



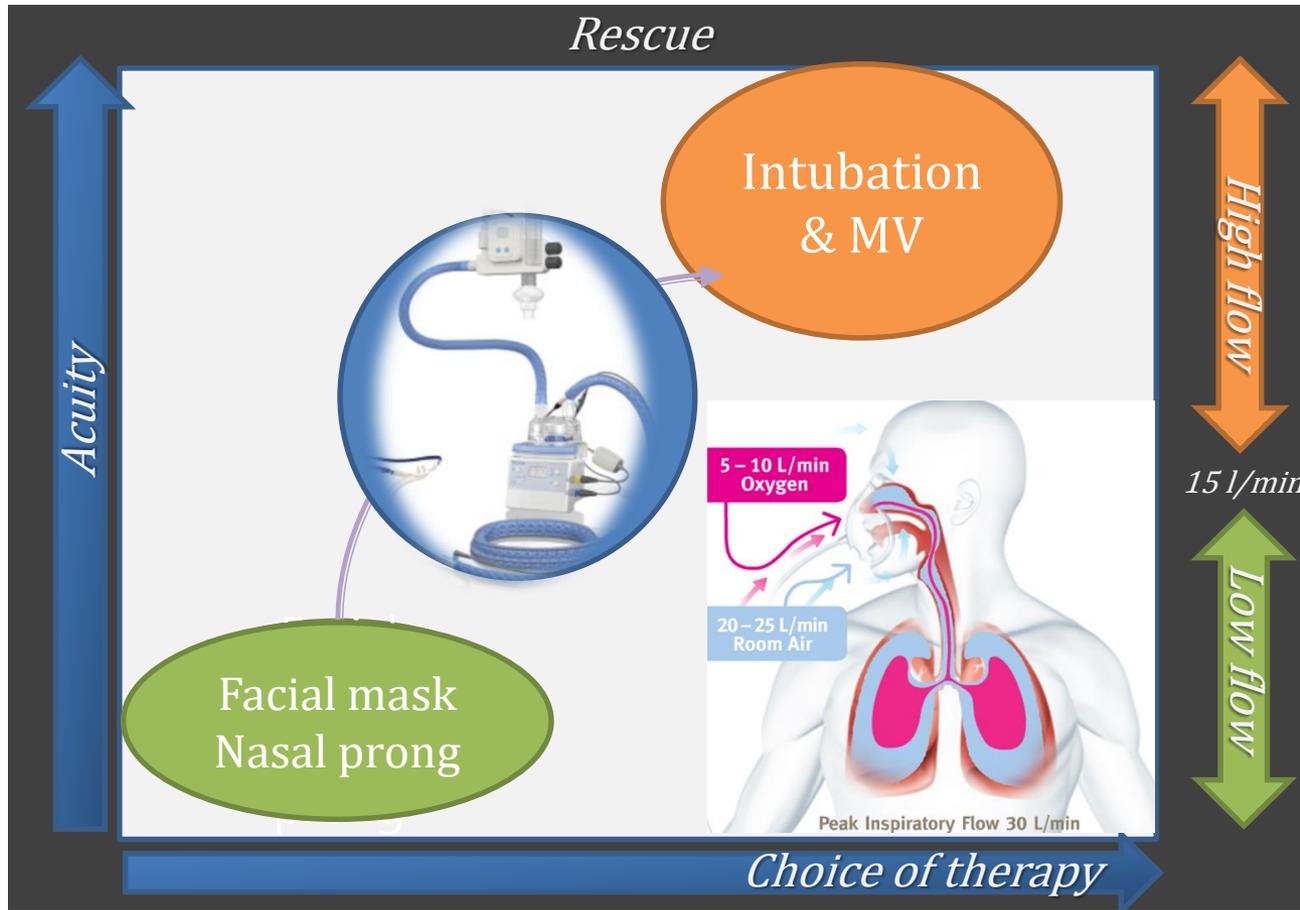
High Flow Nasal Cannula -Basic physiology & optimal setting

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Choice of oxygen delivery devices



