NIV/HFNC in ARDS (ARF)

- **Sunghoon Park**
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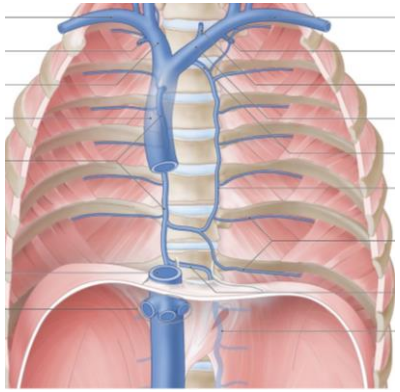
- Director of ICUs
- Hallym University Sacred Heart Hospital

Respiratory system

Pump



- Ventilation failure
  - PaO_2 ↓
  - $PaCO_2$ ↑ ↑

Tx: **Ventilation**

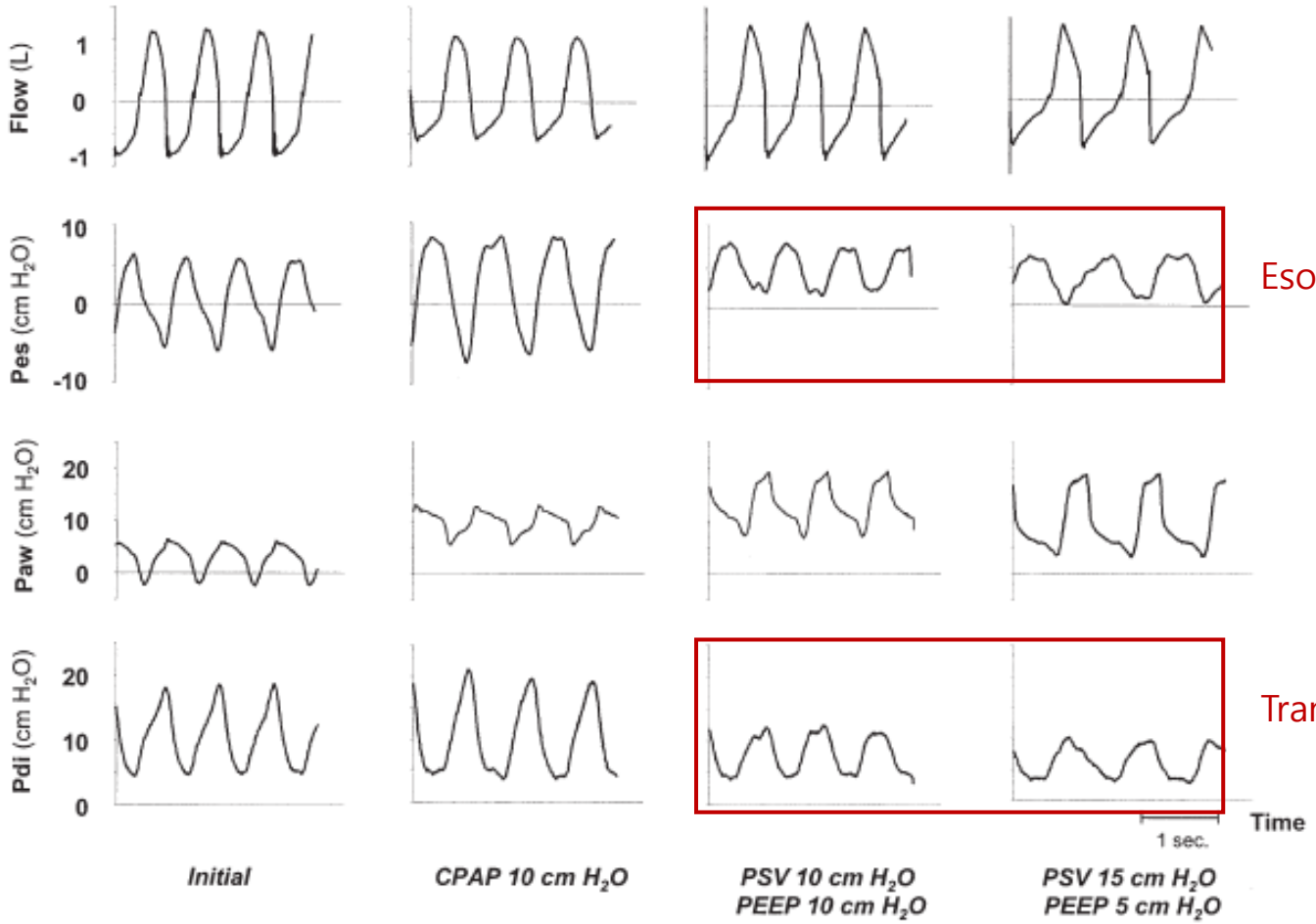
Lungs

- Lung (pulmonary) failure
  - PaO_2 ↓ ↓
  - $PaCO_2$ N or ↓

Tx: **Oxygenation**

Unloading respiratory m. with NIV (not with CPAP)

10 patients with **ALI**



Esophageal Pr. swings

Transdiaphragmatic Pr. swings

L'Her et al. Am J Respir Crit Care 2005;172:1112–1118,

Brochard et al. New Engl J Med 1995; 333:817-22.

AE of COPD

The New England
Journal of Medicine

Volume 333 SEPTEMBER 28, 1995 Number 13

NONINVASIVE VENTILATION FOR ACUTE EXACERBATIONS OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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Abstract *Background.* In patients with acute exacerbations of chronic obstructive pulmonary disease, noninvasive ventilation may be used in an attempt to avoid endotracheal intubation and complications associated with mechanical ventilation.

Methods. We conducted a prospective, randomized study comparing noninvasive pressure-support ventilation delivered through a face mask with standard treatment in patients admitted to five intensive care units over a 15-month period.

Results. A total of 85 patients were recruited from a larger group of 275 patients with chronic obstructive pulmonary disease admitted to the intensive care units in the same period. A total of 42 were randomly assigned to standard therapy and 43 to noninvasive ventilation. The two groups had similar clinical characteristics on admission to the hospital. The use of noninvasive ventilation significantly reduced the need for endotracheal intubation (which was dictated by objective criteria): 11 of 43 patients (26 percent) in the noninvasive-ventilation group were intubated, as compared with 31 of 42 (74 percent) in the standard-treatment group ($P<0.001$). In addition, the frequency of complications was significantly lower in the noninvasive-ventilation group (16 percent vs. 48 percent, $P=0.001$), and the mean (±SD) hospital stay was significantly shorter for patients receiving noninvasive ventilation (23±17 days vs. 35±33 days, $P=0.005$). The in-hospital mortality rate was also significantly reduced with noninvasive ventilation (4 of 43 patients, or 9 percent, in the noninvasive-ventilation group died in the hospital, as compared with 12 of 42, or 29 percent, in the standard-treatment group; $P=0.02$).

Conclusions. In selected patients with acute exacerbations of chronic obstructive pulmonary disease, noninvasive ventilation can reduce the need for endotracheal intubation, the length of the hospital stay, and the in-hospital mortality rate. (N Engl J Med 1995;333:817-22.)

RCT, 5 ICUs and 15-months
N = 85 (43 standard vs. 42 noninvasive)

Inclusion criteria

- Known COPD
- Dyspnea < 2 weeks
- RR > 30/min
- PO_2 < 45 mmHg
- pH < 7.35

Intubation criteria

- Resp. arrest or pause
- Loss of consciousness or gasping for air
- HR < 50 beats/min with loss of alertness
- SBP < 70 mmHg
- pH < 7.3 or below the admission value
- PaO_2 < 45 mmHg despite O_2 therapy

Brochard et al. New Engl J Med 1995; 333:817-22.

AE of COPD

NIV group: NIV > 6hr/day, PSV mode (PS, 20 cmH_2O)
Standard Tx: O2 ~ 5L/min

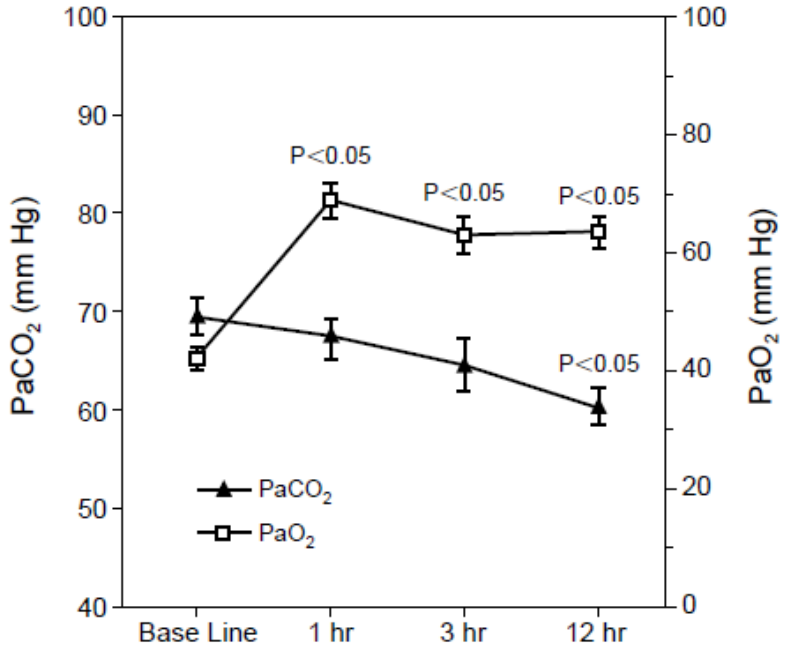
Table 3. Characteristics at Admission and Mortality Rate, According to Whether Endotracheal Intubation Was Required after Assignment to Standard Treatment or Noninvasive Ventilation.*

Characteristic	Standard Treatment		Noninvasive Ventilation		P Value†
	Intubation not required (N = 11)	Intubation required (N = 31)	Intubation not required (N = 32)	Intubation required (N = 11)	
SAPS	10±4	14±5‡	12±3‡	15±4§	0.02
Encephalopathy score	0.7±0.9	1.9±1.2‡	1.6±1.3‡	2.5±1.0	0.007
Respiratory rate — breaths/min	32±8	34±6	34±7	37±7	0.4
PaO_2 — mm Hg	43±14	37±12	42±11	37±9	0.3
$PaCO_2$ — mm Hg	59±15	69±16	70±12	73±11	0.1
pH	7.33±0.09	7.27±0.11	7.28±0.10	7.26±0.10	0.1
Bicarbonate — mmol/liter	31.7±7.7	32.6±6.3	33.7±6.0	32.5±8.4	0.2
Length of hospital stay — days	20±16	41±36‡	17±9	40±22§	<0.001
Deaths — no. of patients (%)	2 (18)	10 (32)	1 (3)	3 (27)	

P_aCO_2, 59 ~73
pH, 7.26 ~ 7.33

Intubation: 26% vs. 74% (P <0.001; NIV vs. standard Tx)
Complications: 16% vs. 48% (P = 0.001)
In-hospital mortality" 9% vs. 29% (P = 0.02)

32 pts successfully treated with NIV (4 ± 4 days)



Gray et al. N Engl J Med 2008;359:142-51.

