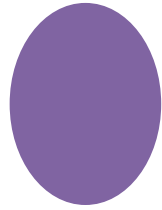
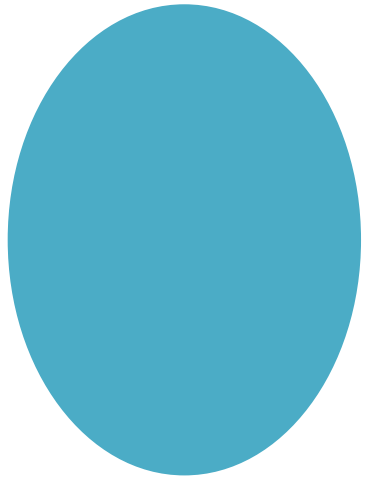




*Obstructive Sleep Apnea  
and  
cardiovascular disease.*

Hussein Kiliddar, MD  
2/29/2020



# Disclosures

I have no  
financial  
disclosures.

# Objectives



Pathophysiology  
of Sleep Apnea



Review of OSA  
and  
cardiovascular  
disease



Future of OSA  
management



? PSG

- Mrs Springfield
  - DM/HTN/HLD
  - NSTEMI (CAD)
  - BMI 41
- Diaphragm paresis

# PSG

	Obstructive Apneas		Hypopneas		Central Apneas		Totals		
	REM	NREM	REM	NREM	REM	NREM	REM	NREM	Total
#	0.0	0.0	21.0	211.0	1.0	0.0	22.0	211.0	233.0
Index	0.0	0.0	24.2	41.1	1.2	0.0	25.4	41.1	38.8
Average Duration	0.0	0.0	18.1	17.1	11.3	0.0			
Maximum Duration	0.0	0.0	23.3	29.3	11.3	0.0			
Average SaO2%	0.0	0.0	95.0	96.0	94.0	0.0			
Low SaO2%	0.0	0.0	86.0	85.0	94.0	0.0			

### Body Position Effects

	Supine	Prone	Left	Right
Total Recording	430.8	0.0	0.0	0.0
Total Sleep Time	360.0	0.0	0.0	0.0
Sleep Efficiency	83.6	0.0	0.0	0.0
AHI	38.0	0.0	0.0	0.0
Low SaO2	85.0	0.0	0.0	0.0

### Baseline Cardiorespiratory

	Wake		REM		NREM	
	High	Low	High	Low	High	Low
SaO2 (%)	97.0	85.0	97.0	86.0	97.0	99.0
Respiratory Rate	18.0	14.0	16.0	14.0	18.0	16.0
ECG	66.0	61.0	62.0	55.0	58.0	51.0

### Other Cardiorespiratory Data

Snoring	Extremely loud
Cardiac Arrhythmia	None noted
Undisturbed Sleep	2.0
Paradoxical Movements	Supine only.

	Minutes	% TRT	% TST	Latency
Total Recording Time	430.8			
Total Sleep Time	360.0	83.6		
Total Wake Time	70.8	0.0		
Stage 1 Sleep	71.0	16.5	19.7	27.0
Stage 2 Sleep	220.5	51.2	61.3	43.5
Stage 3 Sleep	10.5	2.4	2.8	
Stage 4 Sleep	6.0	1.4	1.7	
REM Sleep	52.0	12.1	14.4	160.5

### Sleep Continuity Measures

Sleep Efficiency (%)	83.6
Wake After Sleep Onset (Min)	44.0
# of Awakenings > 5 Minutes	1.0
# of Awakenings > 1 Min & < 5 Min	27.0
# of Arousals (all sources)	233.0
Arousal Index (hr. of sleep)	38.8

### Patient Sleep Estimations

	Subjective	Objective
Total Sleep Time (hrs.)	?	6.0
Sleep Latency (mins.)	?	27.0
# of Awakenings	?	1.0

### Patient Evaluation of Laboratory Sleep Compared to Usual Sleep

All In All	Same as usual
AM Alertness	Feel same as usual

# Review of literature - AHA

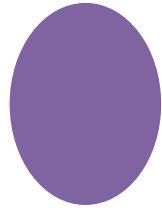
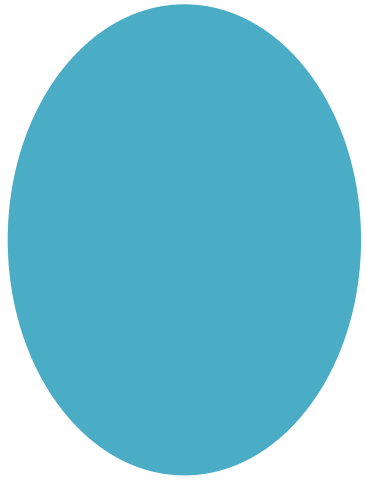
CONTEMPORARY REVIEW