Outline

Physiology of high flow nasal cannula

FiO₂ stability, PEEP, lung volume, WOB, CO₂ washout



Applications of high flow nasal cannula

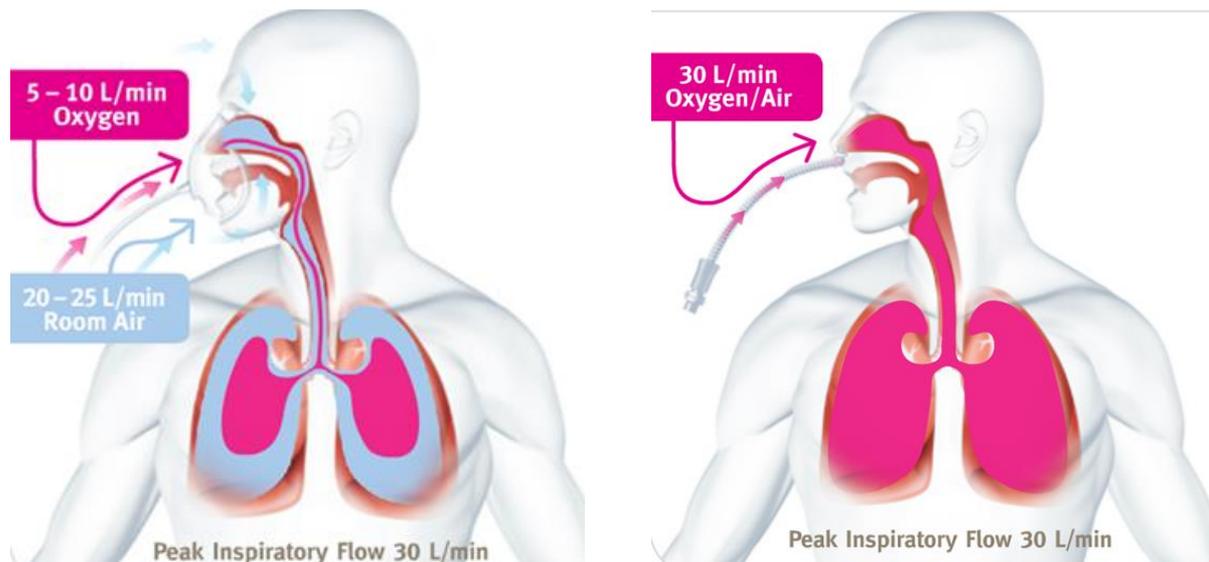
Flow and temperature settings



When to intubate?

What is high flow nasal cannula (HFNC)?

- 30-60 L/min of heated-humidified mix of air and oxygen at set FiO₂
- HFNC is **NOT** a lot of oxygen!



