The ABCs of OSA
An Overview of Obstructive Sleep Apnea
Learning objectives

• Upon completion, the participant should be able to:
  – Understand pathology and prevalence of Obstructive Sleep Apnea (OSA)
  – Discuss potential consequences and economic impact of untreated or under-treated OSA
  – Identify risks and co-morbidities associated with OSA
  – Recommend appropriate diagnosis and screening procedures used to identify OSA
  – Discuss various treatment options and long-term management of patients with OSA
Definition of OSA

- OSA (Obstructive Sleep Apnea) occurs when the upper airway repeatedly collapses during sleep, causing cessation of breathing (apnea) or inadequate breathing (hypopnea) and sleep fragmentation.
Pathologic breathing cycle: OSA

Wakefulness

Airway Patency Compensation

Sleep

Decreased Compensation

Airway Collapse

Hyperventilation \( \downarrow \text{CO}_2 / \downarrow \text{O}_2 \)

Hypoxia/Hypercapnia

Increased Effort

Arousal/Sleep Fragmentation

Sympathetic Activation
Prevalence of OSA in the U.S.

• 5% of population is estimated to have undiagnosed OSA

• As common as adult asthma

• Obstructive Sleep Apnea/Hypopnea (OSA/H) prevalence:
  – Wisconsin study:  
    – 24% of men, 9% of women: Apnea/Hypopnea Index (AHI) > 5  
    – 9% of men, 4% of women: AHI >15  
    – 4% of middle-aged men, 2% of middle-aged women: AHI > 5 and daytime sleepiness  
  – Pennsylvania study:  
    – 17% of men AHI >5  
    – 7% of men, 2% of women: AHI >15

1 Young, et al., AJRCCM 2002  
2 Young, et al., NEJM 1993  
3 Redline, et al., AJRCCM 1997  
Potential health consequences if untreated

• **Short-Term**
  – Automotive accidents
  – Excessive sleepiness
  – Decreased quality of life
  – Neurocognitive and performance deficits

• **Long-Term**
  – Hypertension
  – Heart disease
  – Heart attack
  – Arrhythmias
  – Stroke
  – Impaired glucose tolerance
Consequences of untreated OSA

- Motor vehicle crashes are leading cause of injury, morbidity, and mortality
  - In US, more than 40,000 deaths and 6 million injuries occur from motor vehicle accidents every year\(^1\)
  - Sleep-related accidents comprise 15-20% of all motor vehicle crashes\(^2\)

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The impact of OSA on utilization costs

Risks and co-morbidities
The link between OSA and hypertension

- > 40% of patients presenting with OSA have daytime hypertension (HTN)¹

- 30 to 50% of patients with HTN have OSA²

- Even mild OSA is a risk factor for HTN³, ⁶

- Patients with untreated OSA may be resistant to their anti-hypertensive medications⁴

- Even small decreases in blood pressure may help to decrease the risk of heart attack and stroke⁵

¹Silverberg, et al., *Curr Hypertens R* 2001
²Kraicze, et al., *JACC* 2000
³Bixler, et al., *Arch Intern Med* 2000
⁴Logan, et al., *J Hypertens* 2001
⁵Heinrich, et al., *Circulation* 2002
⁶Neilto, et al., *Jama* 2000
Recommendations for hypertension

The Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC 7) recommends screening patients for OSA when they have:

New onset hypertension or Refractory hypertension

1 Chobanian, A., et al., Hypertension 2003; 42:1206-1252
The link between OSA and heart failure

- Congestive Heart Failure (CHF) affects 1.5-2% of population
- Annual direct cost estimated $20-40 billion
- There is high prevalence of sleep-disordered breathing in patients with CHF (~40-50%)¹
- Many of mechanisms in OSA may play a role in patients with heart failure², ³, ⁴, ⁵

¹ Shara, E., Am J Resp Crit Care Med 2001
² Peker, Y., Am J Resp Crit Care Med 2002
⁵ Yokoe, T., Circulation 2003
The link between OSA and atrial fibrillation

• OSA is commonly seen in patients with Atrial Fibrillation (AF)
  – The adjusted odds ratio for the association between AF and OSA is 2.19\(^1\)

• Patients with untreated OSA have a higher recurrence of AF after cardioversion than patients without a polysomnographic diagnosis of sleep apnea
  – Appropriate treatment with continuous positive airway pressure (CPAP) in OSA patients is associated with lower recurrence of AF
    – 82% recurrence in untreated OSA
    – 42% recurrence in treated OSA with CPAP\(^2\)