NIV in CPE

ORIGINAL ARTICLE

Noninvasive Ventilation in Acute Cardiogenic Pulmonary Edema

Alasdair Gray, M.D., Steve Goodacre, Ph.D., David E. Newby, M.D., Moyra Masson, M.Sc., Fiona Sampson, M.Sc., and Jon Nicholl, M.Sc., for the 3CPO Trialists*

ABSTRACT

BACKGROUND

Noninvasive ventilation (continuous positive airway pressure [CPAP] or noninvasive intermittent positive-pressure ventilation [NIPPV]) appears to be of benefit in the immediate treatment of patients with acute cardiogenic pulmonary edema and may reduce mortality. We conducted a study to determine whether noninvasive ventilation reduces mortality and whether there are important differences in outcome associated with the method of treatment (CPAP or NIPPV).

METHODS

In a multicenter, open, prospective, randomized, controlled trial, patients were assigned to standard oxygen therapy, CPAP (5 to 15 cm of water), or NIPPV (inspiratory pressure 8 to 20 cm of water; expiratory pressure, 4 to 10 cm of water). The primary end point for the comparison between noninvasive ventilation and standard oxygen therapy was death within 7 days after the initiation of treatment, and the primary end point for the comparison between NIPPV and CPAP was death or intubation within 7 days.

- A multicenter open RCT in UK (1:1:1)
- Clinical diagnosis of CPE, RR > 20, pH <7.35

Standard Tx: 0_2
CPAP: 5-15 cmH2O (2.2 hr)
NIPPV: PS 8-20 cmH2O, PEEP 4-10 cmH2O (2.0 hr)

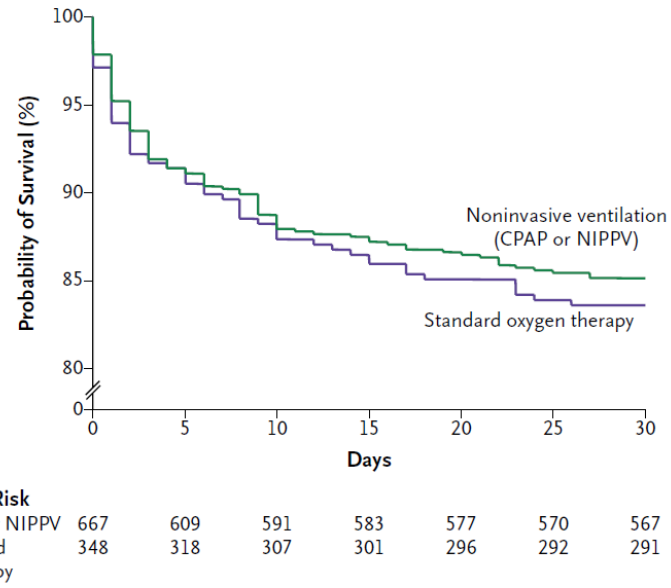
	Standard Oxygen Treatment (N=367)	CPAP (N=346)	NIPPV (N=356)	
	79±9	78±10	77±10	
Respiratory rate (breaths/min)	33±7	32±7	32±7	
Peripheral oxygen saturation (%)	91±8	90±8	90±8	
Arterial pH	7.22±0.08	7.21±0.09	7.22±0.09	
PaO_2 (kPa)	13.1±7.6	13.5±7.7	13.4±8.6	97.5 mmHg
$PaCO_2$ (kPa)	7.6±2.5	7.5±1.9	7.7±2.3	57 mmHg
Serum bicarbonate level (mmol/liter)	21±4	21±4	21±5	

Gray et al. N Engl J Med 2008;359:142-51.

NIV in CPE

No difference in 7-day mortality

A



	Standard Oxygen Treatment (N=367)	CPAP or NIPPV (N=702)	Odds Ratio (95% CI)	P Value
Mean change at 1 hr after start of treatment‡				
Dyspnea score§	3.9	4.6	0.7 (0.2 to 1.3)	0.008
Pulse rate (beats/min)	13	16	4 (1 to 6)	0.004
Blood pressure (mm Hg)				
Systolic	34	38	3 (−1 to 8)	0.17
Diastolic	22	22	0 (−3 to 3)	0.95
Respiratory rate (breaths/min)	7.1	7.2	0.2 (−0.8 to 1.1)	0.74
Peripheral oxygen saturation (%)	3.5	3.0	−0.4 (−1.4 to 0.6)	0.41
Arterial pH	0.08	0.11	0.03 (0.02 to 0.04)	<0.001
Arterial PaO_2 (kPa)	0.7	−0.6	−1.2 (−2.6 to 0.1)	0.07
Arterial $PaCO_2$ (kPa)	0.8	1.5	0.7 (0.4 to 0.9)	<0.001
Serum bicarbonate level (mmol/liter)	1.7	1.8	0.1 (−0.7 to 1.0)	0.77

No differences in intubation or death rates within 7 days

"NIV can decrease WOB, as well as improved oxygenation, during a short period of time"

Hilbert et al. N Engl J Med. 2001;15;344:481-7

Immunocompromised patients

A single center RCT with 52 patients (France)

NONINVASIVE VENTILATION IN IMMUNOSUPPRESSED PATIENTS WITH PULMONARY INFILTRATES, FEVER, AND ACUTE RESPIRATORY FAILURE

GILLES HILBERT, M.D., DIDIER GRUSON, M.D., FRÉDERIC VARGAS, M.D., RUDDY VALENTINO, M.D., GEORGES GBIKPI-BENISSAN, M.D., MICHEL DUPON, M.D., JOSY REIFFERS, M.D., AND JEAN P. CARDINAUD, M.D.

ABSTRACT

Background Avoiding intubation is a major goal in the management of respiratory failure, particularly in immunosuppressed patients. Nevertheless, there are only limited data on the efficacy of noninvasive ventilation in these high-risk patients.

Methods We conducted a prospective, randomized trial of intermittent noninvasive ventilation, as compared with standard treatment with supplemental oxygen and no ventilatory support, in 52 immunosuppressed patients with pulmonary infiltrates, fever, and an early stage of hypoxemic acute respiratory failure. Periods of noninvasive ventilation delivered through a face mask were alternated every three hours with periods of spontaneous breathing with supplemental oxygen. The ventilation periods lasted at least 45 minutes. Decisions to intubate were made according to standard, predetermined criteria.

Results The base-line characteristics of the two groups were similar; each group of 26 patients included 15 patients with hematologic cancer and neutropenia. Fewer patients in the noninvasive-ventilation group than in the standard-treatment group required endotracheal intubation (12 vs. 20, P=0.03), had serious complications (13 vs. 21, P=0.02), died in the intensive care unit (10 vs. 18, P=0.03), or died in the hospital (13 vs. 21, P=0.02).

Conclusions In selected immunosuppressed patients with pulmonary infiltrates, fever, and acute hypoxemic respiratory failure, the use of noninvasive ventilation at an early stage of hypoxemic acute respiratory failure would reduce the need for endotracheal intubation and the incidence of complications. In a prospective, randomized, controlled study, we compared the efficacy of noninvasive ventilation delivered intermittently through a face mask with that of standard medical treatment with supplemental oxygen and no ventilatory support in patients with immunosuppression from various causes in whom hypoxemic acute respiratory failure had been precipitated by pulmonary infiltrates and fever.

METHODS

Study Design and Selection of Patients

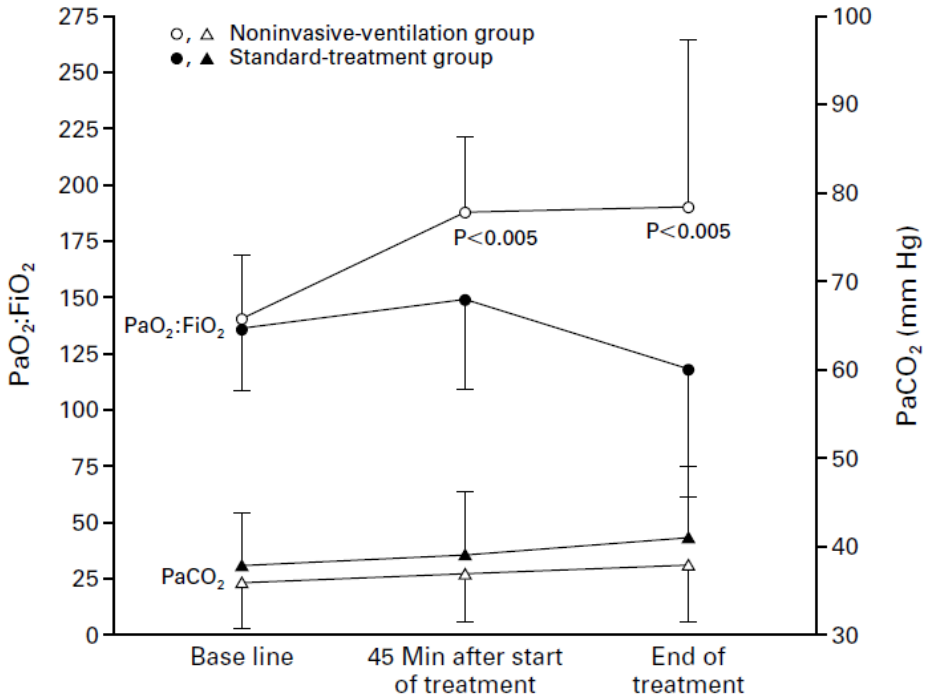
The experimental protocol was approved by the institutional review board of the hospital, and all patients or the next of kin provided written informed consent. From May 1998 through December 1999, consecutive immunosuppressed patients who were transferred to our 16-bed intensive care unit and who had clinical manifestations of pulmonary infiltrates, fever, and hypoxemic acute respiratory failure were enrolled in the study. The immunosuppression could have been caused by neutropenia (defined as a polymorphonuclear leukocyte count of less than 1000 cells per cubic millimeter of blood) after chemotherapy or bone marrow transplantation in patients with hematologic cancers, drug-induced immunosuppression in organ-transplant recipients or as a result of corticosteroid or cytotoxic therapy for a nonmalignant disease, or the acquired immunodeficiency syndrome.

CHARACTERISTIC	NONINVASIVE-VENTILATION GROUP (N=26)	STANDARD-TREATMENT GROUP (N=26)
Age — yr	48±14	50±12
Male sex — no. (%)	18 (69)	19 (73)
SAPS II†	45±10	42±9
Respiratory rate — breaths/min	35±3	36±3
Heart rate — beats/min	108±16	111±14
Systolic blood pressure — mm Hg	127±19	123±17
Body temperature — °C	38.3±0.6	38.5±0.6
Microbiologic diagnosis of pneumonia — no. (%)‡	13 (50)	11 (42)
PaO_2:FiO_2	141±24	136±23
$PaCO_2$ — mm Hg	37±4	38±5
Arterial pH	7.45±0.04	7.43±0.04
White-cell count — cells/mm³		
Patients with immunosuppression from hematologic cancer and neutropenia	264±163	241±147
Patients with other types of immunosuppression	9980±5290	10,590±5730
Types of immunosuppression — no. (%)		
Hematologic cancer and neutropenia	15 (58)	15 (58)
Bone marrow transplantation	8 (31)	9 (35)
High-dose chemotherapy	7 (27)	6 (23)
Drug-induced immunosuppression	9 (35)	9 (35)
Organ transplantation	3 (12)	4 (15)
Corticosteroid therapy	4 (15)	3 (12)
Other	2 (8)	2 (8)
Acquired immunodeficiency syndrome	2 (8)	2 (8)

Hilbert et al. N Engl J Med. 2001;15;344:481-7

Immunocompromised patients

NIV: above PEPP/PEEP = 15 / 6 cm H2O
7±3 hours per day (4±2 days)



- P/F ratio: 141 vs. 136 (RR: 35 vs. 36)
- Intubation: 46% vs. 77% (p = 0.03)
- ICU death: 38% vs. 69% (p = 0.03)
- In-hospital death 50% vs. 81% (p = 0.02)
- Serious complications 50% vs. 81% (p = 0.02)
- Time to intubation: 63h vs. 51h

However, intubation criteria seemed too strict ?

