



## **Sleep apnea: an update**

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### Content

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Definition and pathophysiology of sleep apnea

Sleep apnea: more than only disturbing snoring !

Epidemiology

Therapeutical options (cfr workshop)

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# Content

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## Definition and pathophysiology of sleep apnea

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## Definition

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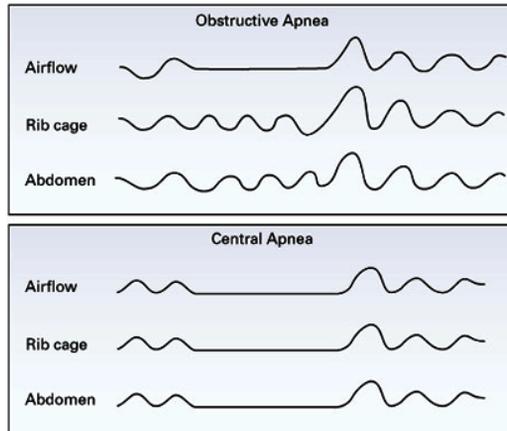
### During sleep

- **Apnea:** no « airflow » for at least 10 sec
- **Hypopnea:** reduction in « airflow » for at least 10 sec with oxygen desaturation and/or a sleep arousal
- Apneas and hypopneas should be differentiated in **obstructive** and **central**.



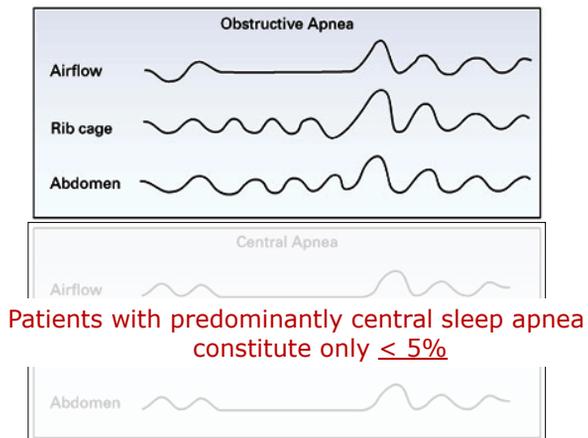
## Difference obstructive vs central

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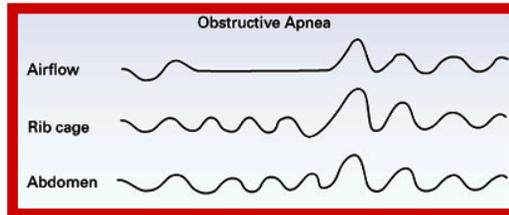


## Difference obstructive vs central

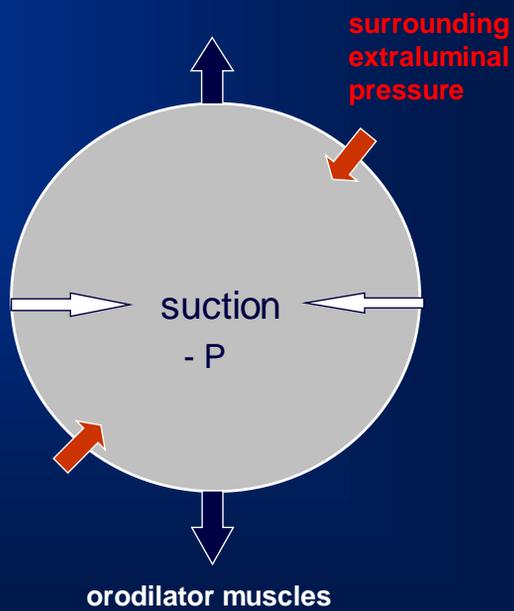
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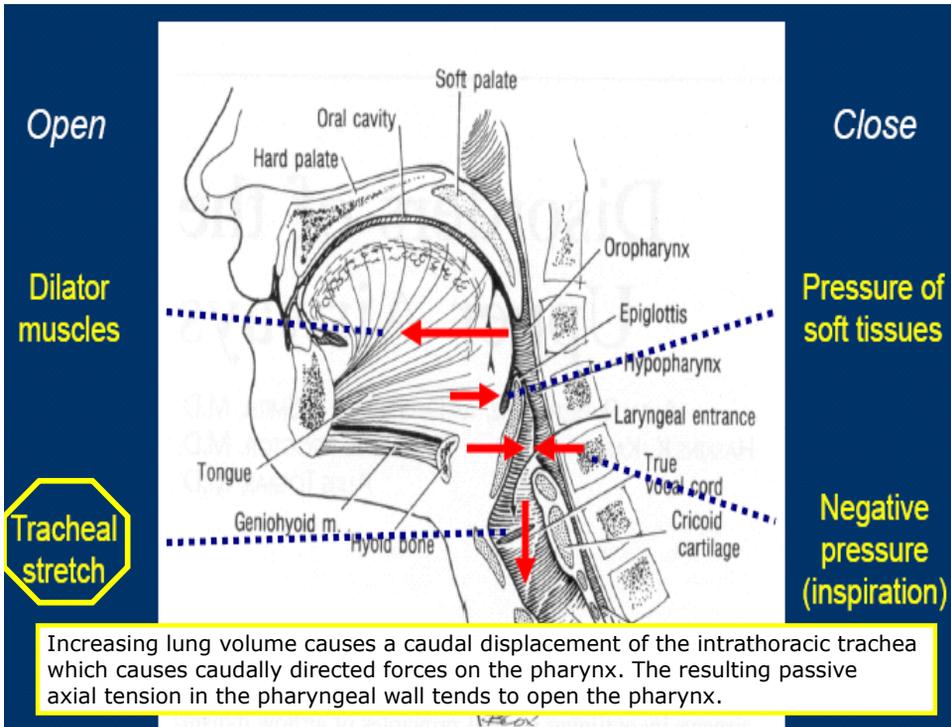
Only obstructive sleep apnea (OSA) will be discussed



Patients with predominantly central sleep apnea constitute only  $\leq 5\%$



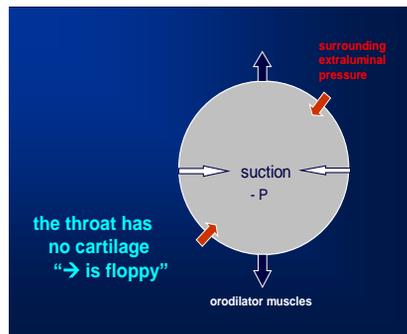
the throat has no cartilage  
“→ is floppy”



## OSA: pathophysiology

During wake, there is a tonic (continuous) tonus of the pharyngeal “orodilator muscles”.

