Obstructive Sleep Apnea

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A Dedication.......
OSA → Definition

- Repetitive episodes of complete or partial upper airway obstruction during sleep
- Events can occur multiple times per hour, resulting in arousals with reduction in oxygen saturation
- 1 out of 10 middle age women
- 1 out of 5 middle age men
- As obesity increases, so does prevalence

Shades of Grey as opposed to Black and White

- Sleep Disorder breathing: a number of respiratory events that occur during sleep
- Gauged on severity and/or degree of obstruction
- A continuum, in increasing severity
  - Snoring
  - Upper Airway Resistance Syndrome
  - Obstructive Sleep Apnea Syndrome
  - Obesity Hypoventilation Syndrome
Pickwickian Syndrome

Snoring

- Nonapneic snoring quite prevalent
- Not necessarily associated with arousals or sleep fragmentation
- Implies increased upper airway resistance
- Possible linkage to daytime somnolence
Why Do We Snore?
Why Do We Snore?
- As We age........
- Palatal lengthening
- Palatal Atrophy
- Loss of static muscle tone
- Alcohol
- Benzodiazepines

Upper Airway Resistance Syndrome
- UARS involves respiratory events that do not qualify as apneas or hypopneas, yet lead to arousals, sleep fragmentation but still cause daytime sleepiness
Obstructive Sleep Apnea Syndrome
- OSAS involves repetitive episodes of upper airway obstruction during sleep
- Hypopneas, partial obstruction
- Apneas, complete obstruction
- Events last a minimum of 10 seconds
- Oxygen Desaturations
- Brief Arousals from sleep
- At least 15 or more scorable respiratory events (apnea, hypopnea, RERAs, respiratory effort-related arousals) per hour of sleep on PSG
- Excessive daytime sleepiness
- Unrefreshing sleep: woke up like only took a nap
- Fatigue
- Insomnia

Sleep Stages
- Stages 1, 2 & 3 = non-REM Sleep, NREM
- REM, rapid eye movement, Sleep
- A normal sleep latency is less than 15 minutes
- Normally 3 to 5 NREM or REM sleep cycles per night
  - Every 90-120 minutes
- Stage 1 → 2%-5%
- Stage 2 → 45%-55%
- Stage 3 → 5%-20%
- REM 20%-25%
Stages

1: light sleep, easily awoken, eyes move slowly, muscle activity slows
   - Hypnic myoclonia, jerks, preceded by sensation of falling
2: Eye movement stops, brain waves slow
   - Sleep Spindles: rapid bursts of brain waves
3: Delta waves, slow brain waves
4: Deep sleep, no eye movement or muscle activity, difficult to arouse
   - Children bedwetting, night terrors, sleep walking
   - REM: breathing more rapid, irregular, shallow, eyes jerk, limbs more paralyzed
   - Increased HR, BP, Penile erections
   - If awoken → bizarre, illogical tales

Respiratory Events....

- Apneas and Hypopneas can occur in any stage of sleep
- Most common in stages 1, 2, and REM, rare in stage 3
- Respiratory events that occur in REM sleep are usually of a longer duration and associated with more severe oxygen desaturations
Symptoms
- Snoring
- Witnessed episodes of gasping or choking
- Restless Sleep
- Early Morning Headaches
- Fatigue
- Regardless of amount of sleep, wake unrefreshed
- Excessive daytime sleepiness
- Inactive situation → somnolence
- Forgetfulness
- Depression
- Sexual Dysfunction

Peripheral Consideration
- Sleep Disruption to Partner
  - Bad Back from sleeping on the couch
- Motor Vehicle Accidents
  - Proponent to PSG; bus, truck, heavy machinery
- Job Related Accidents
Interestingly Enough….

- The degree of daytime sleepiness and its impact on quality of life correlate **POORLY** with the frequency and severity of respiratory events.

