

OSA/OHS

Obstructive sleep apnea

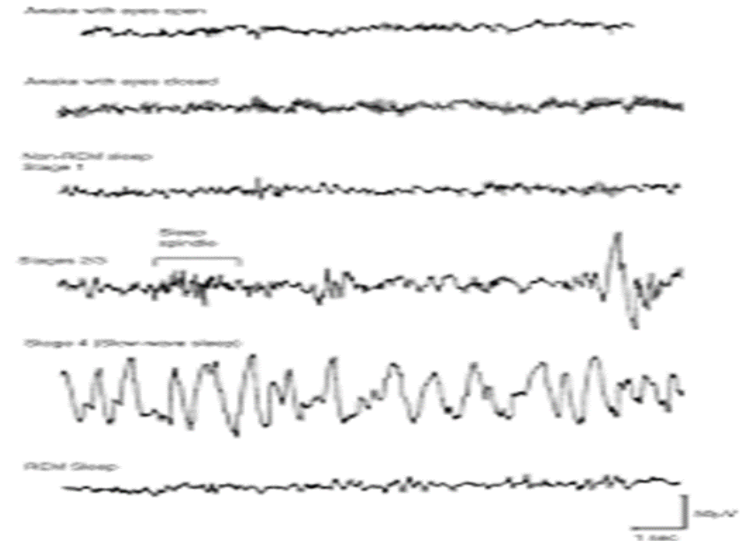
Obesity hypoventilation syndrome

History of sleep

IN 1937 Loomis and colleagues noted fragmentation and fallout of alpha rhythm with sleep onset, and subsequent onset of sleep spindles, K complexes and high amplitude slow waves. Sleep was divided into 5 stages .

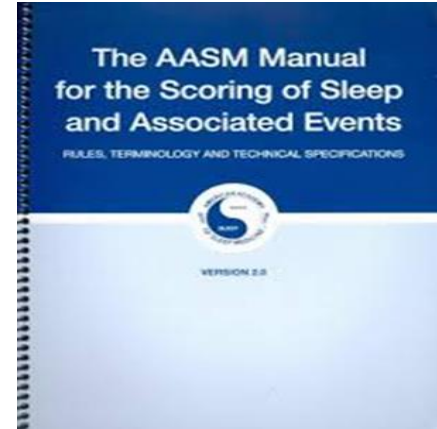
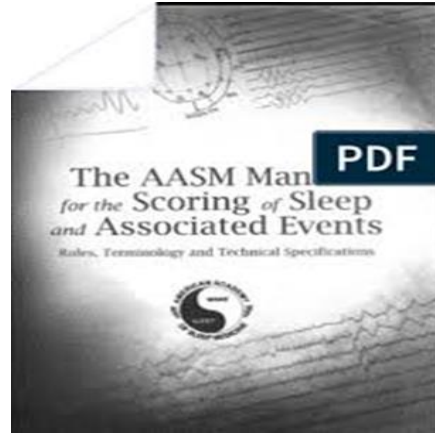
→ the awake stage.

They thought that
during sleep our brains
shuts down during sleep.

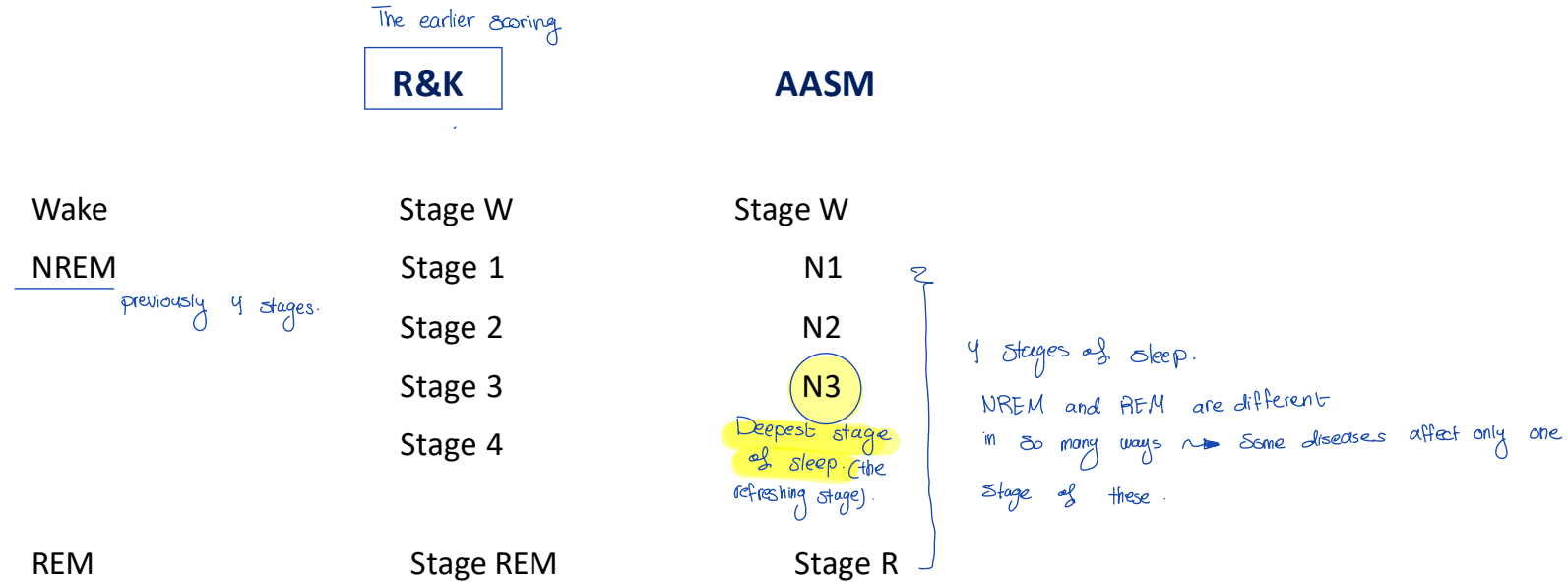


Scoring

In 2004, (AASM): Introduced new sleep scoring manual that would address sleep staging as well as the scoring of arousals, respiratory, cardiac, and movement events



Sleep Stage Nomenclature



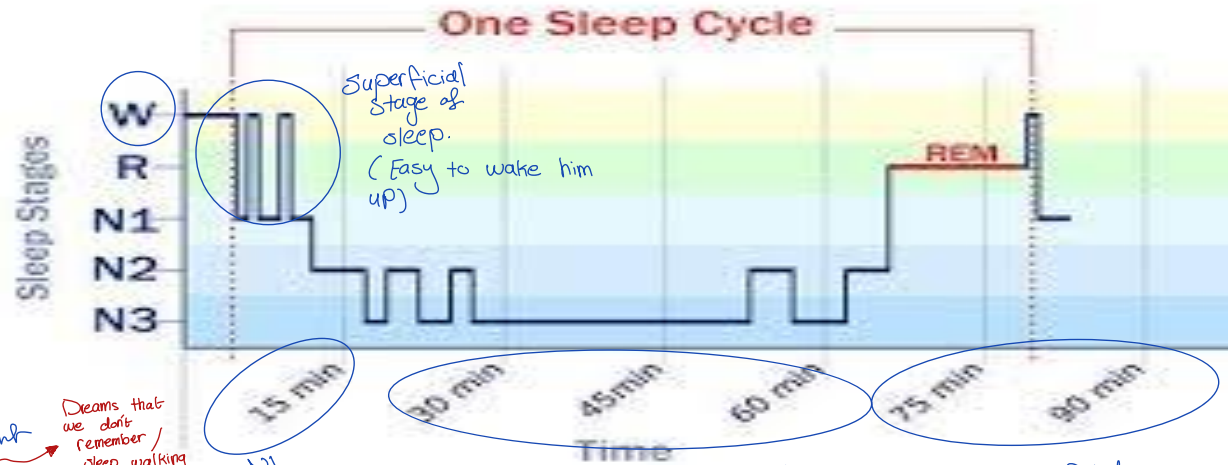
AASM = American Academy of Sleep Medicine²; NREM = non-rapid eye movement;

R&K = Rechtschaffen and Kales A1; REM = rapid eye movement; stages 3 and 4 are combined into stage N3.

Sleep architecture

→ what happens during sleep in terms of one cycle.

→ This cycle happens on average of 3-5 times in one night.



* First half of the night we have more of NREM sleep and the 2nd half more of REM sleep.

Dreams that we don't remember / sleep walking and sleep disorders.

complete paralysis of the muscles (you can't move) / Dreams that we remember.

N2 - N3 fluctuations for 60 min.

REM.

whole process take 1.5

* Note: Sleep walk or talk in the 1st half of the night is characteristic for parasomnia but if in the 2nd it's REM behavioral disorder.

Why do we sleep ?

Why sleep is important ?

Detoxification through glymphatic system / immunity / cognition.
→ lost in patients with Parkinson's

ANIMAL STUDIES

Juvel (67) deprived cats of sleep by putting them on a floating island in a pool so that when they fell asleep they fell in and woke up.



They developed abnormal behaviours and died

Rats lived on a flat circular disk above a pool of shallow water. The experimental rat was hooked up to an EEG and when it showed sleep patterns the carousel would move, causing rat to walk or fall into the water.

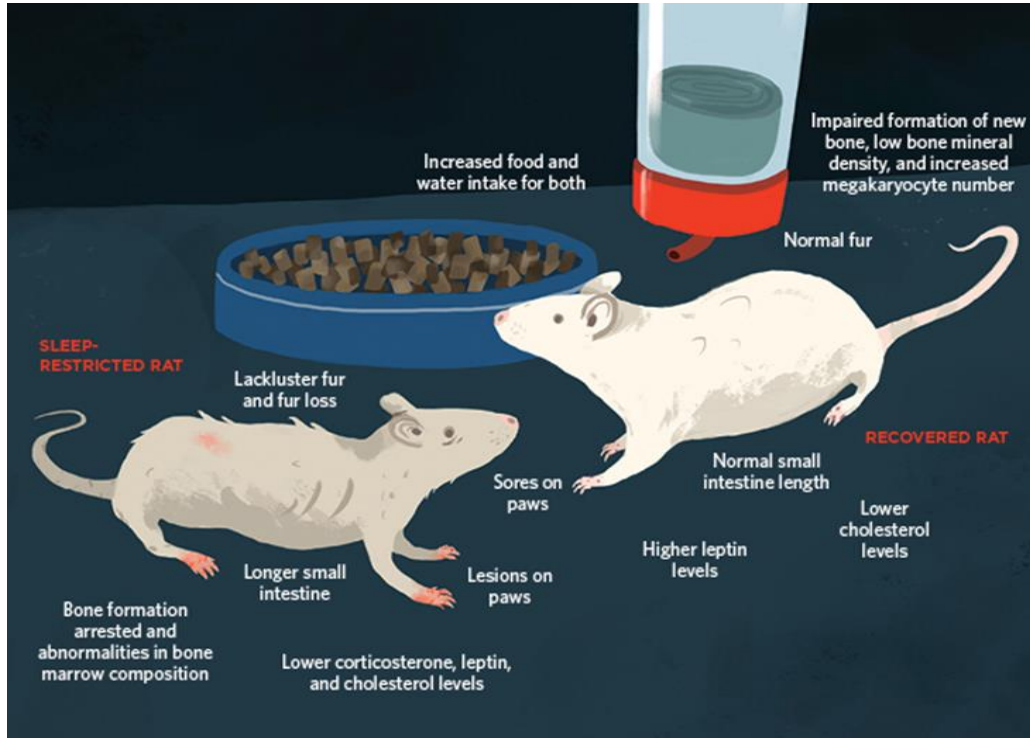


As long as the experimental rat was awake the other could sleep. The experimental rat died after several days.

+ Bone marrow suppression + more infection + less CS

<http://henrynicholls.com/2017/05/06/the-horrors-of-sleep-deprivation/>

Sleep is necessary for survival.



Sleep importance



In human studies.

- Metabolic activity of the brain decreases significantly after 24 hours of sustained wakefulness.
- A decrease in immune system function as measured by white blood cell count.
- Impairment of memory and physical performance and reduced ability to carry out mathematical calculations
- Release of growth hormone in children and young adults takes place during deep sleep
- Sleep deprivation can also cause increased heart rate variability
- Most cells of the body show increased production and reduced breakdown of proteins during deep sleep
- Maintain optimal emotional and social functioning while we are awake.

Sleep deprivation and human errors /Disasters



Chernobyl – Two drowsy plant workers died that night, 28 more in the following weeks, and over 130 were confirmed with radiation poisoning.



Three Mile Island – Sleepy shift workers didn't notice as the plant lost coolant, resulting in the overheating of the reactor's core and almost causing a melt down.



Challenger – Working long hours raised questions about critical decisions, as the space shuttle exploded seconds after launch, killing all 7 crew members.



Exxon Valdez – 1989: Supertanker runs aground, destroying wildlife and spilling 258,000 barrels of crude. Captain was allegedly sleeping at the helm.



Flight 1420 – "Impaired performance from fatigue" was blamed for overshooting the runway in Little Rock, killing 11 and injuring 105 crew and passengers.