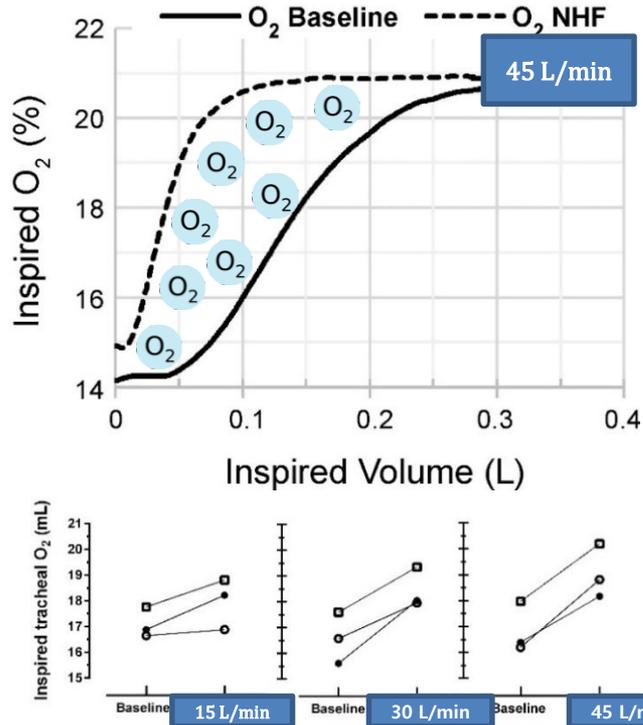
High flow nasal cannula settings

- 30-60 L/min of heated-humidified mix of air and O₂

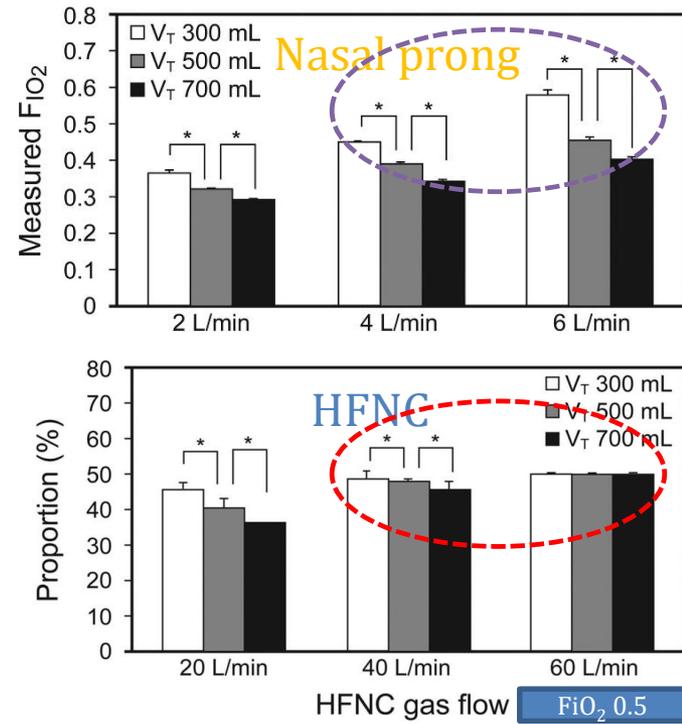


Higher flow

- More O₂ at the same FiO₂

