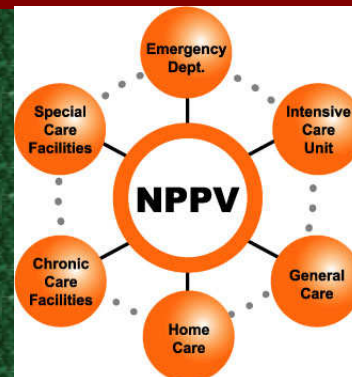


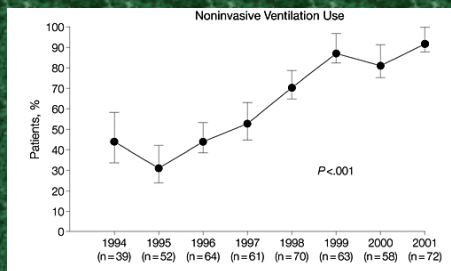
Concerns and Controversial Issues in Noninvasive Positive Pressure Ventilation

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NPPV: Common Therapy in Daily Practice



NPPV as the first choice of mechanical ventilation in AECOPD and CPE



(Girou E et al, JAMA 2003)

Evidence for efficacy of NPPV for various Etiology of ARF (Crit Care Med 2007)

Etiology	Evidence Strength	Recommendation
COPD	A	Recommended
Asthma	C	Optional
Weaning (COPD)	A	Guideline
CPE	A	Recommended
Pneumonia	C	Optional
ALI/ARDS	C	Optional
Immuno-compromized	A	Recommended
Post-operation	B	Guideline
Refused Intubation	C	Guideline
Fibro-Bronchoscopy	B	Guideline

Concerns and Controversial Issues in NPPV

- Is there well defined criteria for NPPV?
- Will NPPV delay the intubation and affect overall mortality?
- How should NPPV be used properly in daily practice?

Criteria of NPPV in AECOPD

- RR ≤ 30 /min,
- PaO₂ ≤ 45 mmHg
- pH ≤ 7.35
- Tachypnea,
- Dyspnea
- respiratory acidosis with PaCO₂ > 55 mm Hg and pH < 7.35

(Brochard N Engl J Med 1995)

(Nava S, RESPIR CARE 2004)

Criteria of Mechanical Ventilation in AECOPD

NPPV

- Moderate to severe dyspnea.
- pH < 7.35 and PaCO₂ > 45mm Hg)
- RR > 25 BPM

Invasive MV

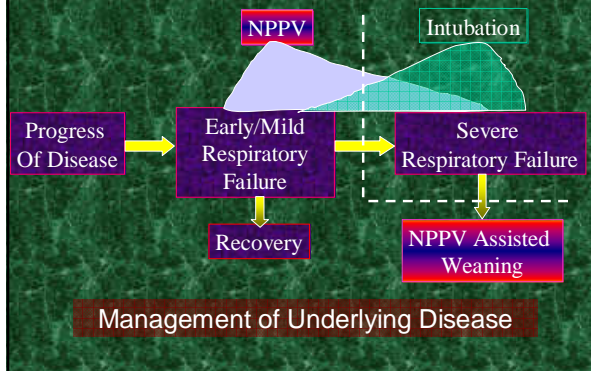
- Unable to tolerate NIV or NIV failure
- Severe dyspnea.
- RR > 35BPM
- PaO₂ < 40 mm Hg or PaO₂/FiO₂* < 200 mm Hg
- pH < 7.25 and/or PaCO₂ > 60 mm Hg
- Respiratory arrest
- Somnolence, impaired mental status
- Cardiovascular complications
- Other complications (GOLD 2007)

Changing Criteria of NPPV in AECOPD

	1992-1996		1997-1999	
	Success	Failure	Success	Failure
pH (baseline)	7.26 ± 0.07	7.21 ± 0.06	7.21 ± 0.08	7.18 ± 0.10
pH (1hr NPPV)	7.31 ± 0.06	7.20 ± 0.09	7.30 ± 0.06	7.18 ± 0.08
PaCO ₂ (baseline)	83 ± 17	91 ± 14	88 ± 16	99 ± 22
PaCO ₂ (1hr NPPV)	75 ± 14	95 ± 18	77 ± 13	100 ± 22

Carlucci A, et al. Intensive Care Med 2003

Potential Roles of NPPV in Acute Respiratory Failure



Question

- * Is NPPV necessary in patients with mild respiratory failure due to AECOPD?

