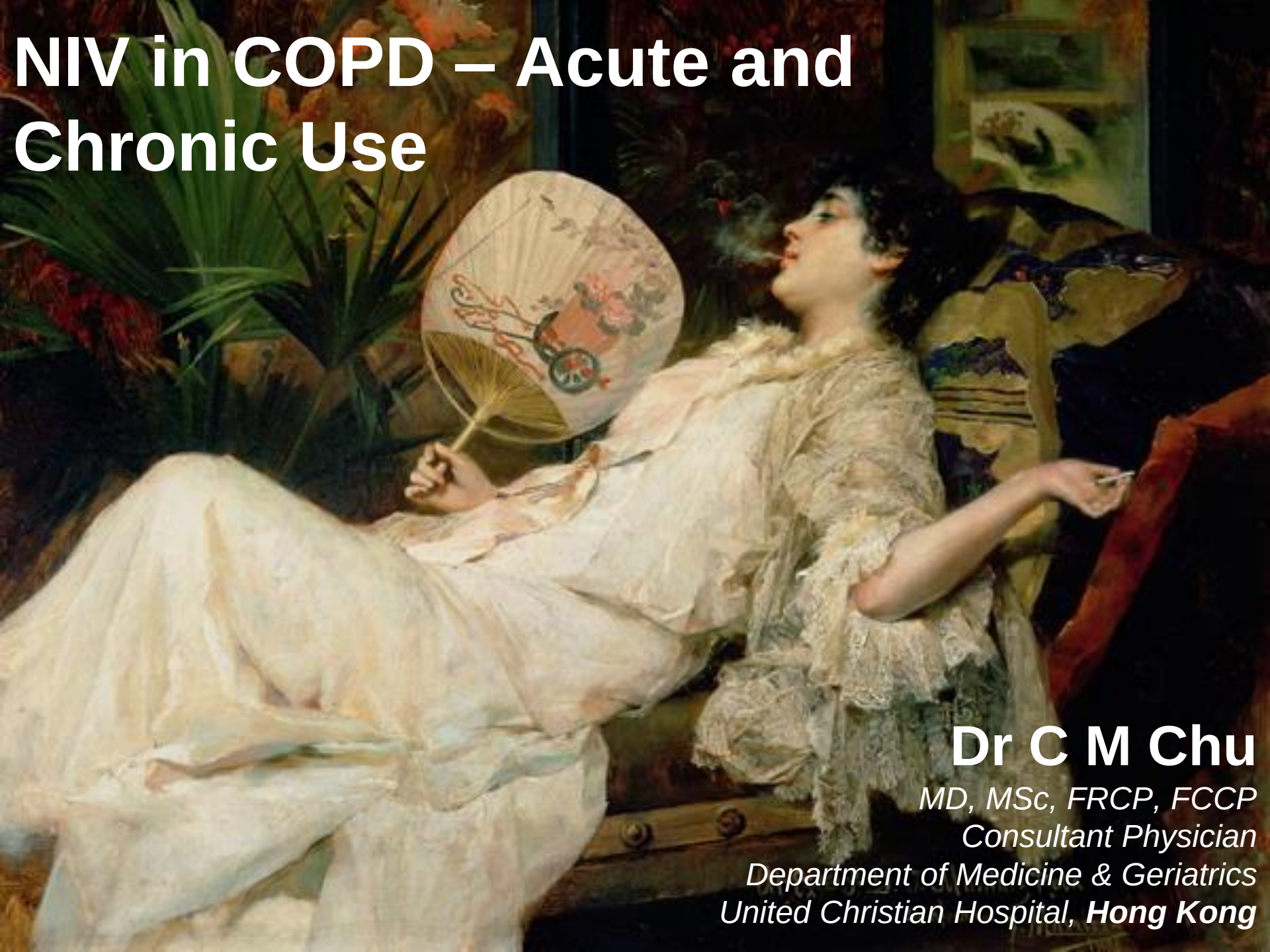
NIV in COPD – Acute and Chronic Use



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NIV in COPD

I. AE-COPD/ARF

II. Weaning of intubated COPD

III. Home NIV

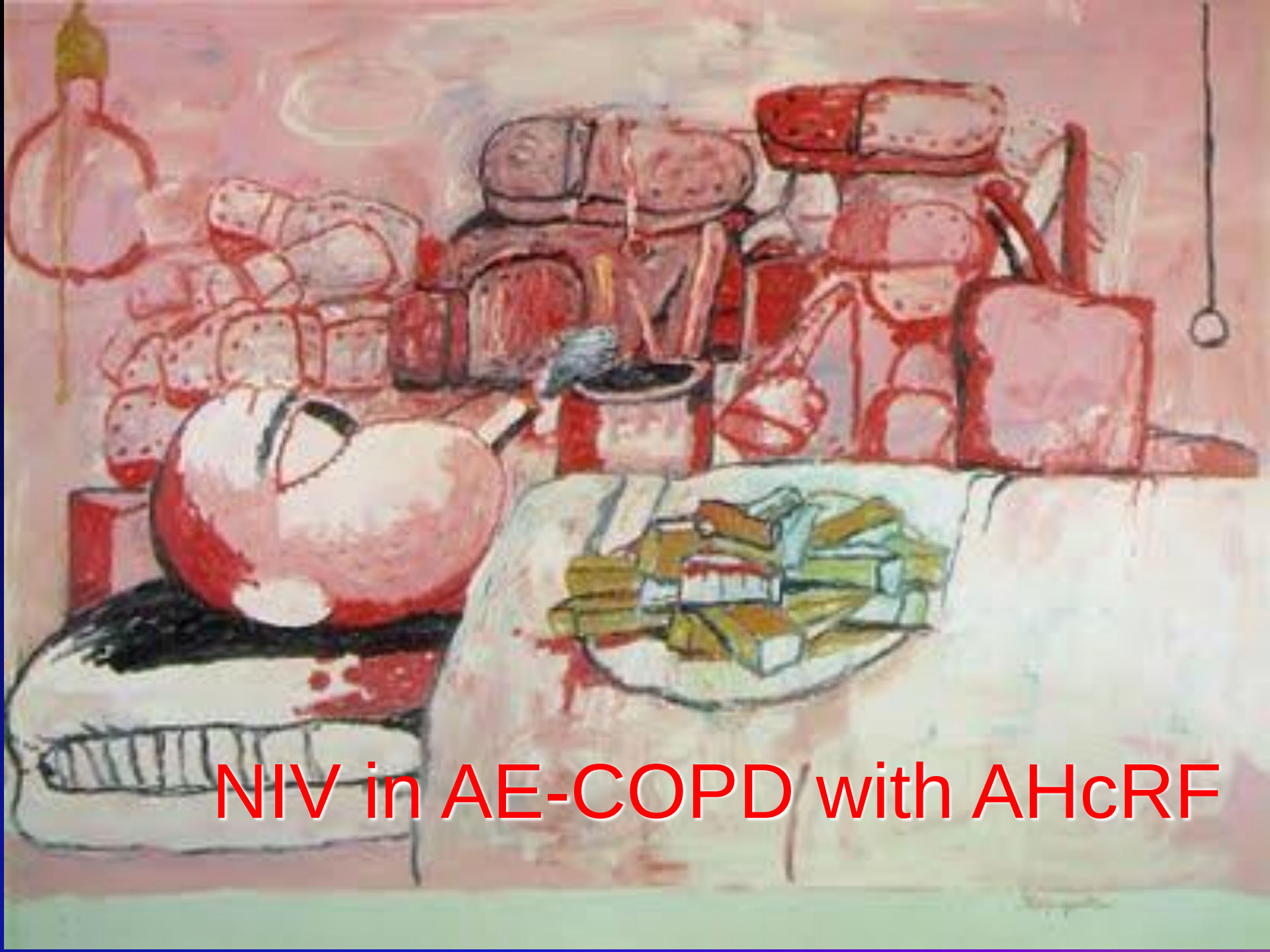
1. Stable pt.

2. After ARF

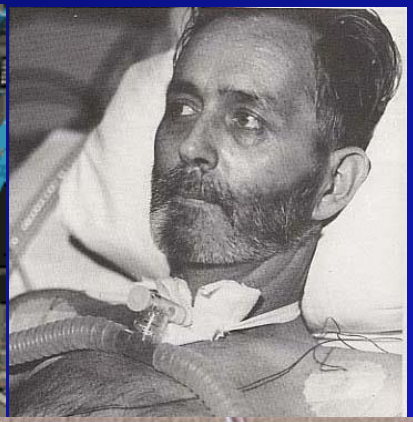
1. COPD/OSA

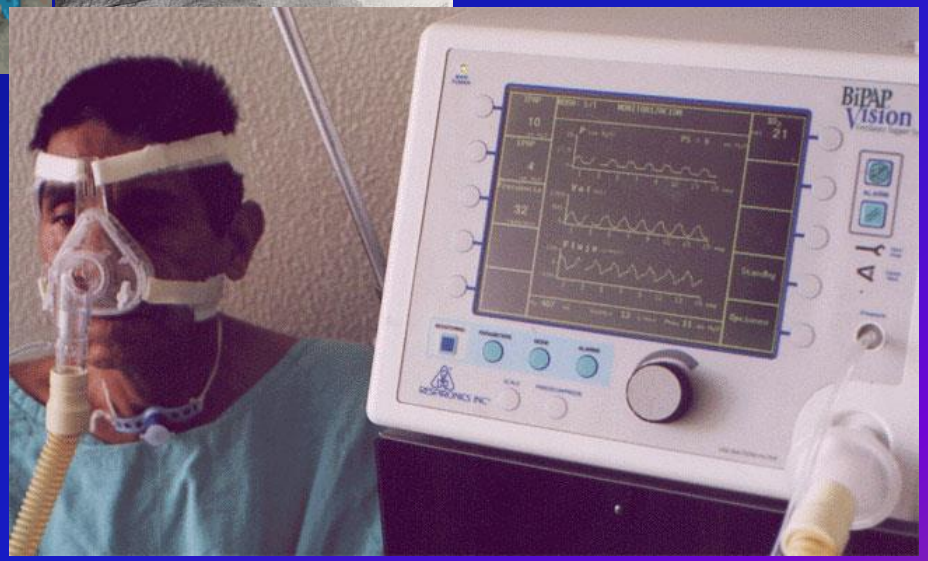
2. COPD rehabilitation

3. Palliative care


NIV in AE-COPD with AHcRF

NIPPV in acute hypercapnic respiratory failure of COPD





AE-COPD with AHcRF

- Persistent acidosis (pH < 7.35) despite maximal medical Rx (NNT 10 to avoid 1 intubation)
- pH < 7.3 strongly advised (50% intubation)