Medical Consequences of OSAS

- Cardiovascular ramifications of untreated, progressive OSAS
  - Hypertension
  - Arrhythmias
  - Myocardial Infarction
  - Cerebrovascular Accidents
  - Pulmonary Hypertension → Cor Pulmonale
    - Upravi, Selexipag
  - Congestive Heart Failure
Pathophysiology of HTN

- Increased sympathetic tone from hypoxemia and frequent arousals
- Apneic episode → decreased cardiac output
  - Increased sympathetic nervous system activation
  - Increased systemic vascular resistance
- Resolution of Apneic episode → increased venous return to the right side of heart
  - Increased cardiac output against increased vascular resistance
- Multiple cycles throughout the evening, the balance shifts from a favorable parasympathetic to a sympathetic tone with resulting HTN

Diagnosis

- Detailed history, subjective feedback is essential
- Question for symptoms as previously described
- Explore sleep hygiene, average time they go to sleep, time to fall asleep, average time get out of bed in a.m.
- Rule out differentials
  - Insomnia
  - Circadian Rhythm Disorder
  - Insufficient Sleep Syndrome, sleep deprivation voluntary but unintentional
    - “NetFlix Binging”
Don’t Forget Bed Partner

- “I’m ready to kill him... then he stops breathing and I think he may in fact be dead...... The he gasps, breathes again and I’m ready to kill him again”
- Most important clinical aid when dealing with pediatric OSA
**Epworth Sleepiness Scale**

- Likelihood of dosing off in 8 different scenarios
  - 0-3
  - 10+ of 24 → pathologic sleepiness

**Physical Exam**

- BMI
  - Height, weight, neck circumference
- Nose
- Nasopharynx
- Oral Cavity
- Oropharynx
- Hypopharynx
- Larynx
Nose

- Congestion
- Infections
- Deviated Septum
- Hypertrophied Turbinates
- Polyps
- Masses
- Nasal Valve Collapse
  - Breath Right Strips

Rhinoscopy

**Middle turbinate hypertrophy**

*(Concha bullosa)*
Rhinoscopy

- Residual Adenoid Pad
- Adenoid Hypertrophy
  - Adult → Rule out HIV/AIDS/Lymphoma
- Masses
- Polyps

Nasopharynx
Nasopharynx

Oral Cavity

- Dental Occlusion
- Size and Tongue Position
- Jaw
  - Retrognathia: posteriorly displaces tongue, narrows pharyngeal airway
  - Prognathia
- Hypoplastic mandible
- Mandibular or Palatal Tori: posteriorly displaces tongue
Macroglossia

Nasion → Retrognathia

Gnathion
Oropharynx

- Tonsils
  - Graded 0-4
    - 0 - Absent
    - 4 - Kissing
- Uvula
- Prominent lateral Pharyngeal walls
  - Mueller Maneuver

Kissing Tonsils
Mueller Maneuver

- Nose pinched
- Mouth Closed → Inhale against a closed glottis
- Observe for retropalatal, retrolingual examined for collapse
- Observe while seated and lying down

Lateral Pharyngeal Fat Pads

- Airway
- Lateral pharyngeal walls
- Mandible
- Parapharyngeal fat pad
- Subcutaneous fat
- Teeth
- Tongue
- Mandible
- Parotid gland
- Lateral pharyngeal walls
- Subcutaneous fat
Friedman Classification
Mallampati Classification
- Varies based on tongue in or out of mouth
  - Friedman is tongue in mouth
  - Notes the positioning between soft palate/uvula/oropharynx
Hypopharynx
- Size and position of Base of Tongue
- Lingual Tonsillar Hypertrophy
- Masses

Enlarged BOT/Lingual tonsils
Larynx

- Mobility of vocal cords
- Masses
- Polyps

LPR
Physiology

- Nasal obstruction → Mouth Breathing
  - Leads to Upper airway collapse & SDB
- Backward rotation of jaw displacing base of tongue posteriorly
- Hyoid bone is lowered → increased risk of pharyngeal collapse
- Nasal obstruction and mouth breathing → increased pharyngeal resistance upstream → increased collapse downstream due to loss of nasal reflex

Putting It All Together

- Drug Induced Sleep Endoscopy
  - Eliminates misleading info based on office exam
  - Mimics night time sleeping
- 's: Done in operative room setting
- 's: Propofol used can over-sedate
- Scope performed, examines the pharynx
- Can record
Cephalometry

