

SEVERE ASTHMA AND COPD: ICU MANAGEMENT GUIDELINES AND CONTROVERSIES

By

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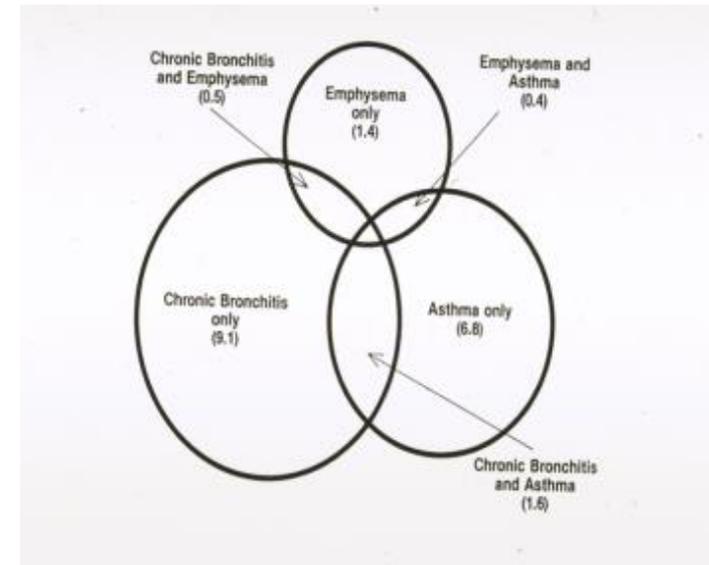
Ain Shams University

Summary: ICU Management of COPD & Asthma

- ICU Trends for Asthma and COPD
- ICU Management: Similarities and Differences
- Goals of Non-Invasive and Invasive Ventilation
- Intubation and Sedation
- Critical Problems in Ventilator Management
- From ICU to Discharge

Critical problems common to COPD and Asthma

- Blunted ventilatory drive with impaired perception of dyspnea
- Severe airway narrowing from inflammation, mucus plugging and bronchoconstriction
- Impaired muscle strength from chronic corticosteroid use
- Ventilatory muscles
 - Diaphragm flattened
 - Accessory muscle recruitment
- Incomplete alveolar emptying at the end of expiration
 - Dynamic hyperinflation
 - Detectable end-expiratory flow Differences



Differences between the asthmatic and COPD patient with respiratory failure

- * Extent of airway reactivity
- * Amount of mucous plugging
- * Degree of emphysema
- * Loss of elastic recoil
- * Large airway collapse
- * Airway microbiome/colonization
- * Precipitant of acute exacerbation
- * Age
- * Co-morbidities

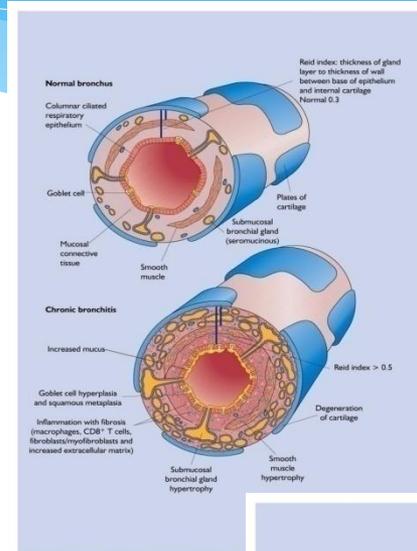
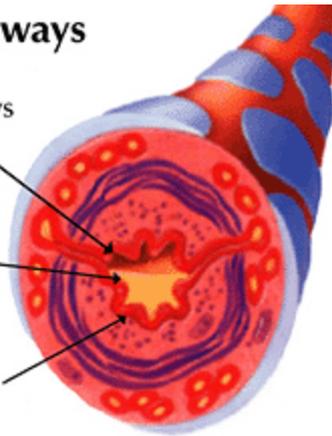
Asthma

