Obstructive Sleep Apnea

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Overview

- Physiology of Sleep
- Evaluation of Sleep
- Definition of Obstructive Sleep Apnea (OSA)
- Prevalence of OSA
- Pathophysiology of OSA
- Medical Treatment of OSA
- Surgical Treatment of OSA
Physiology of Sleep

- REM
- Sleep Latency, REM Latency
- Arousal

Woodson, Tucker “Obstructive Sleep Apnea Syndrome, Diagnosis and Treatment” SIPAC 1996
Evaluation of Sleep

- Polysomnography
  - EMG
  - Airflow
  - EEG, EOG
  - Oxygen Saturation
  - Cardiac Rhythm
  - Leg Movements
  - AI, HI, AHI, RDI
Evaluation of Sleep

- Polysomnography

Woodson, Tucker “Obstructive Sleep Apnea Syndrome, Diagnosis and Treatment” SIPAC 1996
Evaluation of Sleep

- Split-Night Polysomnography
- Epworth Sleepiness Scale
- Multiple Sleep Latency Test
Definition of OSA

- RDI > 5
- RDI > 20 increases risk of mortality
- RDI 20-40 = moderate, >40 = severe
- Upper Airway Resistance Syndrome
  - Shares pathophysiology with OSA
  - No desaturation, continuous ventilatory effort
- Snoring
## Prevalence of OSA

<table>
<thead>
<tr>
<th>Study Location</th>
<th>n</th>
<th>Age Range</th>
<th>Prevalence of AHI&gt;5 (95%CI)</th>
<th>Prevalence of AHI15 (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wisconsin</td>
<td>626</td>
<td>30-60</td>
<td>24 (19-28)</td>
<td>9 (6-12)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>9 (6-11)</td>
<td>4 (2-7)</td>
</tr>
<tr>
<td>Penn</td>
<td>1741</td>
<td>20-99</td>
<td>17 (15-20)</td>
<td>Not given</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 (6-9)</td>
<td>2 (2-3)</td>
</tr>
<tr>
<td>Spain</td>
<td>400</td>
<td>30-70</td>
<td>26 (20-32)</td>
<td>28 (20-35)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>14 (10-18)</td>
<td>7 (3-11)</td>
</tr>
</tbody>
</table>
Pathophysiology of OSA

- Airway size:

Dilating forces ($P_{out}$)
- Structural characteristics promoting patency
- Neuromuscular tone

Collapsing forces ($P_{in}$)
- Structural characteristics promoting collapse
- Negative inspiratory pressure
Pathophysiology of OSA

- Sites of Obstruction:
- Obstruction tends to propagate
Pathophysiology of OSA

- Sites of Obstruction:
Pathophysiology of OSA

- Symptoms of OSA
  - Snoring (most commonly noted complaint)
  - Daytime Sleepiness
  - Hypertension and Cardiovascular Disease are Associated
  - Pulmonary Disease
Pathophysiology of OSA

- Findings in Obstruction:
  - Nasal Obstruction
  - Long, thick soft palate
  - Retrodisplaced Mandible
  - Narrowed oropharynx
  - Redundant pharyngeal tissues
  - Large lingual tonsil
  - Large tongue
  - Large or floppy Epiglottis
  - Retro-displaced hyoid complex
Pathophysiology of OSA

- Tests to determine site of obstruction:
  - Muller’s Maneuver
  - Sleep endoscopy
  - Fluoroscopy
  - Manometry
  - Cephalometrics
  - Dynamic CT scanning and MRI scanning
Medical Management

- Weight Loss
- Nasal Obstruction
- Sedative Avoidance
- Smoking cessation
Medical Management

- CPAP
  - Pressure must be individually titrated
  - Compliance is as low as 50%
    - Air leakage, eustachian tube dysfunction, noise, mask discomfort, claustrophobia
Medical Management

- **BiPAP**
  - Useful when > 6 cm H2O difference in inspiratory and expiratory pressures
  - No objective evidence demonstrates improved compliance over CPAP
Nonsurgical Management