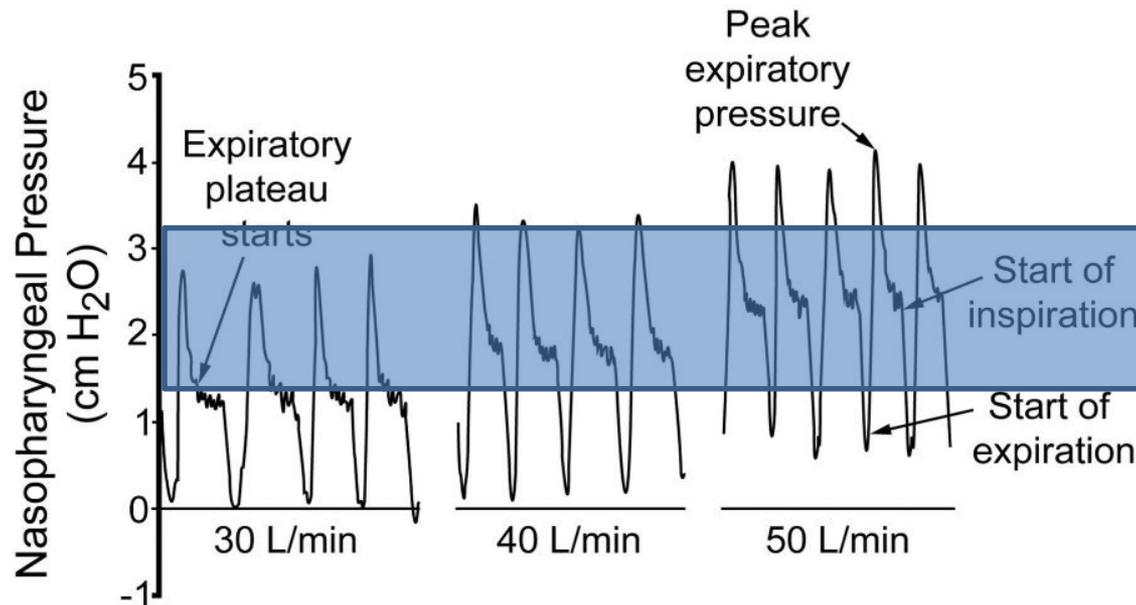


- More stable FiO₂ at ↑ V_T



Higher flow → higher PEEP effect

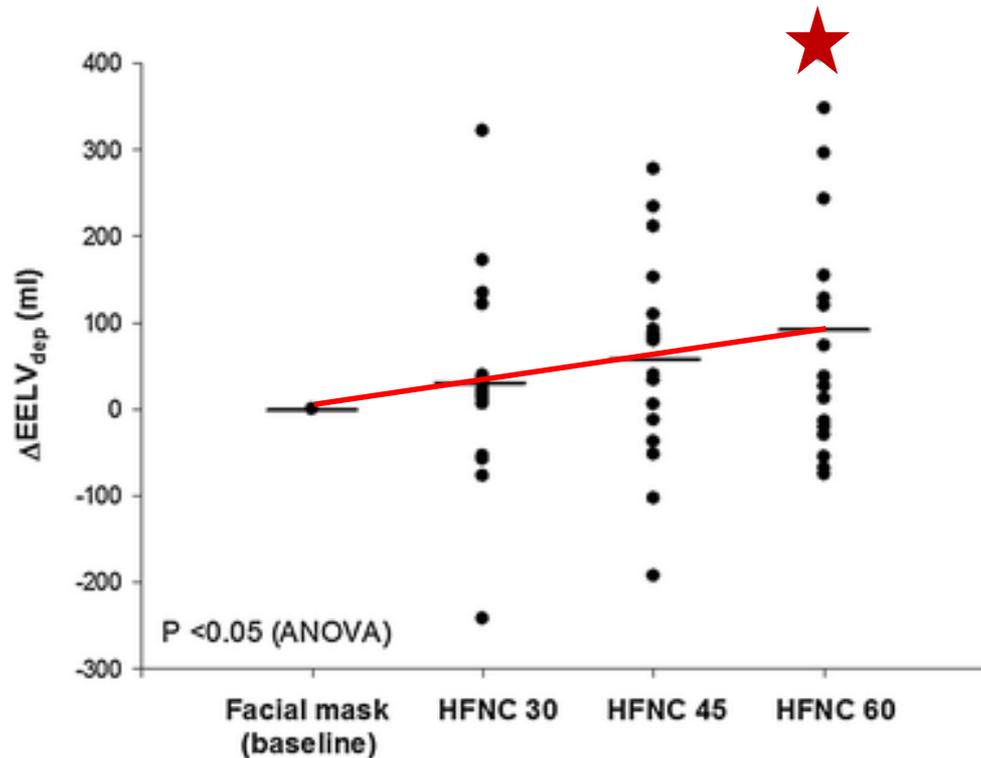
Post-cardiac surgery patients,
No sign of acute respiratory failure



