Breathing at Ease

A Guide to Noninvasive Ventilation Therapy

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Adult Assisted Ventilation Clinic
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Overcoming the Challenges of NIV Therapy

Patient types

- Restrictive disorders (e.g., kyphosis or fibrosis)
- Neuro-muscular disorders and SDB
- Obesity hypoventilation
- COPD
- Complex SDB
- Periodic breathing

OSA
Respiratory System: A Brief Review

- Lungs as vital organs of gas exchange
  - Trachea
  - Bronchial Tube
  - Bronchioles
  - Alveoli
They Don’t Work Alone

- Respiratory muscles
  - Internal/External Intercostal
  - Diaphragm
  - Scalene
  - Sternomastoids
  - Abdominal muscles
When Breathing is Interrupted

• Restrictive diseases
  – Weakened chest wall muscles or abnormalities in the chest wall

• Obstructive disease
  – The obstruction or narrowing of the small airways in the lungs, often characterized by difficulty exhaling

• Obesity hypoventilation syndrome (OHS)
  – Defined by a combination of obesity and a high level of CO2 in the blood
Finding Solutions for Different Respiratory Conditions

- Airway Clearance
- NPPV (Non-Invasive Positive Pressure Ventilation)
- IN (Invasive Ventilation)
Interfaces

Nasal Pillow

Nasal Mask

Full Face
The Early Days

Antique

www.bemeseast.com
Today

Contemporary
Device Download

Demographics

Hours of Use

Pressure Trend

Patterns of Use

(One or more pages)

Long-Term Trends
Device Download
Fixed and Bi-Level Pressure Machines
For treatment of Obstructive Sleep Apnea

• **CPAP**  Continuous Positive Airway Pressure
  – Pressure range of 4 cm/H2O to 20 cm/H2O

• **Bi-Level**  Bilevel Positive Airway Pressure
  – Pressure range of 4 cm/H2O to 25 cm/H2O

• **BiPAP**  Proprietary name of Philips Respironics

• **VPAP**  Proprietary name of ResMed
Auto Bi-Level For
OSA Patients, Non-Responsive or Non-Tolerating CPAP

BiPAP Auto Algorithm

• IPAP vs. EPAP pressure response is determined based on type of event
  – IPAP
    • Flow limitation
    • Hypopnea
  – EPAP
    • Apnea
    • Vibratory Snore

The device triggers (initiates IPAP) and cycles (terminates IPAP and changes to EPAP) as it senses the change in patient flow.
Auto Bi-level Device Settings

- Min EPAP (Adjustable)
- Max IPAP (Adjustable)
- Min Delta (Fixed @ 2 cm)
- Max Delta (Adjustable 3 - 8 cm)

Graph:
- 4 cm level:
  - Apnea
- 25 cm level:
  - Max IPAP
  - Hypopnea
  - P opt
  - P crit
  - 8 cm
- Min EPAP

Graph represents the auto bi-level device settings with various pressure levels and indicative lines for apneas and hypopneas.
QUALIFYING CRITERIA

• Restrictive Thoracic Disorders
  A. Neuromuscular disease or severe thoracic cage abnormality AND
  B. One of the following
     a. ABG PaCO2, while awake and breathing patient’s prescribed FIO2 is > 45 mm Hg,
     b. Sleep oximetry demonstrates oxygen saturation < 88% for > 5 minutes nocturnal,
        while breathing prescribed FIO2,
     c. For neuromuscular disease (only)
        i. MIP < 60 cm H2O or
        ii. FVC < 50% predicted
  C. COPD does not contribute significantly to patient’s pulmonary limitation

• Severe COPD Coverage
  a. ABG (done while awake and on prescribed FiO2) PaCO2 > 52 mmHg
  b. Oxygen saturation ≤ 88% for ≥ a cumulative 5 minutes, minimum 2 hours nocturnal
     recording time (on 2 L/min O2 or prescribed FiO2, whichever is higher)
  c. OSA and CPAP treatment has been considered and ruled out
Bi-Level with Back-up Rate

- BiPAP AVAPS
- BiPAP AVAPS-AE
- BiPAP S/T
- iVAPS
- VPAP Adapt SV
- BiPAP auto SV Advance
• What is AVAPS?
  – Average volume-assured pressure support
  – Vent automatically modifies pressure to maintain an average target user-defined VT
    ▪ 1 cmH₂O per minute change in pressure
  – During AVAPS setup, there may be a period of time before the target tidal volume is achieved (adjustable)
  – AVAPS should not be used when rapid IPAP adjustments are needed to achieve the desired VT
AVAPS & iVAPS

Automatically adjusts the pressure support level to maintain a consistent tidal volume

- IPAP will automatically increase or decrease

ResMed iVAPS: Targets alveolar ventilation rather than Vt by measuring the volume of each breath and subtracting the value of anatomic dead space
AVAPS/iVAPS

Neuromuscular/Restrictive Thoracic Disorders
Obesity/Hypoventilation Syndrome

• Maintains ventilatory support through progression of underlying disease, positional/other changes during sleep