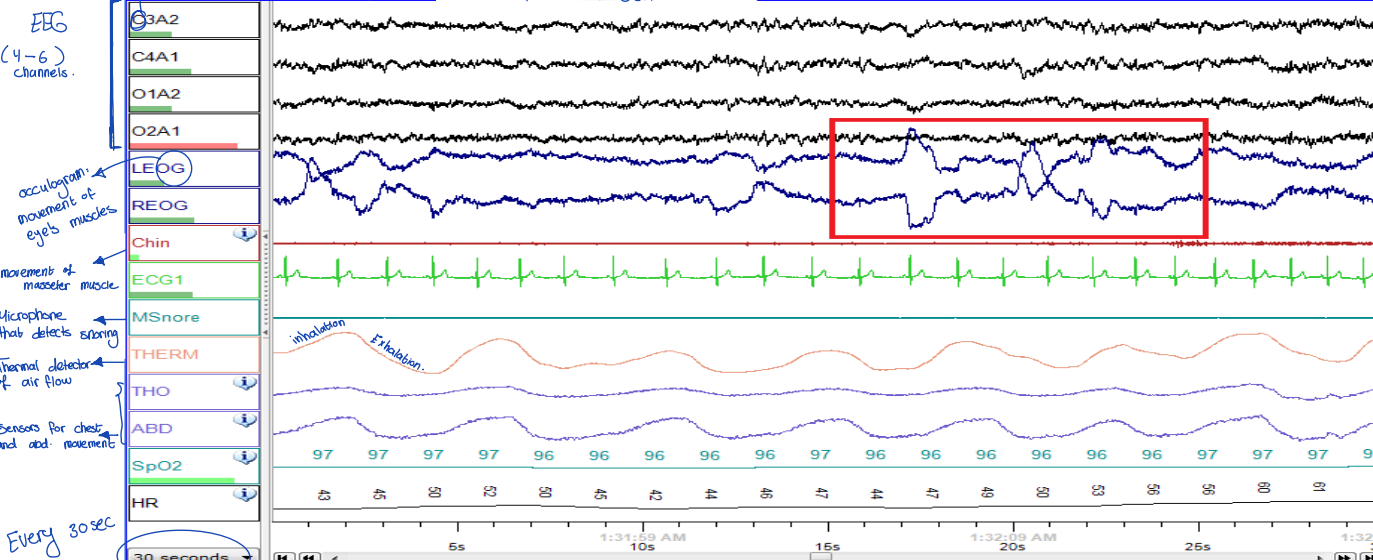
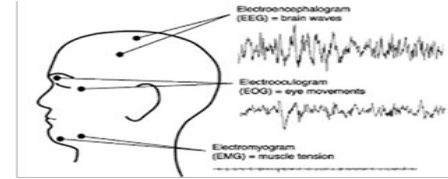
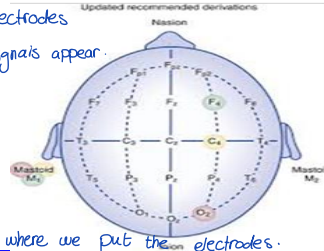
Clarkston Railway Accident – Both the engineer and conductor of train 533 had untreated symptoms of obstructive sleep apnea.

PSG

Set up and data obtained

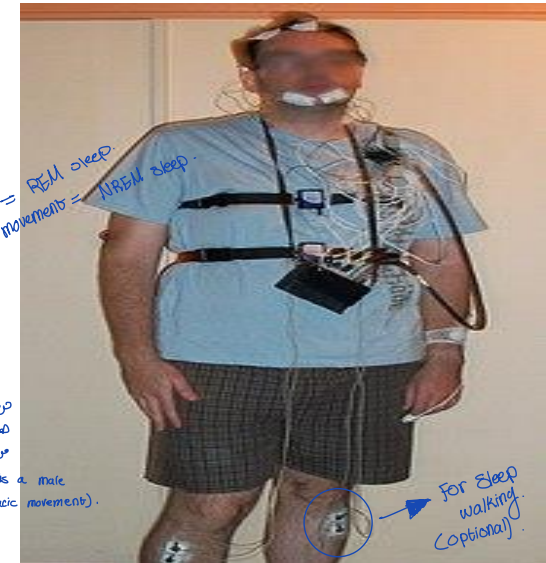
Sleep is analyzed in 30-second epochs, each of which is categorized as rapid eye movement (REM) sleep or non-rapid eye movement (NREM) sleep.

* we use electrodes
then EEG signals appear.

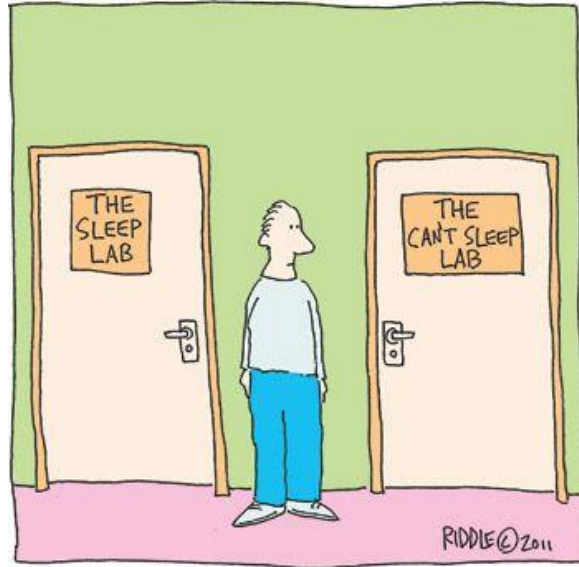


if flat = REM sleep
if some movements = NREM sleep.

Abd. ال اسو
وال اسو
chest ال اسو
That's bc he is a male
(Abdominothoracic movements).

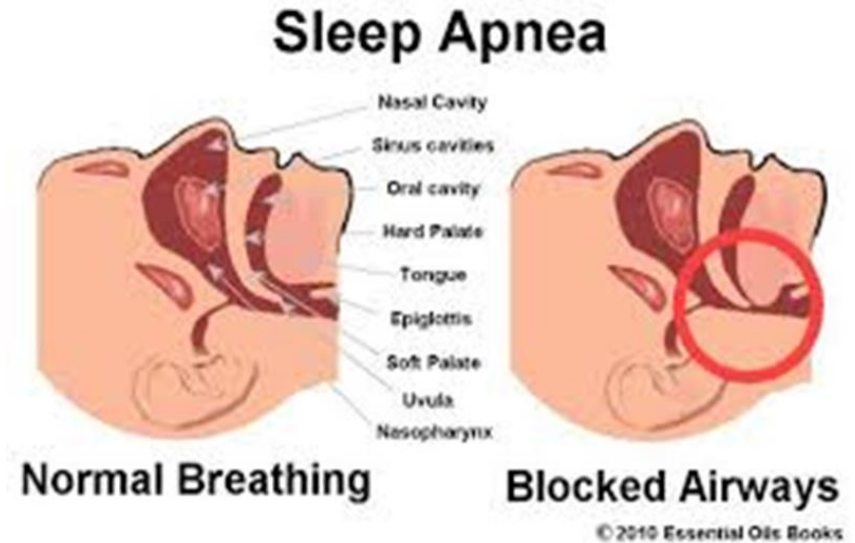
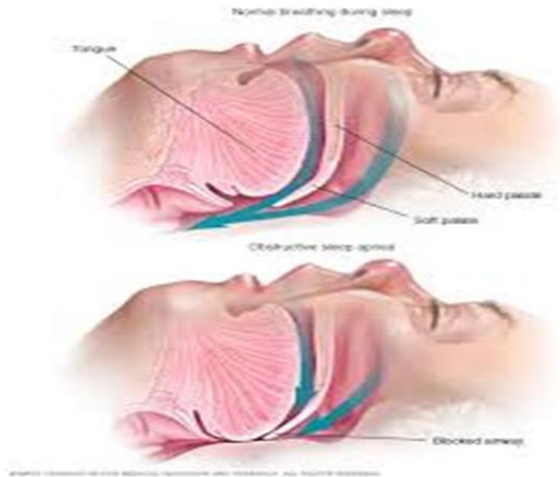


Sleep Study : At lab (level 1) → But there's first night effect where he can't sleep normally.
: At home (level 2) .



Definition

Obstructive sleep apnea (OSA) is a disorder that is characterized by obstructive apneas, hypopneas, and/or respiratory effort-related arousals **caused by repetitive collapse of the upper airway during sleep**. *Multi-factorial* causing acute disruptions to blood oxygen levels, heart rate, blood pressure, intrathoracic pressure, and sleep quality.



Is it common ? *yes common*

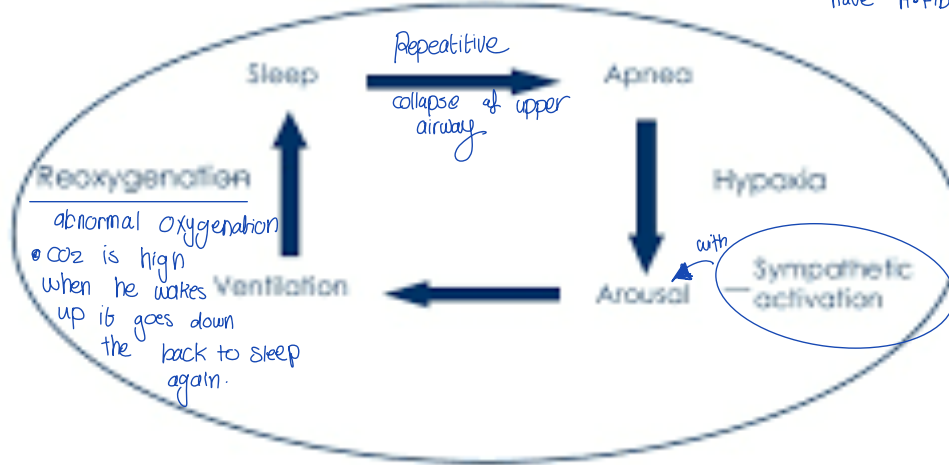
- Recent estimates indicate that from 3% to 23% of women and 9% to 49% of middle-aged men have moderate to severe sleep-disordered breathing as defined by an apnea-hypopnea index (AHI) > 15 events/h.
- 1. Heinzer R, Vat S, Marques-Vidal P, et al. Prevalence of sleep-disordered breathing in the general population: the HypnoLaus study. Lancet Respir Med. 2015.
 2. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased prevalence of sleep-disordered breathing in adults. Am J Epidemiol. 2013



"I'm the Apnea Fairy. I have orders to give you a wake up call at 10:30, 10:47, 10:53, 11:02, 11:17, 11:26..."

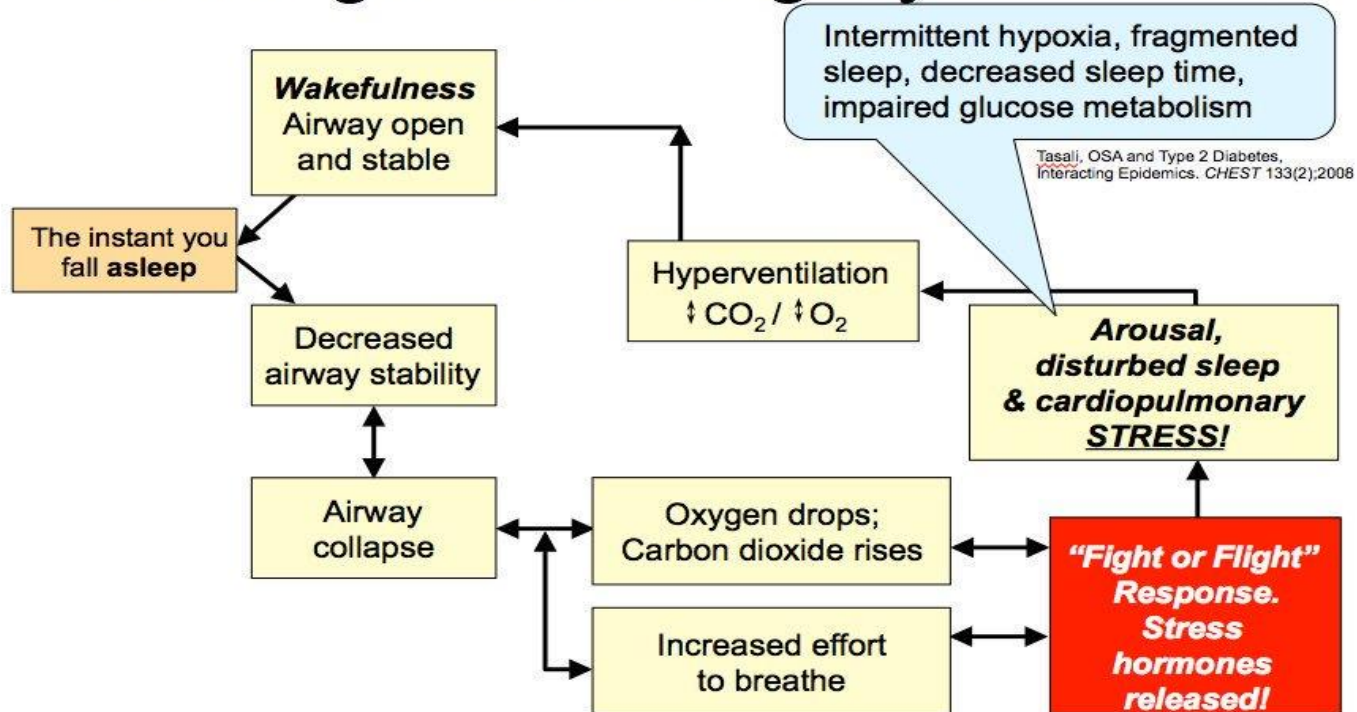
Sleep Apnea Cycle

→ patients are more likely to have A-Fib and high blood pressure.



