Non-Invasive Ventilation

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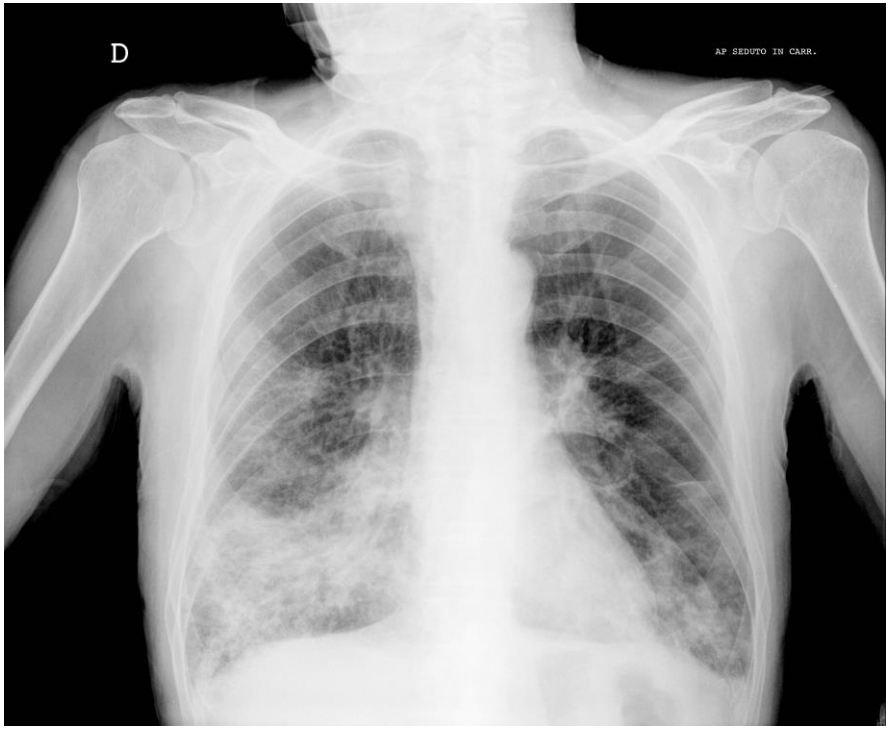
Emergency

Patient 1

- 76 year old man admitted with cough, fever and breathlessness
- Background of COPD on long-term oxygen, hypertension, IHD, CKD, can walk 5 steps, uses oxygen continuously
- Unwell for a few days with productive cough and increase in breathlessness, not eating
- Now unable to walk
- RR 38 and slightly confused



ABG on 2l O_2:

H^+ 69

paO_2 7.4 kPa (55 mmHg)

$paCO_2$ 7.3 kPa (54 mmHg)

HCO_3 19

Patient 2

- 82 year old lady admitted acutely breathless
- Background of IHD and moderate LVSD, one previous admission with decompensated heart failure. Acutely unwell with palpitations, dyspnoea and orthopnoea
- In AF rate 110, RR 42
- SpO_2 87% on 15l O_2 in ED

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Patient 3

- 67 year old man, acute dyspnoea on the haematology ward
- Background of multiple myeloma, 12 days post autologous stem cell transplant. Neutropenic but cell counts starting to improve, now developed cough and fever
- RR 32, alert and orientated
- No cardiovascular compromise

ABG on 15l O_2:

H^+ 41

paO_2 9.1 kPa (69 mmHg)

$paCO_2$ 4.9 kPa (37 mmHg)

HCO_3 23

NIV

NIV	Intubation
Can interrupt for breaks / food…	Intubated stays intubated
Allows on / off weaning	
Minimal complications	Complication risk (VAP etc)
Usually no sedation	Need for anaesthesia / NMB
Comfortable	Sedation for tube tolerance
Portable equipment	Equipment less portable
Less intensive staffing levels	Highly skilled staff / high ratio

