MV in COPD exacerbations

1

SM Copotoiu

AECOPD a worldwide problem

- 1990 COPD 6th most common cause of death
- 2020 to become the 3rd

Relevant alterations in AECOPD ERS/ATS guidelines 2017 ERJ 2017; 49:1600791

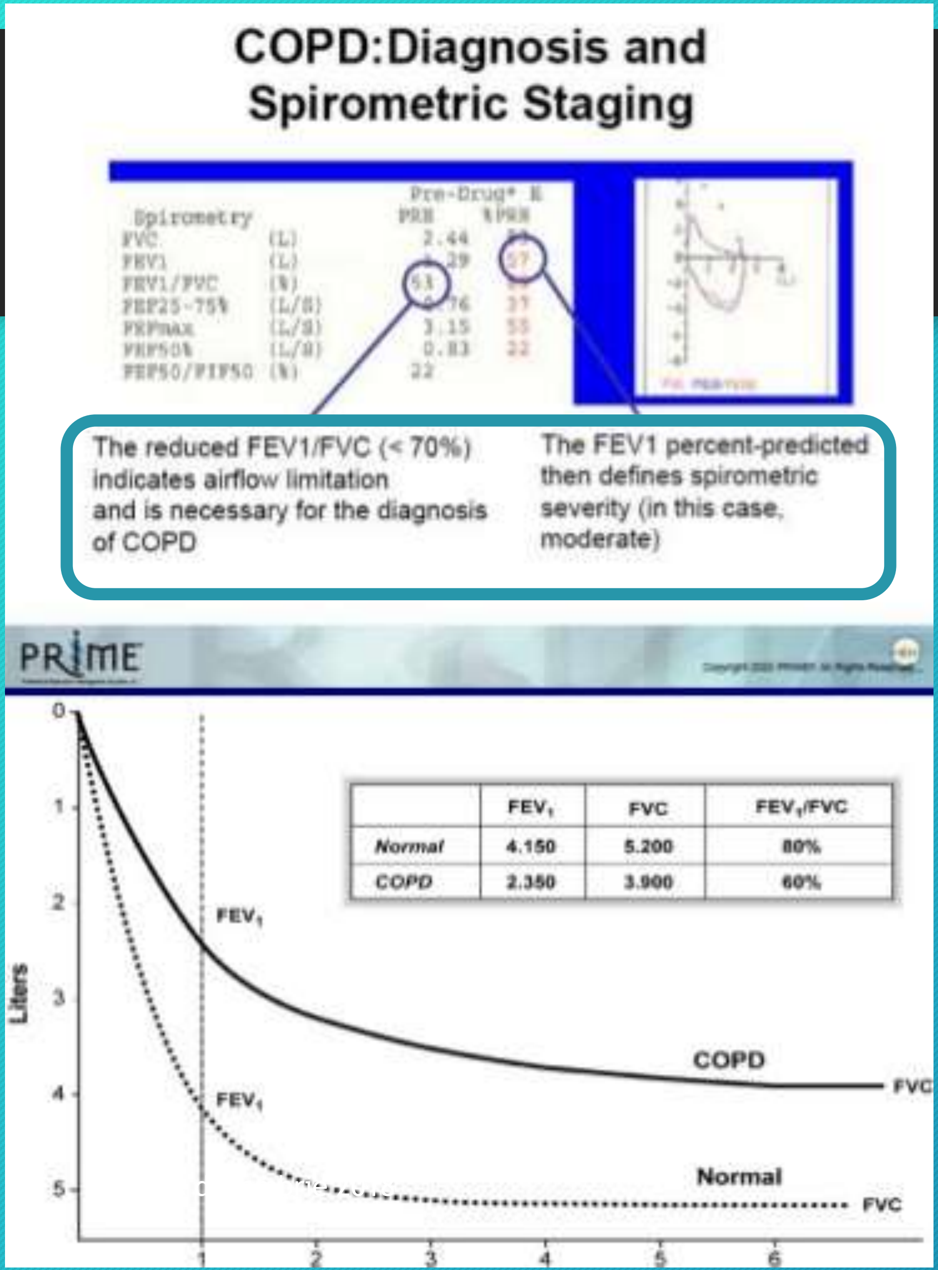
AECOPD = episodes of increasing respiratory symptoms, particularly dyspnea, cough & sputum production, and increased sputum purulence

- Have a negative impact on QOL
- Accelerate disease progression
- Can result in hospital admissions & death

Landing of a COPD patient in the ICU

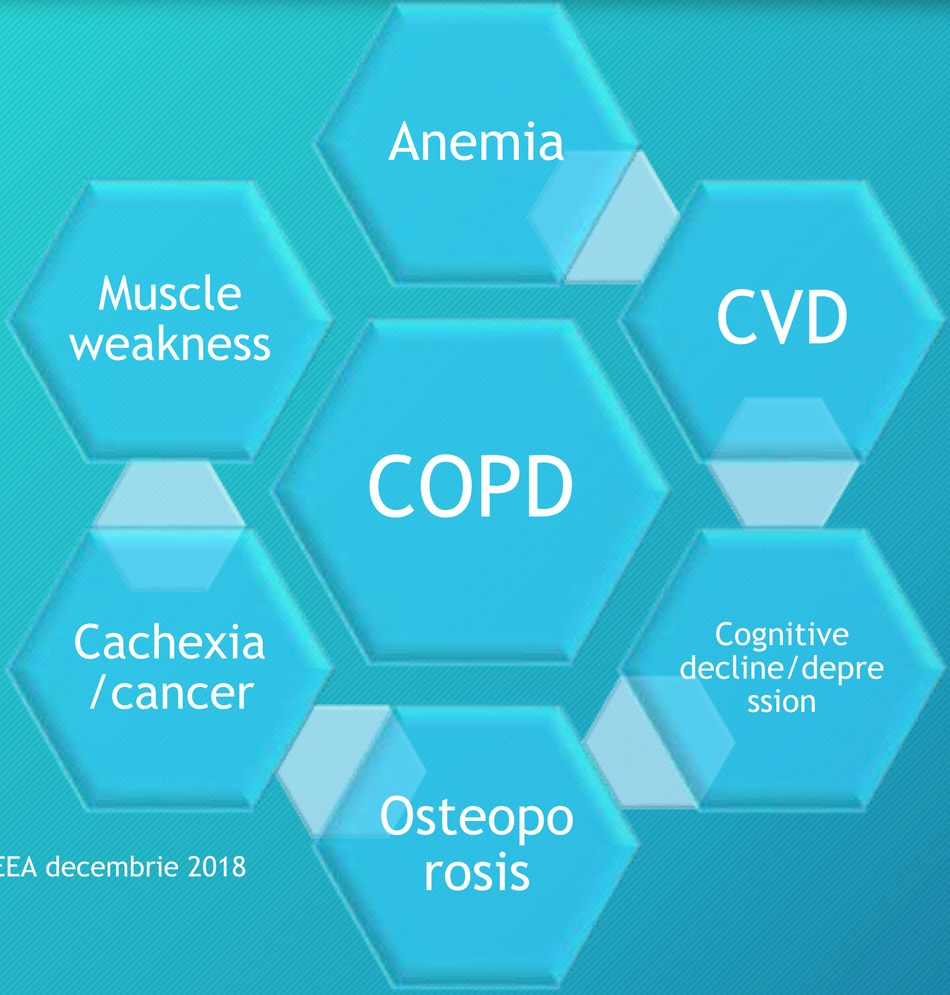
- Postoperatively due to emergency, urgency or scheduled surgery
- Admitted through SMURD or by transfer from a noninvasive clinic - usually COPD exacerbations

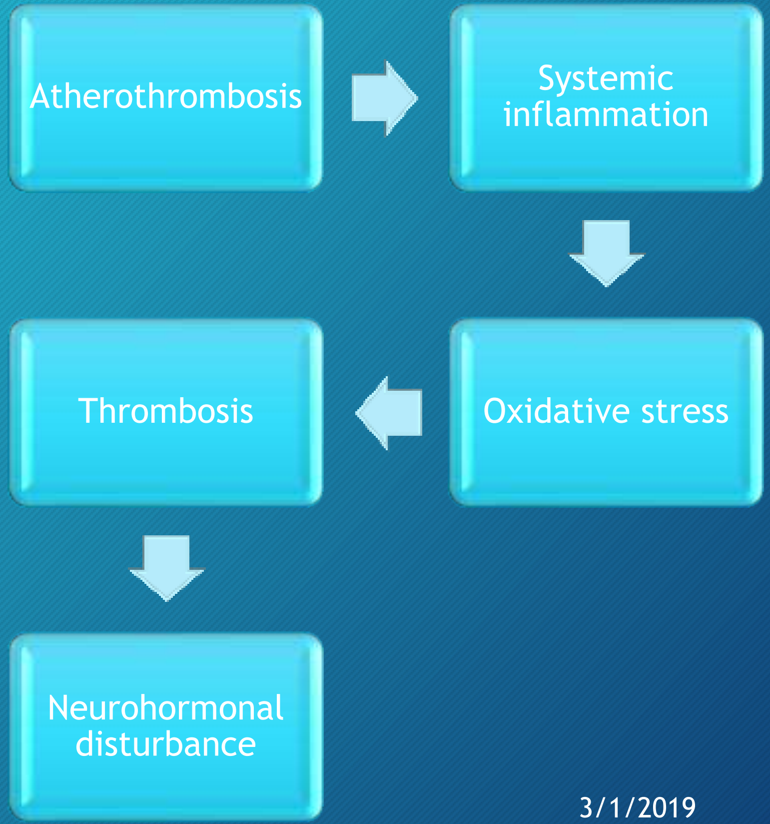
Fundamental physiologic abnormality
Can we change the outcome with perioperative MV strategy?
MV in the ICU
How long can a COPD patient live on a ventilator?
Guidelines?!



Fundamental and pathological hallmark of COPD: **expiratory flow limitation ↓ EFL**

Systemic effects of COPD/mechanisms





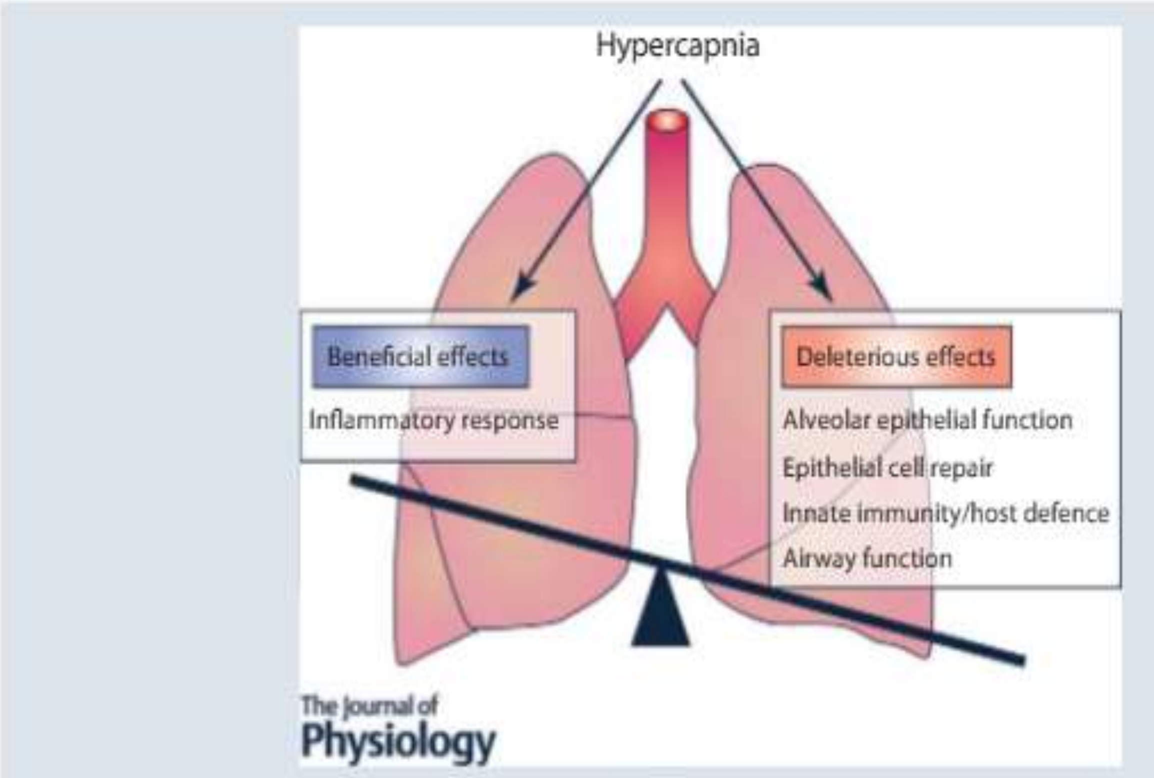
J Physiol 595.8 (2017) pp 2431–2437

SYMPOSIUM REVIEW

Effects of hypercapnia on the lung

Masahiko Shigemura, Emilia Lecuona and Jacob I. Sznajder

Division of Pulmonary and Critical Care Medicine, Northwestern University, Chicago, IL, USA



Lung edema clearance enhanced by CO_2!

Hyperinflation in COPD/ Static Hyperinflation

↓pulmonary elasticity due to emphysema

↓pulmonary recoil pressure to oppose chest recoil

Recoil forces balanced at << normal resting volumes

AECOPD characteristics
Dynamic hyperinflation = fundamental characteristic of COPD and asthma

- ↑end-expiratory pulmonary volume (EELV) over the predicted RLC (residual lung capacity)
- ↑ EELV > VR relaxation volume of the respiratory system

Conditions:

Bronchospasm
Exacerbations AECOPD
↑ventilation due to ↑chemostimulation &
↑ respiratory neural drive

- May be aggravated by mechanical ventilation

↑TLC ≥ 120% of anticipated TLC = thoracic hyperinflation
↑FRC≥ 120% of anticipated FRC = lung hyperinflation