Health effects

Pathologic Breathing Cycle of OSA



The Spectrum of Sleep-Related Breathing Disorders



upper airway
resistance
syndrome

Risk factors

obesity



Tonsillar hypertrophy



Alcohol

Smoking



Typical scenarios: Male, above 50, obese



Small retropharyngeal space



Medical problems in General (Hypothyroid).



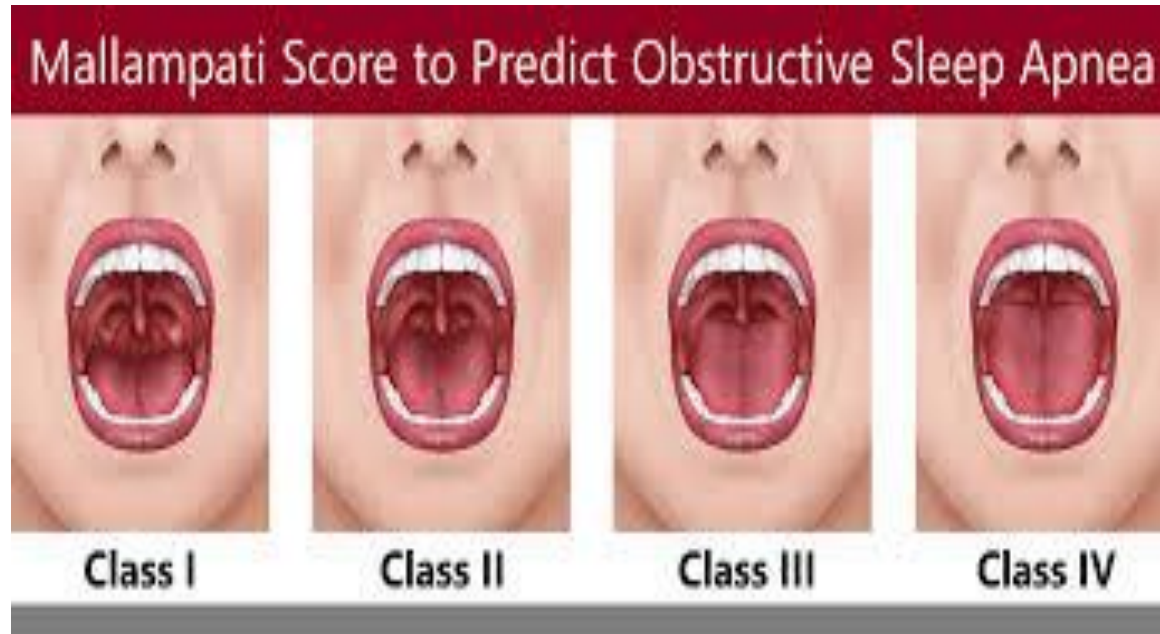
Sedative drugs



Menopause (Before menopause it's more common in males than they have the same degree)



Each unit increase in mallampati score has the odds of having OSA by 2.5, A study in 2006 found



Obstructive Sleep Apnea (OSA)

Common Symptoms & Associated Conditions

Symptoms of Sleep Apnea

Prevalence of Sleep Apnea

Depression



Forgetfulness



Irritability



Headaches



Restless Sleep



AM Sleepiness



Snoring



Dry Mouth



Gasping for Air



Sore Throat



Night Sweats



40% ADHD



73% Alzheimer's



45% Depression



63% Stroke



72% Diabetes



76% Heart Failure



83% Resistant Hypertension



57% CAD



49% AFib



24% Acid Reflux



77% Obesity



→ note how it's very related to neurological disorders.

→ A baby who is diagnosed with ADHD should be screened for OSA

? All related to sympathetic activation during sleep.

} Related to obesity.

Epworth sleepiness scale

A measure of sleep apnea burden in day time.

Epworth Sleepiness Scale

Name: _____ Today's date: _____

Your age (Yrs): _____ Your sex (Male = M, Female = F): _____

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired?

This refers to your usual way of life in recent times.

Even if you haven't done some of these things recently try to work out how they would have affected you.

Use the following scale to choose the **most appropriate number** for each situation:

- 0 = would **never** doze
- 1 = **slight chance** of dozing
- 2 = **moderate chance** of dozing
- 3 = **high chance** of dozing

It is important that you answer each question as best you can.

Situation	Chance of Dozing (0-3)
Sitting and reading	_____
Watching TV	_____
Sitting, inactive in a public place (e.g. a theatre or a meeting)	_____
As a passenger in a car for an hour without a break	_____
Lying down to rest in the afternoon when circumstances permit	_____
Sitting and talking to someone	_____
Sitting quietly after a lunch without alcohol	_____
In a car, while stopped for a few minutes in the traffic	_____

THANK YOU FOR YOUR COOPERATION

© M.W. Johns 1990-97

نتسأل فيه احتمالية
ننام في هذه الحالات

Situation	Chance of dozing			
Sitting and reading	0	1	2	3
Watching TV	0	1	2	3
Sitting inactive in a public place (e.g. movie theatre or a meeting)	0	1	2	3
As a passenger in a car for an hour without a break	0	1	2	3
Lying down to rest in the afternoon when circumstances permit	0	1	2	3
Sitting and talking to someone	0	1	2	3
Sitting quietly after lunch	0	1	2	3
Sitting quietly after lunch	0	1	2	3

- Anything 6 or above → abnormal indicates sleepiness.
- But it's not diagnostic (only measures the burden of it) and follow up.

STOPBANG

→ Questionnaire that indicates the likelihood of how bad is severe OSA → احتمال بظرف severe.

► STOP Questionnaire

- Snoring
- Tiredness
- Observed you stop breathing
- Blood Pressure

► BANG

- BMI > 35
- Age > 50
- Neck circumference > 40 cm (> 15.7")
- Gender male

→ High likelihood of OSA.

High risk: Yes to ≥3 items → Refer for sleep testing

* used extensively in pre-operative studies.

STOB BANG questionnaire

Sensitivity of STOPBANG score of 3 or more to detect moderate to severe OSA is 93% and severe OSA is 100%.

NPP are 90% and 100% .

0-2: low risk for moderate to severe OSA

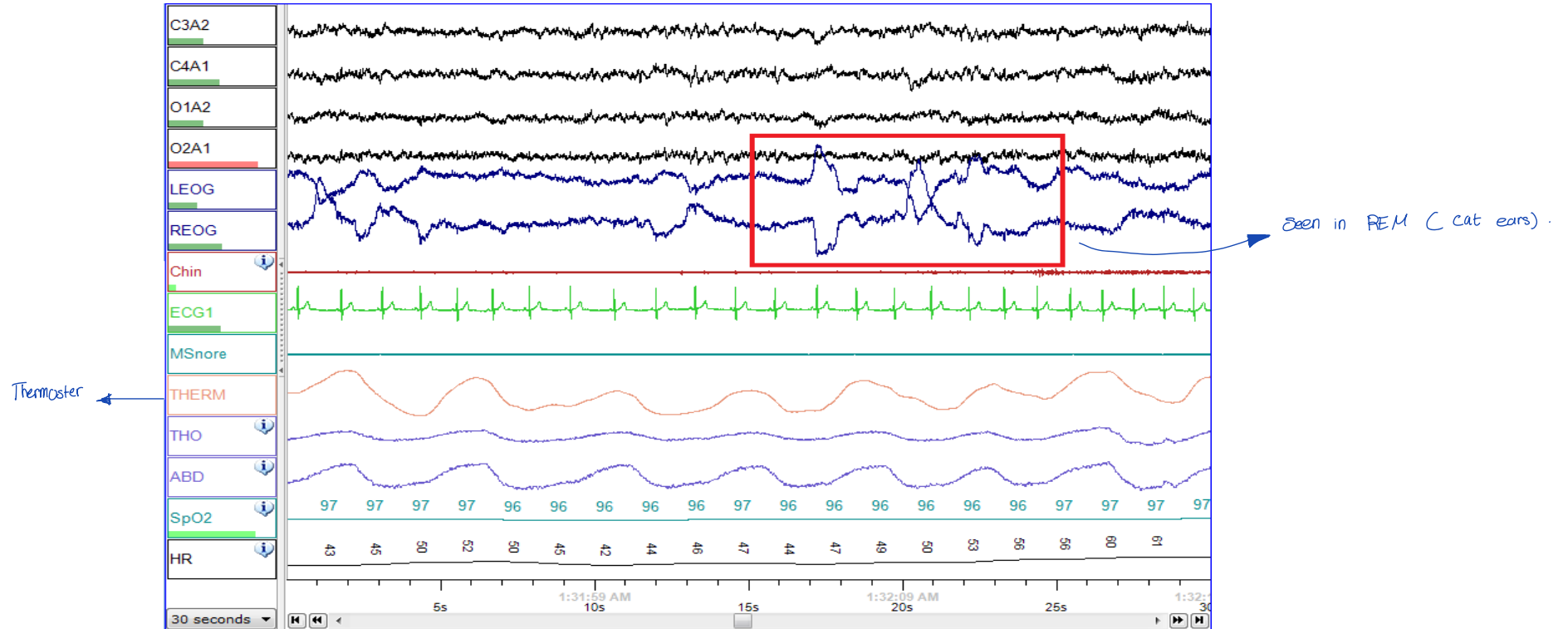
5-8 : high risk for moderate to severe OSA

3-4 :Further criteria are required like if BMI is more than 35 then risk increases .

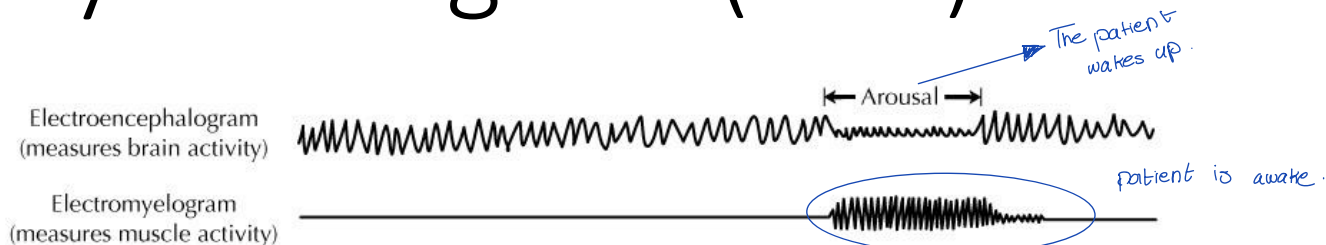
Diagnosis

- Polysymnography .PSG
- Home sleep test
- Oximetry

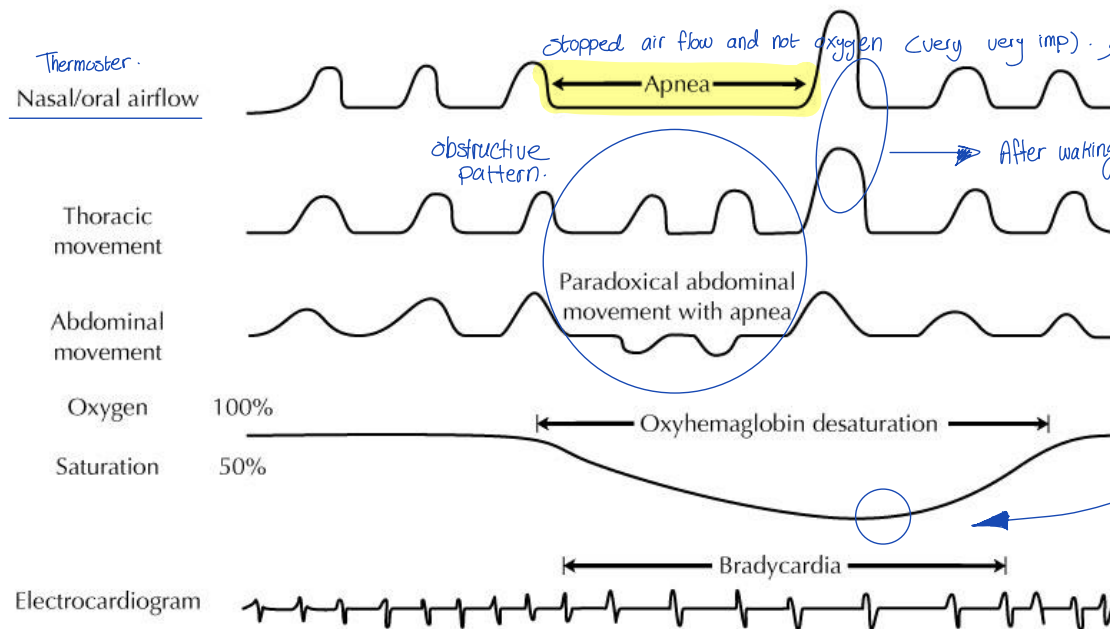
PSG



Polysomnogram (PSG)



You should know the reason: is it obstruction or central from the brain.