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\(^1\) Gami, A.S., et al., Association of Atrial Fibrillation and Obstructive Sleep Apnea. *Circulation* 2004:110::364-367

The link between OSA and diabetes

- Diabetes affects nearly 21 million Americans (7% of population)
  - Diabetes is the 6th leading cause of death in US
  - 2/3 of people with diabetes die from a heart attack or stroke
- Effective treatment of SDB led to improved glycemic control in subjects with Type II diabetes*
  - In subjects who used CPAP > 4 hrs/day, ↓ in HbA1c significantly correlated with days of CPAP use

*Mean CPAP treatment period of 83 days

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1. Centers for Disease Control and Prevention, National Diabetes Fact Sheet, 2005
The link between OSA and anesthesia

- OSA patients may be at risk of complications related to anesthesia due to
  - Significant co-morbidities\(^1, 2\)
  - Susceptible to airway collapse and sleep deprivation\(^1\)
- OSA can affect all phases of perioperative period\(^1, 2, 3\)
  - Guidelines established for all levels of care to address specific concerns
- Anesthesiologists’ role in identification of OSA
  - Likely that majority of patients have not yet been diagnosed\(^1, 3\)

\(^1\)Practice Guidelines for the Perioperative Management of Patients with Obstructive Sleep Apnea. Anesthesiol 2006;104:1081-1093.


\(^3\)Young, et al. The Occurrence of Sleep Disordered Breathing Among Middle Aged Adults. \(N\) Eng \(J\) Med 1993; 328:1230-1235.
The link between OSA and bariatric surgery

- Clinically severe obesity
  - BMI > 40 kg/m² or BMI 35-40 kg/m² with comorbid conditions
  - Obesity well known risk factor for OSA¹
- 71% of patients evaluated for bariatric surgery were identified as having OSA¹
- Initiate CPAP therapy and continuous monitoring for at-risk patients¹,²
- Research supports referring bariatric candidates for sleep study as part of preoperative evaluation¹.

The link between OSA and pain management

- Emerging evidence suggests a link between OSA and opioid medications for pain management
- People suffering from chronic pain often require around-the-clock opioid therapy
- In recent study, AHI was abnormal in 75% of patients who participated
  - 39% OSA
  - Disturbances were predominant during NREM sleep, contrary to what is normally seen with OSA
- Direct relationship found between AHI and daily dosage of methadone

Other risk factors

- Hypothyroidism
- Acromegaly
- Amyloidosis
- Vocal cord paralysis
- Marfan syndrome
- Down syndrome
- Neuromuscular disorders
Diagnosis and screening procedures
For identification of OSA
Diagnosis of sleep apnea

- Physical exam and history
- Asking questions about sleep or symptoms that may occur during the day, indicating a problem with sleep
- Diagnosed by having a polysomnogram or sleep study performed during the patient’s normal sleep time
Patients to consider for OSA screening

- Complain of fatigue or unrefreshing sleep
- Hypertension
  - Newly identified hypertension
  - Resistant or refractory hypertension
- CHF with nocturnal angina or Cardiovascular Disease
- Bariatric patients
- Patients with large necks
  - 17 in for men, 16 in for women
- Patients with small jaws
- Patients with metabolic syndromes
  - (such as diabetes)
Key signs/symptoms of OSA

- Excessive daytime sleepiness
- Loud snoring
- Pauses in breathing at night
- Waking up gasping or choking
- Witnessed snoring or pauses in breathing
Additional signs/symptoms of OSA

- Morning headaches
- Irritability
- Depression
- Memory loss
- Lack of concentration
- Frequent nighttime urination
- Sexual dysfunction
Common questions used to identify OSA

– Do you fall asleep easily watching TV, reading or at times when you do not want to fall asleep?
– Is your snoring louder than your talking?
– How often do you wake up feeling un-refreshed?
– Has your breathing or snoring at night bothered other people?
– Does anything unusual happen when you are asleep?
Methods of screening for OSA

• Epworth Sleepiness Scale
  – 8 questions answered on a scale of 0 – 3
    – 0 = would never doze
    – 3 = high chance of dozing
  – Score > 10 represents daytime sleepiness

• Epworth Sleepiness Scale does not identify cause of sleepiness
  – May include sleep apnea, but also insomnia, lack of time to sleep, etc.

