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Artículo:

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Obstructive sleep apnea: anatomy, physiology and perioperative considerations

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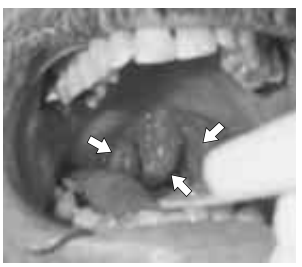
SCOPE OF THE PROBLEM

- About 1 in 15 middle aged adults have moderate OSA
- Incidence in men twice that of women
- 60-90% of adult OSA patients are obese
- Incidence increases with age
- Probably 90% of sufferers are undiagnosed
- Generally obesity and older age are concentrated in the surgical population
- Incidence of OSA in surgical patients probably significantly higher than in the general population
- Given U.S. demographics, diagnosis of OSA is predicted to increase 5-10 fold in the next decade

WHO HAS OSA?

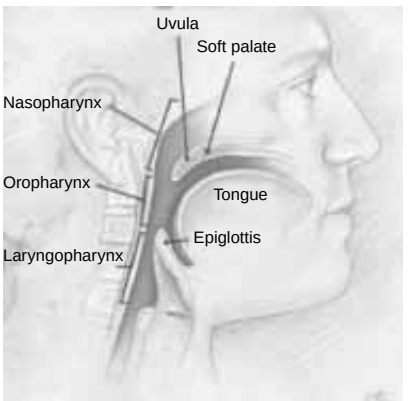


ANATOMY AND PHYSIOLOGY

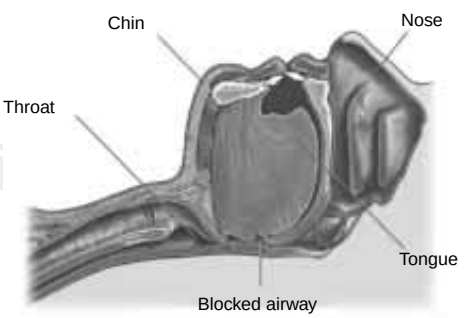
- OSA is defined as cessation of airflow for > 10s, occurring ≥ 5X/hour of sleep
- Clinically results in disturbed sleep cycles, daytime sleepiness and cardiovascular changes
- Anatomy and physiology are well described, relevance to anesthetic care is clear

THE NORMAL AIRWAY

- Three collapsible pharyngeal segments (retropalatal, retroglossal and hypopharynx)
- Pharyngeal muscles actively keep airway open during inspiration



SITES OF OBSTRUCTION

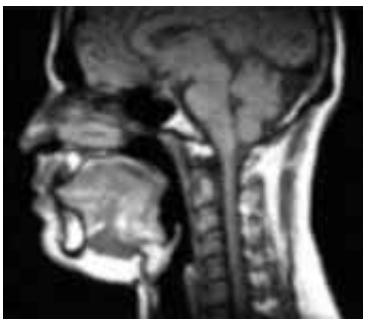


- Genioglossus moves the tongue anteriorly to keep the etroglossal air space open

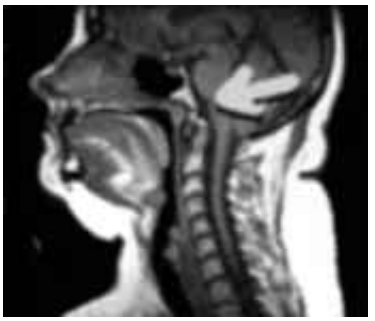
NEGATIVE AIRWAY PRESSURE

- The greater the obstruction, the greater negative pressure developed
- Much greater demands on airway muscles to keep airway patent

NORMAL



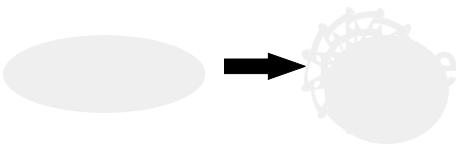
APNEIC



Restriction of the airway during an apneic event

ANATOMY AND PHYSIOLOGY IN OSA

- With obesity there is deposition of fat in the lateral pharyngeal walls
  - Decreases airway diameter and airflow resistance
  - Alters primary axis of airway from transverse to anterior-posterior