But…

NIV

Relies on patient clearing secretions

Rarely tolerated for long periods

Interruptions cause de-recruitment

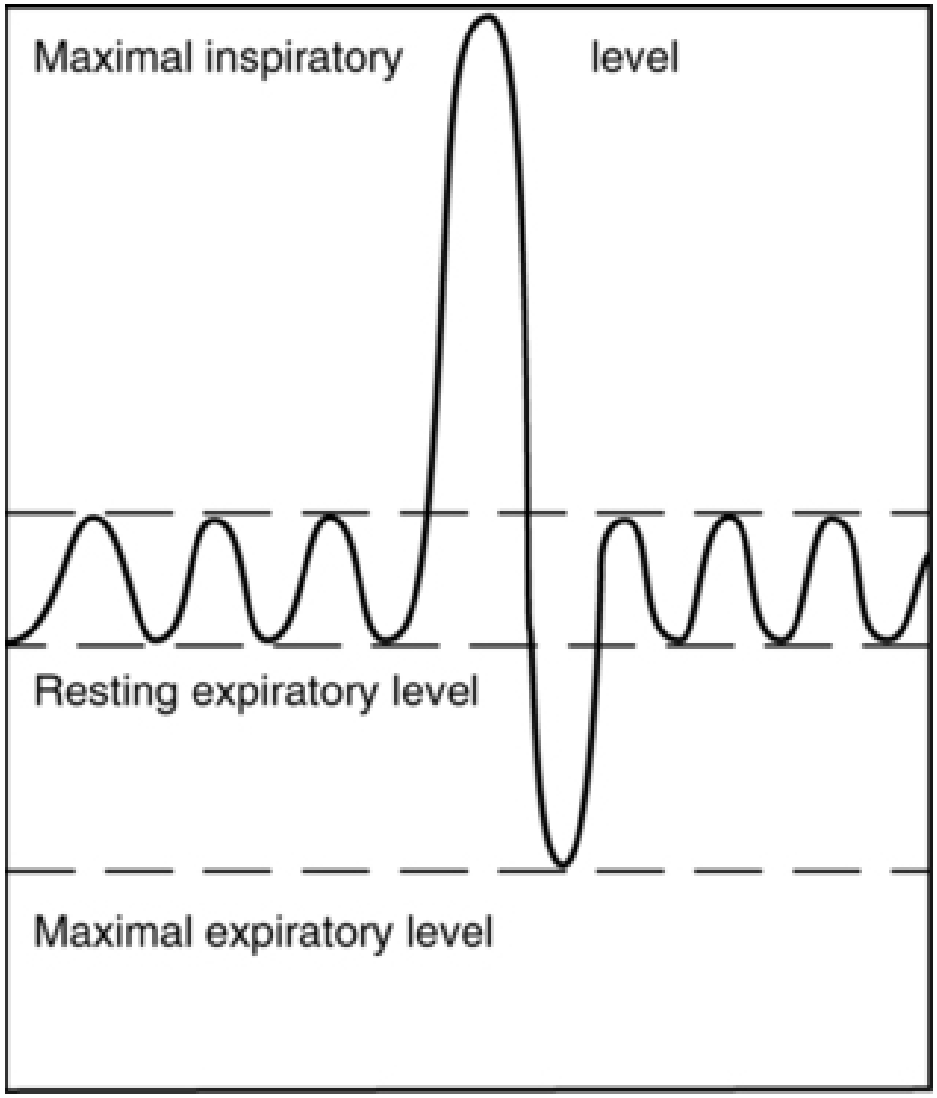
Work of breathing remains relatively high