- P/F ratio < 85 mmHg
- SBP < 70, myocardial ischemia, or VF
- Mental changes (GCS ≤ 8)
- Copious secretion
- ↑ PCO_2 with pH < 7.3

Lemiale et al JAMA. 2015;314(16):1711-1719

Immunocompromised patients (2)

A RCT on 374 patients (28 ICUs) in France and Belgium

Research

Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Noninvasive Ventilation vs Oxygen Therapy on Mortality Among Immunocompromised Patients With Acute Respiratory Failure

A Randomized Clinical Trial

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IMPORTANCE Noninvasive ventilation has been recommended to decrease mortality among immunocompromised patients with hypoxemic acute respiratory failure. However, its effectiveness for this indication remains unclear.

OBJECTIVE To determine whether early noninvasive ventilation improved survival in immunocompromised patients with nonhypercapnic acute hypoxemic respiratory failure.

DESIGN, SETTING, AND PARTICIPANTS Multicenter randomized trial conducted among 374 critically ill immunocompromised patients, of whom 317 (84.7%) were receiving treatment for hematologic malignancies or solid tumors, at 28 intensive care units (ICUs) in France and Belgium between August 12, 2013, and January 2, 2015.

INTERVENTIONS Patients were randomly assigned to early noninvasive ventilation (n = 191) or oxygen therapy alone (n = 183).

MAIN OUTCOMES AND MEASURES The primary outcome was day-28 mortality. Secondary outcomes were intubation, Sequential Organ Failure Assessment score on day 3, ICU-acquired infections, duration of mechanical ventilation, and ICU length of stay.

Editorial page 1697

Supplemental content at jama.com

CME Quiz at jamanetworkcme.com and CME Questions page 1747

Intubation criteria

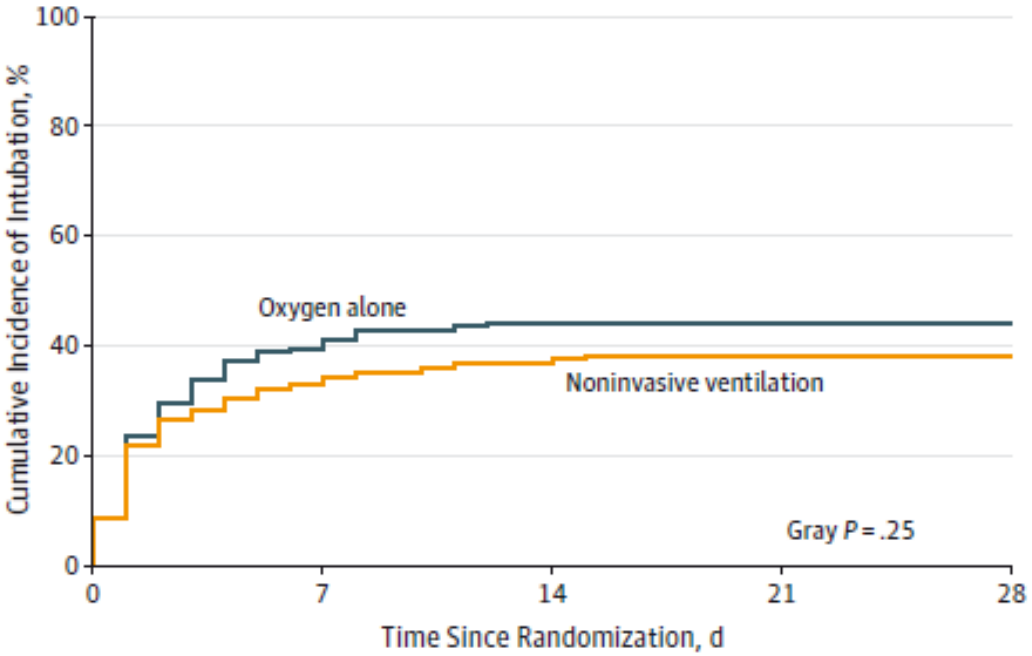
- PaO2 <60 mm Hg on room air,
- Tachypnea >30/min, or respiratory distress at rest
- Respiratory symptom duration less than 72 hours
- Immune deficiency defined as hematologic malignancy or solid tumor (active or in remission for < 5 years)
- Solid organ transplant
- Long-term (>30 days) or high-dose (>1 mg/kg/d) steroids or any immunosuppressive drugs (high dosage or > 30 days)

Characteristic	No. (%)	
	Oxygen Alone (n = 183)	Noninvasive Ventilation (n = 191)
Age, median (IQR), y	64 (53-72)	61 (52-70)
Respiratory parameters at randomization during oxygen therapy, median (IQR)		
Respiratory rate, /min	25 (21-30)	27 (21-31)
Oxygen saturation (Spo_2), %	96 (4-98)	96 (94-98)
Oxygen flow, L/min	9 (6-15)	9 (5-15)
Pao_2:Fio_2 ratio, mm Hg[c]	130 (86-205)	156 (95-248)
SOFA score at randomization, median (IQR)[d]	5 (3-7)	5 (3-7)

Lemiale et al JAMA. 2015;314(16):1711-1719

Immunocompromised patients (2)

	Oxygen Alone (n = 183)	Noninvasive Ventilation (n = 191)	Absolute Difference (95% CI)	*P* Value
28-d mortality	50 (27.3)	46 (24.1)	−3.2 (−12.1 to 5.6)	.47
Need for intubation	82 (44.8)	73 (38.2)	−6.6 (−16.6 to 3.4)	.20
SOFA on day3	4 (2-6)	4 (2-5)	−0.5 (−1.2 to 0.3)	.17



No significant differences

Underpowered to detect a difference?

- 35% mortality rate was assumed in O2 alone group but 27.3% in this study.
- Mortality rate was 50% vs. 81% in Hilbert's study
- HFNC was used frequently in 31.4% vs. 44.3% (in NIV vs O2 alone group)

However, cannot exclude the potential benefit?

- 15% absolute risk reduction when sample size calculation
- The lower limit of 95% CI for mortality, -12.1%
- The lower limit of 95% CI for Intubation, -16.6%

Hypoxemic RF

- Acute cardiogenic pulmonary edema
- Post-operative management
- Immunosuppression
- Community-acquired pneumonia
- ARDS/ALI

} *De novo* RF

"Small-sized studies with various etiologies => heterogeneous (or mixed) results"
=> no recommendation for routine use (except for CPE)

Antonelli et al. Intensive Care Med 2001;27:1718-1728

Community-acquired pneumonia (1)

Intensive Care Med (2001) 27: 1718–1728
DOI 10.1007/s00134-001-1114-4

ORIGINAL

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Predictors of failure of noninvasive positive pressure ventilation in patients with acute hypoxemic respiratory failure: a multi-center study

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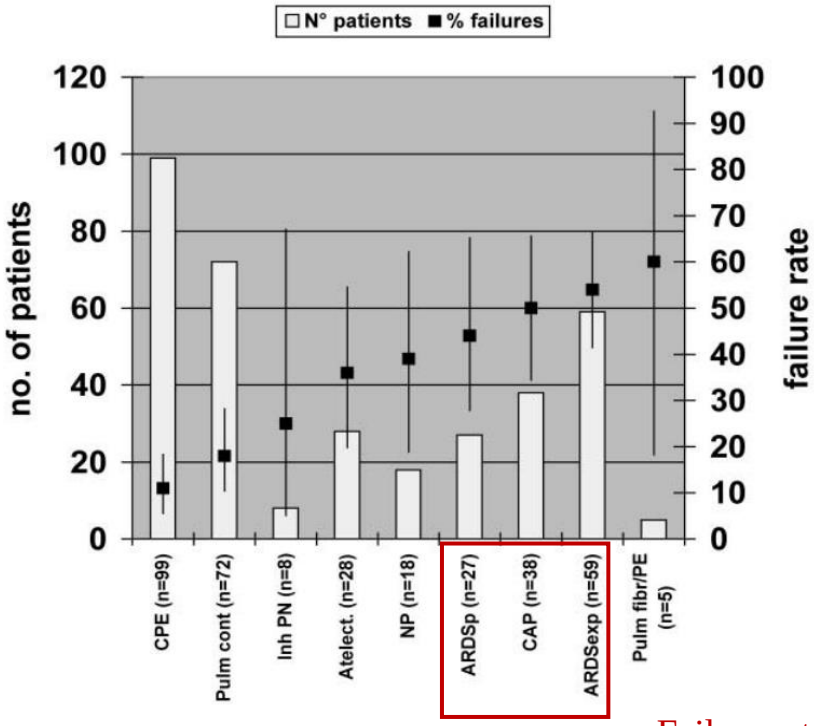
Abstract *Context*: In patients with hypoxemic acute respiratory failure (ARF), randomized studies have shown noninvasive positive pressure ventilation (NPPV) to be associated with lower rates of endotracheal intubation. In these patients, predictors of NPPV failure are not well characterized.
Objective: To investigate variables predictive of NPPV failure in patients with hypoxemic ARF.
Design: Prospective, multicenter cohort study.
Setting: Eight Intensive Care Units (ICU) in Europe and USA.
Patients: Of 5,847 patients admitted 1.72, 95 % CI 0.92–3.23), a simplified acute physiologic score (SAPS II) ≥35 (OR 1.81, 95 % CI 1.07–3.06), the presence of ARDS or community-acquired pneumonia (OR 3.75, 95 % CI 2.25–6.24), and a PaO_2:FiO_2 ≤146 after 1 h of NPPV (OR 2.51, 95 % CI 1.45–4.35) as factors independently associated with failure of NPPV. Patients requiring intubation had a longer duration of ICU stay ($P < 0.001$), higher rates of ventilator-associated pneumonia and septic complications ($P < 0.001$), and a higher ICU mortality ($P < 0.001$).
Conclusions: In hypoxemic ARF, NPPV can be successful in selected populations. When patients have a higher severity score, an older age, ARDS or pneumonia, or fail to improve after 1 h of treatment, the risk of failure is higher.