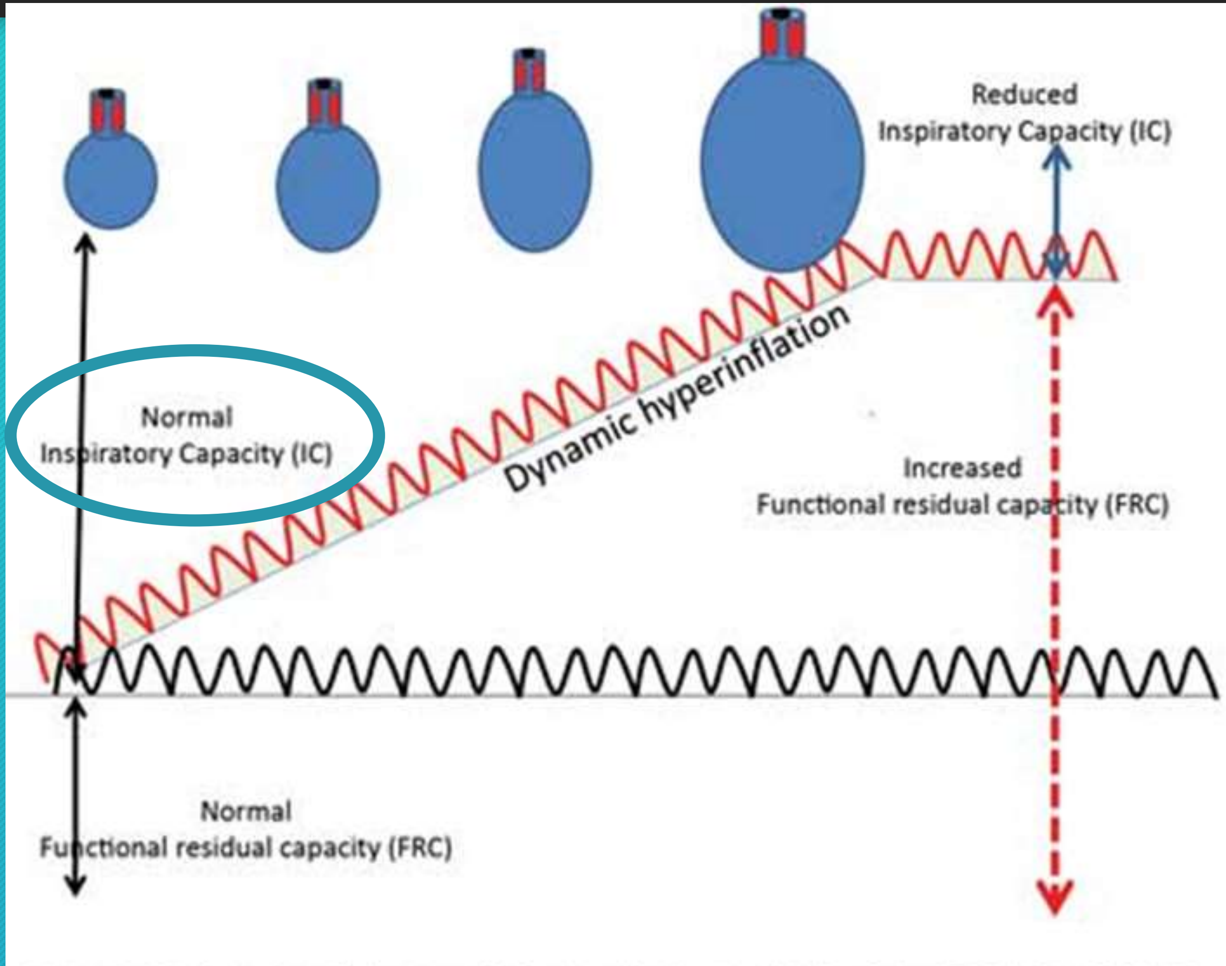


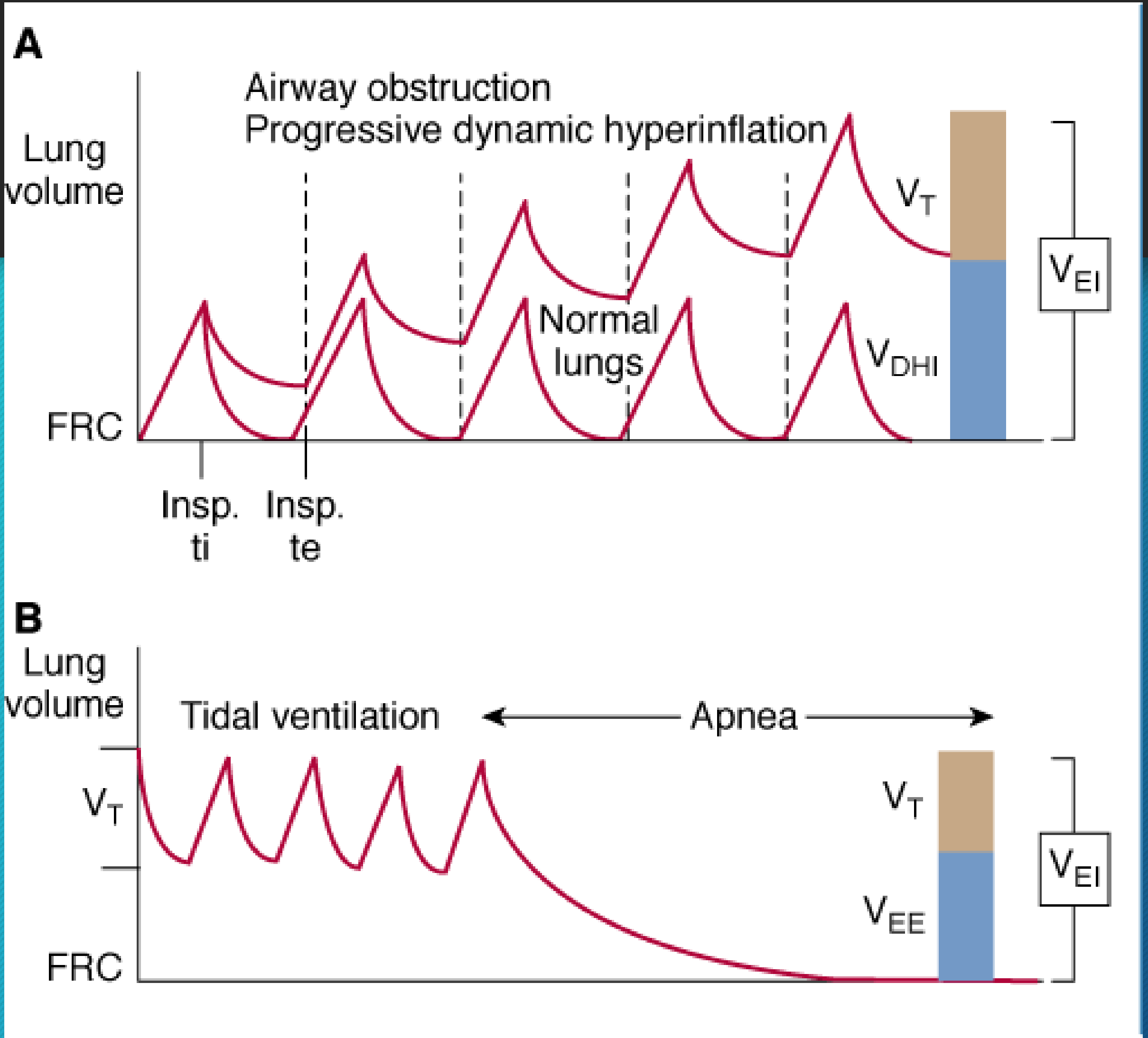
Fig. 4 : Pathophysiology of dynamic hyperinflation (DH) in COPD

↑↑IC or IC/TLC
= indirect measure of lung hyperinflation when TLC is stable.

IC/TLC < 25% associated with ↑CV mortality, ↓LV filling, ↓EDV + ↓exercise tolerance.

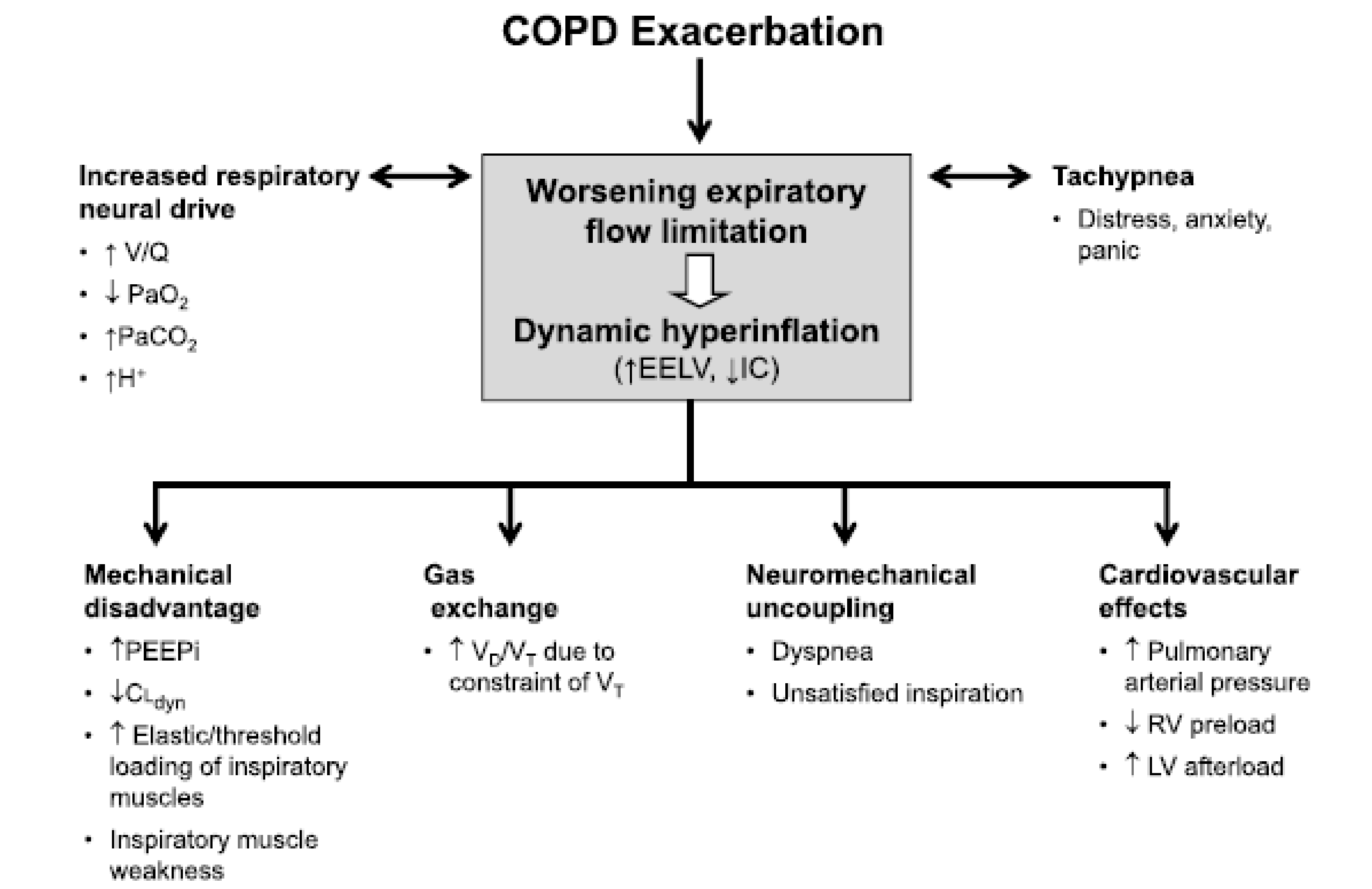
DH

↑ RV > 120% anticipated value = pulmonary gas trapping

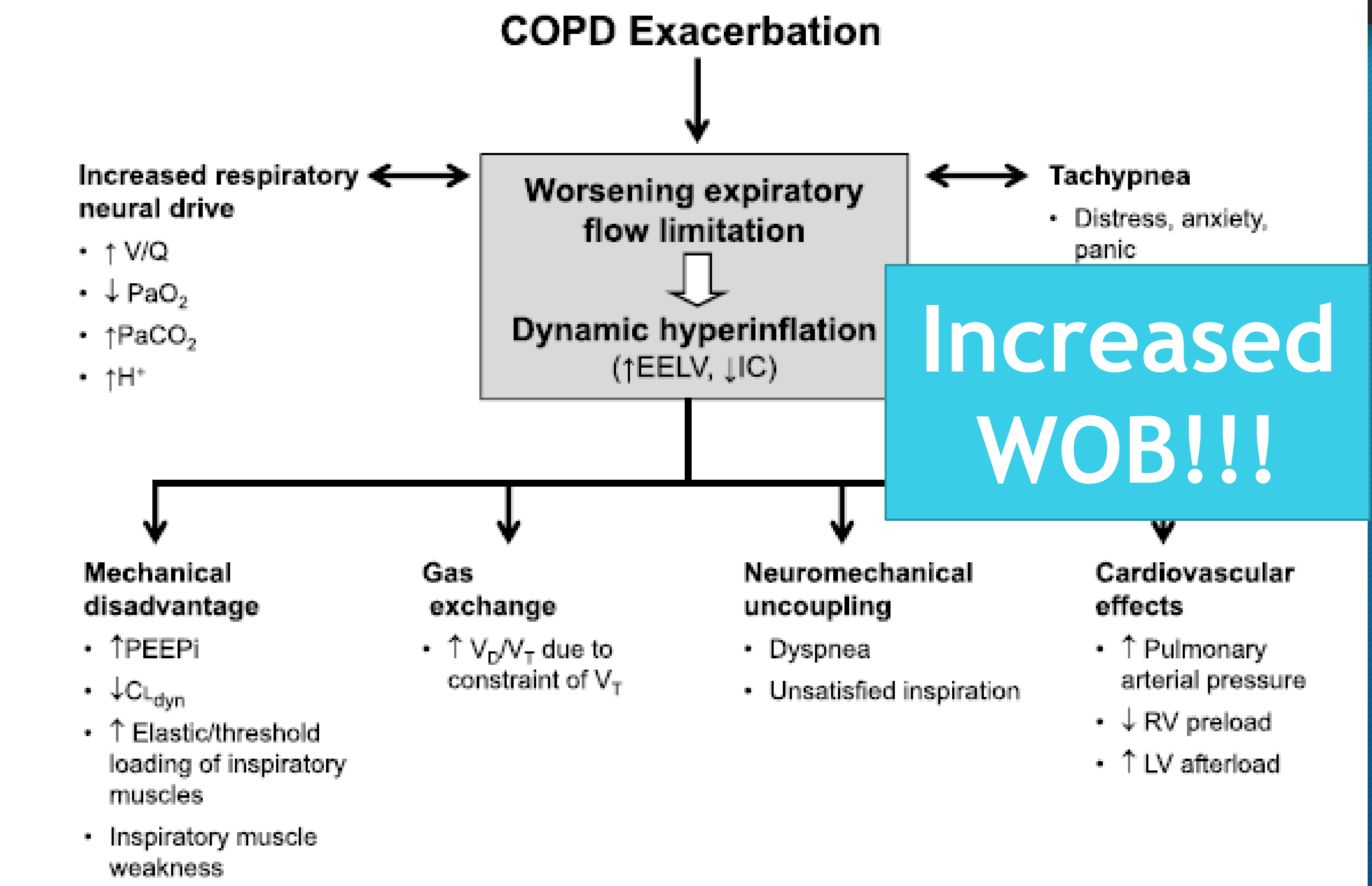


Source: Tobin MJ: *Principles and Practice of Mechanical Ventilation, 3rd Edition:* www.accessanesthesiology.com