NPPV in AECOPD Intubation Need Stratified by pH

	Control(n=171)	NPPV(n=171)	P value
pH<7.30	26.7%(8/30)	7.0%(3/43)	0.042
pH≥7.30	12.8%(18/141)	3.9%(5/128)	0.015

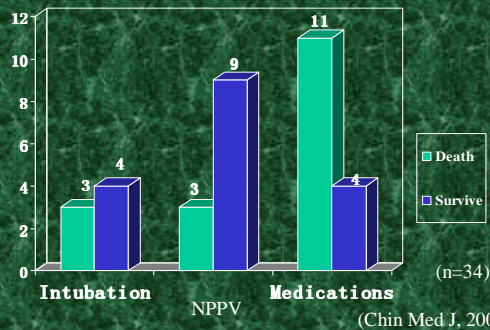
Are there any criteria to select those patients who need ventilation assistance and avoid over use of NPPV in those who don't have hazard of intubation?

(Chin Med J, 2005)

Question

- * Is NPPV effective in patients with severe respiratory failure due to AECOPD ?

Mortality of Patients met the Intubation Criteria (pH<7.20)



NPPV in “do not intubate” severe hypercapnic AECOPD

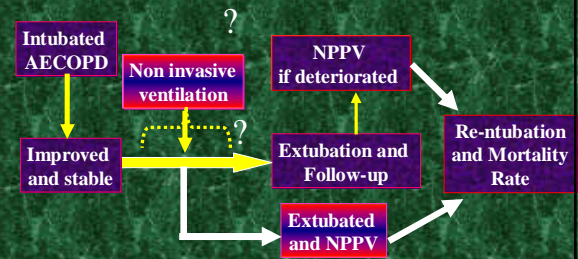
- 21 severe hypercapnic patients (PaCO₂: 104±14mmHg)
- Refused intubation
- Full face mask NPPV with bedside close monitoring
- Success: 15/21

(Zhu GF, et al, Chinese J Tuberc & Respir, 2003)

NPPV in AECOPD

- Application Criteria are variable
- Predictors both for potential beneficial candidates and failure demand for further investigation

NPPV in Weaning of Intubated AECOPD



NPPV for Early Extubation in AECOPD

(48h MV, fail T piece trial)

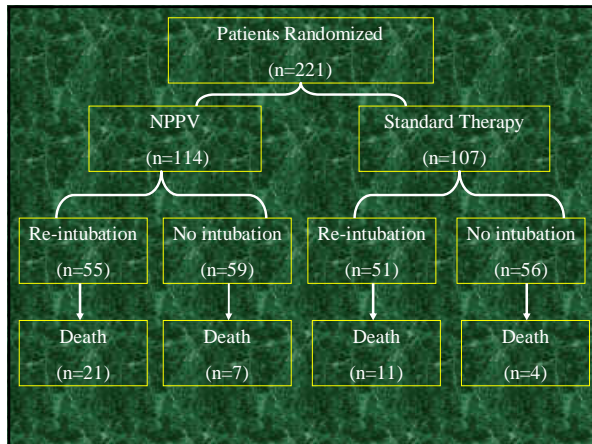
	NPPV	IPPV	P
Weaning at 60 days	22/25 (88%)	17/25 (68%)	N S
Duration of MV (day)	10.2 ± 6.8	16.6 ± 11.8	0.021
Time staying in ICU(day)	15.1 ± 5.6	24.0 ± 13.7	0.005
Survival rate at 60 days (%)	92	72	0.009

(Nava S, Ann Intern Med 1998)

Noninvasive Positive-Pressure Ventilation for Respiratory Failure after Extubation

Andrés Esteban, M.D., Ph.D., Fernando Frutos-Vivar, M.D., Niall D. Ferguson, M.D., Yaseen Arabi, M.D., Carlos Apezteguía, M.D., Marco González, M.D., Scott K. Epstein, M.D., Nicholas S. Hill, M.D., Stefano Nava, M.D., Marco-Antonio Soares, M.D., Gabriel D'Empaire, M.D., Inmaculada Alía, M.D., and Antonio Anzueto, M.D.