- Mechanical efficiency of pharyngeal muscles probably reduced

THE SLEEP CYCLE

- With non-REM sleep, rhythmic activity of upper airway muscles decreases
- In REM sleep pharyngeal tone decreases, may disappear
- Airway obstruction may be a positive feedback loop

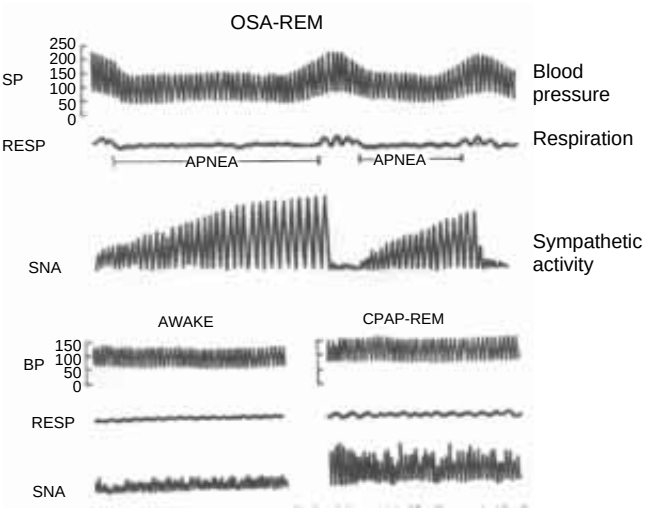
AIRWAY OBSTRUCTION IN OSA SLEEP

- Increased resistance to airflow and increased negative inspiratory pressure
- Decreased pharyngeal tone during REM sleep
- Extrinsic airway compression for tissue
- Snoring occurs in 30-40% of obese men, represents periods prior to and following airway closure

PHYSIOLOGIC EFFECTS OF OBSTRUCTION

- Decreased PaO_2
- Increased $PaCO_2$
- Arousal, increased sympathetic tone
  - Hypertension, systemic and pulmonary

CARDIOVASCULAR EFFECTS OF OBSTRUCTION



CARDIAC EFFECTS OF OSA

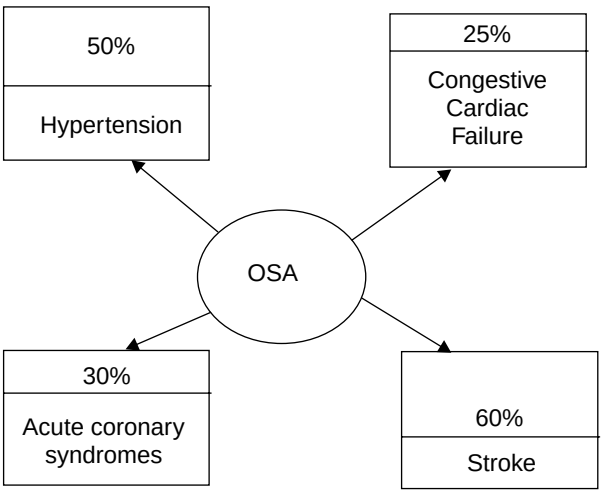
- Increased sympathetic tone
- Increased MvO_2
- Myocardial ischemia and dysrhythmias
- Systemic and pulmonary hypertension

OSA episodes likened to *"…sequential administration of several hundred bolus of pressor agent each day"*.
Bradley, T.; Circulation 2003

CARDIAC EFFECTS OF OSA

- Chronic exposure:
  - Cardiac remodeling:
    LVH
    myocyte necrosis, apoptosis
  - Worsening of LV failure
  - RV failure (*cor pulmonale*)

CHRONIC CARDIOVASCULAR EFFECTS



DIAGNOSIS OF OSA

- Sleep study is definitive
- Presumptive diagnosis:
  - Obesity (BSA > 30 kg/m^2)
    - Snoring or apnea during sleep
    - Daytime drowsiness/fatigue
- In surgical patients, assume OSA risk is there