- Oral appliance
  - Mandibular advancement device
  - Tongue retaining device
Nonsurgical Management

- Oral Appliances
  - May be as effective as surgical options, especially with sx worse on patient’s back
  - However low compliance rate of about 60% in study by Walker et al in 2002 rendered it a worse treatment modality than surgical procedures

Surgical Management

- Measures of success –
  - No further need for medical or surgical therapy
  - Response = 50% reduction in RDI
  - Reduction of RDI to < 20
  - Reduction in arousals and daytime sleepiness
Surgical Management

- Perioperative Issues
  - High risk in patients with severe symptoms
  - Associated conditions of HTN, CVD
  - Nasal CPAP often required after surgery
  - Nasal CPAP before surgery improves postoperative course
  - Risk of pulmonary edema after relief of obstruction
Surgical Management

- Tracheostomy
  - Primary treatment modality
  - Temporary treatment while other surgery is done
  - Thatcher GW. *et al.*: tracheostomy leads to quick reduction in sequelae of OSA, few complications (see table II)
  - Once placed, uncommon to decannulate

<table>
<thead>
<tr>
<th>TABLE II. Complications.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early: Mild: wound infection (4), tissue necrosis (4), pneumonia (1)</td>
</tr>
<tr>
<td>Early: Severe: perioperative cardiopulmonary arrest (1)</td>
</tr>
<tr>
<td>Late: Mild: granulation tissue (8), diagnostic bronchoscopy (7), stoma revision (2)</td>
</tr>
<tr>
<td>Late: Severe: tracheo-innominate fistula (1), severe respiratory distress (2)</td>
</tr>
</tbody>
</table>

Surgical Management

- **Nasal Surgery**
  - Limited efficacy when used alone
  - Verse *et al* 2002 showed 15.8% success rate when used alone in patients with OSA and day-time nasal congestion with snoring (RDI<20 and 50% reduction)

- **Adenoidectomy**
Surgical Management

- Uvulopalatopharyngoplasty
Surgical Management

- **Uvulopalatopharyngoplasty**
  - The most commonly performed surgery for OSA
  - Severity of disease is poor outcome predictor
  - Levin and Becker (1994) up to 80% initial success decreased to 46% success rate at 12 months
Surgical Management

- **UP3 Complications**
  - Minor
    - Transient VPI
    - Hemorrhage <1%
  - Major
    - NP stenosis
    - VPI

<table>
<thead>
<tr>
<th>Complication</th>
<th>n</th>
<th>Rate (%)</th>
<th>95% Confidence Interval (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>7</td>
<td>0.2</td>
<td>(0.1, 0.4)</td>
</tr>
<tr>
<td>Serious complication other than death</td>
<td>47</td>
<td>1.5</td>
<td>(1.1, 1.9)</td>
</tr>
<tr>
<td>Respiratory complication</td>
<td>33</td>
<td>1.1</td>
<td>(0.7, 1.4)</td>
</tr>
<tr>
<td>Reintubation</td>
<td>17</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Emergent tracheotomy</td>
<td>7</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Mechanical ventilation &gt; 48 hours</td>
<td>6</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td>11</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Cardiovascular complication</td>
<td>8</td>
<td>0.3</td>
<td>(0.1, 0.4)</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>9</td>
<td>0.3</td>
<td>(0.1, 0.5)</td>
</tr>
</tbody>
</table>

Some patients experienced more than one complication.
Surgical Management

- Cahali, 2003 proposed the Lateral Pharyngoplasty for patients with significant lateral narrowing:

Cahali MB. Lateral pharyngoplasty: a new treatment for obstructive sleep apnea hypopnea syndrome. 
Surgical Management

- Lateral Pharyngoplasty
Surgical Management

- Lateral Pharyngoplasty
  - Median apnea-hypopnea index decreased from 41.2 to 9.5 ($P = .009$)
  - No control group
  - No evaluation at 12 months
Surgical Management