## 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

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# Pathophysiology of OSA



## Pathophysiology

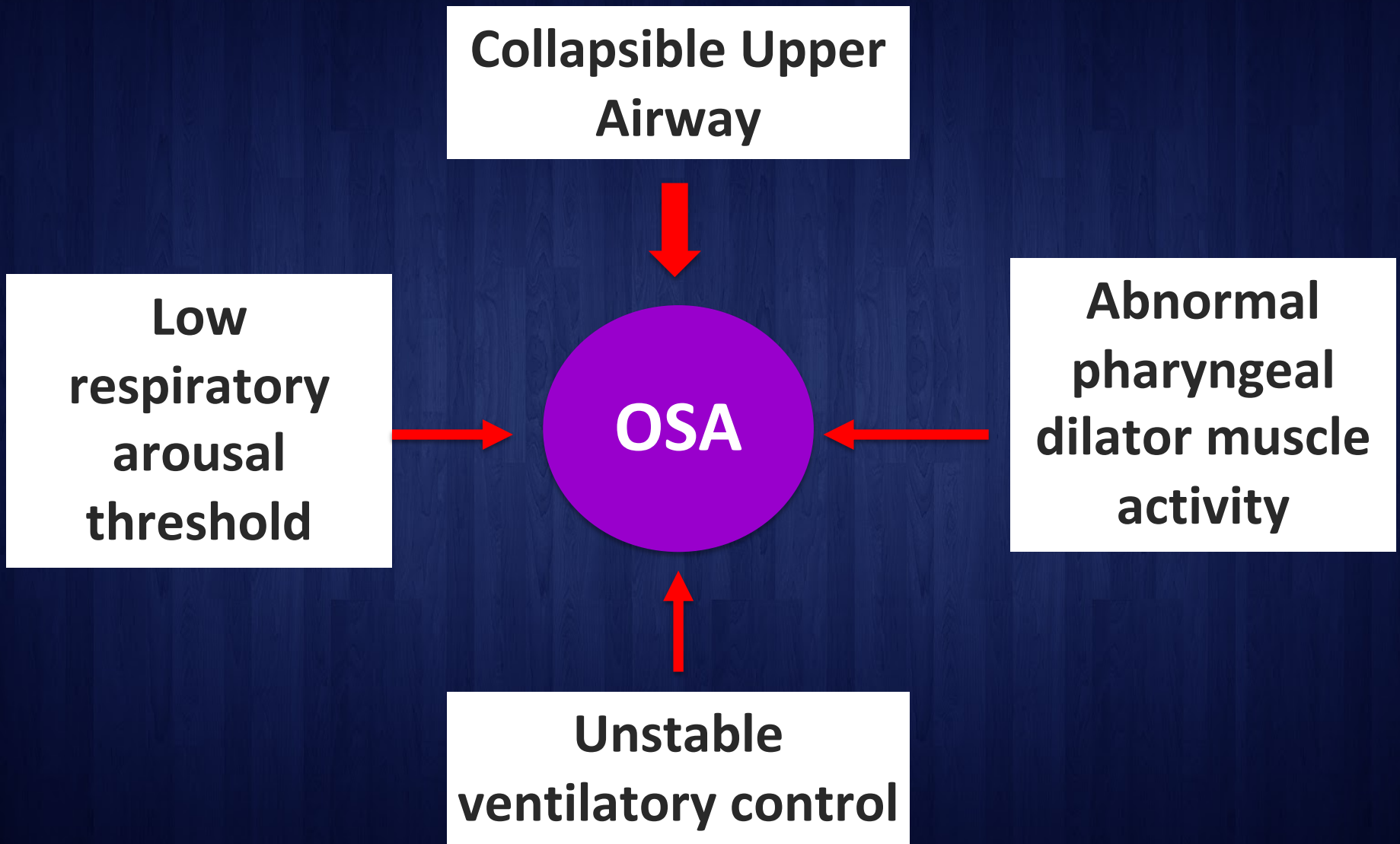
### Anatomical obstruction

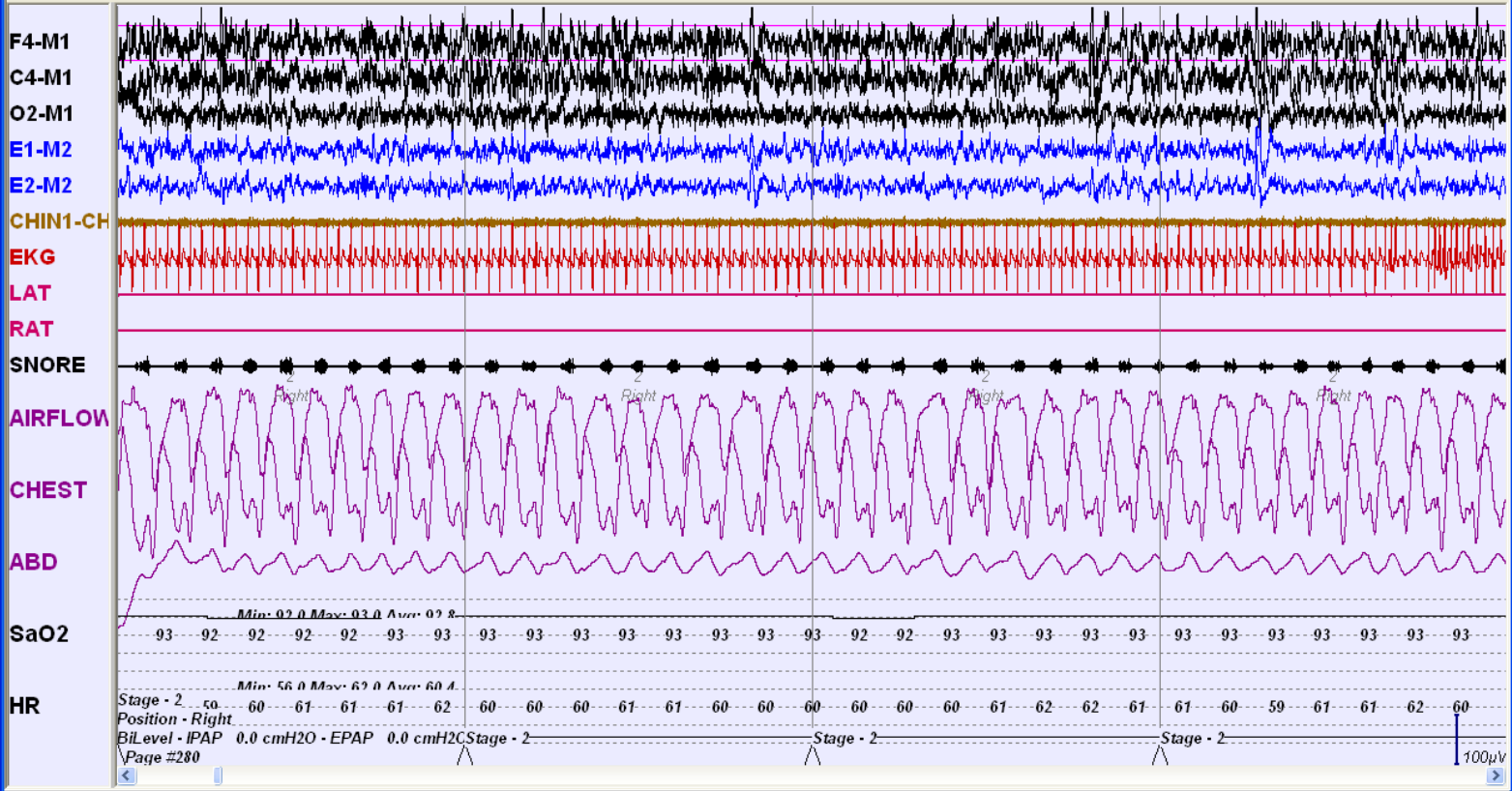