ANESTHETICS AND OSA

- All CNS depressants decrease pharyngeal dilator activity
  thiopental — propofol
  narcotics (I.V. and epidural) — NMBs
  benzodiazepines — nitrous oxide
- Arousal, CO_2 and O_2 responsiveness are diminished
- Interaction of anesthetics and OSA sleep cycle may last a week postoperatively

OSA AND AIRWAY MANAGEMENT

- Presumption of difficult airway
- Prior anesthetic history may be mitigating
  - Prior intubation
  - Adequacy of mask airway
  - Change in body weight or OSA severity
  - Dependence on nocturnal CPAP
- Strategy for difficult airway no different
- Pre-defined airway management strategy

Regional *versus* general anesthesia

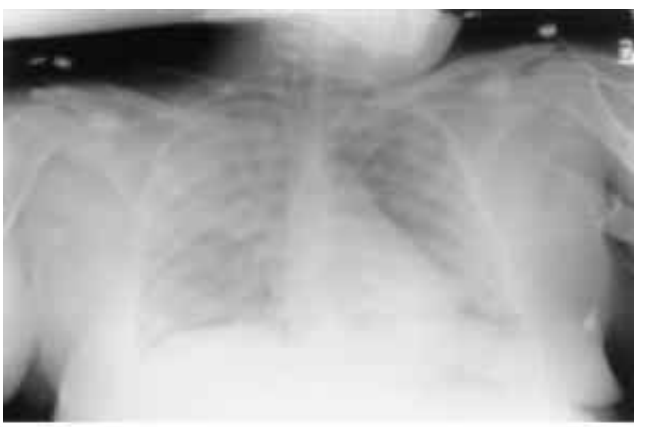
  - Surgical requirement
  - Patient preference
  - Technical difficulty anticipated

- Risk of inability to ventilate
- Risk of aspiration
- Spontaneous ventilation
- Topicalization, sevoflurane
- Patient position, patient accessibility
- Special caution in MAC
- Outpatient surgi-centers, remote locations, more risky than standard operating and recovery rooms

OSA AND POSTOP MANAGEMENT

- Regional analgesic techniques
- Awake extubation
- Pre-defined defined airway management strategy
- Surgery for OSA, more conservative
  Bleeding, swelling, panic
- CPAP unit in PAR (non-airway surgery)

NEGATIVE PRESSURE PULMONARY EDEMA



METHODS OF MANAGEMENT

- Medical
  - CPAP/BiPAP
  - Weight loss

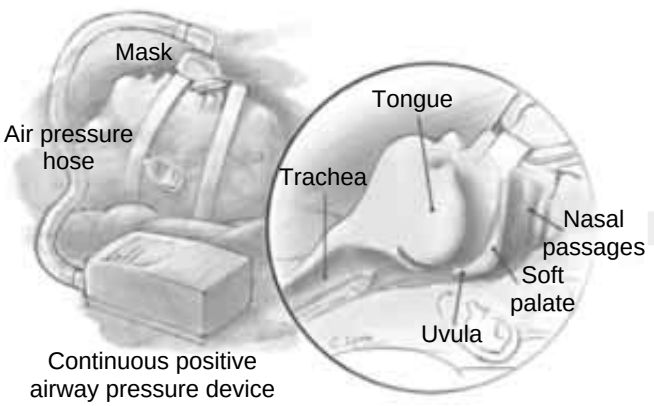
- Dental splints/tongue retaining devices
- Nasopharyngeal tubes
- Sleep hygiene

- Surgical

CPAP AND BIPAP

- CPAP: continuous positive airway pressure
  - (typically 5-10 cm H_2O pressure)
- BiPAP: Bilevel pressure support
  CPAP
  - Bi-pressure: senses inspiration,
    - Provides additional pressure to increase ventilation volume

CPAP EFFECTS



CPAP IN PATIENTS WITH HEART FAILURE AND OSA

- 24 patients with EF ≤ 45% with OSA
- All receiving optimal Rx for heart failure
- Randomly assigned to medical therapy or CPAP
- Pre and post (1 month) respiratory and echocardiographic assessment of treatment effect (blinded)
  Kaneko Y et al NEJM 2003