Evidence base for acute NIV

Randomised controlled trials – reduced intubation, mortality

- Bott J, et al. Lancet 1993;341:1555.
- Brochard L, et al. NEJM 1995;333:817.
- Kramer N, et al. AJRCCM 1995;151:1799.
- Angus RM, et al. Thorax 1996;51:1048.
- Celikel T, et al. Chest 1998;114:1636.
- Martin TJ, et al. AJRCCM 2000;161:807.
- Plant PK, et al. Lancet 2000;355:1931.

Meta-analyses

- COPD acute exacerbations with respiratory failure
- NIV is associated with:
  - Lower mortality (RR = 0.41)
  - Lower intubation rate (RR = 0.42)
  - Lower treatment failure (RR 0.32)
  - Greater improvement in pH, $PaCO_2$, RR at 1 hr
  - Fewer complications (RR = 0.51)
  - Shorter hospital stay
    (weight mean difference = - 3.24 days)

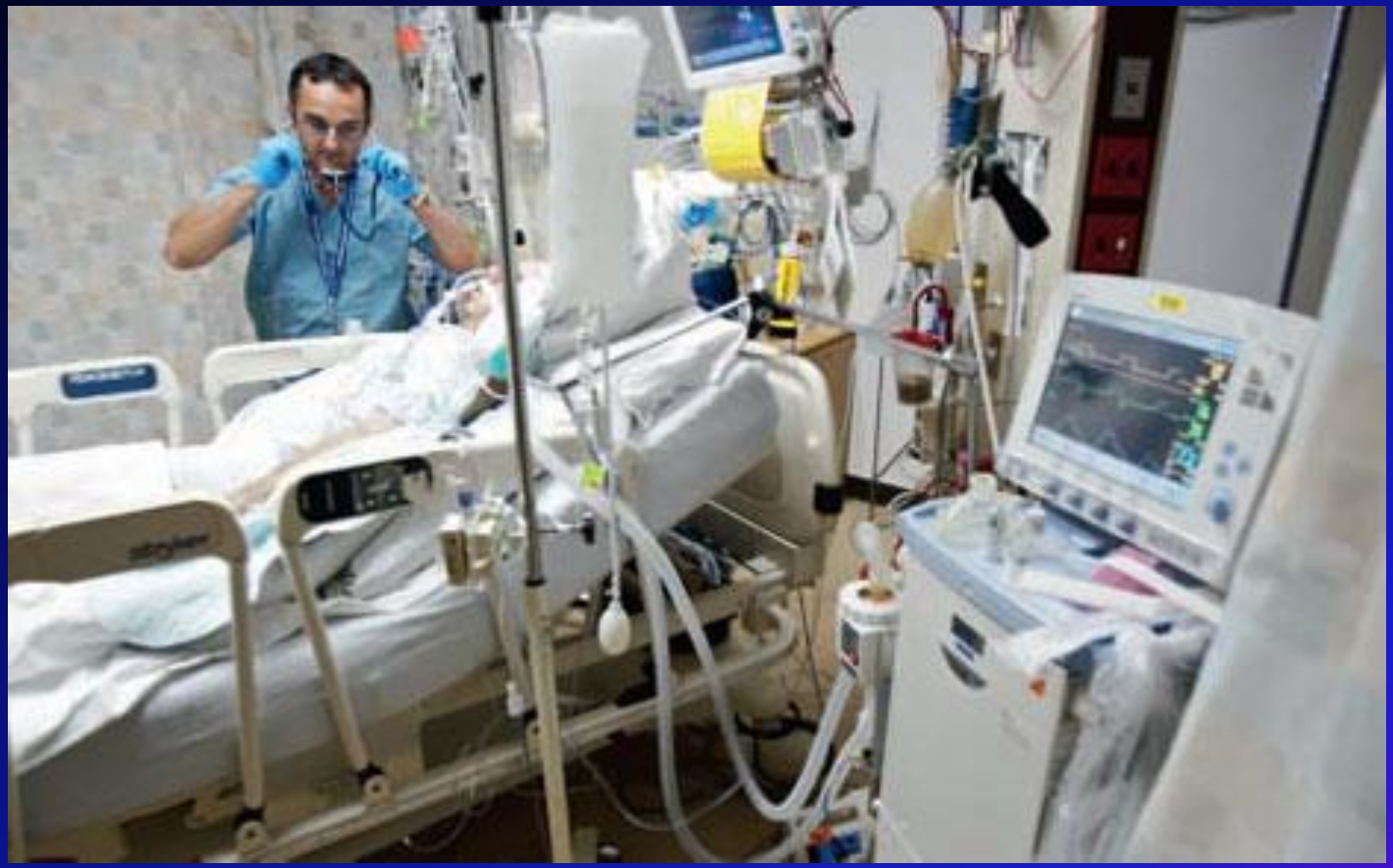
Contraindications

- Cardiac/Respiratory arrest
- Unable to cooperate
- Unable to protect airway or clear secretions, high aspiration risk
- Facial surgery, injury or deformity
- Recent upper GI surgery/anastomosis
- Severely impaired mental state (relative)

Hypercapnic encephalopathy NOT a contraindication, but higher failure rate (86% success with GCS < 8)

NIV in AE-COPD with AHcRF

Trial of NIV should be given in most AE-COPD patients with AHcRF



NIV in weaning of intubated COPD patients

NIV in weaning of patients with Respiratory Failure due to COPD

- 2 group, parallel RCT, Multi-center
- COPD with RF, intubated
- Exclusion
  - Concomitant severe diseases
  - Cardiac arrest, AMI, APO
  - Shock
  - Sepsis
  - Trauma
  - GIB, obstruction, perforation
  - Metabolic coma, DKA
  - Drug overdose
  - Coagulopathy
  - Post-op

Nava S, et al. Ann Intern Med 1998;128:721-728

Protocol

CMV first 12 hr → PSV for 24-36 hrs → T-piece trial → Randomised to NIV or IPSV if failed T-piece

TV 8-10ml/kg

RR 12-16/min

Keep Sao2 > 95%

PS 21 ±2cmH2O

PEEP if necessary

RR > 35/min

PaO2 < 50 mmHg with FiO2 = 40%

HR > 145/min or ↑/↓ by 20%

Severe arrhythmias

SBP > 180 or < 70 mmHg

Agitation, anxiety, diaphoresis

Nava S, et al. Ann Intern Med 1998;128:721-728

Protocol

- NIV
  - PS of 19 ± 2 cm H2O to achieve RR < 25/min and acceptable ABG x 20 – 22 hr/day
  - ↓ PS by 2 – 4 cm H2O per day
  - Trial of spontaneous breathing (3 hours)
    - Sao2> 90% with FiO2 ≤ 40%
    - pH ≥ 7.35
    - Hemodynamic stable; no resp distress, neurological stable
- IPSV
  - PS 17.6 ± 2.1 cm H2O
  - Target RR ≤ 25/min
  - PS decrease daily
  - Intermittent T-piece trial

Nava S, et al. Ann Intern Med 1998;128:721-728

NIV in weaning of patients with Respiratory Failure due to COPD - Results

- 50 enrolled, 25 in each group
- NIV vs. IPSV
  - Fewer days on ventilator: 10.2 vs 16.6 (p =0.021)
  - Shorter ICU stay: 15.1 vs. 24 (p = 0.005)
  - Higher successful weaning at 21 days (p =0.003)
  - No patient had VAP in NIV group (28% in IPSV)
  - Higher 60 days survival (92% vs 72%, p = 0.009)