Negative consequences of Dynamic Hyperinflation in AECOPD

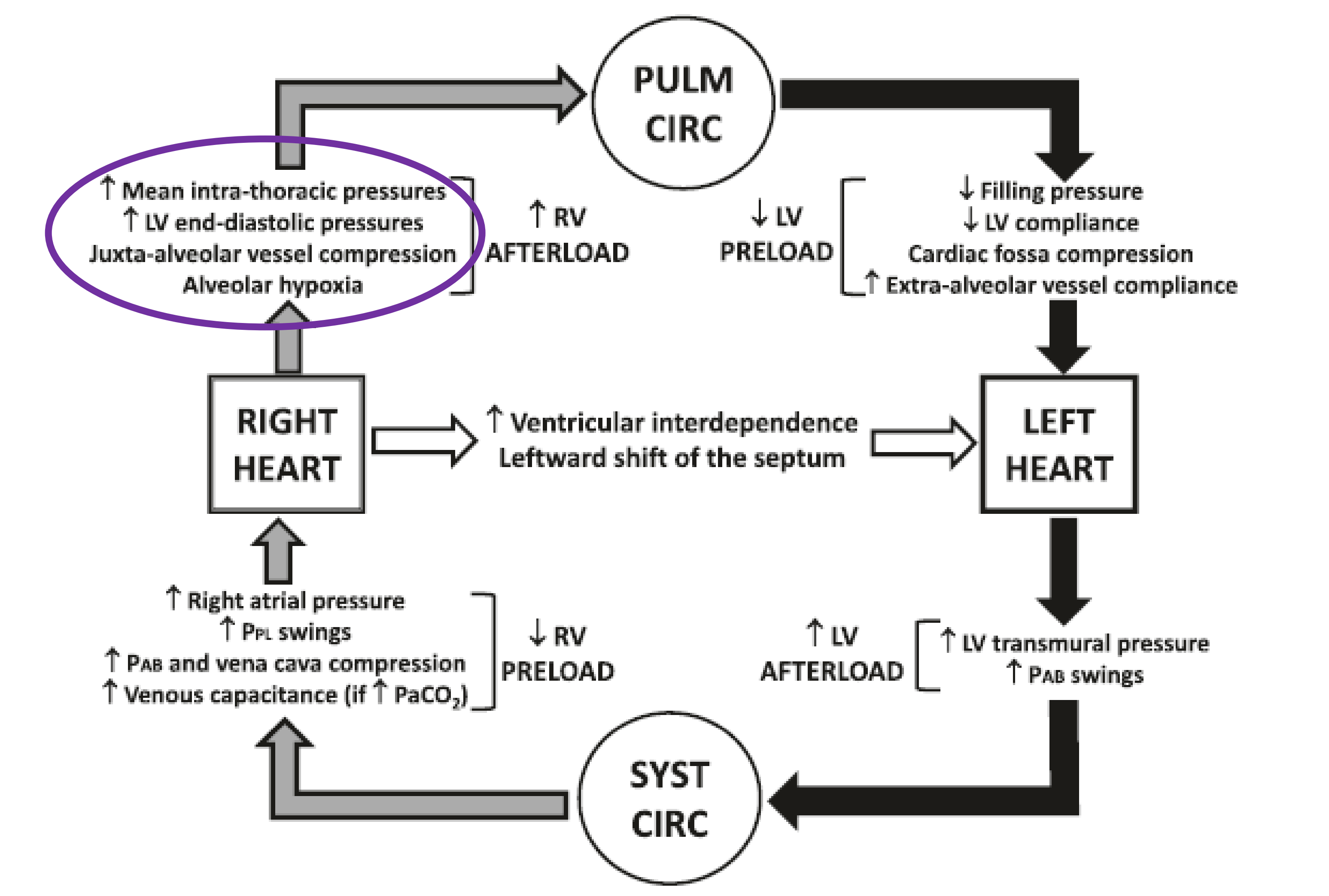


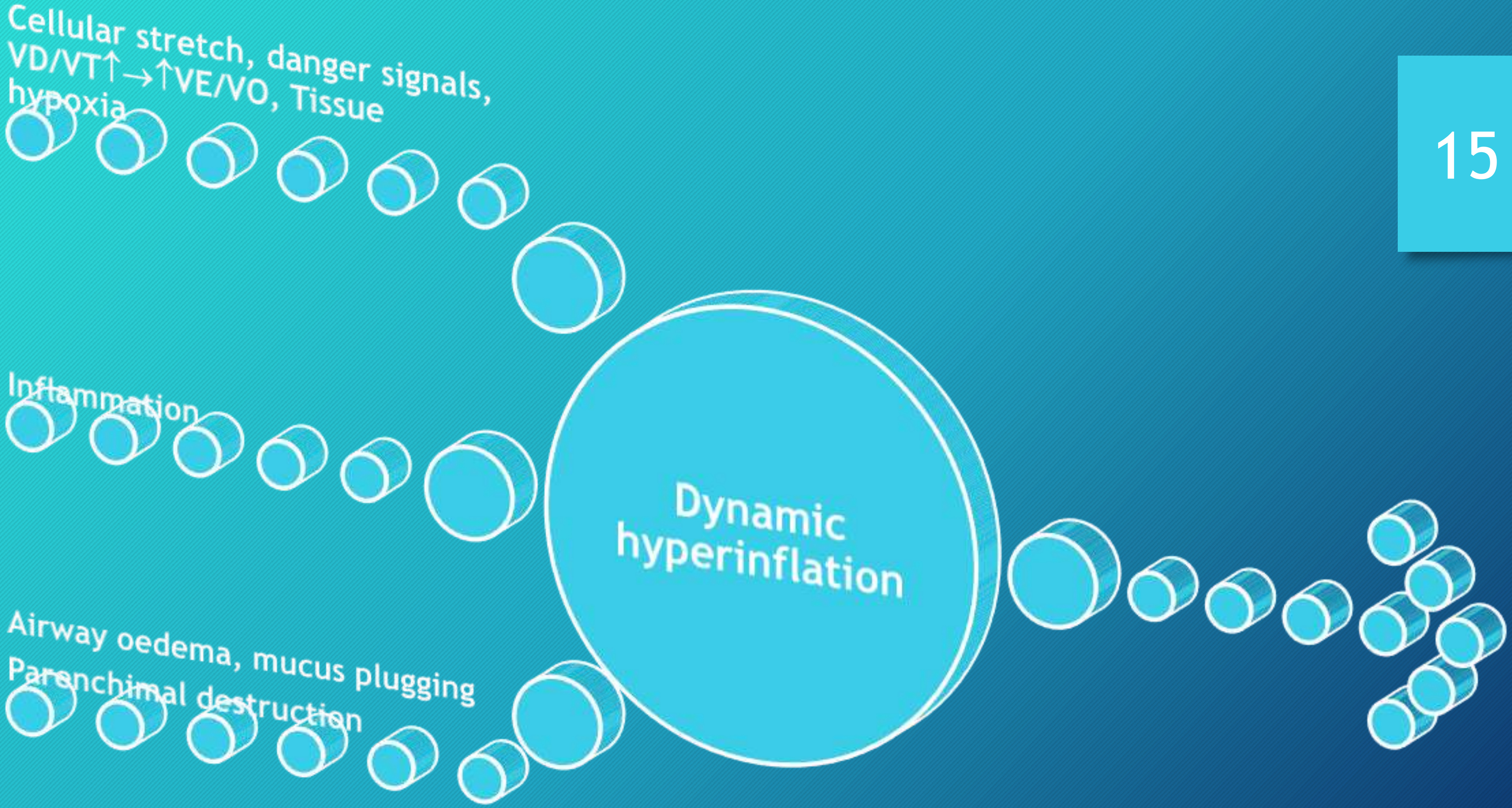
Negative consequences of Dynamic Hyperinflation in AECOPD



Increased WOB!!!

Potential deleterious effects of DH on cardiopulmonary interactions in COPD.



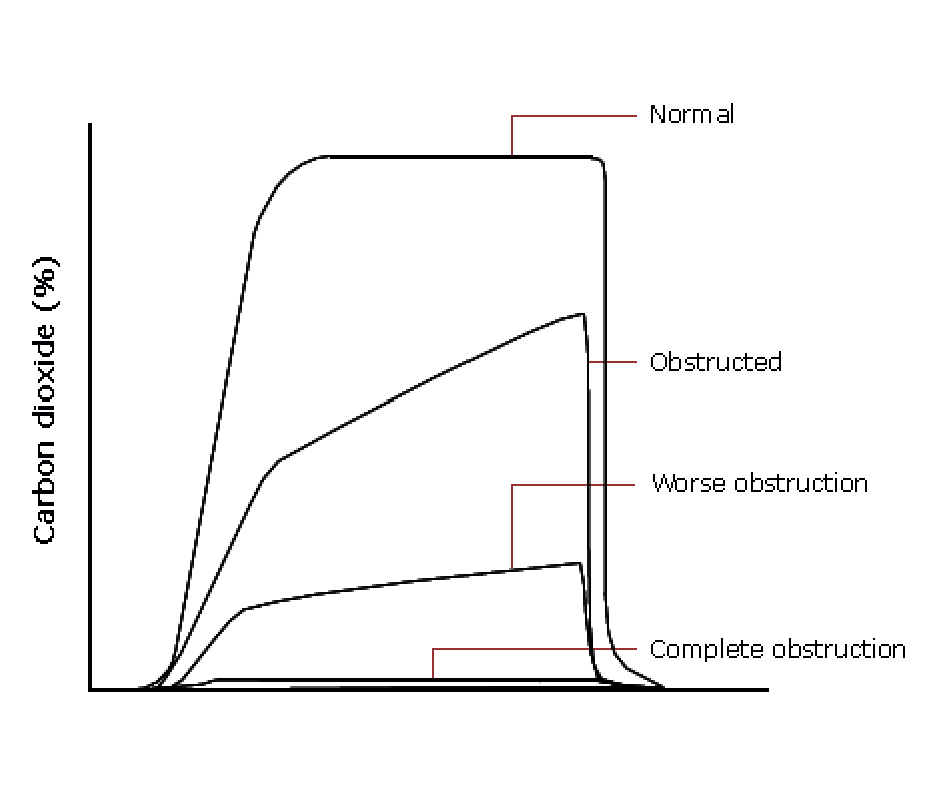


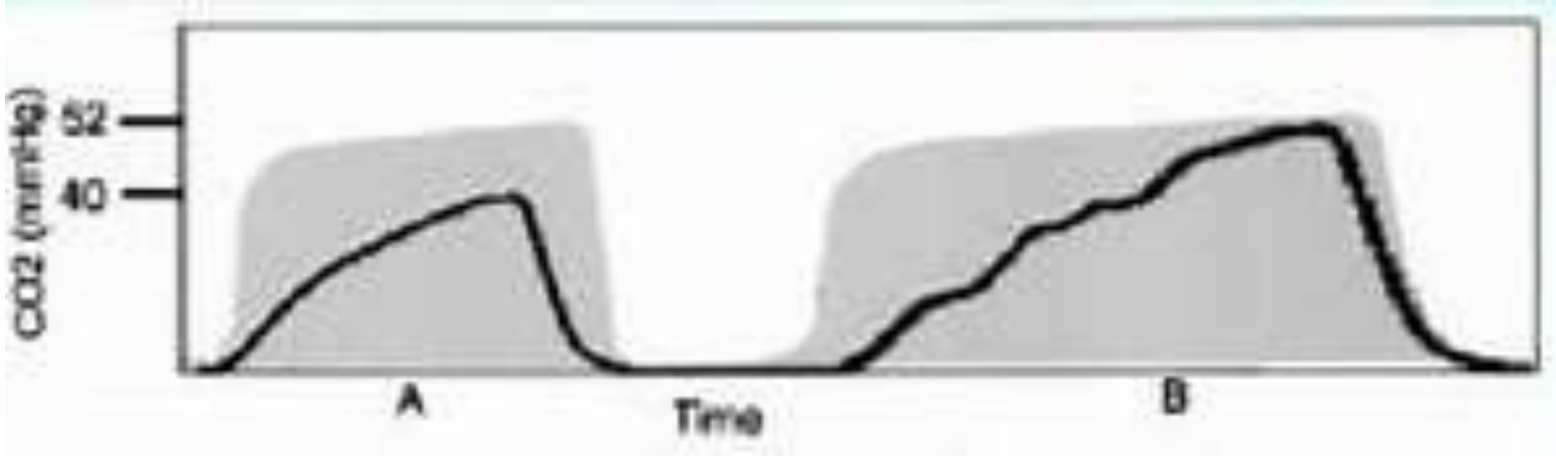
Cellular stretch, danger signals,
VD/VT↑→↑VE/VO, Tissue
hypoxia
Inflammation
Airway oedema, mucus plugging
Parenchimal destruction
Dynamic hyperinflation

Diagnosing DH

- Slow filling of a manual ventilator bag
- Capnography trace not reaching plateau
- Expiratory flow not reaching zero in flow-time/volume graph
- Measure intrinsic PEEP
- If mechanically ventilated, ↑circuit impedance increases iPEEP!

Sharkskin shape capnogram





COPD = ↑$PaCO_2$-$ETCO_2$

DH !?

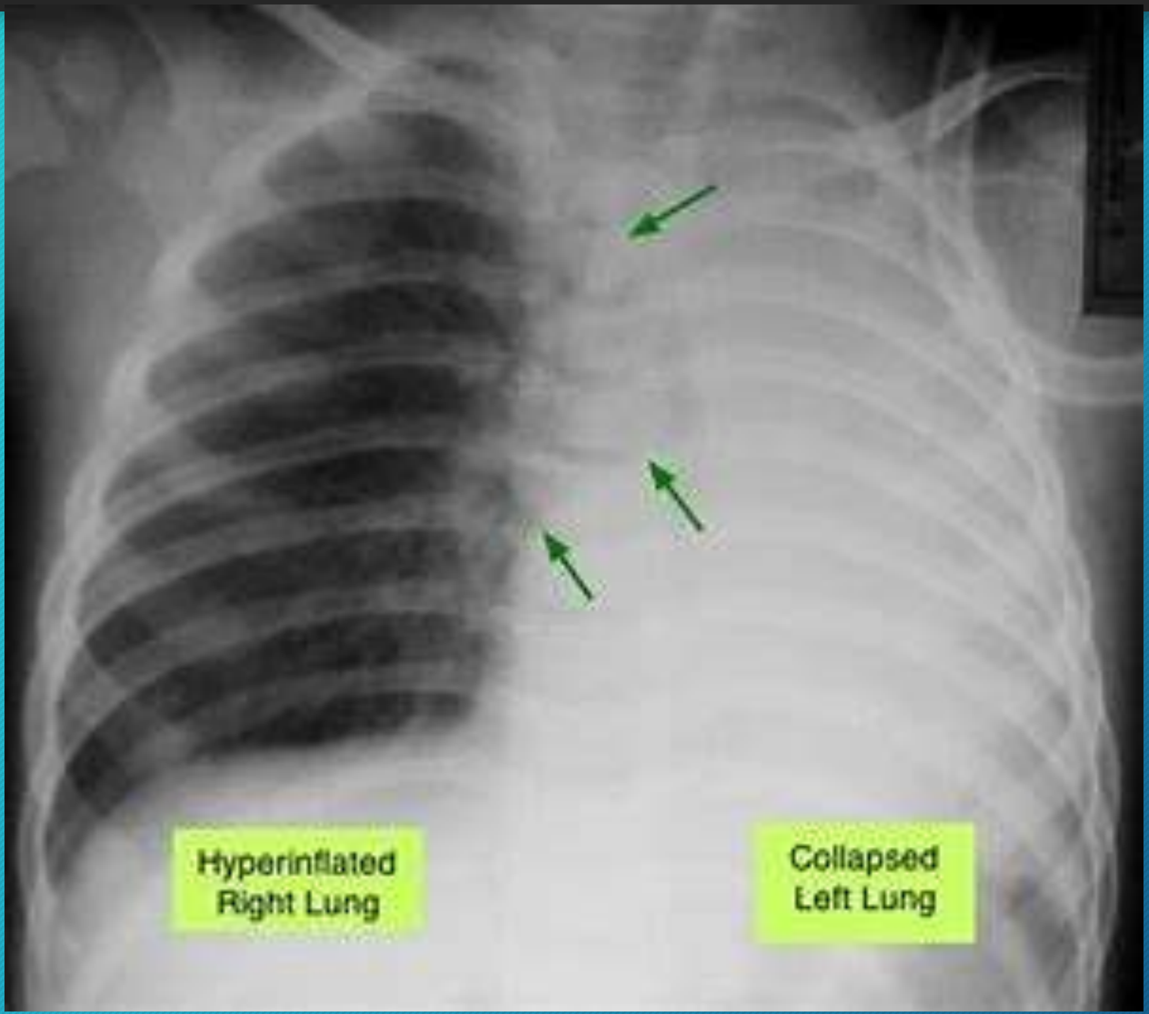
- Bronchoscopy to remove bronchial plugs→↓ HI of the lungs with free bronchi

