# Management of Acute Hypercapnic Respiratory Failure: Case Discussion

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**Which one is the patient with hypercapnia?**

# ACUTE HYPERCAPNIC RESPIRATORY FAILURE (AHRF)

- ✓ The inability to provide alveolar ventilation to keep $PaCO_2$ levels within normal limits
- ✓ pH <7.35 and $PCO_2$ > 45 mmHg indicate acute respiratory acidosis
- ✓ Seen in 20% of COPD exacerbations
- ✓ 12% of hypercapnic COPD cases are lost at the first admission

*Roberts CM, Stone RA, Buckingham RJ,et al Thorax 2011;66:43*

# ACUTE HYPERCAPNIC RESPIRATORY FAILURE (AHRF)

- ✓ Mortality is high in hypercapnic asthma attacks
- ✓ Poor prognostic indicator in complicated cystic fibrosis and bronchiectasis cases
- ✓ It can occur suddenly in neuromuscular and chest wall related diseases, acute decompensated attacks are common in chronic conditions and is a precursor for long-term NIMV at home
- ✓ If not recognized or treated, it can cause seizures, coma, arrest and death

# Hypercapnia

- Hypercapnia is always an indicator of inadequate ventilation.
- $PaCO_2$;
  - Directly proportional to $CO_2$ production
  - Inversely proportional to alveolar ventilation

$$\dot{V}_E = f \times V_T$$

$$\dot{V}_E = \dot{V}_A + \dot{V}_D$$

$$\dot{V}_A = \dot{V}_E - \dot{V}_D$$

$$PACO_2 = \frac{\dot{V}CO_2 \times 0.863}{\dot{V}_A}$$

$$pCO_2 = k \times \frac{V_{CO2}}{V_E\,(1 - V_D/V_T)}$$

# Causes of Respiratory Failure

## Failure to Ventilate

### Neurological

**Respiratory Center**
Opioids, Anesthetics, Brain Injuries

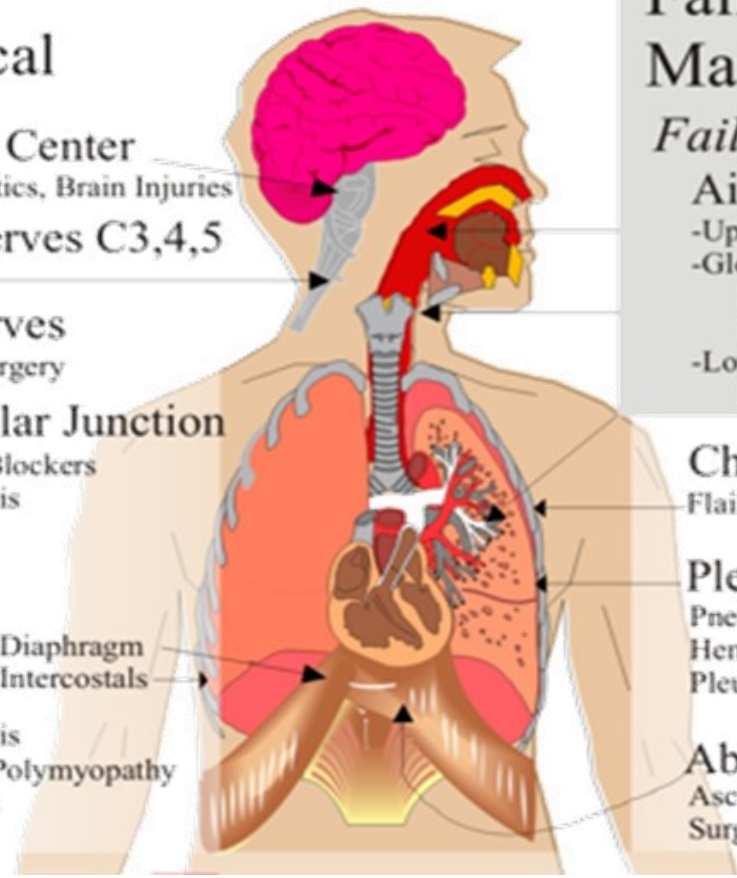
**Cervical Nerves C3,4,5**
Spinal Injuries

