Sleep Apnea: Surgical Management

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Introduction

• 50-70 million Americans have chronic sleep and wakefulness disorder
• Most adults need 7-9 hours of sleep a night
• 2009 CDC Survey Results
  – 74,571 adult respondents in 12 states
  – 35% reported having <7 hours of sleep on average during a 24-hour period
  – 48% reported snoring
  – 38% reported unintentionally falling asleep during the day at least 1 day in the preceding 30 days
  – 5% reported nodding off or falling asleep while driving in the preceding 30 days
A word about physics
Upper airway collapse: Starling resistor model

Compare to West zones of lung

\[ P_{us} = \text{upstream pressure} \]
\[ P_{ds} = \text{downstream pressure} \]
\[ V_{\max} = \text{maximal inspiratory flow} \]
\[ R_{us} = \text{upstream resistance} \].
Distribution of Pcrit

- Normal controls: $P_{crit} < -10 \text{ cm H2O}$
- Simple snoring: $-5 < P_{crit} < -10 \text{ cm H2O}$
- Hypopneas: $0 < P_{crit} < -5 \text{ cm H2O}$
- Obstructive apneas: $P_{crit} > 0 \text{ cm H2O}$
The spectrum
Sleep Apnea

• Three different respiratory events contribute to Obstructive Sleep Apnea-Hypopnea Syndrome (OSAHS)
  – Apnea
  – Hypopnea
  – Respiratory Effort-Related Arousal (RERA)

• Identified by performing a sleep study
Grades of Sleep Apnea Severity

• Mild: AHI 5-15
• Moderate: AHI 15-30
• Severe: AHI greater than 30
Treatment options

- Behavioral modification
- Devices that can be worn
- Surgical options
Behavioral Modification

- Some patients with mild sleep apnea need only to sleep on their sides
- Alcohol avoidance
- Weight loss
Oral Devices
CPAP/BiPAP
Surgical Management
Preoperative Evaluation

- Sleep History
- Physical exam
  - Neck circumference
  - BMI
  - Muller Maneuver
- Imaging
  - Xray
  - CT
  - MRI
- Polysomnography
Friedman Classifications
<table>
<thead>
<tr>
<th>Stage</th>
<th>FTP</th>
<th>Tonsil size</th>
<th>BMI</th>
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<tbody>
<tr>
<td>I</td>
<td>I, IIa, IIb</td>
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Lower stages predict higher success rate of UPPP alone to treat OSA
Friedman algorithm for treatment

• Mild (AHI 5-15)
  – Symptomless: behavior modification
  – Symptoms: behavior, device, consider surgery

• Moderate (AHI 15-30)
  – Symptomless: behavior, device
  – Symptoms: device, consider surgery for device failures

• Severe (AHI >30)
  – Device, consider surgery as adjunct, refer for bariatric surgery BMI>40, consider tracheostomy
Indications for surgery

- Apnea/Hypopnea Index (AHI) >20
- Oxygen desaturation nadir 90%
- Esophageal pressure (PES) more negative than –10 cm H2O
- Cardiovascular derangements (arrhythmia, hypertension)
- Neurobehavioral symptoms (excessive daytime sleepiness)
- Failure of medical management
- Anatomical sites of obstruction (nose, palate, tongue base)
Powell-Riley protocol

- **Phase I**
  - Nasal surgery (septoplasty, turbinate reduction, nasal valve grafting)
  - Tonsillectomy
  - Uvulopalatopharyngoplasty (UPPP) or uvulopalatal flap (UPF)
  - Mandibular osteotomy with genioglossus advancement
  - Hyoid myotomy and suspension
  - Temperature-controlled radiofrequency (TCRF)-turbinates, palate, tongue base
- **Phase II**
  - Maxillomandibular advancement osteotomy (MMO)
  - Temperature-controlled radiofrequency (TCRF)-tongue base
Nasal Surgery

Nasal Surgery - Septoplasty

Alar-Batten Graft

1. to pyriform aperture
Tonsillectomy and adenoidectomy
Palatal surgeries

- snare uvulectomy
- cautery assisted palatal stiffening
- injection snoreplasty
- pillar implants
- Traditional UPPP
- Fairbanks UPPP
- ZPP
Palatal surgeries

• Snare Uvulectomy—for upper airway resistance syndrome and simple snoring, no studies comparing AHI

• Cautery assisted palatal stiffening—for upper airway resistance syndrome, simple snoring, or mild OSA, AHI improved from 12.3 to 5.2

• Injection snoreplasty—for simple snoring caused by palatal flutter, 76.7 to 92% of patients experienced improved snoring, does not last long term, may be repeated
Palatal surgeries