- Laser Assisted Uvulopalatoplasty
  - High initial success rate for snoring
  - Rates decrease, as for UP3 at twelve months
  - Performed awake
Radiofrequency Ablation – Fischer et al 2003

Radiofrequency device is inserted into various parts of palate, tonsils and tongue base at various thermal energies.
Surgical Management

- Fischer *et al* 2003
  - At 6 months showed significant reduction of:
    - RDI (but not to below 20)
    - Arousals
    - Daytime sleepiness by the Epworth Sleepiness Scale
Surgical Management

○ Tongue Base Procedures
  ● Lingual Tonsillectomy
    ○ may be useful in patients with hypertrophy, but usually in conjunction with other procedures
Surgical Management

- Tongue Base Procedures
  - Lingualplasty
    - Chabolle, et al. success rate of 77% (RDI<20, 50% reduction) in 22 patients in conjunction with UPPP
    - Complication rate of 25% - bleeding, altered taste, odynophagia, edema
    - Can be combined with epiglottectomy
Surgical Management

- Mandibular Procedures
  - Genioglossus Advancement
    - Rarely performed alone
    - Increases rate of efficacy of other procedures
    - Transient incisor paresthesia
Surgical Management

- Lingual Suspension:
Surgical Management

- Lingual Suspension:
Surgical Management

- **Hyoid Myotomy and Suspension**
  - Advances hyoid bone anteriorly and inferiorly
  - Advances epiglottis and base of tongue
  - Performed in conjunction with other procedures
  - Dysphagia may result
Surgical Management

- Maxillary-Mandibular Advancement
  - Severe disease
  - Failure with more conservative measures
  - Midface, palate, and mandible advanced anteriorly
  - Limited by ability to stabilize the segments and aesthetic facial changes
Surgical Management

- Maxillary-Mandibular Advancement
  - Performed in conjunction with oral surgeons
Surgical Management

○ Algorithms
  ● Studies efficacy of various algorithms
  ● Therapy should be directed toward presumed site of obstruction
    ○ This does not always guarantee results
Surgical Management

- **Algorithms**
  - Riley *et al* 1992
    - Studied 2 phase approach for multilevel site of obstruction (Stanford Protocol):
      - Phase 1: Genioglossal advancement, hyoid myotomy and advancement, UP3
      - Phase 2: Maxillary-Mandibular advancement in 6 months if phase 1 failed
      - Reported >90% success rate in patients who completed both phases
      - Other studies have lowered this number
      - Testing is done at 6 months
Algorithms

- Friedman et al developed a staging system for type of operation:
Surgical Management

- **Algorithms:**
  - **Friedman et al:**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Friedman Palate Position</th>
<th>Tonsil Size</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
<td>3, 4</td>
<td>&lt;40</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3, 4</td>
<td>&lt;40</td>
</tr>
<tr>
<td>II</td>
<td>1, 2</td>
<td>1, 2</td>
<td>&lt;40</td>
</tr>
<tr>
<td></td>
<td>3, 4</td>
<td>3, 4</td>
<td>&lt;40</td>
</tr>
<tr>
<td>III</td>
<td>3</td>
<td>0, 1, 2</td>
<td>&lt;40</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0, 1, 2</td>
<td>&lt;40</td>
</tr>
<tr>
<td>IV</td>
<td>1, 2, 3, 4</td>
<td>0, 1, 2, 3, 4</td>
<td>&gt;40</td>
</tr>
</tbody>
</table>

All patients with significant craniofacial or other anatomic deformities.

**BMI =** Body Mass Index.
Surgical Management

- Algorithms:
  - Friedman et al:
    - Success = RDI<20 and RDI reduced 50%

Friedman, Michael MD; Ibrahim, Hani MD; Joseph, Ninos J. BS
Conclusions

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- Evaluation of Sleep
- Definition of Obstructive Sleep Apnea (OSA)
- Prevalence of OSA
- Pathophysiology of OSA
- Medical Treatment of OSA
- Surgical Treatment of OSA