- Disconnection from MV + external thoracic compression

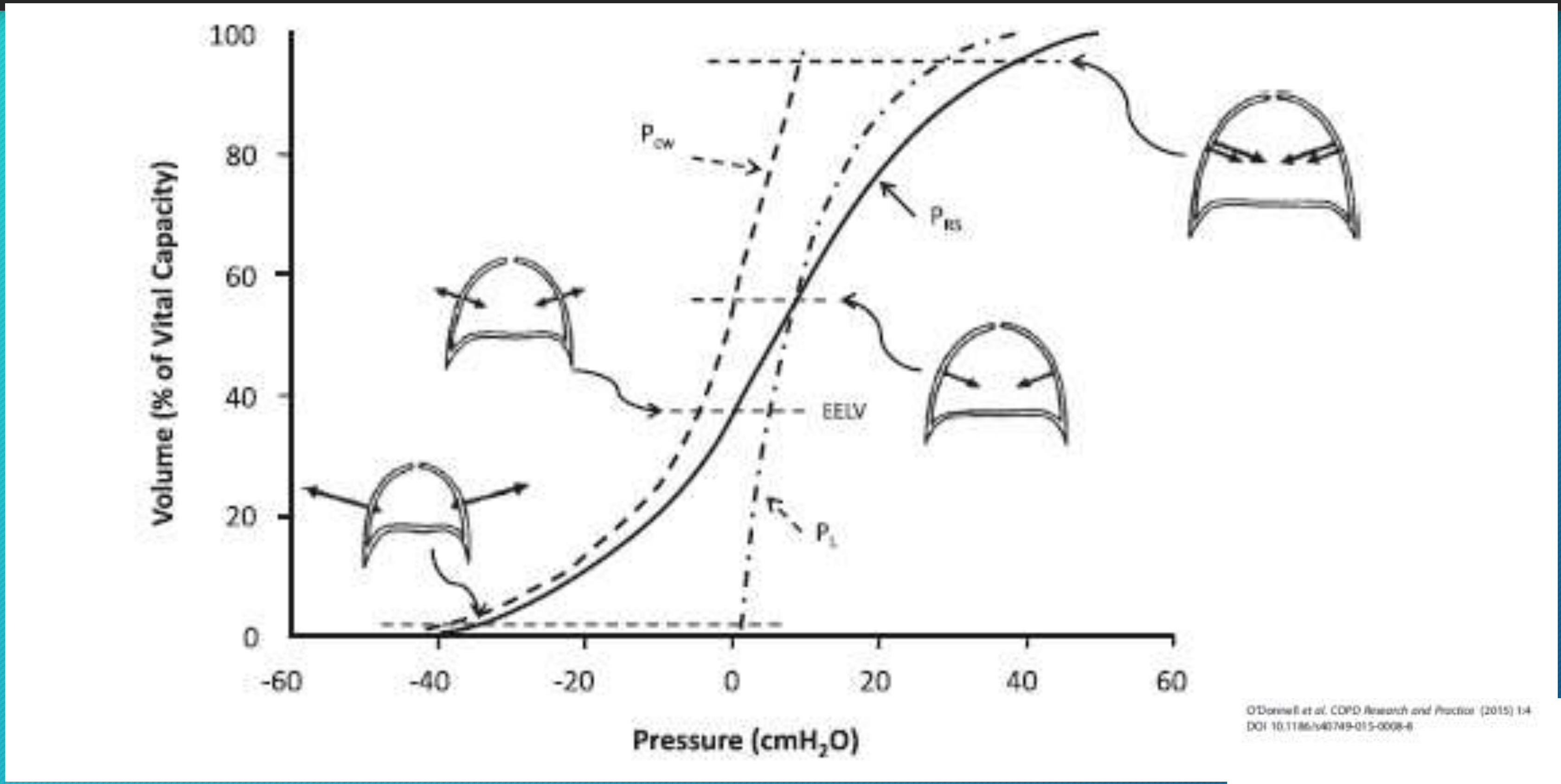
- PEEP →↑ homogeinity


R
ERECT
AP


R

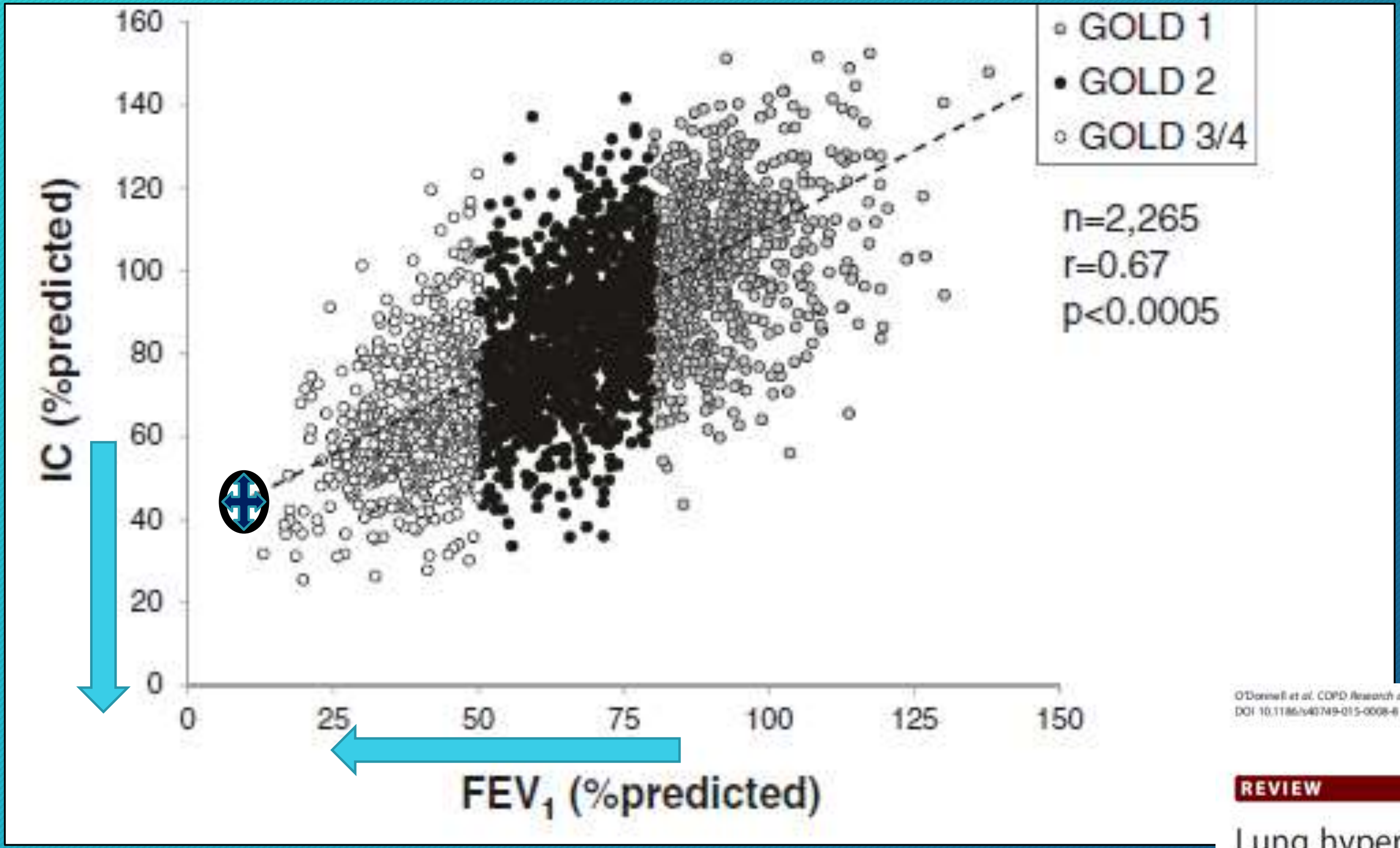

Hyperinflated
Right Lung
Collapsed
Left Lung

AECOPD characteristics
Relaxation in sitting position V/P curves



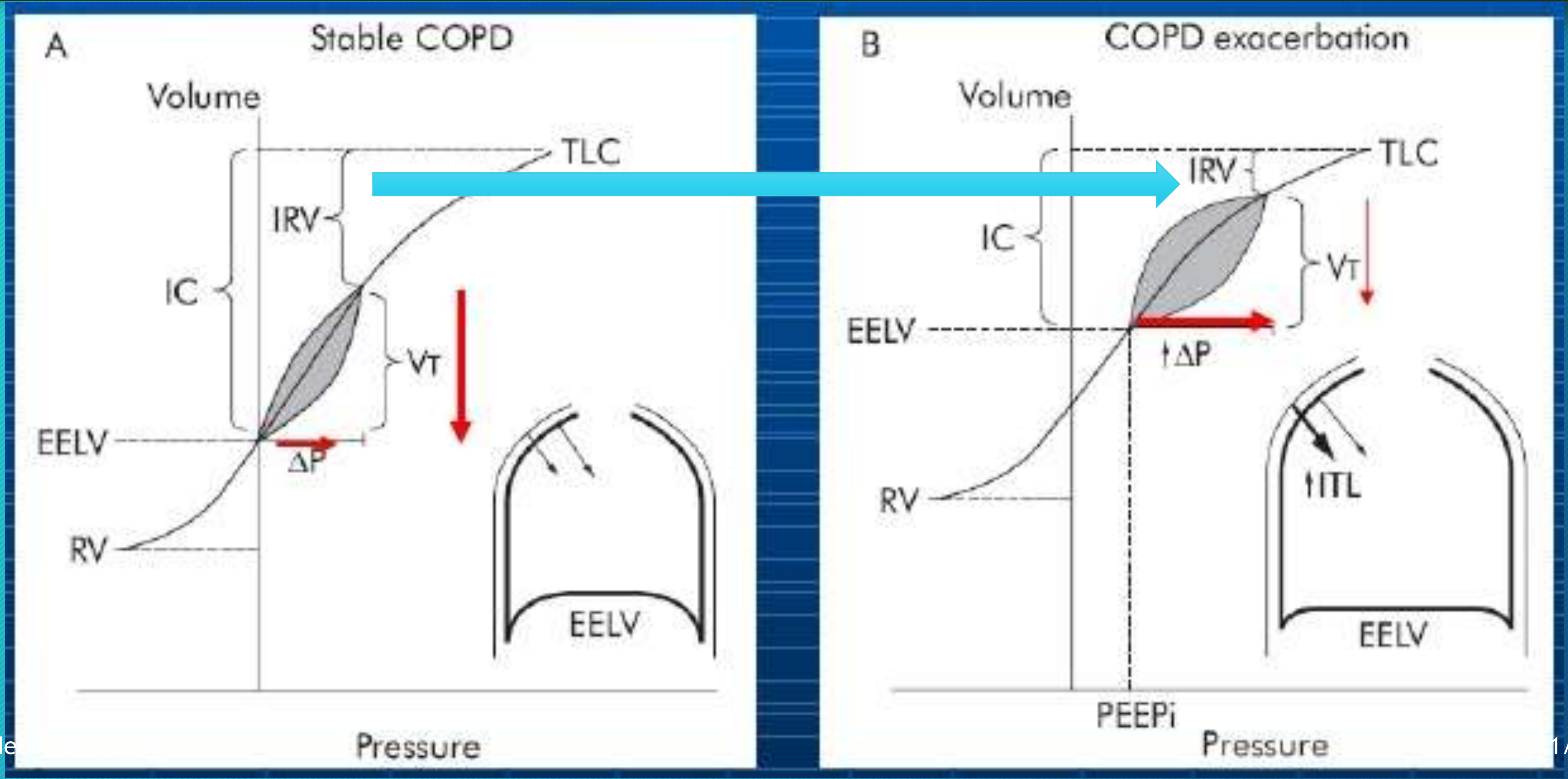
AECOPD characteristics

After Deesomchok A et al. COPD 2010; 427-37
Tashkin DP et al. NEJM 2008; 177:622-9



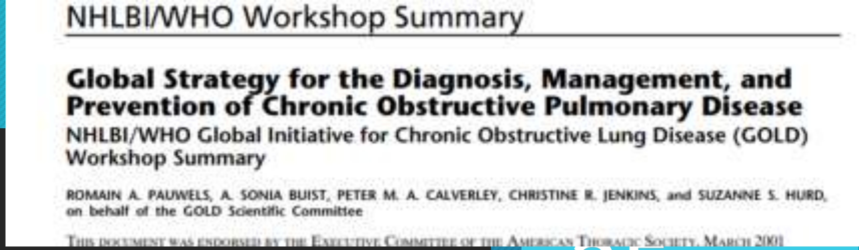
Mechanical effects of AECOPD

Thorax 2006; 61:354-61



How to ventilate an AECOPD patient?

GOLD indications for ICU admission


NHLBI/WHO Workshop Summary

Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease

NHLBI/WHO Global Initiative for Chronic Obstructive Lung Disease (GOLD) Workshop Summary

ROMAIN A. PAUWELS, A. SONIA BUIST, PETER M. A. CALVERLEY, CHRISTINE R. JENKINS, and SUZANNE S. HURD, on behalf of the GOLD Scientific Committee

This document was endorsed by the Executive Committee of the American Thoracic Society, March 2001

- Severe dyspnea that responds inadequately to initial emergency therapy
- Confusion, lethargy, coma
- Persistent or worsening hypoxemia $PaO_2 < 6.7$kPa, 50mmHg
- Severe worsening hypercapnia $PaCO_2 > 9.3$kPa, 70mmHg or
- Severe, worsening respiratory acidosis $pH < 7.30$ despite supplemental O_2

Indications for NIPPV

Ahmed S et al, Indian J Anaesth. 2015, 59(9):589-598

- pH 7.30-7.25
- Nonresponders to medical therapy $PaO2<50mmHg$, $PaCO2 > 80-90mmHg$, $pH \leq 7.2$ with following:
  - Sick, but not moribund
  - Able to protect airway
  - Conscious and cooperative
  - Haemodynamically stable
  - No excessive respiratory secretions
  - Few comorbidities
  - Pts who have declined intubation
  - As a weaning facilitator
  - Home NPPV for pts with recurrent admissions

NIV

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TABLE 14. SELECTION AND EXCLUSION CRITERIA FOR NIPPV

Selection criteria (at least two should be present)	Exclusion criteria (any may be present)
Moderate to severe dyspnea with use of accessory muscles and paradoxical abdominal motion	Respiratory arrest
Moderate to severe acidosis (pH 7.30–7.35) and hypercapnia (Pa_{CO_2} 6.0–8.0 kPa, 45–60 mm Hg)	Cardiovascular instability (hypotension, arrhythmias, myocardial infarction)
Respiratory frequency > 25 breaths/min	Somnolence, impaired mental status, uncooperative patient
	High aspiration risk; viscous or copious secretions
	Recent facial or gastroesophageal surgery
	Craniofacial trauma, fixed nasopharyngeal abnormalities
	Extreme obesity

From Kramer and coworkers (197).

Agitation!

Noninvasive Ventilation for Acute Exacerbations of Chronic Obstructive Pulmonary Disease: "Don't Think Twice, It's Alright!"

ble with the text of this article at www.atsjournals.org.

M. W. Elliott, M.D.
Department of Respiratory Medicine
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Stefano Nava, M.D.
Respiratory and Critical Care Unit
Sant' Orsola and Malpighi Hospital
Bologna, Italy

TASK FORCE REPORT
ERS/ATS GUIDELINE

Management of COPD exacerbations: a European Respiratory Society/American Thoracic Society guideline

Jadwiga A. Wedzicha (ERS co-chair)[1], Marc Miravitlles[2], John R. Hurst[3], Peter M.A. Calverley[4], Richard K. Albert[5], Antonio Anzueto[6], Gerard J. Criner[7], Alberto Papi[8], Klaus F. Rabe[9], David Rigau[10], Pawel Sliwinski[11], Thomy Tonia[12], Jørgen Vestbo[13], Kevin C. Wilson[14] and Jerry A. Krishnan (ATS co-chair)[15]

4) Should NIV be used in patients who are hospitalised with a COPD exacerbation associated with acute or acute-on-chronic respiratory failure?

6) Should pulmonary rehabilitation be implemented in patients hospitalised with a COPD exacerbation?

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- 21 trials
- Only NIV considered for pts with hospitalized AECOPD associated with acute on chronic respiratory failure
- The 4th (7 all) rec: For patients who are hospitalized with a AECOPD associated with acute or acute on chronic respiratory failure, we recommend the use of NIV.
- Power of rec? Strong
- Evidence quality? Low

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- NIV lower mortality rate 7.1 vs 13.9%
- Less likely to require intubation 12% vs 30.6%
- Shorter LOS; mean difference 2.88 days
- Shorter ICU stay ; mean difference 4.99 days
- Fewer complications of treatment 15.7% vs 42%
- No difference in pH after 1 h

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Drawback:
Lack of blinding
No reports on nozocomial pneumonia!!!

6 kPa = 45mmHg
6.5 kPa = 48.7mmHg

BTS guidelines 2017/ Recommendations

For most pts with AECOPD the initial treatment should be optimal medical therapy and targeting an SpO_2 of 88-92% A

NIV should be started when pH<7.35 and pCO_2 ≥6.5kPa and RR > 23 breath/min persist or develop after 1 hour of optimal therapy A

Severe acidosis alone does not preclude a trial of NIV in an appropriate area with ready access to staff who can perform safe endotracheal intubation. B

The use of NIV should not delay escalation to IMV when this is more appropriate C

The practice of NIV should be audited regularly to maintain standards C

BTS

- Advanced age alone should not preclude a trial of NIV A
- Warnings to change the management strategy: worsening of pH, RR: clinical review, change of interface, adjustment of settings, consider IMV

- !!! In sleep disorders breathing pre- AHRF, or evidence as a complication, use controlled NIV during night.

BTS guidelines / red flags for NIV

Red flags

- pH < 7.25 on optimal NIV
- RR > 25/min
- New onset confusion

Check

- Synchronization
- Mask fit
- Exhalation port
- Give physiotherapy
- Bronchodilators
- Consider anxiolytic

NIV

1. Systematic ABG assessment
    1. Assess paO2 - O2 if required
    2. Interpret pH
    3. Interpret paCO2
    4. Interpret metabolic component
    5. Identify the origin - respiratory or metabolic
    6. Interpret results in light of patient’s history

NIV pressure-cycled BiPAP (IPAP + EPAP)

- ↓ the effort of breathing
- Resting respiratory muscles
- ↓ respiratory rate
- ↓ CO_2 levels
- ↑ O_2 levels
- Correcting pH as alveolar ventilation improves
- ↑ the volume of each breath
- ↓ the need for tracheal intubation

Exclusion criteria for NIV BiPAP

- Severe comorbidities
- Severe cognitive impairment
- Facial burns/trauma/surgery
- Vomiting
- Fixed upper airway obstruction
- Undrained pneumothorax
- Inability to protect airway
- Upper GI surgery
- Copious respiratory secretions
- Dying patient
- Bowel obstruction
- Life-threatening hypoxemia
- Haemodynamic instability

Initial FiO_2

Slightly higher than that the patients received prior to CPAP

Adjusted to achieve the required SaO_2 88-95%

Settings Target saturations 88-92%

- Sitting/semirecumbent
- 10cmH2O for IPAP
- 4-5cmH2O for EPAP
- IPAP titration in 2-5 increments at a rate of 5cm every 10min
- Maximum target IPAP 20cmH2O
- EPAP can be increased to a max of 6 cmH2O (increments of 1)
- Every EPAP increase should be associated with an IPAP increase (titrated up by 2).

Success of NIV

- pH improving
- Respiratory rate decreases
- Better $PaCO_2$, PaO_2 at 4 hours of acute NIV BiPAP
- If successful, the recommended duration of therapy is of 48-72 hours
  - D1 as long as possible
  - D2 16hrs
  - D3 12 hrs

Weaning from BiPAP

- ABGs within normal parameters for the patient
- $SpO_2 > 85\%$ in room air or 24-28% O_2 by a Venturi mask
- RR < 25/min
- No use of accessory muscles
- Able to talk in full sentences

NIV failure

- pH worsening/respiratory rate after 4 hours of BiPAP
- Failure to tolerate BiPAP
- GCS decline
- Hypotension
- Uncorrected hypoxemia
- No change in both pH and respiratory rate at 4 hours

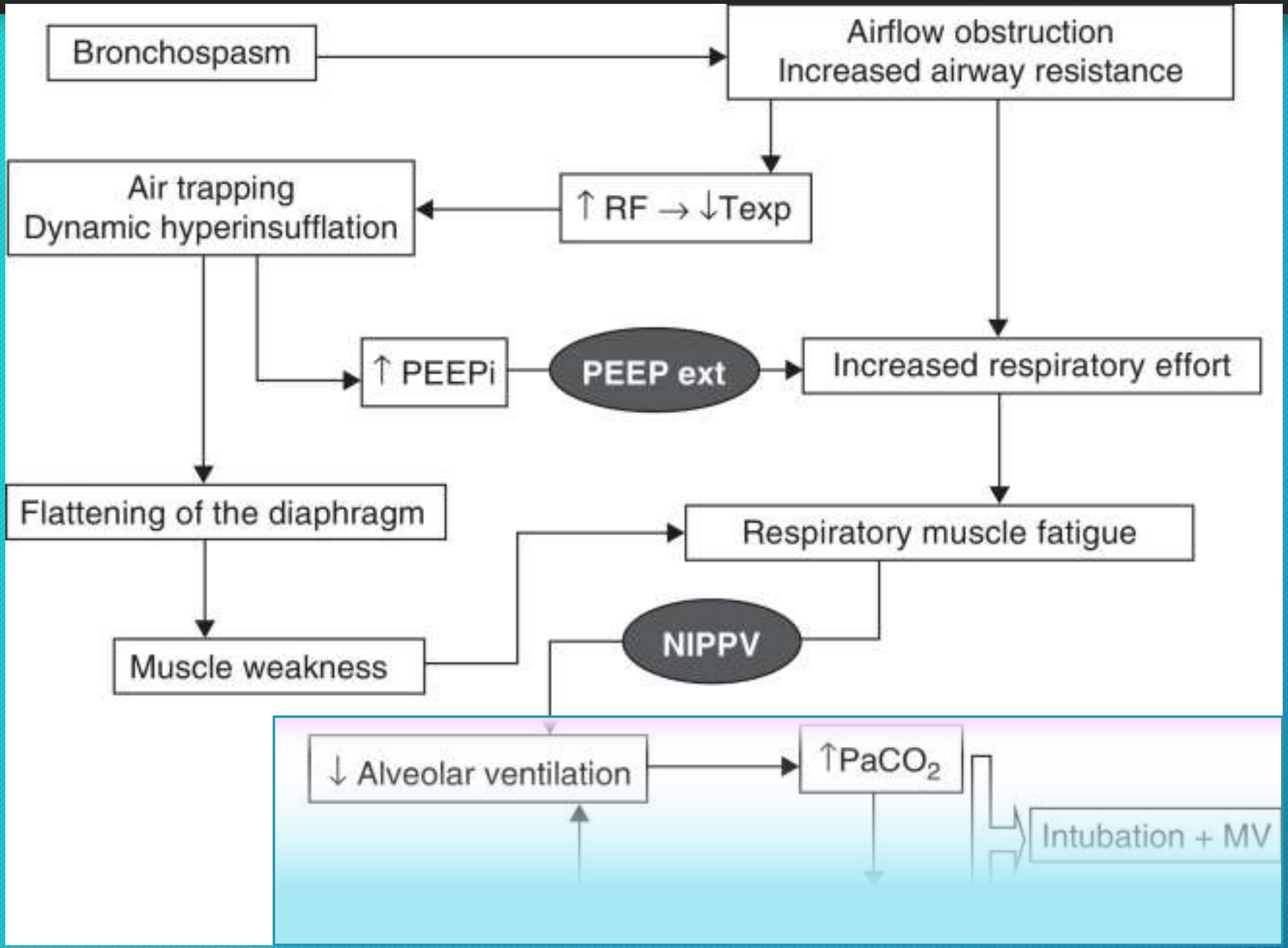
20-40% failure

BTS evidence statements

- Intubation is indicated if NIV is failing unless it is agreed that this is not desired by the patient or it is deemed not in the patient’s best interest. Level 1+.