Asthma Airways

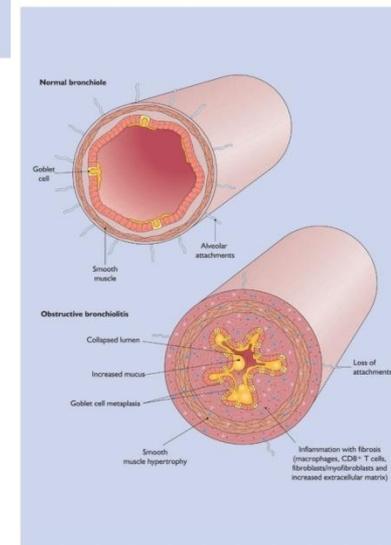
Inflamed Airways

Mucus fills airway

Muscle layer tightens around airway

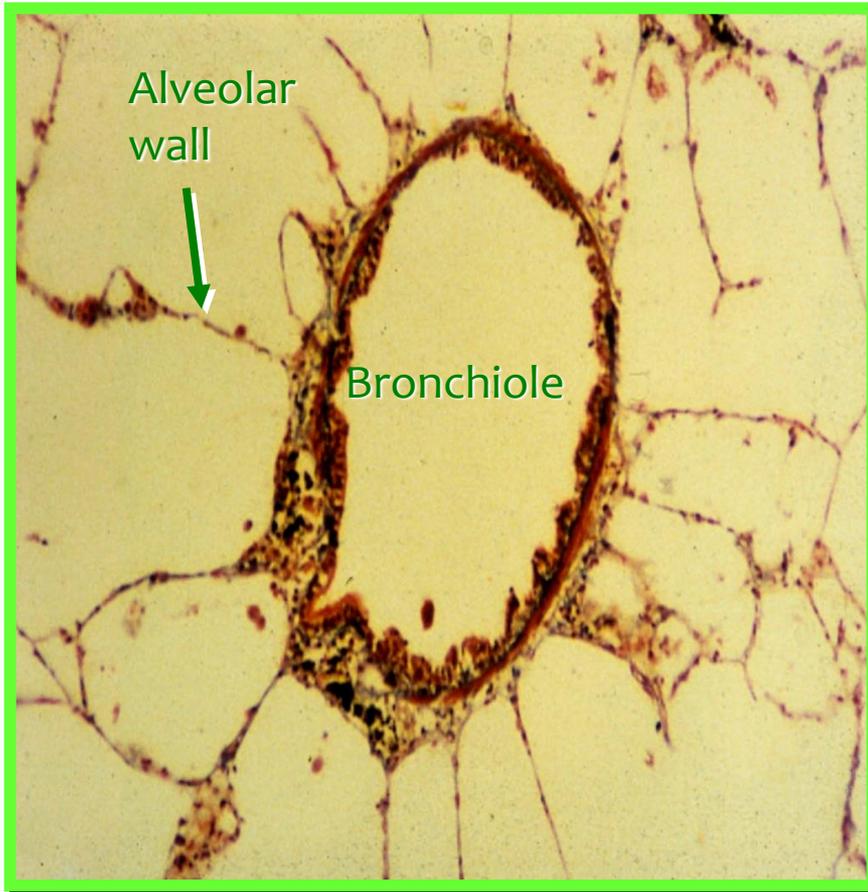


COPD

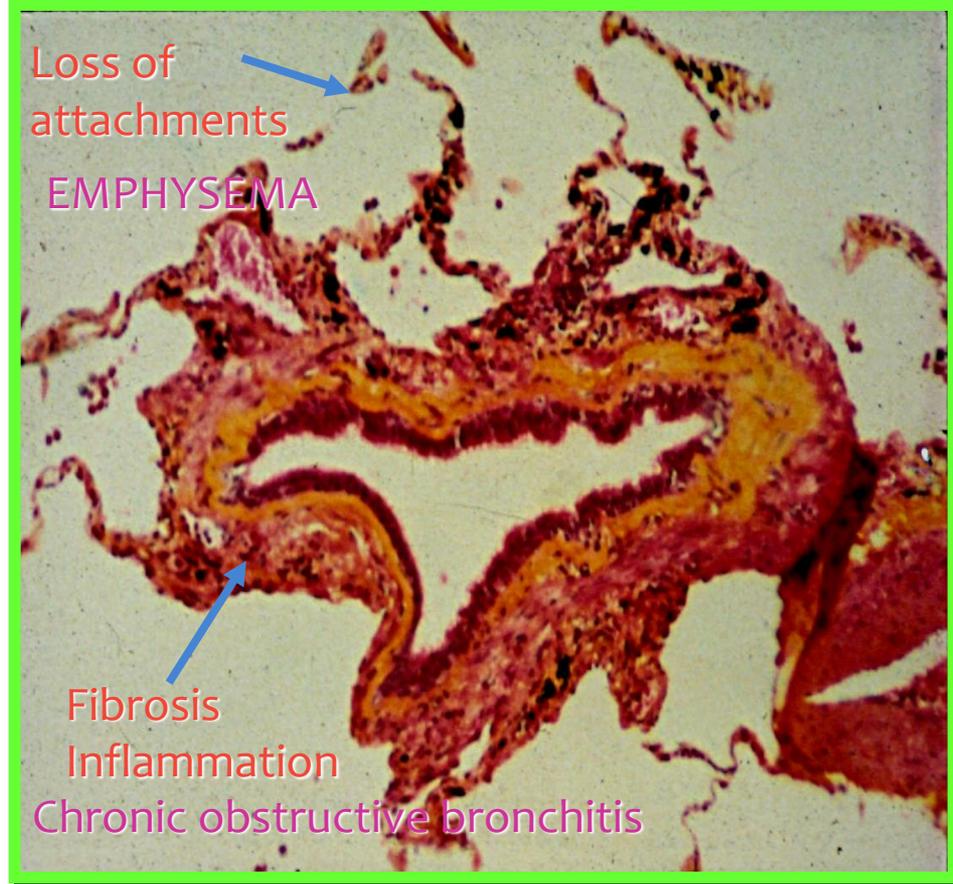


PATHOLOGY OF COPD

Peripheral lung

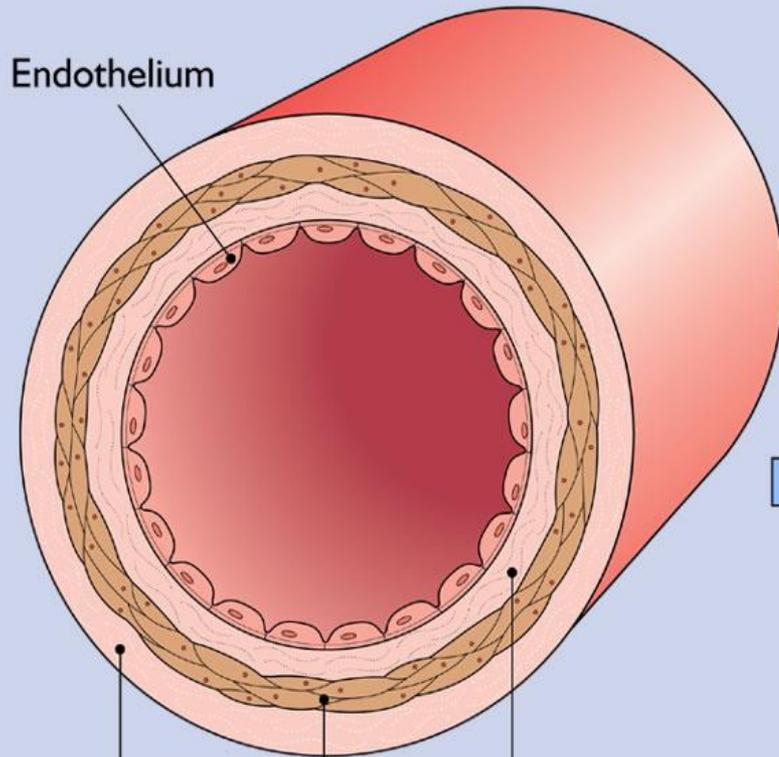


Normal



COPD

Normal small arteriole



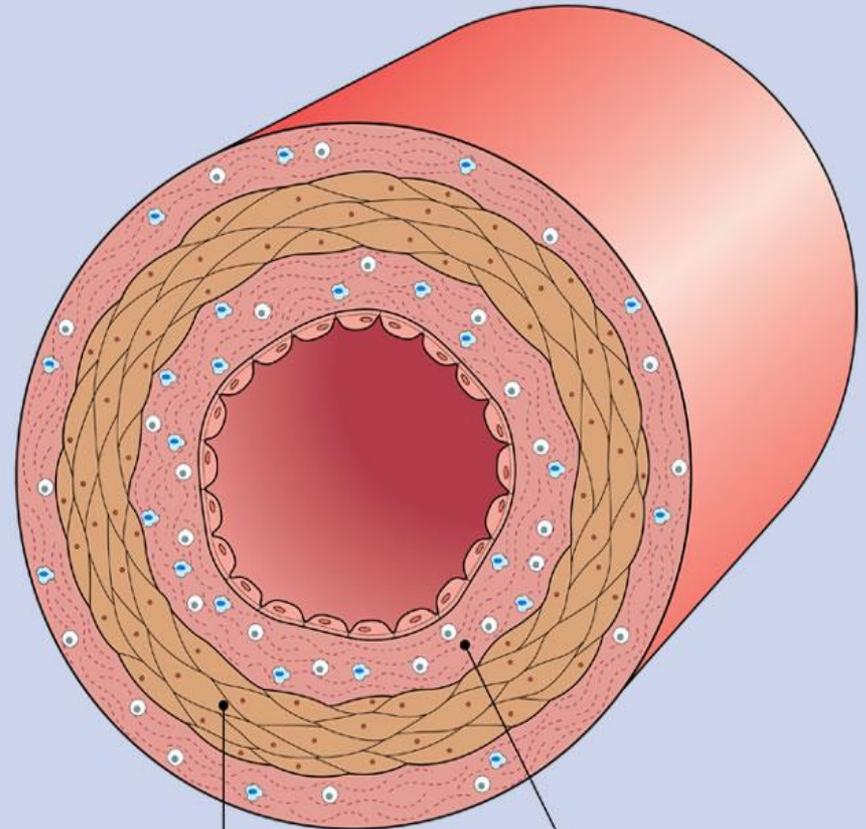
Endothelium

Adventitia

Media
(smooth
muscle)

Intima

Small arteriole with vascular disease



Thickened media

Thickened intima
with fibrosis
and inflammatory cells



Respiratory Center:

- * Chronic CO₂ Rise , abolish hypercapnic drive which depends now on Hypoxia

Indications of admitting OLD patient in ICU

- * **Clinical criteria:**
 - * **Pulse: > 120 / m or marked arrhythmia.**
 - * **Pulsus Pradoxus > 12 mmHg.**
 - * **Central Cyanosis.**
 - * **Resp Rate > 40 / min.**
 - * **Paradoxical abdominal movment.**
 - * **Impaired level of consciousness.**
- * **Laboratory criteria:**
 - * **PaO₂ < 59 mmHg**
 - * **Respiratory acidosis.**