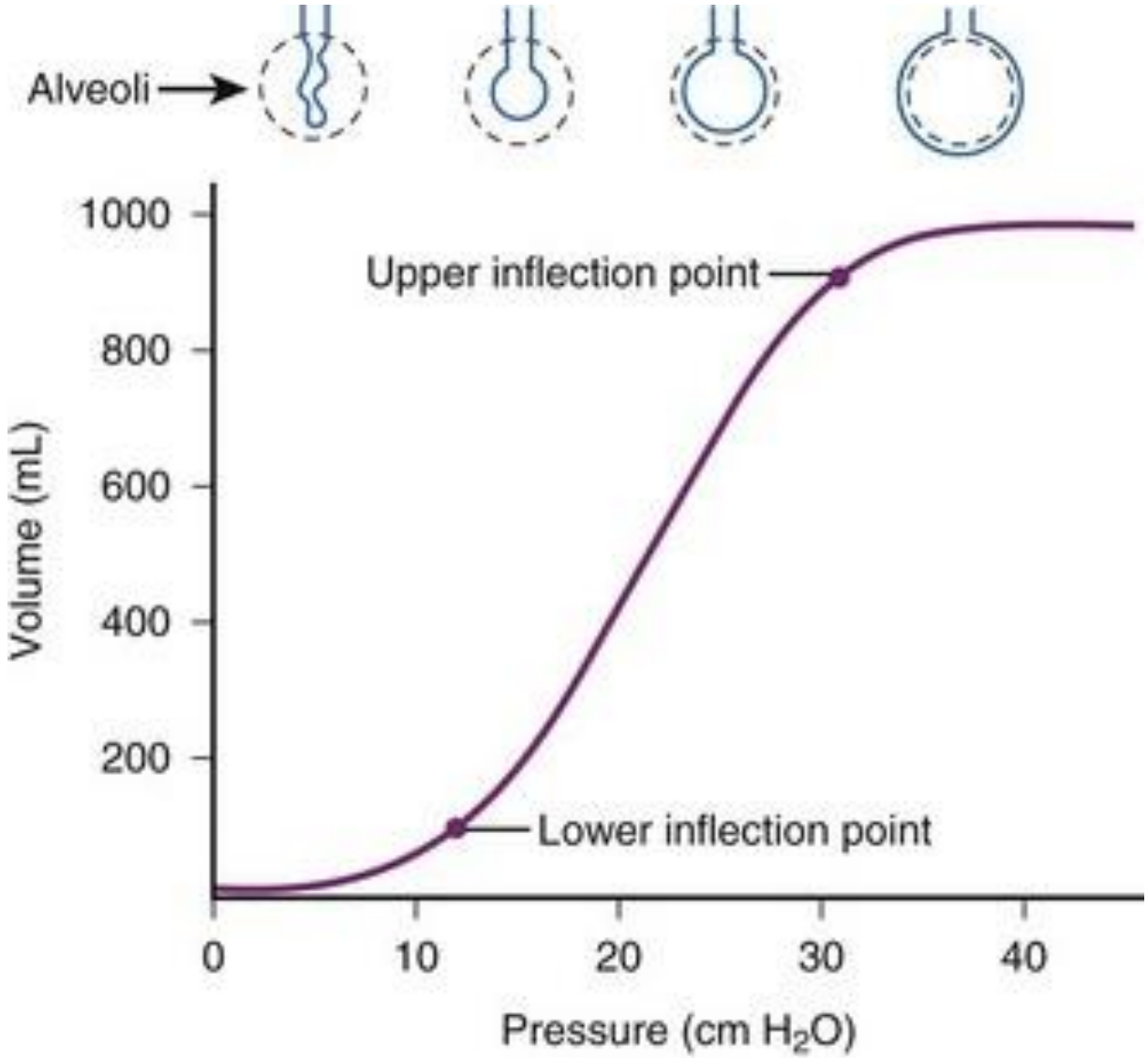
Intubation

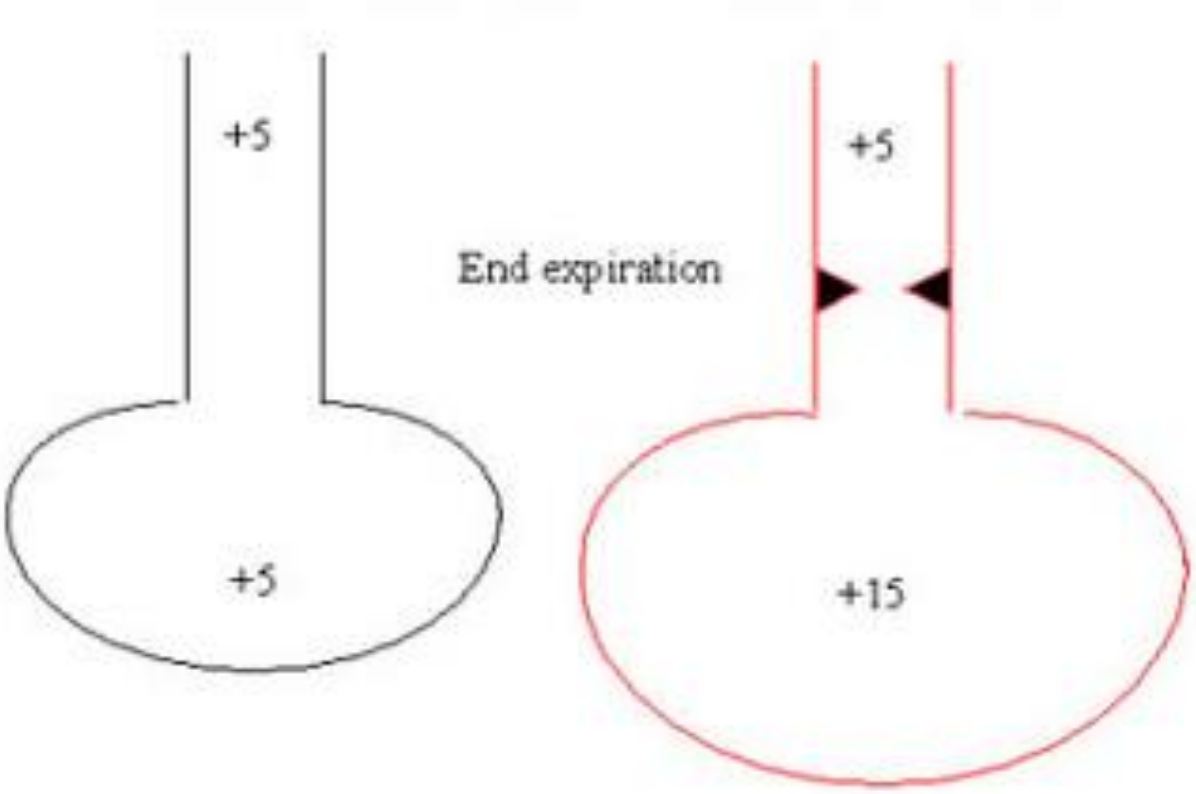
Allows suction / bronchoscopy

