



## CAPS 422

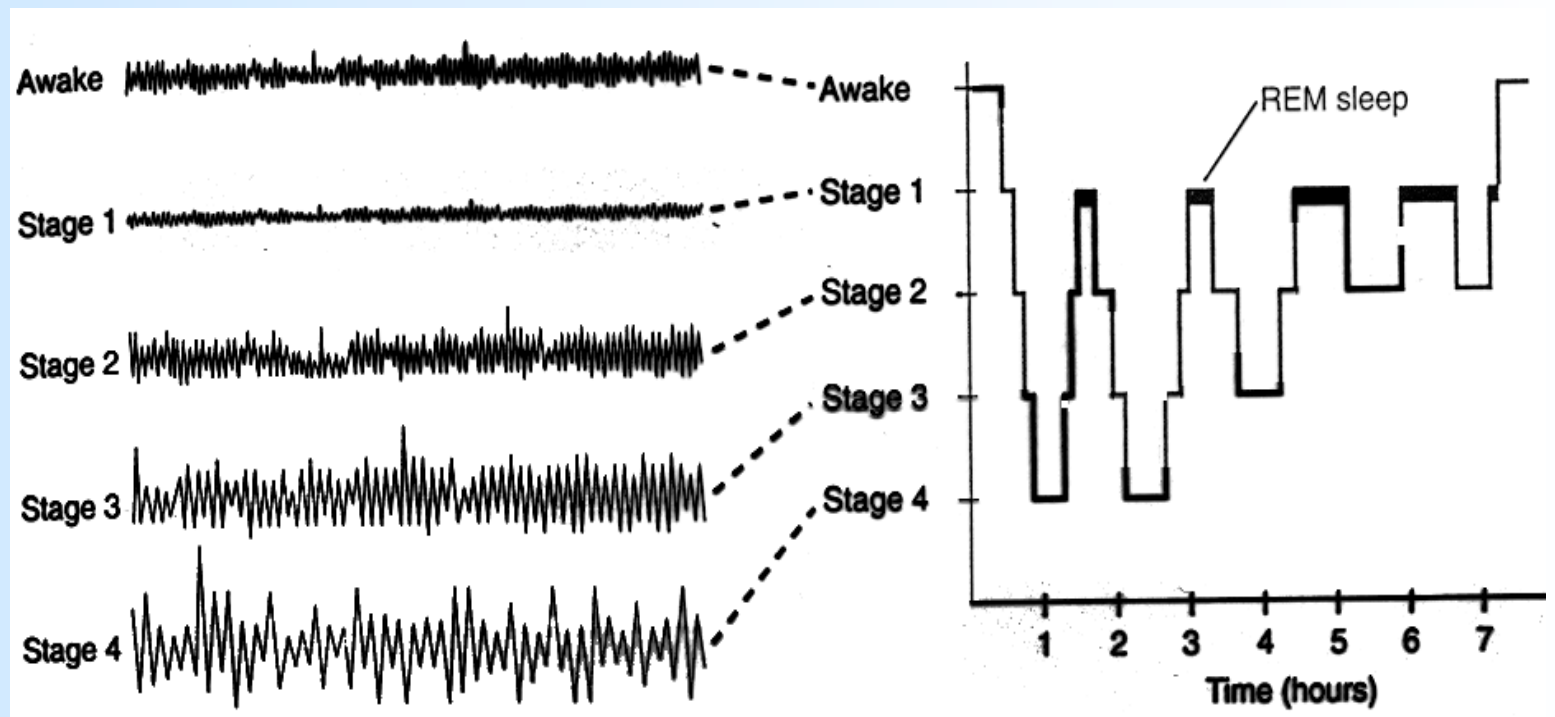
# Breathing During Sleep

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# Sleep Architecture

We spend 1/3 of our lives sleeping, passing from a state of wakefulness to a period of drowsiness, until we enter deeper and deeper stages of sleep- in 90 minute cycles-about 4-5 cycles per night

EEG waves during sleep stages



# Breathing & Sleep Stages

Sleep staging is based on characteristic EEG [electroencephalogram] & eye movement [electro-oculogram, EOG] recordings

## Quiet Sleep [NREM, non rapid eye movement]

- stages 1 & 2: breathing is periodic; VT waxes + wanes; periods of apnea < 10sec
- stages 3 & 4: regular breaths, hypoventilation [  $\uparrow$  PaCO<sub>2</sub> &  $\downarrow$  PaO<sub>2</sub>  $\approx$  2-6 mmHg]

## Active Sleep [REM, rapid eye movement, EEG resembles awake & dreams states]

- breathing frequency is irregular, periods of apnea < 10sec
- hypotonia of intercostal, upper airway dilator + most skeletal muscles  
[exceptions: diaphragm & ocular muscles]