**Phrenic Nerves**
Chest trauma, Surgery

**Neuromucular Junction**
Neuromuscular Blockers
Myasthenia Gravis

### Muscular

**Mypoathy**
Steroids
Myasthenia Gravis
Polyneuropathy/Polymyopathy of Critical Illness




## Failure to Maintain Airway

*Failure of Gas Flow:*

**Airway Obstruction**
-Upper: teeth, tongue
-Glottic:
laryngeal edema
laryngospasm
-Lower: bronchospasm
Inhaled objects

**Chest Wall**
Flail Chest

**Pleural Cavity**
Pneumothorax
Hemothorax
Pleural Effusion

**Abdominal Compression**
Ascites/Hemoperitoneum
Surgical Packs etc

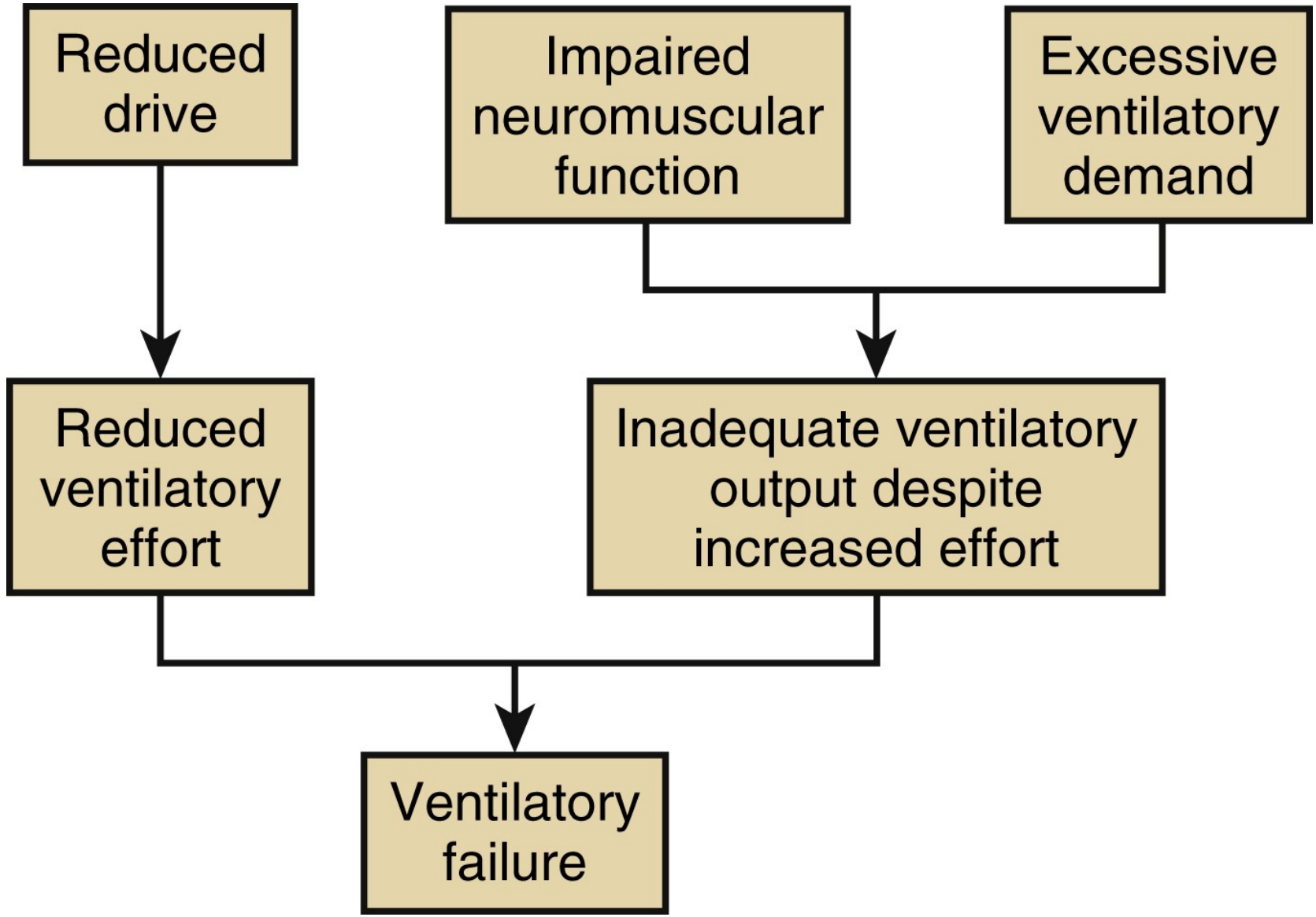
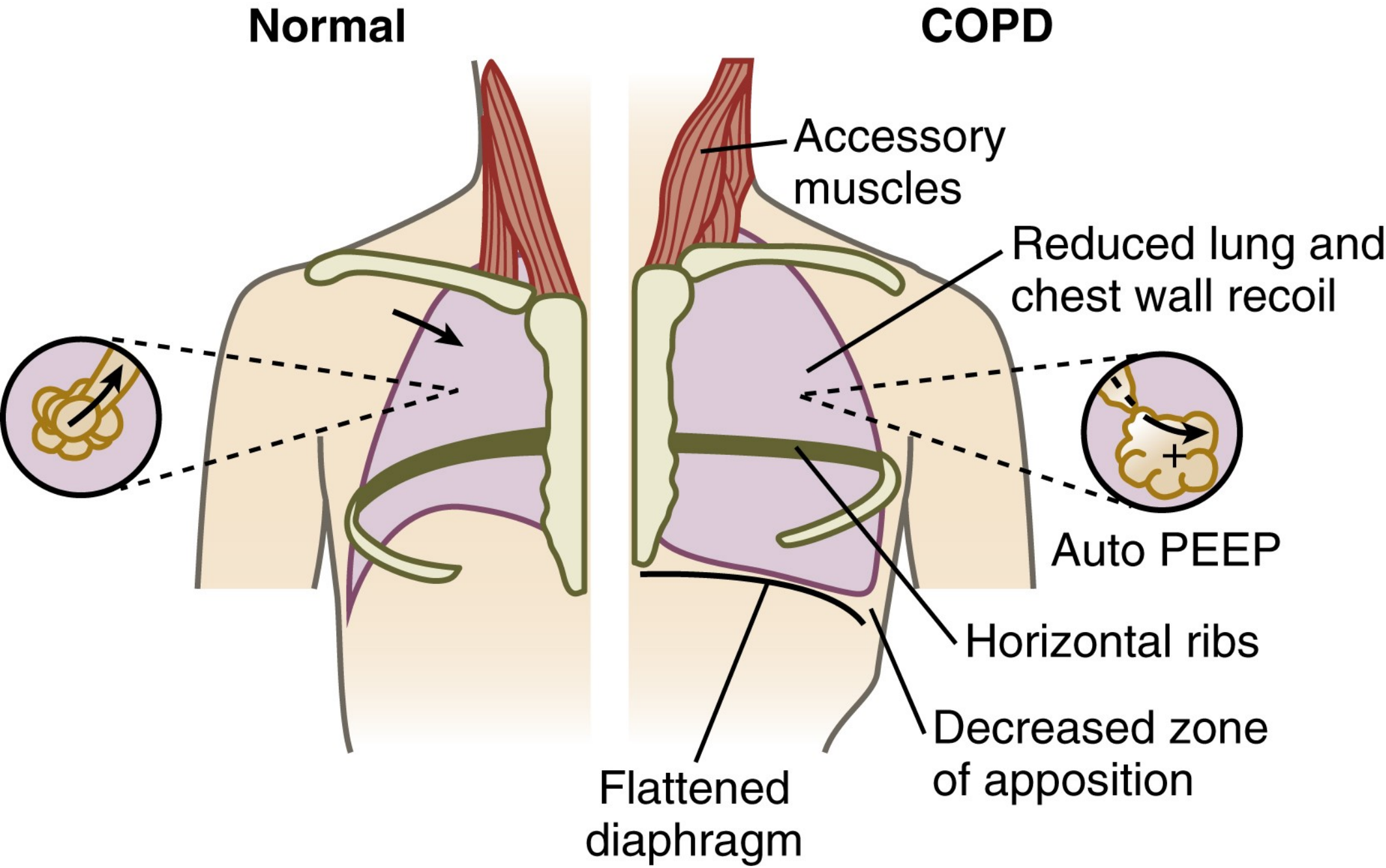

Reduced drive
Impaired neuromuscular function
Excessive ventilatory demand
Reduced ventilatory effort
Inadequate ventilatory output despite increased effort
Ventilatory failure

**Table 132.1** Clinical Classification of Ventilatory Failure by Site

| Site of Defect | Mechanism or Type | Clinical Examples |
|---|---|---|
| **VENTILATORY DRIVE** | Congenital | Primary alveolar ventilation (Ondine's curse) |
| | Acquired | Drug overdose (opioids, sedatives, alcohol); propofol; cerebrovascular accident; neoplasm; carotid body resection |
| | Combination | Obesity-hypoventilation syndrome; myxedema |
| **NEURAL TRANSMISSION** | | |
| Spinal cord | Trauma | Cervical spinal cord injury |
| | Vascular | Vascular accident |
| | Tumor | Primary or metastatic |
| | Other | Poliomyelitis; amyotrophic lateral sclerosis |
| | Demyelinating | Acute idiopathic demyelinating polyneuropathy (Guillain-Barré syndrome) |
| Peripheral nerves | Phrenic nerve lesion | Trauma; cardiac surgery; neoplasm; idiopathic |
| Neuromuscular junction | Autoimmune | Myasthenia gravis |
| | Infectious/toxins | Botulism, tetanus, tick paralysis |
| | Pharmacologic | Neuromuscular blocking agents |
| Neuromuscular | Critical illness | ICU-acquired weakness, ventilator-induced diaphragmatic dysfunction |

| | | |
|---|---|---|
| **VENTILATORY MUSCLES** | Congenital | Muscular dystrophy |
| | Autoimmune | Polymyositis; dermatomyositis |
| | Acquired | Hypophosphatemia; hypokalemia; hypomagnesemia; myxedema |
| **THORACIC** | | |
| Vertebrae and rib cage | Decreased mobility | Kyphoscoliosis; tight casts or bandages; ankylosing spondylitis; flail chest |
| Soft tissues | Extrapulmonary restriction and decreased mobility | Severe obesity |
| Pleura | Extrapulmonary restriction | Pneumothorax; pleural effusion; pleural thickening; malignancy |
| **AIRWAYS** | | |
| Upper | Obstruction | Epiglottitis, foreign body, tumor, vocal cord paralysis, tracheomalacia |
| Lower | Obstruction | COPD, acute severe asthma |
| **PARENCHYMA** | Increased dead space and very high $\dot{V}/\dot{Q}$ | COPD |
| | Very low $\dot{V}/\dot{Q}$; shunt | Severe ARDS |
| **PULMONARY CIRCULATION** | General hypoperfusion | Hypovolemic or cardiogenic shock, CPR, pulmonary hyperinflation (intrinsic PEEP) |
| | Localized hypoperfusion | Pulmonary thromboembolism; venous air embolism |
| **OTHER** | Increased $CO_2$ production (inflammation; hypermetabolism; muscle activity) | Fever; sepsis; burns; severe trauma; shivering; tetany; seizures; malignant hyperthermia |
| | Exogenous $CO_2$ inhalation | Laboratory or industrial accident; therapeutic use; rebreathing |


Normal
COPD
Accessory muscles
Reduced lung and chest wall recoil
Auto PEEP
Horizontal ribs
Decreased zone of apposition
Flattened diaphragm

# ARTERIAL BLOOD GASES ANALYSIS

- ✓ In acute respiratory acidosis, $PaCO_2$ is >45 mmHg while pH is <7.35
- ✓ In acute exacerbation on a chronic basis, pH is higher than expected
- ✓ In chronic hypercapnia, pH is normal or close to normal

- ✓ To distinguish between global hypoventilation and pulmonary disease **«A-a gradient»** should be calculated ($PAO_2 – PaO_2$)
- ✓ It can be calculated practically with the formula **Age x 0.3**