Prolonged treatment possible

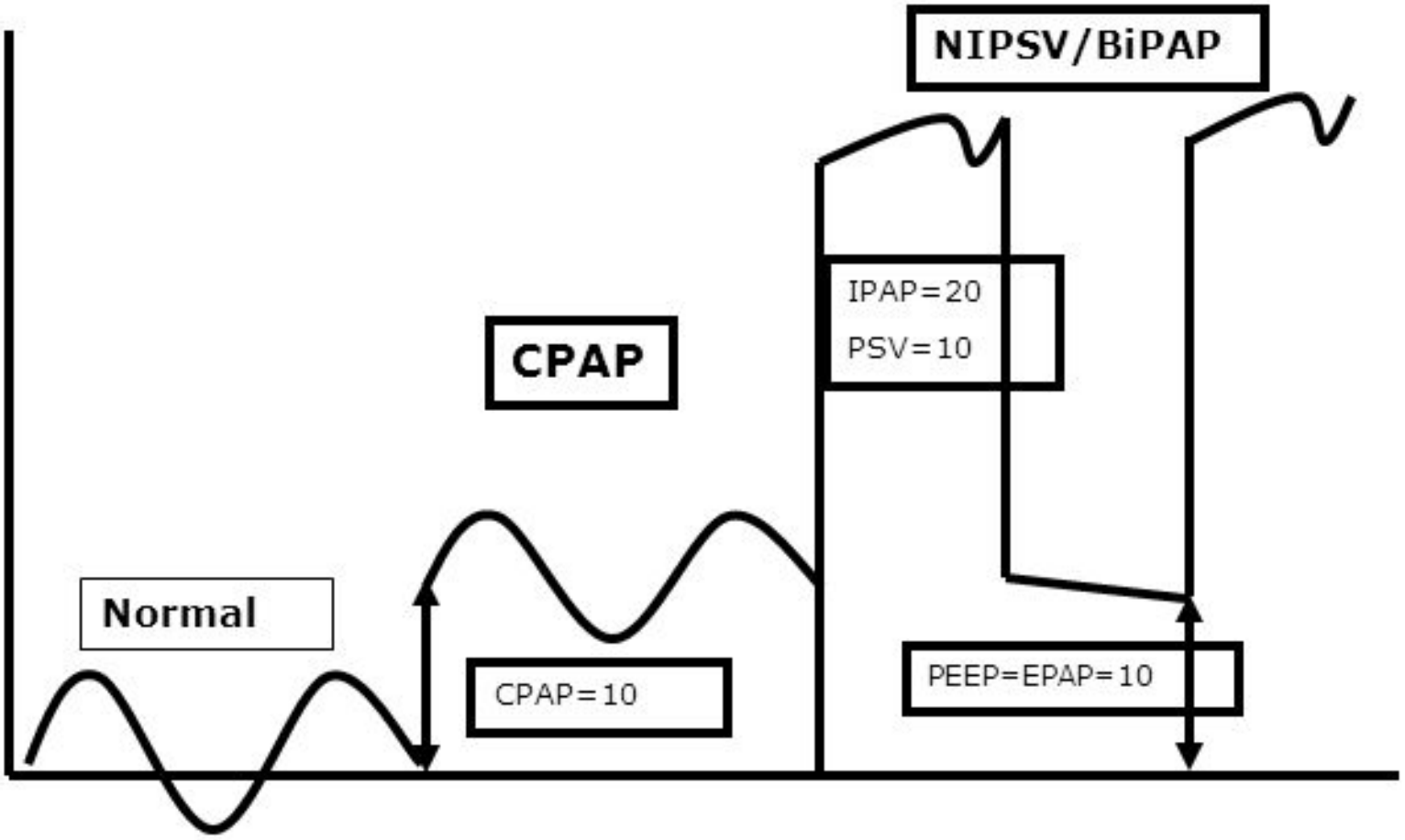
Mandatory modes & sedation allow elimination of work of breathing


