# Sleep Apnea
## & the Eye

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## Online Resources

Lecture Notes
http://richardtrevino.net

Powerpoint Slides
http://slideshare.net/rhodopsin

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Disclosures
None

## Sleep Apnea & the Eye

- Sleep Apnea
  - What it is
  - How it's diagnosed & treated
- Ocular Manifestations
  - Asthenopia
  - CPAP-assoc red eye
  - Floppy eyelid syndrome
  - Retinal Conditions
  - NAION
  - Papilledema
  - Normal tension glaucoma

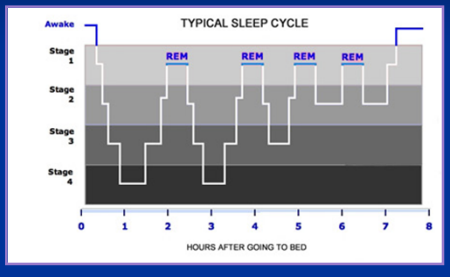
## Sleep Disorders

*OSA is the "most physiologically disruptive and dangerous of the sleep-related disorders."*

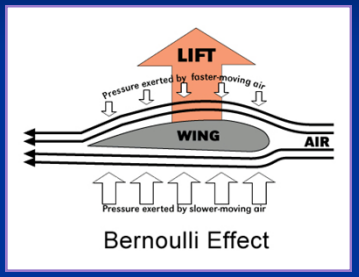
- Sleep apnea
- Insomnia
- Narcolepsy
- Restless leg syndrome
- Parasomnias
- Circadian disorders
- Drug side effects
- Shift work

*J Am Board Fam Med. 2007;20:392-398*

## Sleep Architecture




## Obstructive Sleep Apnea



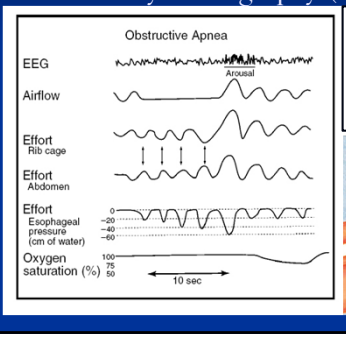

**Any Condition that Causes or Contributes to Upper Airway Narrowing is a Risk Factor for OSA**

Obesity
Enlarged Tonsils
Anatomical Malformations
Neoplasms
Edema of the pharynx
Lymphoid Hypertrophy
Pharyngeal Muscle Weakness
Dyscoordination of Respiratory Muscles

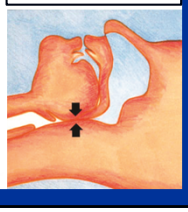
*Thorax 2004;59:73-78*

# Obstructive Sleep Apnea

## Polysomnography (PSG)




**OSA Grading Scale**
Mild: 5-15 episodes/hr
Mod: 15-30 episodes/hr
Severe: >30 episodes/hr



# Obstructive Sleep Apnea

## Clinical Characteristics

**Excessive daytime sleepiness**
- Most common symptom

**Disruptive snoring**
- *"Do you have a snoring problem?"*

**Apneic events witnessed by bed partner**
- Disruptive snoring + witnessed apneas: 94% specificity

**Obesity**
- 30% of pts with a BMI > 30 have OSA, and 50% of pts with a BMI > 40 have OSA.

**Neck circumference**
- ≥40 cm had a sensitivity of 61% and a specificity of 93% for OSA
- Correlates better than BMI

**Male**
- 2-3x more common than female

**Family history of OSA**
- Relatives have 2-4 fold ↑ risk

# Obstructive Sleep Apnea

## Clinical Consequences

**Cardiovascular Disease**
- HTN, CAD/MI, CHF, Arrhythmia

**Stroke**

**Obesity**

**Metabolic Syndrome**

**Other Diseases**
- Morning headache, Eye, Liver, Kidney, others

**Cognitive and Emotional**
- Impaired mental functioning
- Depression
- Mood alteration

**Effects on bed partners**
- Disruptive snoring

**Accidents**
- *Drowsy driving*
- Workplace


# Obstructive Sleep Apnea

## Clinical Evaluation

**History**
- Sleepiness assessment
- Disruptive snoring
- Witnessed apneas

**Physical**
- Obesity
- Neck circumference
- Throat/Mouth exam

**PSG**
- Gold Standard
- Respiratory Disturbance Index; Apnea/Hypopnea Index

*J Fam Prac. 2008;57(8) Suppl (http://www.jfponline.com)*

# Obstructive Sleep Apnea

## Epworth Sleepiness Scale

How likely are you to doze off or fall asleep in the following situations?