Nava S, et al. Ann Intern Med 1998;128:721-728

KM curves - weaning

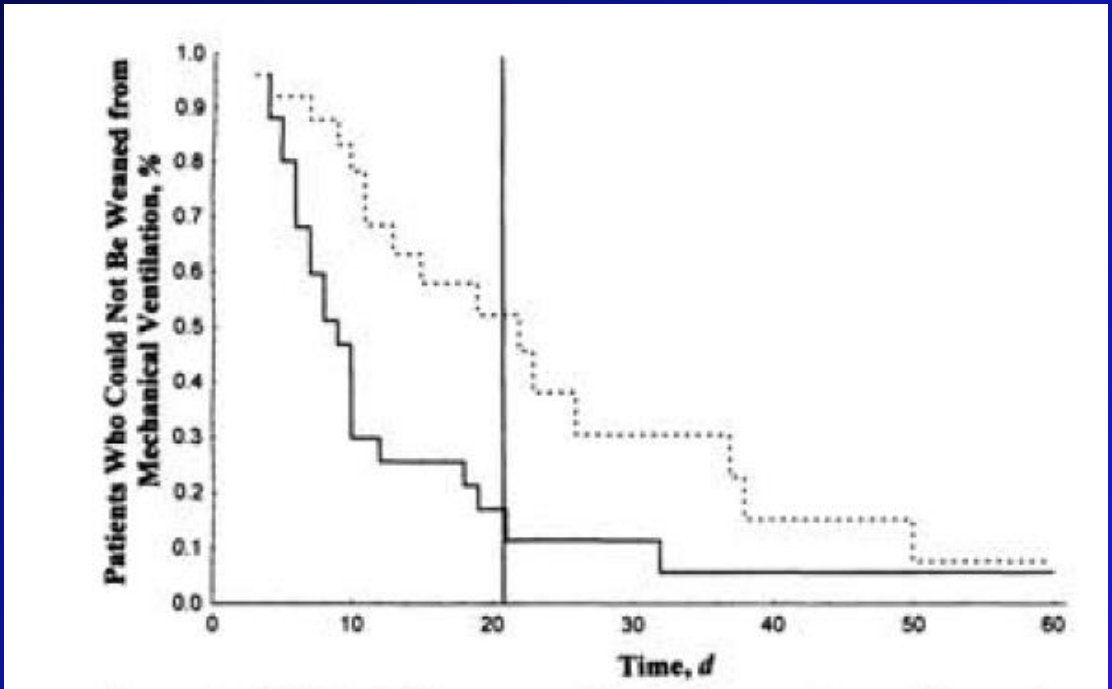


Figure 2. Kaplan-Meier curves for patients who could not be weaned from mechanical ventilation (defined as weaning failure or death linked to mechanical ventilation) in the two groups.

The probability of weaning failure was significantly lower for the noninvasive ventilation group (cumulative probability for 60 days, $P < 0.01$ by the log-rank test). The vertical line represents day 21, usually considered the threshold between weanable and unweanable patients. The solid line represents noninvasive pressure support ventilation; the dashed line represents invasive pressure support ventilation.

Nava S, et al. Ann Intern Med 1998;128:721-728

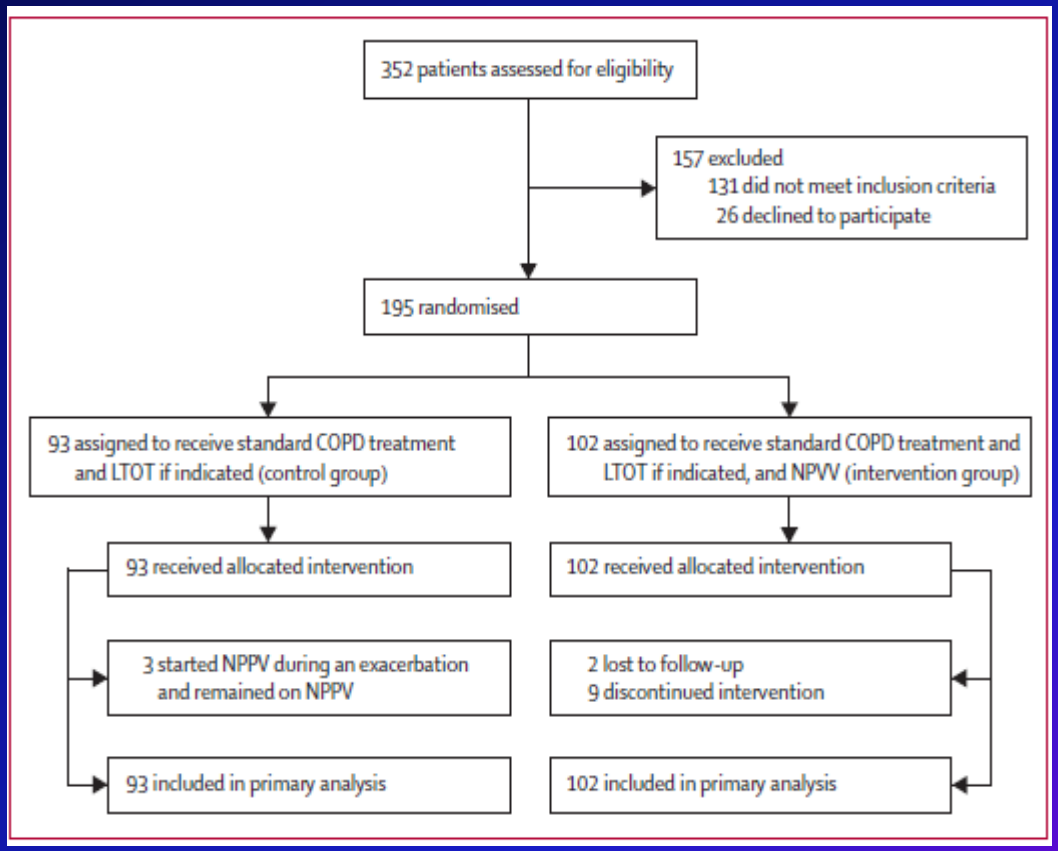
Weaning of intubated COPD patients

NIV may facilitate weaning from ETMV in selected COPD patients


Home NIV for COPD

Non-invasive positive pressure ventilation for the treatment of severe stable chronic obstructive pulmonary disease: a prospective, multicentre, randomised, controlled clinical trial

Thomas Köhnlein, Wolfram Windisch, Dieter Köhler, Anna Drabik, Jens Geiseler, Sylvia Hartl, Ortrud Karg, Gerhard Laier-Groeneveld, Stefano Nava, Bernd Schönhofer, Bernd Schucher, Karl Wegscheider, Carl P Criée, Tobias Welte



Subjects

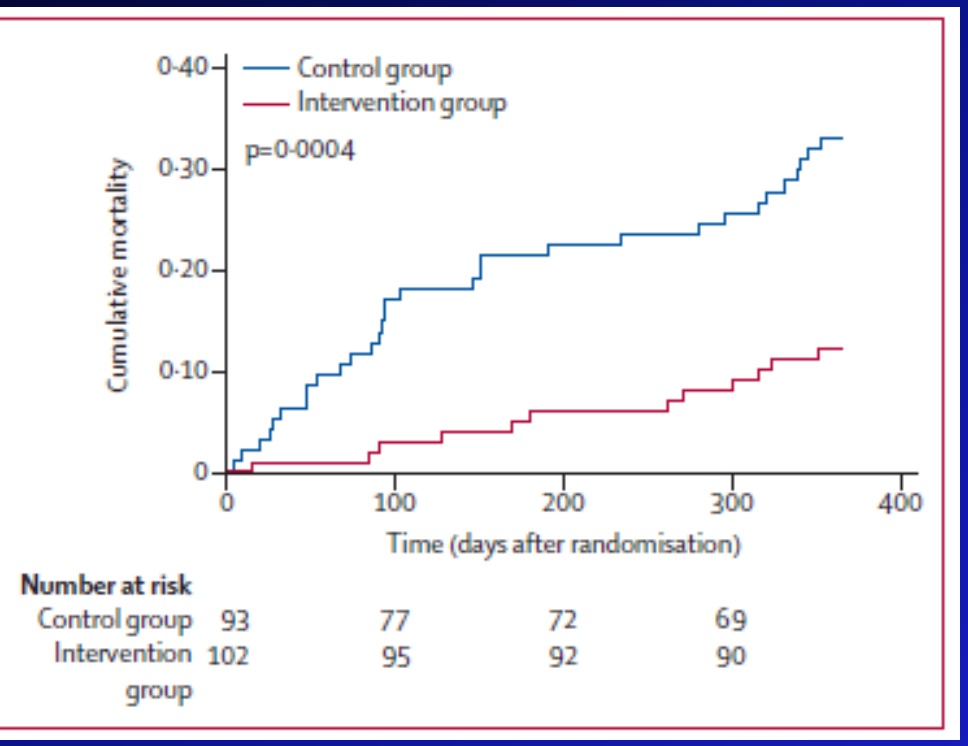
- Stable COPD
- Stage IV disease with chronic hypercapnia
- NIV group – achieve 20% reduction in $PaCO_2$
- Mean IPAP 21.6 cm H_2O; EPAP 4.8 cm H_2O; RR 16.1/min

	Control group (n=93)	Non-invasive positive pressure ventilation group (n=102)
Age, years	64·4 (8·0)	62·2 (8·6)
Male, n (%)	56 (60%)	65 (64%)
Body-mass index, kg/m²	24·5 (5·8)	24·8 (5·8)
FVC, % predicted	53·3% (13·8)	50·4% (13·3)
FEV_1, % predicted	27·5% (8·9)	26% (11·0)
FEV_1/FVC, %	41·2% (11·4)	40·4% (11·5)
Residual volume/total lung capacity, %	72·7% (8·9)	73·0% (8·5)
pH	7·39 (0·05)	7·39 (0·04)
$PaCO_2$, kPa	7·7 (0·7)	7·8 (0·8)
PaO_2, kPa*	8·7 (1·9)	8·6 (2·1)
SaO_2, %*	90·8% (5·9)	90·3% (6·2)
HCO_3^-, mmol/L	33·9 (4·1)	34·3 (4·0)
Base excess, mmol/L	8·0 (3·9)	7·8 (3·8)
6-min walk distance, m	249·6 (145·3)	226·7 (121·2)
Long-term oxygen treatment, n (%)	60 (65%)	67 (66%)

Data are mean (SD), unless otherwise stated. FVC=forced vital capacity. FEV_1=forced expiratory volume in 1 s. $PaCO_2$=arterial carbon dioxide pressure. PaO_2=arterial oxygen pressure. SaO_2=arterial oxygen saturation. HCO_3^-=bicarbonate. *In patients with long-term oxygen treatment, oxygen was applied via nasal cannula at the previously prescribed flow rate.