ED to ICU: Common Initial Management

- * Oxygen: maintain SAT >90% (Controlled O₂ therapy with chronic type II RF)
- * Anti-Inflammatory drugs
 - * IV corticosteroids within 1 hour
120 – 500 mg/d methylprednisolone Cochrane Review 2002; (4): AB002178
 - * Oral prednisone
- * Bronchodilator drugs
 - * Short-acting β_2 agonists + ipratropium Chest 1998; 114: 365 • Am J Med 1999; 107: 363 • Am J Respir Crit Care Med 2000; 161: 1862
 - * IV Theophylline
- * IV Fluid resuscitation

ED to ICU: Differences in Initial Pharmacotherapy Approaches

- * Antibiotics >75% of COPD exacerbation patients in ICU receive empiric antibiotics

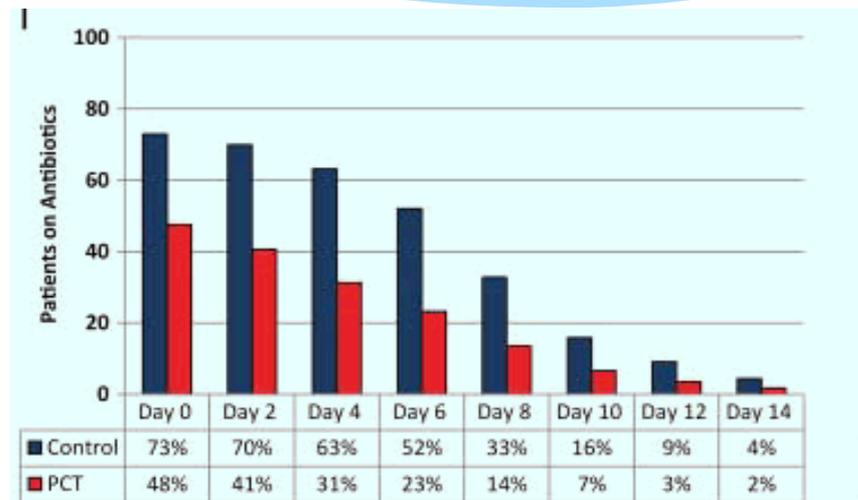
Cochrane Review 2012

- * IV montelukast

Thorax 2000; 55: 260 • Am J
Respir Crit Care Med 2003; 167:
528

- * Magnesium (2-4 g IV)

Cochrane Review 2004; (1): AB001490



Procalcitonin guided algorithms decrease antibiotic exposure in COPD patients with acute exacerbations.

Schuetz et al Clin Inf Disease 2012

Mechanical Ventilation in OLD

Non-invasive ventilation in COPD reduces need for intubation, mortality, and resources

Meta-analysis of 4 ICU studies: NIV vs Supplemental O₂ (Mean pH 7.28)

- * 66% reduction in intubation rate (21 ± 7.7 vs $63 \pm 9.4\%$)
- * 64% reduction in mortality (9 ± 5.6 vs $25 \pm 8.4\%$)
- * NNT to prevent 1 death with NIV is 6.3

Brochard, NEJM 1995; Celikel, Chest 1998; Kramer, AJRCCM 1995;
Martin, AJRCCM 2000; Plant, Thorax 2003



Absolute Contraindications to NIV

American Association Respiratory Care 2004

- * Uncooperative patient
- * Risk of pulmonary aspiration
- * Insufficient respiratory drive
- * Alterations in mental status
- * Inability to tolerate face mask
- * When intubation and mechanical ventilation are indicated