- Neither patients characteristics nor pathophysiological parameters are sufficiently robust to predict success of NIV or MIV but, in general, the more adverse features that are present and the greater the physiologic disturbance the higher the chance of treatment failure or death. Level 2++

Shifting from NIV to IMV



Hypercapnic encephalopathy

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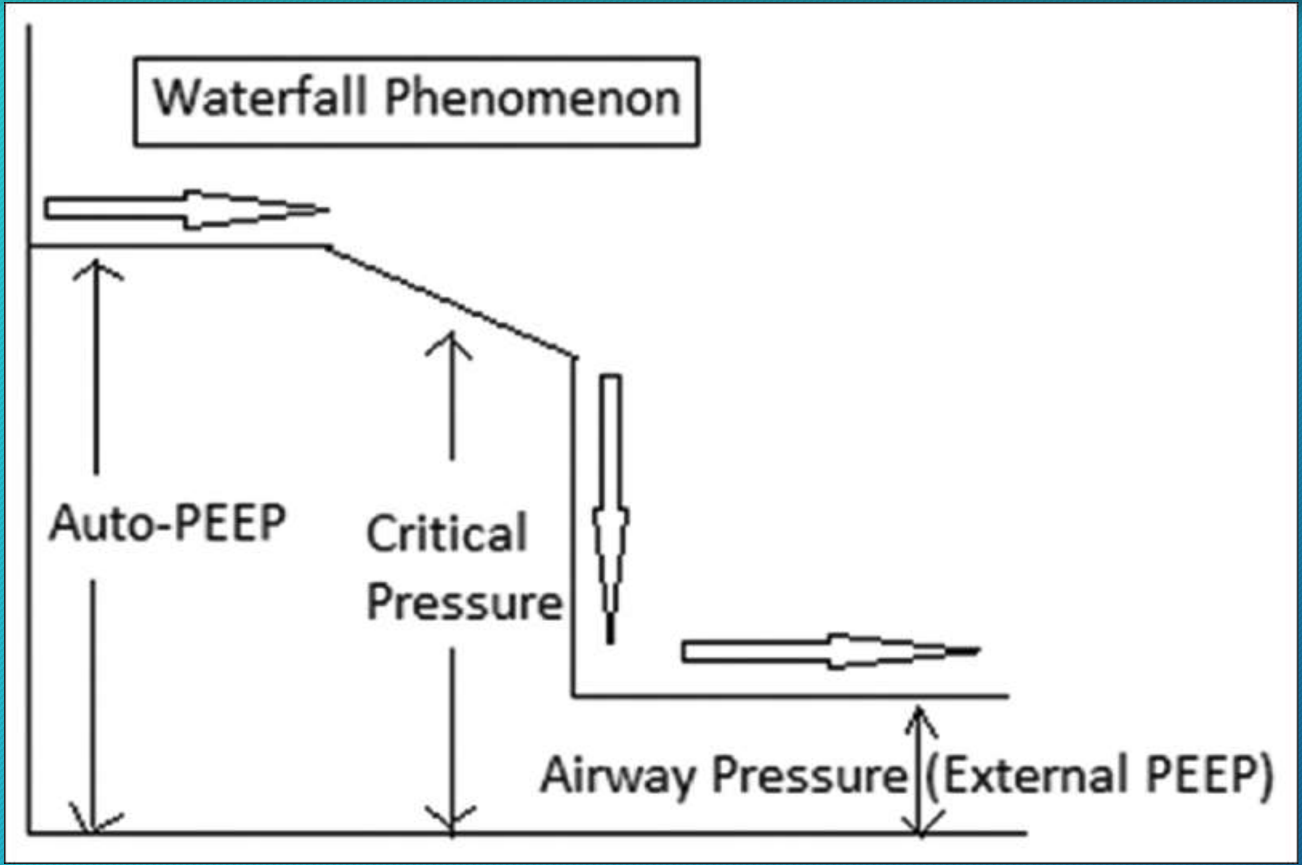
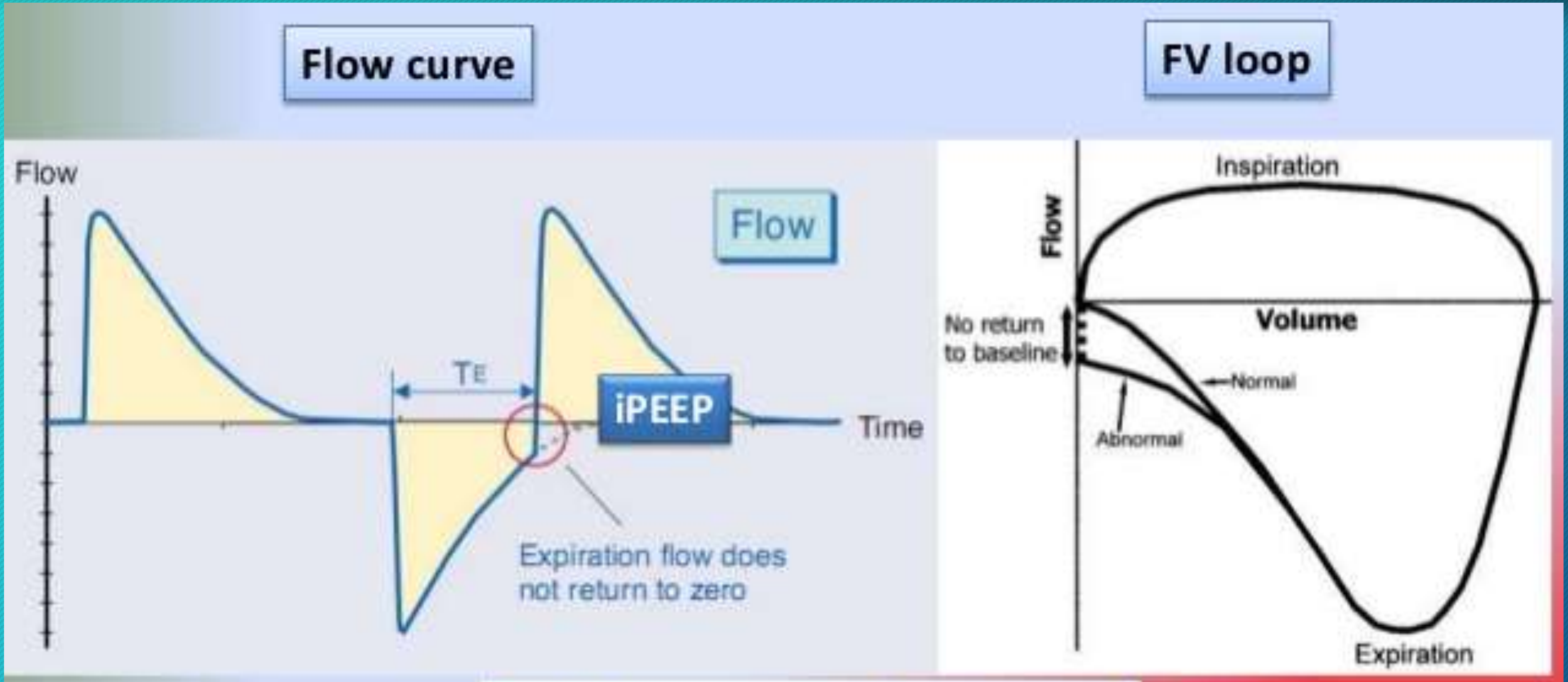
- **Pulmonary rehabilitation: initiated during hospitalization increased exercise capacity, but also mortality?!**

7	For patients who are hospitalised with a COPD exacerbation, we suggest not initiating pulmonary rehabilitation during hospitalisation	Conditional	Very low

PEEP for COPD/waterfall perspective

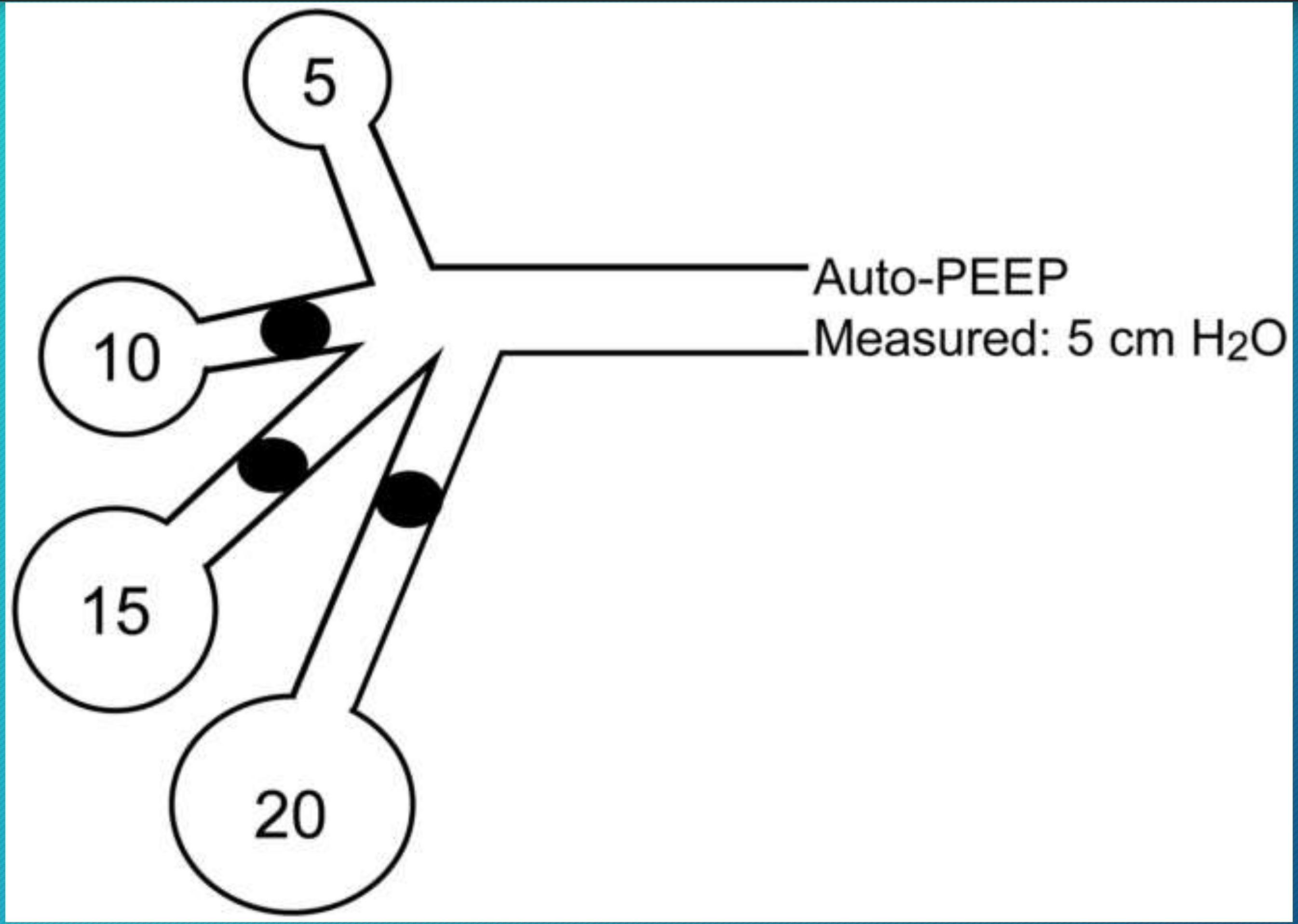


Airtrapping in COPD\iPEEP = air trapping + expiratory muscle contraction



1. Allow more time for expiration
2. Increase inspiratory flow rate
3. Provide ePEEP

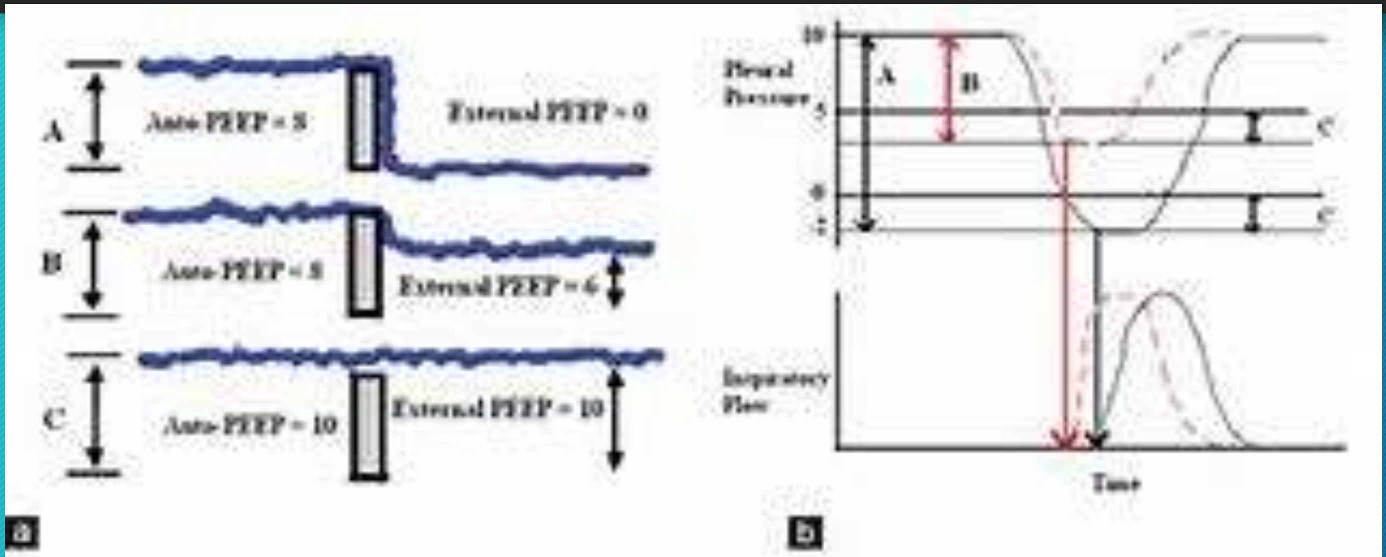
Reasons to perform bronchoalveolar lavaj, suction