- Recurrent airway narrowing and collapse of the pharynx during sleep
- Reduced airway size
- Physical obstruction
- Positional effects

### Neuromechanical impairment

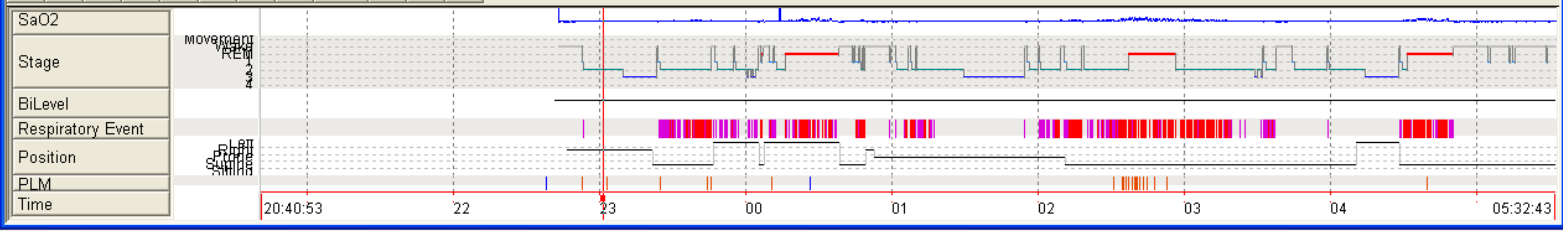
- Impaired pharyngeal dilator muscle function
- Low respiratory arousal threshold
- High loop gain