Respir Care 2004; 49: 810

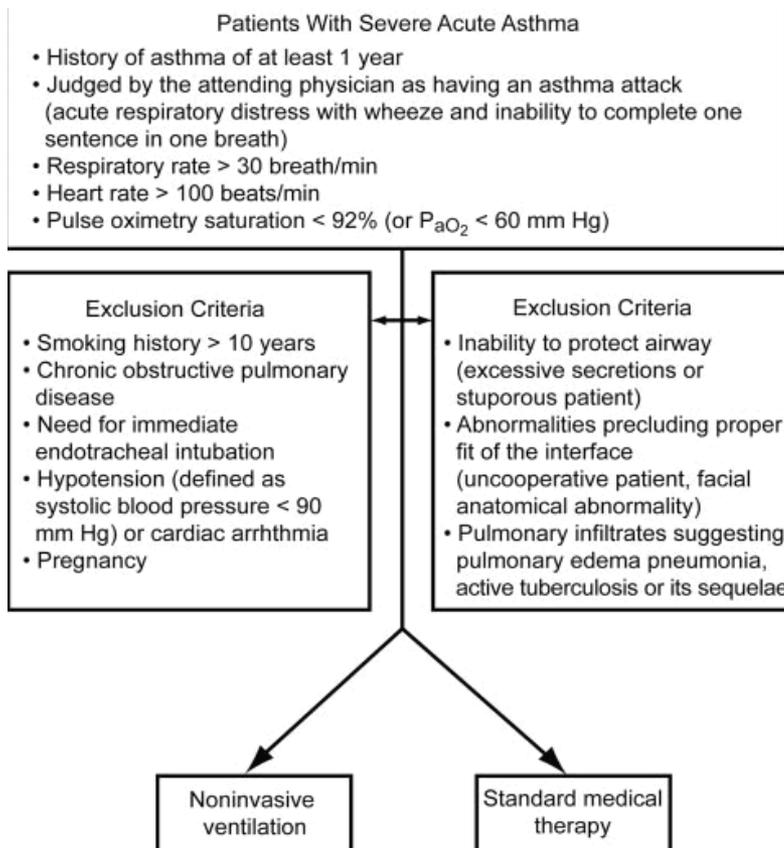
European Respiratory Society 2008

- * Severe hypoxemia
- * Severe acidemia
- * Multi organ failure
- * Upper airway obstruction
- * GI bleeding
- * Copious secretions
- * Encephalopathy with uncooperative patient
- * Inability to fit mask

Ambrosino et al. *ERJ* 2008

NIV use in Near-fatal asthma

Gupta et al., Respir Care 2010



Single center RCT

- * Consecutive asthma subjects over 18 mos.
- * Treated with IV HCT, Mg++, bronchodilators
- * Primary outcome was
 - * improvement in FEV₁ by 50%,
 - * ICU LOS, hospital stay

NIV use in Near-fatal asthma

Gupta et al., Respir Care 2010

Table 3. Outcomes

	Standard Medical Therapy (<i>n</i> = 25)	NIV (<i>n</i> = 28)	<i>P</i>
Primary Outcomes			
≥ 50% improvement in FEV ₁ over baseline (<i>n</i> , %)			
At 1 h	11 (44)	10 (36)	.62
At 2 h	12 (48)	15 (54)	.70
At 4 h	16 (64)	24 (86)	.08
ICU stay (median and IQR h)	24 (18–36)	10 (8–20)	.01
Hospital stay (median and IQR h)	54 (48–72)	38 (24–48)	.01
Secondary Outcomes			
Time to disappearance of accessory muscle use (mean ± SD h)	3.2 ± 1.7	2.3 ± 1.4	.06
Dose of inhaled salbutamol (mean ± SD mg)	42.8 ± 10.4	31.2 ± 14.5	.008
Dose of inhaled ipratropium (mean ± SD mg)	7.6 ± 2.2	5.2 ± 2.8	.007
Failure of primary therapy (<i>n</i> , %)	4 (16)	2 (7)	.35

FEV₁ = forced expiratory volume in the first second

IQR = interquartile range

Recommendations for Intubation and Initiation of Mechanical Ventilation

Louie, Kenyon et al. Clin Rev All Immunol 2011

Absolute	Relative
Cardiorespiratory arrest or apnea	Hypercarbia, e.g. PaCO ₂ >50 mmHg or rising >5 mmHg per hour
Acute respiratory failure with PaO ₂ <60 mmHg or PaCO ₂ >50 mmHg	Worsening respiratory acidosis
Acute chronic respiratory failure	Inability to care for patient appropriately
Decreased level of consciousness	Clinical signs of fatigue, e.g. paradoxical breathing
Hypopneas	Failure to improve with therapy

2 million ED visits per year for asthma exacerbation in the U.S.

- 1) 25% hospitalized
- 2) 5% ICU care
- 3) 2% intubated

Complications:

- 1) 2% (5000 pts) developed barotrauma (Tobin NEJM 2001)
- 2) 20-40% develop myopathy

Recommendations for Intubation and Mechanical Ventilation

Maslow et al. Anesth 2000; Brenner et al. AJRCCM 2009

Orotracheal Intubation

- * Sedation
 - * Ketamine or
 - * Propofol
- * NMB (Succinylcholine)

Inhaled Albuterol recommended for pretreatment prior to intubation to prevent bronchospasm

(Category D)

Recommendations for Initiation of Mechanical Ventilation in Asthma

Louie, Kenyon et al. Clin Rev Allergy Immunol 2012

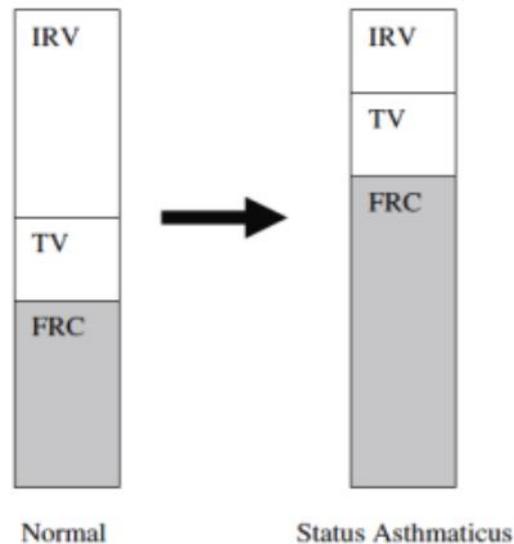


Fig. 2 Effect of dynamic hyperinflation on lung volumes—normal and status asthmaticus. *FRC* functional residual capacity, *TV* tidal volume, *IRV* inspiratory reserve volume