Prospective multicenter cohorts
354 patients with ARF from 8 centers (Europe and USA)
RR > 30, PF ratio < 200



Failure rate > **40%**

Antonelli et al. Intensive Care Med 2001;27:1718-1728

Community-acquired pneumonia (1)

Table 2 Univariate and multivariate analysis of the risk factors for failure of noninvasive ventilation

Variables	No. of failures/total (%)	Univariate analysis		Multivariate analysis	
		OR	95% CI	OR	95% CI
Reason for ICU admission					
Medical	58/218 (27)	1.00			
Surgical/trauma	50/136 (37)	1.96	1.11–3.45		
Age, years					
≤40	18/93 (19.4)	1.00			
> 40	90/261 (34.5)	2.19	1.19–4.06	1.72	0.92–3.23
SAPS II					
< 35	55/236 (23.3)	1.00		1.00	
≥35	53/118 (44.9)	2.68	1.63–4.42	1.81	1.07–3.06
Underlying disease					
None or none of the following	97/333 (29)	1.00			
Diabetes	11/21 (52)	2.47	1.06–5.74		
Etiology of respiratory failure					
None of the following	42/225 (18.6)	1.00		1.00	
ARDS, CAP	66/129 (51.1)	4.77	2.86–7.96	3.75	2.25–6.24
Respiratory rate at baseline, breaths/min					
≤38	79/285 (27.7)	1.00			
> 38	29/69 (42)	1.89	1.06–3.37		
PaO2:FiO2 after 1 h of NPPV					
> 146	64/264[a] (24.2)	1.00		1.00	
≤146	44/89 (49.4)	3.06	1.79–5.21	2.51	1.45–4.35
Sepsis on admission					
No	77/295 (26.1)	1.00			
Yes	31/59 (52.5)	3.13	1.70–5.78		

[a] For one patient PaO2:FiO2 value 1 h after NIV was missing

Overall NIV failure rate 30%

Intubation criteria

- < P_aO_2 65 mmHg with F_iO_2 0.6
- To protect airway (comma or seizure)
- Copious secretion
- Hemodynamic or ECG instability (hypotension for > 1h despite fluid)

Risk factors for NIV failure

- Higher severity
- Older age
- ARDS, CAP
- Failure to improve after 1h

Carrillo et al. Intensive Care Med 2012;38:458–466

Community-acquired pneumonia (2)

Intensive Care Med (2012) 38:458–466
DOI 10.1007/s00134-012-2475-6

ORIGINAL

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Non-invasive ventilation in community-acquired pneumonia and severe acute respiratory failure

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Abstract *Purpose:* The use of non-invasive ventilation (NIV) in severe acute respiratory failure (ARF) due to community-acquired pneumonia (CAP) is controversial, and the risk factors for NIV failure in these patients are not well known. We assessed the characteristics and predictors of outcome of patients with CAP and severe ARF treated with NIV. *Methods:* We prospectively assessed 184 consecutive patients; 102 had "de novo" ARF, and 82 previous cardiac or respiratory disease. We defined successful NIV as avoidance of intubation and intensive care unit (ICU) survival at least 24 h in the ward. We assessed predictors of NIV failure and hospital mortality in multivariate analyses. *Results:* Patients with "de novo" ARF failed NIV more frequently than patients with previous cardiac or respiratory independently predicted NIV failure. Likewise, maximum SOFA, NIV failure and older age independently predicted hospital mortality. Among intubated patients with "de novo" ARF, NIV duration was shorter in hospital survivors than non-survivors (32 ± 24 versus 78 ± 65 h, $p = 0.014$). In this group, longer duration of NIV before intubation was associated with decreased hospital survival (adjusted odds ratio 0.978, 95% confidence interval 0.962–0.995, $p = 0.012$). This association was not observed in patients with previous cardiac or respiratory disease. *Conclusions:* Successful NIV was strongly associated with better survival. If predictors for NIV failure are present, avoiding delayed intubation of patients with "de novo" ARF would potentially minimise mortality.

Single center, prospective cohort study (Spain)
184 ARF (102 de novo & 82 cardiac or respir. ds.)

NIV using BiPAP machine
- IPAP 19 ± 3 cmH_2O
- EPAP 9 ± 1 cmH_2O
- Duration 44 ± 33 h

Baseline characteristics (de novo vs. previous CR)
- age, 62 vs. 72 years (P <0.001)
- SAPSII, 42 vs. 46 (P = 0.078)
- P/F ratio 127 vs. 136 (P 0.084)
- P_aCO_2 42 vs. 60 (P < 0.001)

NIV failure rates (de novo vs. previous CR)
- 46% vs. 26%

Carrillo et al. Intensive Care Med 2012;38:458–466

Community-acquired pneumonia (2)

Risk factors for NIV failure

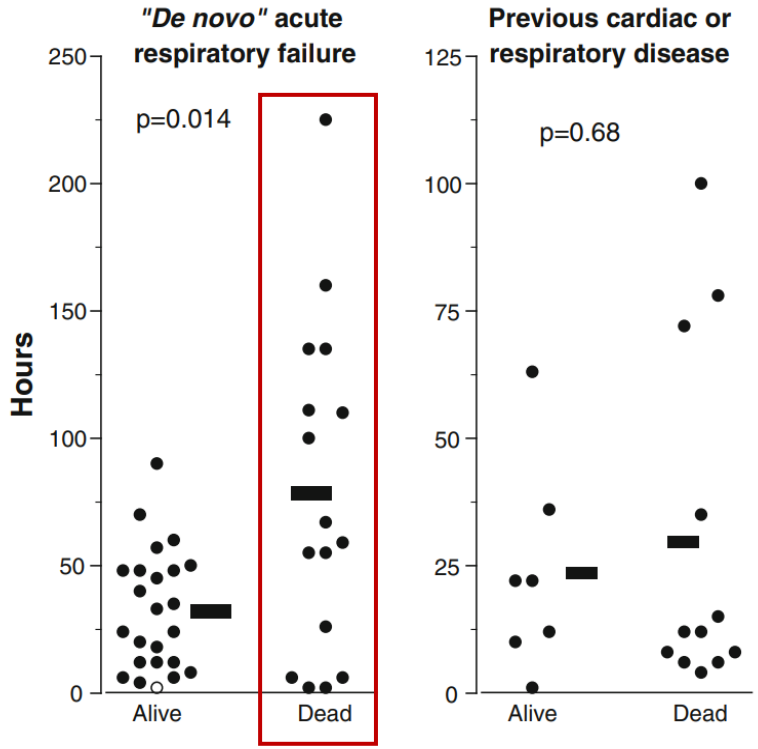
Table 3 Multivariate analysis of variables independently associated with

	Adj. OR	95% CI	*p* value
Maximum SOFA during NIV	1.442	1.187–1.753	<0.001
Worsening X-ray infiltrate 24 h after onset of NIV	84.23	16.74–423.8	<0.001
Heart rate 1 h after NIV onset, min^{-1}	1.064	1.029–1.100	<0.002
PaO_2/FiO_2 ratio 1 h after NIV onset, mmHg	0.980	0.965–0.996	0.012
HCO_3 1 h after NIV onset, mEq/L	0.802	0.711–0.905	<0.001

Risk factors for in-hospital mortality

Table 5 Multivariate analysis of variables independently associated w

	Adj. OR	95% CI	*p* value
Maximum SOFA during ICU stay	1.342	1.158–1.556	<0.001
NIV failure	6.78	1.65–27.95	0.008
Older age (years)	1.118	1.056–1.185	<0.001



"Among intubated patients, a longer NIV was ass. with higher mortality only in those with de novo RF"

Bellani et al. Am J Respir Crit Care Med 2017;195:67–77

ALI/ARDS

ORIGINAL ARTICLE

Noninvasive Ventilation of Patients with Acute Respiratory Distress Syndrome

Insights from the LUNG SAFE Study

Giacomo Bellani[1,2], John G. Laffey[3,4,5,6,7,8], Tài Pham[9,10,11], Fabiana Madotto[12], Eddy Fan[8,13,14,15], Laurent Brochard[4,5,8,14], Andres Esteban[16], Luciano Gattinoni[17], Vesna Bumbasirevic[18,19], Lise Piquilloud[20,21], Frank van Haren[22,23], Anders Larsson[24], Daniel F. McAuley[25,26], Philippe R. Bauer[27], Yaseen M. Arabi[28,29], Marco Ranieri[30], Massimo Antonelli[31], Gordon D. Rubenfeld[8,14,32], B. Taylor Thompson[33], Hermann Wrigge[34], Arthur S. Slutsky[5,8,14], and Antonio Pesenti[35,36]; on behalf of the LUNG SAFE Investigators and the ESICM Trials Group*

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Abstract

Rationale: Noninvasive ventilation (NIV) is increasingly used in patients with acute respiratory distress syndrome (ARDS). The evidence supporting NIV use in patients with ARDS remains relatively sparse.

Objectives: To determine whether, during NIV, the categorization of ARDS severity based on the Pa_{O_2}/Fi_{O_2} Berlin criteria is useful.

was associated with an increase in intensity of ventilatory support, NIV failure, and intensive care unit (ICU) mortality. NIV failure occurred in 22.2% of mild, 42.3% of moderate, and 47.1% of patients with severe ARDS. Hospital mortality in patients with NIV success and failure was 16.1% and 45.4%, respectively. NIV use was independently associated with increased ICU (hazard ratio, 1.446 [95% confidence interval, 1.159–1.805]), but not hospital, mortality. In a propensity matched analysis, ICU mortality was higher in NIV than invasively ventilated

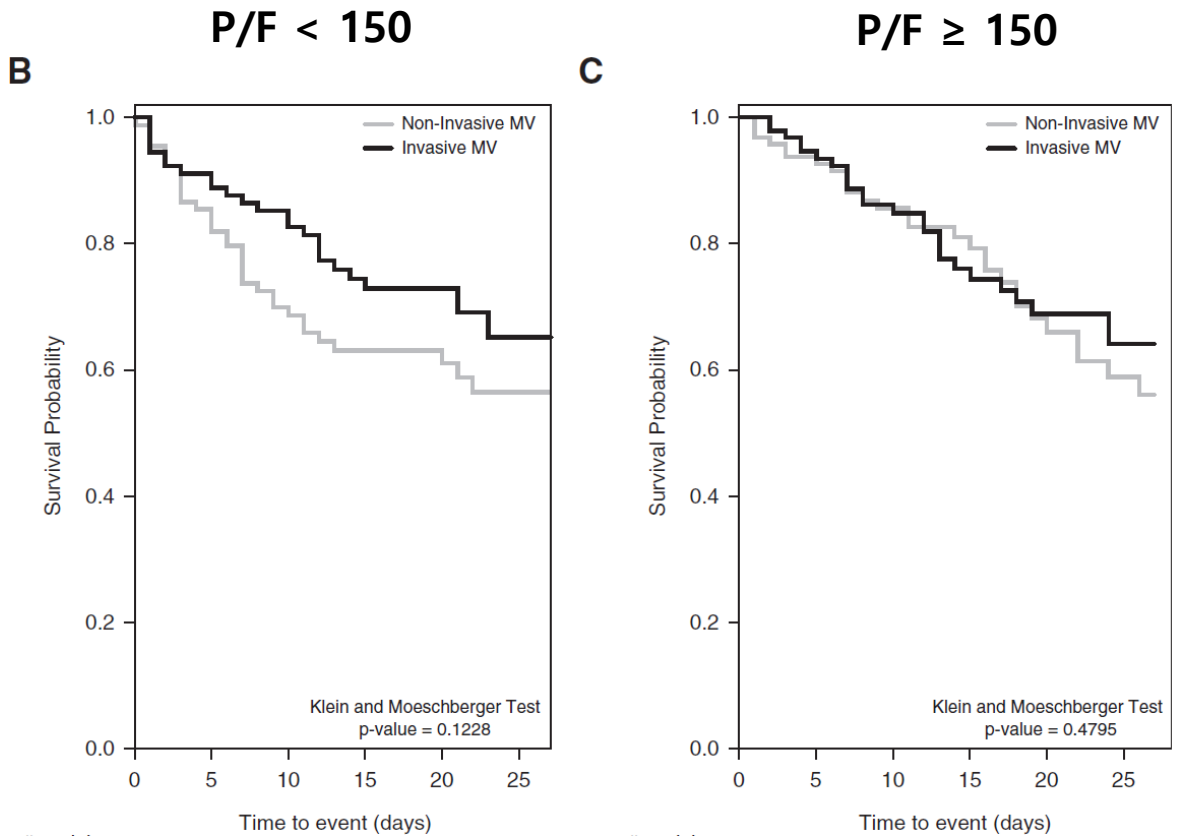
LUNG SAFE study

- Bellani et al. JAMA. 2016;315(8):788-800
- ESICM trials group
- A prospective multicenter cohort
- 459 ICUs from 50 countries across 5 continents
- RWD about clinical practice of ARDS (10.4% of ICU patients)

- 436 (15.5%) of 2,813 patients with ARDS used NIV
- NIV failure: 22.2%, 42.3%, 47.1% for mild, mod., severe ARDS,
- Hosp, mortality: 16.1% vs. 45.4% (for NIV success vs. failure.)