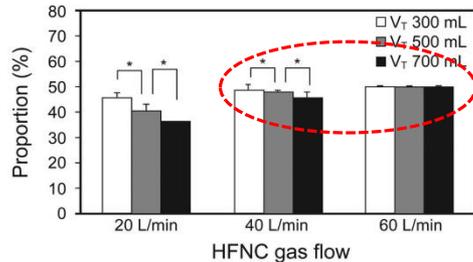
PEEP = 2-3 cmH₂O

Higher flow → larger EELV

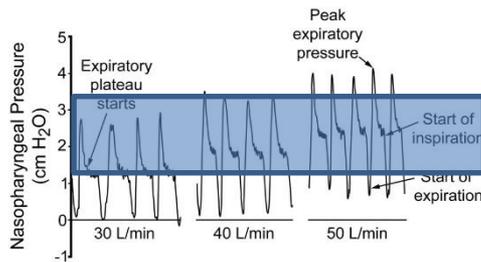
Acute hypoxemic respiratory failure patients



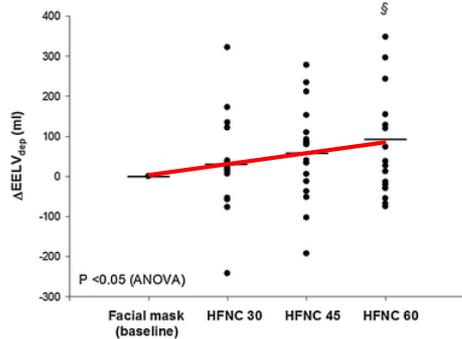
Mechanisms of improved oxygenation



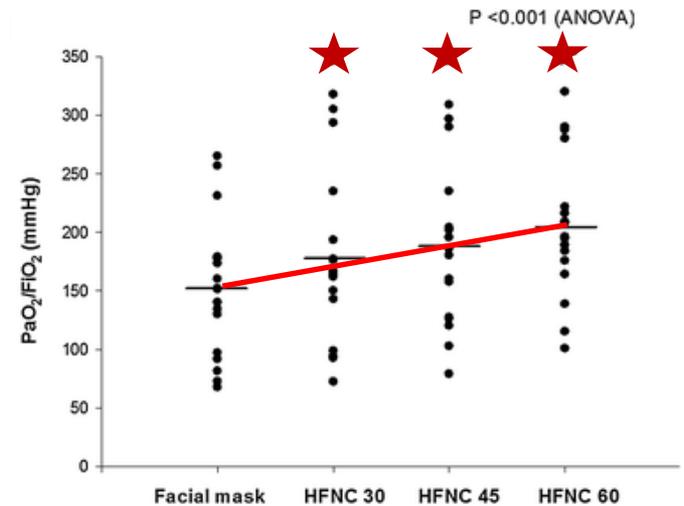
Consistent FiO_2



PEEP



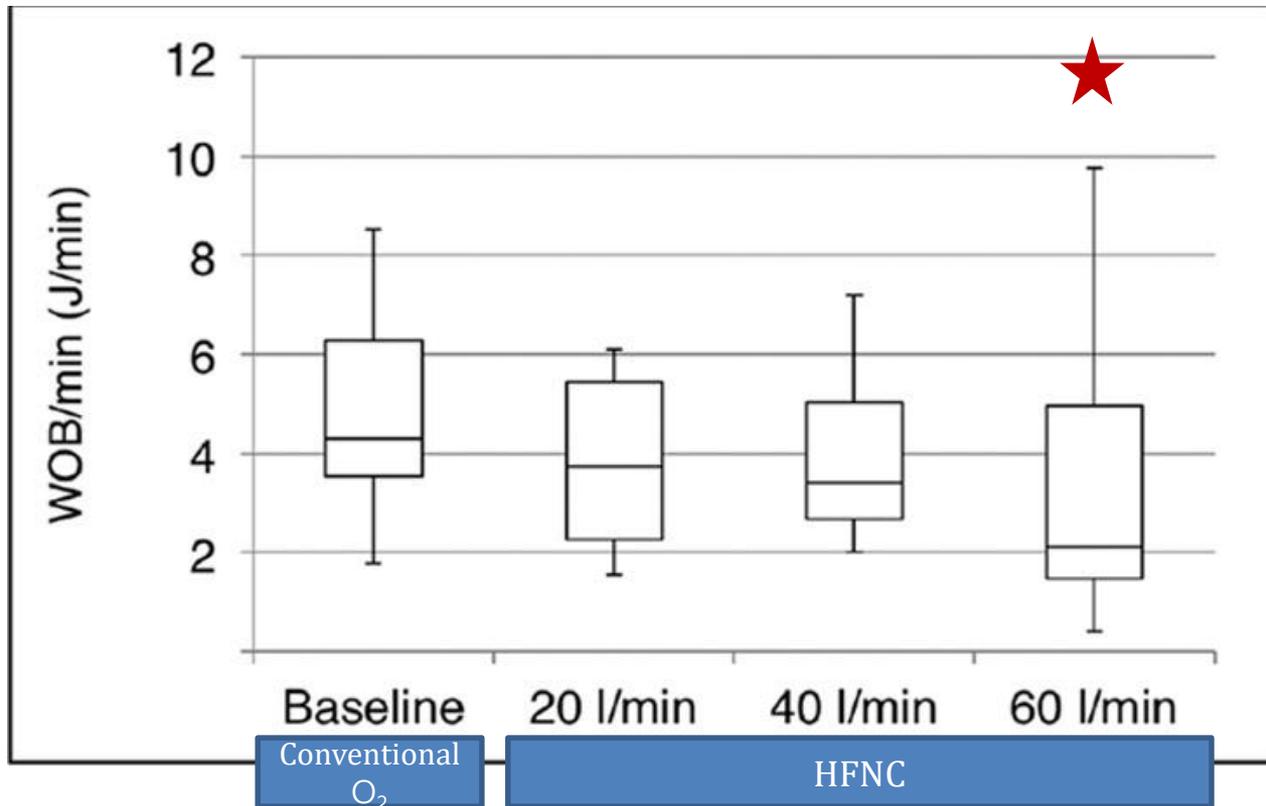
\uparrow lung volume



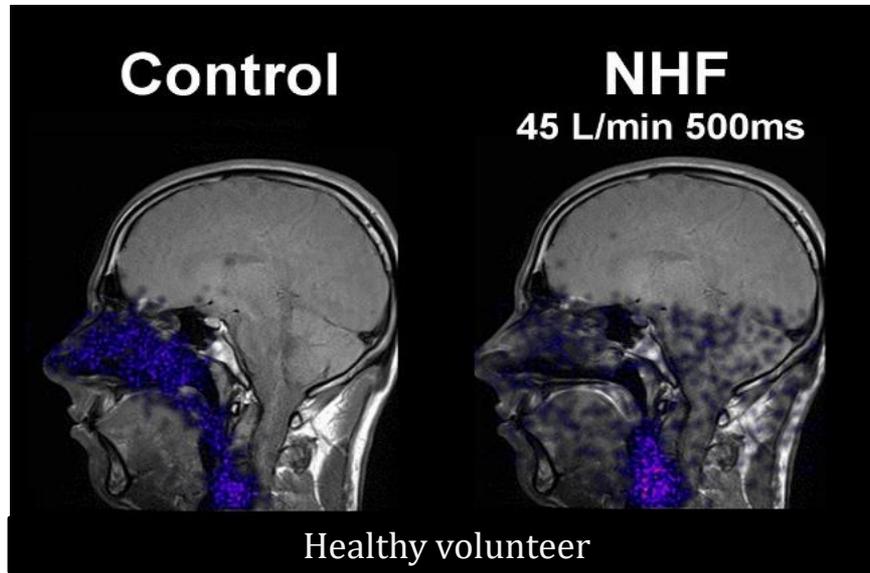
Progressive improvement of $\text{PaO}_2/\text{FiO}_2$