Management of autoPEEP

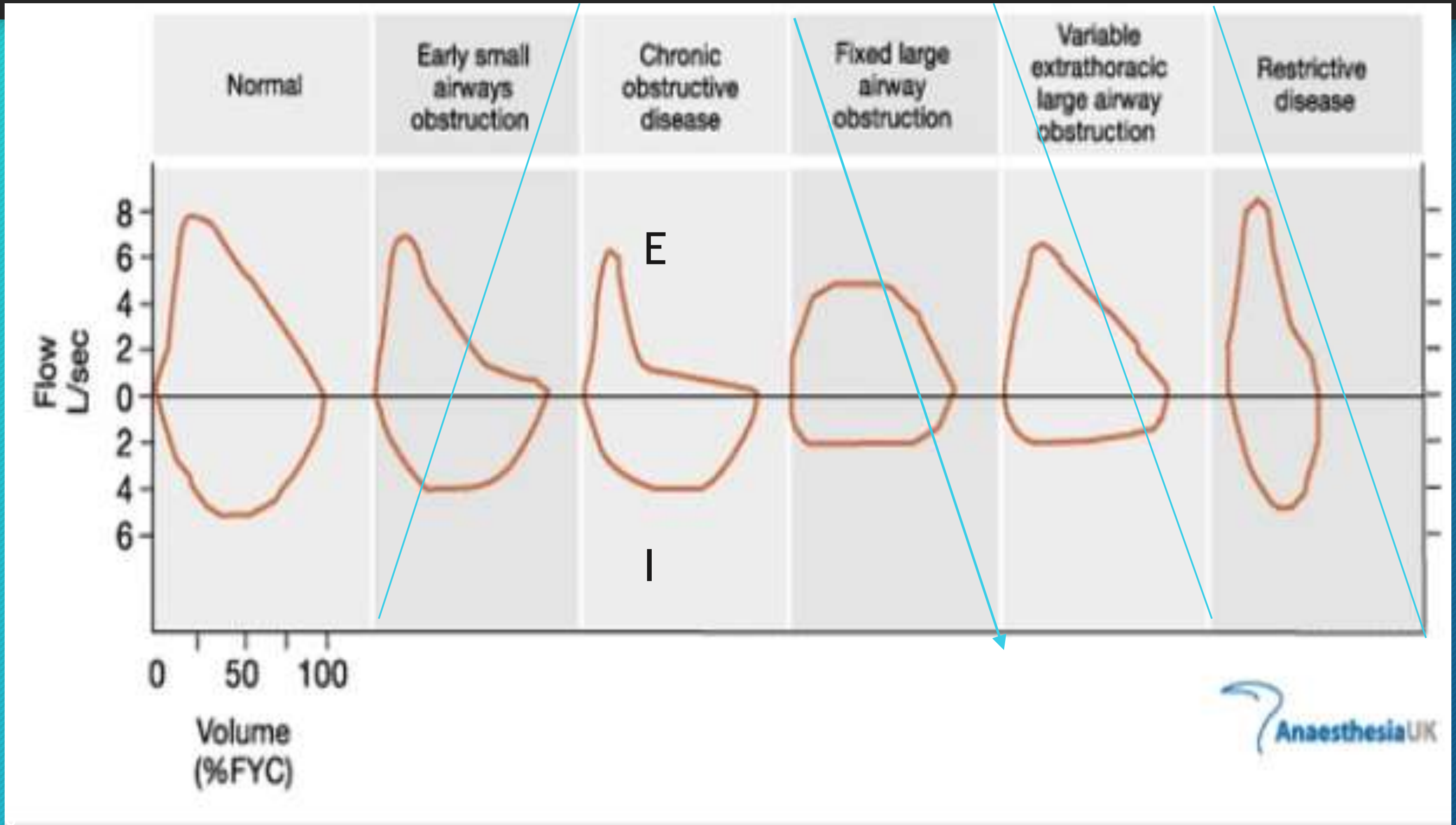
- ↓ minute volume
- ↑ exhaling duration
- Extrinsic PEEP
- Sedation
- Fever control
- Bronchodilators

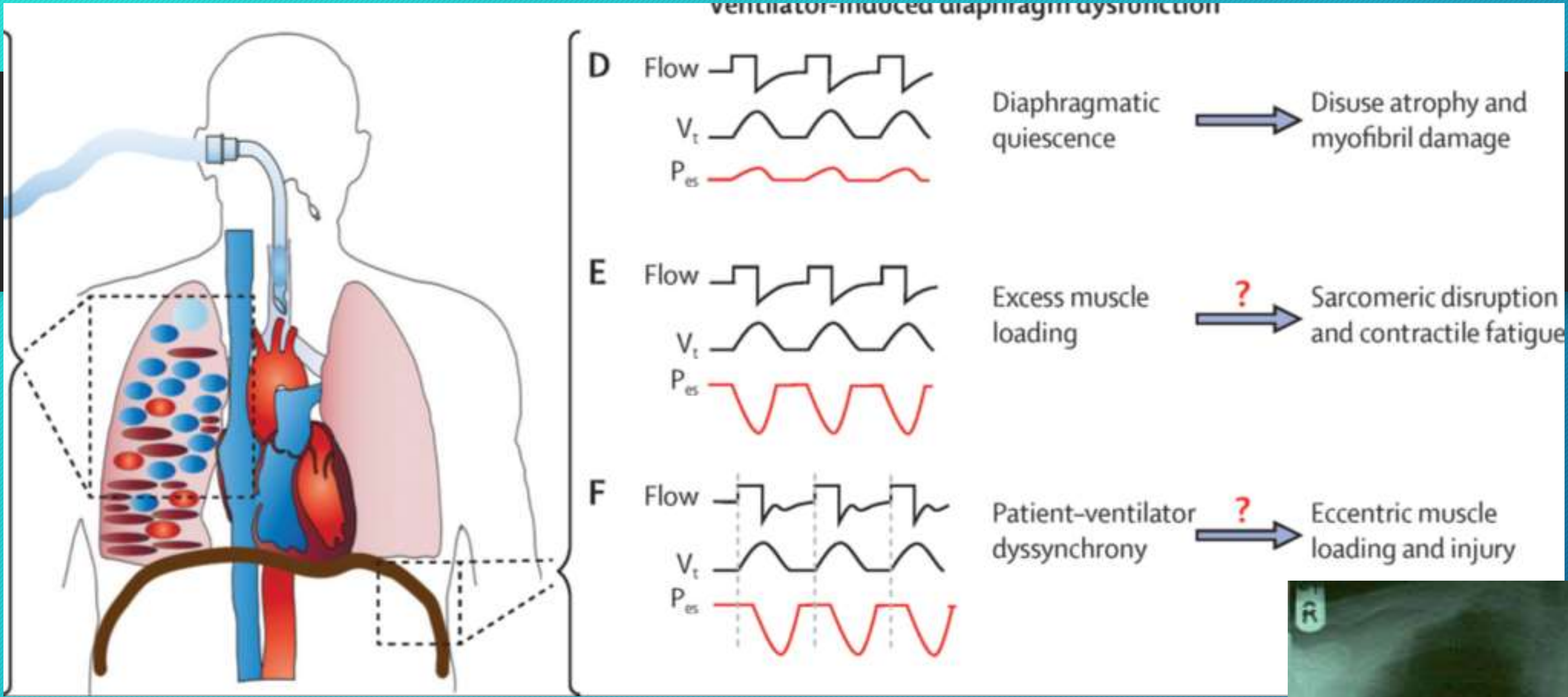
Effect of extrinsic PEEP on WOB
Provide ePEEP!

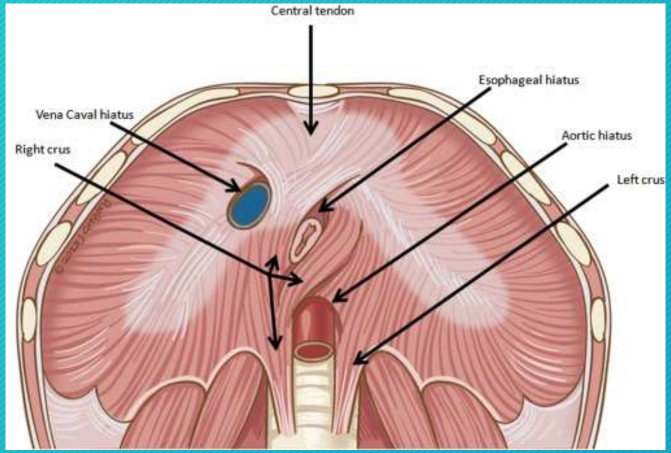


Panel	Auto-PEEP cm H2O	Ventilator Trigger Sensitivity	External PEEP cm H2O	Negative Pressure required to initiate ventilator breath
A	8	2	0	8 + 2 - 0 = 10
B	8	2	6	8 + 2 − 6 = 4
C	8	2	10	8 +2 − 10 = 0

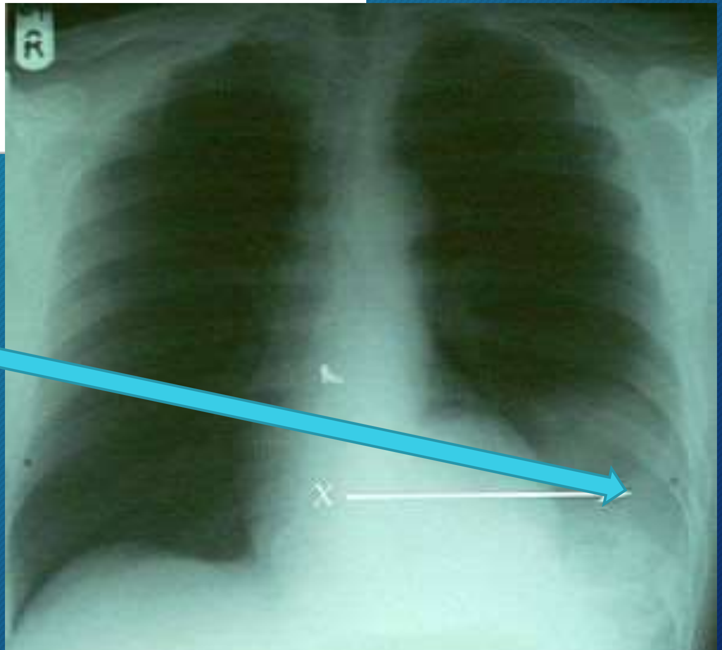
Flow volume loops







Effects of MV on the diaphragm: flattened, split



Ventilation strategy for AECOPD

- Primary goal: ↑PaO2 to 60mmHg & SaO2 to 90%
- ~~VT 8-10ml/kgc~~
- Minventil 115ml/kg
- Long expiratory times
- High inspiratory flow allow short inspiratory times → longer expiratory time for any given RR
- Lower RR
- Volume control more versatile vs pressure control

Minute ventilation

- VT 6-7ml/kg
- RR 12/min. IC is reduced
- Low MV →↑ $PaCO_2$ = the price payed for preventing DH
- Literature suggestion: Risk of DH >>> permissive hypercapnia
- ! Provide enough ventilation to keep a Normal PH, nor a normal $PaCO_2$

Ventilator related factors

- Narrow ET
- External PEEP
- Insensitive triggering
- Decreased triggering threshold of the ventilator

Readiness to wean

Boles JM et al. Reanimation 2008, 17, 74-97

Clinical assessment

- Absence of excessive tracheo-bronchial secretions
- Resolution of disease acute phase for which the patient was intubated

Objective measurements

- Stable CV status (<140/min, sBP 90-160mmHg, no or minimal vasopressors)
- Stable metabolic status
- Adequate oxygenation SaO_2>90% on $FiO_2 \leq 0.4$; P/F ≥150mmHg; PEEP≤8cmH2O
- Adequate pulmonary function: fR<35/min; fR/VT<105resp/min/l;MIP ≤ - 20-25cmH2O1; VT>5ml/kgc; no significant acidosis
- Adequate mentation: no sedation or adequate mentation on sedation

Weaning BTS Guidelines

- Adequate oxygenation P/F > 27 kPa (200mmHg)
- PEEP < 10cmH2o
- Adequate alveolar ventilation pH > 7.3, $PaCO_2$ < 6.5KPa
- Fluid balance optimized

SBT Boles

1st SBT

- 30min
- T tube or low PS: 5-8mmHg ± 5 cmH2O PEEP
- To avoid SIMV!

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

A Craig Davidson,[1] Stephen Banham,[1] Mark Elliott,[2] Daniel Kennedy,[3] Colin Gelder,[4] Alastair Glossop,[5] Alistair Colin Church,[6] Ben Creagh-Brown,[7] James William Dodd,[8,9] Tim Felton,[10] Bernard Foëx,[11] Leigh Mansfield,[12] Lynn McDonnell,[13] Robert Parker,[14] Caroline Marie Patterson,[15] Milind Sovani,[16] Lynn Thomas,[17] BTS Standards of Care Committee Member, British Thoracic Society/Intensive Care Society Acute Hypercapnic Respiratory Failure Guideline Development Group, On behalf of the British Thoracic Society Standards of Care Committee

- http://dx.doi.org/10.1136/thoraxjnl-2016-208281

Box 2 Risk factors for extubation failure following invasive mechanical ventilation (IMV)

- Positive fluid balance
- Raised rapid shallow breathing index during spontaneous breathing trial
- Pneumonia or pulmonary disease as the cause requiring IMV
- Increased age
- Prolonged duration of IMV
- Anaemia
- Increased severity of illness
- Low albumin
- Previous failed extubation
- Bulbar dysfunction

After extubation

1. Venturi Mask
2. Rezervoir nonrebreathing masks 10-15l/min
3. Nasal cannulae FiO_2 0.45

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Management of COPD exacerbations: a European Respiratory Society/American Thoracic Society guideline

Jadwiga A. Wedzicha (ERS co-chair)[1], Marc Miravitlles[2], John R. Hurst[3], Peter M.A. Calverley[4], Richard K. Albert[5], Antonio Anzueto[6], Gerard J. Criner[7], Alberto Papi[8], Klaus F. Rabe[9], David Rigau[10], Pawel Sliwinski[11], Thomy Tonia[12], Jørgen Vestbo[13], Kevin C. Wilson[14] and Jerry A. Krishnan (ATS co-chair)[15]

Humidification with NIV

Recommendation

6. Humidification is not routinely required (Grade D).

Good practice point

Heated humidification should be considered if the patient reports mucosal dryness or if respiratory secretions are thick and tenacious.

Air humidifiers/filters HMEFs AARC guidelines 2012

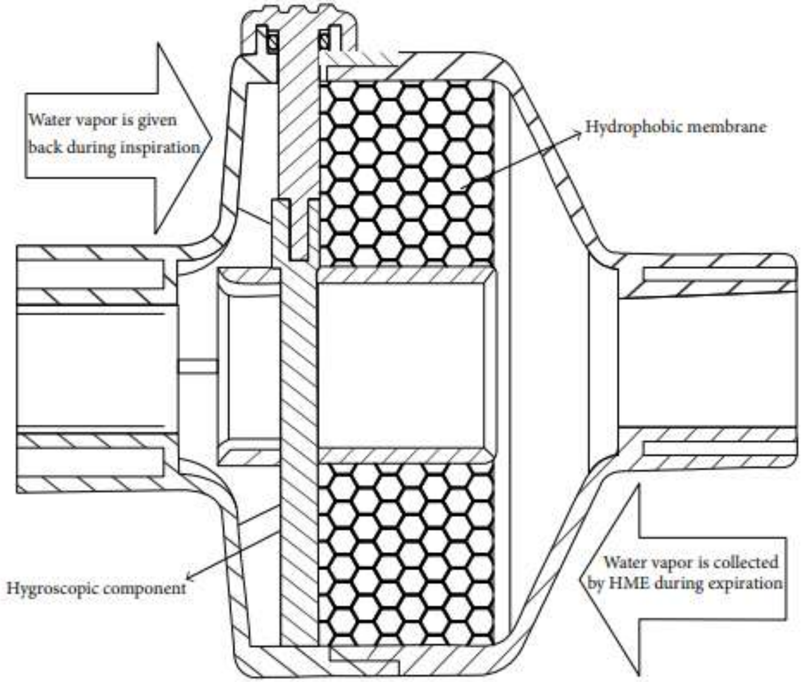


Figure 5: HME.

Table 2: Contraindications for heat and moisture exchangers according to AARC Clinical Practice Guidelines 2012 [11].

(i) Patients with thick or copious secretions.
(ii) When there is loss in expired tidal volume (e.g., large bronchopleurocutaneous fistulas or presence of endotracheal tube cuff leak).
(iii) In patients managed with low tidal volumes like those with ARDS.
(iv) In difficult to wean patients and those with limited respiratory reserve.
(v) Hypothermic patients with body temperature of <32°C.
(vi) In patients with high minute ventilations volumes (>10 L/min).

Standards of humidifiers used with intubated pts HMEF Heat Moisture Exchange Filters

- **Moisture output at least 33g or**
- **Absolute humidity of 75% 9**

TS or NOT? When?

BTS/ICS

It is accepted that translaryngeal intubation beyond 10 days days can be detrimental.

In AHRF due to COPD, and in many patients with NMD or OHS, NIV - supported extubation should be employed in preference to inserting a tracheostomy.

ELSEVIER

Chest

Volume 106, Issue 1, July 1994, Pages 201-209

Clinical Investigations in Critical Care

Survival and Long-term Follow-up of Tracheostomized Patients With COPD Treated by Home Mechanical Ventilation: A Multicenter French Study in 259 Patients

To define more clearly the value of home mechanical ventilation by tracheostomy (HMVT) in patients with advanced COPD, a retrospective French multicenter study group analyzed the prognostic factors and long-term survival of 259 patients with severe COPD, who were tracheostomized for at least 1 year. Seventy-eight percent of the patients died by the end of the observation period. The actuarial survival rate for the overall study population was, therefore, 70 percent at 2 years, 44 percent at 5 years, and 20 percent at 10 years. These results appear to be better than those of the major published series and compare to the prognosis of COPD patients treated by long-term oxygen therapy (LTO) 15 hr/24 hr. The parameters most closely correlated with a survival for more than 5 years were age <65 years, use of an uncuffed cannula, and a PaO_2 >55 mm Hg in room air during the 3 months after tracheostomy (p<0.01). This study, therefore, confirmed the feasibility of HMVT in COPD and should lead to a review of the place of permanent tracheostomy in the long-term prognosis of severe COPD patients.