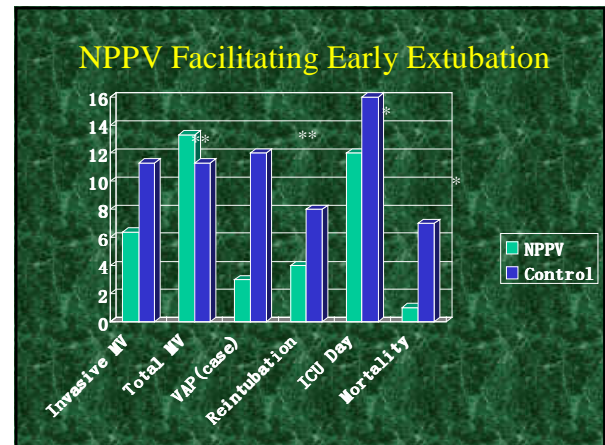
N Engl J Med 350:24www.nejm.org June 10, 2004



Question

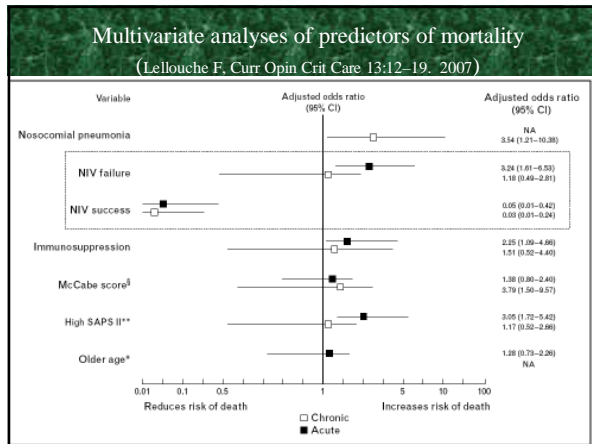
* Is indications or criteria necessary for selection of patients for NPPV assisted early extubation, even in AECOPD ?

- ### Inclusion and Exclusion Criteria cited in a multiple centers study in Mainland China
- Inclusion
 - 1、 Ambulatory before the exacerbation
 - 2、 Respiratory Infection as the cause of AECOPD and intubation
 - 3、 Respiratory Infection was under controlled after proper antibiotics
 - 4、 Stable and no Dyspnea with PSV < 15 cmH₂O and FiO₂<0.4
 - Exclusion
 - Any Contra-indication with NPPV



- ### NPPV as a method of weaning in AECOPD
- There are some evidence to support the application
 - Appropriate for all patients?
 - Further studies are necessary to elucidate the proper patients selection criteria

- ### Concerns and Controversial Issues in NPPV
- Is there well defined criteria for NPPV?
 - Will NPPV delay the intubation and affect overall mortality?
 - How should NPPV be used properly in daily practice?



NPPV failure and overall mortality

- AECOPD and CPE:
 - No increase of mortality
- Hypoxemic RF
 - Variable among different reports
 - Difficult to determine that higher mortality is due to underlying disorder or delayed intubation by using NPPV
 - Criteria for switching NPPV to Intubation are crucial

Intensive Care Med 2006;

Criteria for switching NPPV to Intubation

- Deteriorating consciousness
- Inability to clear secretion
- Intolerance to interface
- Unstable circulation
- Deteriorating oxygenation
- Deteriorating hypercapnia
- No improvement 1-4h after NPPV
($\text{PaCO}_2 \downarrow < 16\%$, $\text{pH} < 7.30$, $\text{PaO}_2 \leq 60\text{mmHg}$ or $\text{OI} < 164\text{mmHg}$)

Respiratory Care 1997; 42:364-367

NPPV in Critical SARS

- Initial improvement: 38/39 (97%)
(Criteria: $\uparrow \text{SpO}_2\%$, \downarrow Dyspnea)
- Criteria for switching NPPV to intubation: $\text{OI} < 100\text{mmHg}$
- Avoid Intubation and Discharge: 26 /39(67%)
- Intubation: 13/39 (33%)
- Mortality: 3/39(8%)
- Overall Mortality: 3. 6%

(Guangzhou)

Concerns of NPPV in SARS

- Delayed intubation leading to more difficult intubation and hypoxemia
- Infection of medical staff

Potential Benefits of NPPV Assisted Intubation

- Maintaining oxygen and ventilation during intubation
- Protecting medical staff from infection

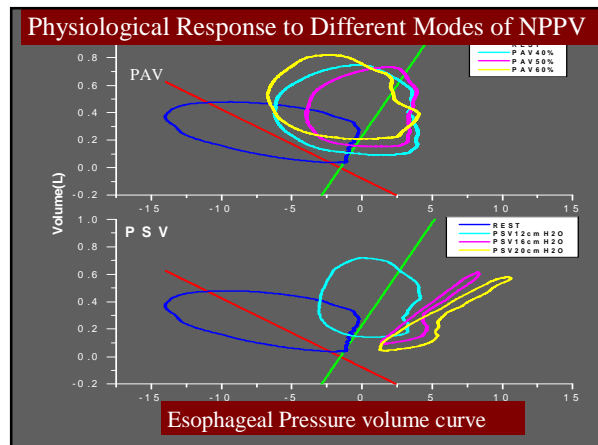
Concerns and Controversial Issues in NPPV