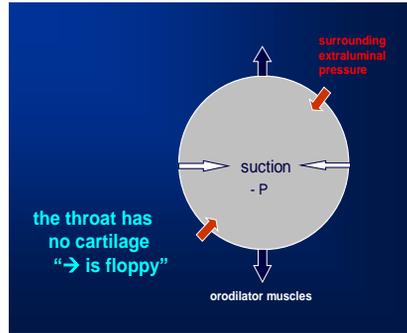
PLUS in case of suction on the pharyngeal wall with tendency to collapse, a phasic increased orodilator tonus appears to avoid pharyngeal collapse.



# OSA: pathophysiology

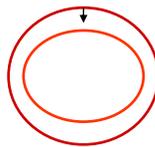
During wake, there is a tonic (continuous) to **Tonic "continuous" tonus** ↓ muscles.

PLUS in case of suction on the pharynx **Phasic reflex** ↓ y to collapse orodilator tonus appears to avoid pharyngeal collapse.



## Sleep

Normal



Normal --- > snoring --- > hypopnea --- > apnea



### **Anatomical pharyngeal narrowing**

*is rarely the only cause, exceptions are "huge" tonsils (in children) or "impressive " micro and/or rethrognathia.*



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### **Increased collapsibility of the pharynx**

due to:

- increased compliance of the pharyngeal wall and/or
- important amount of tissue mass around the collapsible pharyngeal wall.

**The example: obesity !**



+/- 70 % of OSA are obese

OSA is present in +/- 40% of obese  
(men > women)





## **Anatomical pharyngeal narrowing**

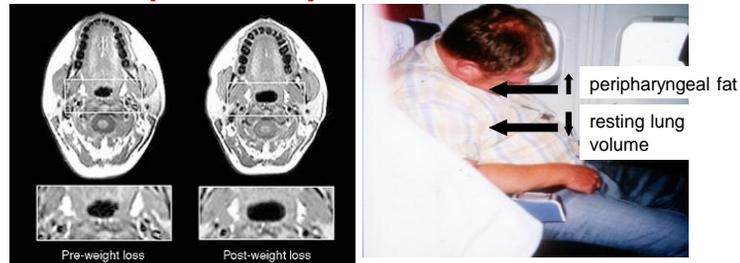
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**The example: obesity !**

### **"Balance of forces" theory"**

During inspiration the contraction of the pharyngeal dilatory muscles appears 100-200 msec earlier than the inspiratory diaphragmatic contraction. In case of no correct amplitude + time balance in muscle activation → pharyngeal collapse.

# Content

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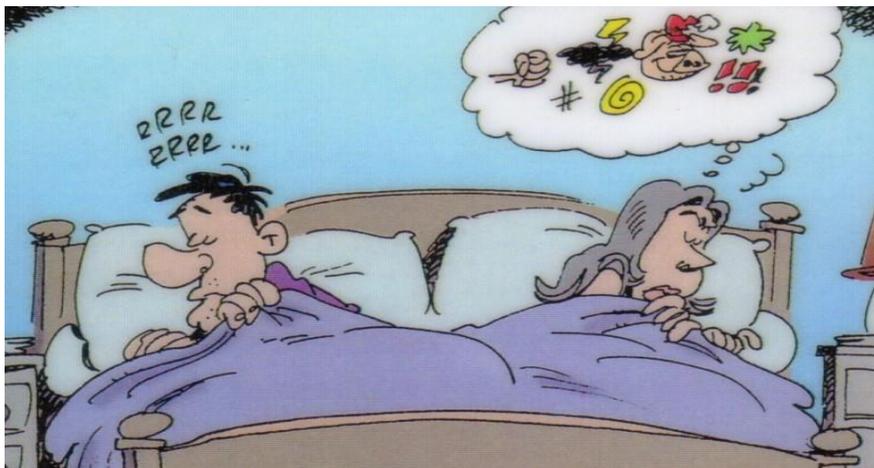
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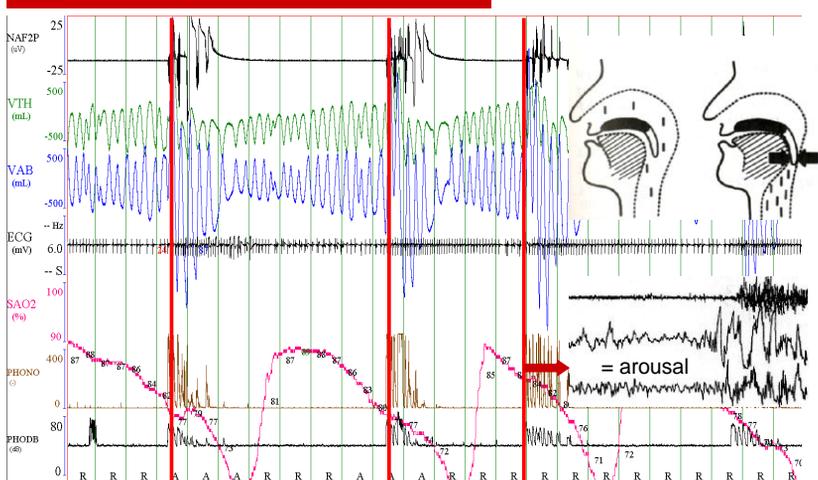




Key – symptoms:

- “Continuous” snoring
- Witnessed apneas
- “Hypersomnolence” during daytime

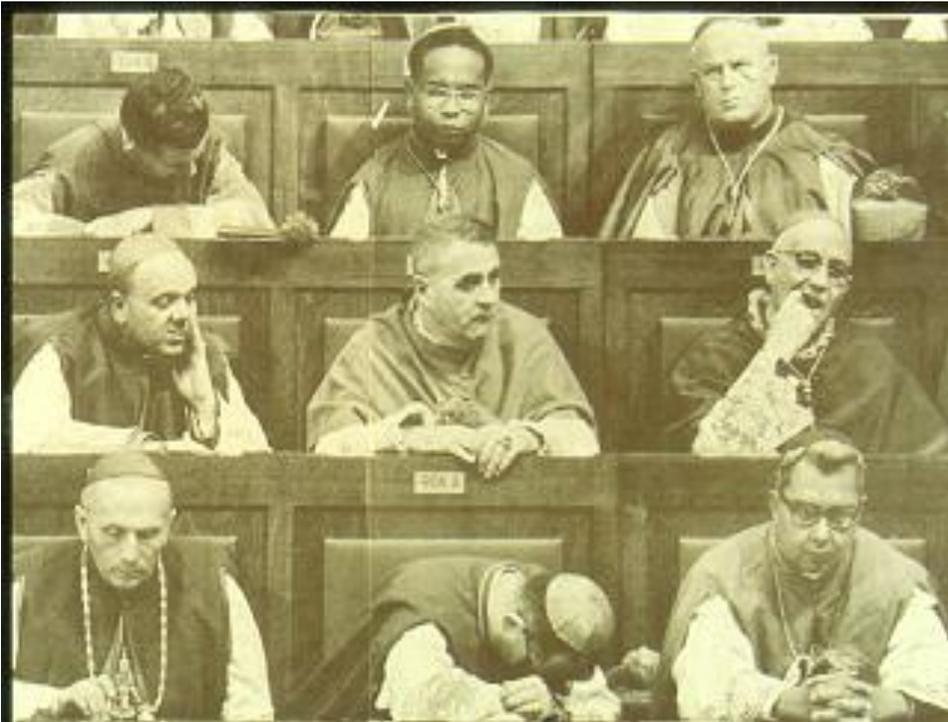
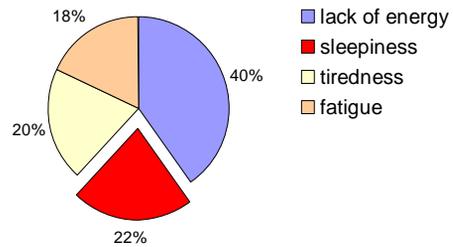
## OSA

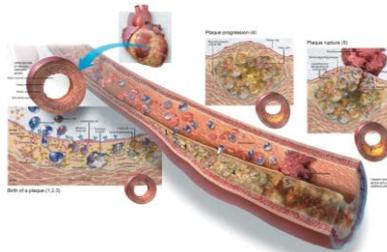
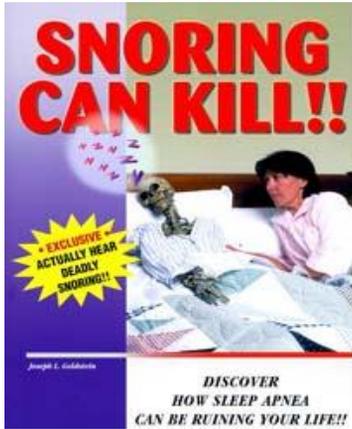


# "Hypersomnolence"

To fall asleep not always present

word preferred to describe their problem  
(Chervin Chest 2000)





### Mechanisms?

**Birth of a plaque (1,2,3)**

- SPERM SECTION OF HEALTHY CORONARY ARTERY
- Blood-lumen
- Intima
- Media
- Adventitia
- LDL
- Macrophage
- Endothelial cell
- Adhesion molecule
- Chemokine
- Smooth muscle cell
- Matrix-degrading enzyme
- LDL
- Macrophage
- Endothelial cell
- Adhesion molecule
- Chemokine
- Smooth muscle cell
- Matrix-degrading enzyme
- LDL
- Macrophage
- Endothelial cell
- Adhesion molecule
- Chemokine
- Smooth muscle cell
- Matrix-degrading enzyme

**Plaque progression (4)**

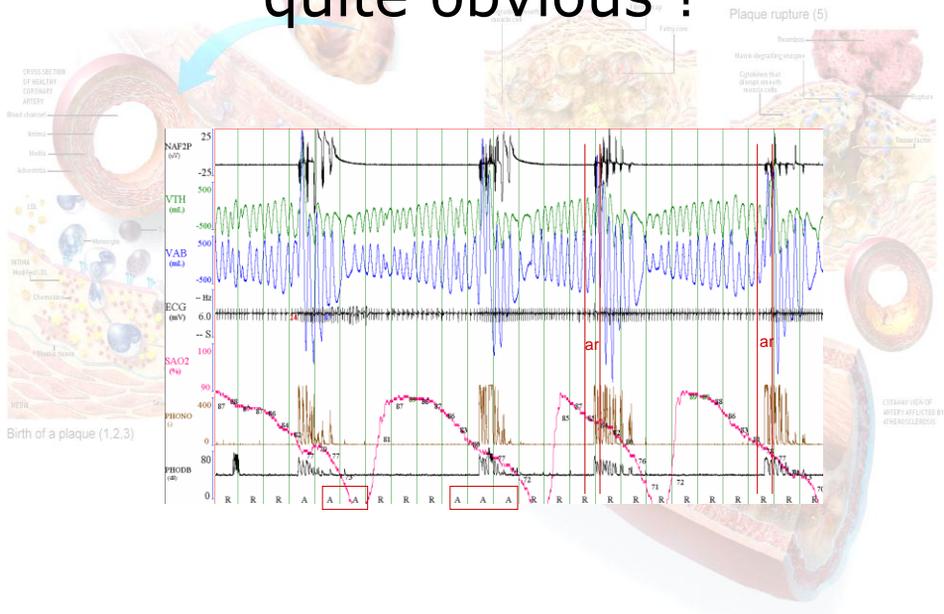
- Fibroblast
- Fatty core
- Necrotic core
- Matrix-degrading enzymes
- Cholesterol-rich macrophage
- Smooth muscle cell

**Plaque rupture (5)**

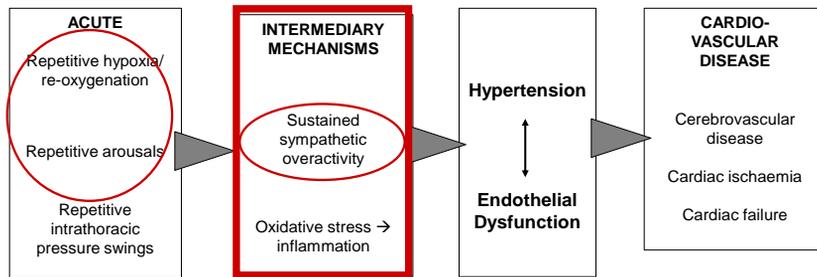
- Fibroblast
- Matrix-degrading enzymes
- Cholesterol-rich macrophage
- Smooth muscle cell

**STAINED VIEW OF ARTERY AFFECTED BY ATHEROSCLEROSIS**

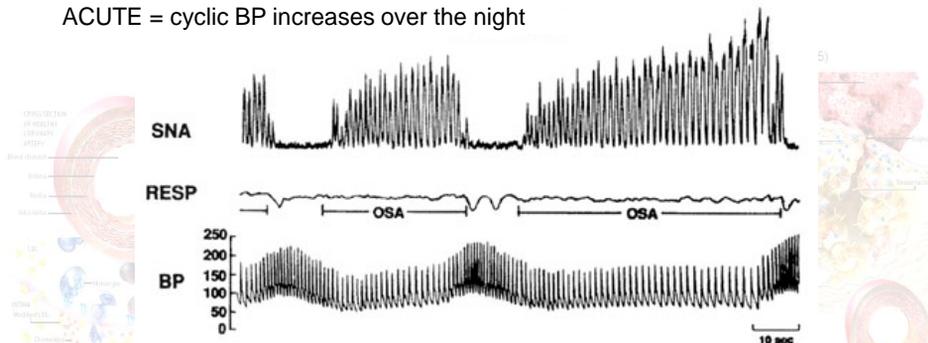
quite obvious !