0 = No chance, 1 = Slight chance, 2 = Moderate chance, 3 = High Chance

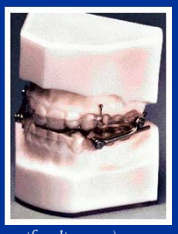
1. Sitting and reading
2. Watching TV
3. Sitting inactive in a public place (theater, meeting)
4. As a passenger in a car for an hour without a break
5. Lying down to rest in the afternoon when circumstances permit
6. Sitting and talking to someone
7. Sitting quietly after a lunch without alcohol
8. In a car, while stopped for a few minutes in traffic

*Sleep 1994;17:160–167*

## Obstructive Sleep Apnea

### Treatment Options

- Behavioral: Weight loss, EtOH avoidance, nonsupine position
- Positive Airway Pressure: CPAP, Provent, others
- Mandibular advancement device
- Surgery: UPPP, Tonsillectomy, Tracheostomy



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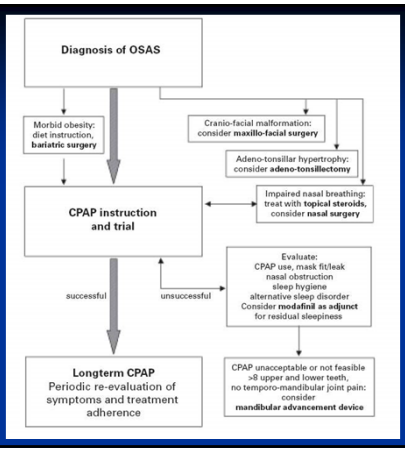



## OSA & the Eye

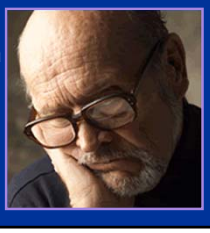
### Ocular Manifestations of Sleep Apnea

- Asthenopia
- CPAP-assoc Red Eye
- Floppy Eyelid Syndrome
- Diabetic Retinopathy
- NAION
- Papilledema
- Normal Tension Glaucoma

## Asthenopia

### Common OSA-associated asthenopic symptoms

- Unexplained symptoms of blur
  - Trouble "focusing eyes"
  - Vision is 20/20 but the patient is c/o blur
- Misinterpreting what is seen
  - Incorrect recording or copying
  - Work-related errors
- Eye strain and/or fatigue
- Headaches
  - Worse in the morning



## Asthenopia

### If OSA is in the medical history

- Ask about sleepiness or fatigue
- Possibly due to poor compliance or residual fatigue
- Offer supportive management (eg. CPAP compliance)

### If OSA is not in the medical history

- High index of suspicion whenever the chief complaint is fatigue or asthenopia
- Especially if habitus is Pickwickian
- Be prepared to screen for sleepiness

## CPAP-associated Red Eye

### Clinical Problems

- Dry eye syndrome
- EXW CL intolerance
- Recurrent corneal erosion
- Infectious conjunctivitis

### Causes

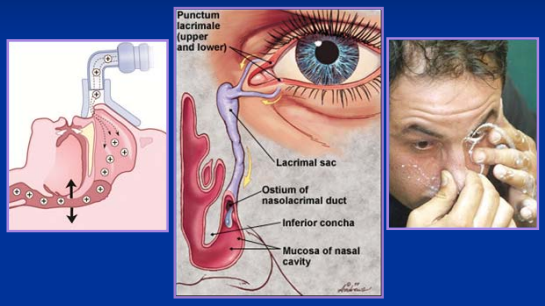
- Air leaks
- Retrograde air flow thru nasolacrimal apparatus (*Saline bubble test*)