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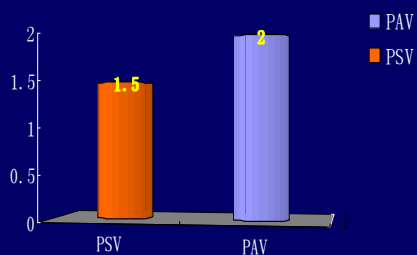
Practical Application of NPPV

- Modes Selection
- Interface Selection
- Parameters Setting
(Tidal Volume, Inspiratory Pressure, etc.)
- Standardized Procedure
(Application procedure, time schedule etc)

- Is patient's response to different mode the same?

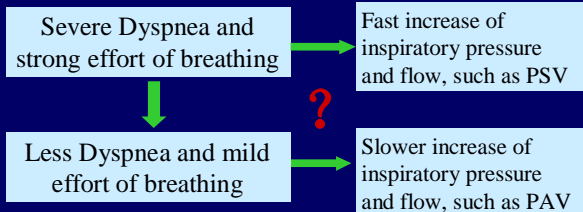


Dyspnea Improvement

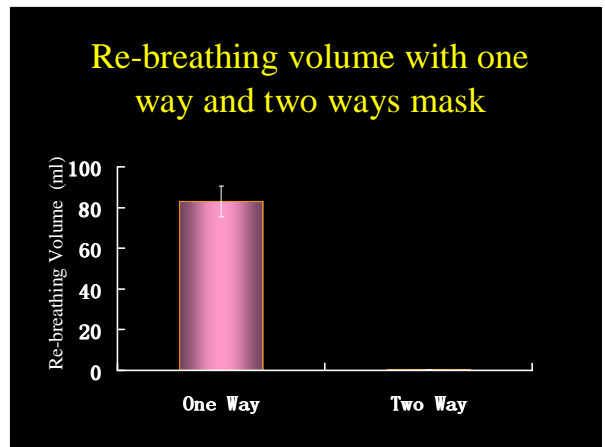
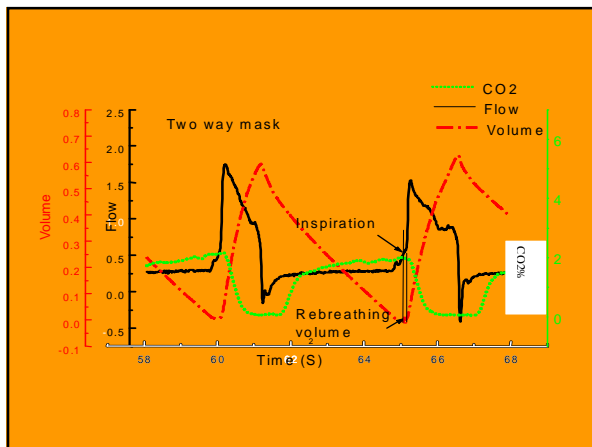
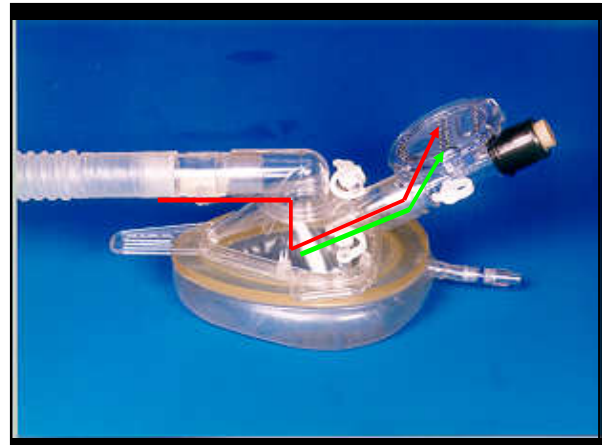
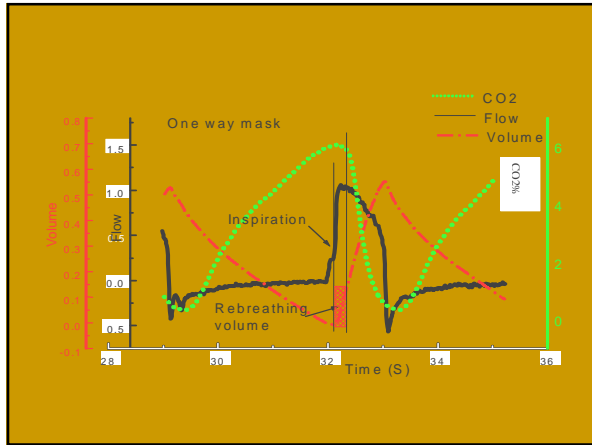