## Control of Breathing during Sleep

1. Ventilatory responses to CO<sub>2</sub> & O<sub>2</sub> both decrease

2. Reflex response to airway irritation is altered

stimuli that cause cough, tachypnea, airway narrowing, when awake cause apnea & airway dilation until strong enough to cause arousal from sleep

3. Arousal mechanisms that protect the sleeper include:

PaCO<sub>2</sub> > 55mmHg

PaO<sub>2</sub> < 40 mmHg

airway irritation

4. Upper airway patency is compromised in sleep

decrease in muscle tone (hypotonia) affects the upper airway dilator muscles resulting variable obstructions & periodic apnea

# The Sleep Apnea Syndrome

Characterized by Christian Guilleminault -Stanford University 1973

- cessation of airflow at the mouth/nose > 10 seconds during sleep
- apnea index (A.I.) = total number of apneas/ sleep time (hours)
- an A.I. > 5 is considered abnormal (over 100 apneas per nights sleep are not unusual). Indices used vary from lab to lab-respiratory disturbance index (RDI) = number of apneas and hypopneas per hour >10 also considered if the clinical symptoms are there.
- during apnea PaCO<sub>2</sub> ↑ [hypercapnia]; ↓PaO<sub>2</sub> ⇒ ↓SaO<sub>2</sub> ⇒ leading to repeated arousals

## There Are Three Types of Sleep Apnea

1) **Central Sleep Apnea** the drive from CNS ceases; mechanisms= injury, idiopathic [unknown]

2) **Obstructive Sleep Apnea [OSA]** respiratory drive continues but airflow ceases-respiratory muscles are active but there is no airflow; obstruction in the UAW as a result of the failure of dilator muscles-tongue falls back]

- airway narrowing & obstruction can result in loud snoring; often associated with obesity; especially high fat deposition in the neck; neck circumference is measured

- earliest descriptions of OSA: Charles Dickens novel, Pickwick Papers, in the character Joe, the fat boy; hence the term ***Pickwickian Syndrome***

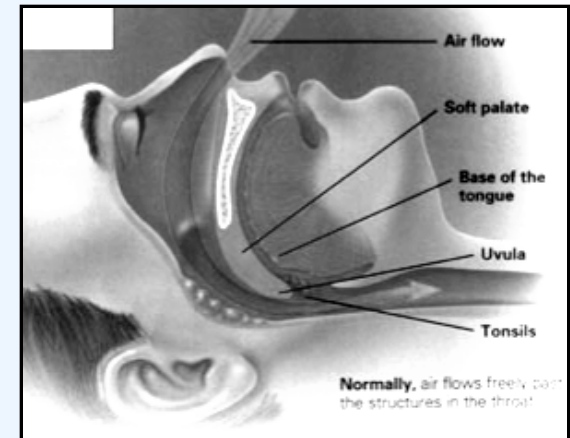
3) **Mixed Sleep Apnea** a combination of the two above

# Symptoms of Obstructive Sleep Apnea [OSA]

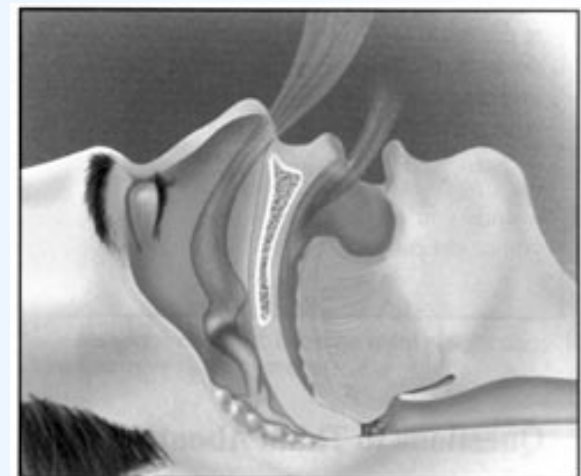
- daytime sleepiness fall asleep at inappropriate times [at the wheel, with a full house hand in a poker game]
- changes in personality [grumpy]
- morning headache
- fitful sleep - loud snoring during sleep