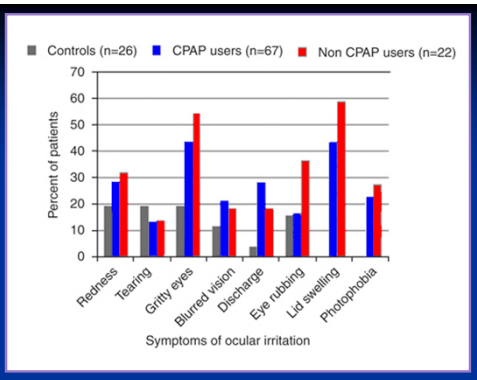
### Treatment

- Lubricating ointments HS, punctal plugs
- CPAP refitting: adjust headgear and pressure
- Intranasal surgery

*Optometry. 2007;78:352-355*

## CPAP-associated Red Eye




Persons with OSA generally have greater ocular discomfort than controls, but is greatest among persons that are noncompliant with CPAP

*Eye 2010;24:843–850*

## Floppy Eyelid Syndrome

### Clinical Characteristics

#### Eyelid hyperlaxity

- Rubbery, easily everted upper eyelids
- Eyelash ptosis with loss of parallelism

#### Papillary conjunctivitis

- Chronic ocular irritation, worse upon waking
- SPK, mucoid discharge common
- Rubbing on pillow case

*Clin Exp Ophthalmol 2005;33:117-125.*

## Floppy Eyelid Syndrome

### Eyelash ptosis

- Downward displacement of eyelashes
- Lashes may point in various directions
- Loss of parallelism
- Pts may trim with scissors

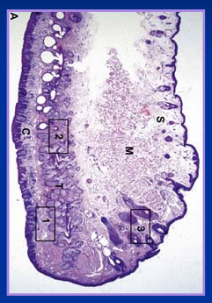
*Ophthalmology 1998;105:165-169*

## Floppy Eyelid Syndrome

## Floppy Eyelid Syndrome

### Etiopathogenesis

- Loss of elastic fibers in tarsus
- May be caused by repeated mechanical trauma, possibly eye rubbing or sleeping with the face buried in the pillow
- FES also highly associated with keratoconus, reinforcing suspected role of mechanical trauma



*Br J Ophthalmol 2013;97:1363-4*

## Floppy Eyelid Syndrome

Treatment

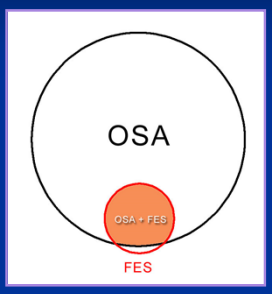
- CPAP therapy
  - Treatment of OSA can improve sxs
- Protect eye during sleep
  - Ointments HS
  - Patching, taping, sleep mask
- Surgery is considered the definitive treatment
  - 25-50% failure rate within 2yrs

*Ophthalmology 2010;117:839-846*

## Floppy Eyelid Syndrome

Relation to OSA

- About 10-20% of OSA pts have FES
- 40% of pts with severe OSA have FES
- 96% pts with FES have OSA
- FES strongly associated with OSA even after adjusting for weight




*Surv Ophthalmol 2010;55:35-46*

## Floppy Eyelid Syndrome

Relation to Glaucoma

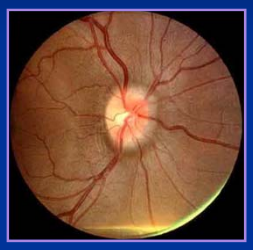
- FES and glaucoma are both associated with OSA
- FES may serve as a marker for those patients with OSA that also have glaucoma
- In a recent study, 5% of OSA pts without FES had glaucoma, compared 23% of those with FES


*J Glaucoma 2014;23:e81-5*

## OSA & the Eye

Ocular Manifestations of Sleep Apnea

- Asthenopia
- CPAP-assoc Red Eye
- Floppy Eyelid Syndrome
- Retinal Conditions
- NAION
- Papilledema
- Normal Tension Glaucoma



