The Basics of ASV

Tips to a Successful Titration

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The Basics of ASV - Objectives

• Understand ASV terminology
• Recognize parameters which need to be adjusted
• Differentiate between hypopneas and Cheyne Stokes patterns
• Understand how different patient types may affect titration decisions
Intended Use

- Non-invasive ventilatory support to treat adult patients with obstructive sleep apnea (OSA) and respiratory insufficiency caused by central and/or mixed apneas and periodic breathing.

ResMed
VPAP Adapt SV
Enhanced

Philips Respironics
BiPAP autoSV
Advanced
Match therapy to patient needs

- ASV is NOT appropriate for patients who:
  - Have chronic and profound hypoventilation
  - Moderate to severe COPD
  - Chronically elevated PCO2 on ABG (> 45 mm Hg)
  - Restrictive thoracic or neuromuscular disease
Key terminology

• **ASV** = Adaptive or Automatic Servo-Ventilation

  – Adaptive/Automatic: the (pressure) target is adjusted according to the input from the patient, i.e. the target is not a fixed value but instead adapts to patient’s breathing patterns

  – Servo-ventilation: therapy is designed to achieve a target ventilation
### Basic Differences in ASV titration devices

<table>
<thead>
<tr>
<th>Respriconics</th>
<th>Resmed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic EPAP titration- wait at least 20 minutes</td>
<td>Manual EPAP titration- wait 30 to 40 minutes</td>
</tr>
<tr>
<td>PS min is adjustable</td>
<td>PS min is fixed at 3</td>
</tr>
<tr>
<td>Auto or Fixed Rate: Auto targets spontaneous ranging 8-14</td>
<td>Auto rate only, targeting approximately 15</td>
</tr>
<tr>
<td>4 minute moving window using Peak Flow Target</td>
<td>3 minute moving window using Minute Ventilation</td>
</tr>
</tbody>
</table>
Key terminology

- **EEP = EPAP**
  - EPAP min
  - EPAP max

- **Max pressure**
  - The absolute maximum pressure the device will deliver irrespective of other settings

- **Pressure Support (PS)**
  - Difference between IPAP and EPAP

- **Min PS/PSmin**
  - The minimum amount of pressure support

- **Max PS/PSmax**
  - The maximum amount of pressure support
Terms to Learn for ASV

- **EPAPmin**
  - The EPAP will not drop below this pressure
- **EPAPmax**
  - The EPAP will not go above this pressure even if events are detected
  
  Responds to all obstructive events- OA, OH, Snares

- **EEP**
  - Technologist titrates manually to alleviate all obstructive events
Pressure Support

• *Psmin*  
  – The minimum amount of pressure support (i.e. minimum difference between the EPAP and the PSmin setting)

• *PSmax*  
  – The maximum amount of pressure support (i.e. maximum difference between the EPAP and the PSmax)

Simply responds to all decreases in flow or minute ventilation
Max Pressure

• *Max pressure*
  – The maximum pressure the device will deliver even if the algorithm indicates a pressure increase is needed

• If Set too low, this value may limit the amount of Inspiratory Pressure delivered.

Ex: *Epap rose to 10, PS rose to 10, that would be a Bipap of 20/10, if Max set below 20, this would limit the amount that needs to be given to the patient.*
Pressure Support- Difference between IPAP and EPAP (IPAP – EPAP)

<table>
<thead>
<tr>
<th>If EPAP is</th>
<th>And PS is</th>
<th>What is the IPAP?</th>
<th>BiLevel setting?</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>4</td>
<td>8</td>
<td>8/4</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>11</td>
<td>11/6</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>6</td>
<td>6/6.....CPAP</td>
</tr>
</tbody>
</table>
Determine the actual pressures exercise