Long-Term Survival in Patients With Tracheostomy and Prolonged Mechanical Ventilation in Olmsted County, Minnesota

Marija Kojicic MD, Guangxi Li MD, Adil Ahmed MBBS, Lokendra Thakur MBBS,
Cesar Trillo-Alvarez MD, Rodrigo Cartin-Ceba MD, Peter C Gay MD, and Ognjen Gajic MD MSc

Respiratory Care • November 2011 Vol 56 No 11

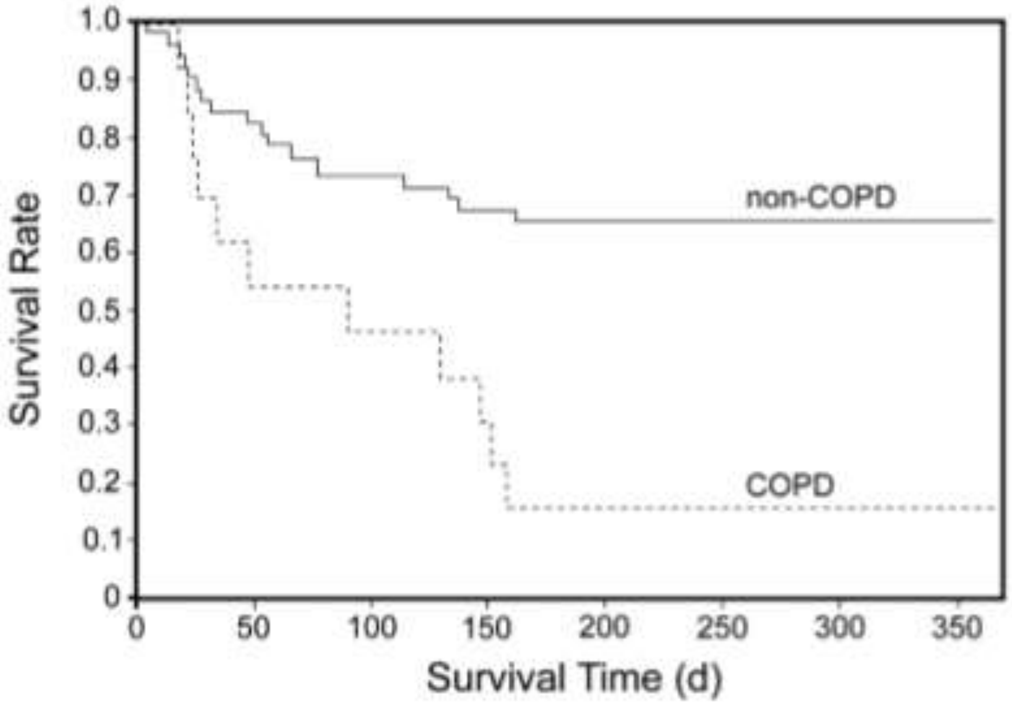
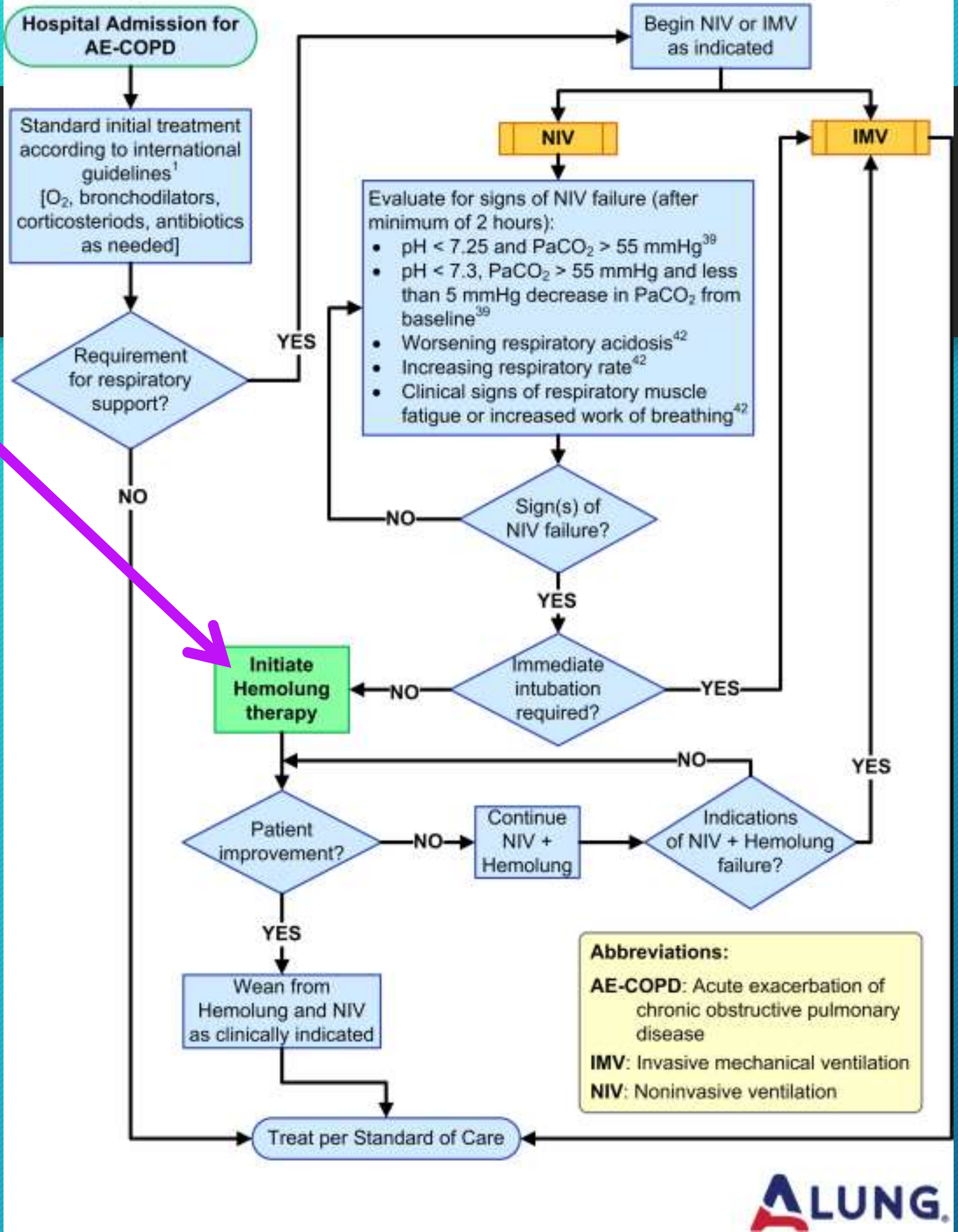


Fig. 1. Kaplan-Meier curve of 1-year survival in patients with versus without COPD, who required prolonged mechanical ventilation (P = .006 via log-rank test).

Survival on the long run?

$ECCO_2R$

Figure 1: Algorithm for use of low-flow $ECCO_2R$ in acute exacerbation of COPD failing NIV



TASK FORCE REPORT
ERS/ATS GUIDELINE

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ECCO2R

2 italian ICUs (May 2011-Nov 2013)

Added to NIV when at risk for NIV failure (at least 2 hrs of continuous NIV)

aPH ≤ 7.3

$PaCO_2$ > 20% of baseline

RR ≥ 30/min or accessory resp muscles/paradoxical abd movements

TASK FORCE REPORT
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Clinical efficacy: the ability to wash out excessive CO_2 by increasing alveolar ventilation.

ECCO2R interruption

Reversion to NIV only when all the following were preserved for at least 12 hrs:

- RR < 25/min
- pHa > 7.35
- PaCO2 < 20% of baseline
- No accessory muscle work and/or paradoxical abd movements

ECCO2R adverse events 52%

Mecahnical

- Membrane lung failure
- Clots/air in circuit
- Pump malfunction
- Tubing rupture

Patient related

- Vein perforation
- Significant bleeding (ICU, packed red cells)
- DH instability
- +... a lot!

AECOPD suggestions / recommendations

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

A Craig Davidson,[1] Stephen Banham,[1] Mark Elliott,[2] Daniel Kennedy,[3] Colin Gelder,[4] Alastair Glossop,[5] Alistair Colin Church,[6] Ben Creagh-Brown,[7] James William Dodd,[8,9] Tim Felton,[10] Bernard Foëx,[11] Leigh Mansfield,[12] Lynn McDonnell,[13] Robert Parker,[14] Caroline Marie Patterson,[15] Milind Sovani,[16] Lynn Thomas,[17] BTS Standards of Care Committee Member, British Thoracic Society/Intensive Care Society Acute Hypercapnic Respiratory Failure Guideline Development Group, On behalf of the British Thoracic Society Standards of Care Committee

a. NIV
b. NIV + ECCO2R (del Sorba et al)
c. IMV : Intubated or tracheostomized
d. IMV + ECCO2R (case reports)

Prolungmeter

AECOPD outcome

CCI pts = chronic critical pts

= successfully survived an initial insult, but do not recover readily enough to be liberated from intensive care.

CCI = organ dysfunction that lasted for 14 days or longer and requiring ICU treatment.

Nelson GI et al. Crit Care Med, 2017, 45(12):2104

How long can a COPD patient live on a ventilator?

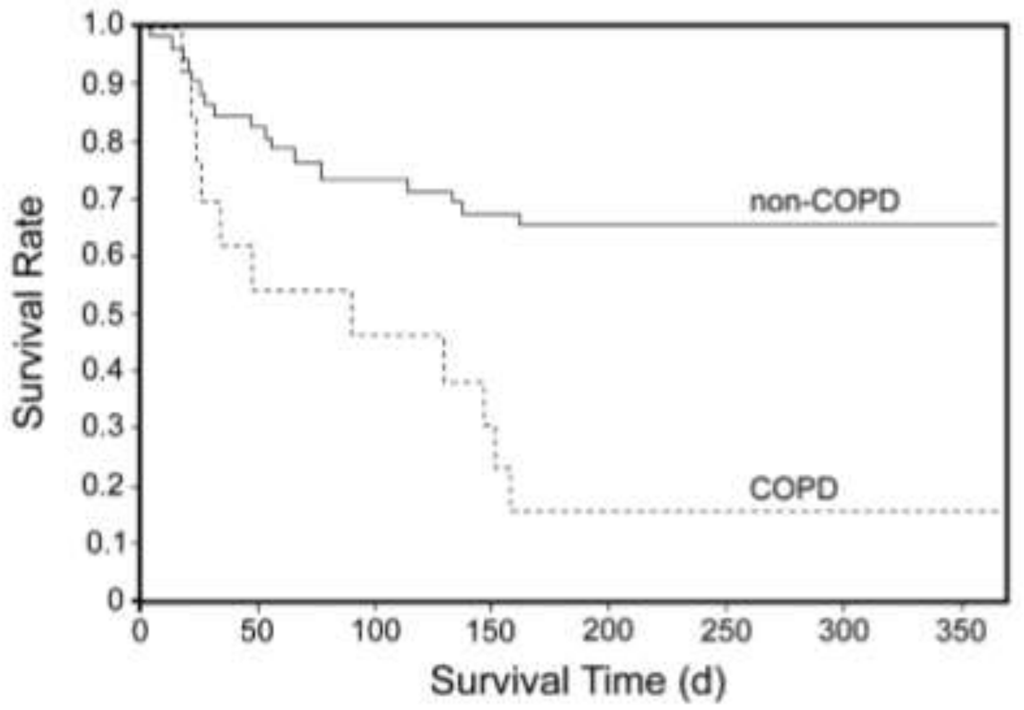

Fig. 1. Kaplan-Meier curve of 1-year survival in patients with versus without COPD, who required prolonged mechanical ventilation (P = .006 via log-rank test).

Table 1. Survivors Versus Non-survivors at One Year

	Non-survivors ($n = 29$)	Survivors ($n = 36$)	*P*
Demographic Characteristics			
Age, median (IQR), y	76 (68–82)	57 (33–68)	< .001
Male, no. (%)	16 (55)	23 (64)	.60
White, no. (%)	25 (86)	27 (75)	.35
History of tobacco smoking, no. (%)	18 (62)	19 (53)	.62
History of alcohol abuse, no. (%)	2 (7)	5 (14)	.45
Body mass index, median (IQR), kg/m^2	25 (22–31)	26 (22–30)	.67
Comorbidities			
Charlson score, median (IQR)	3 (2–4)	2 (0–3)	.13
COPD, no. (%)	11 (38)	2 (6)	.002
Trauma, no. (%)	1 (3)	8 (22)	.04
Neuromuscular disease, no. (%)	2 (7)	5 (14)	.44
Major surgery, no. (%)	11 (38)	11 (31)	.61
Congestive heart failure, no. (%)	7 (24)	8 (22)	.56
Ejection fraction < 45%, no. (%)*	4 (17)	4 (13)	> .99
Dialysis, no. (%)	7 (24)	5 (14)	.35
Diabetes mellitus, no. (%)	11 (38)	7 (19)	.16
ICU Admission Characteristics			
ICU Admission source, no. (%)			.74
Direct admission	1 (4)	0 (0)	
Emergency room	9 (31)	11 (31)	
Floor	9 (31)	9 (25)	
Operating room	9 (31)	15 (42)	
Other hospital	1 (4)	1 (3)	
APACHE III score, median (IQR)	81 (63–92)	64 (51–91)	.14
APACHE III hospital predicted mortality, median (IQR)	0.38 (0.17–0.93)	0.23 (0.08–0.43)	.06
ICU treatments and complications			
Acute lung injury, no. (%)†	20 (69)	20 (56)	.31
Shock, no. (%)†	18 (62)	23 (64)	> .99
Platelet count ≤ $150 \times 10^9/L$‡	25 (86)	23 (68)	.14
Do-not-resuscitate status at hospital admission, no. (%)	2 (6.9)	3 (8.3)	> .99
Outcomes			
Days of mechanical ventilation, median (IQR), d§	24 (18–34)	24 (17–40)	.94
Hospital stay, median (IQR), d	42 (25–83)	43 (30–61)	.86
Hospital Disposition, no. (%)	($n = 10$)	($n = 36$)	.06
Home	1 (10)	11 (31)	
Other Hospital	0 (0)	3 (8)	
Nursing Home	7 (70)	9 (25)	
Rehabilitation	2 (20)	13 (36)	

* Echocardiograph data were available from 54 patients.
† At any time during intensive care unit (ICU) stay.
‡ Lowest value during ICU stay.
§ Patients who were continued on mechanical ventilation were excluded from analysis.
APACHE = Acute Physiology and Chronic Health Evaluation

COPD deceased 5x> survivors 1 year following discharge

Comorbidities			
Charlson score, median (IQR)	3 (2–4)	2 (0–3)	.1
COPD, no. (%)	11 (38)	2 (6)	.0
Trauma, no. (%)	1 (3)	8 (22)	.0
Neuromuscular disease, no. (%)	2 (7)	5 (14)	.4
Major surgery, no. (%)	11 (38)	11 (31)	.6
Congestive heart failure, no. (%)	7 (24)	8 (22)	.5
Ejection fraction < 45%, no. (%)*	4 (17)	4 (13)	> .9
Dialysis, no. (%)	7 (24)	5 (14)	.3
Diabetes mellitus, no. (%)	11 (38)	7 (19)	.1
ICU Admission Characteristics			
ICU Admission source, no. (%)			.7
Direct admission	1 (4)	0 (0)	
Emergency room	9 (31)	11 (31)	
Floor	9 (31)	9 (25)	
Operating room	9 (31)	15 (42)	
Other hospital	1 (4)	1 (3)	
APACHE III score, median (IQR)	81 (63–92)	64 (51–91)	.1
APACHE III hospital predicted mortality, median (IQR)	0.38 (0.17–0.93)	0.23 (0.08–0.43)	.0

International Journal of COPD
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ORIGINAL RESEARCH

Long-term survival for COPD patients receiving noninvasive ventilation for acute respiratory failure

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Annmarie T Lassen[2]
Jørgen Vestbo[1,3]

[1]Department of Respiratory Medicine, [2]Department of Emergency Medicine, Odense University Hospital, University of Southern Denmark, Odense, Denmark; [3]Respiratory Research Group, Manchester Academic Health Sciences Centre, University Hospital South Manchester NHS Foundation Trust, University of Manchester, Manchester, UK

Table 2 Survival and observation time of COPD patients versus non-COPD patients receiving NIV for the first time

	COPD	Non-COPD
Patients, n (male/female)	216 (95/121)	37 (14/23)
Age, years (median)*	72 (45; 66; 79; 91)	71 (24; 62; 80; 88)
Mean survival of mortal patients, days (median)*	227 (0; 15; 810; 2224)	15 (0; 4; 177; 1302)
Mean observation time of survivors, days (median)*	2097 (1707; 1822; 2509; 2582)	2002 (1609; 1728; 2412; 2508)

Note: *(min; 25th percentile; 75th percentile; max).
Abbreviations: COPD, chronic obstructive pulmonary disease; NIV, noninvasive ventilation.

The primary focus of this present study has not been evaluation of the indication for NIV treatment; since 2008, an annual national surveillance of patients with COPD (Dansk Register for KOL [DrKOL]) has been launched, registration practice (International Classification of Diseases [ICD]-10) has been reviewed, and audits performed. In Denmark, treatment with NIV was provided to 9% of all COPD patients admitted with an exacerbation in 2009 and 10% in 2010 and 2011.[9]

AECOPD = high risk
Poor prognosis
??!! What is achievable with NIV outside the ICU
pH<7.25 worse outcome at NIV initiation

Conclusion

Our study confirms that patients with hypercapnic respiratory failure are a high-risk group, often with a poor prognosis. It casts some doubt as to what is achievable from NIV in a non-ICU setting and suggests that regular audits are required to ensure that the right patients are offered the right treatment when admitted with mild hypercapnic respiratory failure. However, the 5-year survival rate was higher than earlier anticipated, justifying the broad approach to NIV treatment in this setting. The high 30-day mortality rate for all NIV-initiated patients was higher (29.3%) than for the group of patients with COPD (24.3%), and this supports the notion that NIV should be dedicated primarily to patients with COPD in exacerbation. The 30-day mortality rate for COPD patients receiving NIV was similar in an audit from 2010, and patients with pH < 7.25 had a worse outcome than patients presenting with higher pH at NIV initiation (unpublished data). Monitoring of patient outcomes in a real-life setting is necessary to ensure optimal selection of patients for NIV in a non-ICU setting.

