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Non-Invasive Ventilation in COPD

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Aims of talk

Discuss

- Brief COPD pathology
- AHRF & ABGs
- Standard AECOPD treatment
- When to add NIV
- Evidence
- NIV mechanisms & contraindications
- NIV settings/modes
- Weaning & ongoing care
- Home NIV in COPD

COPD Definition

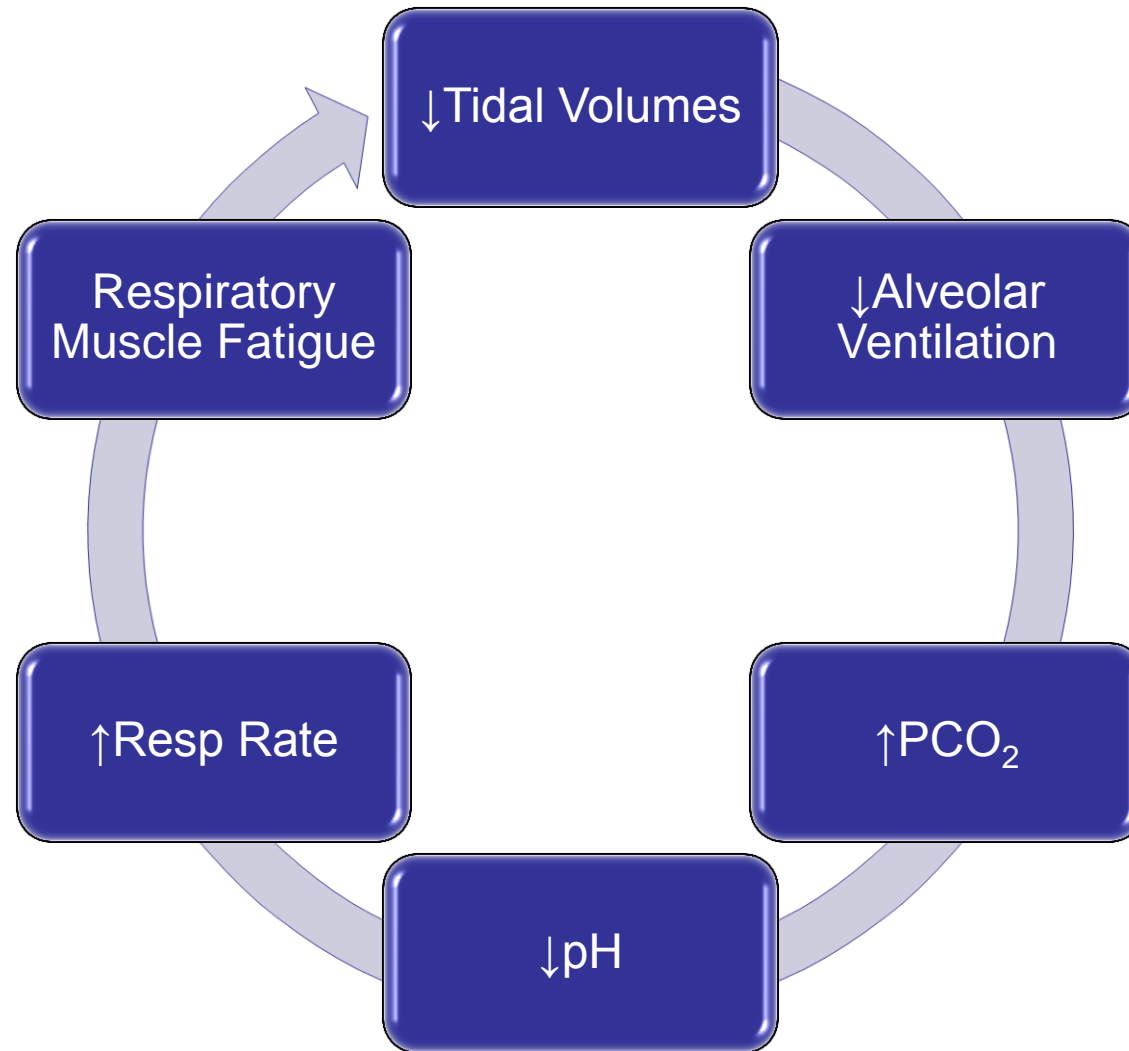
- Chronic airway inflammation due to repetitive exposure to noxious substance
 - Chronic bronchitis
 - Emphysema
 - Or combination of both
- Mild: FEV_1 60-80%
- Moderate: FEV_1 40-59%
- Severe: FEV_1 <40%