* Note: the patient wakes up at the end of apnea

* Max reduction in O_2 is after the patient wakes up.

Scoring respiratory events

- **Apnea** : 90% or more reduction in airflow or complete cessation of air flow for 10 seconds.

Oxygen desaturation is not a criteria.

- **Obstructive apnea**: Apnea with evidence of continued respiratory effort i.e, Chest movement persists
- **Central apnea** : Apnea with absent respiratory effort .i.e, No chest movement . *no orders of the brain → no abd+ chest movement.*
- **Mixed apnea**: if inspiratory effort is absent at the beginning of the event but resumes in the second portion of the event .

زیر
نفس

Scoring Criteria: Respiratory Events

- Hypopnea definition
 - \downarrow flow $\geq 30\%$ from baseline for at least 10 seconds with
 - 1A. (AASM) with 3% O₂ desaturation OR arousal
 - ✓ Requires EEG monitoring
 - ~~1B. (CMS) with 4% O₂ desaturation.~~ *not included.*
- Respiratory Effort Related Arousal (RERA) *X not included.*
 - Flattening of inspiratory portion of nasal pressure (or PAP flow) with increasing respiratory effort leading to arousal
 - No associated desaturation
 - ✓ Requires EEG monitoring

In-lab PSG Data

EEG Data:

- Sleep efficiency & latency
 - Normal 80% efficient.
- Sleep stages & architecture
 - Normal about 5% stage N1, 50% N2, 20% N3 (slow wave sleep) and 20-25% REM
- Arousal Index (AI): sleep disruption
 - Normal AI < 10-25 (large variation by age)

not included

Apnea Hypopnea Index

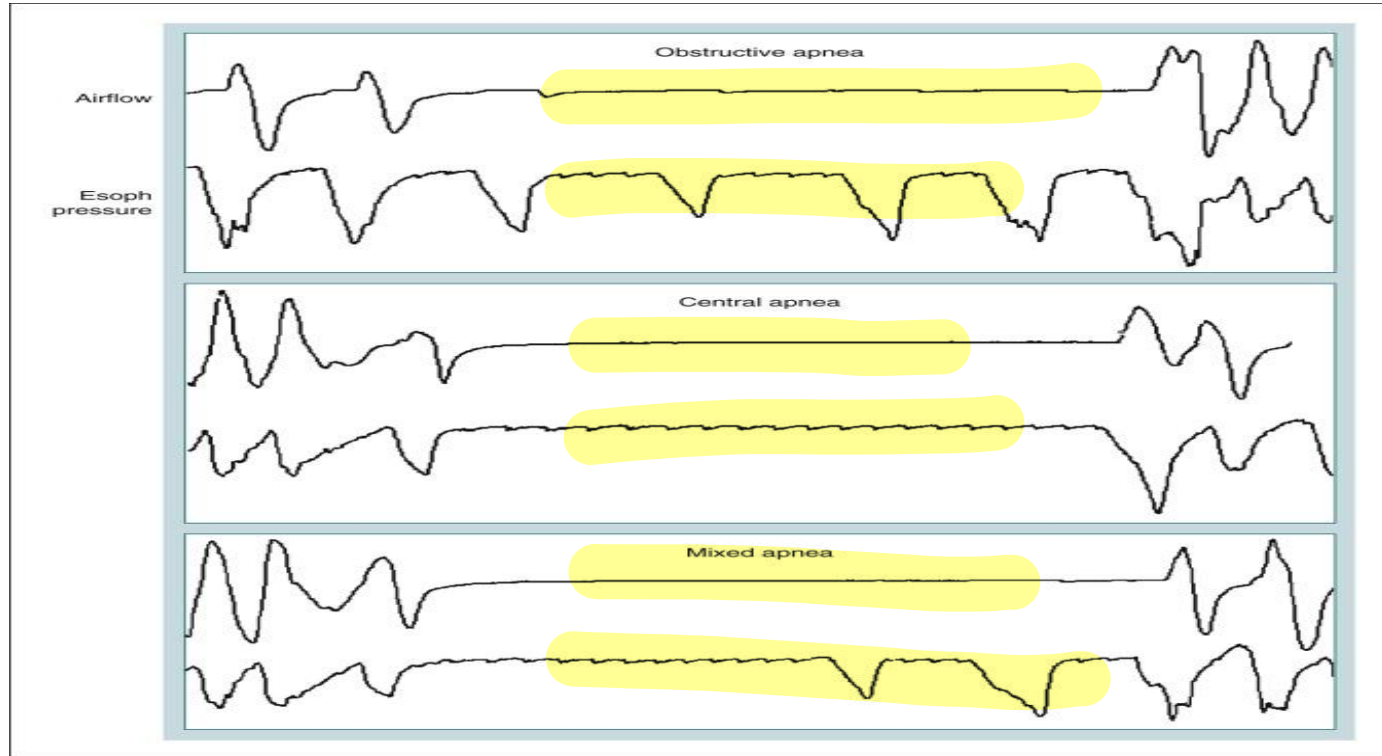
➤ $AHI = (\# \text{ apneas} + \# \text{ hypopneas}) / \text{sleep hours}$

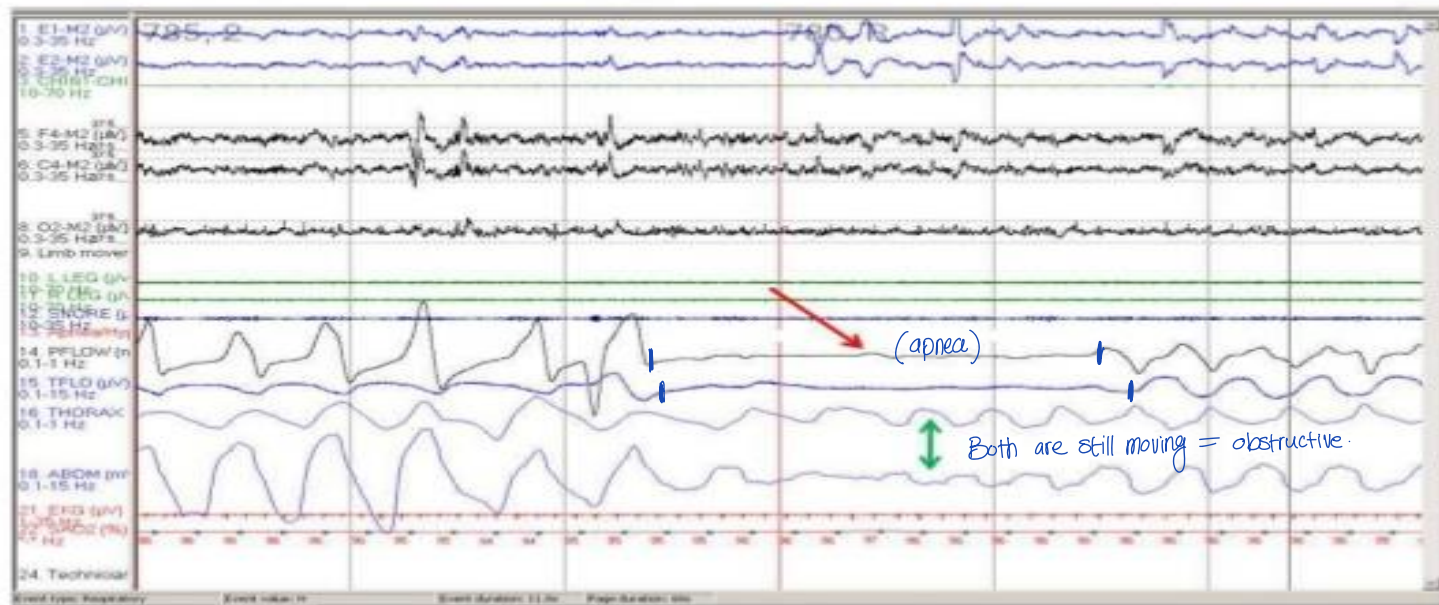
* Normally we stop
breathing for 4 times in
one hour.

- $AHI < 5$: normal
- $AHI 5 - 15$: mild
- $AHI 15 - 29$: moderate
- $AHI 30$ or above : severe

➤ $RDI = (\# \text{ apneas} + \# \text{ hypopneas} + \# \text{ RERAs}) / \text{sleep hours}$

not included.



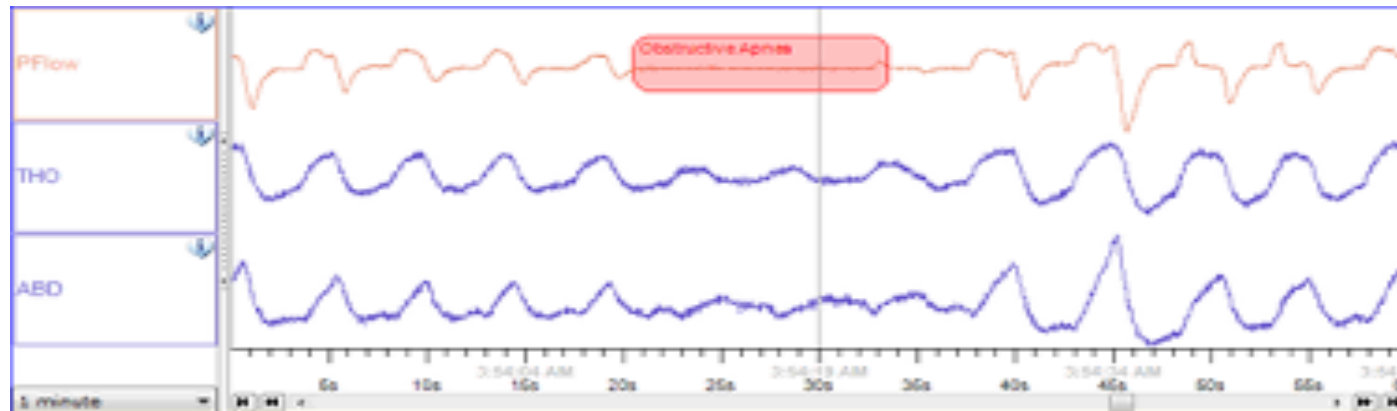


Flow

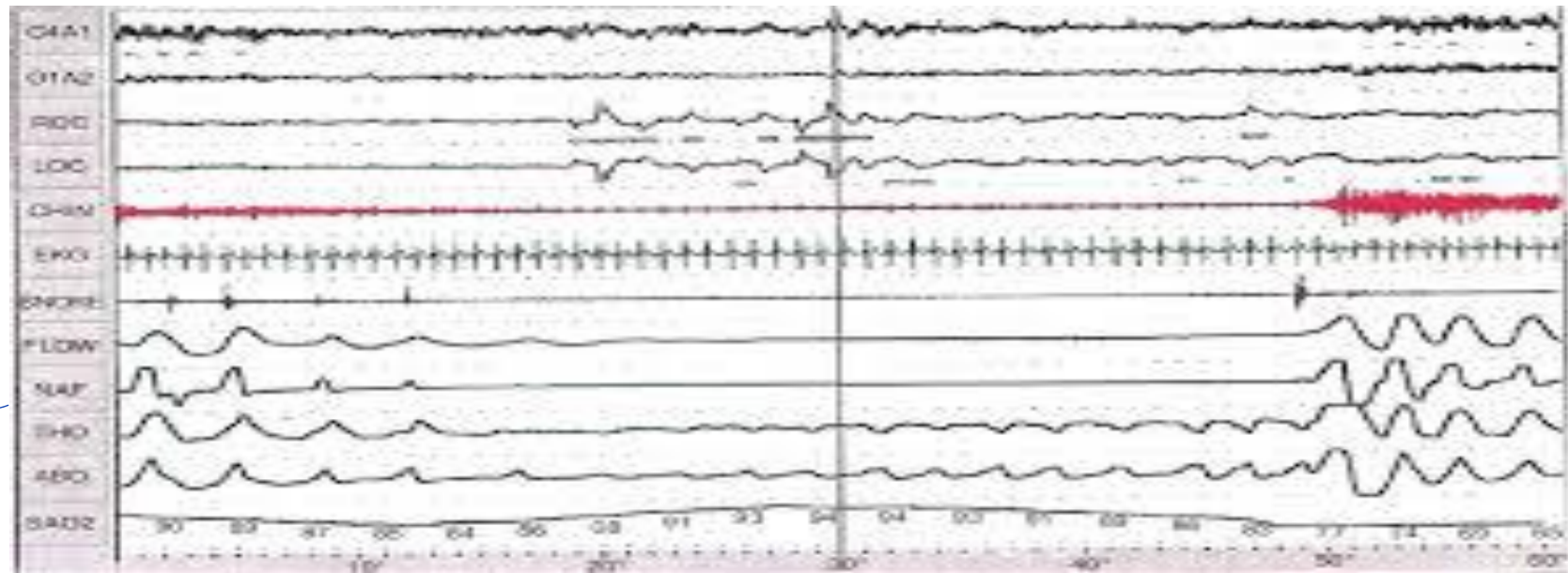
(apnea)