Bellani et al. Am J Respir Crit Care Med 2017;195:67–77

ALI/ARDS



LUNG SAFE study

Higher ICU mortality for NIV than for invasive MV in patients with **PF < 150** (by PSM analysis)

Ventilatory parameters for NIV failure

Low PF ratio
High severity

High inspiratory drive

- High tidal volume
- High inspiratory efforts

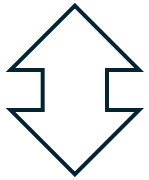
(+/- High respiratory rate)

Increased transpulmonary pressure

Helmet mask

- Large interval volume (~ 18L)
- Gas flow > 30 ~ 50 L/min is needed to prevent rebreathing.
- Measuring MV is not unreliable (set pressure ≠ delivered pressure)
- Slow pressurization -> ↓respiratory m. unloading

d/t Interface compliance



- Minimal leakage
- High PEEP (10-15 cm H_2O) without patient's discomfort
- Asynchrony does not discomfort the patient.

(vs. facial mask: 5-8 cm H_2O)

Patel et al. JAMA. 2016;315:2435-2441

Helmet mask in ARDS

Research

Preliminary Communication | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Noninvasive Ventilation Delivered by Helmet vs Face Mask on the Rate of Endotracheal Intubation in Patients With Acute Respiratory Distress Syndrome

A Randomized Clinical Trial

Bhakti K. Patel, MD; Krysta S. Wolfe, MD; Anne S. Pohlman, MSN; Jesse B. Hall, MD; John P. Kress, MD

IMPORTANCE Noninvasive ventilation (NIV) with a face mask is relatively ineffective at preventing endotracheal intubation in patients with acute respiratory distress syndrome (ARDS). Delivery of NIV with a helmet may be a superior strategy for these patients.

OBJECTIVE To determine whether NIV delivered by helmet improves intubation rate among patients with ARDS.

DESIGN, SETTING, AND PARTICIPANTS Single-center randomized clinical trial of 83 patients with ARDS requiring NIV delivered by face mask for at least 8 hours while in the medical intensive care unit at the University of Chicago between October 3, 2012, through September 21, 2015.

INTERVENTIONS Patients were randomly assigned to continue face mask NIV or switch to a helmet for NIV support for a planned enrollment of 206 patients (103 patients per group). The helmet is a transparent hood that covers the entire head of the patient and has a rubber collar neck seal. Early trial termination resulted in 44 patients randomized to the helmet group and 39 to the face mask group.

MAIN OUTCOMES AND MEASURES The primary outcome was the proportion of patients who required endotracheal intubation. Secondary outcomes included 28-day invasive ventilator-free days (ie, days alive without mechanical ventilation), duration of ICU and hospital length of stay, and hospital and 90-day mortality.

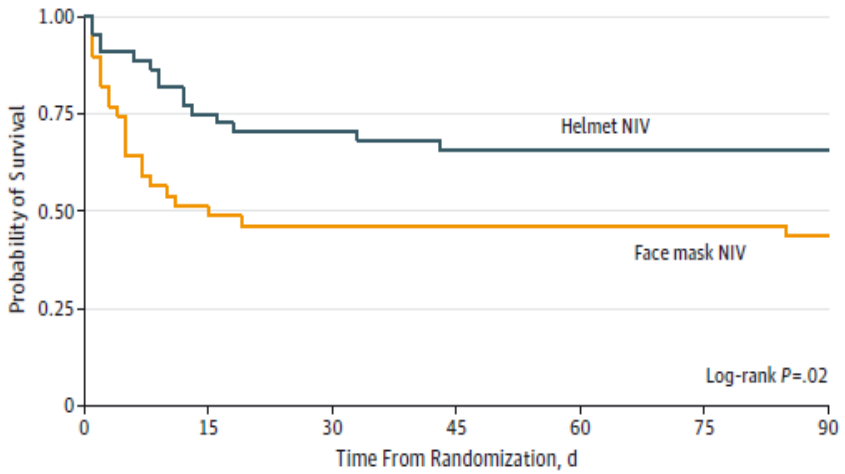
Editorial page 2401
Video at jama.com
Supplemental content at jama.com
CME Quiz at jamanetworkcme.com and CME Questions page 2463

Single-center RCT (Chicago)

- 83 patients with ARDS
- Randomization after 8 h of NIV via face mask
- 44 helmet (P/F 118) vs. 39 face mask (P/F 144).

Outcomes

- Intubation rate, 61.5 vs. 18.2% (P <0.001)
- Hospital mortality, 48.7 vs. 27.3% (P = 0.04)
- 90-D mortality, 56.4 vs. 34.1% (P = 0.02)



Patel et al. JAMA. 2016;315:2435-2441

Helmet mask in ARDS

Table 3. Level of Respiratory Support and Physiologic Parameters During Noninvasive Ventilation

	Noninvasive Ventilation, Median (IQR)		
	Face Mask (n = 39)	Helmet (n = 44)	*P* Value
Respiratory support with NIV[a]			
Duration of NIV, h	26.4 (7.0-60.0)	19.8 (8.4-45.6)	.68
PEEP, cm H_2O	5.1 (5.0-8.0)	8 (5.0-10.0)	.006
Pressure support, cm H_2O	11.2 (10.0-14.5)	8 (5.6-10.0)	<.001
FIO_2, %	60 (50.0-68.6)	50 (40.0-60.0)	.02
SpO_2, %	95.3 (92.3-96.7)	96.2 (94.8-98.4)	.13
Respiratory rate, breaths/min			
Baseline	28.3 (22.1-34.4)[b]	27.7 (21.5-34.6)[b]	
After randomization	29.1 (22.1-37.6)	24.5 (20.4-30.5)	

TASK FORCE REPORT
ERS/ATS GUIDELINES

Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure

TABLE 2 Recommendations for actionable PICO questions

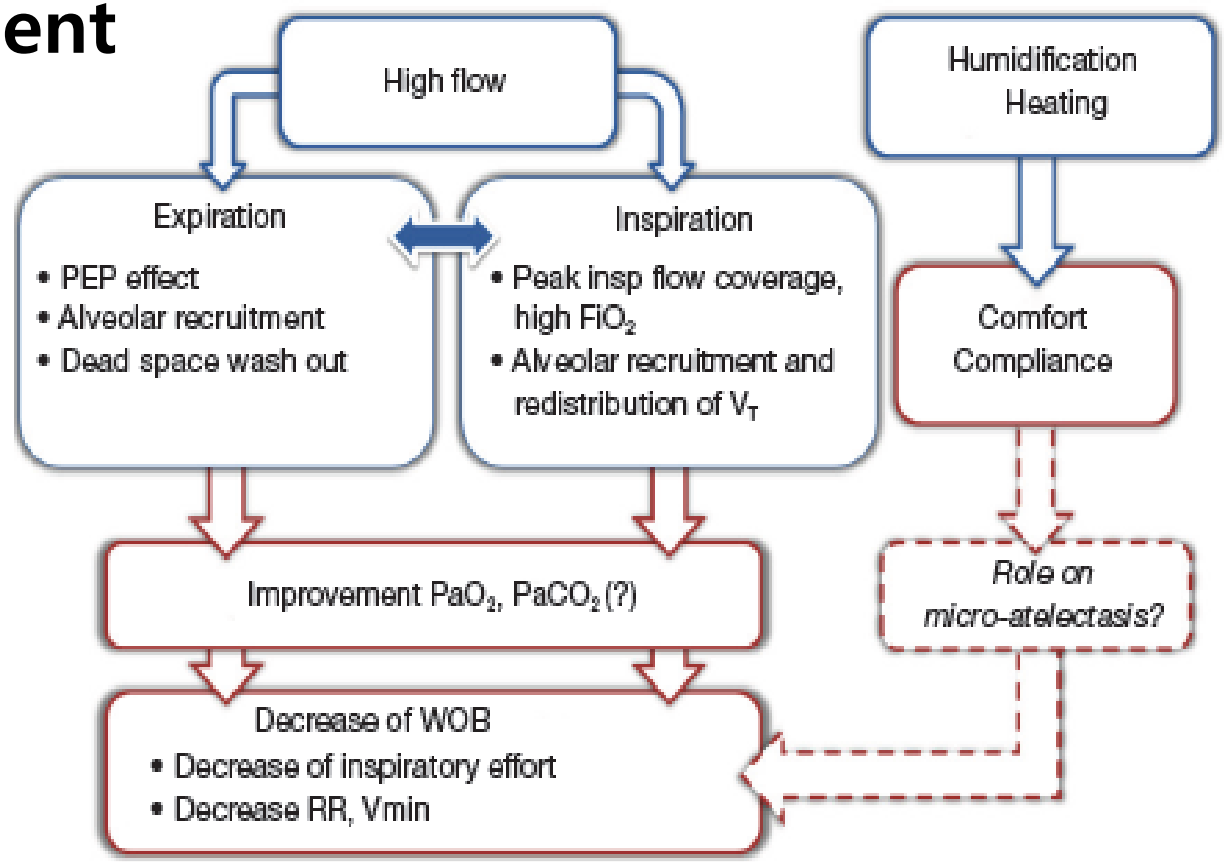
Clinical indication[#]	Certainty of evidence[¶]	Recommendation
Prevention of hypercapnia in COPD exacerbation	⊕⊕	Conditional recommendation against
Hypercapnia with COPD exacerbation	⊕⊕⊕⊕	Strong recommendation for
Cardiogenic pulmonary oedema	⊕⊕⊕	Strong recommendation for
Acute asthma exacerbation		No recommendation made
Immunocompromised	⊕⊕⊕	Conditional recommendation for
De novo respiratory failure		No recommendation made
Post-operative patients	⊕⊕⊕	Conditional recommendation for
Palliative care	⊕⊕⊕	Conditional recommendation for
Trauma	⊕⊕⊕	Conditional recommendation for
Pandemic viral illness		No recommendation made
Post-extubation in high-risk patients (prophylaxis)	⊕⊕	Conditional recommendation for
Post-extubation respiratory failure	⊕⊕	Conditional recommendation against
Weaning in hypercapnic patients	⊕⊕⊕	Conditional recommendation for

[#]: all in the setting of acute respiratory failure; [¶]: certainty of effect estimates: ⊕⊕⊕⊕, high; ⊕⊕⊕, moderate; ⊕⊕, low; ⊕, very low.