- Lateral Facial X-ray
- Provides evaluation of soft tissue and skeletal relationships, posterior airway space, length of soft palate, hyoid position
- ‘-’s: Limited predictive value for surgical outcome
- Mandibular plane to hyoid bone distance less than 20 mm higher success in UP3

MP-H: Good Prognostic Indicator
Polysomnography

- Simultaneous recording of multiple physiologic parameters during sleep
- Essential to diagnosis of Sleep Disorder
- 4 Levels
  - Level 1: Standard, at least 6 hours, continuous monitoring
    - EEG, ECG, EOG, EMG (chin & legs), Nasal and oral airflow, SaO2, Thoracic and abdominal movement, body position, snoring
  - Level 2: unattended study, in home
    - ‘-‘: lack of trained attendant
    - ‘+‘: comfort of your own home
  - Level 3: unattended
    - Three parameters: heart rate, airflow, oximetry
    - ‘-‘: Underestimates AHI, apnea-hypopnea index, can’t differentiate sleep vs. wake
  - Level 4: unattended, limited
    - 1-2 parameters, one being Oxygen saturations
    - ‘-‘: false positives in COPD
    - ‘-‘: false negatives in healthy OSA patients with minor destas

PSG

- Level 2: unattended study, in home
  - ‘-‘: lack of trained attendant
  - ‘+‘: comfort of your own home
- Level 3: unattended
  - Three parameters: heart rate, airflow, oximetry
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Treatment
- Goals: reduction in morbidity and mortality
- Improve QOL of patient and sleep partner
- CPAP: continuous positive airway pressure
  - GOLD STANDARD
- Behavioral Interventions
- Surgery as last resort
- Educate patient as to risks of MVA and job related injury due to daytime somnolence

Pediatric OSA
- Central Vs. Obstructive
- Most Common is Adenotonsillar Hypertrophy
- PSG
- Maternal Feedback: KEY!
- Always Observe overnight
- Flash Pulmonary Edema
Flash Pulmonary Edema

Type II POPE
- Tonsils $\rightarrow$ PEEP
- Post tonsillectomy $\rightarrow$ Removes PEEP
- Altered permeability and interstitial fluid do not resolve spontaneously
- Interstitial fluid transudate leads to pulmonary edema
- Foot on door $\rightarrow$ friend goes to ram door $\rightarrow$ move foot $\rightarrow$ door flies open $\rightarrow$ Everyone laughs
Behavioral Modifications

- Avoidance of alcohol and or sedatives at bedtime
- Because not getting good sleep, may feel sedative would improve → further exacerbating apnea
- Weight Loss
- Positional Changes
  - HOB elevation
  - Supine sleep → tongue displaced
  - Tennis ball on back of shirt

CPAP

- Gold Standard
- Pneumatic Splint preventing airway collapse
- Various masks, nose, mouth, both
- CPAP titration trial
  - Tweaks settings
    - Too Low: not properly treated
    - Too High: central apneas
  - Split study vs. second study
Compliance

- If tolerates CPAP → problem solved
- 25-30% refuse CPAP after titration trial
  - Lack of understanding of morbidity
  - Refusing to accept diagnosis
  - Perceived lack of symptomatology
  - Claustrophobia
  - Associated Costs
- Effective CPAP at least 4 hours, 5 nights a week
- Newer technology tracks compliance

If CPAP pressure too high to go to sleep → RAMP
HIGH CPAP → Consider BiPAP to improve tolerance
AUTO-PAP → Variable pressures with each cycle

Various Options

Nasal  Nasal Pillow  Full Face
What They Will Complain About

- Air Leaks
- Breakdown of nasal or facial skin
- Skin Rash
- Mask Discomfort
- Rhinitis
- Nasal Congestion
- Nose Bleeds
- Nasal Dryness
- Throat Irritation
- Eye Irritation
- Increased Barometric Pressure to Middle Ear

Poiseuille’s Law

$$\text{Resistance} = \frac{8\eta L}{\pi R^4}$$
Oral Appliance

- Increase Upper airway patency
- Bring mandible and base of tongue forward stabilizing mandible prevent t falling open during sleep
- Increase genioglossus muscle activity via downward rotation maintains airway patency
- Mandibular Repositioning Device
  - Mild to Moderate OSA
    - 's: TMJ, dental separation, excess salivation, dry mouth