## Diabetic Retinopathy

OSA increases risk of progression of retinopathy

- Diabetic retinopathy is more common and severe in patients with OSA, independent of other risk factors
- Risk of progression associated with severity of OSA
- CPAP may slow progression of diabetic retinopathy by minimizing nocturnal hypoxia
- Diabetics with OSA should be screened for retinopathy and encouraged to be compliant with CPAP

*Am J Ophthalmol. 2010;149:959–963*

## Other Retinal Disorders Associated with OSA

Central Serous Chorioretinopathy

- OSA may be a risk factor for CSCR, and treatment of OSA has been reported to hasten recovery of CSCR

Central Retinal Vein Occlusion

- OSA may be a risk factor for CRVO, and has been associated with bilateral simultaneous CRVO

Anti-VEGF treatment failure

- OSA has been associated with Avastin treatment failure of AMD and diabetic macular edema

## NAION

### Clinical Characteristics

- Most common acute optic neuropathy in pts >50yo
- Sudden painless visual loss, *usually upon awaking*
- Nerve fiber bundle VF defects
- Diffuse or sectoral disc edema
- Disc at risk: small, crowded
  - Mean C/D = 0.2
  - All ≤ 0.4

## NAION

### Pathophysiology

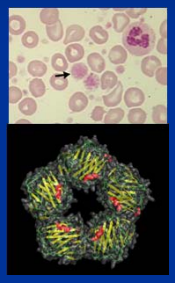
- Idiopathic ischemic process
  - Disorder of posterior ciliary artery circulation
  - Transient poor circulation in the ONH
  - ***Trigger Event:*** Fall in blood pressure below a critical level?
  - There is no actual blockage of the posterior ciliary arteries
- Cascade Effect
  - Mechanical crowding caused by small crowded disc
  - Ischemia → Swelling → Compression → Ischemia

*http://webeye.ophth.uiowa.edu/dept/AION/Index.htm*

## NAION

### Diagnosis: Must exclude GCA in every case

- ESR
- C-Reactive Protein
  - Levels increase in presence of inflammation
  - Upper limit normal does not rise with age
- Platelets
  - Secondary thrombocytosis due to chronic inflammation



## NAION

### Treatment

- Aspirin
  - Decreases incidence in fellow eye at 2 yrs, but not at 5 yrs
- Surgical decompression
  - No benefit (Ischemic Optic Neuropathy Decompression Trial)
- Control of predisposing systemic disease
  - May slow progression or reduce incidence in fellow eye
  - Hypertension, Diabetes, Hyperlipidemia, OSA
- Avoid phosphodiesterase 5 inhibitors (Viagra, Cialis, etc)
  - May increase risk of NAION in fellow eye

## NAION

### Relation to OSA

| NAION Patients with OSA | | |
|---|---|---|
| Palombi (2006) | 89% | HTN: 59%, DM: 37% |
| Arda (2013) | 85% | Controls: 65% (matched for DM, HTN) |
| Bilgin (2013) | 56% | Controls: 22% (matched) |

### Conclusions

- OSA may be the systemic disorder most frequently associated with NAION
- Every patient newly diagnosed with NAION should be tested for OSA

## Papilledema

### Clinical Characteristics

- Disc swelling associated with increased ICP
- Symptoms of elevated ICP: Headache, tinnitus, TOV
- Chronic papilledema (months) may lead to optic atrophy and vision loss

## Papilledema

### Work-up
- Urgent MRI or CT scan
- Lumbar puncture if imaging normal

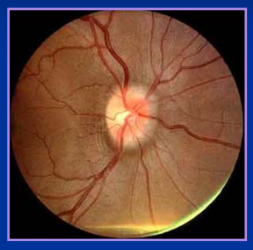
### Idiopathic Intracranial Hypertension
- "Pseudotumor cerebri"
- Syndrome of elevated ICP, papilledema, normal MRI/CT, normal CSF
- Secondary pseudotumor cerebri syndromes with an identifiable cause (venous sinus thrombosis, vitamin A toxicity, COPD, OSA)
- Tx: Diamox 250mg po QID , Underlying cause if known