Less inspiratory effort

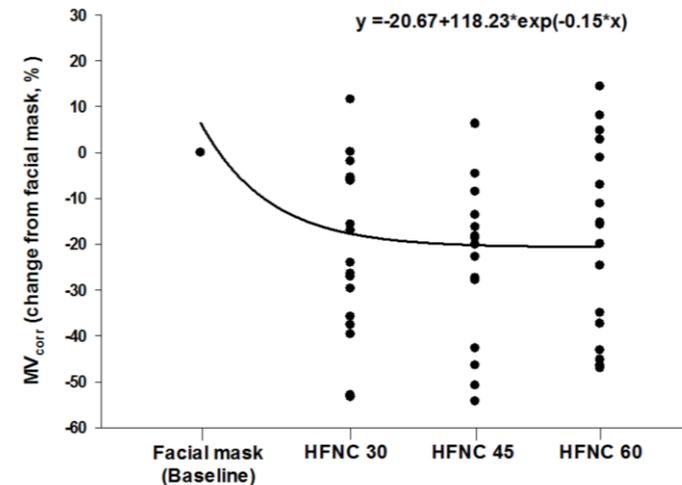
Patients with hypoxemia or hypercapnia (RR > 20/min)



CO₂ washout

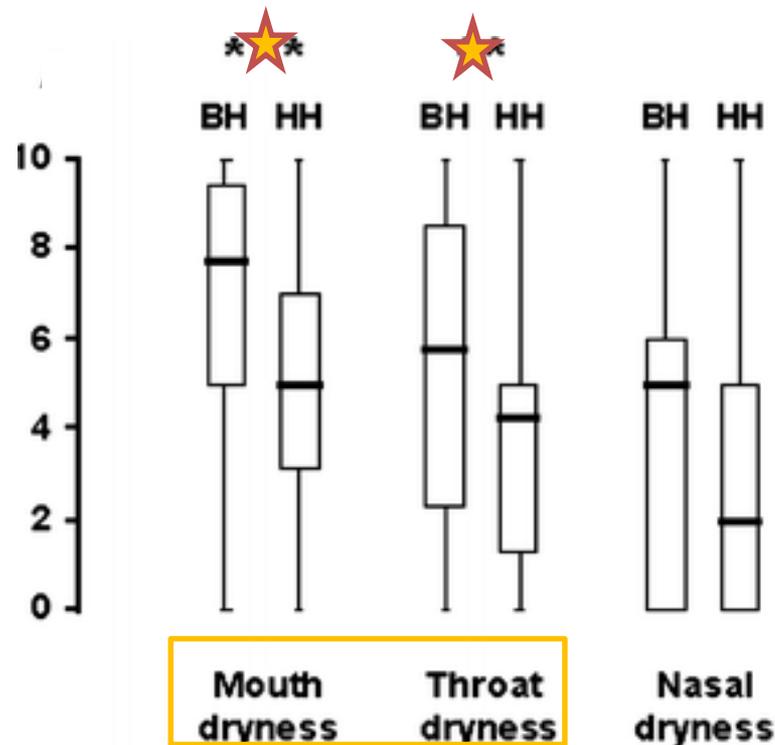


Acute hypoxemic respiratory failure patients



Reduce anatomical dead space
Effect plateau at **30 L/min**

Humidification on comfort

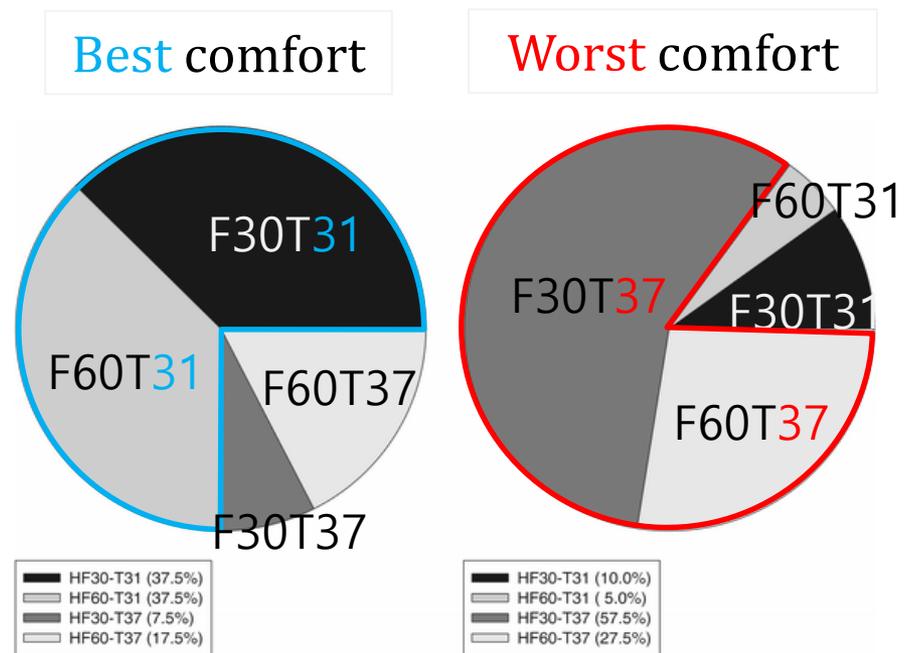
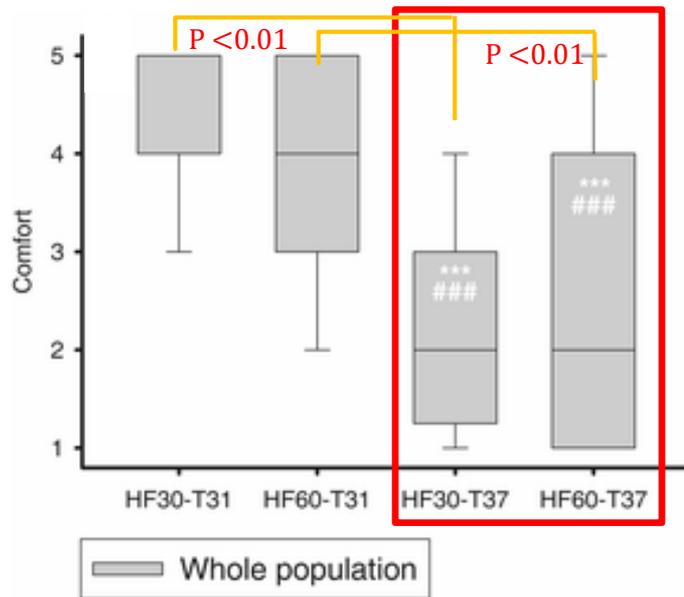