Table 1: Baseline demographic and clinical characteristics of patients

Outcomes



- 1-yr mortality
  - NIV: 11.8%
  - Control: 33.3%
- Hazard ratio 0.24
- QoL – 6.2 point improvement in SGRQ, p = 0.029

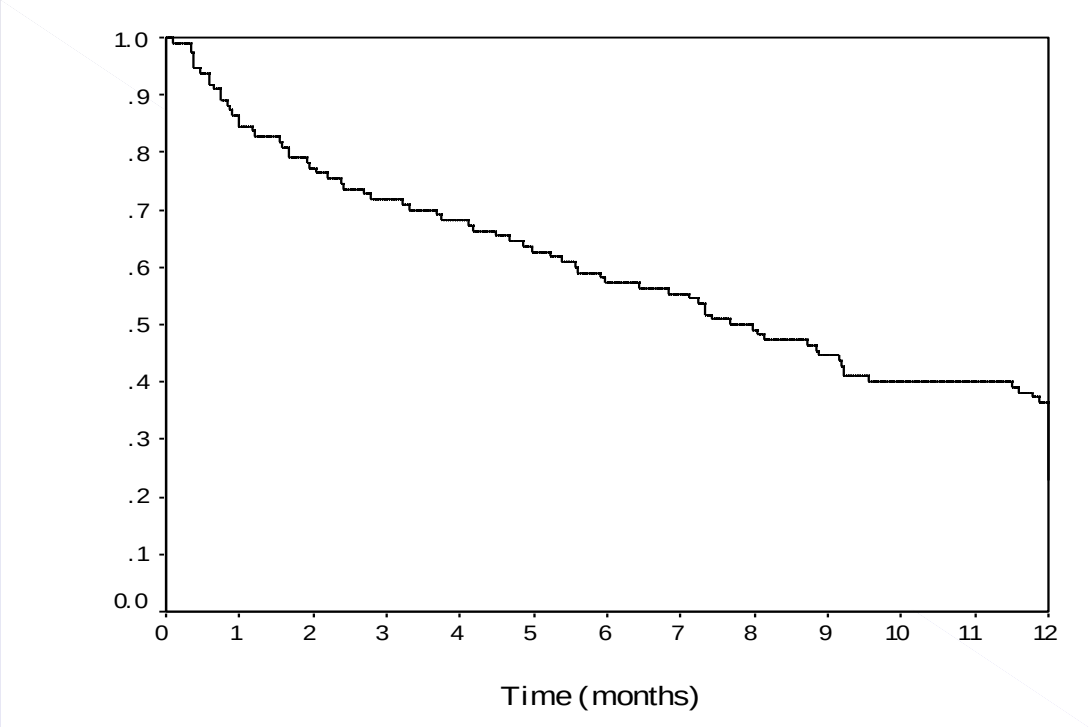
Home NIV in survivors of COPD after ARF

Problem of the Survivor of ARF in COPD

High rates of recurrent respiratory failure

High mortality

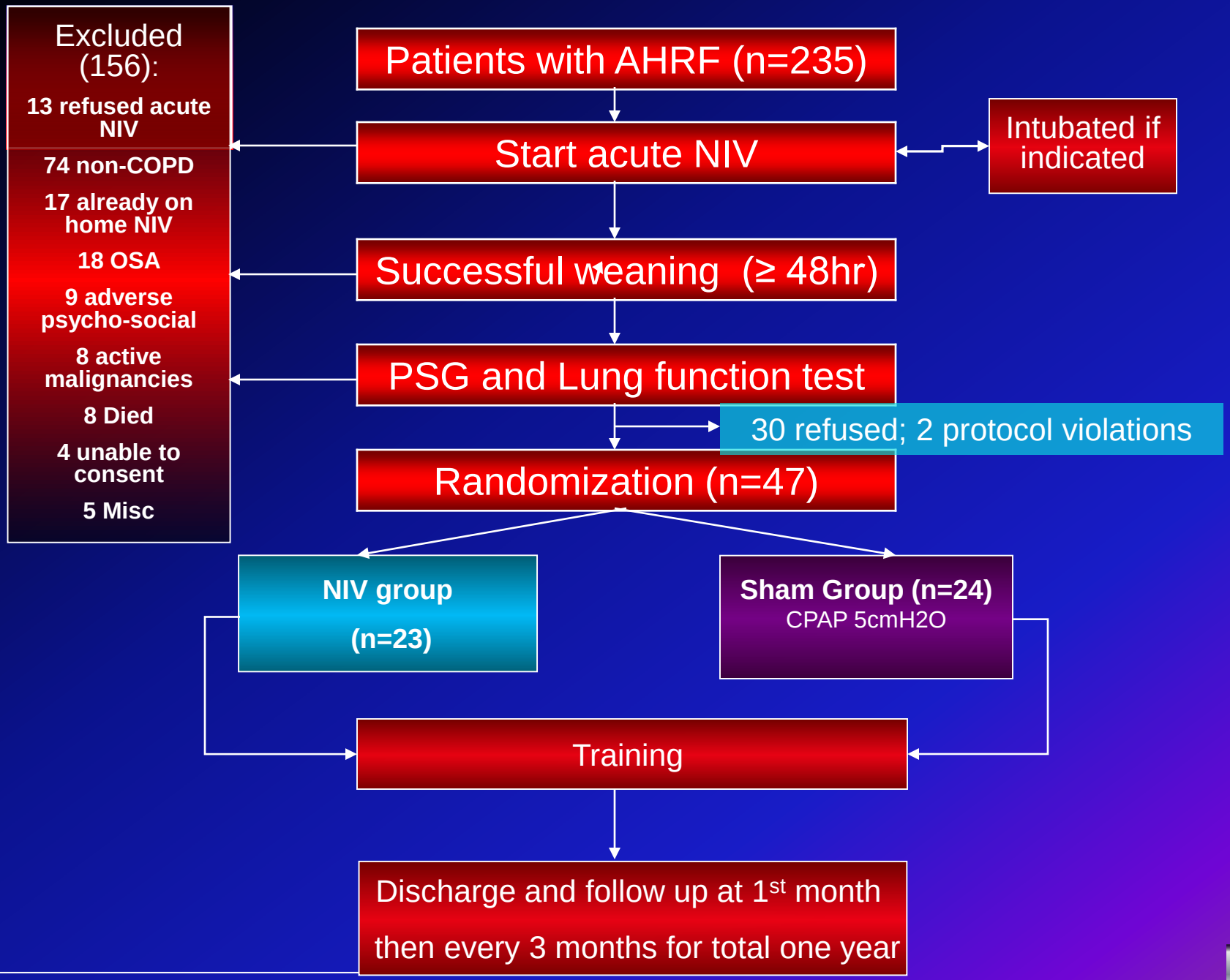
Probability of Event-free Survival



Recurrent AHRF: 63% in 1 year

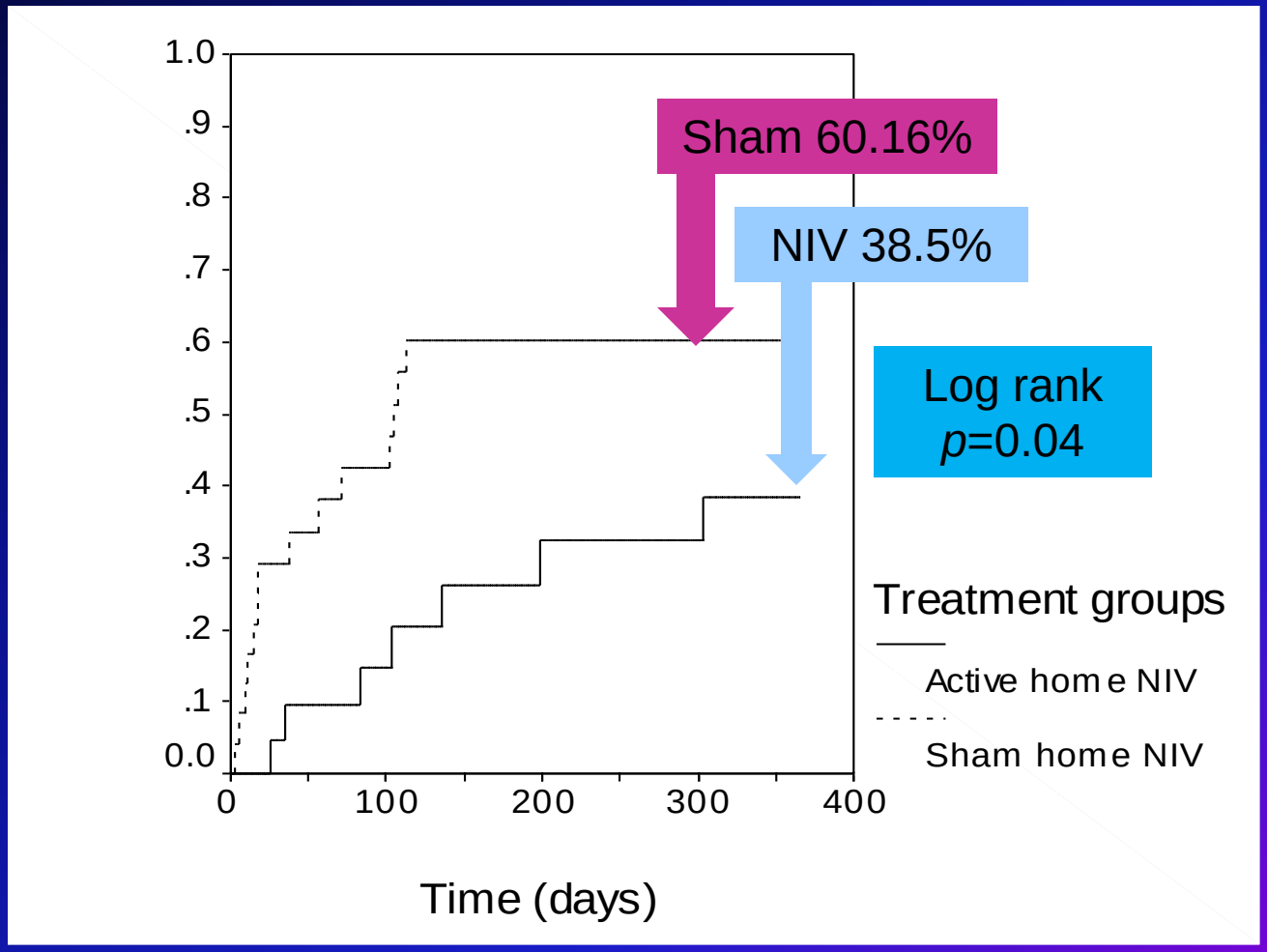
Death ~ 50%

Chu CM, et al. Thorax 2004;59



Cheung AP, et al. INT J TUBERC LUNG DIS 14(5):642–649