## Papilledema

### Relation to OSA
- Stein (2011)
  - Reviewed 2.3 million insurance company billing records
  - Persons with OSA have 30% to 100% increased risk of developing papilledema
- Parvin (2000)
  - 4 pts with unexplained papilledema that resolved with successful treatment of OSA
  - ICP may be normal during the day but elevated at night
  - Intermittent (nocturnal) ↑ ICP can cause sustained papilledema
  - Hypercapnia-induced cerebral vasodilatation elevates ICP

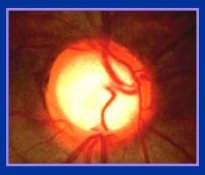
## OSA & the Eye

### Ocular Manifestations of Sleep Apnea
- Asthenopia
- CPAP-assoc Red Eye
- Floppy Eyelid Syndrome
- Retinal Conditions
- NAION
- Papilledema
- Normal Tension Glaucoma



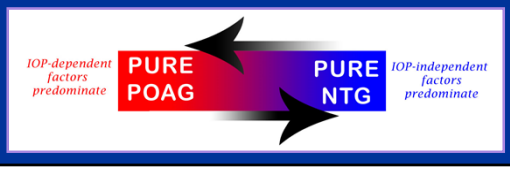
## Normal Tension Glaucoma

### Clinical Characteristics
- Probably a variant of POAG
- IOP is never documented above 21 mmHg
- Peripapillary hemorrhages may be more frequent
- Peripapillary atrophy may be more marked
- VF defects tend to be deeper and more localized



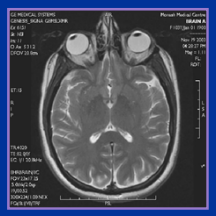
## Normal Tension Glaucoma

### Pathophysiology
- IOP-independent factors predominate
  - Vascular insufficiency: CVD, HTN
  - Vasospasm: migraine, Raynaud's phenomenon
  - Translaminar pressure difference: low ICP




## Normal Tension Glaucoma

### Diagnosis
- R/O other glaucomas
  - POAG with diurnal IOP fluctuation
  - IOP normalization (Burnt-out glaucoma, steroids)
- R/O other optic neuropathies
  - NAION, space-occupying lesions, congenital anomalies
  - When to order neuroimaging:
    - Younger age (<50 yrs)
    - Reduced VA (< 20/40)
    - Vertically aligned VF defects
    - Neuroretinal rim pallor



*Ophthalmology 1998;105:1866-1874*

## Normal Tension Glaucoma

**Glaucoma Patients with OSA**

| | | |
|---|---|---|
| POAG | Girkin (2006) | 1% |
| POAG | Roberts (2009) | 17% |
| POAG | Mojon (2000) | 20% |
| NTG | Khandgave (2013) | 23% |
| POAG | Balbay (2014) | 33% |
| NTG | Bilgin (2014) | 42% |
| POAG | Blumen (2010) | 48% |
| NTG | Marcus (2001) | 57% |
| NTG | Mojon (2002) | 50-60% (varies with age) |

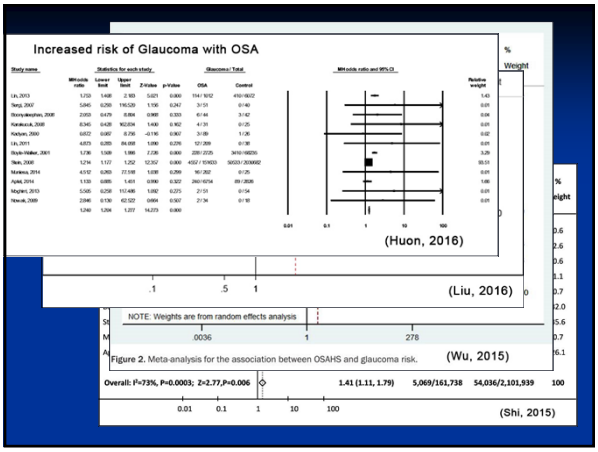
Greater than general pop estimate of 10-20%

