Obstructive Sleep Apnea: Beyond UPPP
The spectrum of techniques and literature

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Objectives

- Overview of OSA
  - Definition, diagnosis, consequences

- Conservative/Medical Therapy

- Indications for surgery

- Clinical Guidelines

- Otolaryngic Evaluation and Examination
  - Fiberoptic Nasopharyngeal Endoscopy
  - Lateral cephalometric radiograph

- Overview of Procedures
  - Technique, Efficacy/Outcomes

- Stanford (Riley-Powell) Protocol
Obstructive Sleep Apnea

- Defined as greater than 5 respiratory “events” per hour of sleep
  - “events” – apnea, hypopneas, respiratory effort-related arousals

- Affects 4% of men and 2% of women over 50
  - 3 million men and 1.5 million women
  - Often undiagnosed, other studies have shown prevalence of 24% in men and 9% in women

- Classification
  - Mild – 5-15 events per hour
  - Moderate – 15-30 events per hour
  - Severe – >30 events per hour
Obstructive Sleep Apnea

- Lies along a spectrum

![Graph showing the spectrum of patient populations between Snorers, UARS, and OSA.](http://emedicine.medscape.com/article/295807-overview)
Obstructive Sleep Apnea

- Snoring – sound from vibrating pharyngeal tissues
- UARS – upper airway resistance syndrome
  - Snoring + AHI<5 + excessive daytime sleepiness/somatic complaints
- OSA
  - AHI>5
Relevant Indices

- Apnea Index (AI)
  - Cessation of airflow for at least 10 seconds

- Hypopnea Index (HI)
  - Reduction of airflow (>30%) for 10 seconds AND reduction in O2 saturation by at least 4%
  - OR reduction of airflow (>50%) for 10 seconds AND O2 saturation decrease by at least 3% or EEG arousal

- Apnea-Hypopnea Index (AHI)

- RERA Index (RERAs)
  - Abnormal breathing for at least 10 seconds that leads to arousal

- Respiratory Disturbance Index (RDI)
Diagnosis

- History
  - Snoring, occasional apneic/gasping spells
  - Excessive daytime sleepiness (Epworth Sleepiness Scale)
  - Restless sleep
  - Morning fatigue/irritability
  - Morning and nocturnal headaches
  - Memory loss, decreased cognitive functions
  - Depression, personality/mood changes
  - Decreased libido, impotence
  - Nocturnal sweating, enuresis
Diagnosis

- Polysomnogram is gold standard
  - Evaluates number of respiratory events, oxygen saturation, CO2 retention, sleep architecture
- AHI>5 confirms OSA
  - Mild – 5-15 events per hour
  - Moderate – 15-30 events per hour
  - Severe – >30 events per hour
Consequences of untreated OSA

- Especially when AHI>20
  - HTN
  - CHF, CAD, CHF, Arrhythmias, Pulmonary HTN
  - Cerebrovascular disease
  - Insulin resistance
  - Problems with attention, memory, executive functions
  - Increased MVAs
  - Increased mortality
First line treatments

- Weight loss
  - 10% weight gain → 32% increase in AHI
  - 10% weight loss → 26% decrease in AHI

- Improved sleep hygiene

- Oral appliance

- CPAP/BiPAP
CPAP/BiPAP

- Best form of medical treatment, but not a cure
- Protective
  - Decreases aforementioned consequences
  - One night off CPAP reverses all gain derived from using device
- Often poorly tolerated
  - Fewer than 50% “adequately treated”
    - Adequate treatment defined as 4 hours of CPAP per night for 70% of nights
Indications for Surgery

- AHI > 20
- Oxygen nadir < 90%
- Esophageal pressure less than -10 cmH2O
- Cardiovascular derangements
  - Arrhythmia, HTN
- Neurobehavioral symptoms
- Failure of Medical Therapy (CPAP/BiPAP)
- Anatomical sites of obstruction
Clinical Guidelines

- AAOHNS Practice and Advocacy Statement (2012) refers to the AASM Clinical Guideline for the evaluation, management, and long term care of OSA in adults

- “Surgical procedures may be considered as a secondary treatment for OSA when the outcome of PAP therapy is inadequate, such as when the patient is intolerant of CPAP, or CPAP therapy is unable to eliminate OSA (Consensus)”
Clinical Guidelines

- “Surgery may also be considered as a secondary therapy when there is an inadequate treatment outcome with an oral appliance, when the patient is intolerant of the OA, or the OA therapy provides unacceptable improvement of the clinical outcomes of OSA (Consensus)”

- “Surgery may also be considered as an adjunct therapy when obstructive anatomy or functional deficiencies compromise other therapies or to improve tolerance of other OSA treatments (Consensus)”
Clinical Guidelines