Severe COPD & Respiratory Failure

- Chronic airway inflammation
- ↑mucus production
- Small airway narrowing/collapse
- Chronic hyperinflation
- ↓lung compliance

- During acute insult: exacerbation of above leading to
 - further ↓lung compliance

AHRF in AECOPD



ABG

- Consider ABG in AECOPD when:
 - RR \geq 24 bpm
 - FiO₂ \geq .40 to maintain SpO₂ 88-92%
 - Increasing FiO₂ requirements
 - Confusion
 - Drowsiness
 - Asterixis



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AHRF

- ABG (normal ranges):
 - pH 7.35 – 7.45
 - PaCO₂ 35 – 45 mmHg
 - PaO₂ >80 mmHg
 - Bicarb 22 – 28 mmol/L
 - VBG (if ABG unavailable):
 - pH 7.32 – 7.42
 - PvCO₂ 40 – 50 mmHg (although not very reliable)
 - PvO₂ does not reflect PaO₂
 - Bicarb also not accurate on VBG
- AHRF:
pH <7.35
PaCO₂ >45 mmHg
Bicarb >28 suggests ↑PCO₂ >48 hrs

AHRF in AECOPD

- Typical acute clinical presentation:
 - RR 20-30 bpm
 - Hypoxia
 - Poor air entry & wheeze
 - Use of accessory muscles
 - Anxious or drowsy
 - ABG (example):
 - pH 7.26
 - PaCO₂ 75
 - PaO₂ 50
 - Bicarb 33
 - BE +6

Standard AECOPD Care

- Inhaled bronchodilators
 - SABA - e.g. salbutamol
 - SAMA - e.g. ipratropium (although evidence is weak)
- Systemic corticosteroids
 - PO prednisolone 37.5 – 50mg
- Antibiotics
- Supplemental oxygen titrated to SpO₂ 88-92%

AT RISK OF HYPERCAPNIA: AVOID OVER OXYGENATION

Titrate Oxygen to SpO₂ 88-92% ACC: Yellow Zone SpO₂ 80-85% / Red Zone SpO₂ <80%



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When to start NIV in AECOPD

- Arterial pH 7.31-7.35 (& PaCO₂ >45)
 1. Inhaled salbutamol & oral corticosteroid
 2. Optimal positioning
 3. Controlled oxygen: titrated to SpO₂ 88-92%
 4. Start NIV, or recheck ABG after 1 hour
 - pH <7.35 → commence NIV
- Arterial pH 7.25-7.30 (& PaCO₂ >45)
 1. Commence NIV
 2. Inhaled salbutamol & oral corticosteroid
 3. Optimal positioning
 4. Controlled oxygen: titrated to SpO₂ 88-92%
 5. Recheck ABG after 1 hour
 - pH worse → ensure NIV optimised → consider intubation

When to start NIV in AECOPD

- Arterial pH < 7.25 (& PaCO₂ >45)
 1. Consider intubation & mechanical ventilation
 2. Commence NIV if not for intubation
 3. Inhaled salbutamol & oral corticosteroid
 4. Optimal positioning
 5. Controlled oxygen: titrated to SpO₂ 88-92%
 6. Recheck ABG after 1 hour
 - pH worse → ensure NIV optimised → reconsider IMV
 - consider palliative focus

