Nocturia and Sleep Apnea

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Outline
- Introduction
- Background & Incidence
- Definitions
- Differential Diagnosis of Nocturia
- Risk Factors of OSA
- Mechanism of OSA-Nocturnal Polyuria
- Diagnosis and Treatment
- Summary

Background
- Nocturia is a very common problem
- 4% of children have habitual nocturia
- 58% of women between 50-60yo
- 72% of women over 80yo
- 7.3% of women with incontinence
- 25% of women with irritative voiding symptoms
- 24% of women with difficulty emptying

Definitions
- NOCTURIA
- NOCTURNAL POLYURIA
- POLYURIA
- NIGHTTIME FREQUENCY
- Nocturnal urine volume
Nocturia
- The number of voids during a night’s sleep.
- Each void is preceded and followed by sleep

Nocturnal Polyuria
- Nocturnal urine volume greater then 20% of daily output in young adults to greater then 30% in elderly when including the first morning void.

Polyuria
- 24 hour voided volume in excess of 2800ml (i.e. in an average 70 kg patient, >40ml/kg).

Nighttime Frequency
- The number of voids recorded at night, that is, from the time that the individual goes to bed, with the intention of sleeping, to the time that the individual wakes up, with the intention of rising.
- Nocturnal Urine Volume: the total volume of urine passed during the night, including the first morning void.
### Differential Diagnosis of Nocturia

<table>
<thead>
<tr>
<th>Diurnal Polyuria</th>
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<tbody>
<tr>
<td>- Diabetes Mellitus</td>
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<td>- 1 polydipsia</td>
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<td>- Diabetes Insip.</td>
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<td>- Hypercalcemia</td>
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<tr>
<th>Bladder Storage/Empty Problems</th>
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<tbody>
<tr>
<td>- Infection</td>
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<td>- Urogenital atrophy</td>
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<td>- OAB</td>
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<table>
<thead>
<tr>
<th>Nocturnal Polyuria</th>
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<tr>
<td>- Daytime fluid retention</td>
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<tr>
<td>- Venous insufficiency</td>
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<tr>
<td>- Diuretic therapy</td>
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<td>- CHF</td>
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<tr>
<th>Sleep-Related Issues</th>
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<tr>
<td>- Sleep disturbance</td>
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<tr>
<td>- Obstructive Sleep Apnea</td>
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<tr>
<td>- Time spent in bed</td>
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<tr>
<th>Behavioral, Psychological, Environmental Issues</th>
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<tr>
<td>- Hypoventilation</td>
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### What is sleep apnea?

- Family of sleep disorders also known as sleep disordered breathing
  - Obstructive sleep apnea (MC, 5%)
  - Central sleep apnea
  - Upper airway resistance syndrome
  - Simple snoring
  - Complex sleep apnea
  - Cheyne-stokes respiration
  - Hypoventilation

### Obstructive Sleep Apnea

- Hypoventilation
Obstructive Sleep Apnea

- Results from:
  - Collapse of upper airway during inspiration due to decreased neurologic drive from the brain to dilate upper airway muscles while asleep

Risk Factors of Obstructive Sleep Apnea

- Obesity: greatest predictor
- Daytime somnolence
- Typically can have 4-7 episodes of nocturia per night
- Snoring
- Familial predisposition related to craniofacial structure and airway size
- Enlarged adenoids
- History of enuresis

Risk factors, cont.

- Increasing age
- Male gender
- Post-menopausal females
- Increasing body weight
- Small jaw
- Large tongue
Symptoms

- Snoring
- Tiredness
- Pauses in breathing while asleep
- Depression
- Restless sleep
- Sweaty sleep

Obstructive Sleep Apnea (OSA)

- OSA produces a complex set of conditions that includes:
  - Hypoxia
  - Hypercapnea
  - Acidosis
  - Negative pressure breathing
  - Episodic Bursts of Sympathetic Stimulation

Obstructive Sleep Apnea (OSA)

- Can lead to:
  - Daytime sleepiness
  - Cognitive decline
  - Hypertension
  - Behavioral problems in children
Is it dangerous?

- Yes
  - Associated with 3-fold increase risk for heart attack, stroke, and death from any cause.
- Puts strain on heart and lungs possibly leading to heart failure and pulmonary hypertension if untreated
- #1 cause of hypertension
  - Treatment→decrease mean BP 10 points

Predictors of OSA

- To determine whether familial factors affect the development of sleep apnea-hypopnea syndrome and upper airway caliber
- 51 first degree relatives of thin OSA patients (BMI<30)
- 51 controls matched for age, sex, height, weight
- Each patient underwent NPSG, measurements of airway dimensions, bony and soft tissue dimension
  - Lateral cephalometry
  - Acoustic pulse reflexometry

Characteristics of Relatives of Patients with the Syndrome and Controls

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Relatives</th>
<th>Controls</th>
<th>P Value</th>
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<tbody>
<tr>
<td>Total, n</td>
<td>51</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Men, n</td>
<td>35</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Mean age (SE), y</td>
<td>36 (2)</td>
<td>35 (2)</td>
<td></td>
</tr>
<tr>
<td>Mean body mass index (SE), kg/m²</td>
<td>24 (1)</td>
<td>24 (1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol, n</td>
<td>24</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Nocturnal choking, n</td>
<td>8</td>
<td>1</td>
<td>0.03</td>
</tr>
<tr>
<td>Excessive daytime sleepiness, n</td>
<td>28</td>
<td>16</td>
<td>0.01</td>
</tr>
<tr>
<td>Sleeping against wall, n</td>
<td>10</td>
<td>2</td>
<td>0.03</td>
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More evidence of sleep apnea in 1st degree relatives than a control group. Structural issues in the airway may be involved as a predisposing factor.
Sleep Disordered Breathing and Cardiovascular Disease