<table>
<thead>
<tr>
<th>Initial Settings</th>
<th></th>
<th></th>
<th></th>
<th>Actual Pressure</th>
<th>Actual Inspiratory pressure varies to meet the target ventilation</th>
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</thead>
<tbody>
<tr>
<td>EPAP</td>
<td>PSmin</td>
<td>PSmax</td>
<td>Maximum Pressure*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>15</td>
<td>25</td>
<td></td>
<td></td>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EPAP</td>
<td>Min Inspiratory Pressure</td>
<td>Peak Insp Pressure @ max PS</td>
<td>@ these settings</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- EPAP: Extra Positive Airway Pressure
- PSmin: Minimum Positive Airway Pressure
- PSmax: Maximum Positive Airway Pressure
- Maximum Pressure*: 25
- Actual Inspiratory pressure varies to meet the target ventilation
### Determine the actual pressures exercise

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<th>Initial Settings</th>
<th>Maximum Pressure*</th>
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<td><strong>EPAP</strong></td>
<td><strong>PSmin</strong></td>
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<tr>
<td>11</td>
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The actual inspiratory pressure will not go above the EPAP pressure plus the PSmax and will not exceed the maximum pressure.
Evaluate your patient type

• Complex Patients- Sensitive to pressure increases
• CHF- may be more likely to have Cheyne Stokes and/or central events, but may have strong obstructive component as well.
• Opioid users- May be more likely to have Cheyne Stokes or Centrals.
Let’s talk about manual CPAP titrations

• Titrate to worse case scenario

• Patient usually requires higher pressures while supine and/or during REM

• Fixed pressure setting is normally prescribed at the level that resolves supine/REM events
Possible reasons to use an AutoCPAP?

• Is the patient sensitive to higher pressures?
• Does the patient have significant positional or REM related events?
• Was their an inadequate and/or incomplete titration in the lab?
• Do they just want an Auto for comfort?
How do you use an AutoCPAP?

• Set the patient on a minimum and maximum pressure
  – Commonly wide open 4 -20cm

• After a few days, or weeks, download
  • Download reveals
    – ......frequent obstructions (apnea, hypopneas, snoring) at pressures below 8cm
    – ......few obstructions at 9 and 10
    – ......no obstructions at 11 cm

  – Clinically, what would you do for a fixed pressure? What would you do if you were leaving on an AutoPap?
EEP or EPAP min – EPAP max

- EEP: manual titration to alleviate obstructive component

- EPAP min – EPAP max: range set to automatically titrate to alleviate obstructive component
So how does Pressure Support work? The simple answer...

- It’s the ASV or the **Automatic/Adaptive, Servo-Ventilation** component
  - Min and Max pressures – Adjusts automatically
- It’s function? To make all flow patterns look just alike....

![Waveform Diagram]

- Recognizes decrease
- Responds by increasing Pressure to bring waveforms up to previous levels
But.....that looks like a Hypop to me?

- We learned earlier, *Auto* EPAP responds to hypopneas

AND....

- Pressure Supports responds to decreased flow

How does the machine or tech tell the difference?
Quick Review......Central Vs. Obstructive

Obstruction- airway is closed or partially closed

Central- no obstruction- CNS is not telling body to breathe thus...

   Periodic breathing is central type event
During the time of decreased flow, the Servo Ventilation algorithm, will attempt to ‘fix’ the hypopnea by increasing PS.
What happens next?

• If airway is obstructed, or partially obstructed, PS increase is “blocked” and prevents ASV from making waveforms look the same.
If Respironics unit is used, the AUTO EPAP increases pressure to open the obstructed airway. According to algorithm...2 hypops/apneas increase by 1... 3 snores, etc.