• Patient with sleep apnea may have normal value
## Epworth sleepiness scale

<table>
<thead>
<tr>
<th>Situation</th>
<th>Chance of Dozing (0 – 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
<td>0 - 1 - 2 - 3</td>
</tr>
<tr>
<td>Watching television</td>
<td>0 - 1 - 2 - 3</td>
</tr>
<tr>
<td>Sitting, inactive in a public place, for example, a theater or meeting</td>
<td>0 - 1 - 2 - 3</td>
</tr>
<tr>
<td>As a passenger in a car for an hour without a break</td>
<td>0 - 1 - 2 - 3</td>
</tr>
<tr>
<td>Lying down to rest in the afternoon when circumstances permit</td>
<td>0 - 1 - 2 - 3</td>
</tr>
<tr>
<td>Sitting and talking to someone</td>
<td>0 - 1 - 2 - 3</td>
</tr>
<tr>
<td>Sitting quietly after lunch without alcohol</td>
<td>0 - 1 - 2 - 3</td>
</tr>
<tr>
<td>In a car, while stopped for a few minutes in traffic</td>
<td>0 - 1 - 2 - 3</td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td></td>
</tr>
</tbody>
</table>
The Berlin Questionnaire

- Simple, self-administered patient questionnaire
- Asks patients to report their symptoms
- Questionnaire is specific to OSA
- Identifies patients at high risk for OSA who are likely to benefit from diagnosis
The Berlin Questionnaire

- Uses 10 questions to assess:
  - Presence and frequency of snoring behavior
  - Wake-time sleepiness or fatigue
  - History of HTN and/or obesity
- Persistent or frequent symptoms in 2 of 3 categories indicates a high likelihood of OSA
RU SLEEPING RTS

- In-home objective screening device that provides real-time results
- Provides continuous apneic event scoring
- Designed to be used to supplement other subjective screening methods such as questionnaires and diaries
- Offers solution to patients who are on a waiting list for PSG
What is a sleep study?

- Polysomnography is a painless study that is done in a laboratory setting to monitor patient’s sleep patterns.
- The study may record the following during sleep:
  - Brain wave activity
  - Respiratory pattern
  - Heart rate
  - Chest movement
  - Leg movement
  - Eye movement
- Identification and treatment of the sleep disorder may occur.
POLYSOMNOGRAPHY IN OSA
POLYSOMNOGRAPHY (NREM)

EEG
EOG/L
EOG/R
EMG
EKG
LAT/RAT
FLOW
EFF/THOR
EFF/ABDN
SaO2

______________________________
POLYSOMNOGRAPHY (REM)

EEG
EOG/L
EOG/R
EMG
EKG
LAT/RAT
FLOW
EFF/THOR
EFF/ABDN
SaO₂
Sleep apnea patterns

- Normal
- Central apnea
- Mixed apnea
- Obstructive apnea
Obstructive sleep apnea

- EEG
- Airflow
- Effort (Rib Cage)
- Effort (Abdomen)
- Effort (Pes)
- $\text{SaO}_2$

Arousal

10 sec
Measures of sleep apnea frequency

- **Apnea Index**
  - Number of apneas per hour of sleep
  - Number of obstructive apneas per hour of sleep
  - Number of central apneas per hour of sleep

- **Hypopnea Index**
  - Number of reduction in patient flow per hour of sleep
  - Number of central or obstructive hypopneas per hour of sleep

- **Apnea / Hypopnea Index (AHI)**
  - Number of apneas + hypopneas per hour of sleep

- **Arousal Index (AI)**
  - When the patient arouses from sleep or changes sleep staging that does not normally occur at night
  - Number of arousals in EEG activity per hour of sleep
  - Associated with apnea/hypopnea/desaturation events
  - Associated with other events (PLM, seizure, etc)
Classification of respiratory events

- Mild Sleep Apnea
  - AHI is 5 to 15 with excessive daytime sleepiness (EDS)
- Moderate Sleep Apnea
  - AHI >15 to 30 with EDS
- Severe Sleep Apnea
  - AHI > 30 with EDS
Why get a sleep study?

• Signs and symptoms are poor predictors of disease severity\(^1\)
• Appropriate therapy dependent on severity
• Failure to treat leads to:
  – Motor vehicle crashes
  – Potential risk of increased morbidity and mortality from co-morbid conditions
• Other causes of daytime sleepiness

Treatment options
Medical interventions

- Oral appliances
- Positive airway pressure
  - Continuous positive airway pressure
  - Bi-level positive airway pressure
- Other (limited role)
  - Medications
  - Weight loss
  - Behavioral therapy
  - Oxygen
OSA Therapy

- Of those patients being treated for OSA, 70 - 80% utilize CPAP therapy with a nasal mask\(^1\)

- CPAP provides positive pressure to provide a pneumatic splint for the patient’s airway

\(^1\) Frost & Sullivan, Sleep Apnea Models, 2001
PAP therapy for patients with OSA