Repetitive struggling !



ACUTE = cyclic BP increases over the night



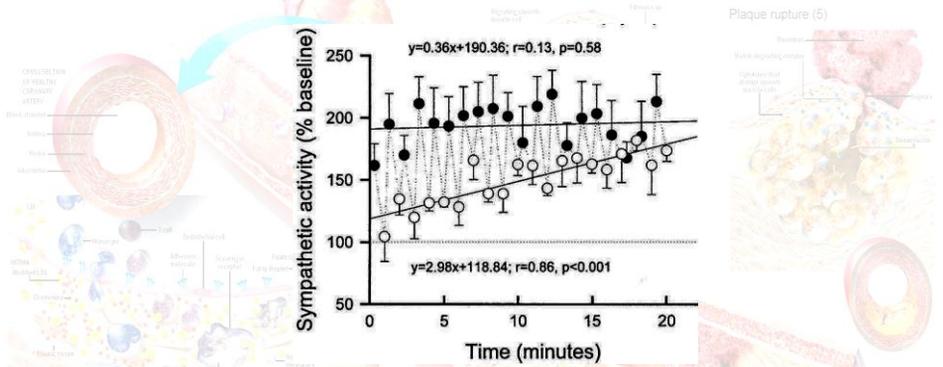
During each obstructive event there is an increase in sympathetic activity (represented in the slide as muscle sympathetic nerve activity (SNA)) which is accompanied by a BP increase.

There are substantial data providing support that asphyxia during the apnoea acutely stimulates chemoreceptors and chemoreceptor stimulation acts through the central nervous system to increase sympathetic neural activity: BP increases as the apnoea progresses.

During the resumption of ventilation, the restoration of venous return and consequently increased cardiac output, together with severely constricted peripheral circulation, contribute to an acute increase in BP.

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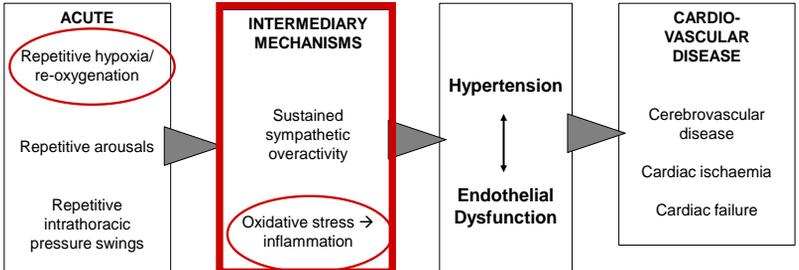
**NIGHTLY CYCLIC SYMPATHETIC OVERACTIVITY → SUSTAINED 24 h HT**

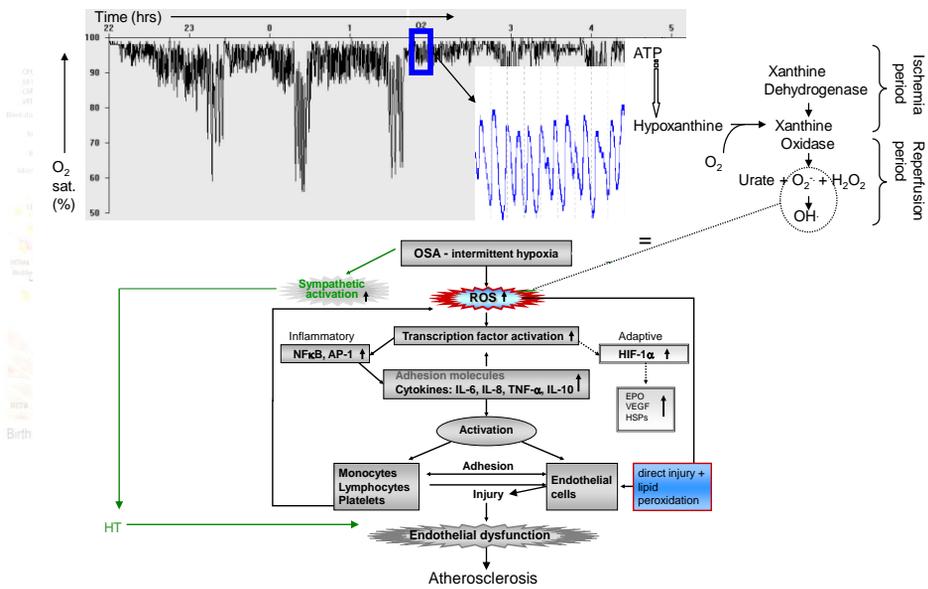
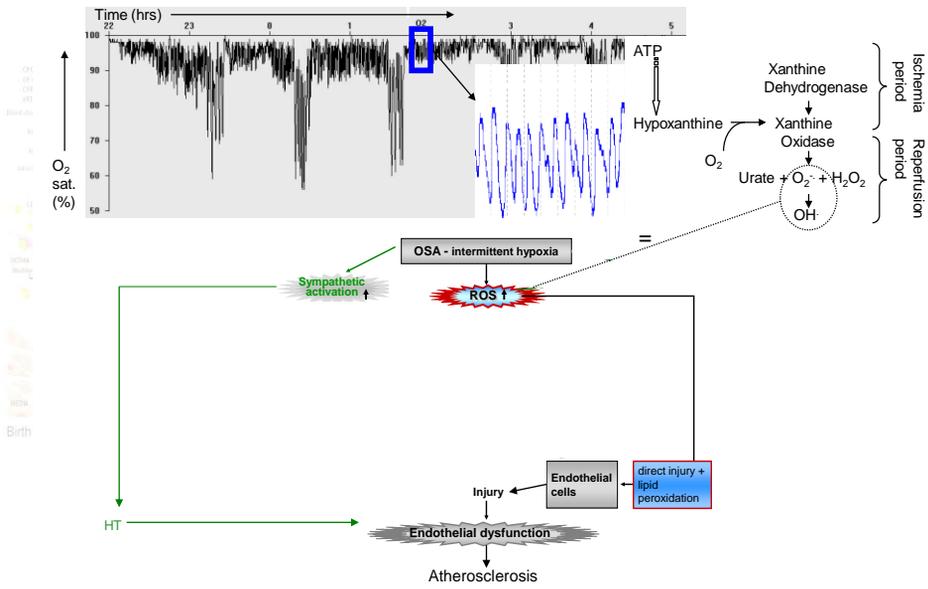


Xie (JAP 2000) administered to healthy subjects intermittently a hypercapnic hypoxic gas mixture (20 sec on the gas mixture, 40 sec normoxia).