Initial Ventilator Settings

- * Volume control > PC
- * $FiO_2=1.0$
- * Long expiratory rate I:E >1:2
- * Low tidal volume 5-7 cc/kg
- * Low rate, 8-10 bpm
- * PEEP <5 cm H₂O

Hypercapnia is preferable to hyperinflation

Initial ventilator settings in acute respiratory failure of COPD

- * **Mode:** Pressure or volume control (or institutional bias)
- * **FiO₂:** 1.0 initially; drop ≤ 0.50 to keep SaO₂ $\geq 92\%$
- * Controlling dynamic hyperinflation
 - * **Rate:** 10 to 12 breaths/min
 - * **Tidal volume:** 8 to 10 ml/kg
 - * **Inspiratory time:** 0.6 to 1.2 sec
 - * **P_{plat}** < 30 cm H₂O to limit air-trapping & over-distention
 - * **Inspiratory flow** ≥ 60 L/min, e. g. 80-100 L/min
- * **PEEP:** ≥ 5 to 12 cm H₂O to counteract iPEEP.
- * **Flow waveform:** Descending ramp to improve distribution of ventilation

* **Goal of Mechanical Ventilation : “Do no harm”**

- Protect patient and lungs
- Provide adequate oxygenation
- Control dynamic hyperinflation = Minute volume (VE), E time, Raw

* **Recommendations for permissive hypercapnia**

1. Assure adequate sedation (? Paralysis)
2. Avoid in patients with elevated ICP, PA HTN
3. Allow PaCO₂ to rise gradually
4. Take steps to lower VCO₂ (ex Extracorporeal CO₂ removal strategies)
5. Don't use bicarbonate

Complications of mechanical ventilation in the obstructive lung disease

- Arrhythmias
- Laryngospasm
- Worsening bronchospasm
- Aspiration
- Seizures
- Hypotension (20-40%)
- Inadequate ventilation
- Mucous plugging of ETT
- Barotrauma
- Auto-PEEP
- Dysynchrony with ventilator and agitation

OLD in ICU: Common problems

Pneumomediastinum

Probability of barotrauma in all ventilated patients in 2.9% at 3.4 d
Anzueto ICM 2004



Risk factors:

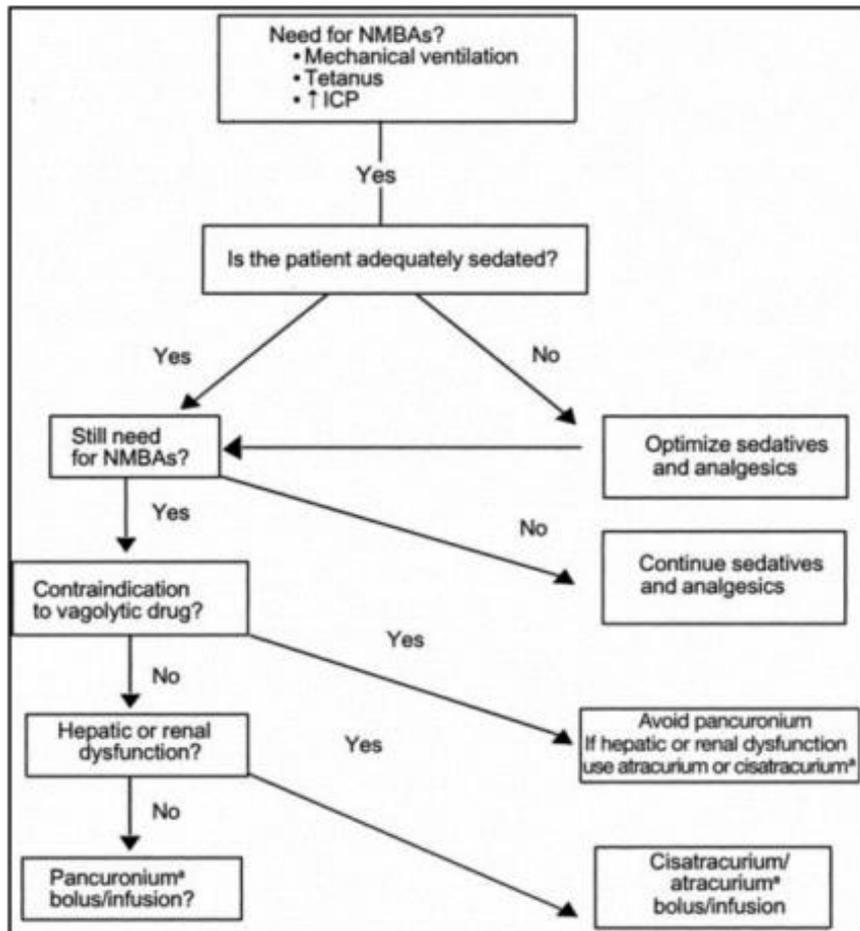
- P plat > 35 cm H₂O
- Lung compliance <30 ml/cmH₂O
- Lung necrosis
- Trauma
- Iatrogenic
- No paralytic agent used (11.4% vs. 4%; p=0.01)