- **Palatal Implants (Pillar®)**
  - Minimally invasive and less painful than other palatal surgeries
  - Woven cylindrical implants inserted to stiffen palate and reduce palatal flutter causing snoring, indicated for simple snoring
  - Patient selection: small tonsils more than 2 cm apart, no signs of tongue base collapse, Friedman I or II, redundant palatal tissue
  - Can be performed under local anesthesia
  - Extrusion rates per patient is about 10%
  - Reduces snoring sound intensity, does not completely eliminate snoring
  - Recent 4 year longitudinal study showed subjective improvement degrades over time to nearly baseline
Palatal surgeries

- **Uvulopalatopharyngoplasty**

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- **Success rates:**
  - Stage I, 81%
  - Stage II, 37%
  - Stage III, 8%

- **Success defined as reduction in AHI by 50% to less than 20**
Palatal surgeries

• Fairbanks technique
  – Reported to improve on traditional UPPP by improving lateralization of pillars
  – Minimizes shortening of the soft palate to maintain valvular patency
  – Results similar to traditional UPPP
Palatal surgeries

• Zetapalatopharyngoplasty
  – Indicated for patients with history of tonsillectomy
  – Indicated for Stage II and III patients, moderate to severe OSA
  – Widens retropalatal space
  – Greater risk for VPI
  – Cure rates for stage II patients who also undergo tongue base RF with ZPP reported as 70%
Palatal surgeries

- Uvulopalatal flap can be done in office under local and is initially reversible
Palatal advancement pharyngoplasty

• Shortens the bony palate with osteotomy to increase the nasopharyngeal opening
• Reported to decrease RDI from average of 52.8 to 12.3 in responder group
• Success rates improved over UPPP for Stage III patients
Tongue base reduction

- Radiofrequency electrodes used to create scar tissue contraction and therefore volume reduction
- In-office procedure done under local with minimal side effects, may be repeated to optimal effect
- More effective when used in conjunction with UPPP
Submucosal lingualplasty

- Open approach to address macroglossia
- Reduction in tongue volume increases airway volume
- Bleeding into cavity postoperatively most dangerous complication
- Author recommends meticulous hemostasis with clips
SMILE (Intraoral submucosal minimally invasive lingual excision)

- Initially, neurovascular bundles are identified with ultrasound
- Percutaneous approach with coblation followed by copious irrigation through endoscope until sufficient volume is removed
- Initially reported in small number of pediatric Down’s patients with good outcomes
Repose tongue base suspension

- Patient selection: best candidates have posterior collapse of tongue into hypopharynx when supine
- Not indicated for retropalatal upper airway obstruction
- Relative contraindications: macroglossia, poor oral hygiene
- Success rates reported as 51-78%, some in combination
Lingual tonsillectomy

- Proposed for lingual tonsil hypertrophy contributing to hypopharyngeal collapse
- Definition of this condition is subject to some debate
- One study proposes: 10 mm in diameter and abutting both the posterior border of the tongue and the posterior pharyngeal wall
Multilevel pharyngeal surgery

- Hyoid myotony and suspension
- Genioglossus advancement with mandibular osteotomy
Hyoid myotomy with suspension

- Hyoid Repose system similar to tongue base suspension technique
- Study shows improvement in AHI from 40 to 19
Genioglossus advancement with mandibular osteotomy

- Osteotomy shapes can vary but rectangular less invasive and preserves mandibular integrity
- Advancement of genioglossus is goal
- Success rate variable from 22-67%
A word about other surgeries

- Maxillomandibular advancement osteotomy with rigid fixation, Phase II procedure
  - Documented success >90%
A word about other surgeries

Tracheostomy

– 100% success rate
– Variation for tube-free stoma
– Can be revised to include the strap muscles for closure and hands-free speaking
A word about other surgeries

- Recent meta-analysis of bariatric surgery effect on AHI found:
  - With BMI change from 55 to 37
  - AHI reduced from 55 to 16
  - Meets criteria for successful OSA intervention
Conclusions

• Sleep disorders are multifactorial and often multilevel
• Milder cases respond more readily to single intervention
• The more severe the sleep disorder, the more involved the intervention
• Surgical cure only provides reduction in severity and CPAP likely still necessary
References

- Adult Obstructive Sleep Apnea: Pathophysiology and Diagnosis Susheel P. Patil, MD, PhD, Hartmut Schneider, MD, PhD, Alan R. Schwartz, MD, and Philip L. Smith, MD Chest. 2007 July ; 132(1): 325.
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