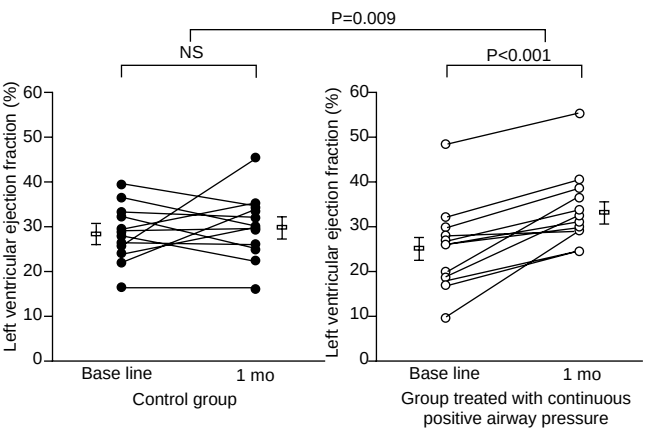
Effects of CPAP on Heart Rate and Blood Pressure

Heart rate and blood pressure*.

Variable	Control group			Group receiving continuous positive airway pressure		
	Base line	1 Mo	P value	Base line	1 Mo	P value
Heart rate (beats/min)	67 ± 4	67± 4	NS	68 ± 3	64± 3	0.007†
Systolic blood pressure (mmHg)	128 ± 7	134 ± 8	NS	126 ± 6	116 ± 5	0.02‡
Diastolic blood pressure (mmHg)	60 ± 4	58 ± 3	NS	62 ± 4	59 ± 2	NS

* NS denotes not significant. Plus-minus values are means ± SE. There were no significant differences in base line values between the control group and the group given continuos positive airway pressure. Unless otherwise specified, P values are for the comparisons between base-line values and one-month values within the group.
† P = 0.09 for the comparison between the groups.
‡ P = 0.008 for the comparison between the groups.

EJECTION FRACTION BASELINE AND AT 1 MONTH

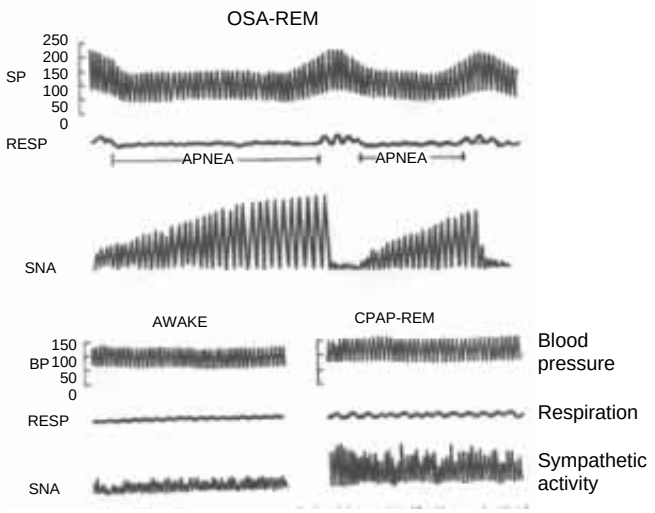


CPAP IN PATIENTS WITH HEART FAILURE AND OSA

- In the control group, no change in ejection fraction (from 29 ± 2 to 30 ± 2 percent)
- Ejection fraction increased in all 12 subjects treated with CPAP (from 25 ± 3 to 34 ± 2 percent)

- While absolute change is small:
  Significant effect at this level of function
  Improvements in functional capacity can be meaningful

CARDIOVASCULAR EFFECTS OF CPAP



METHODS OF MANAGEMENT

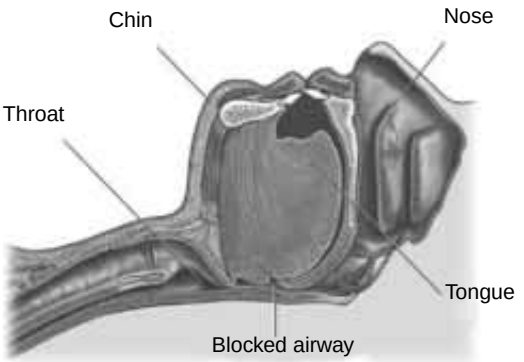
- Medical
  - CPAP/BiPAP
  - Weight loss
  - Dental splints/tongue retaining devices
  - Nasopharyngeal tubes
  - Sleep hygiene