BH: Bubbled humidification, HH: heated humidification

Better humidification → **more comfort.**

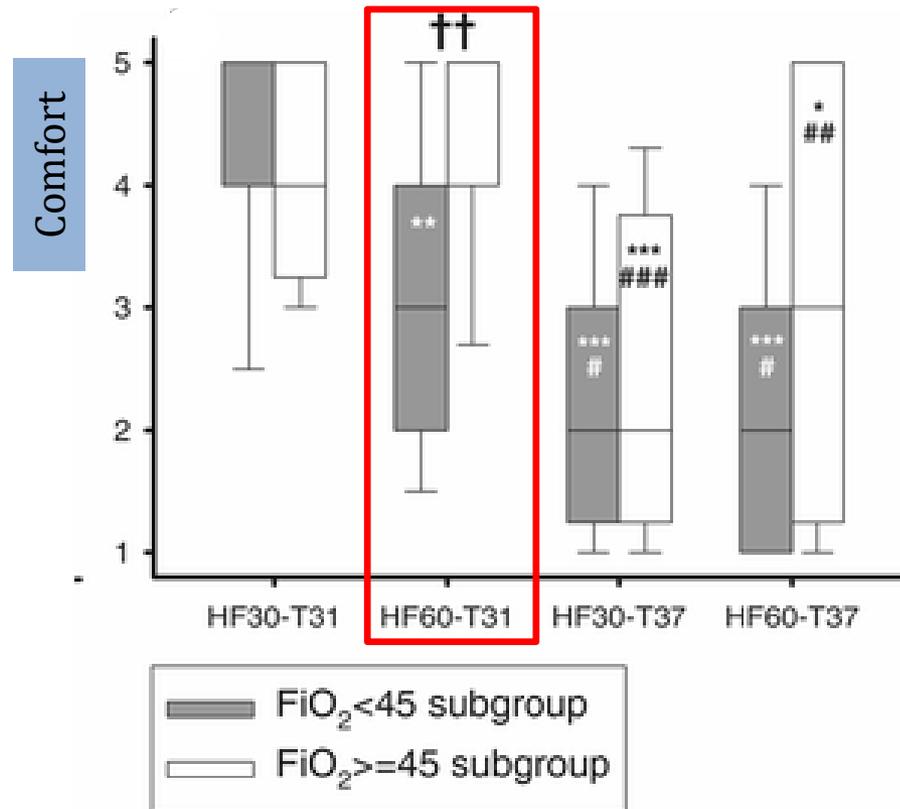
Temperature and flow rate on comfort

Acute hypoxemic respiratory failure patients



Higher temperature → less comfort.
No clear effect of higher flow.

