Average Volume-Assured Pressure Support Treatment in COPD

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Objective

- Understanding respiratory failure in correlation with COPD
- Understanding Overlap syndrome
- Effect of AVAPS on the quality of life in COPD patients
- How to obtain AVAPS for Chronic respiratory Failure in the hospital setting

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Chronic Obstructive Pulmonary Disease

- COPD is characterized by airway limitation or obstruction. Dyspnea is caused by airflow limitation, gas trapping, gas exchange abnormalities and mucus hypersensitivity. Patient with COPD will experience respiratory muscle weakness and reduced muscle endurance leading to COPD exacerbations and ultimately acute or chronic respiratory failure.
- The correlation between the severity of airflow obstruction and symptoms can be misaligned
- Estimated 700,000 hospitalizations occur nationally each year with 1 in 5 readmitted within 30 days of discharge
- National cost for readmission are approximately $9,000 and $12,000 each visit and upward of $20,000

Stage	Spirometric Findings
Mild	FEV_1/FVC <.70 FEV_1 ≥ 80% predicted
Moderate	FEV_1/FVC <.70 FEV_1 between 50% and 80% predicted
Severe	FEV_1/FVC <.70 FEV_1 between 30% and 50% predicted
Very Severe	FEV_1/FVC <.70 FEV_1 <30% predicted or FEV_1 <50% predicted + chronic respiratory failure

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Understanding Respiratory failure

- What is respiratory failure: Significant ventilation/perfusion mismatching with increase in physiological dead space leading to hypercapnia and acidosis
- Shift in breathing patten results in adaptive physiological response –Changes the brains activity to lessen the risk of respiratory muscle fatigue and minimize breathlessness in order to maintain homeostasis
- When the respiratory system fails one or both of its functions (oxygenation and ventilation) – oxygenation and cardon dioxide elimination are decreased
- Chronic respiratory failure develops over several days or longer allowing for renal compensation and an increase in bicarbonate concentration shifting the PH to decrease slightly

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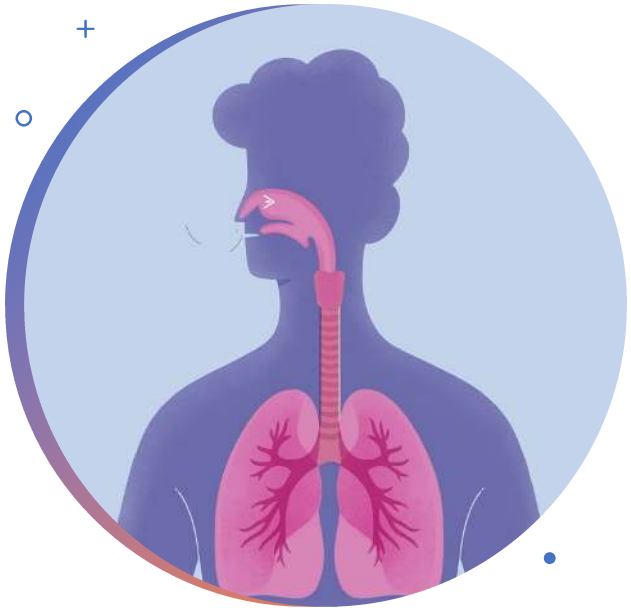

Respiratory Failure prevalence in COPD

- Acute respiratory failure represents the progression of COPD
- Changes may occur in individuals with less COPD severity; however, this will have a dramatic impact the deterioration
- Patient with an acute hypercapnic episode of respiratory failure are associated with significantly higher mortality rate both initially and with in the following 12 months.

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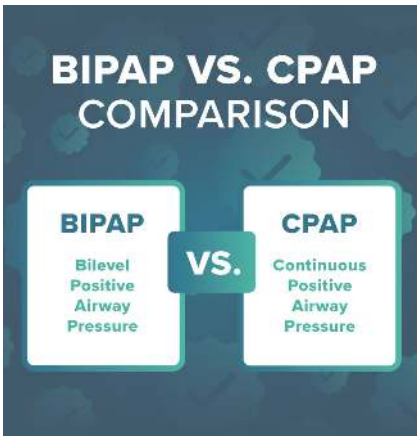
CPAP and BIPAP used with AECOPD

- Continues positive airway pressure (CPAP) causes improvement in respiratory patterns, by splinting open the airway and reducing airway resistance, however, it increases dynamic pulmonary hyperinflation - effects are more significant in patients with inspiratory muscle weakness.
- Bilevel Positive Airway Pressure sets and inspiratory pressure and expiratory positive pressure that causes volume to be a dependent variable. Asynchrony and intolerance is noted some decreasing compliance and effect.