-2 Marked Deterioration 2 Marked Improvement

Hypothesis on Mode Selection in NPPV



- Dose different interface have the same effect?



Cross-over Study of One Way and Two Way Masks

8 COPD with
PaCO₂ 9.98 ±
2.40 Kpa,

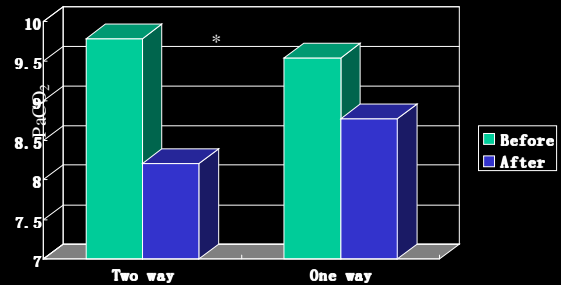
IPAP=17.6 ± 2.4 ,
EPAP=4 ,
PSV=13.6 ± 2.4

One way or two way mask
ventilation (1hr)

Rest for 0.5hr

Cross-over to
another mask (1hr)

Reduction of PaCO₂ with different mask



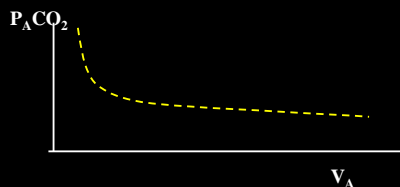
• Proper parameters Setting?

Current Parameters Setting in NPPV

- Patient's tolerance guided
- Subject to experience of operator and patient's co-operation

Alveolar Ventilation – PaCO₂ Relation

- PaCO₂ = 0.863 x VCO₂ / V_A
Ventilatory capacity vs demand
Normal V_A: 4L/min, PaCO₂: 40mmHg



Detection of Dead Space and Alveolar Ventilation



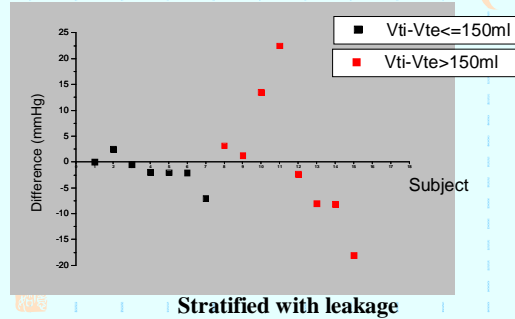
NICO (RESPIRONICS, 7300)

Calculation of Tidal Volume (with target reduction of PaCO₂:5-10mmHg)

- $PaCO_2 = K \times VCO_2 / VA$
 $VA = VT(1 - VD/VT) \times f$
 Calculated $VT = \{(PaCO_2)_1 \times (VT1 - VD) / (PaCO_2)_2\} + (VD + V_{mask} - V_{mouth\ piece})$
 (providing f unchanged)
 Calculated $VT = \{(PaCO_2)_1 \times (VT1 - VD) / (PaCO_2)_2\} \times f1/f2 - (VD + V_{mask} - V_{mouth\ piece})$
 (Modification with change of breathing frequency)

The Difference between Measured and Target PaCO₂

(Difference = PaCO₂(Measured) - PaCO₂(Target))



Measured and Target PaCO₂ (Within ±3mmHg)

Leakage	Yes	No	Total	%
≤150ml	6	1	7	85.7%
>150ml	2	5	8	28.6%
Total	8	7	15	53.3%

Summary

- Is NPPV underused or overused?**
 Strong Evidence only in some Indications, more research is demanded.
- Will NPPV delay the intubation and affect overall mortality?**
 Not in AECOPD, but not clear in hypoxemic Respiratory Failure. Switching criteria from NPPV to Intubation is crucial and demands further study.
- How should NPPV be used properly in daily practice?**
 Experience based rather than evidence based, demanding further well designed study.

Thank You