**Bedside US superior to CXR 53% vs 16%;
p<0.001**

Brook et al J Ultrasound Med 2009

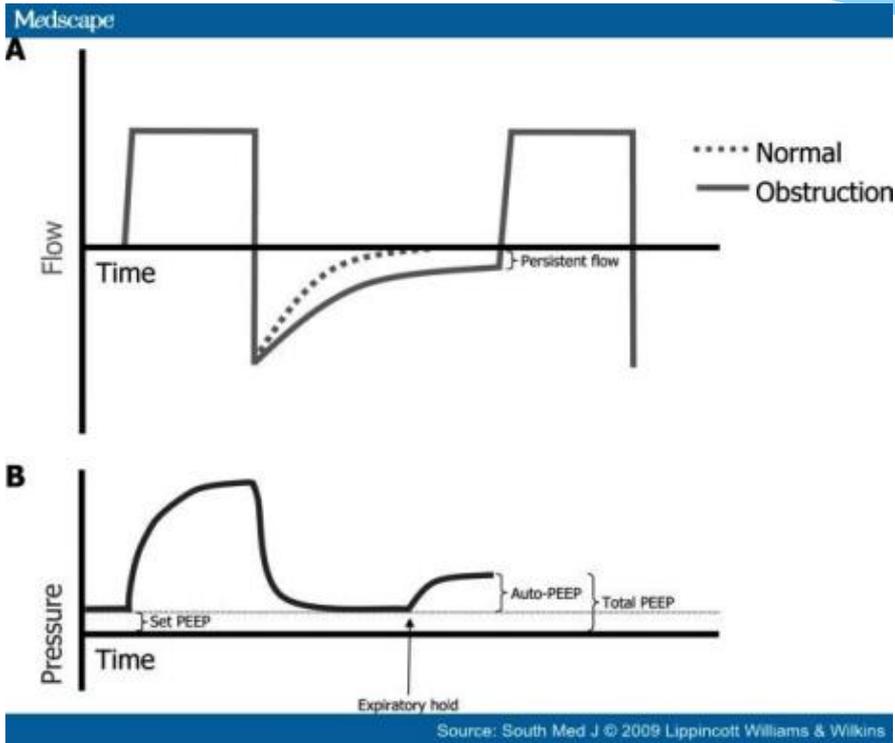
Should we be worrying about Neuromyopathy?

Price, Kenyon, Stollenwerk, Ann Int Care 2012 A fresh look at paralytics in the critically ill: real promise and real concern.



- * Critical illness polyneuromyopathy (CIPM) remains a major concern for critical care physicians.
- * Little evidence that use of NMBAs < 48 hrs causes CIPM.
- * Benzylisoquonium (e.g. cisatracurium) NMBAs appear safer than aminosteroid (e.g. pancuronium) NMBAs

Auto-PEEP



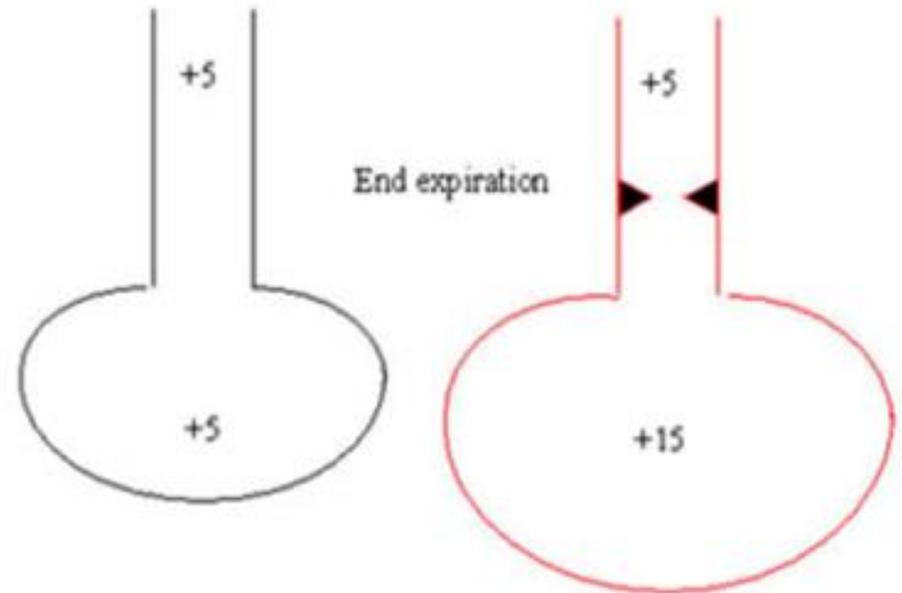
- * Lungs don't empty to FRC at end expiration
- * Work of breathing is affected
- * Difficult to trigger ventilator