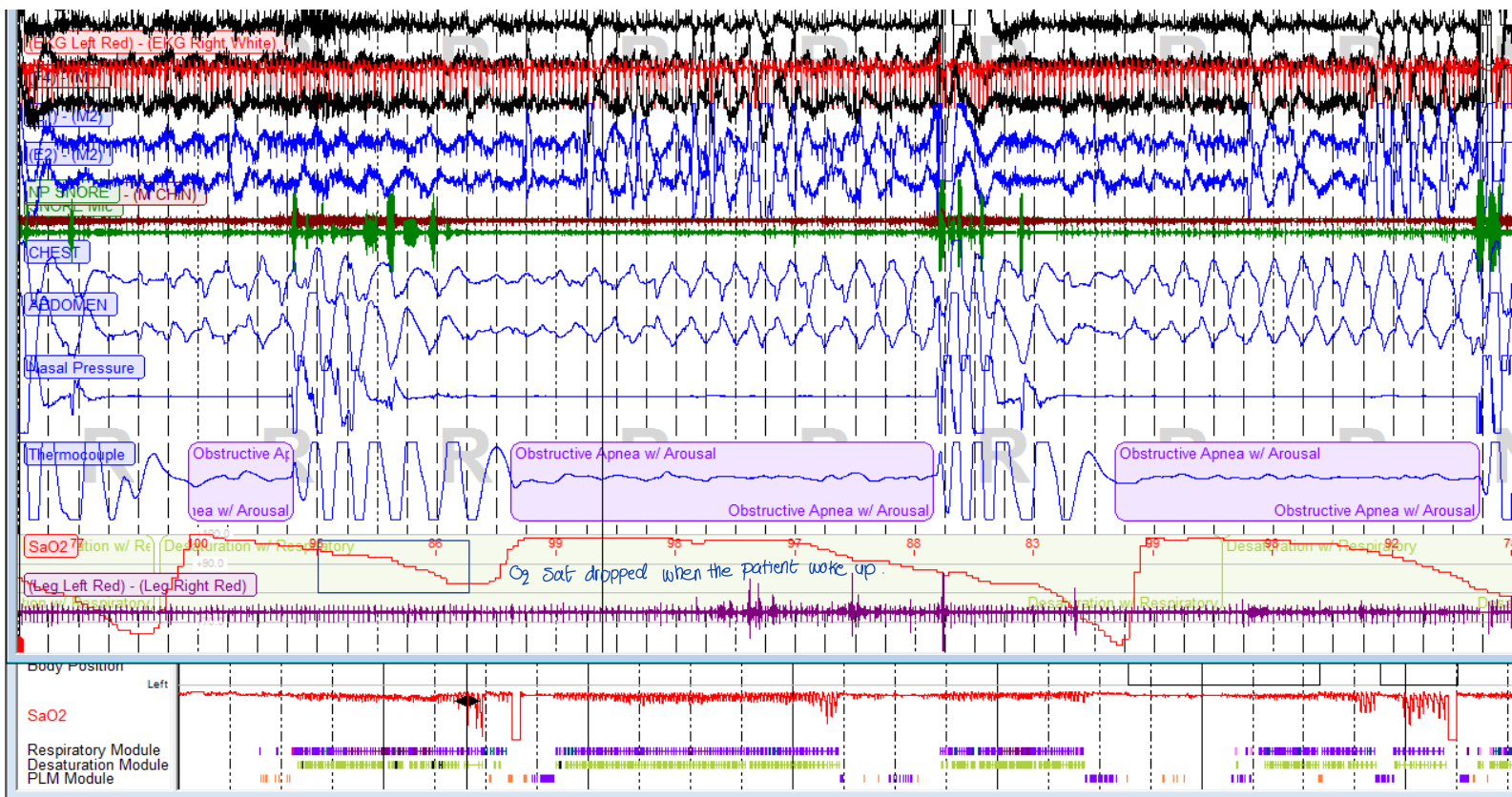
Both are still moving = obstructive.

obstructive



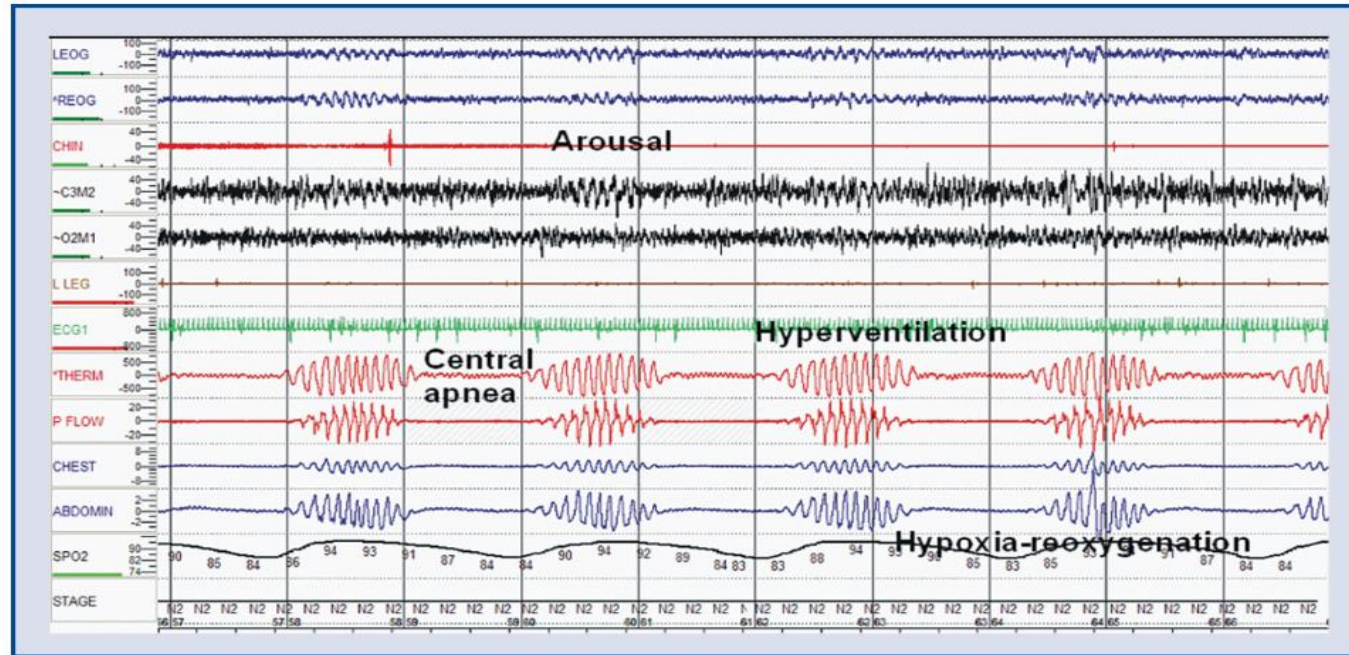
obstructive





crescendo decrescendo changes in tidal breathing which sandwich central apneas.

note that arousals occur at the peak of hyperventilation. This contrasts with the arousals occurring at the termination of obstructive apneas

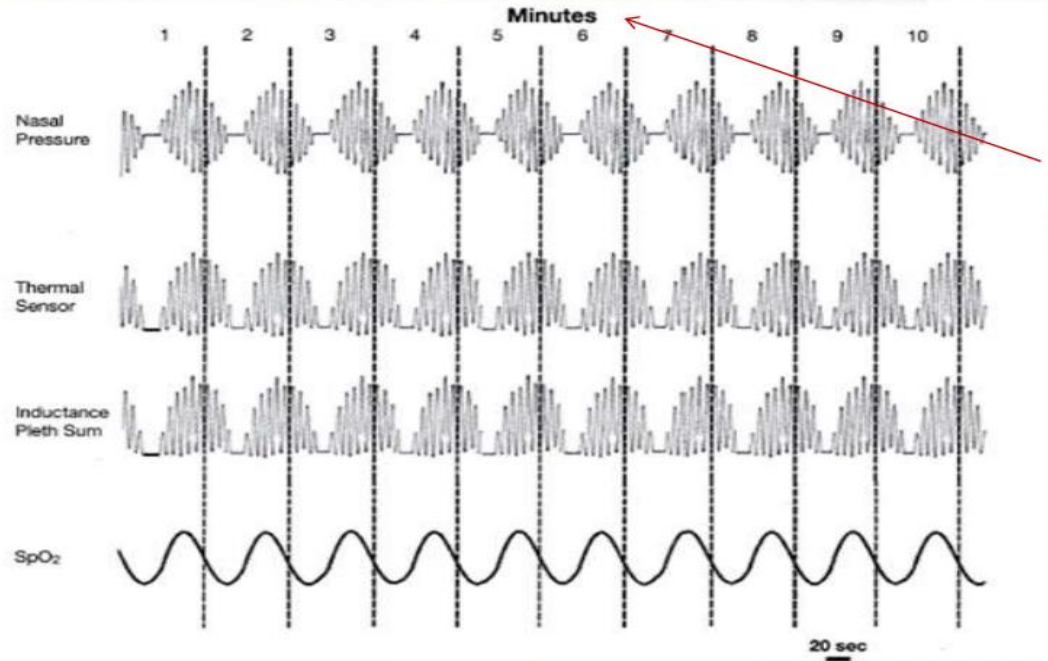


Cheyne-Stokes Breathing

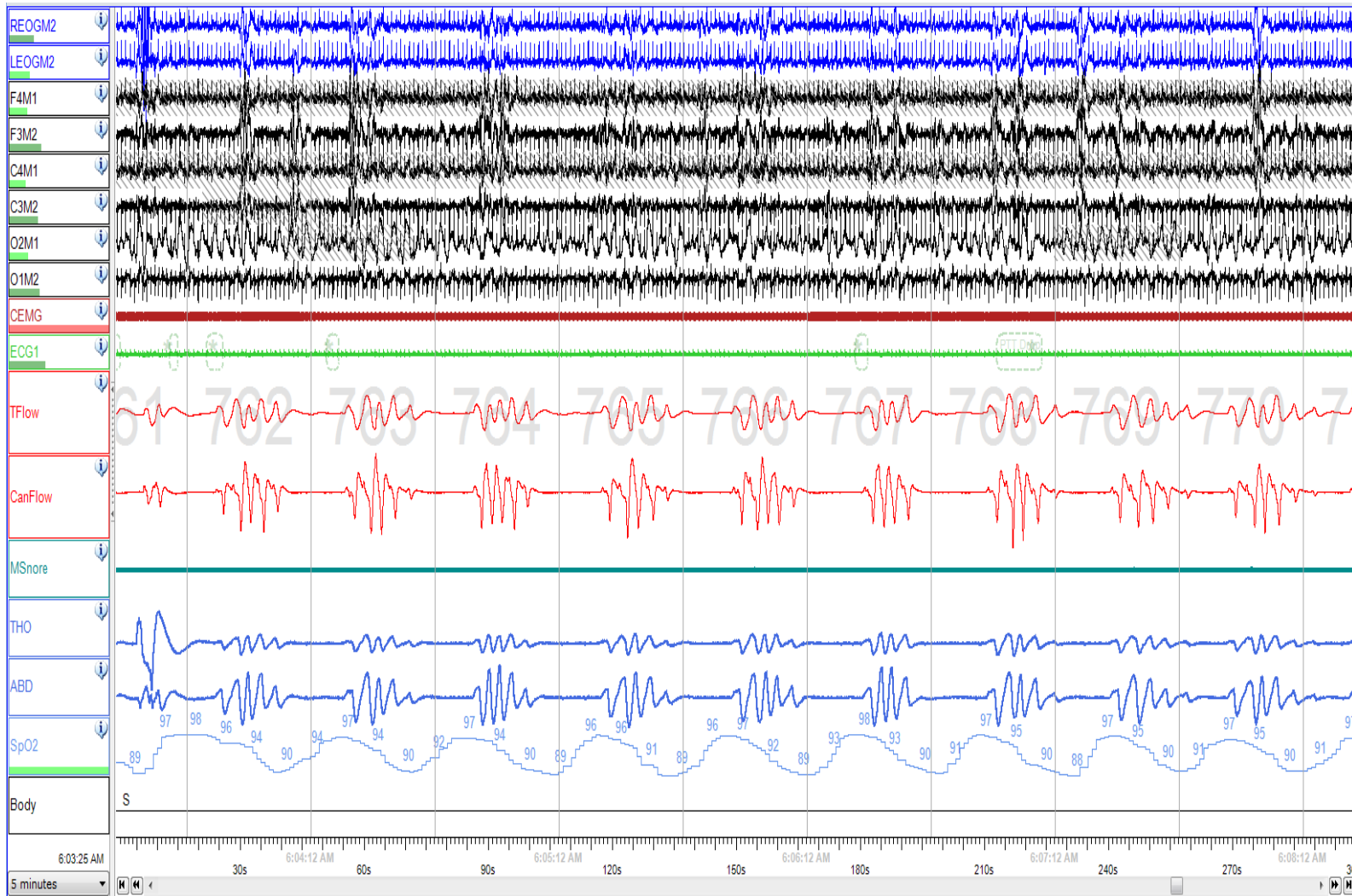
A type of central apnea : Hyperventilation - hypo- and apnea.
Seen in patient with HF and strokes - or structural brain abnormality.