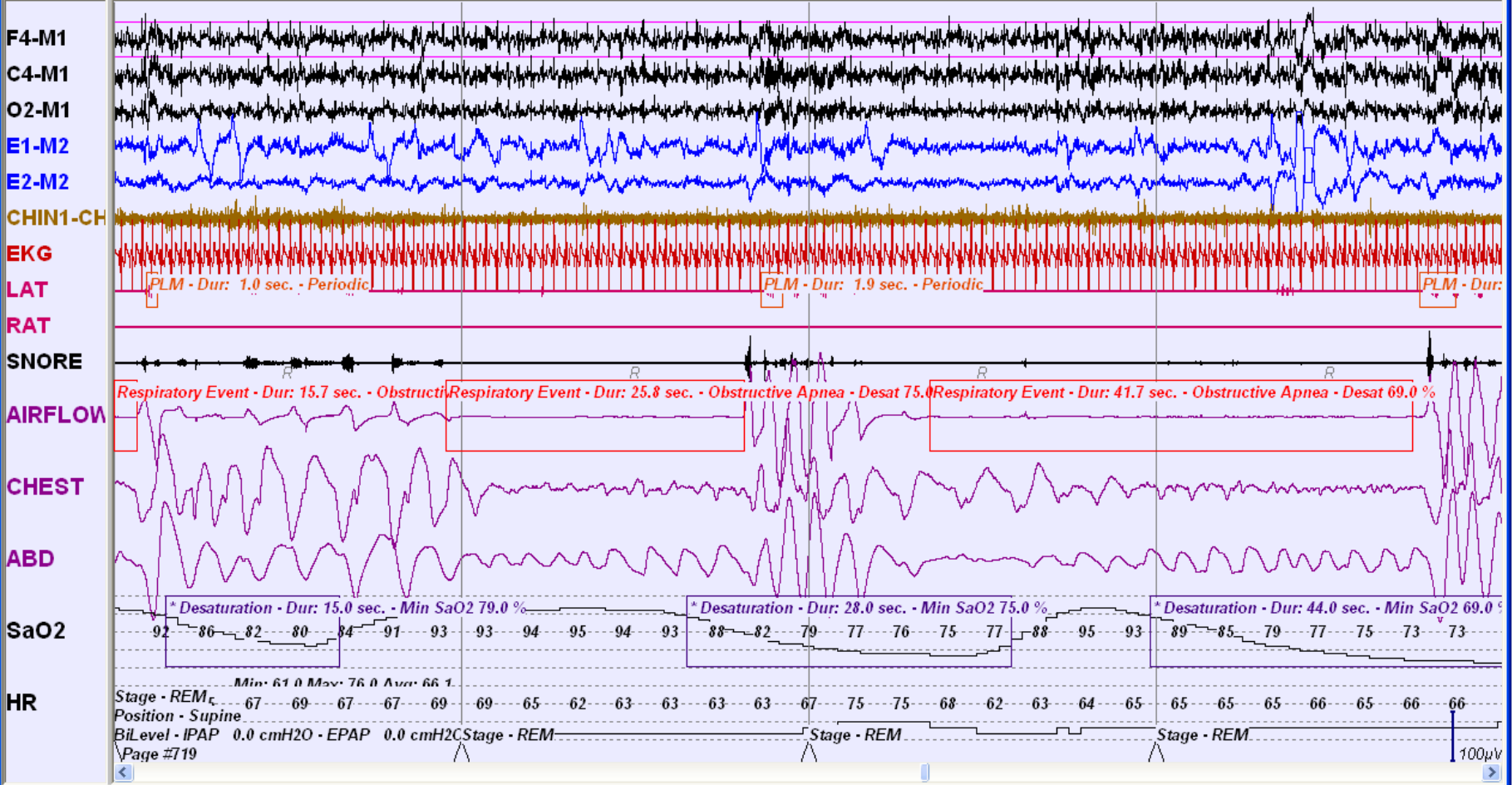




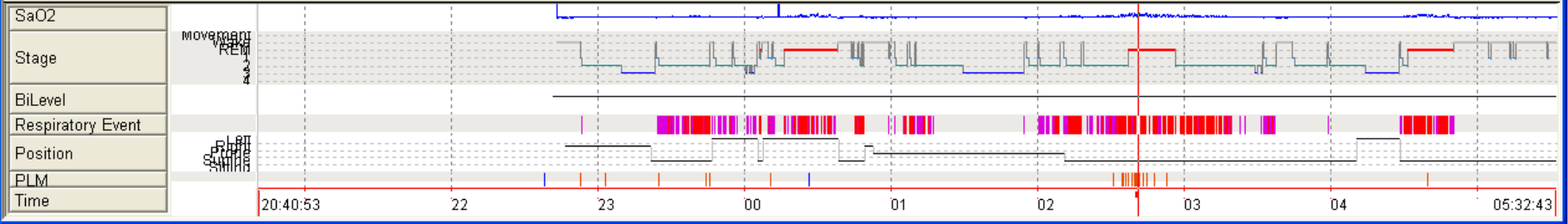


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# OSA and Cardiovascular Diseases