Primary Study Outcome - Recurrent AHRF



Cheung AP, et al. INT J TUBERC LUNG DIS 14(5):642–649

HMV vs HOT after AE-COPD

Murphy P, et al.

JAMA. 2017 Jun 6; 317(21): 2177–2186.

Inclusion

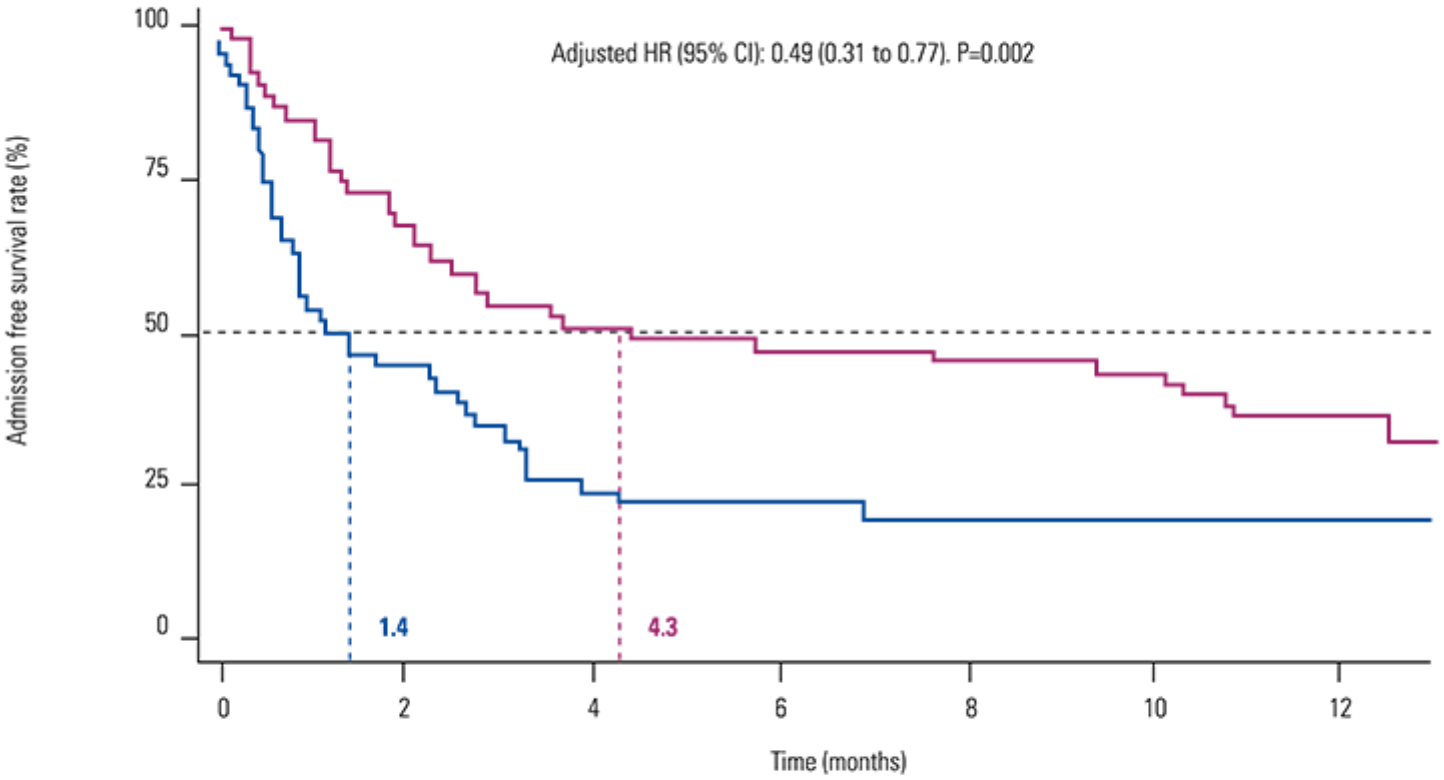
- FEV1 <50% of predicted
- In patient admission with AE-COPD.
- Persistent hypercapnia 2 to 4 weeks after the resolution of the hypercapnic acidosis.
- Chronic hypoxia PaO2 <55 mmHg or <60 mmHg complications
- Smoking > 20 pack-years.

Results

1. HMV combined with HOT can significantly reduce the risk of hospital readmission or death by 51% within 12 months in hypercapnic COPD patients.
2. Improved QoL
3. Health economics analysis underway