NIV Treatment Evidence in AHRF

- Addition of NIV to usual care:
 - ↓ respiratory acidosis with 1 hour
 - ↓ mortality during hospital stay
 - ↓ need for endotracheal intubation
 - ↓ hospital LOS

Evidence summary

NIV vs usual care for AHRF due to AECOPD

Outcome	Usual care	Usual care plus NIV	Risk Reduction	No. of participants (studies)
Mortality	183 / 1000	99 / 1000	46%	854 (12 RCTs)
Intubation	341 / 1000	123 / 1000	64%	1105 (17 RCTs)
Mean LOS	17.5 days	14.1 days	19%	888 (10 RCTs)

NIV for management of AHRF due to AECOPD, Cochrane Review 2017



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NIV Definition

- Application of positive airway pressure (PAP) without the use of an invasive tracheal tube
- Evolved from CPAP in 1980s
- Works by:
 - Reducing respiratory muscle workload
 - Increasing tidal volumes
 - Increasing residual volumes
 - Reducing small airway collapse
- Common treatment of HRF in:
 - COPD
 - Bronchiectasis/CF
 - OHS
 - Neuromuscular disorders
 - Chest wall disorders



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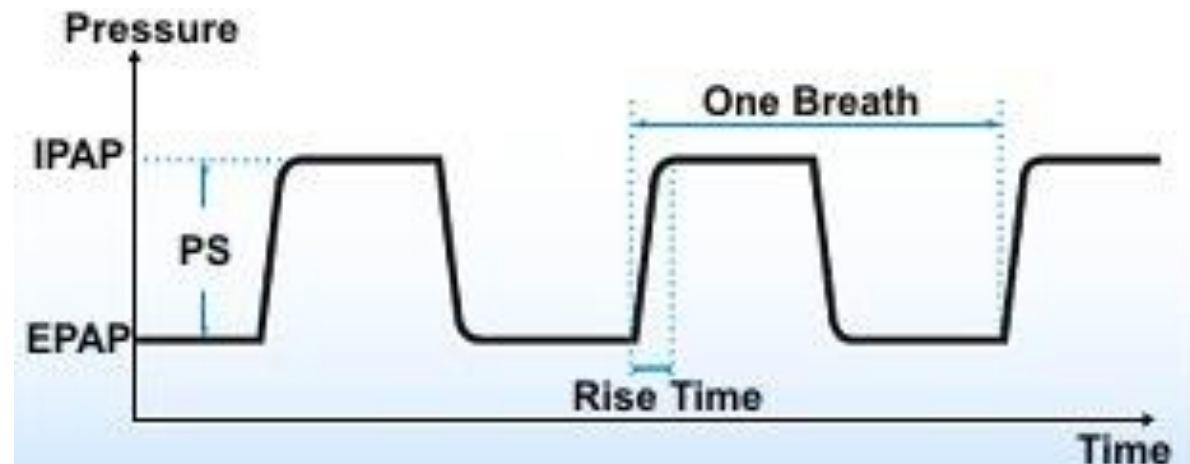
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Contraindications to NIV

- Shock
- Life threatening hypoxemia
- Life threatening cardiac arrhythmias
- Inability to protect own airway
- GCS <8
 - NIV may be indicated if patient not for intubation
- Marked confusion
- Facial trauma/burns or recent facial/upper airway surgery
- Uncontrolled emesis
- GI bleeding/obstruction
- Copious unmanageable respiratory secretions
- Pneumothorax
 - Will likely require a pleural drain

NIV Settings

- IPAP
- EPAP
(IPAP minus EPAP = Pressure Support)
- Rise time
- BRR (S/T mode)
- Inspiratory time (BRR)
- Trigger sens.
- FiO₂



NIV Settings

	Spont	S/T	VTPS	PC
EPAP	✓	✓	✓	✓
IPAP	✓	✓	Range	✓
Target TV			✓	
Rise time	✓	✓	✓	✓
BRR		✓	✓	✓
Insp time		✓	✓	For both spont & BRR
Trigger	✓	✓	✓	✓

