CPAP titration:

*PSG technologist or at Home*

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Conflict of Interest

• No financial interest to declare
Outline

• Discuss the goals of CPAP therapy
• Discuss how CPAP titration is done in the laboratory
• Discuss how CPAP titration can be done in the home
• Compare the two approaches
• Summary
What are the goals of CPAP Therapy?

- To eliminate obstructive apneas and hypopneas
- To eliminate Respiratory Effort Related Arousals (RERAs) and airflow limitation
- To improve oxygenation
- To improve sleep architecture and reduce arousals from sleep
- To improve symptoms
- To reduce morbidity and mortality associated with OSA
Flow Limitation/Hypopnea with Arousal

Hernandez et al, CHEST 2001; 119: 442-
0.0 cm H₂O

5.0 cm H₂O

10.0 cm H₂O

15.0 cm H₂O
In Lab Manual CPAP Titration

- Patient receives education regarding CPAP
- Careful fitting of the mask
- Acclimitization period
- CPAP level is adjusted manually throughout the recording time
- Issues can be addressed in real time (e.g. mask leak, pressure discomfort, need for supplemental oxygen)
- Ability to determine immediately if complex sleep apnea or periodic breathing is present
Central Apnea

No Flow

No Effort

Requires either desaturation or aousal
An example of a patient with CSB

In Lab Manual CPAP Titration

• **Optimal CPAP titration**
  – Reduces RDI < 5/hour for at least 15 minutes
  – Minimum SaO$_2$ >90%
  – Supine REM sleep not continuously interrupted by arousals or awakenings
  – All at the selected “optimal pressure”
In Lab Manual CPAP Titration

- Labor intensive approach, requires trained technologist to monitor and adjust pressures throughout the night
- Expensive
- Optimal pressure sometimes not achieved in one night titration
- Lack of standardized protocol

Stepanski EJ, J Clin Sleep Med 2005
Factors that Affect CPAP level

- Amount of REM sleep
- Length of the soft palate
- Degree of respiratory effort
- Body position

Sforza E et al., AJRCCM 1995
Sullivan CE, et al., Bull Eur Physiopathol Respir 1984
Factors that Affect CPAP level

• Level of obesity cannot predict CPAP settings

Kushida C et al., J Clin Sleep Med 2008
Home CPAP (APAP) titration

• Autotitrating PAP (APAP or VPAP) Monitor sleep-disordered breathing and adjust pressure accordingly

• Different ways of detecting airflow (e.g. vibration, airflow reduction, flow vs time profile or impedance with forced oscillation)
APAP

- Most start at low pressures (4 cmH$_2$O)
- Increase or decrease the pressure according to airflow detection
- Goal is to deliver minimum effective pressure in all sleep stages and body positions every night
APAP

• Two Main approaches to use:
  – Use as continuous therapy
  – Use for a short period of time and then switch to fixed CPAP level based on data from the APAP machine ($P_{95}$)
APAP

• Other data available:
  – Adherence
  – Residual respiratory events
  – Air leaks
APAP vs CPAP

• APAP and CPAP equally effective in reducing AHI <10/hour
• Improves sleep quality
• Reduces sleepiness
• Improves Quality of Life

Boudeqyns A et al, Thorax 1999
dOrtho MP, et al, Chest 2000
Nussbaumer Y et al, Chest 2006
APAP vs CPAP

- APAP pressures on average are lower than conventional CPAP
  Hudgel DW and Fung C, Sleep 2000
  Scharf MB et al, Sleep 1996

- Only slight improvement in adherence to therapy
  Massie CA, et al, AJRCCM 2003
APAP vs CPAP

- Education and motivation by health care providers are the most important influences on adherence to CPAP therapy, not the machine

Berry RB Sleep Med 2001
Weaver TE Curr Opin Pulm Med 2006
APAP

- No recording of sleep or stages
- Some cannot detect flow limitation (RERAS)
- No oxygenation data
- No information on algorithms to detect events and respond to them**
- Can miss or miss interpret events/artefacts and cause inappropriate pressure changes

Marrone O et al, Chest 2002
Brown LK Chest 2006
An example of a patient with CSB

Distribution of pressure values calculated by each equation and titrated by the APAP device.
Autoset titration pressure vs Somnosmart titration pressure