Time to readmission or death from randomisation to follow-up at 1 year

Intention to treat analysis

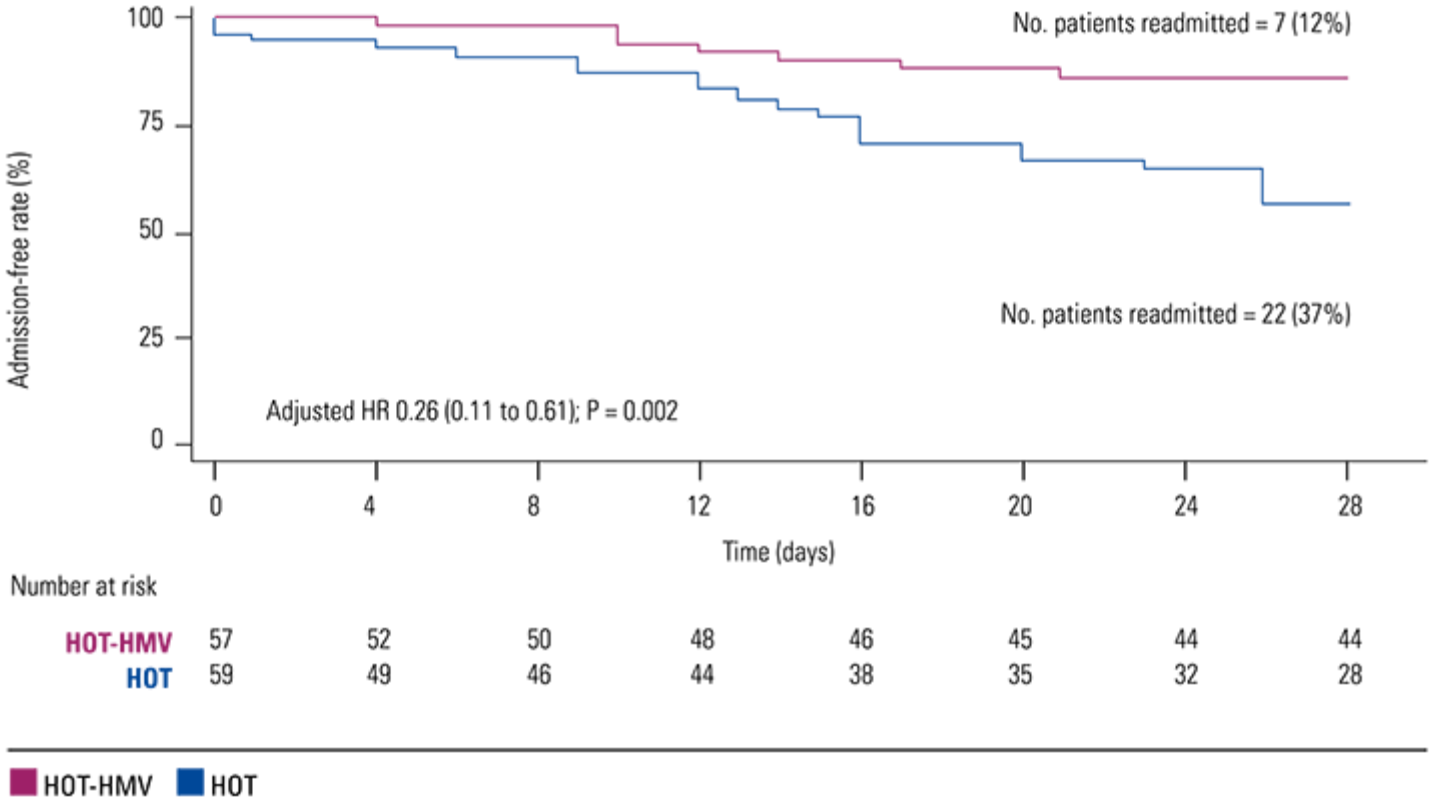


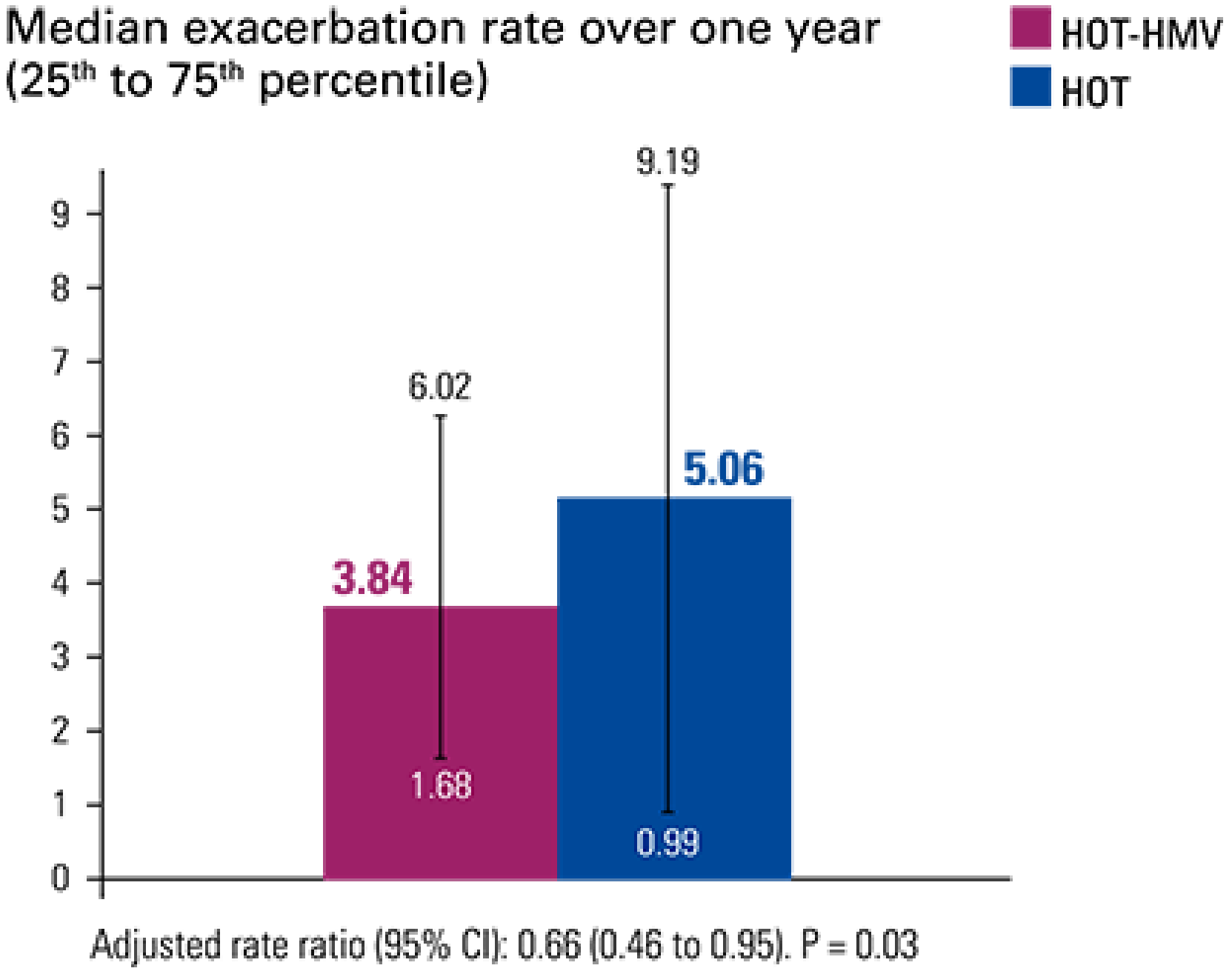
Number at risk

HOT-HMV	57	37	28	26	25	24	16
HOT	59	23	11	10	8	8	6

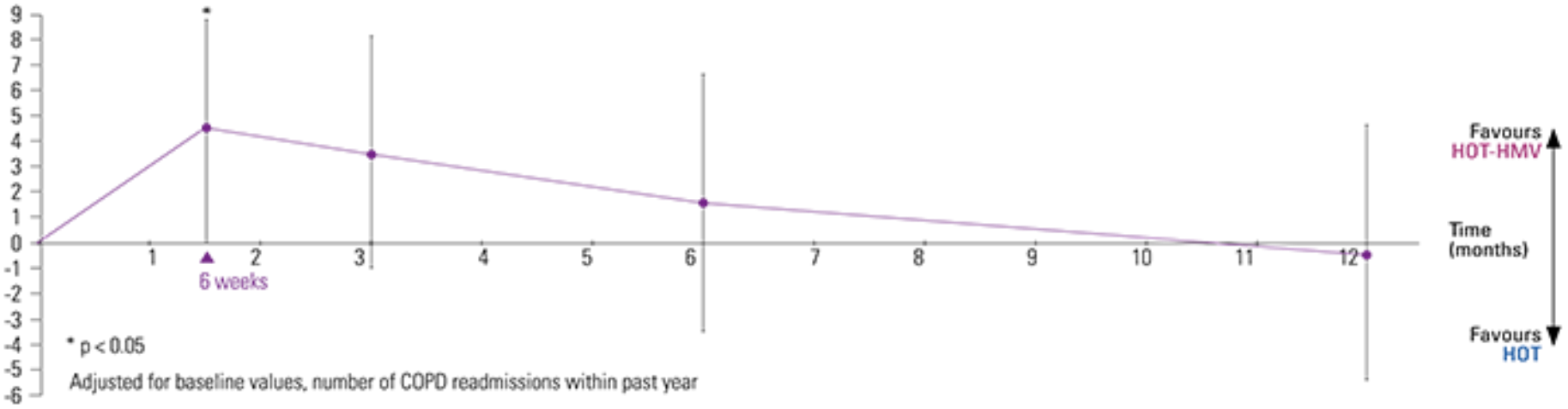
HOT-HMV HOT - - - Median admission free survival time

Time to hospital readmission by treatment arm




Median exacerbation rate over one year
(25th to 75th percentile)
HOT-HMV
HOT
9.19
6.02
5.06
3.84
1.68
0.99
0
1
2
3
4
5
6
7
8
9
Adjusted rate ratio (95% CI): 0.66 (0.46 to 0.95). P = 0.03

SRI questionnaire



* $p < 0.05$

Adjusted for baseline values, number of COPD readmissions within past year

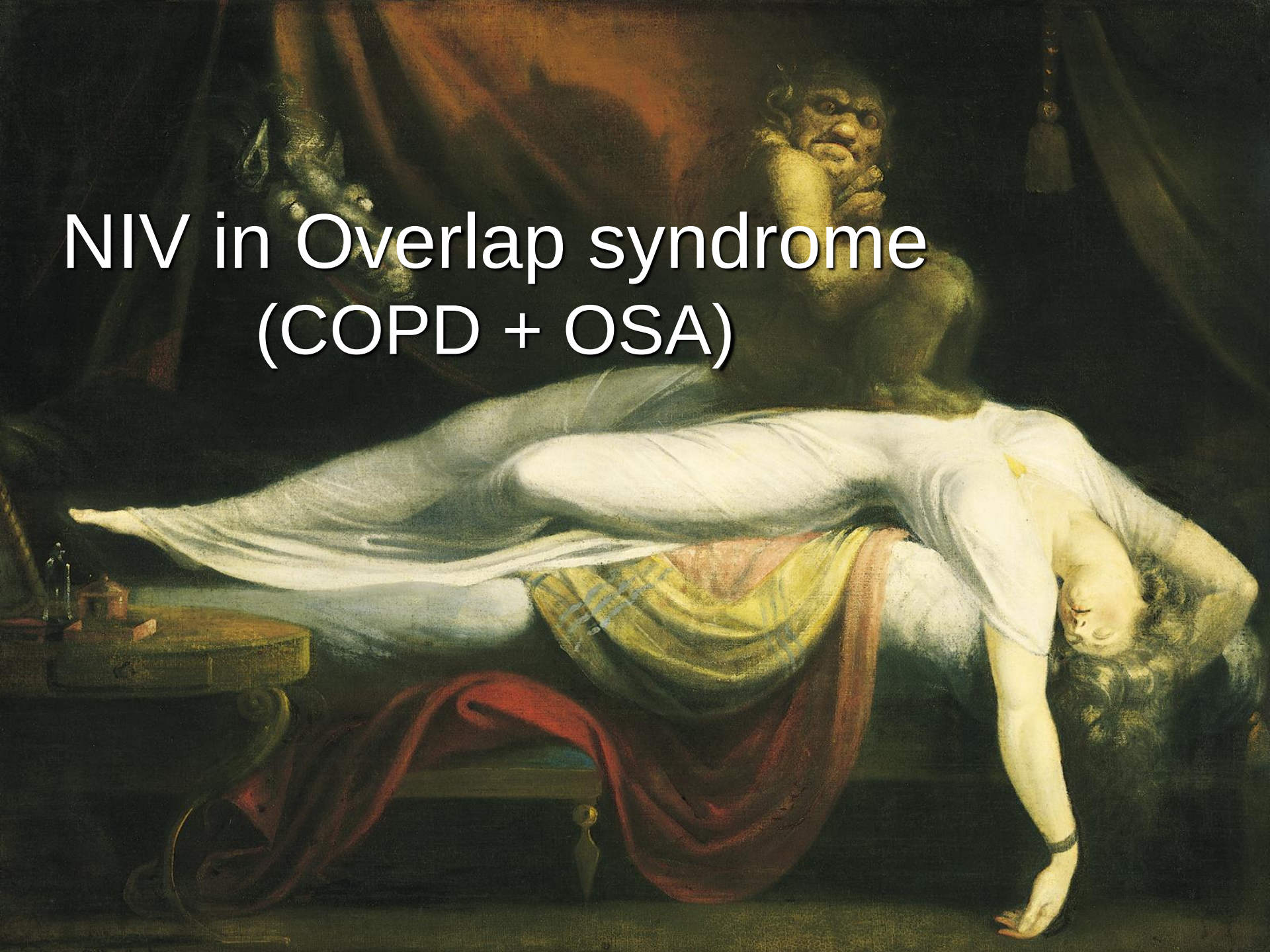
Home NIV for COPD

Stable hypercapnia

- Improves survival(1 RCT)
- Improves QoL
- Maximal tolerated pressure

Following ARF

- Persistent hypercapnia > 2 weeks
- Improved survival
- ? Recurrent ARF
- More RCTs needed