- ✓ If $PCO_2$ is high and **A-a gradient is normal**, it means there is **hypoventilation**
- ✓ If $PCO_2$ is high and **A-a gradient>20 mmHg**, it indicates underlying **lung disease**

# MECHANICAL VENTILATION IN HYPERCAPNIC RESPIRATORY FAILURE

## WHAT IS THE PURPOSE?

- ✓ Reducing inspiratory muscle and respiratory load
- ✓ Reducing dynamic hyperinflation and auto-PEEP
- ✓ Improving gas exchange

Non-invasive mechanical ventilation (NIMV)

Invasive mechanical ventilation (IMV)

Hemodynamic instability

Loss of consciousness

Inability to protect airway, inability to expel secretions

History of facial, esophageal, gastric surgery

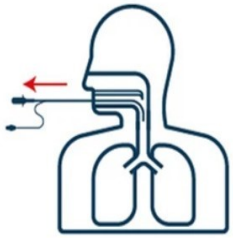
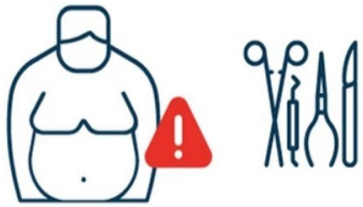
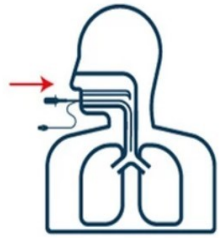
# How to manage the patient?

NIV

HFNC

IMV

## When should high flow nasal cannula (HFNC) be used in the clinical setting?

| Hypoxemic respiratory failure *(moderate certainty)* | Following extubation *(moderate certainty)* | Postoperative HFNC in high risk and/or obese patients following cardiac or thoracic surgery *(moderate certainty)* | Peri-intubation period *(moderate certainty)* |
|---|---|---|---|
|  |  |  |  |
| **Strong recommendation** | **Conditional recommendation** | **Conditional recommendation** | **No recommendation** |

ESICM
EUROPEAN SOCIETY OF INTENSIVE CARE MEDICINE

**The role for high flow nasal cannula as a respiratory support strategy in adults: a clinical practice guideline. *Intensive Care Med* 46, 2226–2237 (2020).**

# In hypercapnic ventilatory failure;

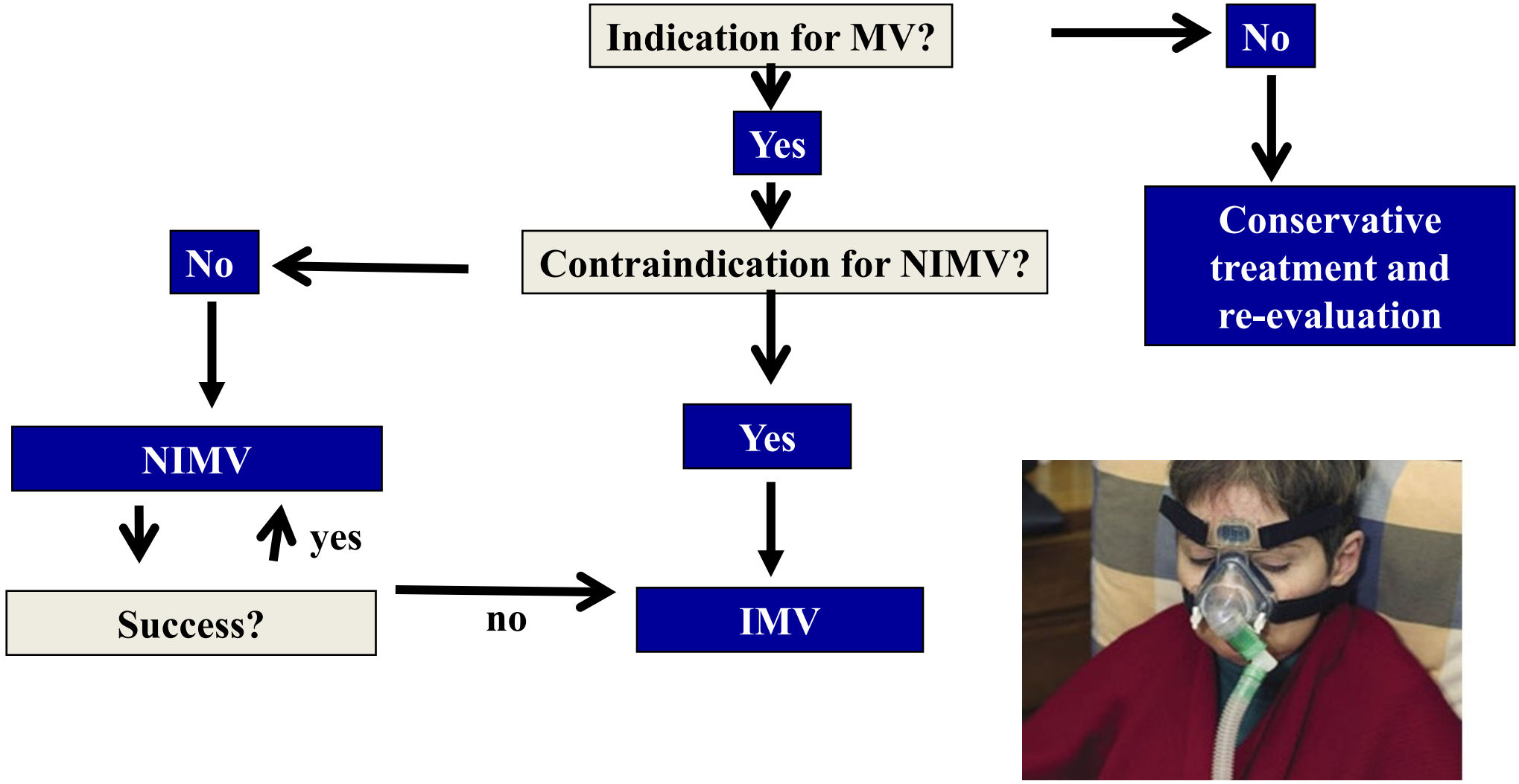
- ✓ First choice for hypercapnic respiratory failure NIMV
- ✓ HFNC may be an alternative for patients with low tolerance and mild to moderate respiratory acidosis
- ✓ HFNC alternately during NIMV treatment

*Use of nasal high flow oxygen during acute respiratory failure. Intensive Care Med 46, 2238–2247 (2020).*

*High-Flow Nasal Cannula for Chronic Obstructive Pulmonary Disease with Acute Compensated Hypercapnic Respiratory Failure: A Randomized, Controlled Trial. Int J Chron Obstruct Pulmon Dis. 2020 Nov 24;15:3051-3061.*

*Huang Y, Lei W, Zhang W, Huang JA. High-Flow Nasal Cannula in Hypercapnic Respiratory Failure: A Systematic Review and Meta-Analysis. Can Respir J. 2020;2020:7406457. Published 2020 Oct 29. doi:10.1155/2020/7406457*

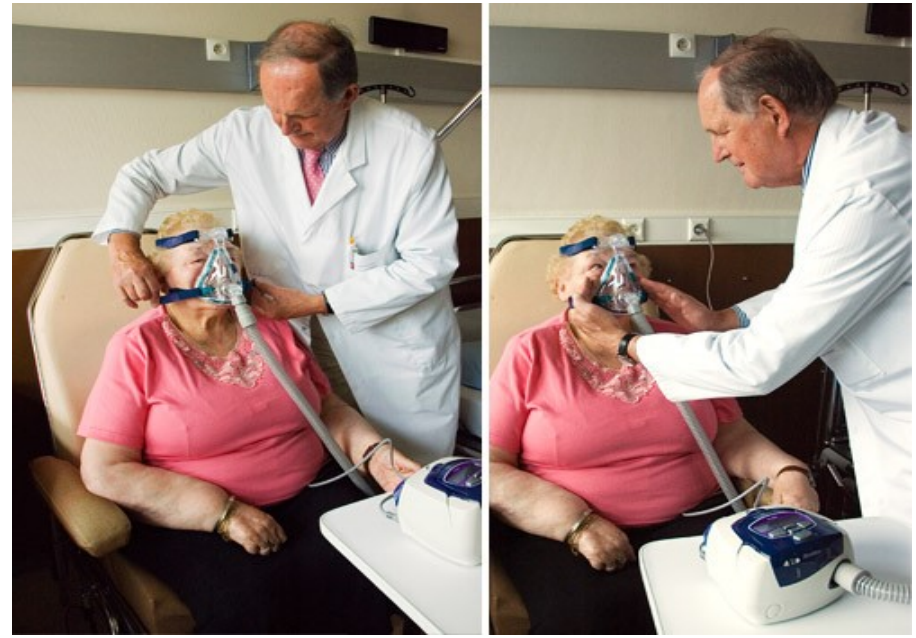
# Mechanical Ventilation



## INDICATIONS FOR NIMV

- ✓ Moderate to advanced dyspnea
- ✓ Tachypnea
- ✓ Accessory respiratory muscle use
- ✓ Gas exchange impairment:

$PaCO_2 > 45$ mmHg, Ph < 7.35



***!!! Hypercapnic encephalopathy is not a contraindication for NIMV !!!***

# CONTRAINDICATIONS FOR NIMV:

## ABSOLUTE:

- Respiratory arrest
- Difficulty fitting mask

## PARTIAL:

- Medically unstable conditions
- Hypotensive shock
- Uncontrolled
- Cardiac ischemia
- Arrhythmia
- Upper GI bleeding
- Agitation, inability to communicate
- Inability to protect airway
- Swallowing disorder
- Hypersecretion
- Multiple organ failure
- Recent upper GI or GI surgery


97 HR bpm
117/79 BP mmHg
89 SpO2 %
26 RR BrPm
100%
Prog1
ST
Clinical Settings
1/3
Pathology *
Normal
Mode
ST
IPAP
10.0 cmH2O
EPAP
4.0 cmH2O
Backup Rate
10 bpm
Advanced Settings
Lk 0 | RR 26 | Ti 0.6 | Vt 239 | MV 6.3

Bedside | ABG


101 HR bpm
105/71 BP mmHg
94 SpO2 %
24 RR BrPm
100%
Prog1
ST
Monitoring
2/8
11.0
5.0
5.0 cm H20
Lk 0 L/min
Vt 297 mL
RR 24 bpm
MV 7.1 L
Ti 0.8 s
I:E 1:2.1
Lk 0 | RR 24 | Ti 0.8 | Vt 297 | MV 7.1

# Suggested appropriate initial ventilator settings for a COPD patient

Click on the settings button to see the reason why this setting is chosen

| Setting | Appropriate value in COPD | Why |
|---|---|---|
| Mode | S/T mode | |
| IPAP | 12-14 cm | |
| EPAP or PEEP | 4-6 cm | |
| Back up rate | 12 bpm | |
| Ti Min<br>Ti Max | 0.3 sec.<br>1.0 sec | |
| Trigger Cycle | Medium<br>High | Setting cycle sensitivity to HIGH results in shorter inspiratory time and longer expiratory time useful to ensure complete lung emptying and avoid hyperinflation.<br>MEDIUM trigger sensitivity is sufficient in obstructive lung disease. |
| Rise Time<br>Fall Time | 150 ms<br>200 ms | |

# Initial settings in acute neuromuscular disease

The Amyotrophic Lateral Sclerosis is a restrictive lung disease.
The suggested initial settings are as shown:

| | |
|---|---|
| Mode | S/T |
| IPAP | 11 cm $H_2O$ |
| EPAP | 5 cm $H_2O$ |
| Backup rate | 12 bpm |
| Ti Min | 0.5 sec |
| Ti Max | 1.5 sec |
| Trigger | Medium |
| Cycle | Low |
| Rise time | 200-300 msec |
| Fall time | 200 msec |
| Oxygen | 0 - 4 LPM |

# AVAPS

## Average Volume Assured Pressure Support
## Volume Guaranteed Pressure Support

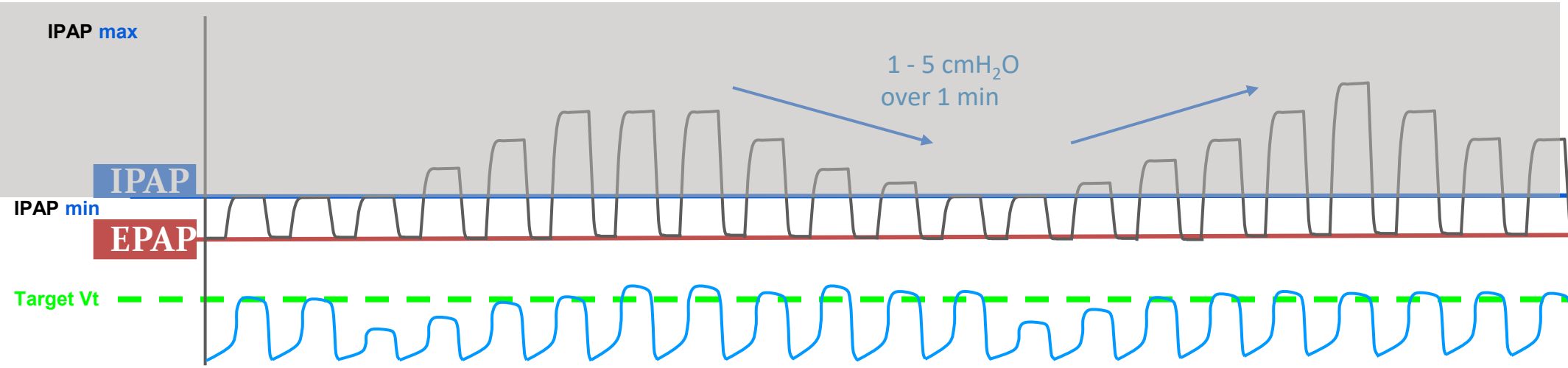
1. Measuring Vte in each breath
2. Comparing the average Vte with the target Vte in each breath
3. Calculating the pressure required to reach the target Vte
4. To do this, progressively increasing the IPAP value in each breath if necessary

   (< 1cmH2O/min)

It is a system that automatically adjusts the pressure to ensure that the patient has an average good ventilation.


Nfs Verme
Hız
25
VT
687
V̂E
17.2
TSB
20
Top.Sızın.
36
Hs. Tetikl.
100
TI/TTOT
36
Mesajlar
Maske:Diğer, Exh Port:PEV
Test için Menüyü kullan
Etkin Mod: AVAPS
VT
500
Hız
15
S-Süresi
1.35
Artış
3
EPAP
5
Min P
20
Maks P
25
O2
35
AVAPS Ayarları
Alarm Ayarları
Modlar
Menü
Bekleme