- Shahar et al
- Cross sectional results Sleep Heart Health Study of approx 6000 subjects.
- Association between CV disease and sleep apnea.
- Odds ratios were higher for CHF and CVA vs MI
- SDB was associated with self reported CHF & CVA more than CAD

OSA and the recurrence of atrial fibrillation

- Mayo prospective study
- Are patients with untreated OSA more likely to have recurrence of atrial fibrillation after cardioversion?
- 39 patients with diagnosed OSA referred for atrial fibr and cardioversion
  - 27 patients were not being treated with CPAP or using it inappropriately
  - 12 patients treated with CPAP
  - 79 random patients with afib s/p cardioversion (controls)
- Which group was more likely to have recurrence of atrial fibrillation at 12 months?

Mechanism of Obstructive Sleep Apnea and Nocturia

- OSA is a chronic condition
- OSA is created when the body tries to inhale through an obstructed airway.
- This creates a negative intrathoracic pressure
- The heart distends in this negative pressure environment
- Normal ventilation requires only 1-2 cm H2O pressure, whereas esophageal pressures as low as -80 to -90 cm H2O have been recorded during a single obstructive apnea event.
Mechanism of Obstructive Sleep Apnea and Nocturia

- Cardiac distension causes release of Atrial Natriuretic Peptide (ANP)
- Natriuretic peptides are volume-regulating peptides.
- ANP acts to decrease volume in an actual or perceived hypervolemic state.
- ANP is a short-acting substance with a 2-3 min. half-life

- ANP has no diurnal variation
- It has a powerful renal effect, causing sodium and water excretion at 2.5 and 3.5 times the normal rate respectively
- ANP inhibits the secretion of aldosterone, ADH, vasopressin and the entire rennin-angiotensin-aldosterone system.
- Normal physiologic mechanism of fluid homeostasis is circumvented.

Diagnosis and Treatment

- Referral for Sleep Study:
  - Polysomnography (PSG) is considered the gold standard diagnostic test for obstructive sleep apnea-hypopnea (OSAH) and other sleep disorders
  - During PSG, the patient sleeps (overnight) while connected to a variety of monitoring devices that record physiologic variables
  - Patterns of physiologic abnormalities during sleep may be diagnostic of OSAH and other disorders
- Patients should abstain from caffeine and alcohol the day of the testing
- Ambien can be given for insomnia
- The sleeping room is equipped with an infrared camera and audio system, allowing the technician to monitor the patient
Diagnosis and Treatment

- Physiologic Measurements:
  - O$_2$ Saturation
  - EKG to r/o arrythmias
  - EEG: follow sleep patterns
  - Body Position
  - Limb Movements: Bilateral EMG of anterior tibialis

Polysomnography Derived Information

- Total Sleep Time (TST): broken down into Stage I-II (light sleep) vs. III-IV (heavy sleep), REM sleep
- Sleep Efficiency: TST divided by total bed time
- Sleep Stage Percentage: Stage of sleep divided by TST
- Sleep Stage Latency and Duration: Amount of time until onset of and duration in each sleep stage

Polysomnography Derived Information

- Arousals: number of awakenings
- Apnea: obstruction of airflow, characterized as obstructive (structural), central, or mixed
- Hypopnea: Abnormal reduction, but not cessation of airflow
- Snoring, Body Position, O$_2$ Saturation, Limb Movements are all scored to create Indices.
Treatments for OSA

- Continuous Positive Airway Pressure (CPAP)
- OSA and associated nocturia or nocturnal polyuria can be corrected with CPAP.
- CPAP home unit, outpatient mgmt.
- Follow-up with Sleep Specialist, titrate CPAP to effect

Treatment

- Multi-disciplinary approach
- Removal of compromising adenotonsillar tissue: T&A (particularly children-can correct enuresis)
- Life-style changes: Weight loss
- Weight loss can lead to improved management of associated contributing medical conditions: DM, HTN

Problems with CPAP

- COMPLIANCE!!!
- COMPLIANCE!!!
- COMPLIANCE!!!
- COMPLIANCE!!!
- COMPLIANCE!!!
CPAP and compliance

- Heated humidification increases CPAP use over no humidification (5.52 vs 4.93 hours per night)\(^1\)
  - Other studies have refuted this

- Intensive support improves nightly use of CPAP
  - CPAP home education, in lab x 3 nights, education of partner
  - Versus usual therapy
  - Followup 6 months
  - *(3.9 vs 5.4 hours per night)*\(^2\)

\(^1\)Chest 1999;116:403-408
\(^2\)AJRCCM 1999;159:1096-1100

Summary

- Nocturia is a common condition that increases with age

- Nocturnal polyuria of OSA is an evoked response to the negative thoracic pressure due to inspiration against a closed airway

- OSA is associated with cardiovascular disease (HTN, AF, CHF) and Nocturnal Polyuria

Summary

- Sleep studies should be considered when risk factors are present or increased suspicion of OSA

- The gold standard for diagnosis of OSA - nocturia is polysomnography

- OSA can be easily treated by Continuous Positive Airway Pressure, with a complete reversal of nocturnal polyuria along with possible improvement of other medical problems.