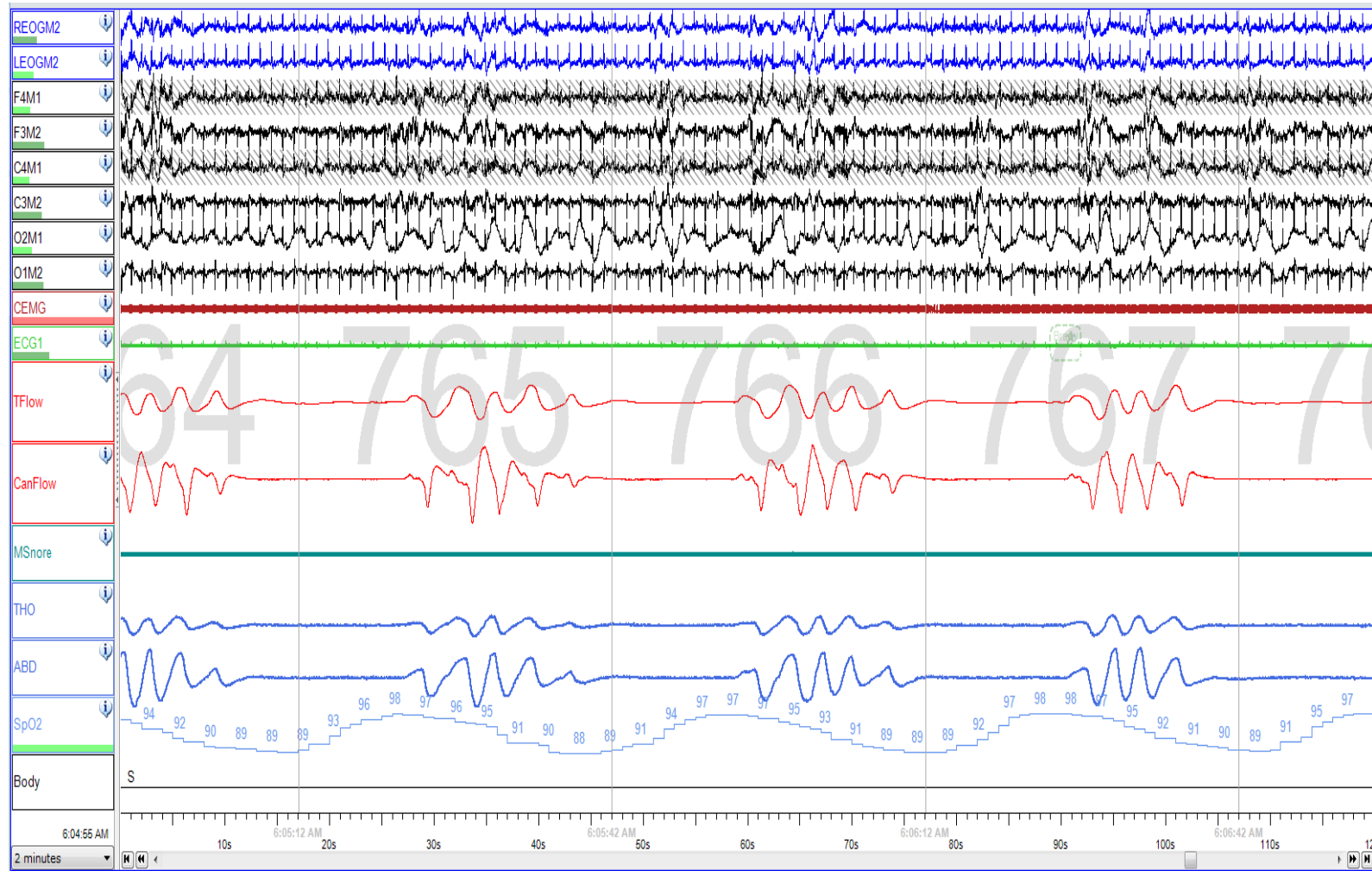
- episodes of ≥ 3 consecutive central apneas and/or central hypopneas separated by a crescendo and decrescendo change in breathing amplitude .
- ≥ 5 central apneas and/or central hypopneas per hour of sleep associated with the crescendo/decrecendo breathing pattern recorded over ≥ 2 hours of monitoring with a cycle length of ≥ 40 seconds.