# AVAPS


IPAP max
1 - 5 cmH2O
over 1 min
IPAP
IPAP min
EPAP
Target Vt

# IVAPS

## Intelligent Volume Assured Pressure Support

Target alveolar ventilation

Va : f x (VT- Vd) : 12 x (500-150) ml : 4,2 lt/dk

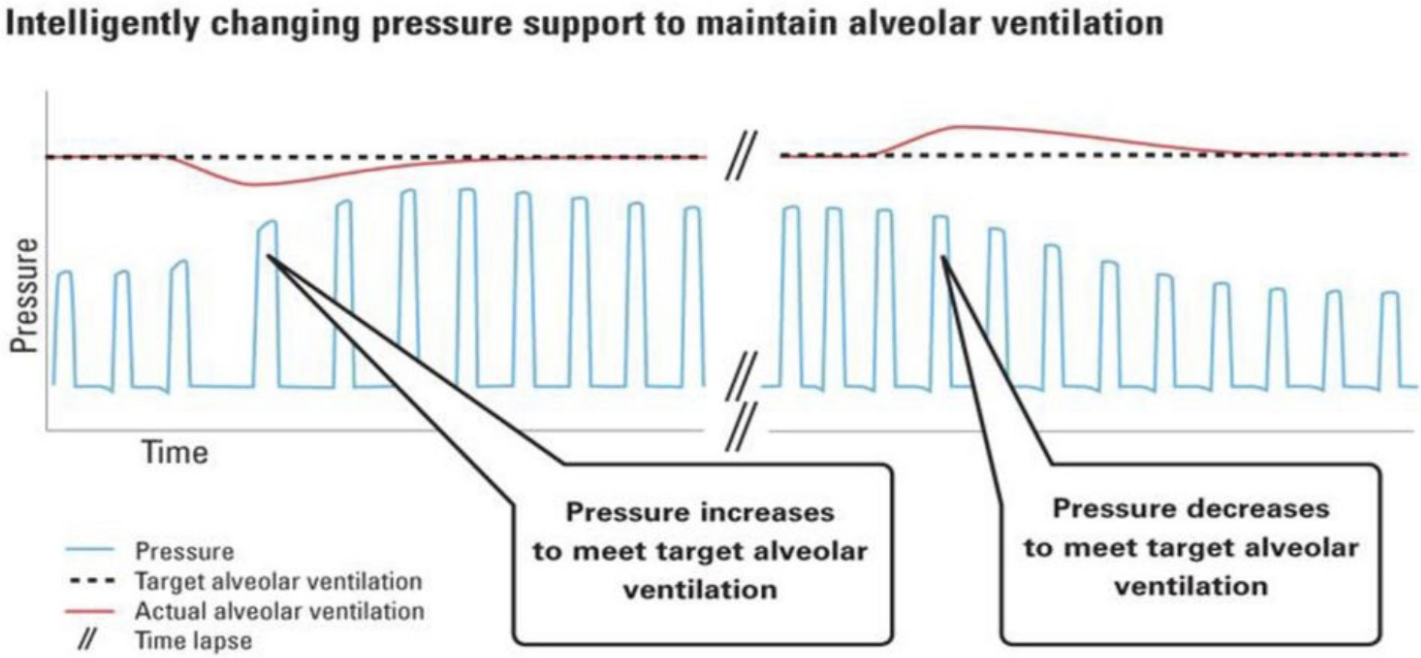
Target Va, EPAP, Height, f, Min PS, Max PS

# IVAPS

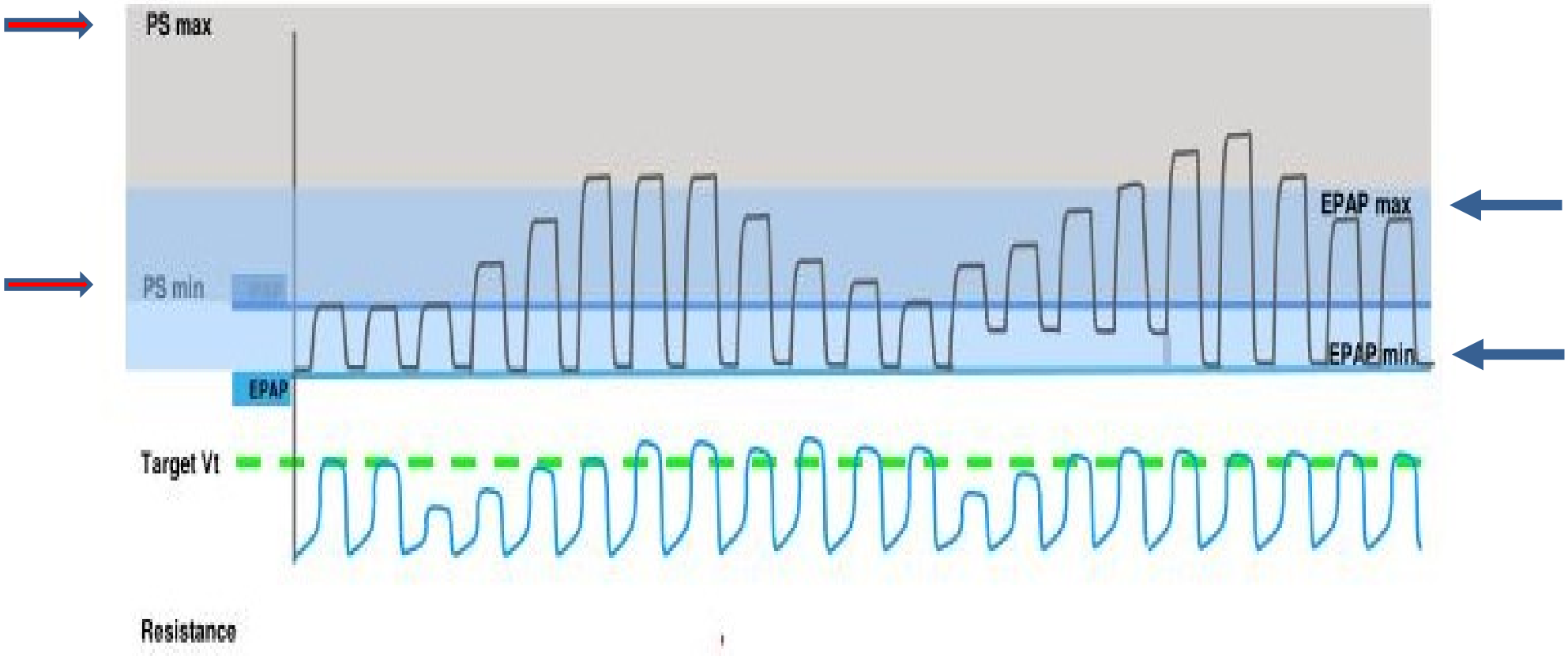
## Intelligent Volume Assured Pressure Support