- Surgical- medical Rx fails, or surgical etiology

SURGERY FOR OSA

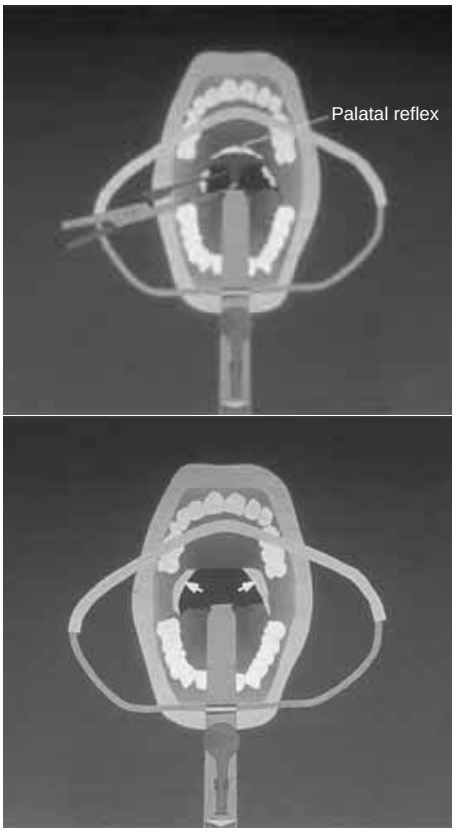
- Uvulopalatopharyngoplasty (UPPP)
- Genioglossus advancement
- Hyoid-myoid suspension
- Surgeries for non-obese OSA

SITES OF OBSTRUCTION, SURGICAL APPROACHES

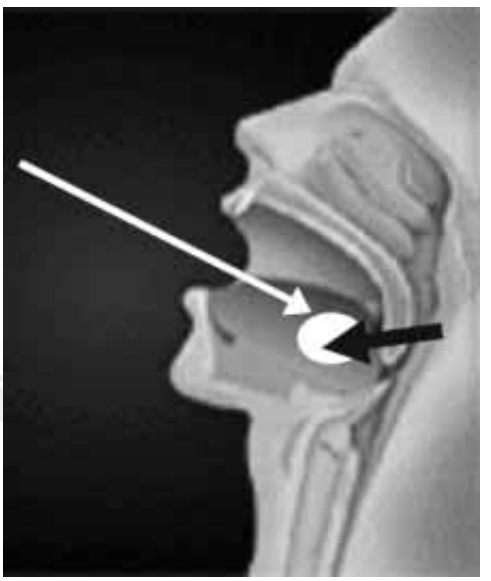


SURGERY FOR OSA

- Uvulopalatopharyngoplasty (UPPP)