Maximal inspiratory level
Resting expiratory level
Maximal expiratory level


Alveoli
1000
800
600
400
200
Volume (mL)
Upper inflection point
Lower inflection point
0
10
20
30
40
Pressure (cm H_2O)


+5
+5
End expiration
+5
+15

CPAP or BiPAP?



COPD

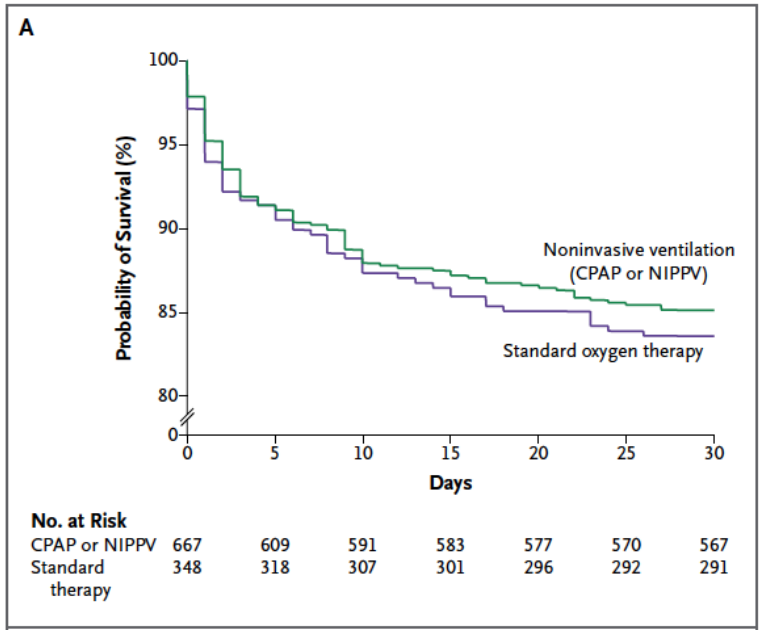
Plant *et al* 2000 (Lancet)

	Standard	NIV	p
Intention-to-treat			
Failed	32/118 (27%)	18/118 (15%)	0·02
Died	24/118 (20%)	12/118 (10%)	0·05
Subgroup analysis			
pH<7·30			
Failed	16/38 (42%)	13/36 (36%)	0·64
Died	13/38 (34%)	8/36 (22%)	0·31
pH>=7·30			
Failed	16/80 (20%)	5/82 (6%)	0·01
Died	11/80 (14%)	4/82 (5%)	0·06