Expiratory Positive Airway Pressure

- Provent
- Nasal Device
- Valve opens during inspiration
- Closes during expiration
- Increases Expiratory Positive Airway Pressure maintains patency of upper airway until next inspiration
Surgery

- Snorers
- CPAP failures, cannot tolerate
- Improve CPAP compliance
- Surgery geared to correct area of obstruction
  - Hence may be multilevel
    - Nose/Nasopharynx
    - Oral Cavity/Oropharynx
    - Hypopharynx

Nasal Surgery

- Resolution of obstruction will help SDB, snoring, upper airway resistance syndrome, OSAS
- Improves CPAP tolerance, i.e. nasal pillars
- Mouth breathing $\rightarrow$ downward posterior displacement of mandible, posterior superior shift in genioglossus $\rightarrow$ oropharyngeal obstruction
- Nasal Valve Surgery (breath right strips)
  - Cottle maneuver
- Septoplasty
- Turbinate Reduction
- Polyps
- Adenoids
S/P Septoplasty

Oropharyngeal Surgery
- Tonsillectomy
  - Tonsillar hypertrophy narrows oropharyngeal inlet→ hence tonsillectomy alleviates obstruction
- Primary Site in Children (plus adenoids)
- Secondary Site in adults
  - Contributing factor
  - Often removed in conjunction with other procedure
Palatopharyngeal Surgery
- Soft Palate and lateral pharyngeal walls are most compliant part of upper airway
- Retropalatal region is one of the main areas of collapse in SDB
- Goals of surgery are to shorten or stiffen and reduce/prevent tissue collapse
- Uvulopalatopharyngoplasty UP3
- Transpalatal Advancement Pharyngoplasty
- Expansion Sphincteroplasty
- Uvulopalatal Flap
- Palatal Implants
- Injection Snorplasty
- Ablation via radiofrequency

Uvulopalatopharyngoplasty
- Removal of tonsils if present
- Uvula
- Redundant soft palate tissue
- Anterior Tonsillar Pillars
- Posterior Pillars Sutured Forward
- As a result nasopharynx and oropharynx are advanced in an anterior posterior direction
- Eliminates obstruction at this level
- Isolated procedure success rate of 40-50%
- Elimination OSAS
  - Attributes to pharyngeal obstruction distally, i.e. hypopharynx
Hypopharynx

- Accounts for failures of more proximal sleep apnea surgical treatment attempts
- Assessed via Mueller Maneuver
- Goal: reduce tongue or make more room for the tongue
- Radiofrequency ablation of tongue base
- Genioglossus Advancement
- Hyoid Suspension
- Tongue Suspension
- Transoral Midline Glossectomy
- Mandibular Advancement
- Maxillomandibular Advancement
Hyoid Suspension
Genioglossus Advancement
When All Else Fails…..

- Tracheostomy
- Eliminates the entire upper airway from the equation
- Cap during day, open at night

In my practice

- Poiseuille’s Law
- Decreasing Resistance is Key
- Ablation
  - Radiofrequency
  - No Cutting
  - Tongue Base
  - Palate
  - Turbinates
- Allergy Management
- Nasal Hygiene
Coblator Wand

Turbinate Reduction and Out fracture
Tongue Base Ablation

Try to Get Some Sleep....

- Leads everywhere.....
- Uncomfortable Bed.....
- Miss your wife, your pillow, your dog.....

- Solution......
Try to Get Some Sleep....

Home Sleep Study

- Granted there are limitations, yet over a two night trial get more than enough info to diagnose appropriately
- Auto-PAP
- Eliminate need for split study or second CPAP titration trial
- Patient looking for excuses to avoid surgery, CPAP machines
Work Cited


Work Cited

- Sher, AE et al. The Efficacy of Surgical Modifications of Upper Airway in Adults with OSAS. Sleep. 1996;19:156
- Wright, J et al. The Efficacy of Nasal CPAP in Treatment of OSAS is not proven. Am J Respir Critical Care Med. 2000;161:1776