# OSA Prevalence in CV Disorders

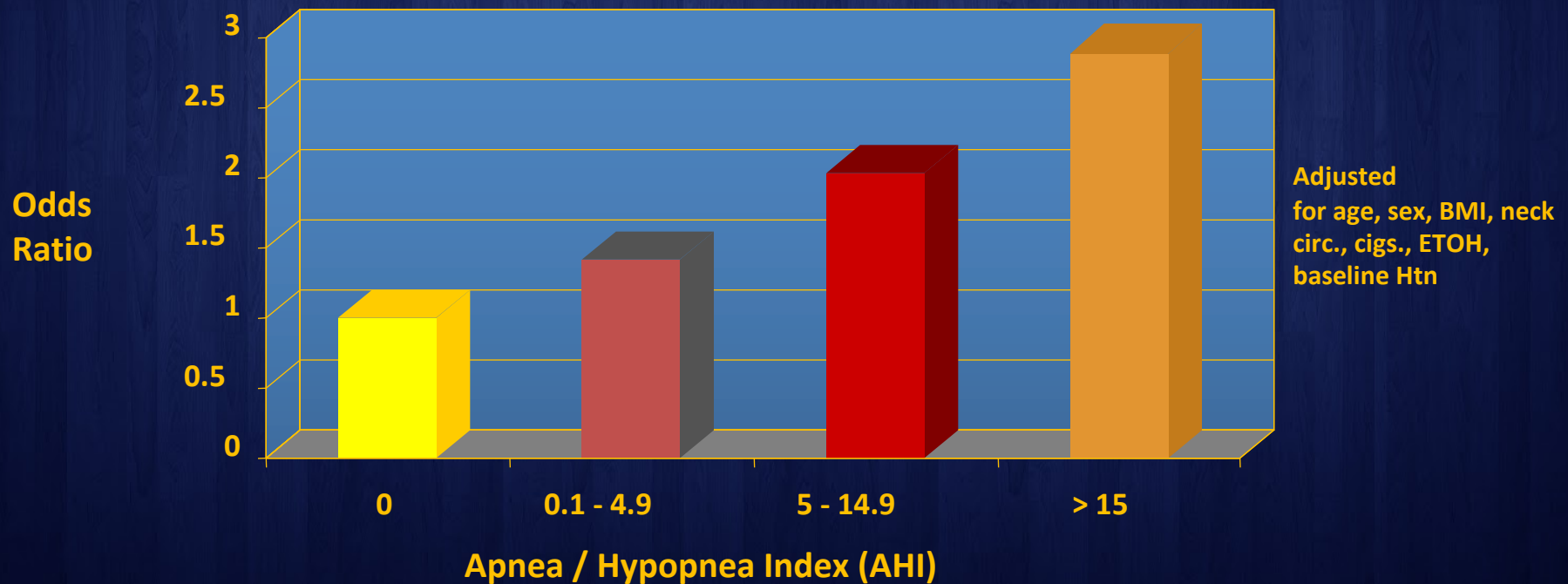
Condition	%
Hypertension	30-83
Stroke	30-58
HF, r EF	12-53
HF, p EF	40
Hypertrophic CM	40
Atrial fibrillation	25-80
ESRD	40-60

## OSA and HTN

- Of all the cardiovascular disease processes associated with OSA, the relationship with hypertension is the best established.
- The relationship is particularly strong between OSA and resistant hypertension, 1 study found the prevalence of OSA to be 71% in patients with resistant hypertension versus 38% in those with essential hypertension

# OSA and Hypertension

## Prospective Study of Association Between OSA and Hypertension Wisconsin Sleep Cohort Study



# OSA and HTN

- BP, HR, SNS activity all decrease during sleep
- Elevate with awakenings or arousals
- Increase SNS activity,  $\downarrow O_2$ 
  - Activate inflammatory systems
  - Impaired vasodilatation, arterial stiffening
  - Increase aortic stiffness
  - Salt and water retention



# HTN and CPAP

- Meta-analysis of 5 randomized trials enrolling 457 total patients found a significant reduction in 24 hr ambulatory blood pressure 4.78 mm systolic and 2.95 mm Hg diastolic
- As well as reduction in mean nocturnal diastolic blood pressure in patients
- While the magnitude of this reduction was relatively modest, it has been shown that even small reductions in blood pressure confer reduced risk of adverse cardiovascular events

# OSA and PH

OSA is strongly associated with PH and may play a causative role in its pathophysiology

10% to 20% of patients with moderate-to-severe OSA have

coexisting PH, the prevalence of OSA in patients with PH

diagnosed by RHC is 70-80%

PH resulting solely from OSA is generally mild; however, OSA can further exacerbate PAP /PVR when superimposed on PH associated with other underlying causes.

Studies have demonstrated reduction in PVR/PAP in patients treated with CPAP.

# OSA and PAF



AF 1-2%

5

In OSA population 5% have AF



In AF population 32-39% have OSA



Significant independent association exist between OSA and AF even after controlling for confounding factors (HTN/HF/Obesity)



Growing body of evidence to suggest a significant role of OSA in recurrent and/or treatment-refractory AF.