Rochwerg et al. Eur Respir J 2017; 50: 1602426

High flow nasal cannula (HFNC)

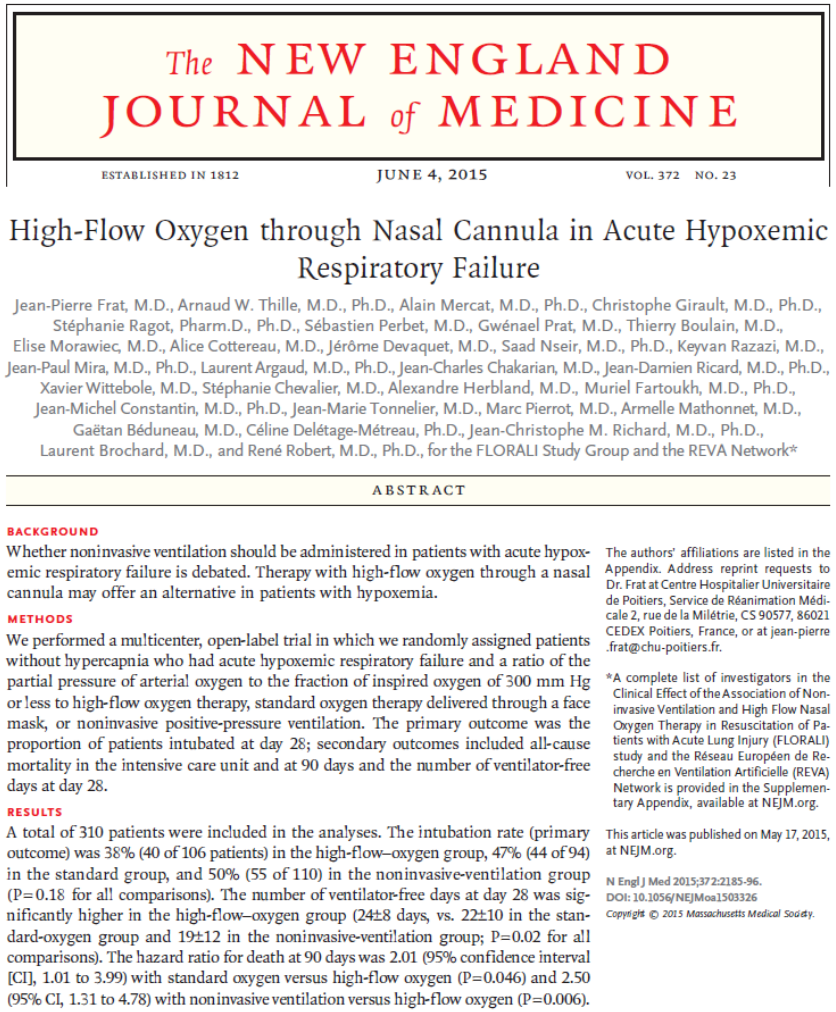
Flow treatment



Frat et al. Ann Transl Med 2017;5(14):297 and Mauri et al. Intensive Care Med 2017;43:1453-1463

Frat et al. NEJM 2015;372:2185~2196

Acute hypoxemic RF



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JUNE 4, 2015 VOL. 372 NO. 23

High-Flow Oxygen through Nasal Cannula in Acute Hypoxemic Respiratory Failure

Jean-Pierre Frat, M.D., Arnaud W. Thille, M.D., Ph.D., Alain Mercat, M.D., Ph.D., Christophe Girault, M.D., Ph.D., Stéphanie Ragot, Pharm.D., Ph.D., Sébastien Perbet, M.D., Gwénael Prat, M.D., Thierry Boulain, M.D., Elise Morawiec, M.D., Alice Cottereau, M.D., Jérôme Devaquet, M.D., Saad Nseir, M.D., Ph.D., Keyvan Razazi, M.D., Jean-Paul Mira, M.D., Ph.D., Laurent Argaud, M.D., Ph.D., Jean-Charles Chakarian, M.D., Jean-Damien Ricard, M.D., Ph.D., Xavier Wittebole, M.D., Stéphanie Chevalier, M.D., Alexandre Herbland, M.D., Muriel Fartoukh, M.D., Ph.D., Jean-Michel Constantin, M.D., Ph.D., Jean-Marie Tonnelier, M.D., Marc Pierrot, M.D., Armelle Mathonnet, M.D., Gaëtan Béduneau, M.D., Céline Delétage-Métreau, Ph.D., Jean-Christophe M. Richard, M.D., Ph.D., Laurent Brochard, M.D., and René Robert, M.D., Ph.D., for the FLORALI Study Group and the REVA Network*

ABSTRACT

BACKGROUND

Whether noninvasive ventilation should be administered in patients with acute hypoxemic respiratory failure is debated. Therapy with high-flow oxygen through a nasal cannula may offer an alternative in patients with hypoxemia.

METHODS

We performed a multicenter, open-label trial in which we randomly assigned patients without hypercapnia who had acute hypoxemic respiratory failure and a ratio of the partial pressure of arterial oxygen to the fraction of inspired oxygen of 300 mm Hg or less to high-flow oxygen therapy, standard oxygen therapy delivered through a face mask, or noninvasive positive-pressure ventilation. The primary outcome was the proportion of patients intubated at day 28; secondary outcomes included all-cause mortality in the intensive care unit and at 90 days and the number of ventilator-free days at day 28.

RESULTS

A total of 310 patients were included in the analyses. The intubation rate (primary outcome) was 38% (40 of 106 patients) in the high-flow–oxygen group, 47% (44 of 94) in the standard group, and 50% (55 of 110) in the noninvasive-ventilation group (P=0.18 for all comparisons). The number of ventilator-free days at day 28 was significantly higher in the high-flow–oxygen group (24±8 days, vs. 22±10 in the standard-oxygen group and 19±12 in the noninvasive-ventilation group; P=0.02 for all comparisons). The hazard ratio for death at 90 days was 2.01 (95% confidence interval [CI], 1.01 to 3.99) with standard oxygen versus high-flow oxygen (P=0.046) and 2.50 (95% CI, 1.31 to 4.78) with noninvasive ventilation versus high-flow oxygen (P=0.006).

The authors' affiliations are listed in the Appendix. Address reprint requests to Dr. Frat at Centre Hospitalier Universitaire de Poitiers, Service de Réanimation Médicale 2, rue de la Milétrie, CS 90577, 86021 CEDEX Poitiers, France, or at jean-pierre.frat@chu-poitiers.fr.

*A complete list of investigators in the Clinical Effect of the Association of Noninvasive Ventilation and High Flow Nasal Oxygen Therapy in Resuscitation of Patients with Acute Lung Injury (FLORALI) study and the Réseau Européen de Recherche en Ventilation Artificielle (REVA) Network is provided in the Supplementary Appendix, available at NEJM.org.

This article was published on May 17, 2015, at NEJM.org.

N Engl J Med 2015;372:2185-96.
DOI: 10.1056/NEJMoa1503326

FLORALI study

RCT in 23 ICUs in France and Belgium
310 non-hypercapnic AHRF
106 HFNC, 94 SOT, 110 NIV

Inclusion criteria

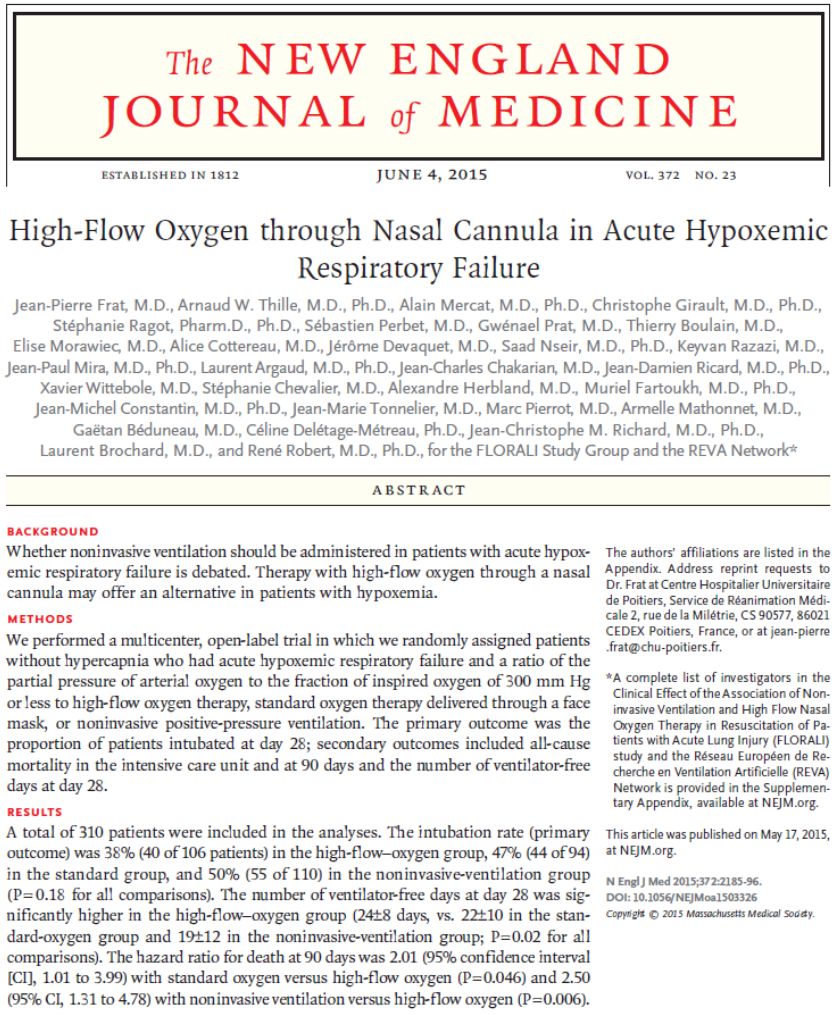
- RR > 25
- P/F ratio ≤ 300
- PCO2 ≤ 45 mmHg
- No history of chronic respiratory failure

Exclusion criteria

- PCO2 > 45 mmHg
- AE of asthma or COPD
- Cardiogenic pulmonary edema
- GCS < 12
- Neutropenia, vasopressors, hemodynamic instability

Frat et al. NEJM 2015;372:2185~2196

Acute hypoxemic RF



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FLORALI study

Standard oxygen group

- Nonrebreather face mask at a 10 L/min or more
- SpO2 target ≥ 92%

HFNC group

- Flow 50L/min, FiO2 1.0
- At least 2 calendar days
- SpO2 target ≥ 92%

NIV group

- Face mask
- TV (exhaled), mean 9.2 ml/kg (PBW)
- Above PEEP/PEEP, mean 8/5 cmH2O
- At least 2 calendar days (>8h/day)
- HFNC was allowed during NIV breaks
- SpO2 target ≥ 92%