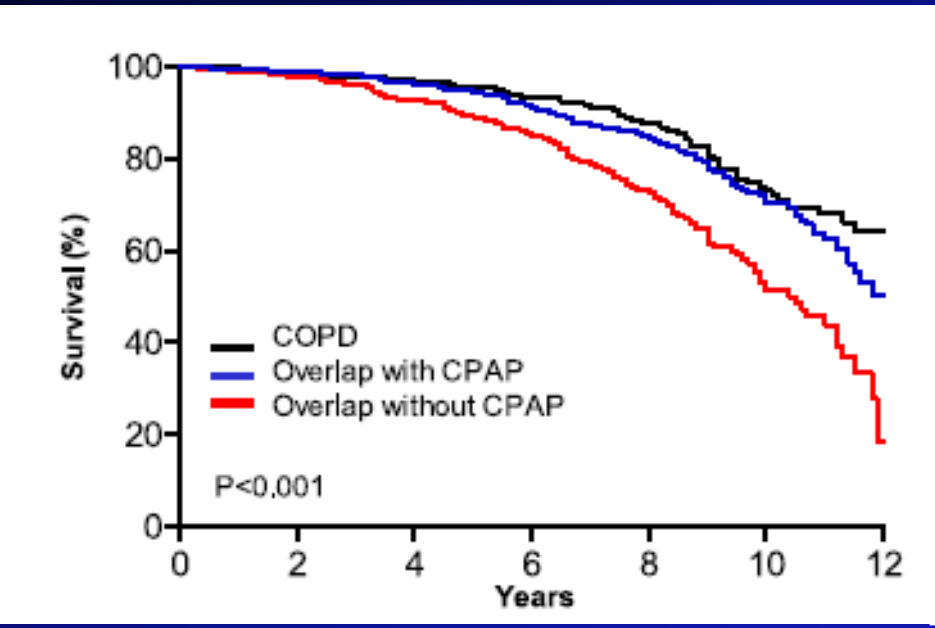

NIV in Overlap syndrome
(COPD + OSA)

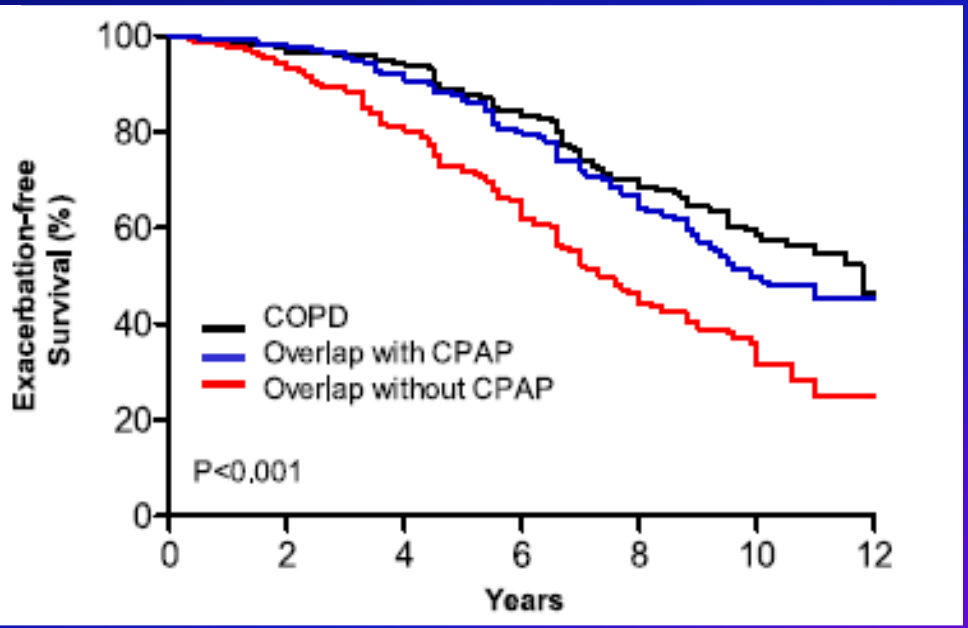
II. Overlap syndrome (COPD + OSA)

Worse prognosis vs. either condition alone

- More nocturnal desaturation
- Worse hypoxemia and hypercapnia
- More nocturnal arrhythmias
- Pulmonary HT, RHF
- Lower 5-yr survival

Survivals and exacerbation requiring hospitalisation





Marin JM et al. AJRCCM 2010;182:325-331

CPAP in overlap syndrome

Adjusted for age, sex, BMI, smoking, alcohol, comorbidities, FEV1 and sleepiness scores:

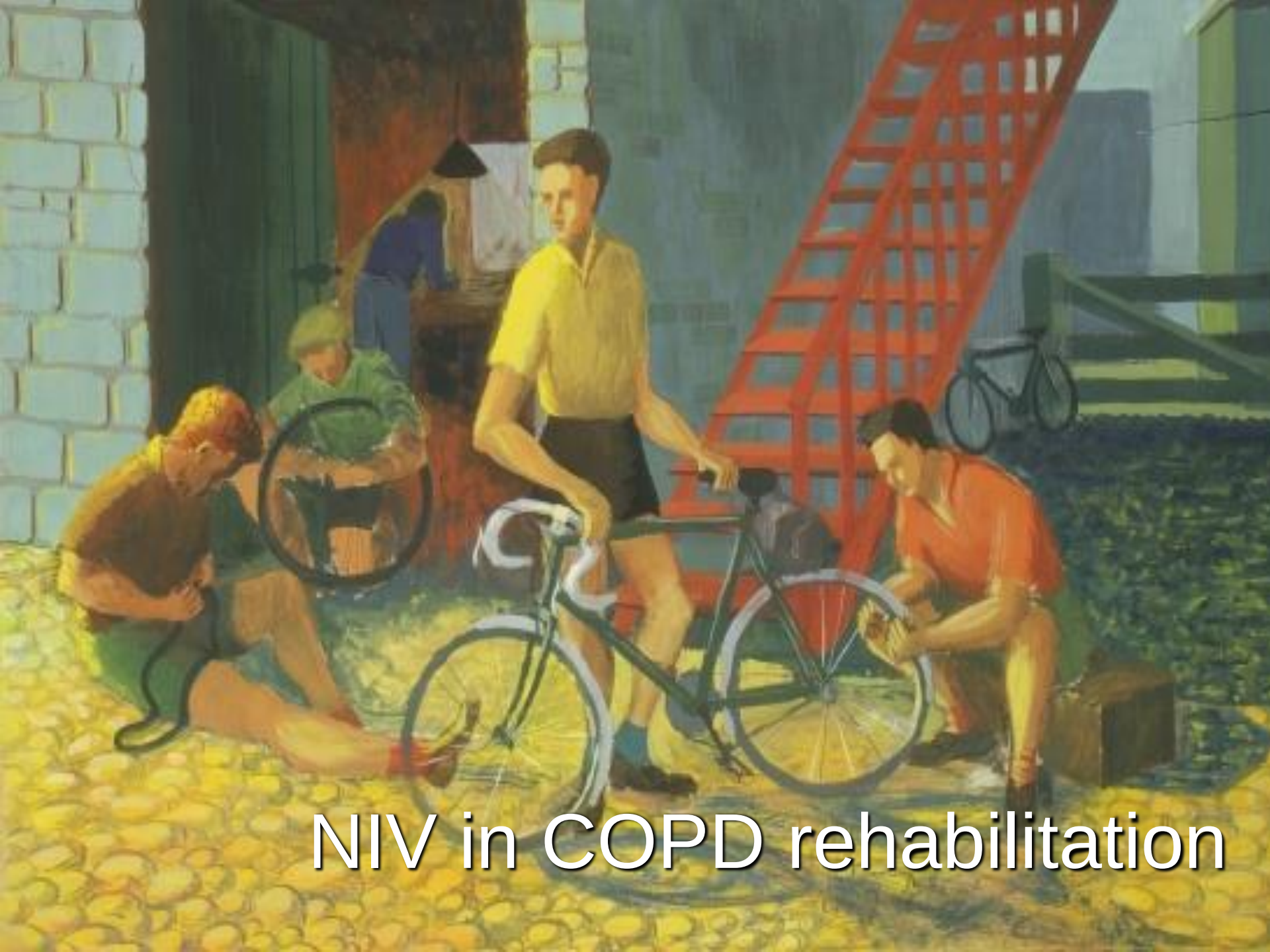
- Untreated overlap syndrome vs. COPD
  - Higher risk of mortality
  - Higher risk of hospitalisation for COPD exacerbation
- CPAP-treated overlaps have same mortality and exacerbation risk vs. COPD