# OSA and PAF Pro-arrhythmic mechanisms



Alteration in sympathetic and parasympathetic system regulation



Nocturnal surge in SNS/BP



Structural remodeling of the atria/LAE/LVH



Episodic hypoxia and activation of RAS



Exaggerated swings in the Intra-thoracic pressure



Hypercarbia (slows atrial conduction)



# OSA and AF ORBIT-AF

- Coexisting OSA patients had significantly worse AF sx/ recurrent/ rhythm control/ poor outcome for ablation therapy.
- There is evidence that treating OSA modifies these risks.

# Arrhythmias

- Sinus pauses/ SB
  - Tachy-brady syndrome
  - Complex ventricular ectopy
  - SVT/ NSVT
  - Prolong QT
  - Sudden cardiac death
- 
- There are limited data suggesting a beneficial effect of cpap therapy on reducing rhythm disturbances in OSA patients

# SDB and HF (rEF)



SDB 50% - 70%.



CSA accounts for two thirds of the sleep apnea.



Therapy is controversial

CPAP somewhat helpful  
ASV (CANPAP) – not beneficial  
ASV (SAVIOR-C) - harmful in CHF  
ASV (ADVENT-HF) – on going

# OSA and CAD/CVA



Increased SNS activity, oxidative stress, and predilection to poorly controlled and/or resistant hypertension.