## Prevalence

- 24 % of the adult male population over 30
- male : female ratio is 2:1; with the gap closing after menopause



normal airflow



airflow in OSA during apnea

# DISTINGUISHING BETWEEN THE SLEEP APNEAS

## Polysomnography [Sleep Study]

measures EEG,EOG,EMG, airflow, ribcage & abdomen movement, SaO<sub>2</sub>

### CENTRAL APNEA

cessation of airflow > 10 sec + no movement of the RC and ABD

### OBSTRUCTIVE APNEA

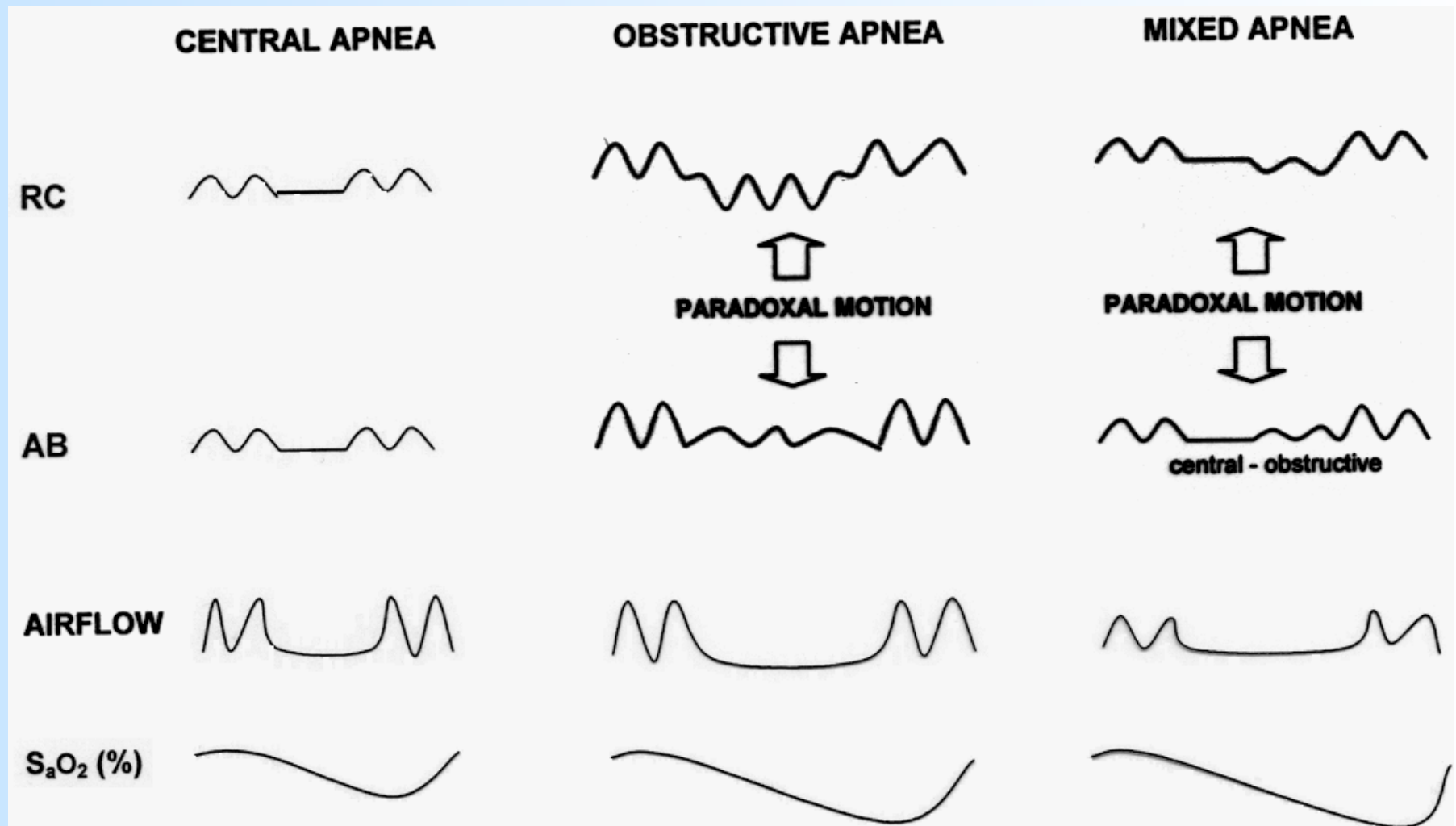
cessation of airflow > 10 sec + paradoxal movement of RC and ABD

### MIXED APNEA

cessation of airflow > 10 sec + initially absence of RC & ABD movement progressing to presence of both movements.



# DISTINGUISHING BETWEEN THE SLEEP APNEA



# Treatment of Sleep Apnea

- **NASAL CPAP**-“ continuous positive airway pressure” keeps the aw open – applied by a nasal mask, 80% effective; humidification + chin strap helps patient compliance- web pages for users! [preferred & common form of treatment]

- **DENTAL APPLIANCES** designed to reposition the jaw + tongue mild sleep apnea / plain snorers with no apnea but aw narrowing

- **SURGERY** “life in hands of the ENT surgeons if CPAP does not work”

**UPPP [uvulopalatopharyngoplasty]** remove tissue from back of the throat, tonsils, uvula, p/t of the soft palate side effects-necrotic tissue success rate is 30%

**LAUP [laser assisted uvulopalatopharyngoplasty]** newer version

- **Maxillomandibular Advancement** in selected patients