• **CPAP**
  – One level of pressure on inspiration and exhalation
  – Device may have the option to provide pressure relief in early exhalation

• **Bi-level therapy**
  – One level of pressure on inspiration and lower level of pressure on expiration
  – Device may have the option to provide pressure relief in early exhalation

• **Auto titration therapy**
  – Device pressure is adjusted based on airway dynamics and device algorithm
Goals of treating OSA with PAP

**Short Term**
- Maintain open airway
- Improve quality of sleep
- Alleviate daytime symptoms
  - Sleepiness
  - Moodiness/Impaired concentration/Memory loss
  - Morning headache

**Long Term**
- Reduce mortality and morbidity
  - Decrease cardiovascular consequences
  - Reduce sleepiness
- Improve quality of life

Long-term management
Compliance and acceptance of OSA therapy
CPAP therapy adherence

• How is OSA treatment adherence defined?
  – >= 4 hours of use, >=70% of time (Kribbs\textsuperscript{1})

• Studies show patient adherence to therapy is not ideal
  – Kribbs found that 54% could be inconsistent users\textsuperscript{1}
  – Weaver found 47% inconsistent users\textsuperscript{2}

\textsuperscript{1} Kribbs, et al., Objective Measurement of Patterns of Nasal CPAP Use by Patients with OSA. \textit{American Review of Respiratory Disease} 1997:147 No. 4
\textsuperscript{2} Weaver, et al., Night-to-Night Variability in CPAP Use Over the First Three Months of Treatment. \textit{Sleep} 1993:20(4):278-283
Ensure patients receive effective therapy

- Look for
  - Acceptance
  - Tolerance
  - Response

- Enhance patient education

- Proactive in addressing non-tolerance and non-response
CPAP clinical pathway

- OSA Diagnosis
- Therapy Selection
  - Patient Education
    - Helpful hints
      - Ramp time
      - Ramp start pressure
      - Mask-off alarm
      - Mask satisfaction/fit
      - Humidification
      - Flex technology
  - CPAP Set-up
  - Patient Follow-up
    - Encore 1.6
    - Phone in Compliance
- Effective Therapy?
Monitoring for effective therapy

- Effective Therapy
  - No
  - Non-Acceptance
  - Non-Tolerance
  - Non-Response
  - Nasal Symptoms
  - Mask Issues
  - Pressure Issues
  - Psychosocial Concerns
  - No Perceived Benefit

- Yes
- Effective Therapy Achieved

- No
  - Go to Bi-level* Therapy

*or Auto-Adjusting Bi-level Therapy
Compliance reports

Included in this report are:
- Hours of Usage
- Pressures
- FOSQ Score (if applicable)

Patterns of Use
Summary of Compliance

Impact of therapy effectiveness

Quality of life with therapy

- Humidification
- C-Flex
- Overall daily use
Average AHI
- Treat similar to sleep study standards
- If the AHI > 5 with EDS or >15 consistently, you may want to address with the patient & MD

Average Vibratory Snore Index
- Determines the amount of snoring or airway movement with therapy
- Excessive snoring may negatively impact therapy

Leak Information
- Acceptable leak based on pressure and mask being used
- High mask leaks may cause pressure levels to be inaccurate
Tools that may improve compliance

- Comfort settings on exhalation
  - Provide relief during exhalation phase to allow for improved comfort to CPAP therapy
- When to use:
  - Initial set up
  - Pressure intolerance

1 Aloia, et. al. Chest, June 2005
2 Rosenthal, et. al Sleep, June 2005
Tools that may improve compliance

• Ramp
  – Allows for patient to fall asleep at a lower pressure and acclimate to pressure over time
  – Can be adjusted based on pressure drop and length of time until patient is back at prescribed PAP pressure while falling asleep
Tools that may improve compliance

• Humidification adds moisture for patients receiving PAP therapy
  – Cool humidifiers or heated humidifiers available

• Humidification may improve compliance by decreasing effects of:
Tools that may improve compliance

- **Nasal**
  - A common starting mask for OSA patients
- **Full**
  - Good for mouth breathers
- **Pillows/Prongs**
  - Claustrophobia
  - Allergic reaction
  - Side sleepers
- Chinstrap may be used for mouth leak with nasal interfaces
- Reimbursement provided for replacement equipment
In summary

– Pathology and prevalence of OSA
– Potential consequences and economic impact of untreated or undertreated OSA
– Risks and co-morbidities associated with OSA
– Diagnosis and screening procedures used to identify OSA
– Various treatment options and long-term management of patients with OSA
– Any questions?

THANK YOU!