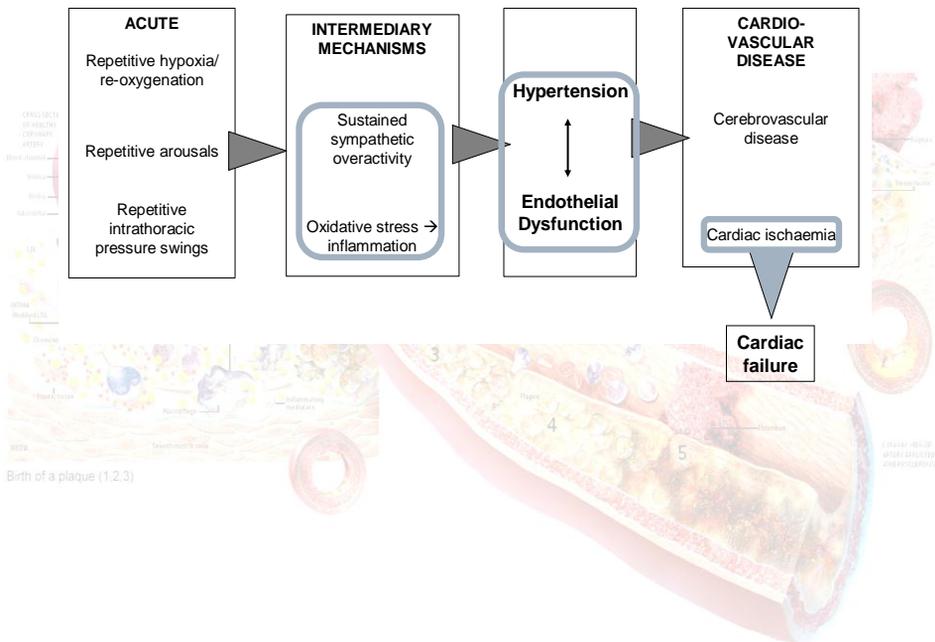
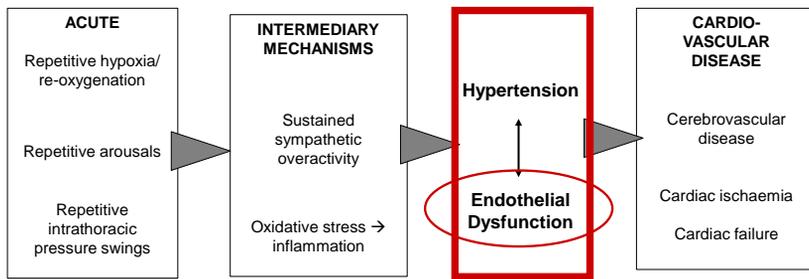
MuscleSNA followed a cyclic crescendo decrescendo pattern (increase with asphyxia, decrease with normoxia), but with each successive interasphyxia period, muscleSNA became progressively elevated, not returning to baseline, already within minutes.

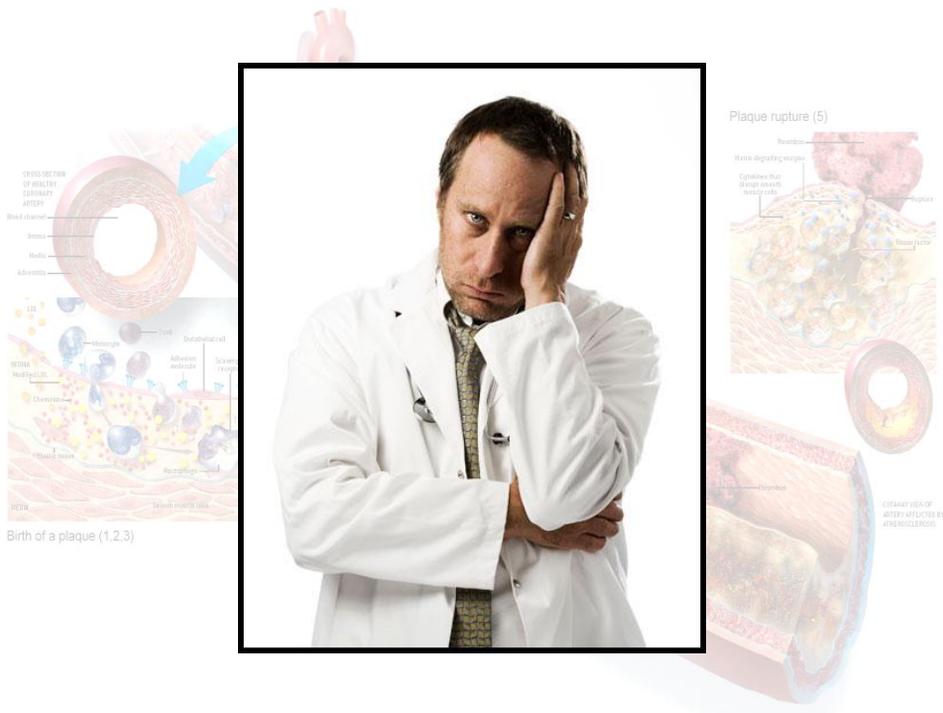
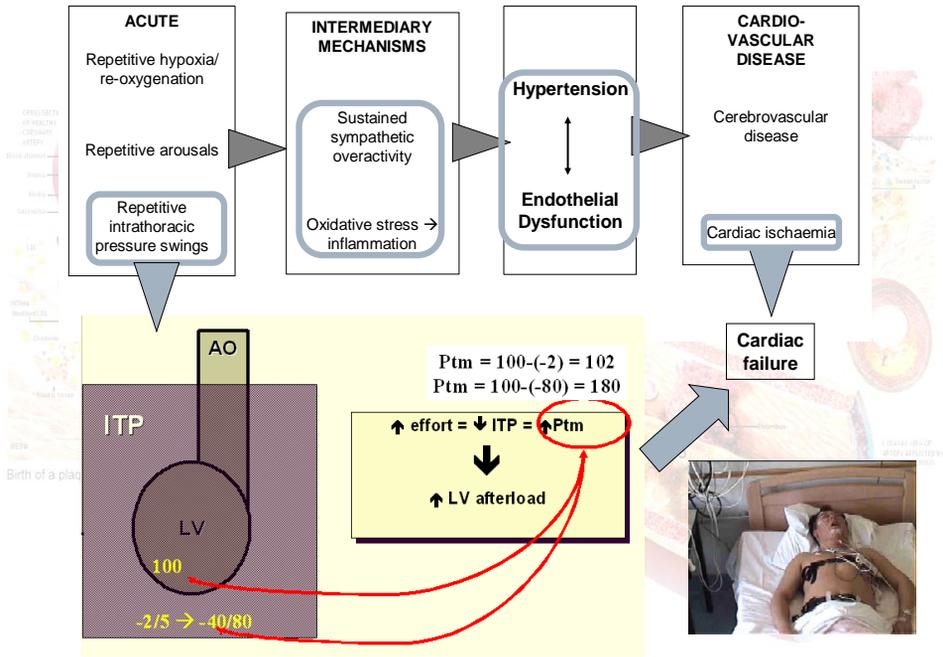
There exist human clinical data suggesting that chemoreflex sensitivity can be reset, augmented following exposure to cyclic intermittent hypoxia, resulting in a concomitant depressed baroreceptor control sensitivity.