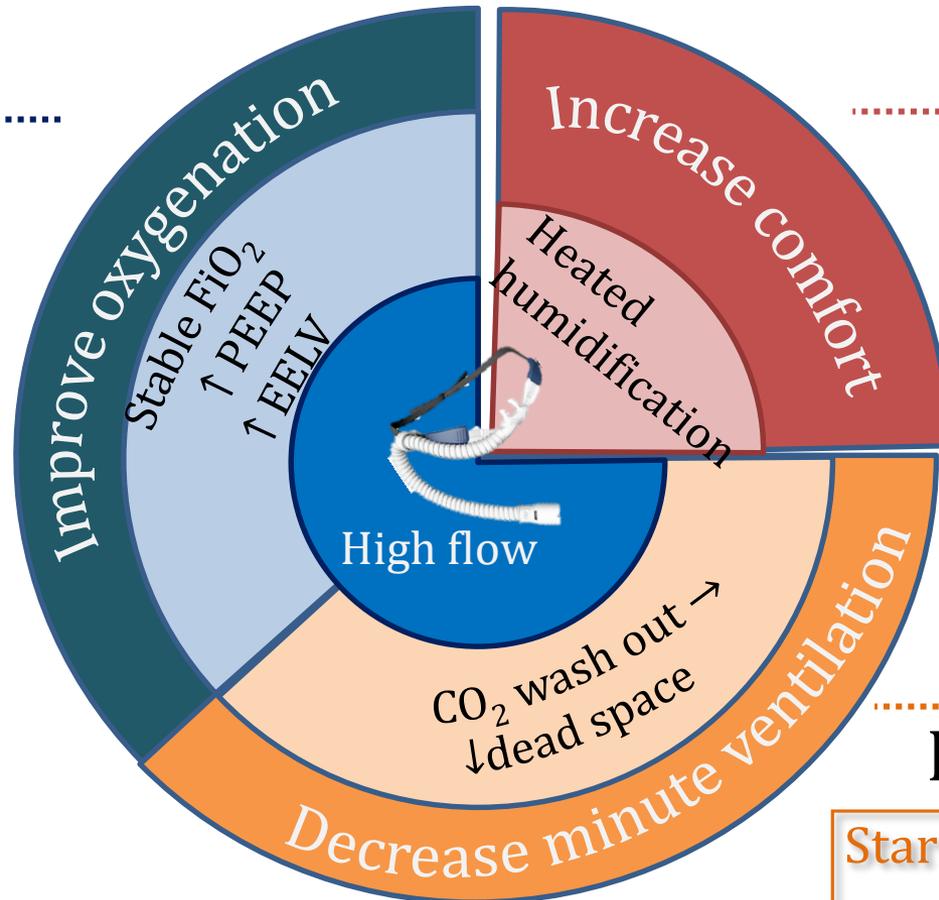
Higher flow → more comfort in severe patients



Physiologic basis of HFNC settings

Hypoxemia

Start from
flow 60 L/min



Discomfort

Decrease
temperature (31°C),
Increase flow in
more severe pts

Hypercapnia

Start from 30 L/min,
Increase if hypoxemic

Late failure → worse outcome

Failure of high-flow nasal cannula therapy may delay intubation and increase mortality

Intensive Care Med 2015;41:623

- 175 pts /w HFNC failure: 130 early (≤ 48 h), 45 late (> 48 h)

Early intubation associated with

- ↓ ICU mortality (39.2 vs. 66.7%)
- ↑ extubation success (37.7 vs. 15.6%)
- ↑ ventilator weaning (55.4 vs. 28.9%)
- ↑ ventilator-free days (8.6 vs. 3.6)

Conclusions: Failure of HFNC might cause delayed intubation and worse clinical outcomes in patients with respiratory failure. Large prospective and randomized controlled studies on HFNC failure are needed to draw a definitive conclusion.

How to predict HFNC failure?

Predictors of Intubation in Patients With Acute Hypoxemic Respiratory Failure Treated With a Noninvasive Oxygenation Strategy*

Crit Care Med 2018;46:208

- Post hoc analysis of the FLORALI trial
- Early (1 hour) prediction of failure (intubation)

Multivariate Logistic Regression Analyses of Factors Associated With Intubation

Risk Factors	OR (95% CI)	p
In patients treated with conventional O ₂ therapy by nonrebreathing mask ^a		
Respiratory rate ≥ 30 breaths/min at H1	2.76 (1.13–6.75)	0.03
In patients treated with high-flow nasal cannula oxygen therapy ^a		
Heart rate at H1 (per beat/min)	1.03 (1.01–1.06)	< 0.01
In patients treated with noninvasive ventilation ^{ab}		
Tidal volume > 9 mL/kg of predicted body weight at H1	3.14 (1.22–8.06)	0.02
Pao ₂ /Fio ₂ ≤ 200 mm Hg at H1	4.26 (1.62–11.16)	0.003

When to intubate?

Intubation!!

- GCS < 12,
- Unstable V/S
- RR > 40/min
- Copious secretions
- pH < 7.35
- SpO₂ < 90% for > 5 min
(FLORALI trial, NEJM 2015;372:2185)

If pts with HFNC → increased
HR at 1hour





*Thank
You*