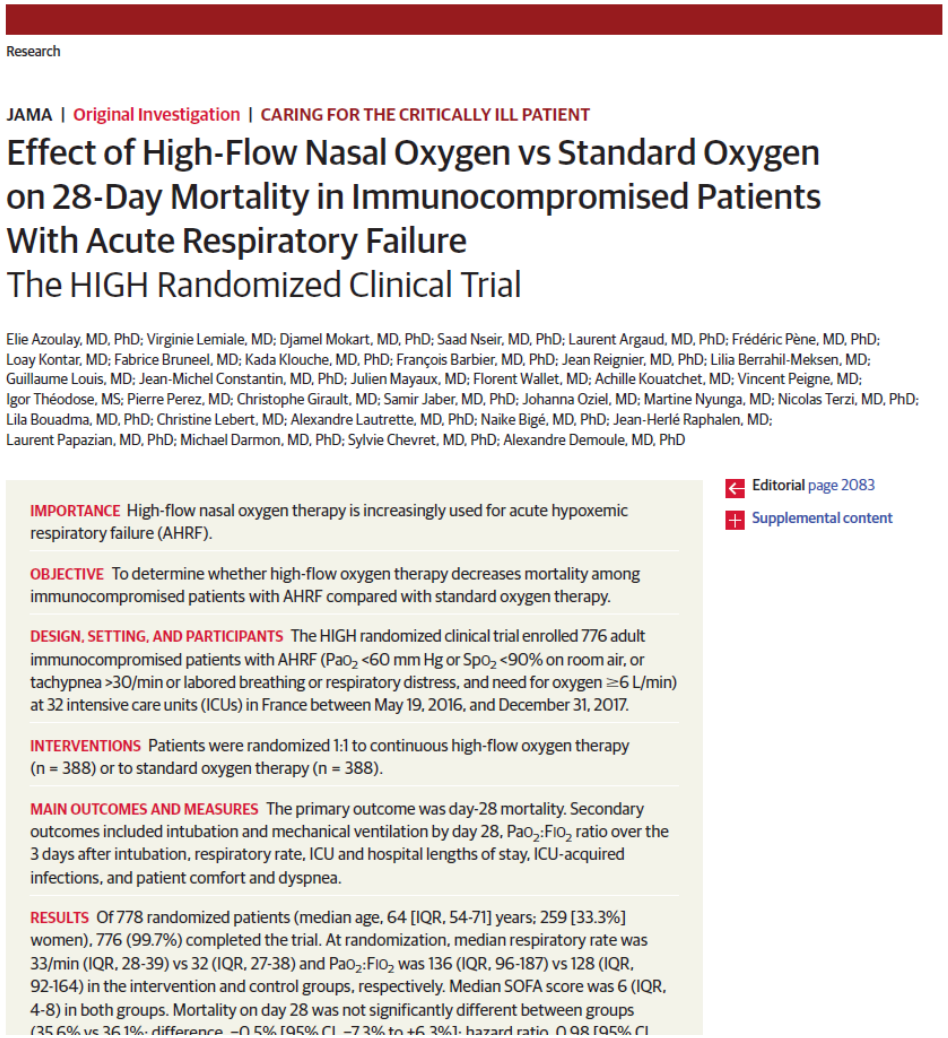
Frat et al. NEJM 2015;372:2185~2196

Acute hypoxemic RF

Outcome	Study Group			P Value†	Odds Ratio or Hazard Ratio (95% CI)	
	High-Flow Oxygen (N=106)	Standard Oxygen (N=94)	Noninvasive Ventilation (N=110)		Standard Oxygen vs. High-Flow Oxygen	Noninvasive Ventilation vs. High-Flow Oxygen
Intubation at day 28						
Overall population				0.18	1.45 (0.83–2.55)	1.65 (0.96–2.84)
No. of patients	40	44	55			
% of patients (95% CI)	38 (29–47)	47 (37–57)	50 (41–59)			
Patients with Pao_2:Fio_2 ≤200 mm Hg‡						
Unadjusted analysis				0.009	2.07 (1.09–3.94)	2.57 (1.37–4.84)
No. of patients/total no.	29/83	39/74	47/81			
% of patients (95% CI)	35 (26–46)	53 (42–64)	58 (47–68)			
Adjusted analysis§	—	—	—	0.01	2.14 (1.08–4.22)	2.60 (1.36–4.96)
Ventilator-free days						
Overall population	24±8	22±10	19±12	0.02	—	—
Patients with Pao_2:Fio_2 ≤200 mm Hg	24±8	21±10	18±12	<0.001	—	—
At day 90						
Overall population						
Unadjusted analysis				0.02	2.01 (1.01–3.99)	2.50 (1.31–4.78)
No. of patients	13	22	31			
% of patients (95% CI)	12 (7–20)	23 (16–33)	28 (21–37)			
Adjusted analysis**	—	—	—	—	2.36 (1.18–4.70)	2.33 (1.22–4.47)

Azoulay et al. JAMA. 2018;320:2099-2107.

HFNC vs. O2 in immunocompromised patients



Research

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of High-Flow Nasal Oxygen vs Standard Oxygen on 28-Day Mortality in Immunocompromised Patients With Acute Respiratory Failure

The HIGH Randomized Clinical Trial

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Editorial page 2083

Supplemental content

IMPORTANCE High-flow nasal oxygen therapy is increasingly used for acute hypoxemic respiratory failure (AHRF).

OBJECTIVE To determine whether high-flow oxygen therapy decreases mortality among immunocompromised patients with AHRF compared with standard oxygen therapy.

DESIGN, SETTING, AND PARTICIPANTS The HIGH randomized clinical trial enrolled 776 adult immunocompromised patients with AHRF (Pao_2 <60 mm Hg or Spo_2 <90% on room air, or tachypnea >30/min or labored breathing or respiratory distress, and need for oxygen ≥6 L/min) at 32 intensive care units (ICUs) in France between May 19, 2016, and December 31, 2017.

INTERVENTIONS Patients were randomized 1:1 to continuous high-flow oxygen therapy (n = 388) or to standard oxygen therapy (n = 388).

MAIN OUTCOMES AND MEASURES The primary outcome was day-28 mortality. Secondary outcomes included intubation and mechanical ventilation by day 28, Pao_2:Fio_2 ratio over the 3 days after intubation, respiratory rate, ICU and hospital lengths of stay, ICU-acquired infections, and patient comfort and dyspnea.

RESULTS Of 778 randomized patients (median age, 64 [IQR, 54-71] years; 259 [33.3%] women), 776 (99.7%) completed the trial. At randomization, median respiratory rate was 33/min (IQR, 28-39) vs 32 (IQR, 27-38) and Pao_2:Fio_2 was 136 (IQR, 96-187) vs 128 (IQR, 92-164) in the intervention and control groups, respectively. Median SOFA score was 6 (IQR, 4-8) in both groups. Mortality on day 28 was not significantly different between groups (35.6% vs 36.1%; difference, −0.5% [95% CI, −7.3% to +6.3%]; hazard ratio, 0.98 [95% CI

RCT of 776 patients from 32 ICUs in France
388 HFNC vs. 388 SOT
SpO2 target ≥ 95%

Inclusion criteria

- AHRF
- PaO2 < 60 or SpO2 < 90% (room aire)
- RR > 30 or respiratory distress requiring O2 6 L/min

Exclusion criteria

- Hypercapnea ($PaCO_2$ ≥ 50 mmHg) indicating NIV
- Cardiogenic pulmonary edema indicating NIV

Immunocompromization

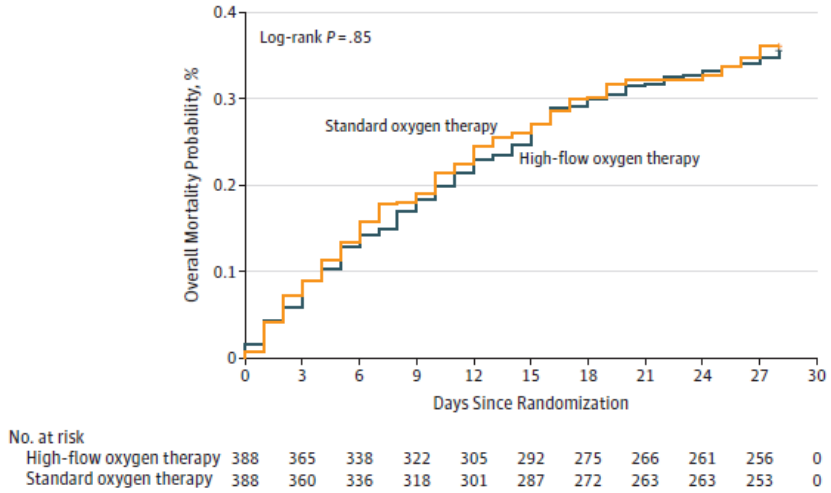
- Long-term (>3 months) or high-dose (>0.5mg/kg/d) steroids
- Use of other immunosuppressant drugs,
- Solid organ TPL, solid tumor requiring chemotherapy (within 5 yrs)
- Hematologic malignancy regardless of time
- Primary immune deficiency

Azoulay et al. JAMA. 2018;320:2099-2107.

HFNC vs. O2 in immunocompromised patients

Table 2. Primary and Secondary End Points[a]

End Points	No. (%) High-Flow Oxygen Therapy (n = 388)	No. (%) Standard Oxygen Therapy (n = 388)	Mean Difference, % (95% CI)[b]	Relative Difference (95% CI)	*P* Value
Primary					
All-cause day-28 mortality	138 (35.6)	140 (36.1)	−0.5 (−7.3 to 6.3)	HR, 0.98 (0.77 to 1.24)	.94
Secondary					
Invasive mechanical ventilation[c]	150 (38.7)	170 (43.8)	−5.1 (−12.3 to 2.0)	HR, 0.85 (0.68 to 1.06)[d]	.17
ICU-acquired infection	39 (10.0)	41 (10.6)	−0.6 (−4.6 to 4.1)	HR, 1.01 (0.96 to 1.06)[d]	.91
ICU mortality	123 (31.7)	122 (31.4)	0.3 (−6.3 to 6.8)	RR, 1.01 (0.82 to 1.24)	.64
Hospital mortality	160 (41.2)	162 (41.7)	−0.5 (−7.5 to 6.4)	RR, 0.99 (0.84 to 1.17)	.77
Length of stay, median (IQR), d					
ICU	8 (4-14)	6 (4-13)	0.6 (−1.0 to 2.2)	NA[e]	.07
Hospital	24 (14-40)	27 (15-42)	−2 (−7.3 to 3.3)	NA[e]	.60



Coudroy et al. Lancet Respir Med 2022;10: 641–49

HFNC vs. HFNC/NIV in immunocompromised patients

High-flow nasal oxygen alone or alternating with non-invasive ventilation in critically ill immunocompromised patients with acute respiratory failure: a randomised controlled trial

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Summary

Background Although non-invasive ventilation (NIV) is recommended for immunocompromised patients with acute respiratory failure in the intensive care unit (ICU), it might have deleterious effects in the most severe patients. High-flow nasal oxygen (HFNO) alone might be an alternative method to reduce mortality. We aimed to determine whether HFNO alone could reduce the rate of mortality at day 28 compared with HFNO alternated with NIV.

Methods FLORALI-IM is a multicentre, open-label, randomised clinical trial conducted in 29 ICUs (28 in France and one in Italy). Adult immunocompromised patients with acute respiratory failure, defined as respiratory rate of 25 breaths per min or more and a partial pressure of arterial oxygen to inspired fraction of oxygen ratio of 300 mm Hg or lower, were randomly assigned (1:1) to HFNO alone (HFNO alone group) or NIV alternating with HFNO (NIV group). Key exclusion criteria were severe hypercapnia above 50 mm Hg, patients who could strongly benefit from NIV (ie, those with underlying chronic lung disease, with cardiogenic pulmonary oedema, or who were postoperative), severe shock, impaired consciousness defined as Glasgow coma score ≤12, urgent need for intubation, do not intubate order, and contraindication to NIV. Patients were assigned using computer-generated permuted blocks and were stratified according to centre and to the type of immunosuppression using a centralised web-based management system. In the HFNO alone group, patients were continuously treated by HFNO with a gas flow rate of 60 L/min or the highest tolerated. In the NIV group, patients were treated with NIV with a first session of at least 4 h, and then by sessions for a minimal duration of 12 h a day, with a dedicated ventilator, targeting a tidal volume below 8 mL/kg of predicted bodyweight, and with a positive end-expiratory level of at least 8 cm H_2O. NIV sessions were interspaced with HFNO delivered as in the HFNO alone group. The primary outcome was mortality at day 28 and was assessed in the intention-to-treat population. Secondary outcomes were mortality in the ICU, in hospital, at day 90 and at day 180, intubation at day 28, length of stay in the ICU and in hospital, number of ventilator-free days at day 28, number of oxygenation technique-free days at day 28, and efficacy and tolerance of oxygenation techniques. The trial is registered with ClinicalTrials.gov, NCT02978300, and is complete.