مُسْ قَلْبِي
التَّوْبِي

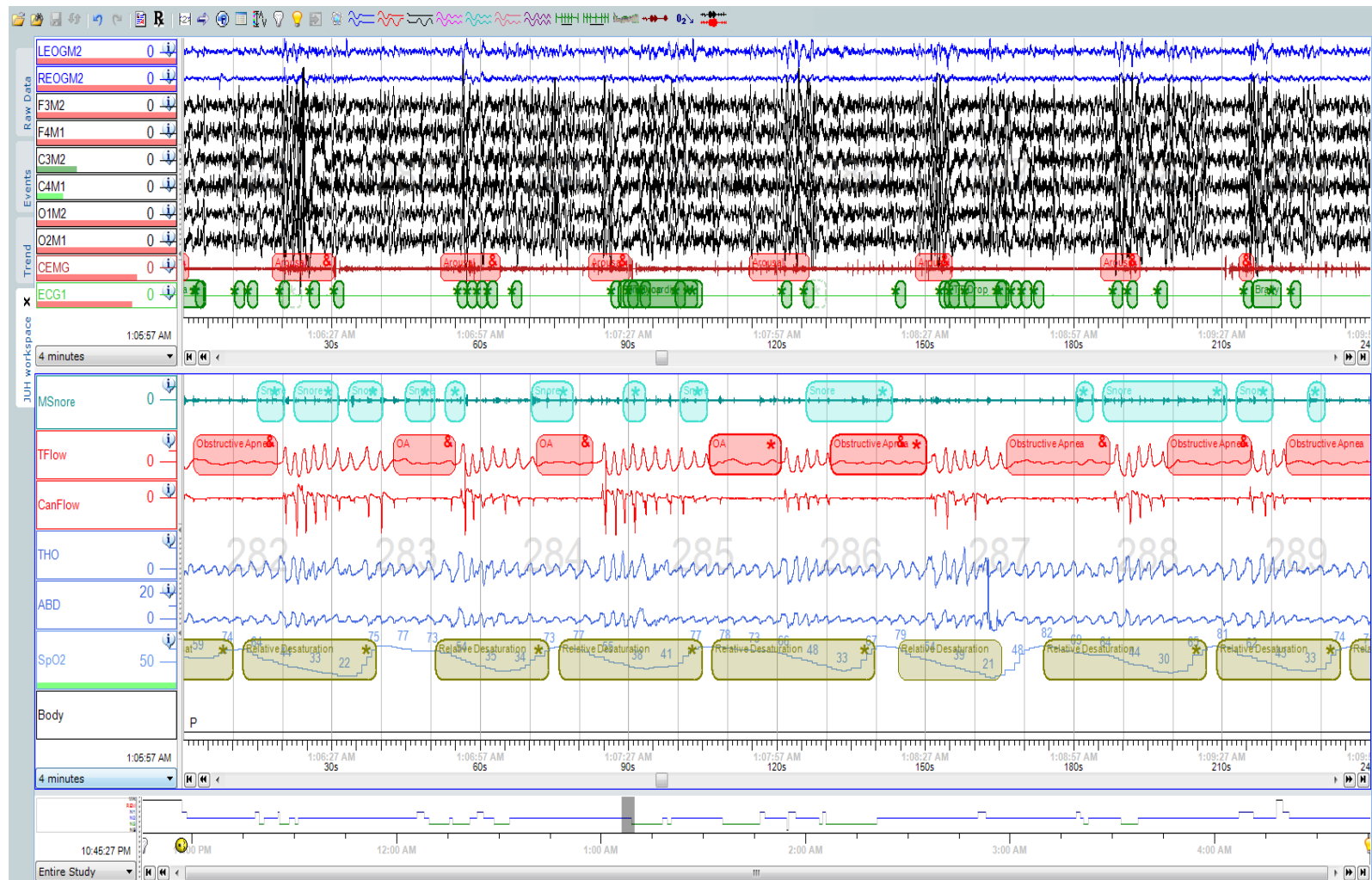


More
than 40
secs.
duration

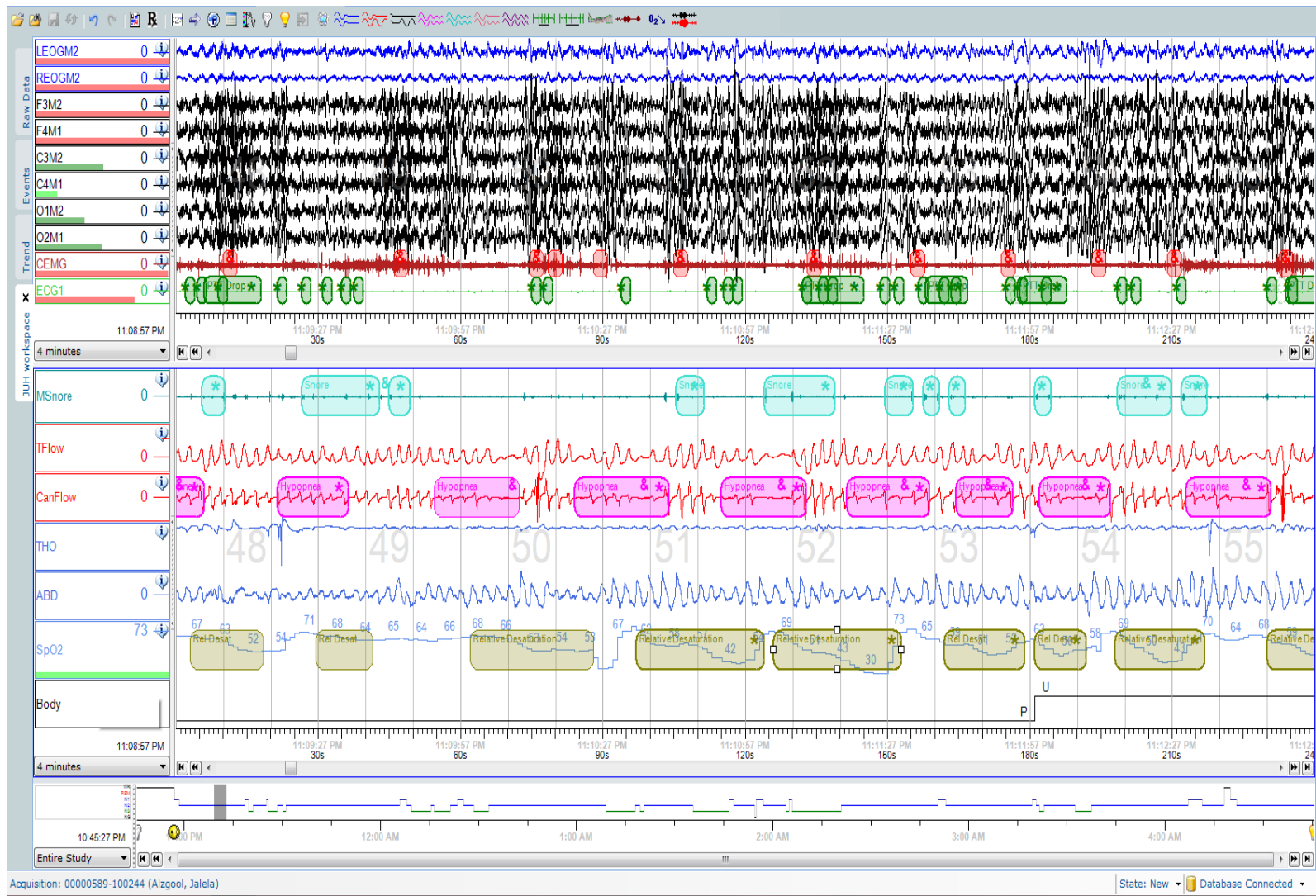




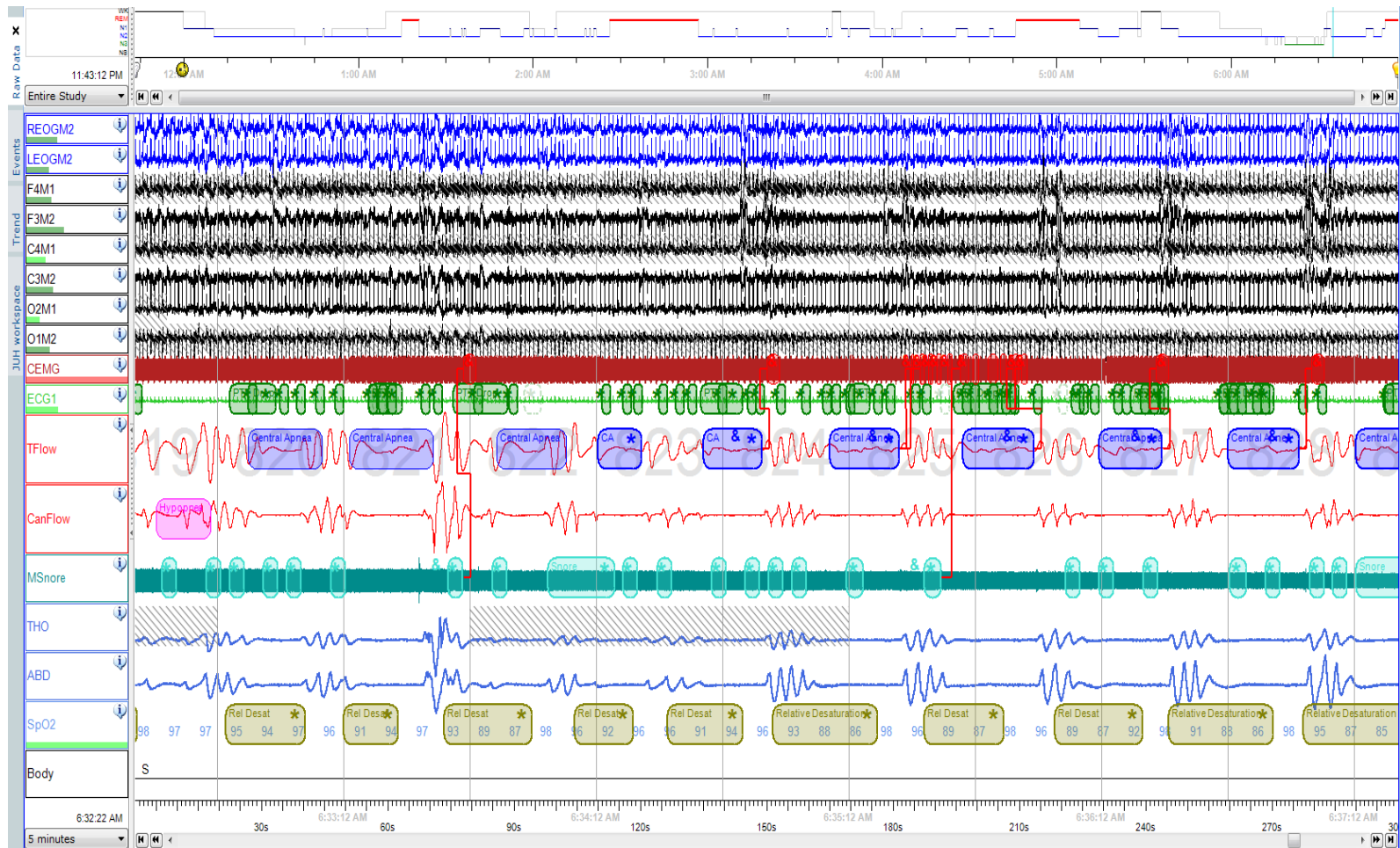
central



obstructive



(obstructive)



acquisition: 00000230-100931 (alshobaki, kamal)

State: New Database Connected

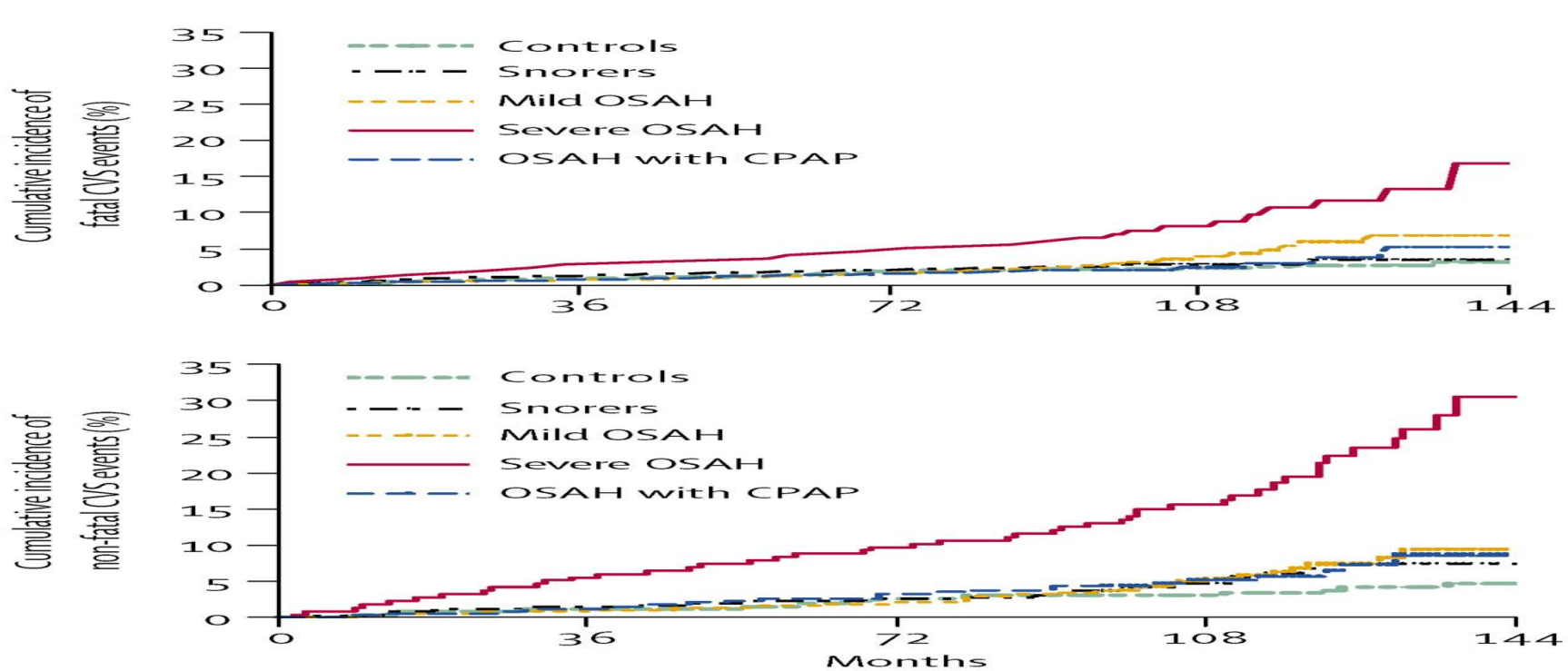
Treatment

- Weight loss ,avoid sedatives and alcohol
- Stop smoking
- CPAP
- Surgery
- Dental appliances

CPAP(continuous positive airway pressure)

- Flow generator with tubing and mask.
- Takes air from the room and push it into airways .
- It Pushes air out under pressure which keeps airways open and non collapsible .





Numbers at risk

Controls	264	262	259	258
Snorers	377	372	361	232
Mild OSAH	403	401	392	264
Severe OSAH	235	229	221	167
OSAHS with CPAP	372	364	361	229

Long-term cardiovascular outcomes in men with obstructive sleep apnoea-hypopnoea with or without treatment with continuous positive airway pressure: an observational study. AUMarin JM, Carrizo SJ, Vicente E, Agusti AG SOLancet. 2005

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CPAP for Prevention of Cardiovascular Events in Obstructive Sleep Apnea in moderate and severe CSA.

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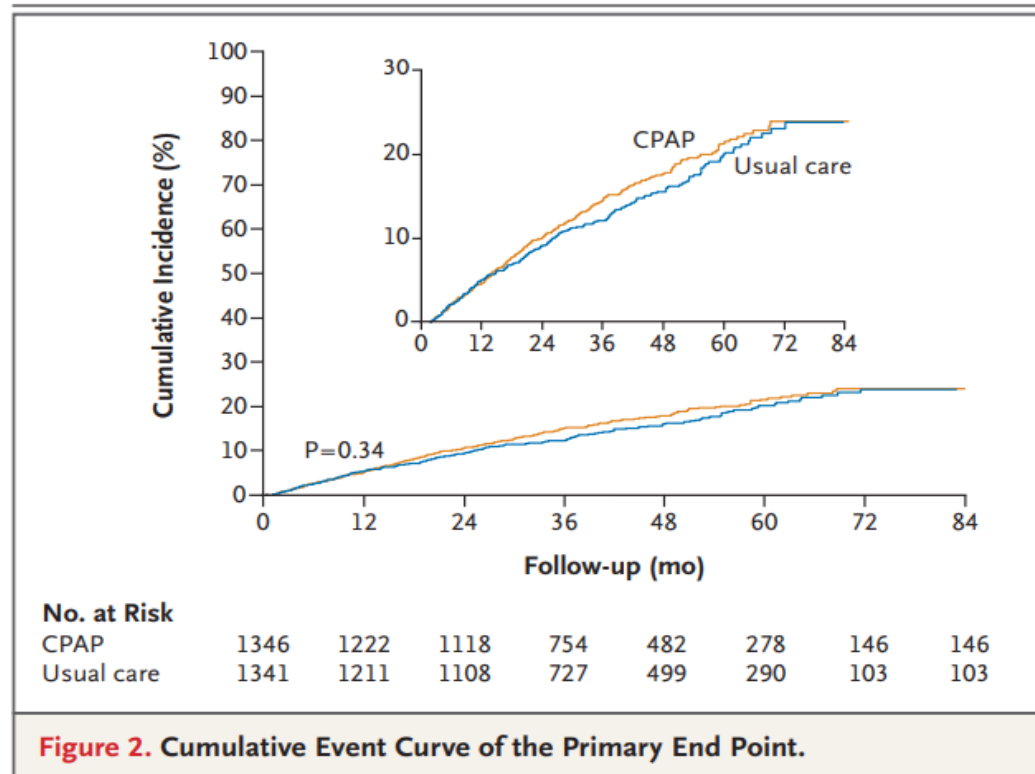
ABSTRACT

* Till this day there's no
enough evidence

The primary composite end point was death from cardiovascular causes, myocardial infarction, stroke, or hospitalization for unstable angina, heart failure, or transient ischemic attack.

CONCLUSIONS:

Therapy with CPAP plus usual care, as compared with usual care alone, did not prevent cardiovascular events in patients with moderate-to-severe OSA and established cardiovascular disease.



- Measures the main outcomes were a composite of acute coronary syndrome (ACS) events, stroke, or vascular death (major adverse cardiovascular events); cause-specific vascular events; and death.
- **Meta-analysis** of 10 randomized clinical trials including 7266 patients.
- Conclusions : The use of PAP, compared with no treatment was not associated with reduced risks of cardiovascular outcomes or death for patients with sleep apnea.
- Beneficial effects on anxiety, depression, daytime sleepiness and physical function . *(cognitive function was improved more the cardiovascular events)*

Association of Positive Airway Pressure With Cardiovascular Events and Death in Adults With Sleep Apnea: A Systematic Review and Meta-analysis. AUYu J, et al, JAMA. 2017.

Compliance

- Mask
- Humidifier
- Ramp
- Autotitartion
- Bilevel

Dental appliances

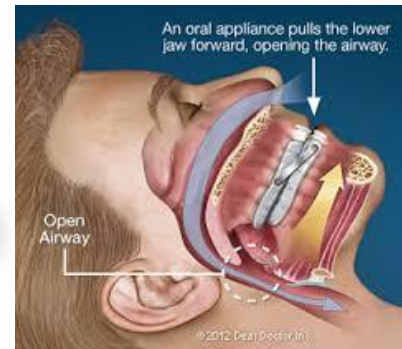
- Proper patient selection

- pulling the lower jaw forward

- for mild to moderate

- Severe → Doesn't work you need CPAP

- moderate → CPAP and dental appliances both work equally



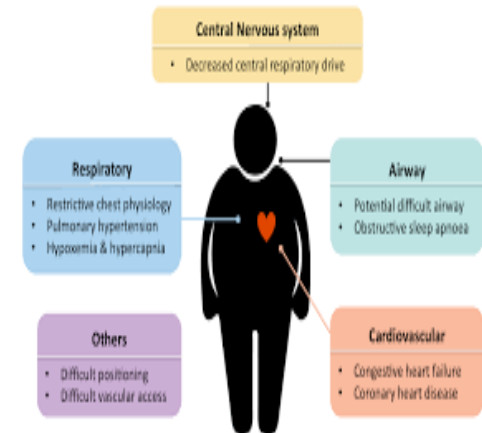
Surgery for OSA

- Surgery 30-40% effective and lost after years → Depends on the assessment.

Definition of OHS

→ could include OSA
in 90% of the cases.

- Obesity hypoventilation syndrome (OHS) is defined as a combination of obesity (body mass index $\geq 30 \text{ kg}\cdot\text{m}^{-2}$ **AND**
- daytime hypercapnia (arterial carbon dioxide tension $\geq 45 \text{ mmHg}$) occurring in the absence of an alternative neuromuscular, mechanical or metabolic explanation for hypoventilation .



Clinical presentations

- Acute on top of chronic type 2 respiratory failure .

- Referral to respiratory clinic for

Suspected OSA

Unexplained dyspnea .

Pulmonary hypertension

They usually have HTN,DM or other comorbidities .

- The prevalence of OHS is similar in men and women

OHS

Nearly 75% were misdiagnosed and treated for obstructive lung disease (most commonly chronic obstructive pulmonary disease) in spite of having no evidence of obstructive physiology on pulmonary function testing

Make sure

- No obstructive lung disease.

- No Musculoskeletal disease

Marik PE, Desai H. Characteristics of patients with the “malignant obesity hypoventilation syndrome” admitted to an ICU. J Intensive Care Med 2013.

OSA and OHS

- Approximately 90% of patients with OHS have obstructive sleep apnoea (OSA) defined by an apnoea/hypopnoea index (AHI) ≥ 5 events/h).
- 70% of patients have concomitant severe OSA (AHI ≥ 30 events/h)
- The remaining patients have non-obstructive sleep hypoventilation with no or mild OSA.