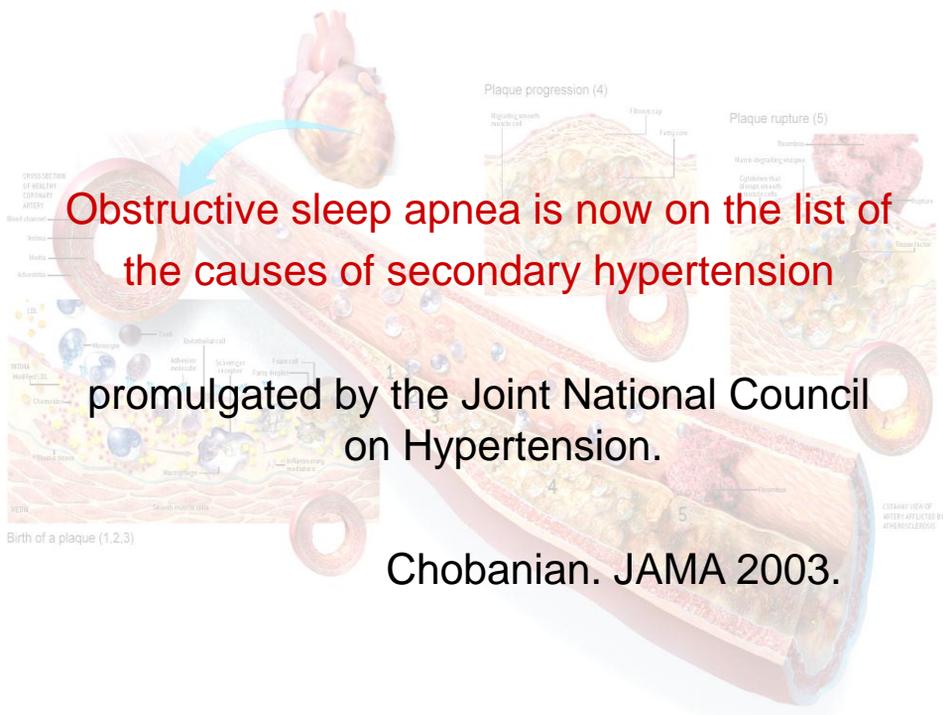
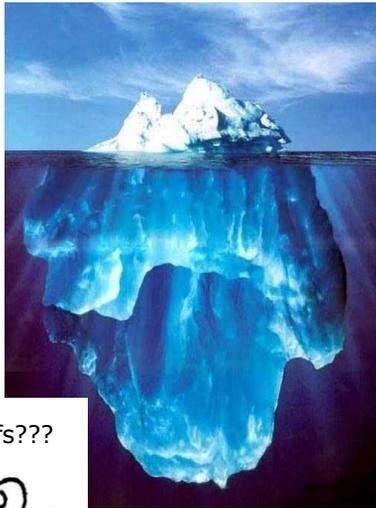




The blood vessel is a dynamic organ capable of sensing injury (due to shear stress in case of HT, excessive ROS production), communicating such injury via intracellular signals, and subsequently altering its structure (vasodilation <-> vasoconstriction → remodelling/atherosclerosis).



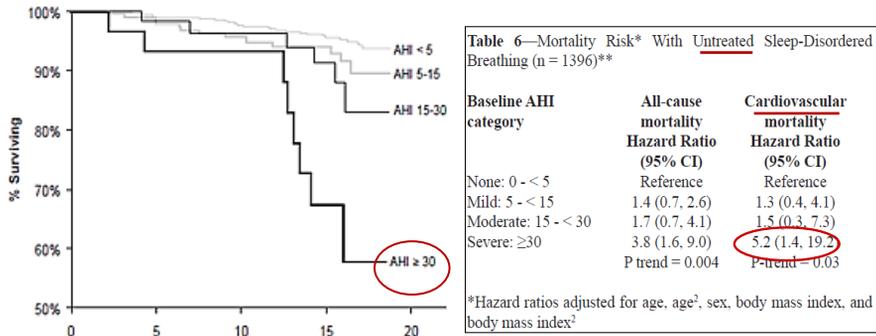




**Sleep disordered breathing and mortality: eighteen-year follow-up of the Wisconsin sleep cohort.**

Young T, Finn L, Peppard PE, Szklo-Coxe M, Austin D, Nieto F.J, Stubbs R, Hla KM.

Department of Population Health Sciences, University of Wisconsin-Madison, Madison, WI, USA. tbyoung@wisc.edu



Young. Sleep 2008; 1071

**Long-term cardiovascular outcomes in men with obstructive sleep apnoea-hypopnoea with or without treatment with continuous positive airway pressure: an observational study**

Follow-up during 10.1 +/-1.6 yrs of a male population (n=1651):

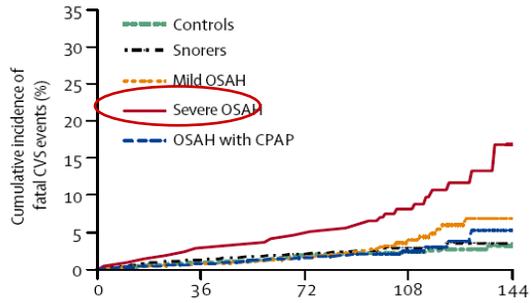
- 264 healthy men
- 377 simple snorers
- 403 untreated mild-moderate OSA
- 235 untreated severe OSA
- 372 CPAP treated OSA

Marin. Lancet 2005; 1046

Odds ratio (95% CI)  
on incidence of **fatal CVS** events:

Part\*adj: 3.02 (1.44-7.33) -  
p=0.015

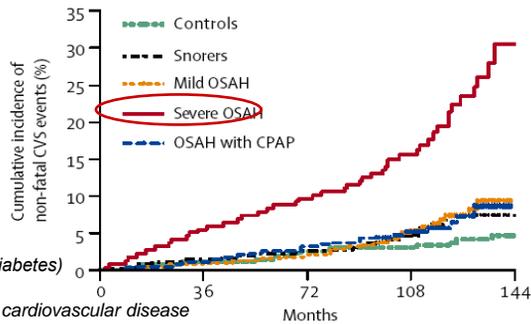
Fully\*\*adj 2,87(1,17-7,54) -  
p=0.025



Odds ratio (95% CI)  
on incidence of **non-fatal CVS**  
events:

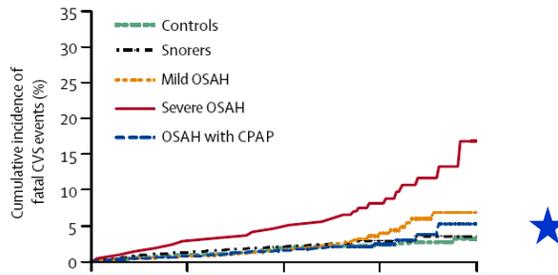
Part\* adj: 3.32 (1.24-7.41) -  
p=0.0005

Fully\*\* adjj: 3,17(1,12-7,52) -  
p=0.001

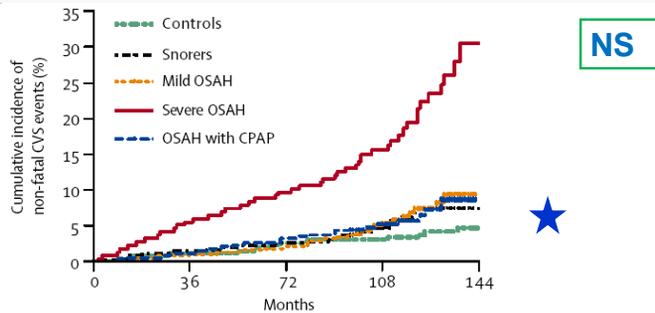


\*for all kind of cardiovascular risks  
(age, BMI, smoking, .....cholesterol, diabetes)

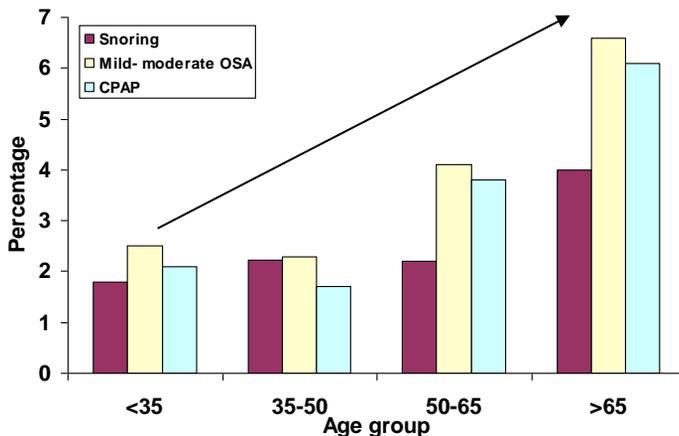
\*\* also including hypertension, baseline cardiovascular disease



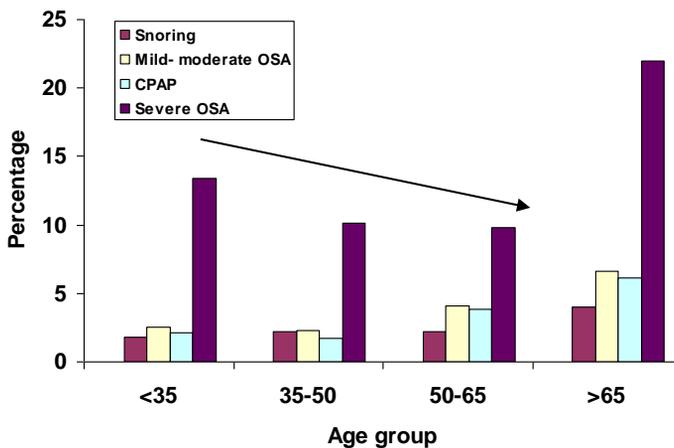
Subjects on CPAP treatment using CPAP > 4 h/night presenting a  
baseline AHI>30 or AHI in between 5 and 30 with symptoms



**CVD Mortality rates in snorers, mild to moderate and CPAP treated patients (Data from Marin et al, 2005 and Lavie et al, 2006, personal communication)**



**CVD Mortality rates of snorers, mild to moderate, severe and CPAP treated patients (Data from Marin et al. 2005, Lavie et al. 2006, personal communication)**



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Sleep apnea: more than only disturbing snoring !

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## Sleep apnea: prevalence

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TABLE 2. AGE-SPECIFIC PREVALENCE RATES OF OSAH AT DIFFERENT SCORES OF THE APNEA-HYPOPNEA INDEX BASED ON POLYSOMNOGRAPHIC RESULTS FOR THE TOTAL SAMPLE OF 1,050 MEN AND 1,098 WOMEN

Data	Percentage of Subjects (95% Confidence Interval)				
	≥ 5	≥ 10	≥ 15	≥ 20	≥ 30
<b>Men</b>					
All ages, yr	26.2 (20-32)	19.0 (14-24)	14.2 (10-18)	9.6 (7-12)	6.8 (5-9)
30-39	9.0 (2-16)	7.6 (0-15)	2.7 (1-5)	2.1 (0-4)	2.1 (0-4)
40-49	25.6 (14-37)	18.2 (9-27)	15.5 (7-24)	10.1 (5-15)	7.0 (3-11)
50-59	27.9 (17-38)	24.1 (15-34)	19.4 (11-27)	14.7 (8-21)	11.4 (6-17)
60-70	52.1 (33-71)	32.2 (17-48)	24.2 (12-37)	15.0 (8-22)	8.6 (4-14)
<b>Women</b>					
All ages, yr	28.0 (20-35)	14.9 (9-20)	7.0 (3-11)	6.0 (2-9)	2.9 (0-5)
30-39	3.4 (0-7)	1.7 (0-4)	0.9 (0-2)		
40-49	14.5 (3-25)	9.7 (0-19)			
50-59	35.0 (20-50)	16.2 (5-27)	8.6 (1-17)	8.3 (0-16)	4.3 (0-10)
60-70	46.9 (31-63)	25.6 (13-38)	15.9 (6-26)	13.0 (3-22)	5.9 (0-13)

Definition of abbreviation: OSAH = obstructive sleep apnea-hypopnea.