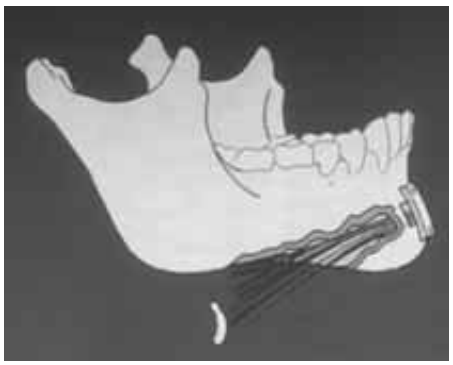


- Radiofrequency tongue base reduction

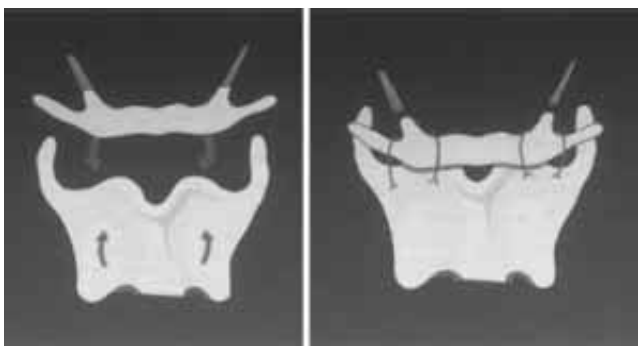


SURGERY FOR OSA

- Genioglossus advancement

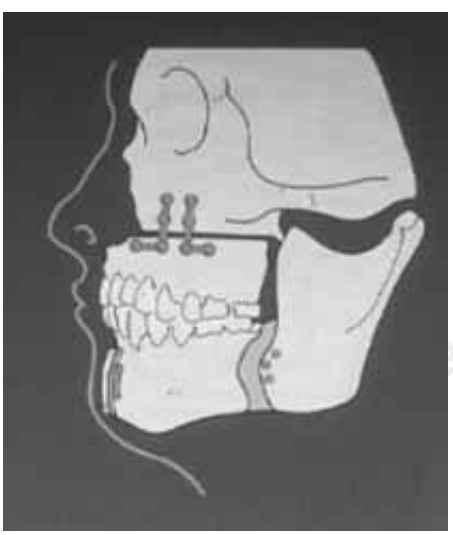


- Hyoid-myoid suspension



The hyoid bone is pulled forward in front of the larynx, it can help stabilize the retroglossal space

- Maxillomandibular advancement



SPECIALTY SURGERY FOR OSA

- Maxillomandibular advancement
- Nasal
- Adenoid and tonsillectomy
- Tracheostomy- temporary
  Permanent (> 50/night, SpO_2 < 60%)
- (Gastric bypass)

PEDIATRIC OSA

- OSA symptoms in children typically differs from adults
  - Snoring, worsened by URIs,
  - More continuous, without arousals
  - Irritability/behavior disorders
  - Poor attention span
  - Mouth breathing
  - Small stature (growth hormone)
- Peak age is 2-5 years, second peak, late teens
- Common cause is adenoid and tonsillar hyperplasia
- Sleep study rarely necessary
- Surgical treatment:
  - Adenoid and tonsillectomy
  - Turbinate reduction
  - UPPP
  - Maxillofacial reconstruction
- Adult-like OSA increasing (childhood obesity)
- Children with surgery for OSA overnight observation
  - Age < 3 years
  - History severe OSA
  - Medical co-morbidities
  - Craniofacial abnormalities
  - Social factors
  - CNS dysfunction or hypotonia
- CPAP not indicated
- Document desaturations and apneic spells

DISORDERS ASSOCIATED WITH OSA

Achondroplasia	Arthrogryposis multiplex congenita
Down syndrome	Beckwith-Wiedemann syndrome
Hunter's syndrome	Crouzon syndrome
Klippel-Feil syndrome	Fragile X syndrome
Larsen's syndrome	Hemifacial microsomia
Prader-Willi syndrome	Hurler's syndrome
Pierre Robin sequence	Marfan syndrome
Riley-Day syndrome	Pfeiffer's syndrome
Treacher Collins syndrome	Shy-Drager syndrome
Cerebral palsy	**Arnold-Chiari malformation**
Hydrocephalus	**Hypothyroidism**
Meningomyelocele	**Myotonic dystrophy**
Laryngeal neurofibroma	Sickle cell disease

Lymphoproliferative disorders
Vascular rings

Hypotonia
Polio

Syringobulbia/myelia
Gastroesophageal reflux
Goiter
Fetal alcohol syndrome

Head injury

SUMMARY

- Obesity is epidemic and OSA is under diagnosed
- Higher risk groups concentrated in surgical population
- Perioperative period can turn a non-OSA patient into an OSA patient
- Acute and chronic effects of OSA are under appreciated, Rx effect is dramatic
- Pediatric population unique considerations
  Surgery more likely to be in the airway
  Many comorbid conditions that may prone to OSA
  - Neuromuscular disorders
  - CNS conditions
  Well defined airway and analgesic plan, pre and post operatively
- Airway *versus* non-airway surgery
- Outpatient settings are very high risk areas
- Avoid "creep" in sedation cases