OHS with sleep hypoventilation

- The American Academy of Sleep Medicine (AASM) has arbitrarily defined **sleep hypoventilation** in adults by the following criteria:
- $\text{PaCO}_2 > 55 \text{ mmHg}$ for $> 10 \text{ min}$ or
- An increase in PaCO_2 (or surrogate as end-tidal carbon dioxide tension or TcCo_2) $> 10 \text{ mmHg}$ compared to an awake supine value to a value $> 50 \text{ mmHg}$ for $> 10 \text{ min}$.

TcCo₂

Transcutaneous carbon dioxide

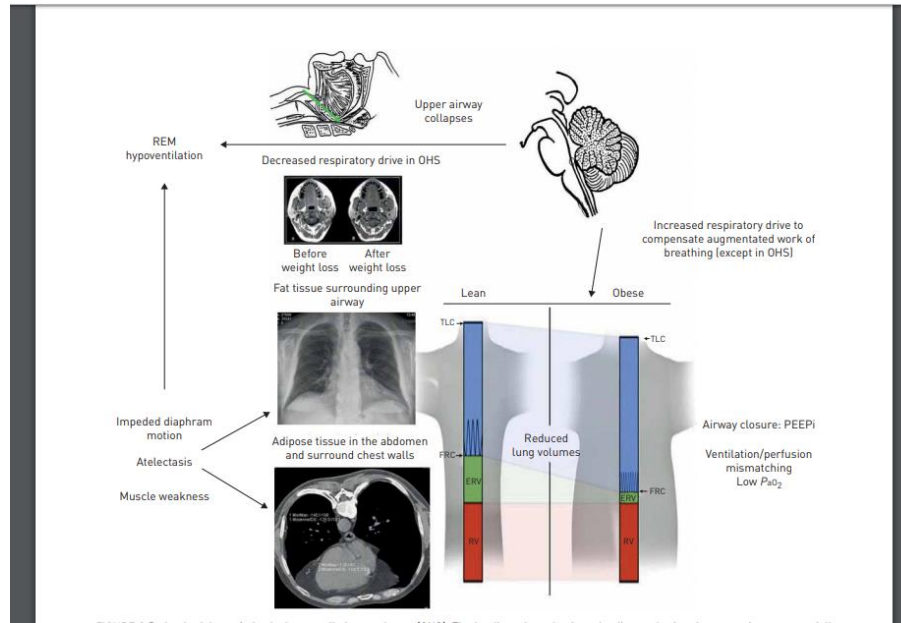


Pathophysiology of obesity hypoventilation syndrome (OHS).

Obesity-related changes in the respiratory system

Central hypoventilation.

Obstructive sleep apnoeas and hypoventilation during sleep, mainly during rapid eye movement

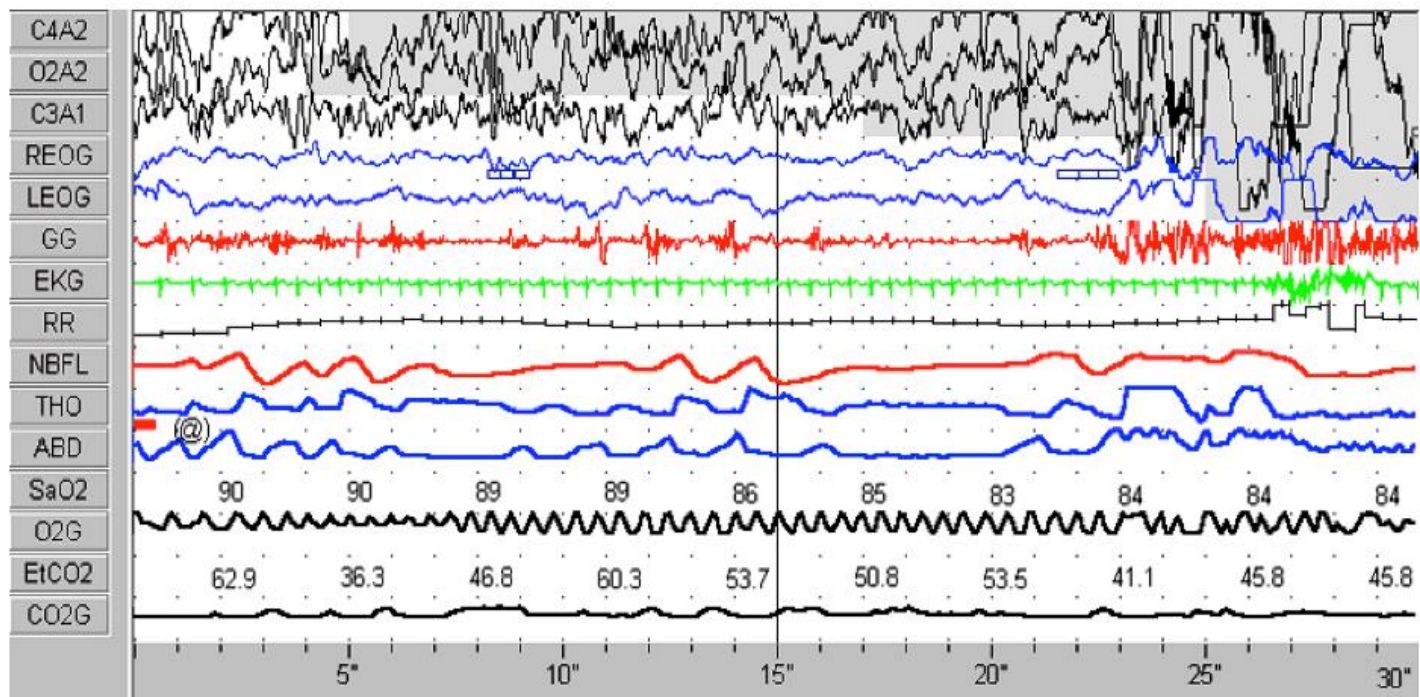


Criteria for diagnosis

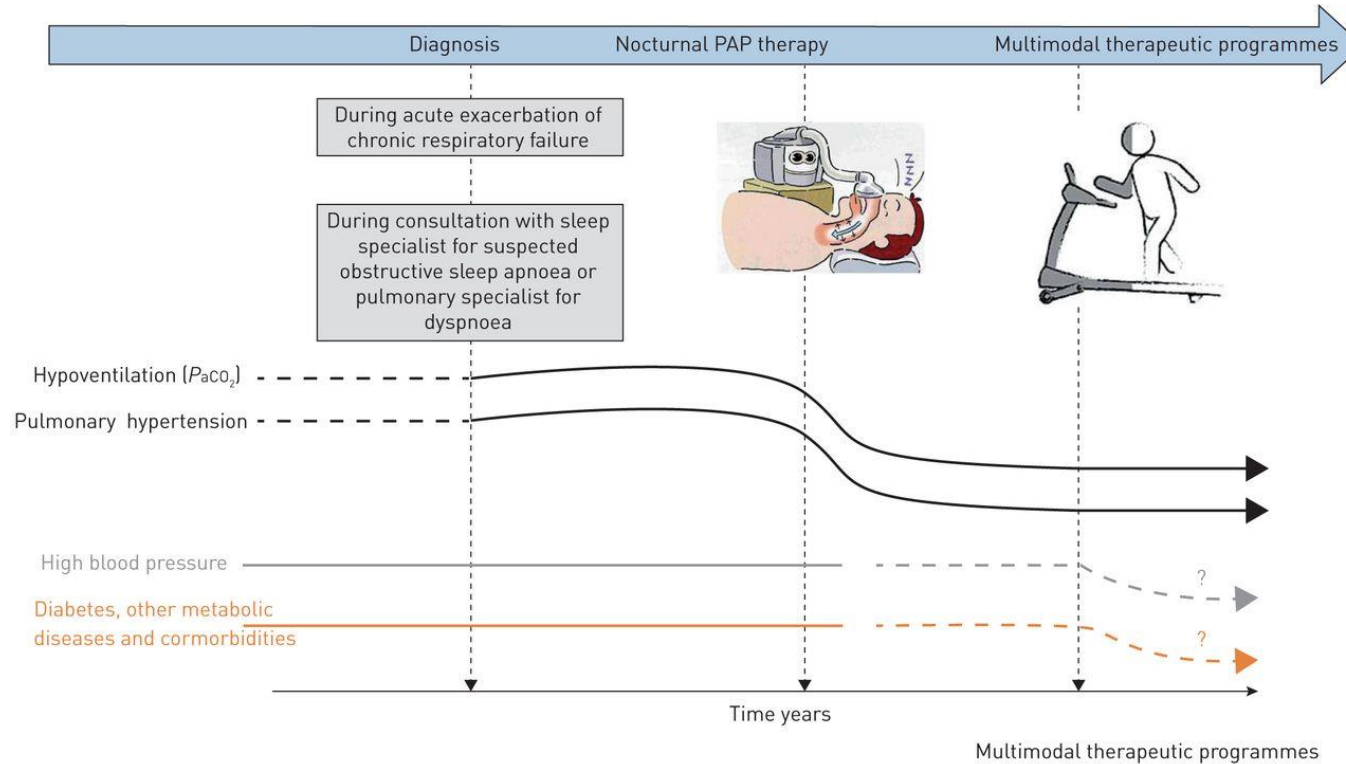
- Room air arterial blood gas.

Supportive tests for diagnosis :

- Elevated serum bicarbonate levels >27 mmol/L....? **Early stage** . NPPV
- And hypoxaemia

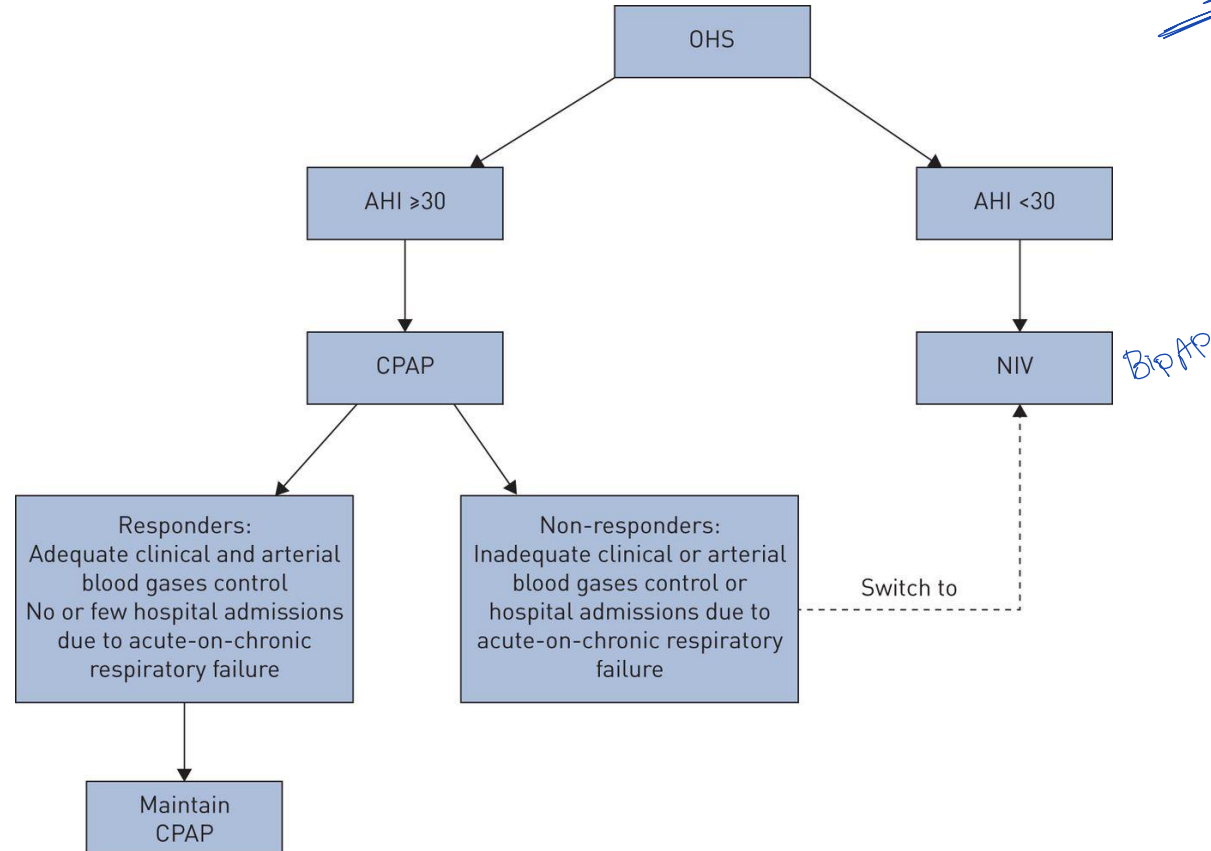


Management of patients with obesity hypoventilation syndrome (OHS) from diagnosis to integrated care to modify health trajectories.



Juan F. Masa et al. Eur Respir Rev 2019;28:180097

Obesity hypoventilation syndrome (OHS) management strategy.



Juan F. Masa et al. Eur Respir Rev 2019;28:180097