- Though not specifically quoted in the AAOHNS Practice and Advocacy statement, the AASM Clinical guideline also states
  - OSA diagnosis and severity should be confirmed objectively prior to surgery
  - Patients should be evaluated for eligibility for surgery
  - Patient should be properly counseled regarding options, risks/benefits, side effects, likelihood of success, and complications
  - Surgery can be considered in patients with mild OSA and severe obstructing anatomy that is surgically correctible
Otolaryngic Evaluation

- Complete history as discussed earlier
- PSG results
- Comorbidities
Otolaryngic Examination

- Flexible fiberoptic nasopharyngoscopy
- Lateral Cephalometric Radiograph
Fiberoptic Laryngoscopy

- Evaluate level(s) of obstruction
  - Nasal cavity, nasopharynx, oropharynx, hypopharynx

- Rule out anomalies
  - 2% of patients have an anomaly or malignancy that explains their OSA
Fiberoptic Laryngoscopy

- Procedure
  - Evaluate nasal cavity, nasopharynx, oropharynx, hypopharynx
  - Müller’s maneuver
    - Attempted inspiration with mouth and nose closed

http://ws.ajou.ac.kr/~ent/new/case_topic/RHINODATA/snoring.htm
Müller’s Maneuver
Cephalometric Radiograph

- Lateral XR of head

- Advantages
  - Widespread access, low cost, minimal radiation

- Disadvantages
  - Static 2D representation of dynamic 3D structures
  - Patient sitting upright, not supine as when sleeping
  - However, when paired with the dynamic view afforded by flexible scope, 2D disadvantage is minimized
Cephalometric Radiograph

http://www.cakitches.com/general/cephalometric-radiograph.html
Cephalometric Radiograph

- Normal measurements
  - MP-H – 15.4mm
  - PNS-P – 37mm
  - PAS – >10mm
  - Sella-Nasion-B (SNB) – >76°
Cephalometric Radiograph

Cephalometric Radiograph
Classification of Level of Obstruction

- Fujita
  - Type 1: only palatal obstruction
  - Type 2: both palatal and tongue base obstruction
  - Type 3: only tongue base obstruction

- Important for guiding surgical decision making
Procedures

- **Nasal**
  - Septoplasty
  - Turbinate reduction
  - Nasal valve

- **Soft Tissue Ablation**
  - Uvulopalatopharyngoplasty (UPPP)
  - Uvulopalatal Flap (UPF)
  - Laser Assisted uvulopalatoplasty (LAUP)
  - Laser midline glossectomy/lingualplasty (LMG)
  - Radiofrequency tongue base ablation (RFTBA)

- **Skeletal Modification**
  - Genioglossus advancement (GA)
  - Hyoid myotomy and suspension (HM-1, HM-2)
  - Orthognathic procedures
    - Mandibular Advancement (MA)
    - Maxillomandibular Advancement (MMA)

- **Bypass Upper Airway**
  - Tracheotomy
Disclaimer

- Comparing the “success” rates between procedures is a difficult task
  - Different definitions of success
  - Methodological differences in studies
  - Small sample sizes
### Table 3 Criteria defining surgical success

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Definition</th>
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| 1A | \[
\frac{Postop \text{ RDI}}{Preop \text{ RDI}} \leq 50\%
\] |
| 1B | \[
\frac{Postop \text{ AI}}{Preop \text{ AI}} \leq 50\%
\] |
| 2A | \[
\frac{Postop \text{ RDI}}{Preop \text{ RDI}} \leq 50\% \quad \text{and} \quad Postop \text{ RDI} \leq 20 \text{ apneas and hypopneas per h}
\] |
| 2B | \[
\frac{Postop \text{ RDI}}{Preop \text{ RDI}} \leq 50\% \quad \text{and} \quad Postop \text{ RDI} \leq 15 \text{ apneas and hypopneas per h}
\] |
| 2C | \[
\frac{Postop \text{ RDI}}{Preop \text{ RDI}} \leq 50\% \quad \text{and} \quad Postop \text{ RDI} \leq 10 \text{ apneas and hypopneas per h}
\] |
| 2D | \[
\frac{Postop \text{ AI}}{Preop \text{ AI}} \leq 50\% \quad \text{and} \quad Postop \text{ AI} \leq 10 \text{ apneas per h}
\] |
| 3 | \[
\frac{Postop \text{ RDI}}{Preop \text{ RDI}} \leq 40\% \quad \text{and} \quad \frac{Postop \text{ AI}}{Preop \text{ AI}} \leq 40\% \quad \text{and} \quad \text{Postop AI} < 10 \text{ apneas per h} \quad \text{or} \quad \text{Postop RDI} < 15 \text{ apneas and hypopneas per h} \quad \text{and} \quad \text{Postop AI} < 15 \text{ apneas per h}
\] |
Nasal Surgery

- Obstruction can contribute to SDB and CPAP intolerance
- OMB causes autorotation of the mandible, decrease in the PAS, and worsening of SDB
- However, major effect of surgery is subjective improvement in nasal breathing and daytime sleepiness, with little to no effect on subjective parameters
Uvulopalatopharyngoplasty (UPPP)
Uvulopalatopharyngoplasty (UPPP)