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**Study group and research network listed in full in the appendix

CHU de Poitiers, Médecine Intensive Réanimation, Poitiers, France; INSERM CIC 1402, groupe ALIVE, Université de Poitiers, Poitiers, France (Prof R Coudroy PhD, Prof J-P Frat PhD, Prof A W Thille PhD); **CHRU de Tours, Médecine Intensive Réanimation, CIC 1415, CRICS-TriggerSEP Research Network, Centre d'étude des Pathologies Respiratoires, INSERM U1100, Universite´ de Tours, Tours, France** (Prof S Ehrmann PhD); **Médecine Intensive & Réanimation, Hôpital Cochin, APHP Centre, Université de Paris, Paris, France** (Prof F Pène PhD); **Groupe Hospitalier Universitaire APHP-**

FLORALI-IM study

RCT in 29 ICUs in France and Italy
299 non-hypercapnic AHRF
154 HFNC vs. 145 NIV/HFNC

Inclusion criteria

- RR > 25
- P/F ratio ≤ 300

Exclusion criteria

- PCO2 > 50 mmHg
- Those who benefits from NIV (CPE and post-OP)
- GCS < 12
- Severe shock
- An urgent need for intubation

HFNC group

- 60 L/min

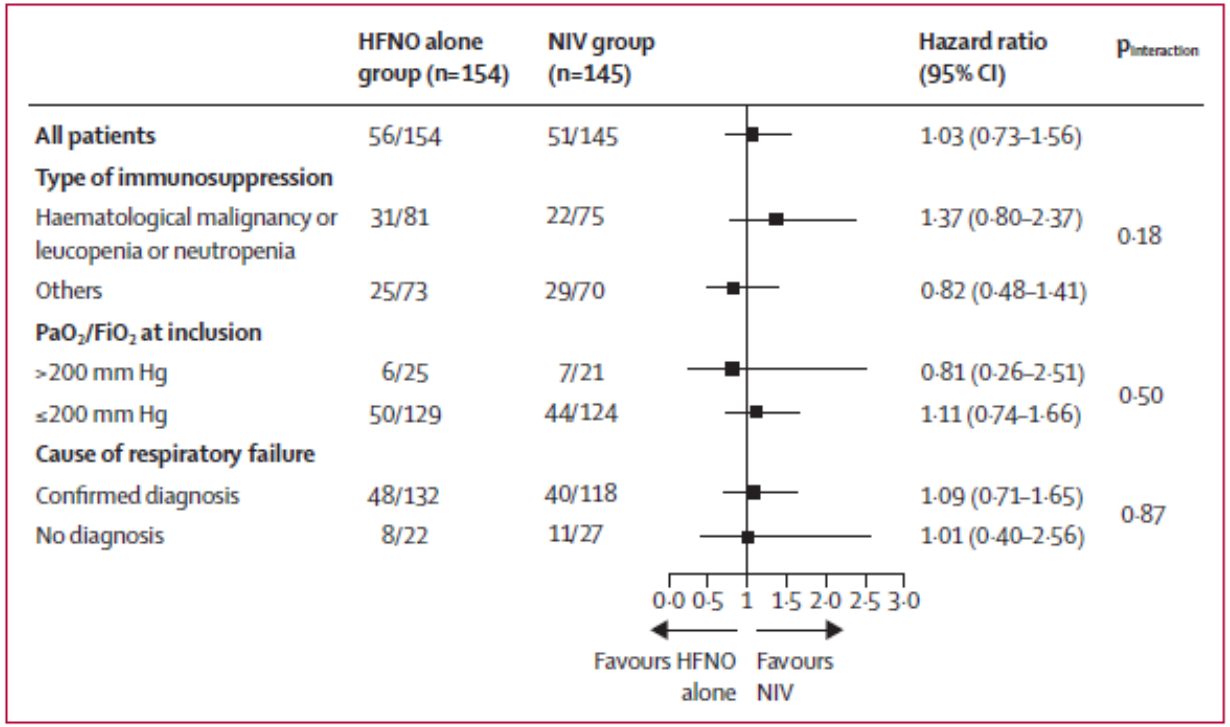
NIV/HFNC group

- NIV 4h → at least 12h/day
- PSV mode, TV < 8 ml/kg(PBW), PEEP ≥ 8 cmH2O

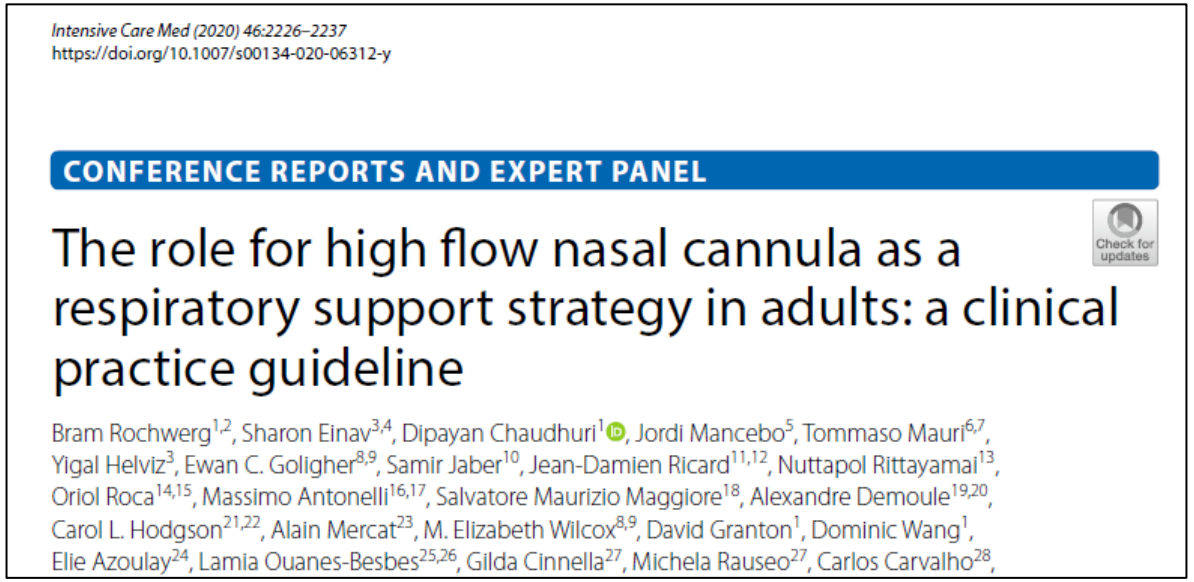
Coudroy et al. Lancet Respir Med 2022;10: 641–49

HFNC vs. HFNC/NIV in immunocompromised patients

	HFNO alone group (n=154)	NIV group (n=145)	Absolute or mean difference (95% CI)	p value
Primary outcome				
Mortality at day 28	56 (36%)	51 (35%)	1·2 (–9·6 to 11·9)	0·83
Secondary outcomes				
Intubation at day 28	78 (51%)	67 (46%)	4·4 (–6·8 to 15·5)	0·44
Mortality of intubated patients in the ICU	40/78 (51%)	43/67 (64%)	-	-
Mortality				
In the ICU	45 (29%)	49 (34%)	–4·6 (–15·0 to 5·9)	0·39
In hospital	63 (41%)	60 (41%)	–0·5 (–11·5 to 10·6)	0·93
At day 90	67 (44%)	63 (43%)	0·1 (–11·1 to 11·2)	0·99
At day 180	76 (49%)	70 (48%)	1·1 (–10·1 to 12·3)	0·85
Length of ICU stay, days	6 (4 to 13)	7 (4 to 14)	–2·0 (–3·5 to –0·6)	0·30
Length of hospital stay, days	14 (10 to 25)	16 (9 to 28)	–1·1 (–5·6 to 3·4)	0·39
Ventilator-free days at day 28, days	18 (0 to 28)	17 (0 to 28)	0·1 (–2·8 to 3·0)	0·92
Oxygenation technique-free days at day 28, days	4·5 (0 to 28)	4 (0 to 28)	0·0 (–3·1 to 3·1)	0·96
Respiratory parameters 1 h after treatment initiation				
PaO_2/FiO_2, mm Hg	143 (76)	199 (91)	–56 (–77 to –35)	<0·001
Respiratory rate, breaths per min	27 (7)	29 (8)	–1·6 (–3·4 to 0·1)	0·059
Change in discomfort scale, mm	–4 (–18 to 4)	0 (–16 to 17)	–8·5 (–16·2 to –0·8)	0·040
Time to intubation, h [n]	20 (5 to 58) [78]	29 (9 to 72) [67]	–2·3 (–23·4 to 18·8)	0·24



Guidelines for the use of HFNC



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https://doi.org/10.1007/s00134-020-06312-y

CONFERENCE REPORTS AND EXPERT PANEL

The role for high flow nasal cannula as a respiratory support strategy in adults: a clinical practice guideline

Bram Rochwerg[1,2], Sharon Einav[3,4], Dipayan Chaudhuri[1], Jordi Mancebo[5], Tommaso Mauri[6,7], Yigal Helviz[3], Ewan C. Goligher[8,9], Samir Jaber[10], Jean-Damien Ricard[11,12], Nuttapol Rittayamai[13], Oriol Roca[14,15], Massimo Antonelli[16,17], Salvatore Maurizio Maggiore[18], Alexandre Demoule[19,20], Carol L. Hodgson[21,22], Alain Mercat[23], M. Elizabeth Wilcox[8,9], David Granton[1], Dominic Wang[1], Elie Azoulay[24], Lamia Ouanes-Besbes[25,26], Gilda Cinnella[27], Michela Rauseo[27], Carlos Carvalho[28],

2020

EUROPEAN RESPIRATORY JOURNAL
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S. OCZKOWSKI ET AL.

ERS clinical practice guidelines: high-flow nasal cannula in acute respiratory failure

Simon Oczkowski[1,2,26], Begüm Ergan[3,26], Lieuwe Bos[4,5], Michelle Chatwin[6], Miguel Ferrer[7], Cesare Gregoretti[8,9], Leo Heunks[10], Jean-Pierre Frat[11,12], Federico Longhini[13], Stefano Nava[14,15], Paolo Navalesi[16,17], Aylin Ozsancak Uğurlu[18], Lara Pisani[14,15], Teresa Renda[19], Arnaud W. Thille[11,12], João Carlos Winck[20], Wolfram Windisch[21], Thomy Tonia[22], Jeanette Boyd[23], Giovanni Sotgiu[24] and Raffaele Scala[25]

2022

Summary

- Based on the current data, including FLORALI study, there might not be a one-size-fits all oxygenation strategy in patients with AHRF.

- However, in patients with *de novo* respiratory failure, vigorous breathing efforts generate large TV, causing SILI, that can be associated with NIV failure.

- Hence, HFNC or helmet NIV seems to be a better choice than face-mask NIV in patients with moderate-to-severe AHRF.

Thank you for your attention