**Fixed alveolar ventilation**

**Automatically adjusts pressure support and respiratory rate to provide optimal ventilatory support**

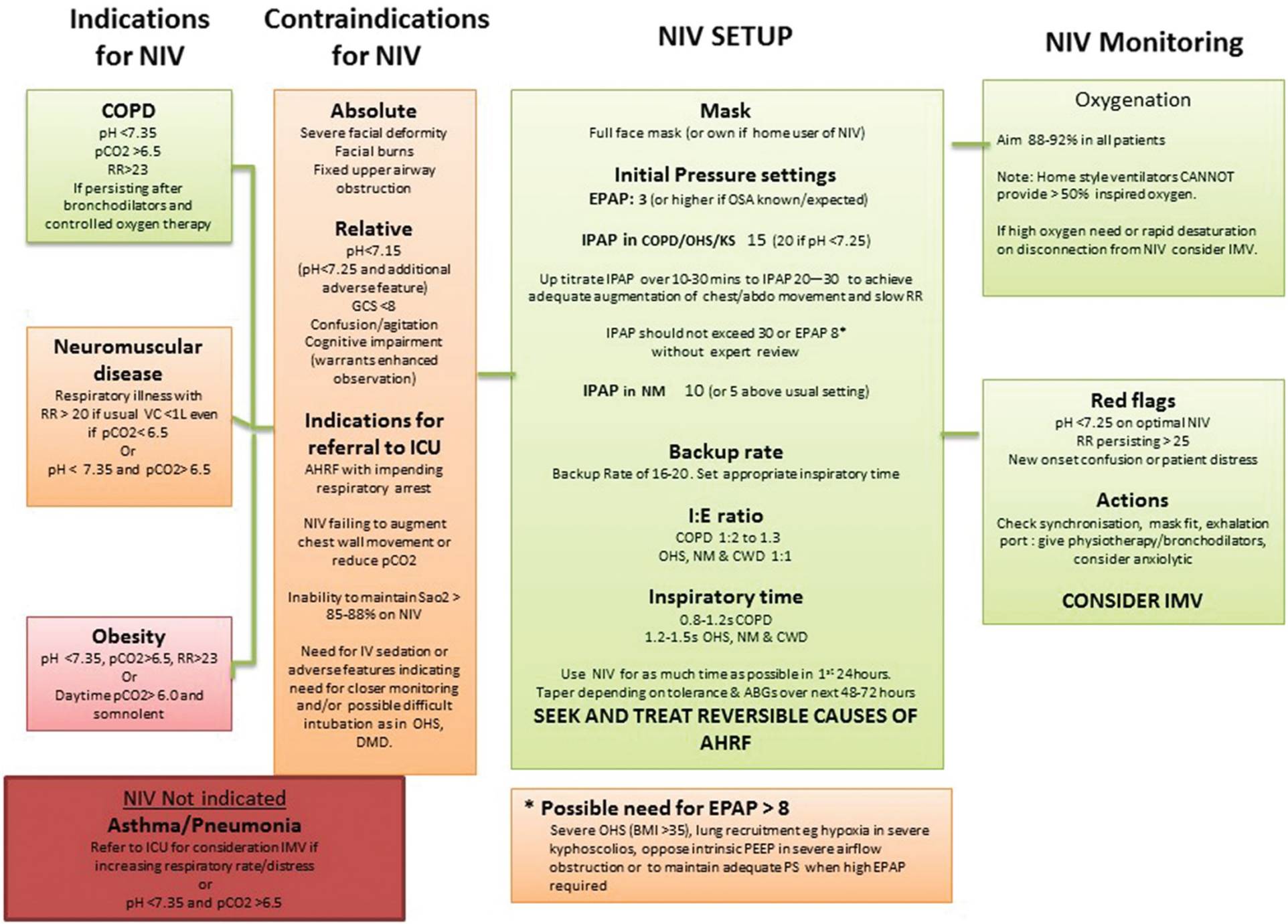


# AVAPS-AE
# Noninvasive auto-titrating ventilation



# AVAPS-AE
# For Whom?

- ✓Neuromuscular diseases
- ✓Restrictive thoracic wall pathologies
- ✓COPD patients with chronic respiratory failure
- ✓Chronic hypercapnic obesity hypoventilation patients


Indications for NIV
COPD
pH <7.35
pCO2 >6.5
RR>23
If persisting after bronchodilators and controlled oxygen therapy
Neuromuscular disease
Respiratory illness with RR > 20 if usual VC <1L even if pCO2< 6.5
Or
pH < 7.35 and pCO2> 6.5
Obesity
pH <7.35, pCO2>6.5, RR>23
Or
Daytime pCO2> 6.0 and somnolent
Contraindications for NIV
Absolute
Severe facial deformity
Facial burns
Fixed upper airway obstruction
Relative
pH<7.15
(pH<7.25 and additional adverse feature)
GCS <8
Confusion/agitation
Cognitive impairment (warrants enhanced observation)
Indications for referral to ICU
AHRF with impending respiratory arrest
NIV failing to augment chest wall movement or reduce pCO2
Inability to maintain Sao2 > 85-88% on NIV
Need for IV sedation or adverse features indicating need for closer monitoring and/or possible difficult intubation as in OHS, DMD.
NIV Not indicated
Asthma/Pneumonia
Refer to ICU for consideration IMV if increasing respiratory rate/distress
or
pH <7.35 and pCO2 >6.5
NIV SETUP
Mask
Full face mask (or own if home user of NIV)
Initial Pressure settings
EPAP: 3 (or higher if OSA known/expected)
IPAP in COPD/OHS/KS 15 (20 if pH <7.25)
Up titrate IPAP over 10-30 mins to IPAP 20—30 to achieve adequate augmentation of chest/abdo movement and slow RR
IPAP should not exceed 30 or EPAP 8* without expert review
IPAP in NM 10 (or 5 above usual setting)
Backup rate
Backup Rate of 16-20. Set appropriate inspiratory time
I:E ratio
COPD 1:2 to 1.3
OHS, NM & CWD 1:1
Inspiratory time
0.8-1.2s COPD
1.2-1.5s OHS, NM & CWD
Use NIV for as much time as possible in 1st 24hours.
Taper depending on tolerance & ABGs over next 48-72 hours
SEEK AND TREAT REVERSIBLE CAUSES OF AHRF
* Possible need for EPAP > 8
Severe OHS (BMI >35), lung recruitment eg hypoxia in severe kyphoscolios, oppose intrinsic PEEP in severe airflow obstruction or to maintain adequate PS when high EPAP required
NIV Monitoring
Oxygenation
Aim 88-92% in all patients
Note: Home style ventilators CANNOT provide > 50% inspired oxygen.
If high oxygen need or rapid desaturation on disconnection from NIV consider IMV.
Red flags
pH <7.25 on optimal NIV
RR persisting > 25
New onset confusion or patient distress
Actions
Check synchronisation, mask fit, exhalation port : give physiotherapy/bronchodilators, consider anxiolytic
CONSIDER IMV

# Ventilator Settings

- Beginning:
  - EPAP: 3-5 $cmH_2O$
  - IPAP: 8-12 $cmH_2O$
  - PS: 7-16 $cmH_2O$
- Change:
  - EPAP + 1 (according to $SpO_2$)
  - IPAP + 2 (according to TV and $PaCO_2$)
- Patient comfort:
  - Rise time: 0.1 sn
  - İnspiryum time: <1.0 sn.
- Oxigenation: Target $SpO_2$<90-92

# Patient 1

**56 year old female, Height: 160, Weight: 85**

**Symptoms: Respiratory distress, cough increasing in the last 5 days**

**Has Severe COPD**

**Has not used nebulized bronchodilators in the last 3 days**

**Chest X-ray: Increased ventilation, infiltrations compatible with pneumonia**

**Blood gases analyses: pH: 7.26, pCO2: 82, pO2: 75, HCO3: 20, SO2: 90**

**CRP: 20 mg/L BK: 17,000 Creatine: 1.8 mg/dl BUN: 55**

**Physical examination:**

**Uses accessory respiratory muscles**

**Respiratory rate: 27/min**

**Auscultation:**

**Quiet lung**

**Vital findings:**

**Temperature: 38.5**

**Pulse: 125/min**

**BP: 150/80**

**COPD Exacerbation with respiratory failure**

**NON-INVASIVE MECHANICAL VENTILATION**

When should we perform the first blood gas check?
Should we transfer the patient to intensive care?

- ✓ **The patient should be closely monitored for the first eight hours**
- ✓ **It is expected that pH and PaCO2 will improve within 30 minutes-2 hours**
- ✓ **NIV can also be applied in a short-term ward environment**

# Patient 1

**Admission ABG: pH: 7.26, $pCO_2$: 82, $pO_2$:** 75, HCO3: 20, **$SO_2$ : 90**

**IPAP: 12, EPAP:6 , fiO2:4 lt/dk, rise time:0.3 sn, exp trigger:%45**

**After 1 hour: pH: 7.28, $pCO_2$: 78, $pO_2$:** 80, **$HCO_3$:** 21, **$SO_2$:** 93

**IPAP: 16, EPAP:7 , fiO2:4 lt/dk, rise time:0.1 sn, exp trigger:%75**

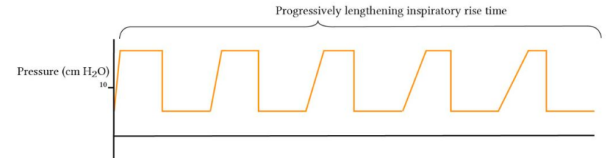
NIV is continued

# How to set the NIV?

**IPAP= (PS+PEEP) or (PS+EPAP)**

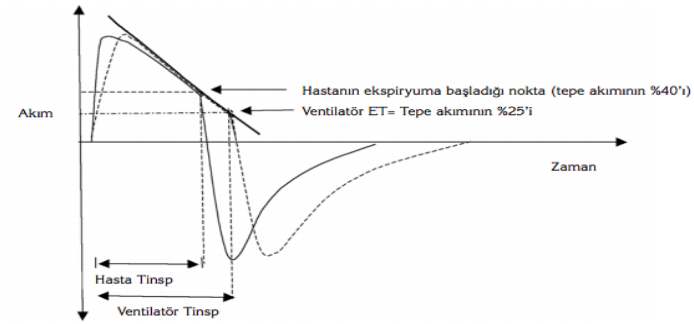
- ✓ **IPAP** → 6-8 mL/kg TV
- ✓ **EPAP (CPAP/PEEP)** → Preventing CO2 rebreathing, minimum 4-5 cmH2O

- ✓ **Rise time** → Short 0.1 sec




- ✓ **Time for inspiration** → 0.8-1.0 sec
- ✓ **Trigger** → According to patient effort and comfort
- ✓ **Expiratory trigger** → For the COPD patients %50-75
- ✓ **Respiratory rate for S/T mode** → 12-16/min