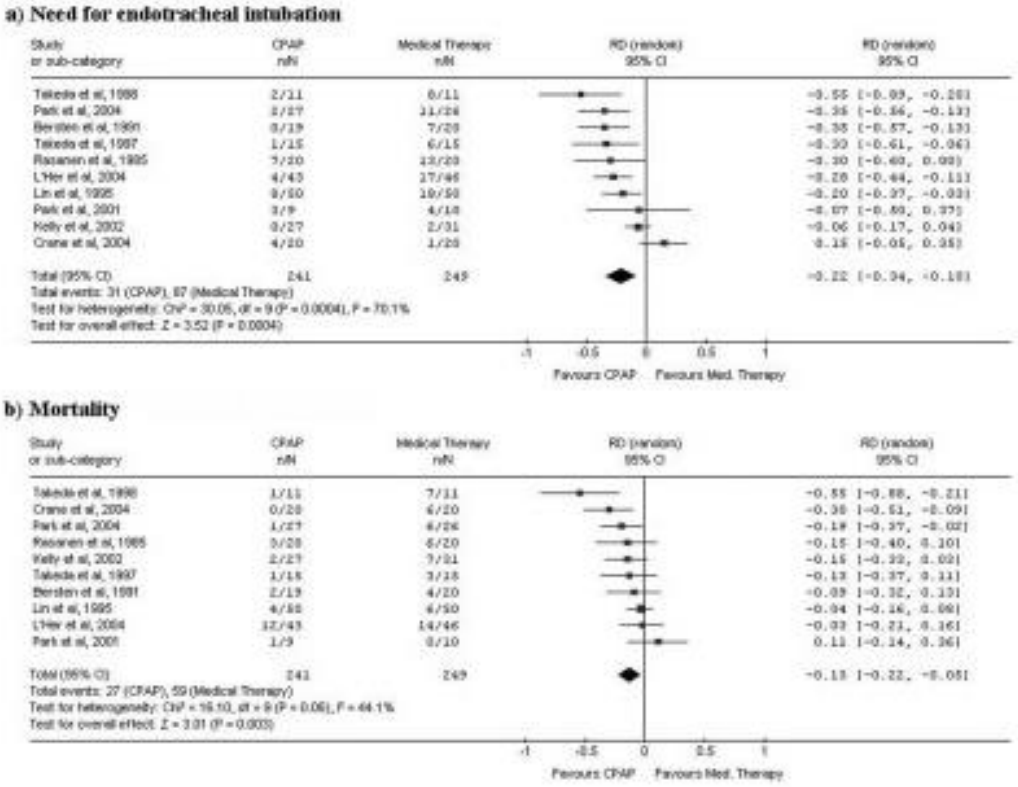
Table 2: **Primary outcome and in-hospital mortality**

The early use of NIV for mildly and moderately acidotic patients with COPD in the general ward setting leads to more rapid improvement of physiological variables, a reduction in the need for invasive mechanical ventilation, and a reduction in in-hospital mortality

Cardiogenic pulmonary oedema



Gray *et al* 2008 *NEJM* (3CPO)



Winck *et al* 2006 *Crit Care*

Pneumonia with immuno-compromise

Hilbert *et al* 2001
NEJM

TABLE 2. OUTCOMES OF TREATMENT.*

OUTCOME	NONINVASIVE-VENTILATION GROUP (N=26)	STANDARD-TREATMENT GROUP (N=26)	P VALUE	RELATIVE RISK (95% CI)
Intubation — no./total no. (%)	12/26 (46)	20/26 (77)	0.03	0.60 (0.38–0.96)
Immunosuppression from hematologic cancer and neutropenia	8/15 (53)	14/15 (93)	0.02	0.57 (0.35–0.93)
Drug-induced immunosuppression	3/9 (33)	5/9 (56)	0.32	0.60 (0.20–1.79)
Immunosuppression from the acquired immunodeficiency syndrome	1/2 (50)	1/2 (50)	0.83	1.00 (0.14–7.10)
Initial improvement in PaO_2:FiO_2 — no. (%)	12 (46)	4 (15)	0.02	
Sustained improvement in PaO_2:FiO_2 without intubation — no. (%)	13 (50)	5 (19)	0.02	
Death in the ICU — no./total no. (%)†	10/26 (38)	18/26 (69)	0.03	0.56 (0.32–0.96)
Immunosuppression from hematologic cancer and neutropenia	7/15 (47)	13/15 (87)	0.02	0.54 (0.30–0.96)
Drug-induced immunosuppression	3/9 (33)	4/9 (44)	0.50	0.75 (0.23–2.44)
Immunosuppression from the acquired immunodeficiency syndrome	0/2	1/2 (50)	0.50	0.50 (0.13–2.00)
Total duration of any ventilatory assistance — days				
Among all patients	6±3	6±5	0.59	
Among survivors	5±2	3±5	0.12	
Length of ICU stay — days				
Among all patients	7±3	9±4	0.11	
Among survivors	7±3	10±4	0.06	
Death in the hospital — no./total no. (%)	13/26 (50)	21/26 (81)	0.02	0.62 (0.40–0.95)
Immunosuppression from hematologic cancer and neutropenia	8/15 (53)	14/15 (93)	0.02	0.57 (0.35–0.93)
Drug-induced immunosuppression	4/9 (44)	6/9 (67)	0.32	0.67 (0.28–1.58)
Immunosuppression from the acquired immunodeficiency syndrome	1/2 (50)	1/2 (50)	0.83	1.00 (0.14–7.10)