endothelial dysfunction, promotion of a procoagulable state

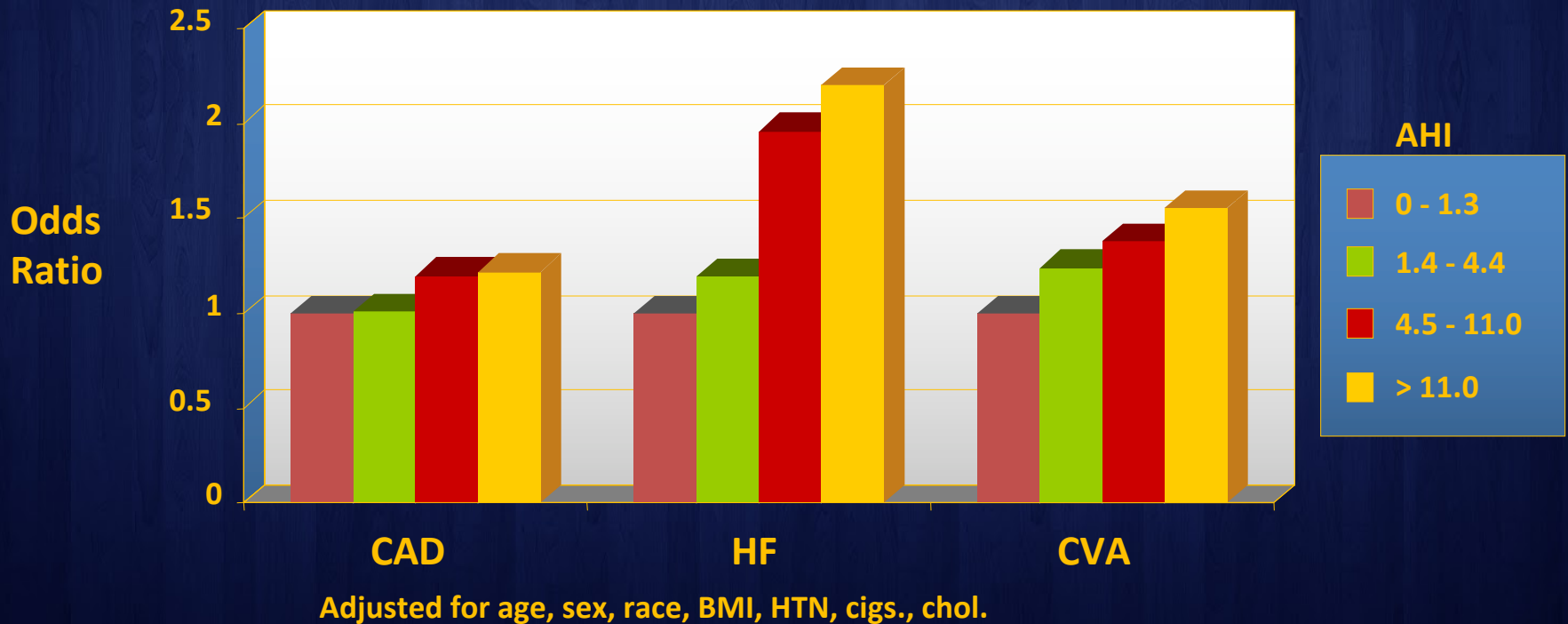


Metabolic dysregulation/ Insulin resistance

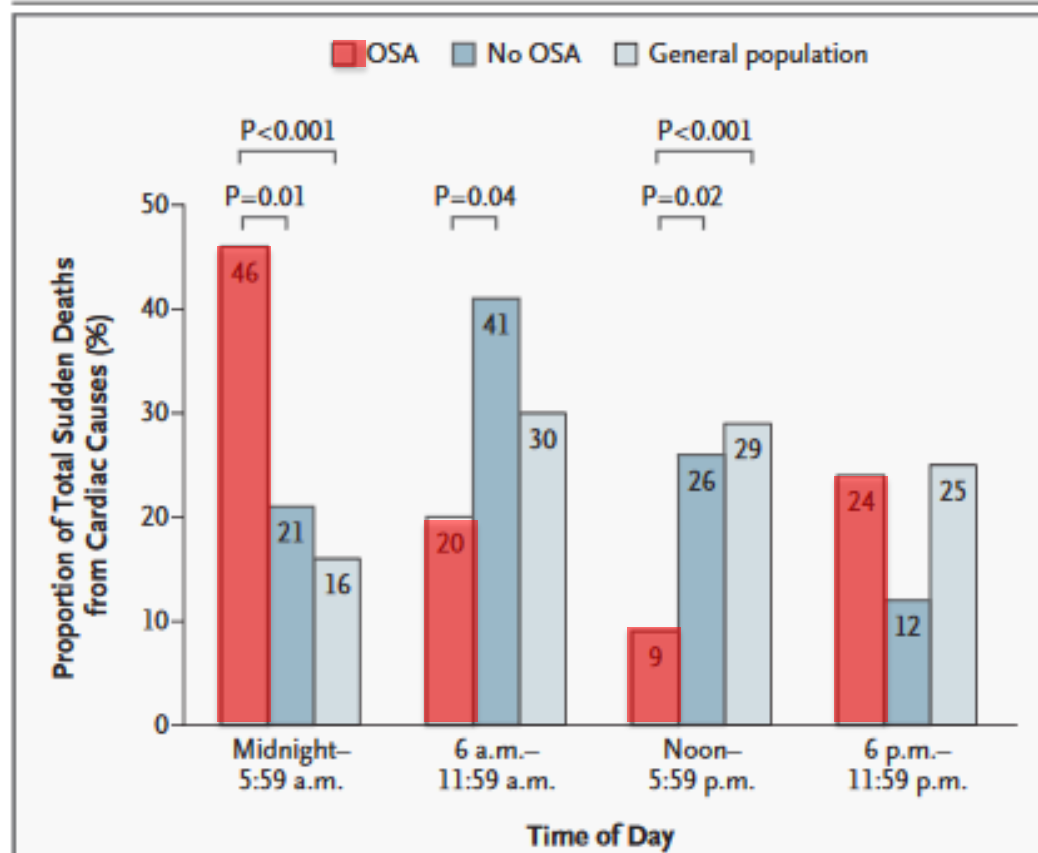


# OSA and Cardiovascular Disease

Cross Sectional Study of Association Between OSA and CVD  
Sleep Heart Health Study (SHHS)



# OSA and Sudden Cardiac Death Timing



**Figure 1.** Day–Night Pattern of Sudden Death from Cardiac Causes in 78 Persons with and 34 Persons without Obstructive Sleep Apnea (OSA) and in the General Population.

Data for the general population were derived from Cohen et al.<sup>1</sup>

# OSA and CAD/CVA

## early studies

- Increased risk of mortality post CVA in untreated OSA patients
- OSA treatment on improving cardiovascular outcomes
  - significant reduction in the composite end point of cardiovascular death, acute coronary syndrome, hospitalization for HF, or need for coronary revascularization

# OSA and CAD/CVA

## recent RCT

- In patients with a history of stroke, Hsu et al found no reduction in recurrent CVA events in patients with OSA treated with CPAP
- Parker et al— showed no difference in CVS outcome in patients with CAD treated with CPAP

# Other trials,....

- SAVE trial
  - The largest RCT designed to investigate the question of whether treating OSA with CPAP may improve cardiovascular outcomes in patients with established CVD.
    - No reduction in primary end points
- Barbe et al (not established CVD)
  - No reduction in cardiac end points
- Yu et al (meta analysis of 10 RCT)
  - No association between PAP therapy and major CV events

# Confusion/ Limitations

- While PAP therapy appears to be effective in reducing sx of OSA, the results of these RCT do not support its efficacy in reducing the risk of adverse CV events in patients with OSA.