- ✓ **AVAPS – TV, Min IPAP, Max IPAP**
- ✓ **Alarm settings!!**



# GENERALLY NIMV START-UP SETTINGS

The purpose of PEEP during NIMV is to overcome intrinsic PEEP in obstructive diseases

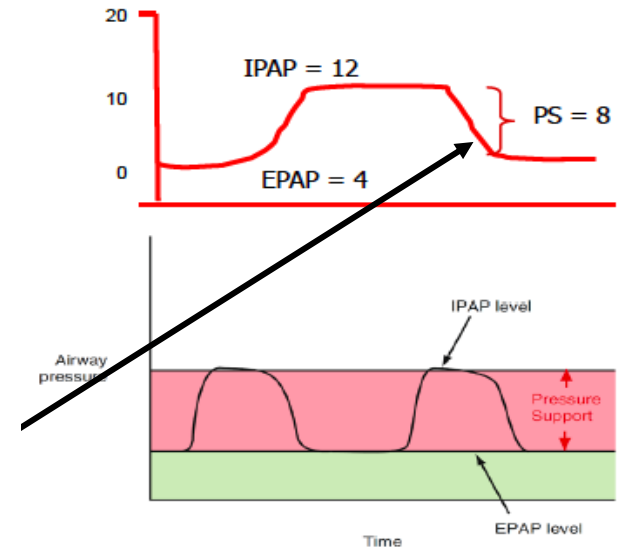
Since PEEP cannot be measured during NIMV,
low PEEP (≤ 5 cmH2O) is recommended

## Ventilatör Basınç Ayarları

IPAP:
8-10 cm H2O
Minute ventilation

EPAP:
4-5 cm H2O
Oxigenation

Difference between PS
7-16 cm H2O



# Patient 1

**After 2 hour of NIMV: pH: 7.27, pCO2: 84, pO2:** 70, HCO3: 19, **SO2: 85**

**IPAP: 22, EPAP:8 , fiO2:6 lt/dk**

After 30 min : The patient uses accessory respiratory muscles, SS: 30, agitated, sweating, confused consciousness

**Intubation and Invasive mechanical ventilation**

# UNTIL WHEN SHOULD WE APPLY NIMV?

BTS/ICS guideline for the ventilatory management of acute hypercapnic respiratory failure in adults

- ✓ Until the patient's general condition improves and pH and $pCO_2$ return to normal
- ✓ NIV duration should be maximized in the first 24 hours as tolerated by the patient
- ✓ Depending on the patient's own respiratory effort and $pCO_2$ level, its frequency is reduced within 2-3 days before stopping at night

# Patient 1

Patient is being monitored with IMV for 4 days under maximum medical treatment

4th day blood gas: pH: 7.38, $pCO_2$: 55, $pO_2$: 90, $HCO_3$: 29, $SO_2$: 96

SBT failed, but patient is cooperative, Chest X-ray regressed

Should we extubate? Should we change MV settings?

# Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure

*Recommendations*

We suggest NIV be used to facilitate weaning from mechanical ventilation in patients with hypercapnic respiratory failure. (Conditional recommendation, moderate certainty of evidence.)

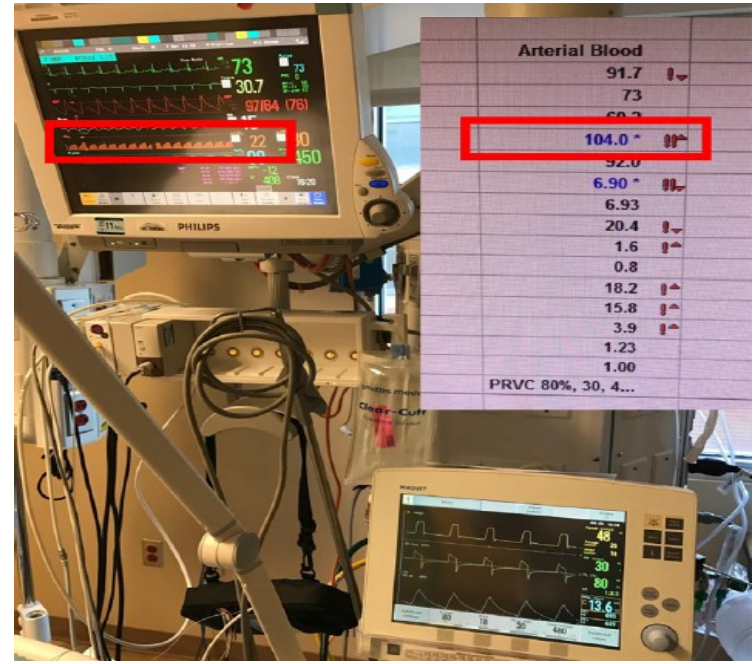
We do not make any recommendation for hypoxaemic patients.

- **NIV after extubation in patients with acute exacerbations of COPD who fail SBT****
- **The use of NIV for weaning is complex and requires more experience**
- **Therefore, the committee offers a conditional recommendation rather than a strong recommendation**

# Patient 1

- The patient was extubated on the 4th day of his ICU stay and after continuing his treatment with NIV for a while, she was discharged in stable condition.

# HOW SHOULD MV SETTINGS BE?




- For NIV
  - Increase the gradient between IPAP and EPAP

- For IMV
  - Initially 100% FiO2
  - PEEP 5, TV 6 to 8 mL / kg PBW
  - If there is spontaneous breathing, expirium trigger should be adjusted
  - Respiratory rate 14-16/min
  - Auto-PEEP monitoring should be done, measured with expirium hold
  - If auto PEEP is not available, respiratory rate is gradually increased

# Patient 2

- HD, Age: 60, gardener,
- Brought to the emergency room due to difficulty breathing, weakness, and confusion.
- Has been feeling weak for a year, complaints have increased in the last 3 weeks, cannot cough strongly
- Uses bronchodilators due to COPD
- Diagnosed with Diabetes
- Physical examination does not have much obstruction, but sounds are very reduced. Heart rhythmic, no edema, no cyanosis.