In selected immunosuppressed patients with pneumonitis and acute respiratory failure, early initiation of noninvasive ventilation is associated with significant reductions in the rates of endotracheal intubation and an improved likelihood of survival to hospital discharge.

Caution

- Lobar pneumonia
- Aspiration pneumonia
- ALI / ARDS
- Any condition not expected to improve rapidly!

- Reduced conscious level
- Difficulty clearing secretions
- Cardiovascular failure / metabolic acidosis etc.

- Prolonged ineffective trials of NIV delay definitive treatment (intubation if appropriate) and increase mortality

What if the patient does not tolerate it?

- Nursing experience is key
- Start slowly and build up
- Analgesia may help dyspnoea and increase comfort
- Consider sedation / anxiolytics
- Choice of drug and dosing depends on setting & level of monitoring

- Remember - prolonged ineffective trials of NIV delay definitive treatment (intubation if appropriate) and increase mortality

What if it doesn't work?

- If respiratory acidaemia persists, increase inspiratory pressure support
- If oxygenation remains poor, add / increase O_2 and / or increase expiratory pressure
- NIV is an adjunct – remember to treat the underlying problem
- Plan for failure – define 'trial period' from outset
- Before you start: decide what to do next – palliation versus intubation

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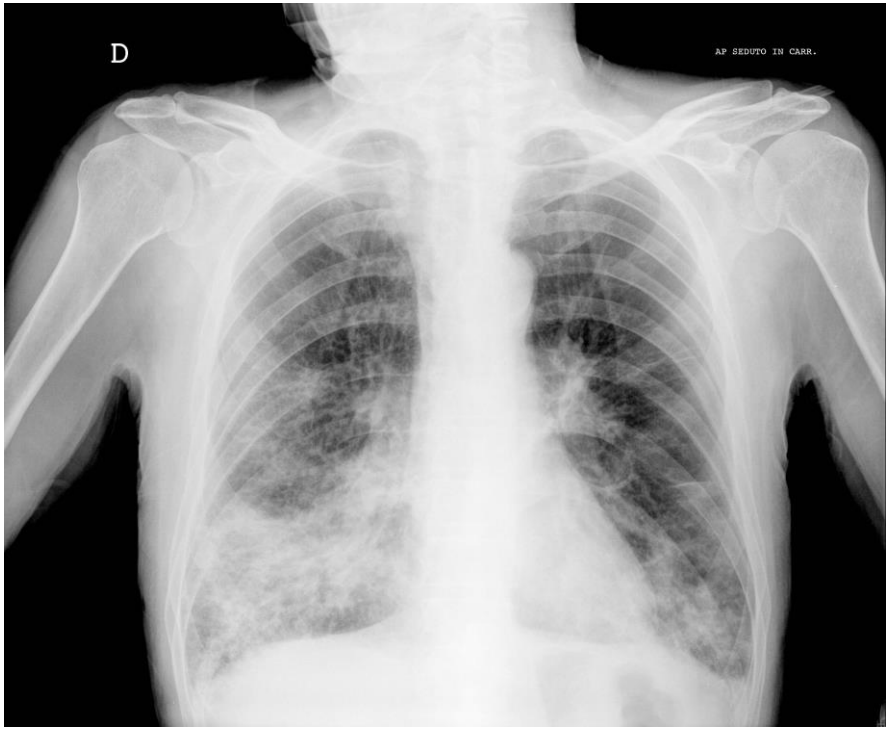