Initiation & Titration of NIV in AECOPD

- Commence at:
 - IPAP 14, EPAP 4, rise time 0.2s
- Increase IPAP in 2 cmH₂O increments
 - Aim for tidal volumes 8-10 mL/kg ideal body weight
 - IPAP 20-25 not uncommon
- Avoid increasing EPAP unless obesity present
- Minimise FiO₂ aiming for SpO₂ 88-92%
- Within 1 hour there should be a:
 - ↓ Resp Rate
 - ↓ PaCO₂
 - ↑ pH

Optimising NIV

- Tidal Volumes 8-10 mL ideal body weight
 - e.g. 175cm male = 71kg IBW = 570 – 710mL TV
- Leak/mask fit
- Asynchrony
 - Rise time
 - BRR
 - Trigger
- FiO_2
 - SpO_2 88-92%

Ongoing treatment/when to cease

- Short breaks only during initial 24 hours
- Beyond 24 hrs & once pH normalised consider:
 - Cease
 - Observe for clinical signs of AHRF

or

- ↑time off NIV during day
- Daily check of pH
- Cease daytime NIV
- Then cease nocte NIV



Delivery of NIV outside ICU

- Can be done safely and effectively provided:
 - Adequately trained staff
 - Ability to quickly escalate to ICU when required
 - Easy access to equipment including ABG analyser
- Patients likely to require ICU management:
 - Other acute organ failure
 - Cardiovascular instability
 - Oxygen requirements $>40\%$ to achieve $SpO_2 \geq 88\%$
 - More severe acidosis: $pH < 7.25$
 - Delirium

Ongoing care

- Cease systemic corticosteroid
- Wean O₂*
- Ongoing smoking cessation support as applicable
- LAMA, LABA, ± ICS
- Inhaler education & management plan
- Pulmonary Rehab
- Annual vaccines (influenza & pneumococcal)
- *Home O₂:
 - PaO₂ <56 mmHg at rest
 - or PaO₂ <60 mmHg in pulmonary hypertension
 - Reassess as outpatient



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Home NIV in COPD

- Struik et al. 2014: RCT (n=201)
 - Standard care vs SC plus home nocte NIV
 - All admitted for NIV for AHRF due to AECOPD
 - Improvement in PaCO₂ but no difference in time to hospital readmission or death, little difference in HRQL
- Murphy et al. 2017: RCT (n=116)
 - Home O₂ vs Home O₂ plus nocte NIV
 - COPD with FEV₁ <50% predicted, meet criteria for home O₂ & PaCO₂ >53 mmHg (baseline)
 - Time to readmission or death: 1.4 vs 4.3 months (O₂ vs O₂+NIV)

Home NIV in COPD

- COPD with $FEV_1 < 50\%$
- Established on home O_2
- Outpatient $PaCO_2 > 53$ mmHg with normal pH
 - Trial of home NIV in addition to O_2

- NIV settings in HOT-HMV Trial:
 - IPAP 24 cmH₂O
 - EPAP 4 cmH₂O
 - BRR 14 cmH₂O
 - 7.6 hrs nocte (at 12 months)

Key messages

- Consider ABG in AECOPD with clinical signs of hypercapnic respiratory failure
- Add NIV to standard care if AHRF present
- Aim for tidal volumes of 8-10 mL/kg IBW
- Control oxygen therapy both on & off NIV aiming for SpO₂ 88-92%
- Staff experience & familiarity of NIV crucial to success
- Consider home NIV for patients on home O₂ with persistent baseline hypercapnia

Great resources

- BTS/ICS guideline for the ventilatory management of acute hypercapnic respiratory failure in adults
Thorax 2016 (vol. 71)
- ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure
European Respiratory Journal 2017 (vol. 50)
- Noninvasive ventilation in acute respiratory failure in adults
UpToDate 2018



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