# Patient 2

## Admission to ER

$PaO_2$ :58

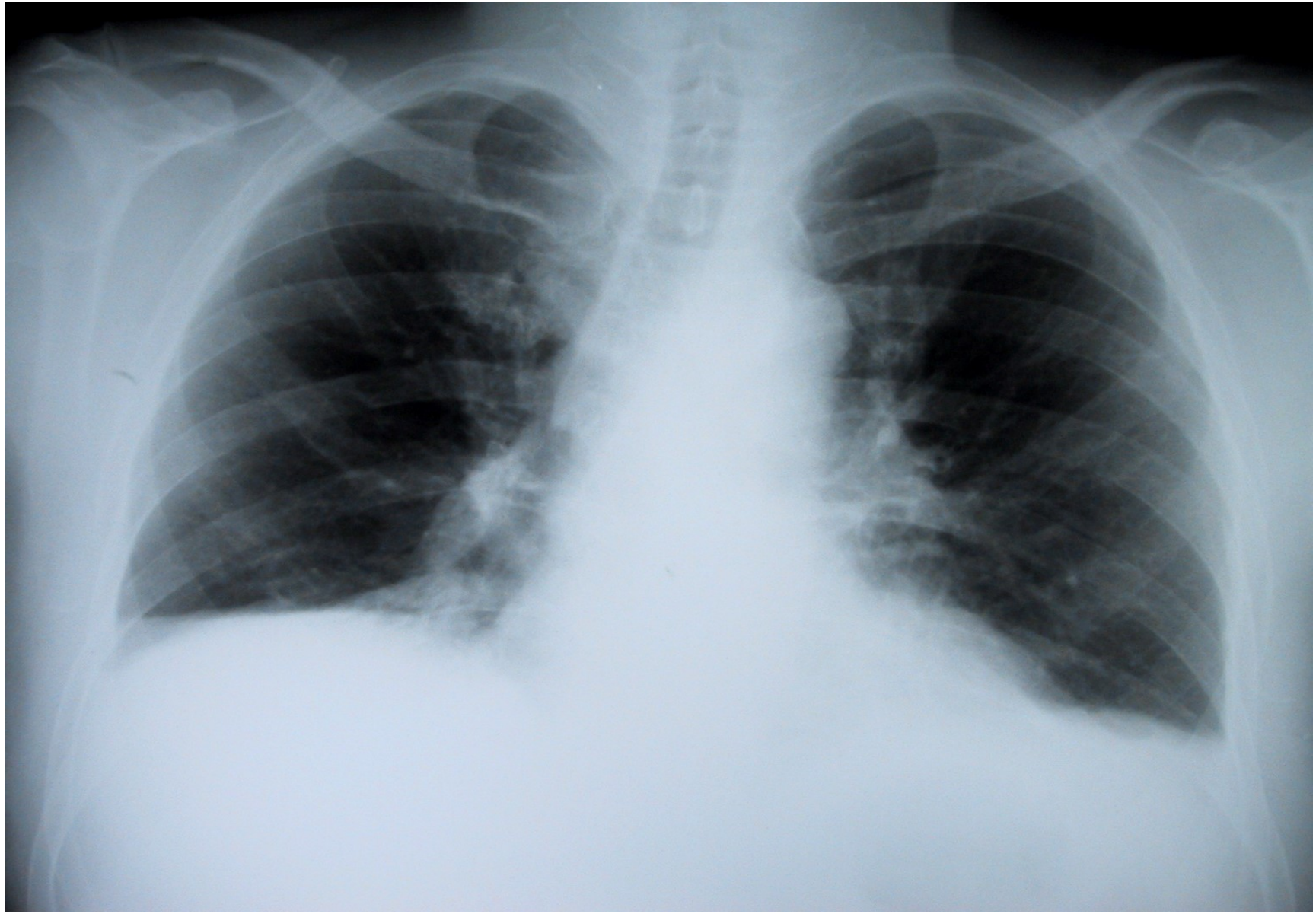
$PaCO_2$: 68

pH : 7.28

$O_2$ Sat : 87

$HCO_3$ : 26

BE: 3



# Patient 2

- D(A-a)O2= 8 mmHg
- Questioned for intoxication.
- Thyroid function tests are normal
- Nutrition is good
- No electrolyte imbalance
- Left ventricular functions are normal
- OSA is not considered

# Patient 2

| | Admission | Bronchodilator+ Oxygen | NIV 1h | NIV 2h |
|---|---|---|---|---|
| $PaO_2$ | : 58 | : 61 | : 82 | : 79 |
| PaCO2 | : 68 | : 71 | : 59 | : 50 |
| pH | : 7.28 | : 7.31 | : 7.38 | : 7.41 |
| $O_2$ Sat | : 87 | : 89 | : 96 | : 96 |
| $HCO_3$ | : 26 | : 32 | : 35 | : 32 |
| BE | : 3 | : 11 | : 9 | : 8 |

# Patient 2

- Neurology consultation
- Cerebral MRI:
  - lacunar infarct
- Tensilon and Pridostigmine tests are normal
- EMG:
  - Compatible with Motor Neuron Disease

# Patient 2

- Spirometry:
  - FVC: 1.98 lt (%67)
  - $FEV_1$: 1.59 lt (%67)
  - $FEV_1$/FVC: 80

- BiPAP
- EPAP 5, IPAP 12

# Patient 2

- Motor neuron disease
- Spinal cord anterior horn disease
- ALS: Amyotrophic Lateral Sclerosis
- Starts from the distal ends of the upper extremities
- Weakness, atrophy, fasciculations, inability to perform fine movements, dysphagia, dysarthria, Babinski positivity,
- The most important feature is the absence of sensory deficit.
- Respiratory muscle involvement
- Inability to cough, difficulty swallowing, basal atelectasis, restrictive loss

[ Critical Care Guidelines and Consensus Statements ]

CHEST

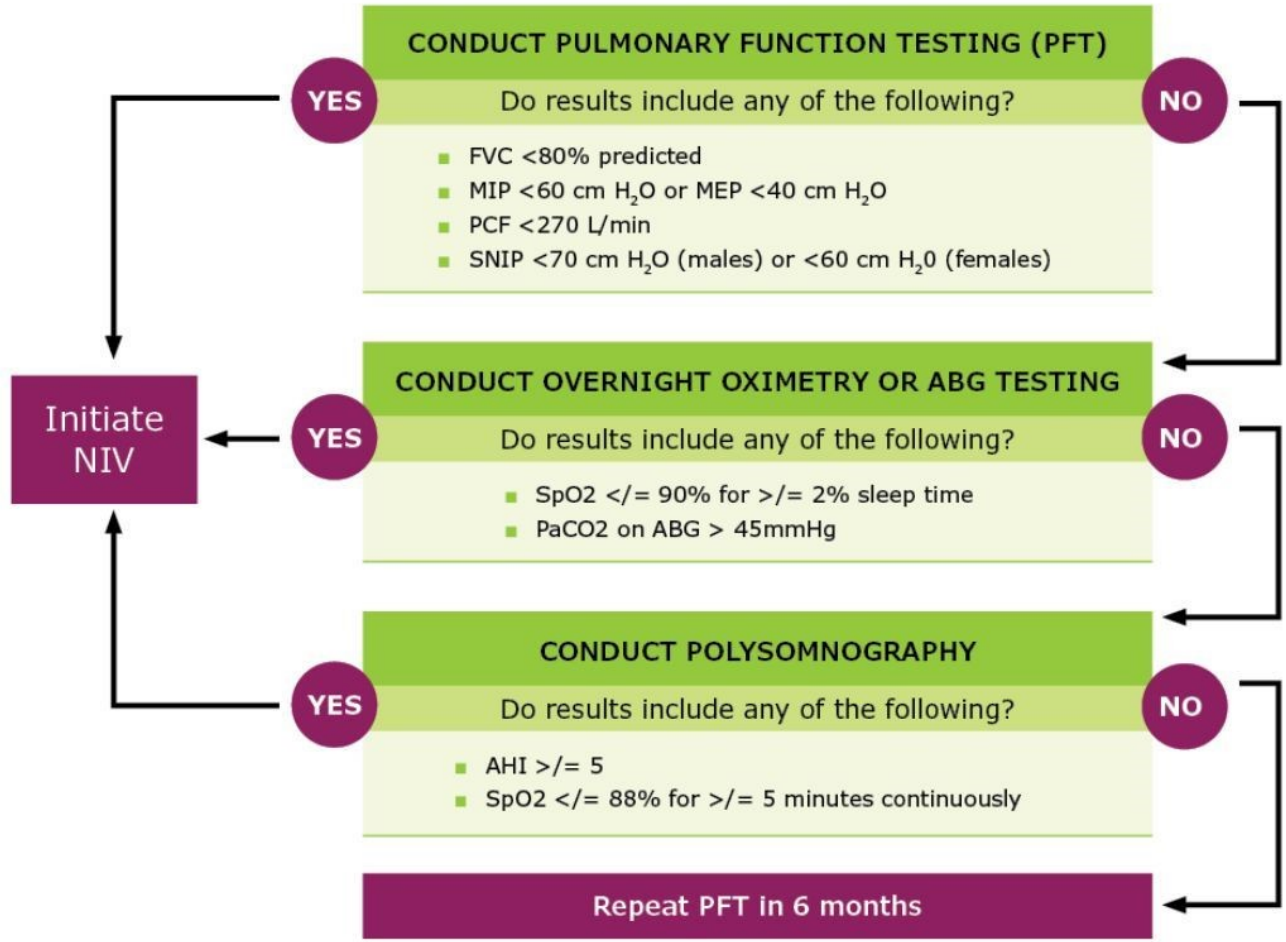
# Respiratory Management of Patients With Neuromuscular Weakness



## An American College of Chest Physicians Clinical Practice Guideline and Expert Panel Report

# Algorithm for Initiation of Noninvasive Ventilation

Based on a CHEST clinical practice guideline and expert panel report, this flowchart outlines an algorithm for initiation of noninvasive ventilation (NIV) for adult patients with neuromuscular disease experiencing fatigue, headache, concentration/memory difficulty, and/or respiratory symptoms.




Last updated July 27, 2023


CHEST

# Conclusion

- Hypercapnic respiratory failure treatment is arranged according to the underlying cause
- NIV is the most successful treatment method
- Early weaning should be tried to avoid IMV complications
- Long-term home treatments should be arranged for patients with chronic hypercapnia and symptoms