(Not RCT because of ethical constraints)

Marin JM et al. AJRCCM 2010;182:325-331

NIV in Overlap syndrome

CPAP improves survival and reduces hospitalisation for COPD/OSA



NIV in COPD rehabilitation

III. NIV for COPD rehabilitation

NIV during exercise training

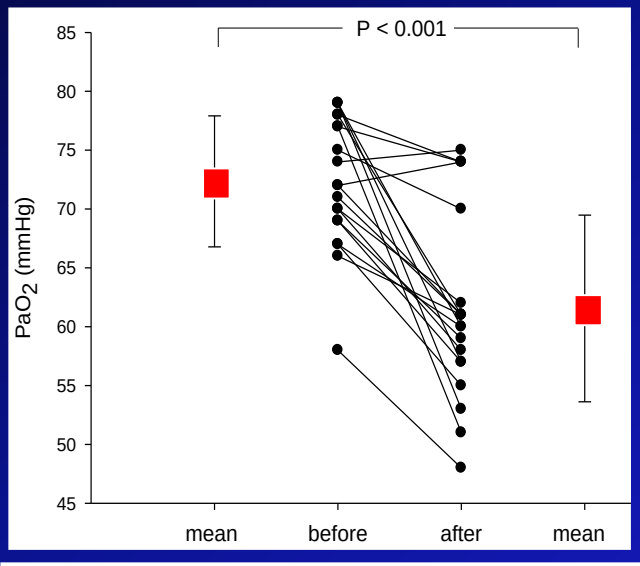
- Inspiratory pressure support improves ET and SOB [Keilty SE, et al. Thorax 1994]
- PAV+CPAP improves endurance time during cycling [Dolmage TE, et al. Chest 1997]
- IPS sustains exercise induced lactataemia (13.6 min vs. 5.5 min) – training effect? [Polkey MI et al. Thorax 2000]
- Systematic review: exertional dyspnoea and exercise endurance favour NIV [van' t Hul A, et al. J Cardiopulm Rehab 2002]
- Long term benefit?

Nocturnal NIV + PR

- NIV + PR improves fatigue, MRF score, cognition, $PaCO_2$, daily step count in hypercapnic COPD [Duiverman ML et al. Thorax 2008]
- NIV + PR improves 6-min walk and longest distance walked, FEV1, ABG, SF-36 and hyperinflation in GOLD IV COPD [Köhnlein T et al. Resp Med 2009]

Noninvasive ventilation during walking in patients with severe COPD: a randomised cross-over trial

M. Dreher, J.H. Storre and W. Windisch



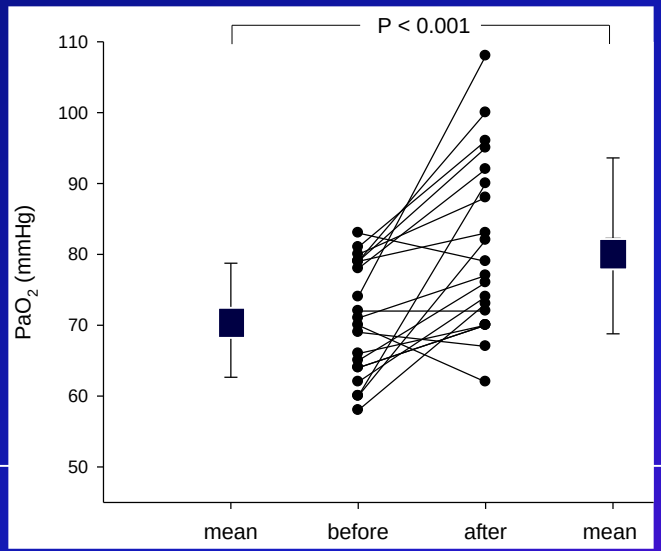
50

P<0.001

53

6

209



$PaCO_2$ [mmHg]

Borg Dyspnea Scale

P<0.001

Walking distance [m]

P<0.05

50

n.s.

51

4

252

Dreher M. et al. *Eur Respir J* 2007; 29:930-93

NIV in COPD rehabilitation

NIV maybe a useful adjunct in rehabilitation for severe COPD

NIV in palliative care?

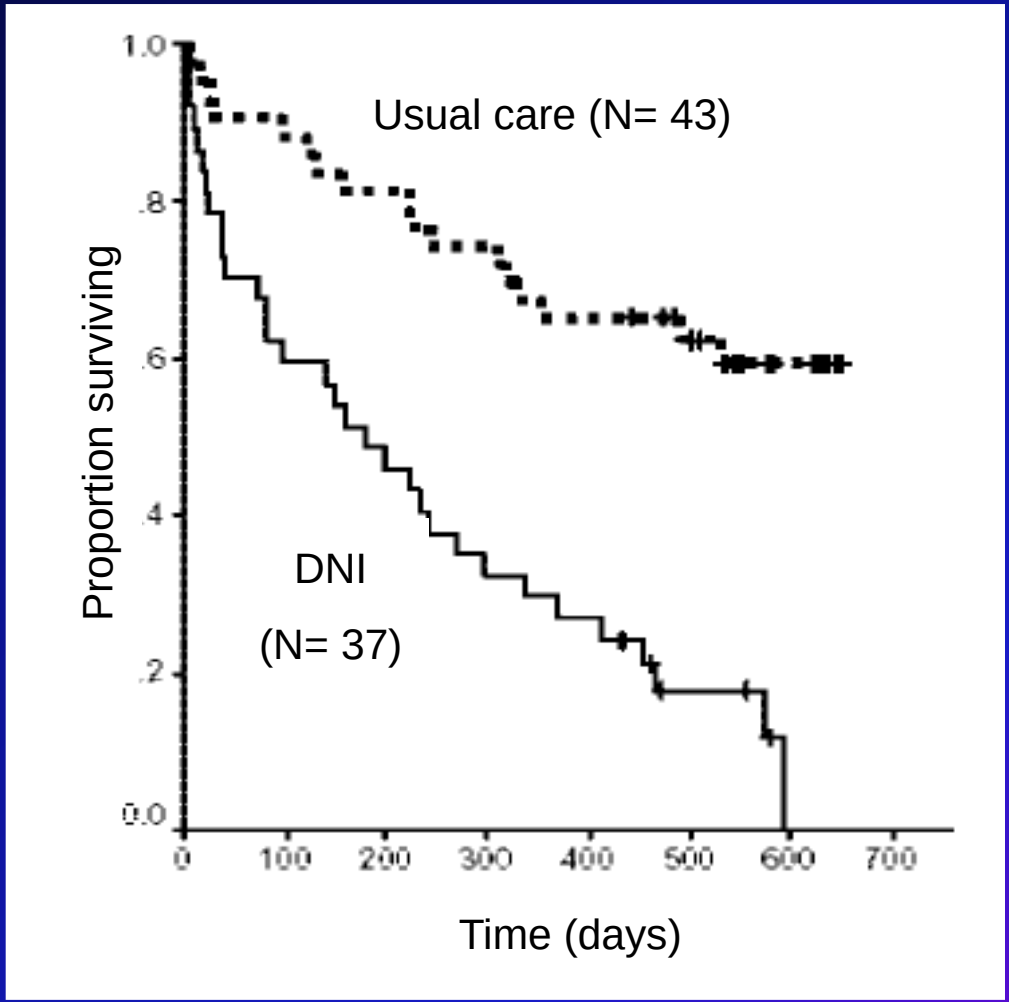
(Courtesy of Dr Jeff Ng, PC unit,

Haven of Hope Hospital)

Consideration near the end of life

Dimensions	Potential Benefits	Potential Burdens
Physical	1. Prolong survival 2. Relief in dyspnoea	1. Prolong the process of dying 2. Discomfort over face (e.g. pressure narcosis) 3. Building up of bronchial mucus 4. Noise, especially from alarm of NIV machine 5. Demanding in cooperation by patient
Psychological		Causing anxiety (including claustrophobia)
Social	1. Improvement in alertness in communication 2. Buying time to say goodbye and to achieve “closure”	1. Hindrance in communication by the mask 2. Discharge at home impossible without a ventilator
Others		1. Difficulty in withdrawal 2. Training required for care-givers 3. Cost

NIV for DNR COPD – poor survival



Chu CM, et al. Crit Care Med 2004; 32:372–377

Palliative use of NIV in COPD

No RCT evidence

Individualise

Need to define specific therapeutic goal

Conclusions

AE-COPD with ARF	
Weaning from ET-MV	
Home NIV	
COPD/OSA	
Pulmonary Rehabilitation	
Palliative care	

Conclusions

AE-COPD with ARF	Trial of NIV in majority
Weaning from ET-MV	
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Conclusions

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Weaning from ET-MV	NIV may facilitate weaning in selected patients
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Conclusions

AE-COPD with ARF	Trial of NIV in majority
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Home NIV	Reduce mortality in stable hypercapnic COPD RCT in recurrent ARF
COPD/OSA	
Pulmonary Rehabilitation	
Palliative care	

Conclusions

AE-COPD with ARF	Trial of NIV in majority
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Palliative care	

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Pulmonary Rehabilitation	Useful adjunct Nocturnal use/Training use
Palliative care	Individualised Burdensome


Thank you