# SAVE Study

- Excluded if they had EDS
- Excluded if severe hypoxemia
- 63% Asian
- Mean BMI 29
- HSAT (Included CSA/CSR/complex apnea)
- Minimum level of CPAP therapy 3 hours
  - Other studies suggest CPAP  $\geq$  4 hours minimum is required to achieve CV benefits in non-sleepy patients <sup>2,3</sup>

<sup>1</sup>NEJM August 2016

<sup>2</sup>Barbe et al. JAMA 2012; 307

<sup>3</sup>RICCADSA Trial – AJRCCM Sept 2016, 194(5)

# Keep the CPAP



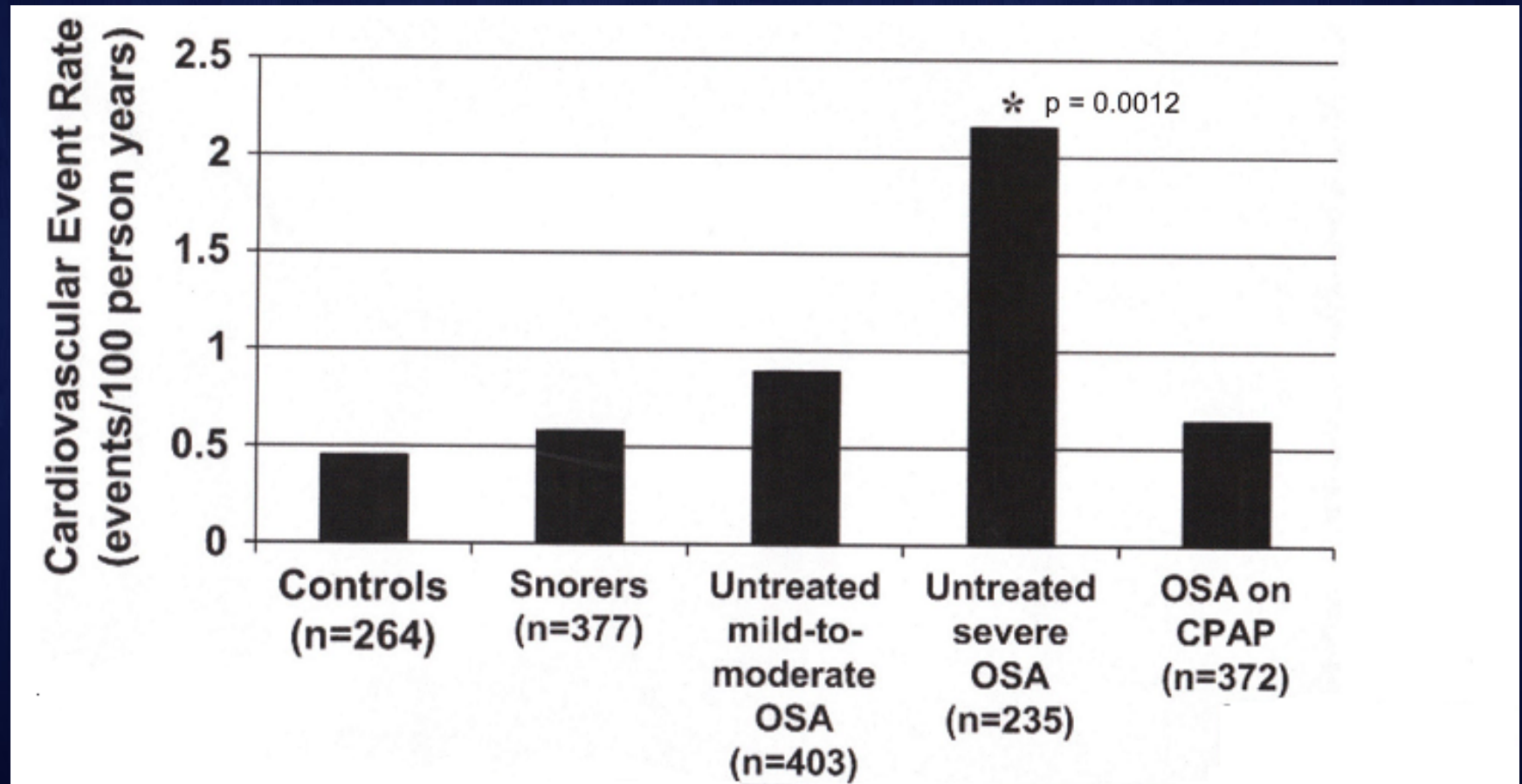
Yu's meta-analysis revealed that in the 4 RCTs



achieving median adherence >4 hours/night, PAP therapy was associated with a significantly lower risk of adverse cardiovascular events



# Cardiovascular Events On CPAP



# ACC 2017 Guidelines

- Hypertension
- Smoking
- Diabetes
- Dyslipidemia
- Excessive weight
- Low fitness
- Unhealthy diet
- Psychosocial stress
- *Sleep apnea*

# Conclusions



Sleep apnea is common and the prevalence is expected to increase.



Obesity is not the only risk factor for OSA!



Think about screening for sleep apnea in your patients with cardiovascular disease.

# Future

- Aussies
  - No prescription needed
- CVS minute clinic to stream line OSA care
- CPAP are getting smaller
- Non CPAP therapy - Inspire