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AVAPS and AVAPS AE

- What is AVAPS: Integrates the characteristics of both volume and pressure-control modes bases on a target tidal volume setting. Set ranges of values using a min and a max IPAP for AVAPS.
- What is AVAPS AE: Monitors the patient's upper airway resistance and automatically adjust the EPAP to maintain upper airway patency.
- Dyssynchronization of the vent is avoided due to the inspiratory pressure changed increasing patient comfort

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Early AVAPS use in COPD hospitalizations

- Study completed on 80 patients with respiratory failure in the ER 33 S/T and 47 AVAPS. The results concluded PaCO2 excretion was faster in the AVAPS group in the first hour with 3 patient requiring intubation; while 5 required intubation in the S/T group.
- Study carried out on 100 patient's randomly divided into 2 groups. AVAPS patients had a significant reduction in PCo2 compared to BIPAP at 6 and 24 hours.

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AVAPS use at home

- A randomized controlled study of 40 stable hypercapnic COPD patient where randomized 1:1 Ratio using AVAPS ST and BIPAP ST for 6 months of consistent treatment
- Results were measured using a health survey, exercise tolerance 6-minute walk test and evaluated after 6 month of treatment.
- AVAPS treatment resulted in the greatest improvement over all areas including vitality, confidence, physical function, and decreased bodily pain. Patients also had a decrease in daytime PaCO2 and increased 6-minute walking distance
- Prevents respiratory failure, alleviates anxiety, increased physical function, decreases atelectasis, decrease muscle fatigue

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Case Study

- 60 Y.O. Man with a history of COPD, anxiety, chronic respiratory failure. FEV1/FVC 40% FEV1 20% post-bronchodilator. Findings consistent with VERY SEVERE, GOLD GRADE 4, GROUP D COPD. Patient has been readmitted 3 times in the past 12 months due to acute respiratory failure. Patient stated, "I get short of breath at home and very anxious, so I call the ambulance". Patient is a current smoker with limited activity. Upon arrival patient was intubated during current visit.
- Rational: This patient has stage 4 COPD treated with medication. Patient is limited at home due to severity of the COPD and frequency of COPD exacerbations. During these readmissions patient receives BIPAP, Q4 Duoneb and steroids. Patient would benefit from a AVAPS machine at home to prevent rehospitalizations and decrease the work of breathing during exacerbations and anxiety.

pH 7.391
PCO2 **52.7 mmHg**
PO2 98.9 mmhg

HCO3 21 - 28 mmol/L
32 (H) Base Excess, Arterial -2 - 2 mmol/L
6 (H)
Ventilation Mode PRVC

pH **7.247 (L)**
PCO2 **84.2 mmHg**

PO2 **41.1 mmHg**

HCO3 21 - 28 mmol/L
37 (H)
Base Excess, Arterial -2 - 2 mmol/L **7 (H)**
Ventilation Mode Arterial BIPAP

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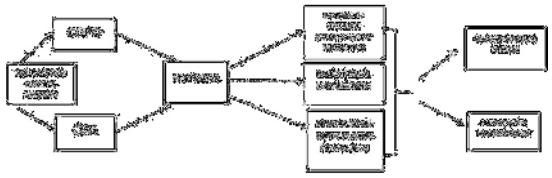
Overlap Syndrome (OS)



- Identified in patient with Obstructive Sleep Apnea (OSA) and COPD
- Patient with OS have more profound nocturnal oxygen desaturation then patient is OSA or COPD alone.
- Increase of Hypoxia in OS causes increased risk of cardiovascular disease including atrial fibrillation, right heart failure, and pulmonary hypertension- increasing mortality rate
- Sleep disorders are the third most common factor affecting the quality of life in COPD
- 2015 study assess 44 COPD patients who had full polysomnography suitable for analysis, OSA was present in 29 of those individuals (65.9%).
- Consider work up for NIV BIPAP or AVAPS

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Treatment for Overlap syndrome

- CPAP is the most effective treatment for OSA. It reduces upper airway resistance, therefore reducing nocturnal hypoventilation. CPAP therapy can improve survival outcomes for OSA patients by increasing their FEV1, PaO_2, $PaCO_2$ and mean pulmonary artery pressure. CPAP can be exhausting for those with weaken respiratory muscle preventing the muscles from resting and decreasing compliance.
- BIPAP treatment for patients with COPD and OSA are beneficial due to the splinting open of the airways and allowing for exhalation. Volumes are inconsistent for ventilation
- AVAPS splits open the airway and allows for adjustments base on the patient needs ie; sleep position, lung compliance

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Case Study

54y/o male with a history of OSA and COPD (overlap syndrome) presented to ED with complaints of sob and respiratory failure. Upon admission patient was hypoxic and hypercapnic with decreased mental status. Patient is noncompliant of his CPAP due to comfort and discontinued use in 2018. Patient's spirometry results FEV1/FVC 43% FEV1 32 %. Patient has had 5 admission in the past 12 months with 2 readmissions in the last month. Admission diagnosis involved was for respiratory failure and A-fib with RVR.

- pH 7.350 - 7.450 **7.334 (L)**
- PCO2 35.0 - 45.0 mmHg **70.3 (HH)**
- PO2 80.0 - 100.0 mmHg **109.0 (H)**
- O2 Saturation Arterial % 99.0
- HCO3 21 - 28 mmol/L **37 (H)**

Rational:
Due to patient's untreated OSA and worsening of Respiratory failure and COPD. Patient will require volume ventilation to promote gas exchange via NIV therapy. Patient was intolerable of continuous pressures and is demonstrating the need for mouthpiece ventilation for daytime as the pco2 elevates.