Kessler R et al. Chest 2003;123:704-710
APAP and CV System
APAP and SBP

Dursunoglu N et al, Respiration 2005
APAP and DBP

Dursunoglu N et al, Respiration 2005
Individual and average changes in SBP (SAP) in patients treated with CPAP or APAP

Patruno V et al. Chest 2007;131:1393-1399
Individual changes in DBP (DAP) in patients treated with CPAP or APAP

Patruno V et al. Chest 2007;131:1393-1399
Individual changes in insulin resistance (HOMA-IR) in patients treated with CPAP or APAP

Patruno V et al. Chest 2007;131:1393-1399
AASM Practice Parameters

1. APAP not used to diagnose OSA
2. Special patient types (CHF, COPD, etc) not to have APAP
3. APAP not to be used during split night study
4. APAP can be used during attended PSG
AASM Practice Parameters

- 5. APAP can be used in some patients without morbidities
- 6. APAP can be used to determine fixed CPAP level
- 7. Close clinical f/u necessary
- 8. In lab study needed if symptoms do not resolve on APAP

AHRQ: Agency for Healthcare Research and Quality Systemic Review

- 15,816 papers initially identified
- 861 met criteria for review
- 24 total met final criteria for use in the systemic review (Randomized Controlled Trials)
## Table 11 Strength of evidence of APAP versus CPAP

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Number of trials</th>
<th>Total number</th>
<th>Trials with data for Meta-analysis</th>
<th>Meta-analysis results comparing APAP with CPAP</th>
<th>Favors</th>
<th>Strength of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical outcomes (death, cardiovascular events and others)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>N/A</td>
<td></td>
<td>Insufficient</td>
</tr>
<tr>
<td>Compliance</td>
<td>24</td>
<td>1008</td>
<td>22</td>
<td>0.18 hours (95% CI 0.05 to 0.31; P = 0.006)</td>
<td>APAP</td>
<td>Moderate</td>
</tr>
<tr>
<td>Apnea-Hypopnea Index</td>
<td>16</td>
<td>548</td>
<td>16</td>
<td>0.25 events/hour (95% CI -0.16 to 0.66; NS)</td>
<td>No difference</td>
<td>Moderate</td>
</tr>
<tr>
<td>Epworth Sleepiness Scale</td>
<td>22</td>
<td>954</td>
<td>18</td>
<td>-0.48 (95% CI -0.81 to -0.15; P = 0.005)</td>
<td>APAP</td>
<td>Moderate</td>
</tr>
<tr>
<td>Arousal Index</td>
<td>10</td>
<td>356</td>
<td>9</td>
<td>-0.85 events/hour (95% CI -2.2 to 0.5; NS)</td>
<td>No difference</td>
<td>Moderate</td>
</tr>
<tr>
<td>Minimum O₂ saturation</td>
<td>9</td>
<td>258</td>
<td>9</td>
<td>-1.3% (95% CI -2.2 to -0.4; P = 0.003)</td>
<td>CPAP</td>
<td>Moderate</td>
</tr>
<tr>
<td>Sleep efficiency</td>
<td>3</td>
<td>126</td>
<td>0</td>
<td>No difference</td>
<td></td>
<td>Insufficient</td>
</tr>
<tr>
<td>Rapid eye movement sleep</td>
<td>9</td>
<td>273</td>
<td>0</td>
<td>No difference</td>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>Slow wave sleep</td>
<td>8</td>
<td>243</td>
<td>0</td>
<td>No difference in seven trials; one trial favored APAP</td>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>Quality of life</td>
<td>9</td>
<td>509</td>
<td>0</td>
<td>No difference in eight trials; one trial favored APAP</td>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>3</td>
<td>149</td>
<td>0</td>
<td>No difference in two trials; one trial favored CPAP (decrease in diastolic blood pressure)</td>
<td></td>
<td>Insufficient</td>
</tr>
</tbody>
</table>

APAP: auto-titrating CPAP; CPAP: continuous positive airway pressure; N/A: not applicable; NS: non-significant.

Ip et al, Systemic Reviews 2012; 1: 20-
AHRQ: Agency for Healthcare Research and Quality Systemic Review

- APAP improved adherence by 11 minutes
- APAP reduced sleepiness (ESS) by 0.5 pts
- CPAP fixed improved oxygen saturation by 1.3%
- Studies had only short term f/u and excluded patients with co-morbidities
- No study on objective clinical outcomes

Ip et al, Systemic Reviews 2012; 1: 20-
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