**OSA Patients with Glaucoma**

| | | POAG | NTG |
|---|---|---|---|
| | Geyer (2003) | 1% | 1% |
| | Kadyan (2010) | 2% | |
| | Karakuck (2008) | 3% | 10% |
| | Aptel (2014) | 4% | |
| | Mojon (1999) | 4% | 3% |
| | Boonyaleephan (2008) | 5% | 9% |
| | Hashim (2014) | 5% | 15% |
| | Boyle-Walker (2011) | 8% | |
| | Bendel (2008) | 27% | |
| | Sergi (2007) | | 6% |
| | Lin (2010) | | 6% |

NTG is at least as common as POAG in this patient population

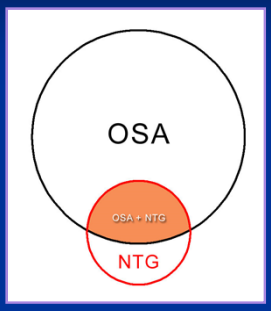
Greater than general pop estimate of 1.5-3%




## Normal Tension Glaucoma

Relation to OSA

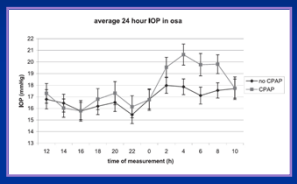
- 5%-10% of OSA patients have NTG *(0.5% general pop)*
- Up to 50% of NTG patients have OSA
- Treatment of OSA may help stabilize NTG (Kremmer, 2003) and improve VF performance (Sebastian, 2006)




## Normal Tension Glaucoma

CPAP Increases IOP

- Kiekens (2008)
  - Diurnal IOP measured with and without CPAP
  - Average IOP and diurnal fluctuation higher with CPAP
  - Speculate that CPAP elevates intrathoracic pressure, leading to higher central venous pressure, and ultimately higher IOP
  - Recommend regular screening of VF and the optic disc for all patients with OSA, especially those treated with CPAP

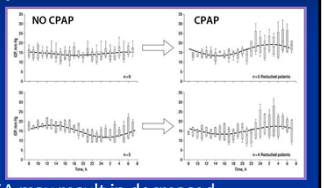



*Invest OphthalmolVis Sci. 2008;49:934–940*

## Normal Tension Glaucoma

CPAP Increases IOP

- Pepin (2010)
  - Diurnal IOP measured with and without CPAP
  - CPAP caused a significant increase in nocturnal IOP
  - Speculate that some effects of untreated OSA may result in decreased nocturnal IOP and these are normalized by use of CPAP
  - Concludes that IOP changes induced by CPAP are explained by restoring normal IOP rhythm rather than by a deleterious effect of the device




*Arch Ophthalmol 2010;128:1257-1263*

## Normal Tension Glaucoma

- Ulusoy (2015)
  - Compared glaucoma prevalence, IOP and CDR among OSA patients who did and did not use CPAP
  - No difference in glaucoma prevalence with CPAP use

*Med Sci Monitor 2015;21:3415-3419*

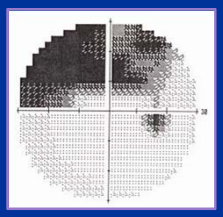
## Normal Tension Glaucoma

OSA May Cause NFL Loss Without Glaucoma

- NFL thinning may represent preclinical NTG
- This "silent optic neuropathy" may evolve into NTG in some patients

OSA May Cause VF Loss Without Glaucoma

- VF loss may occur due to optic nerve damage caused by cerebral ischemia and intermittent ICP elevation



## Normal Tension Glaucoma

Conclusions & Recommendations

- Persons with OSA should be screened for glaucoma
  - Risk of glaucoma is correlated with severity of OSA
- Patients with NTG should be screened or at least questioned about OSA
  - Treatment of uncontrolled OSA may help stabilize glaucoma and improve VF performance
- Initiation of CPAP therapy may increase nocturnal IOP
  - The clinical significance of this in unknown

## Thank You!