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Take Home Messages

Best evidence base in acute on chronic T2RF in COPD

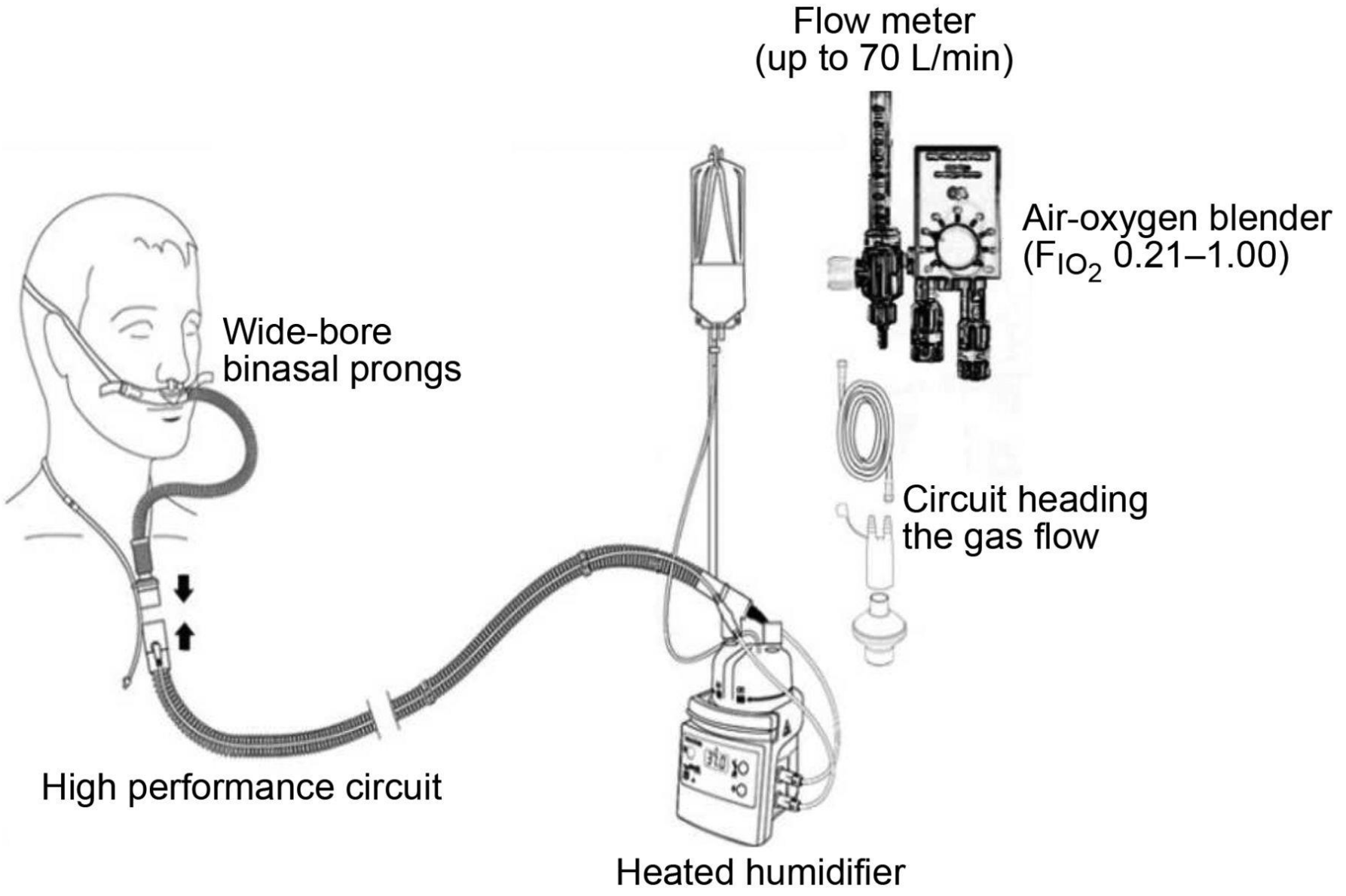
Beware metabolic acidosis or multi-organ failure

Prepare to fail / Always have a ‘Plan B’

Helpful as an adjunct in acute cardiogenic pulmonary oedema

May avoid need for invasive ventilation in immuno-compromise

Cautious sedation can aid tolerance – but consider setting carefully


Flow meter
(up to 70 L/min)
Air-oxygen blender
(F_{IO_2} 0.21–1.00)
Wide-bore
binasal prongs
Circuit heading
the gas flow
High performance circuit
Heated humidifier

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