Auto or intrinsic PEEP should be checked twice to three times/day

Auto PEEP : Strategies and Ideas

- * **Evaluation of distressed and ventilated patient:**
 - remove patient from ventilator
 - Aggressive Bronchodilators
 - Trial of heliox (70:30)
- * **Ventilator Adjustments:**
 - Reduce V_e (<10 l/min)-- RR
 - Shorten T_i
 - Raise PEEP

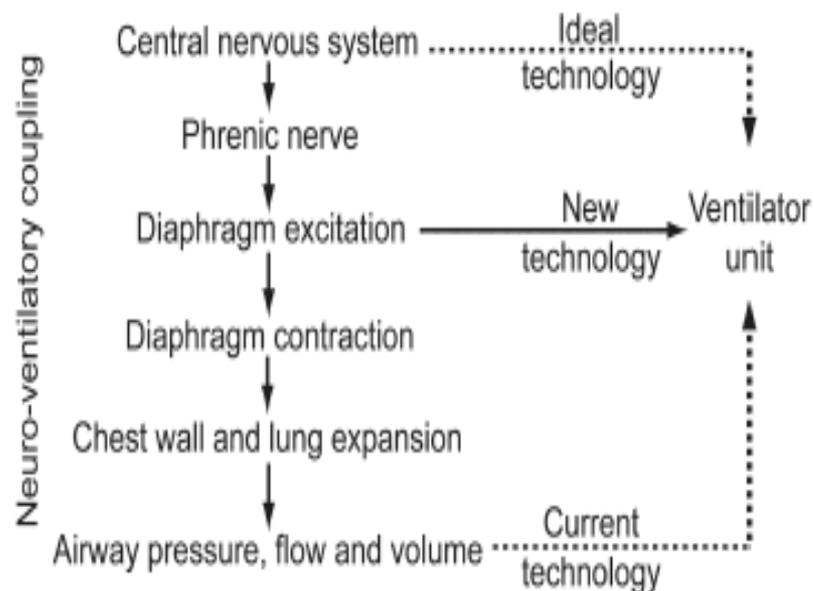
Auto-PEEP or Intrinsic PEEP



Advances in patient-ventilator synchrony: Neurally adjusted ventilatory assist

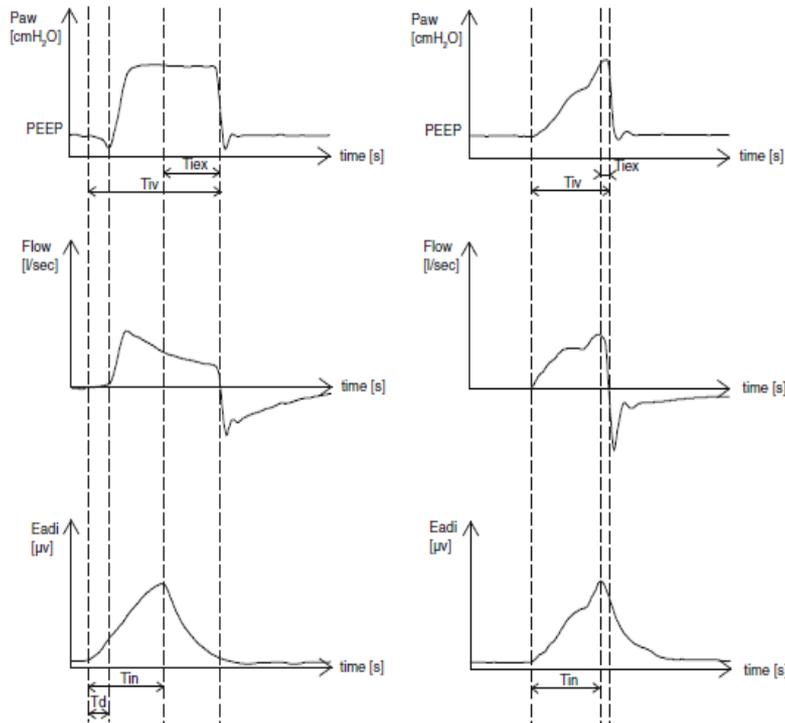
Sinderby Nature Med 1999; Verbrugge et al Respir Care 2011

- * Diaphragmatic activity measured with esophageal catheter
- * Ventilator assist is driven by degree of diaphragm drive and NAVA support level
- * Potential benefit in COPD and children



Advances in patient-ventilator synchrony: Neurallyadjusted ventilatory assist

Piquioloud et al ICM 2011;



32 subjects with COPD and others with acute respiratory failure ventilated on PSV and NAVA

- * Asynchrony events decreased by >50% on NAVA
- * Trigger delay decreases from 178 ms to 69 ms

THANK YOU

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