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Duran. AJRCCM 2001; 685



Key – symptoms:

“Continuous” snoring  
 Witnessed apneas  
 “Hypersomnolence” during daytime

+

Nycturia  
 Impotence !!!  
 Hypertension and  
 cardiovascular morbidity

Studies of OSA have shown that **severe OSA** constitutes an important cardiovascular morbidity/mortality risk that can be reduced by proper treatment.

Moreover, in view of the higher cardiovascular morbidity/mortality risks in younger patients, diagnosis and treatment of the syndrome should be carried out at the earliest age possible.





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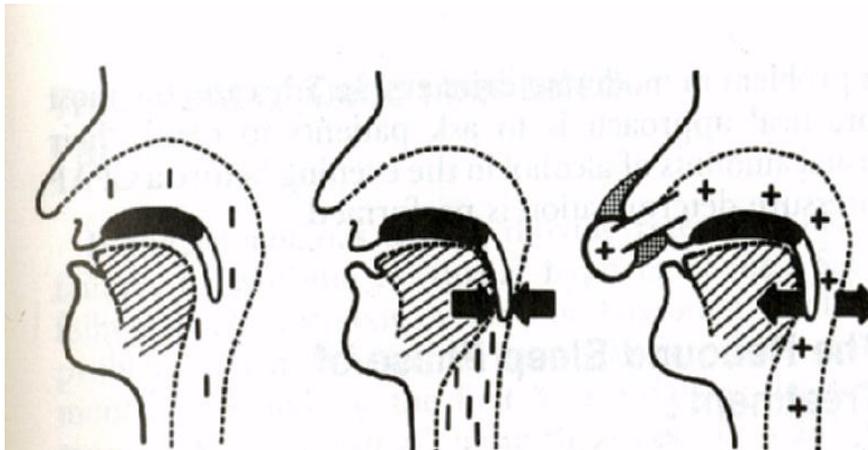
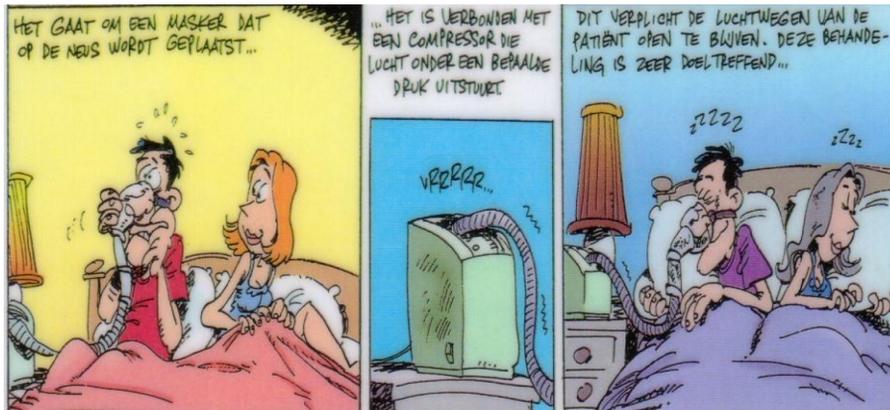
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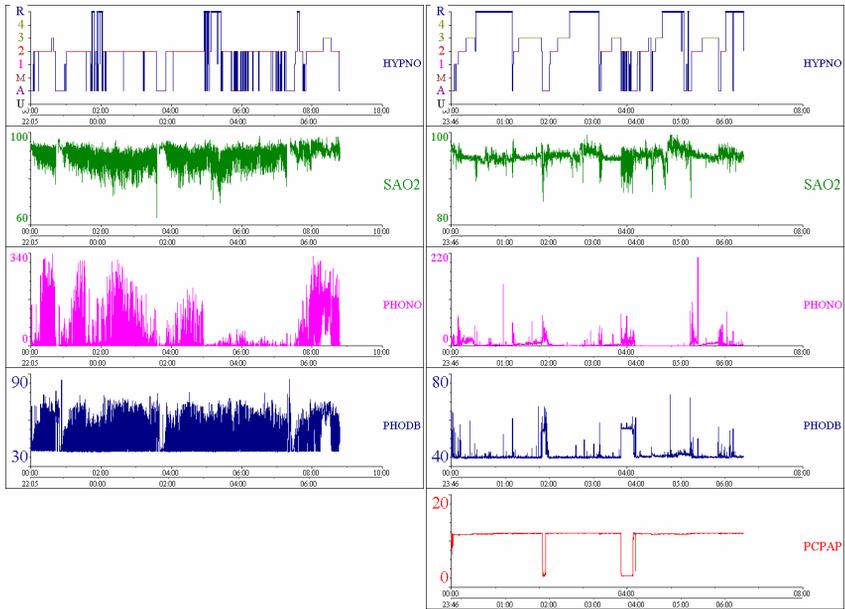
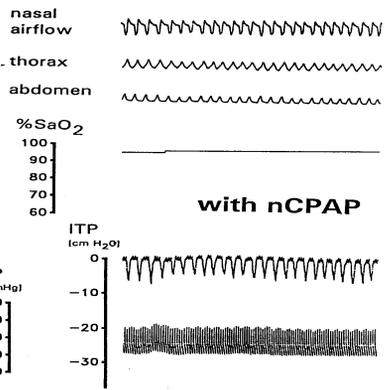
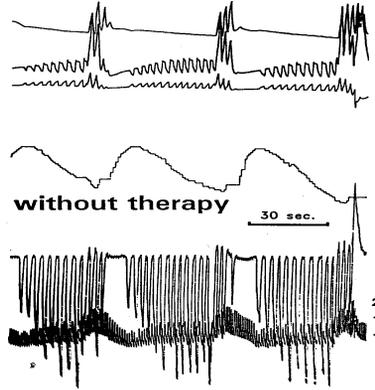
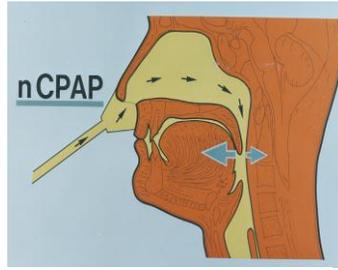
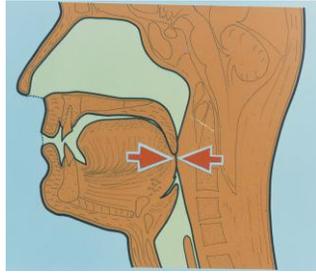
Therapeutical options (cfr workshop)

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# CPAP



- Pneumatic splint
- Reduces upper airway edema that result from chronic vibration and occlusion of the airway





Questions?