- Most common procedure performed for OSA over the last 30+ years
- Only widens oropharyngeal inlet
- Does not address hypopharyngeal obstruction
- Overall success rate of 40% (2a, 2d)
  - Type I obstruction: 52%
  - Type II/III obstruction: 5%
  - Benefit appears to decrease with time
Uvulopalatal Flap

Fig. 1. Techniques used for uvulopalatal flap surgery. (A) Preoperative. (B) Post-tonsillectomy and uvular flap design. (C) Mucosal excision. (D) Trimmed and sutured flap.
Uvulopalatal Flap

- Modification of UPPP
- Studies show no statistical difference in outcome compared to UPPP
- The only statistically significant difference was decreased pain compared to UPPP
Laser Assisted Uvulopalatoplasty (LAUP)
Laser Assisted Uvulopalatoplasty (LAUP)

- Can be done under local anesthesia in the office
- Often performed for snoring only
- Paucity of data comparing pre and post-operative PSG to define success
  - **Success rates range from 0-87%** (1a, 2a)
- Studies have shown decreased PAS and worsening RDI in the immediate post-operative period
- AASM recommends **against** this procedure for OSA
Laser Midline Glossectomy/Lingualplasty

Laser Midline Glossectomy/Lingualplasty

- CO2 laser used to ablate posterior midline tongue
- Often performed after failed UPPP and evidence of hypopharyngeal obstruction
  - Salvage rate 42% (n=12, 1a)
- One study reported primary UPPP+LMG
  - Success rate 77% (n=22, 2a)
Radiofrequency Tongue Ablation

http://curemysleepapnea.com/local-radiofrequency-ablation-treatment/
Radiofrequency Tongue Ablation

- Uses needle electrode, results in frictional heating of tissues (needle itself is not hot)
- Tissue ablation occurs at 47°C
- Energy disbursement proportional to 1/r, thus heat dissipation is limited and surrounding tissue is spared
- Not viewed as an efficacious single treatment modality
  - **Success rate 20-30%** (2a, 2d)
Genioglossus Advancement

Source: Semin Respir Crit Care Med © 2005 Thieme Medical Publishers

Genioglossus Advancement

- No studies evaluating efficacy/outcomes of GA alone
- Usually performed in conjunction with HM
Hyoid myotomy and suspension

HM-1

HM-2
Hyoid myotomy and suspension

- No studies evaluating efficacy/outcomes of HM alone
- Usually performed in conjunction with GA
Orthognathic Procedures

- Mandibular advancement
  - Performed as primary surgical approach on “bird-like” faces
  - Small sample size, but near complete resolution of OSA in reports

- Maxillomandibular advancement
  - Performed as primary surgical approach on non-obese, maxillo-mandibular deficient patients
  - **Success Rate 95%** (n=38, 2a)
Tracheotomy

- Most effective surgical treatment (bypasses obstruction)
  - >90% immediate resolution
  - Remaining OSA symptoms likely due to central apnea, which often resolves with elimination of obstructive apnea

- Poor patient acceptance

- Now often used as temporary measure for airway protection in patients with severe OSA with morbid obesity or significant craniofacial anomalies

- Permanent tracheotomy most often used in those with obesity hypoventilation syndrome and those with significant craniofacial anomalies who have failed all other forms of medical and surgical treatment

- You should warn all patients going to surgery about the possibility of a tracheotomy (likely temporary) should you run into any airway difficulties intra-operatively or post-operatively
Outcomes of combined procedures

- UPPP+GA+HM-1 – success rate 57% (n=233,2a)
  - Mild/moderate OSA – 75%
  - Severe OSA – 42%

- UPPP+GA+HM-2 – success rate of 73% (n=11,2a)
Outcomes of combined procedures

- **UPPP+GA** – success ranges 38-78% (3 studies n=9, n=35, n=24, 2c, 2a, 2a) data could not be combined due to incomplete demographic data
- **GA+HM-1** – success rate of 66% (n=6, 2a)
- **GA+HM-2** – success rate of 100% (n=3, 2a)
Stanford Protocol

- Developed by Riley and Powell
- Based on the assumption that Fujita classifications can serve as the basis for establishing a treatment plan
- Systematic, 2 phase approach
Stanford Protocol

- Phase I Success Rate 60% (2a)
  - Mild/moderate OSA – success rate 75%
  - Severe OSA – success rate 40%

- Phase II Success Rate after phase I fail 95% (2a)
Stanford Protocol

• Critiques
  • Some Phase I failures were not willing to go through Phase II due to discomfort. If these failure could be identified preoperatively, they could be immediately put into Phase II
  • The difference in success rate of mild/moderate versus severe OSA implies the Fujita classification is not the sole guiding principle for surgical decision making
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Questions?
Thank You!
References


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Image References