OR

For ResMed unit, the technologist should manually increase the EEP pressure after 30 or 40 minutes if unresolved
autoSV acclimation zone

GOAL: Adjust user-set parameters for optimal efficacy and adherence

Set mode to BiPAP autoSV Advanced

- Establish initial settings as indicated below or as ordered by physician
- Ensure proper mask fit to allow algorithm to work effectively
- Have patient breathe on autoSV Advanced at basic settings below
- Adjust $\text{EPAP}_{\text{min}}, \text{Bi-Flex}$ and $\text{PS}_{\text{min}}$ settings to patient comfort

EEP 4

<table>
<thead>
<tr>
<th>EPAP$_{\text{min}}$</th>
<th>4 cm H$_2$O*</th>
<th>Max pressure</th>
<th>25 cm H$_2$O</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPAP$_{\text{max}}$</td>
<td>15 cm H$_2$O</td>
<td>Rate</td>
<td>auto</td>
</tr>
<tr>
<td>$\text{PS}_{\text{min}}$</td>
<td>0 cm H$_2$O</td>
<td>Bi-Flex</td>
<td>To patient comfort</td>
</tr>
<tr>
<td>$\text{PS}_{\text{max}}$</td>
<td>20 cm H$_2$O</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*If patient has known CPAP pressure of < 10 set EPAP$_{\text{min}}$ at 4 cm H$_2$O or patient comfort

*If patient has known CPAP pressure of > 10 set EPAP$_{\text{min}}$ at 6-8 cm H$_2$O or patient comfort
AutoSV titration zone

Monitor patient PSG
Wait.... Watch.... Observe.... Think
Patience is the key to successful titration

At lights out observe for patient's inability to maintain sleep due to severe obstructive apneas
and
At lights out observe for indications of therapy intolerance
If no
Observe for peak inspiratory pressure being limited by $P_{\text{max}}$
If no
Observe for inadequate breathing rate
If no

Titrating zone

For patient comfort and to allow sleep onset increase $EPAP_{\text{min}}$ to open the airway
If yes
Return to ☆

For patient comfort and to allow sleep onset adjust Bi-Flex settings or increase $P_{\text{min}}$
If yes
Return to ☆

Observe for:
1. Leak: fix mask leak
2. Obstructive events: increase $EPAP_{\text{min}}$
3. Central events: increase $P_{\text{max}}$
If yes
Return to ☆

Set fixed rate to a minimum 8-10 bpm or 2 below resting respiratory rate including apneas; set I-Time for 1.5 seconds
If yes
Return to ☆

Wait a minimum of 20 minutes to assess effect before making another change.
ASV Normalizes Breathing

• Recommended Protocol for ResMed
  – Wait 30–40 min for patient to stabilise on therapy & any vocal cord closures (caused by hypocapnia) to be resolved
  – After this time, assume any apneas are ‘closed’ and (obstructive) & increase the EEP until apneas are resolved.
Food For Thought
SDB goes away in REM. Is this pattern more likely OSA or CSR?

Centrally mediated events tend to improve during REM sleep. Obstructive events get worse.
Central or obstructive hypopnea? Likely response to CPAP?
Central sleep apnea (CSA) is defined as:

1. An apnea hypopnea index (AHI) > 5; and
2. Central apneas/hypopneas > 50% of the total apneas/hypopneas; and
3. Central apneas or hypopneas ≥ 5 times per hour; and
4. Symptoms of either excessive sleepiness or disrupted sleep.

Complex sleep apnea (CompSA) is a form of central apnea specifically identified by the persistence or emergence of central apneas or hypopneas upon exposure to CPAP or an E0470 device when obstructive events have disappeared. These patients have predominately obstructive or mixed apneas during the diagnostic sleep study occurring at greater than or equal to 5 times per hour. With use of a CPAP or E0470, they show a pattern of apneas and hypopneas that meets the definition of CSA described above.
• Relevant ICD-9-CM diagnosis code
• ICD-9 code Description
• 327.21 Primary central sleep apnea
• 327.22 High-altitude periodic breathing
• 327.27 Central sleep apnea in conditions specified elsewhere
• 327.29 Other organic sleep apnea
• 786.04 Cheyne-Stokes respiration
  – Central sleep apnea due to Cheyne-Stokes breathing pattern*
Questions?