• Provides the assurance of a selected tidal volume within a bi-level system

• Alarms to indicate that tidal volume is not being maintained
AVAPS is NOT Recommended for Rapidly Changing Breathing Patterns, Unstable Physiology

- Periodic breathing requiring a variable breath-by-breath response system
  - Prevents overshooting or undershooting the PaCO\textsubscript{2} breath by breath
  - Does not augment the patients tidal volume consistently

- ICU patients with acute changes in compliance, resistance. Vent alarms more reliable than titration algorithm
AVAPS and Digital Auto-Trak™

- Proprietary software package of patient comfort features (enhanced trigger sensitivity, redundant cycling modes, IPAP/EPAP transition)

- Recognizes and compensates for leak
  - Breath-by-breath sensitivity for optimal comfort

- Automatically adjusts to changing breathing patterns throughout the night
Auto Servo Ventilation – Indications, Basics of Algorithm, and Titration

Indication for ASV
• Central Apnea/Central Hypopnea
• Complex Apnea
• Cheyne Stokes Respiration

ResMed VPAP Adapt SV
Respironics BiPAP auto SV Advance
BiPAP AutoSV Advanced Algorithms

• EPAP adjusts to maintain upper airway stability

• **BiPAP ASV** monitors peak flow during a 4 minute moving window and changes pressure support (IPAP levels) breath by breath to stabilize the breathing pattern, back-up RR kicks in as needed
Auto EPAP Algorithm: Obstructed Airway Apnea Detection

- **Definition:** 80% reduction (moving baseline) flow for 10 sec.
- **Response:** For (2) OA within 3-min. window EPAP will \(\uparrow\) 1 cmH\(_2\)O
Auto EPAP Algorithm: Patent Airway Apnea detection

- **Definition:** 80% reduction (moving baseline) flow for 10 sec.
- **Response:** CA events are reported only. EPAP does not

![Graph showing flow response and back-up breaths]
Auto EPAP Algorithm: Hypopnea Detection

• **Definition:** 40% reduction (moving baseline) flow for 10 sec.

• **Response:**
  - Hypopnea will ↓ peak flow, algorithm 1\textsuperscript{st} responds with ↑ pressure support
  - For (2) Hypopneas within 3-min. window not corrected by pressure support, EPAP will ↑ 1 cmH\textsubscript{2}O
  - Goal of ASV to operate primarily as CPAP until pressure support is required
S9 ViPAP COPD
Designed to Treat COPD

TiControl Chart

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Optimizing Patient-Device Synchrony

Trigger & Cycle Sensitivity

Rise Time

TiControl
KEY TERMINOLOGY

- **EPAPmin**: The EPAP will not drop below this pressure.
- **EPAPmax**: The EPAP will not go above this pressure even if events are detected.
- **Max Pressure**: The maximum pressure the device will deliver even if the algorithm indicates a pressure increase is needed.
- **Pressure Support min**: The minimum amount of pressure support delivered each breath (i.e., minimum difference between the EPAP and the Psmin setting).
- **Pressure Support max**: The maximum amount of pressure support that can be delivered (i.e., maximum difference between EPAP and the PIP).
- **Target Vte**
- **Peak Inspiratory Pressure**: The maximum pressure reached on inspiration to deliver the pressure support determined by the algorithm.
Portable Volume and Pressure Controlled Ventilator

- Provides continuous or intermittent ventilatory support for the care of individuals who require mechanical ventilation
- May be used for both invasive and noninvasive ventilation
- Adult and pediatric patients weighing at least 5 kgs (11 lbs)
- Patients suffering from acute or chronic respiratory failure, acute or chronic respiratory insufficiency or obstructive sleep apnea
- To be used in the home, institution/hospital or portable settings
Ventilation Types and Modes

• Volume Control Ventilation
  - Assist Control (AC)
  - Synchronized Intermittent Mandatory Ventilation (SIMV)
  - Control Ventilation (CV)

• Pressure Control Ventilation
  - CPAP
  - Spontaneous (S)
  - Spontaneous/Timed (S/T)
  - Timed (T)
  - Pressure Control (PC)
  - PC-SIMV
Mouthpiece Ventilation

IDEAL FOR DAYTIME USE FACILITATES SPEAKING, EATING RELIEF FROM NOCTURNAL INTERFACE

Patients must have:

- Sufficient strength and coordination of their bulbar muscles
- Be able to speak, swallow and protect their airway

Spontaneous mode, S/T of PC
Respiratory rate = 2 - 6
IPAP = enough to give Vt that is required
EPAP = 0-4
Alarm = off
Benefits of Mouthpiece Ventilation

• Improves cough and voice function
• MPV facilitates mechanically assisted coughing
• Around the clock assistance
• Mask ventilation at night
• Mouthpiece ventilation during the day
• Patient Quality of Life
• Easily applicable
TROUBLESHOOTING NIV

- INTERFACE
- RATE AND TIDAL VOLUME (PREFERRED PRESSURES)
- TRIGGERING SENSITIVITY
- RAMP
- INSPIRATORY TIME (CYCLING ASYNCHRONY)
- RISE TIME
Questions?