His frequent hospitalization and exacerbation are progressing his disease process and causing a decrease in his physical ability from muscle atrophy. BIPAP has been tried and failed and confirmed by an ABG.

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Contraindications

- Cardiac/Respiratory arrest
- Upper airway blockages
- GI bleeds
- Encephalopathy
- Fascial problems

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Complications

BAROTRAUMA (LOW RISK- PRESENT IN FIXED POSITIVE PRESSURE VENTILATION)

HEMODYNAMIC COMPROMISE- PATIENTS WITH SEVERE DISEASE HYPOTENSIVE AND UNDERLYING CARDIAC DISEASE WITHOUT ADEQUATE THERAPY ARE AT RICK OF A DECREASE IN CARDIAC OUTPUT BY 10-13%

NIV- ASSOCIATED PNEUMONIA OCCURS IN 5.7% (STUDY LOOKED AT 5,870 NIV PATIENTS)

INCREASE ASPIRATION RISK.

FACIAL SKIN LESIONS- ASSOCIATED WITH ILL FITTING MASK

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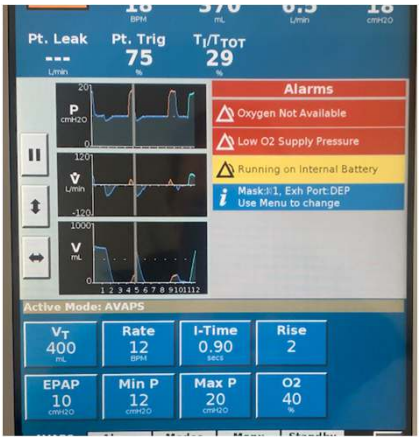
AVAPS Settings

- Target tidal volume is 8 ml/kg of IBW and adjusted based on patient pathology
- Max IPAP = 20-25 cm H2O
- Min IPAP = EPAP +4 cm H2O (no less the 8 cmH2O
- Rate = 2-3 BPM below patient resting



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Does INS cover NIV

Steps for qualifying a patient for AVAPS

1. Secondary Chronic respiratory failure or Acute on Chronic respiratory failure
2. Patient will need one of the following

A. PCO2 >52mm Hg or FEV1<50% of predicted

B. PCo2 between 48-51 mm Hg or FEV1<51-60% of predicted and 2 or more respiratory related hospital admissions within the past 12 months

1. Notes must include
   a. FaceSheet
   b. Doc H/P and any Medical necessity for pressure support ventilation due to progression of disease.
   c. ABG results
   d. Information if patient was previously on bi-level with or without rate as an outpatient and documentation of why bi-level was not sufficient

Sample notes:

Patient requires a non-invasive ventilator due to the severity of chronic respiratory failure J96.10 consequent to COPD J44.9. Ventilation is required to decrease work of breathing, improve pulmonary status and interruption of respiratory support could lead to serious harm including decline in health status, increased risk of CO2 retention and death. Patient requires AVAPS over BIPAP due intolerance of BIPAP and continued distress. Patient is able to clear their secretions and protect their airway.

Primary Diagnosis

- COPD
- Emphysema
- Chronic Bronchitis
- Cystic Fibrosis
- Scoliosis
- Intestinal Lung Disease
- Obesity Hypoventilation Syndrome (OHS)

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Take Away

- AVAPS should be consider in patient with Acute/Chronic Respiratory failure as a first line intervention – Shows rapid results in CO2 reduction compared to BIPAP
- Patient with overlap syndrome may have received CPAP once for OSA management, however, due to the progression of COPD and physiological changes it may not be the most beneficial and ultimately further progression and decrease compliance
- Evaluate patient need for post-acute continuation of therapy to improve quality of life and decrease hospital utilization and disease progression.
  - Patient with an acute hypercapnic episode of respiratory failure are associated with significantly higher mortality rate both initially and within the following 12 months.
  - 80% of patient have an estimated 12% to 40% of muscle lose per week for prolong bed rest. This is increased with intubated patients. It can take an average of 1 week to recover per day of hospitalization.
- AVAPS can improve oxygenation, ventilations, decrease atelectasis, increase heart function which ultimately can reduce blood pressure, heart rate, and the risk for pulmonary hypertension and cardiovascular disease.
  - Can also be used in patient with obesity hypoventilation and restrictive patients

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Resources

- https://www.sciencedirect.com/science/article/pii/S0012369215446501
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8880836/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9811600/#:~:text=As%20compared%20to%20BIPAP%20(S%2FT)%20mode%2C%20application,mechanics%20during%20exacerbation%20in%20COPD.
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6298617/#:~:text=The%20overlap%20syndrome%20(OS)%20was,with%20OSA%20or%20COPD%20alone.
- https://rtmagazine.com/disorders-diseases/chronic-pulmonary-disorders/copd/bipap-noninvasive-ventilation-copd/

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Questions

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