in patients who are persistently symptomatic, challenging to pharmacologically rate control, or in whom a rhythm control strategy will be pursued.
3. Sick sinus syndrome.
4. Tachy-brady syndrome.
5. Ventricular tachycardia or frequent ventricular ectopy.
6. Survivors of sudden cardiac death.
7. Coronary artery disease.
8. Cerebrovascular disease.
9. Patients at elevated risk for future cardiovascular events.

A comprehensive
assessment

Targeted specific
therapy

Treatment: We agree with the recommendations from the 2009 Adult Obstructive Sleep Apnea Task Force of the American Academy of Sleep Medicine regarding treatment of OSA:

- a. Clinical correlation is necessary to determine whether CPAP-intolerant patients should be referred for upper airway surgery or oral appliance therapy. A multidisciplinary approach to the management of OSA should be used as appropriate for each individual patient, including involvement of physicians trained in sleep medicine, otolaryngology-head and neck surgery, cardiology, maxillofacial surgery, and dentists trained in sleep dentistry.

Tietjens JR, et al. J Am Heart Assoc.
2019;8:e010440.



Conclusions

- OSA is highly prevalent in the general population
- There is a great night-by-night intraindividual variability of about 35-40% of the AHI
- The burden of Sashould be taken into account for the diagnosis of OSA rather than a single overnight study
- A number of treatment options for OSA are available
- A multidisciplinary approach is necessary for an accurate clinical management of these patients