Thorax 2001;**56**:708–712

Non-invasive ventilation in acute exacerbations of chronic obstructive pulmonary disease: long term survival and predictors of in-hospital outcome

P K Plant, J L Owen, M W Elliott

Table 4 Variables at 4 hours associated with failure of treatment

Variable	*Univariate analysis p value*	*Multivariate analysis* Odds ratio	*Multivariate analysis* p value
At enrolment			
H^+	<0.001	1.23 (1.05 to 1.43) per nmol/l	<0.01
Pao_2	0.035		
$Paco_2$	<0.001	1.77 (1.28 to 2.45) per kPa	<0.01
Allocation to NIV	0.038		
At 1 hour			
Fall in H^+	0.119		
Change in Pao_2	0.193		
Change in $Paco_2$	0.276		
Change in respiratory rate	0.209		
At 4 hours			
Fall in H^+	0.035	0.89 (0.82 to 0.97) per nmol/l	<0.01
Change in Pao_2	0.896		
Change in $Paco_2$	0.104		
Change in respiratory rate	0.009	0.92 (0.84 to 0.99) per breath/min	0.04

$Paco_2$, Pao_2 = arterial carbon dioxide and oxygen tensions; NIV = non-invasive ventilation.

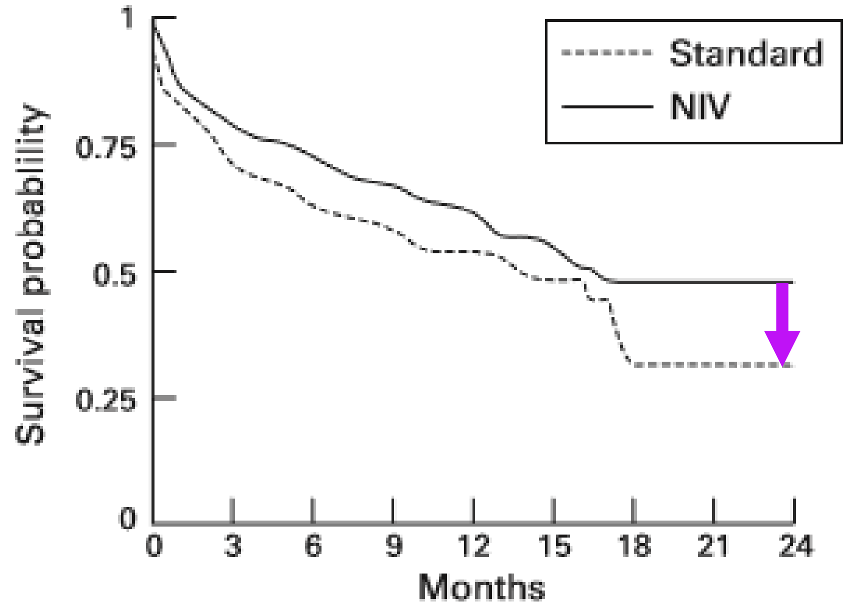

Figure 1 Kaplan-Meier plot of survival from enrolment. Median survival 13.4 months in standard treatment group v 16.8 months in NIV group (p=0.12).

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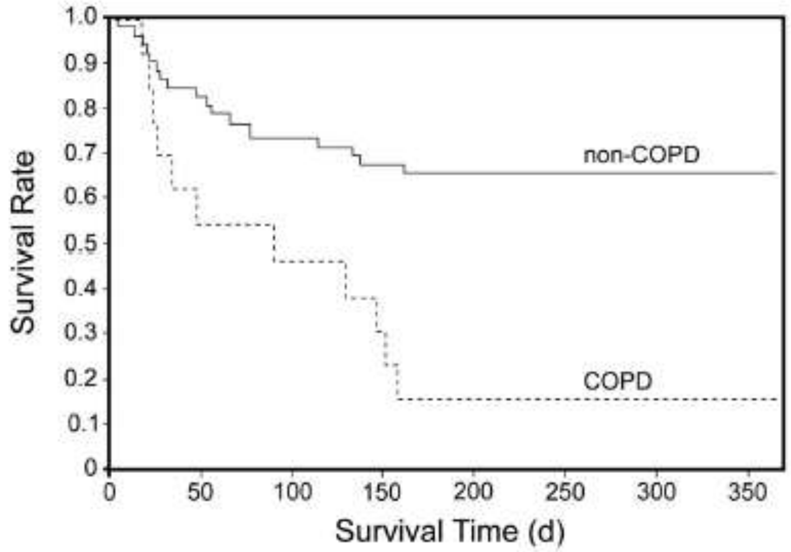

Fig. 1. Kaplan-Meier curve of 1-year survival in patients with versus without COPD, who required prolonged mechanical ventilation (*P* = .006 via log-rank test).

Table 2. Causes of Death After Hospital Discharge

Patient Number	Age (y)	COPD	Cause of Death Per Medical Record or Death Certificate	Days of Survival After Discharge
1*	85	No	Respiratory failure (hypercapnic, hypoxic respiratory failure, diaphragmatic weakness)	28
2	87	No	Gastric carcinoma	31
3	76	No	Stroke (cerebral infarct)	29
4	41	No	Stroke (acute right cerebellar hemorrhage)	70
5	77	Yes	Stroke (not specified)	46
6	88	No	Unknown	80
7	81	Yes	Unknown	23
8	74	Yes	Respiratory failure (COPD, squamous-cell lung cancer, and stroke)	58
9	52	Yes	Respiratory failure (sepsis, acute respiratory distress syndrome)	84
10	68	No	Necrotizing pancreatitis (massive bleeding)	49

* Patient discharged on mechanical ventilation

Effects of Hypercapnia and Hypercapnic acidosis on hospital mortality in Mechanically Ventilated Patients

Turuvoipati R et al. Crit Care Med, 45:e642-e656

"Hypercapnic acidosis during the first 24 hrs on intensive care admission is more strongly associated with increased hospital mortality than compensated hypercapnia or normocapnia."

ANZICS = 1 245 694 pts /47198 mechanically ventilated.

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COPD was an independent risk factor for 1 year survival!

BTS statements

- There is evidence of “prognostic pessimism” among clinicians caring for patients with AECOPD.
- Rec 37. Clinicians should be aware that they are likely to understimate survival in AECOPD treated by IMV. Grade B
-
- Rec 38. Clinicians should discuss management of possible future episodes of AHRF with patients following an episode requiring ventilatory support because there is a high risk of recurrence. Grade B

Dovepress

COMMENTARY

Acute exacerbation of COPD: is it the "stroke of the lungs"?

Georgios Hillas,[1] Fotis Perlikos,[1] Nikolaos Tzanakis[2]

COMMENTARY

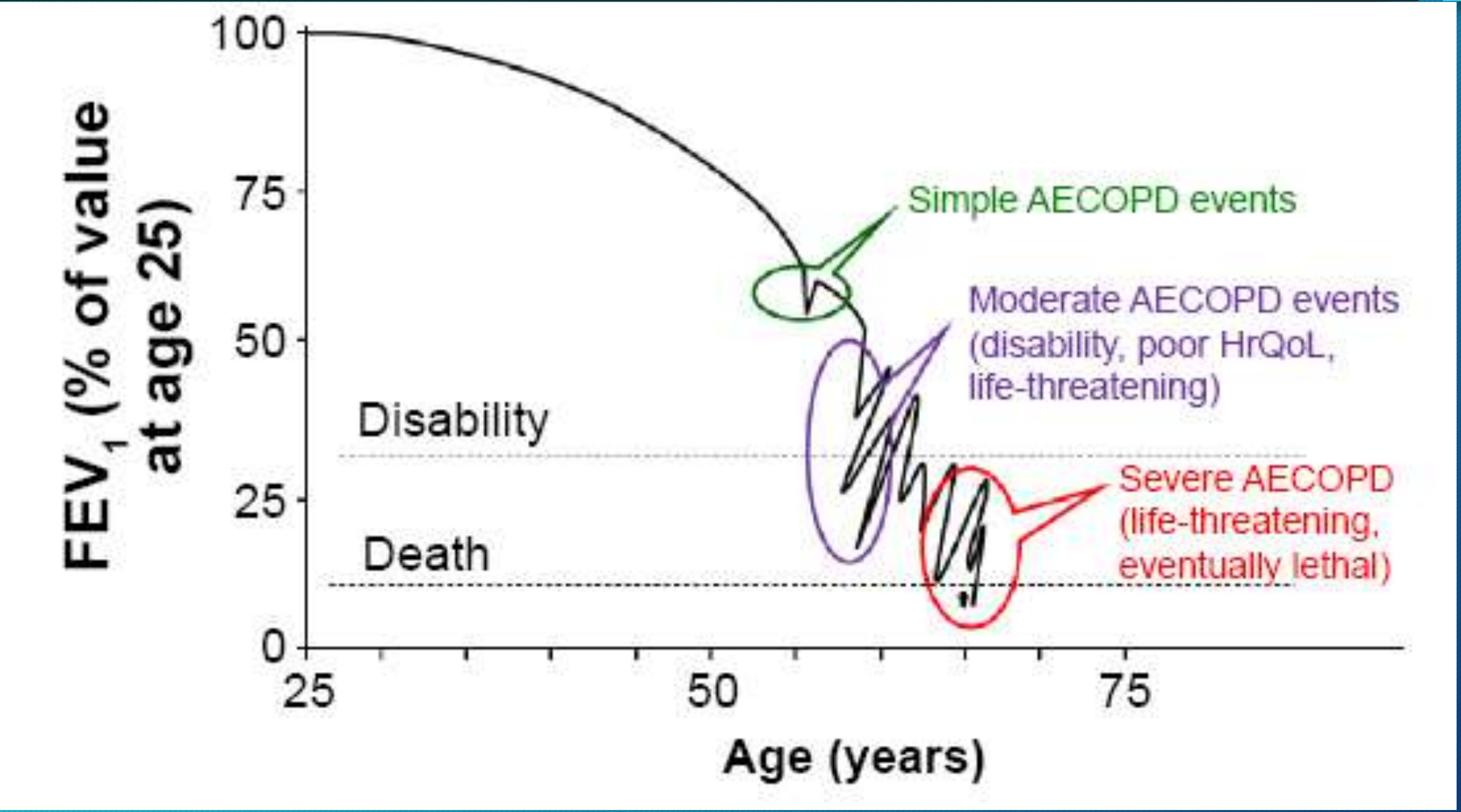
Acute exacerbation of COPD: is it the "stroke of the lungs"?

Abstract | Fulltext | Metrics | Get Permission

Semicolon or disease's full-stop period →	Sharp losses of lung function
Triggering a catastrophic cascade →	More symptoms, lung function decline, lower exercise capacity, higher hospitalization rates and lower quality of life, increased mortality
Relapsing event →	Frequent exacerbator = COPD phenotype
Overwhelming →	In post-AECOPD period, serious adverse events in other organ systems are more frequent
Killer →	90 days mortality rate >6%
Emergency →	Severe medical condition demanding immediate action

Figure 2 AECOPD is the "stroke of the lungs".
Abbreviation: AECOPD, acute exacerbation of chronic obstructive pulmonary disease.

Semiocolon evolution of lung dysfunction in COPD due to AECOPD



Management COPD perioperatively
Slinger P.IARS 2013 review curse lectures; www.iars.org

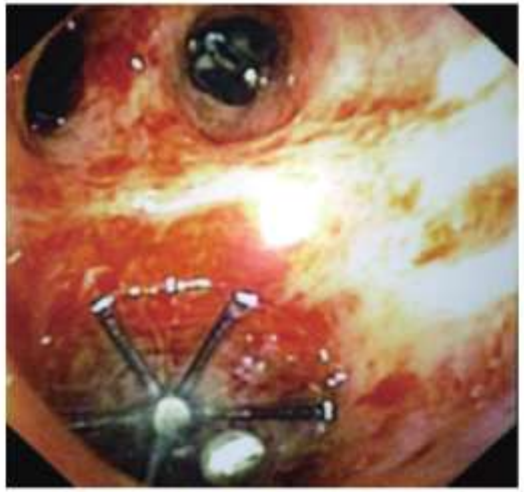


Figure 1 Three Spiration "intrabronchial" valve (IBV) occluding subsegmental airways.

- Nocturnal hypoxemia
- RV dysfunction
- Al pts COPD stage II or III need ABGs to identify patients at risk of developing hypercapnia
- Bullae - blebs asymptomatic until >50% of the hemithorax (+ restrictive respiratory disease)

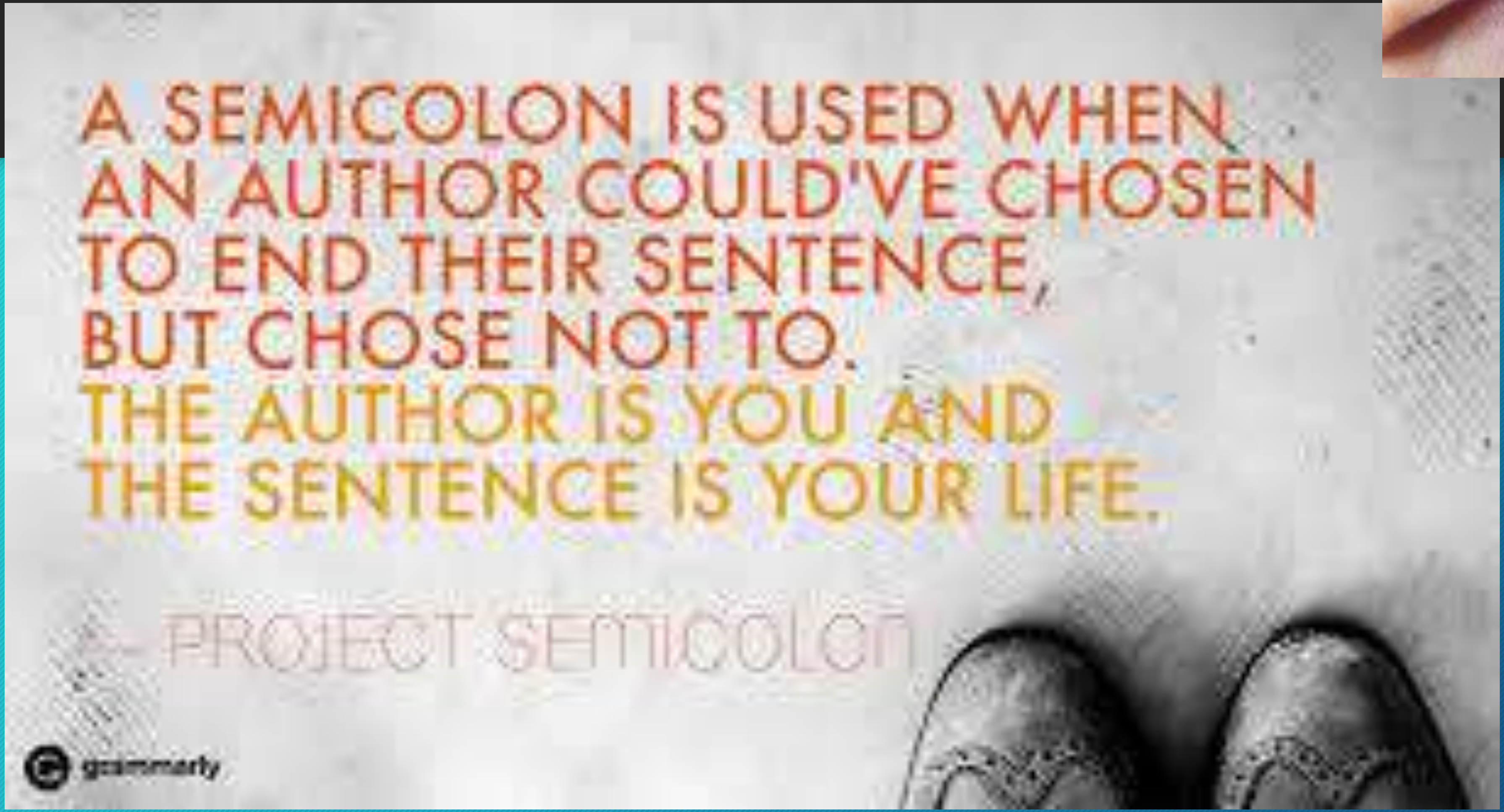
Recently: reduction interventional bronchoscopy - unidirectional br valves.

Management COPD perioperatively

Slinger P.IARS 2013 review curse lectures; www.iars.org

4 perioperatve complications:

- Atelectasis
- Bronchospasm
- Respiratory tract infections
- Pulmonary edema


A SEMICOLON IS USED WHEN
AN AUTHOR COULD'VE CHOSEN
TO END THEIR SENTENCE,
BUT CHOSE NOT TO.
THE AUTHOR IS YOU AND
THE SENTENCE IS YOUR LIFE.
PROJECT SEMICOLON
grammarly