HFNC
Role in
Weaning and post-extubation

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하 직 환

AMERICAN THORACIC SOCIETY DOCUMENTS

Official Executive Summary of an American Thoracic Society/American College of Chest Physicians Clinical Practice Guideline: Liberation from Mechanical Ventilation in Critically Ill Adults

Gregory A. Schmidt, Timothy D. Girard, John P. Kress, Peter E. Morris, Daniel R. Ouellette, Waleed Alhazzani, Suzanne M. Burns, Scott K. Epstein, Andres Esteban, Eddy Fan, Miguel Ferrer, Gilles L. Fraser, Michelle Ng Gong, Catherine L. Hough, Sangeeta Mehta, Rahul Nanchal, Sheena Patel, Amy J. Pawlik, William D. Schweickert, Curtis N. Sessler, Thomas Strøm, Kevin C. Wilson, and Jonathon D. Truwit; on behalf of the ATS/CHEST *Ad Hoc* Committee on Liberation from Mechanical Ventilation in Adults

This official clinical practice guideline of the American Thoracic Society (ATS) and the American College of Chest Physicians (CHEST) was approved by the ATS Board of Directors, December 2016, and by the CHEST Board of Regents, October 2016

Am J Respir Crit Care Med Vol 195, Iss 1, pp 115–119, Jan 1, 2017

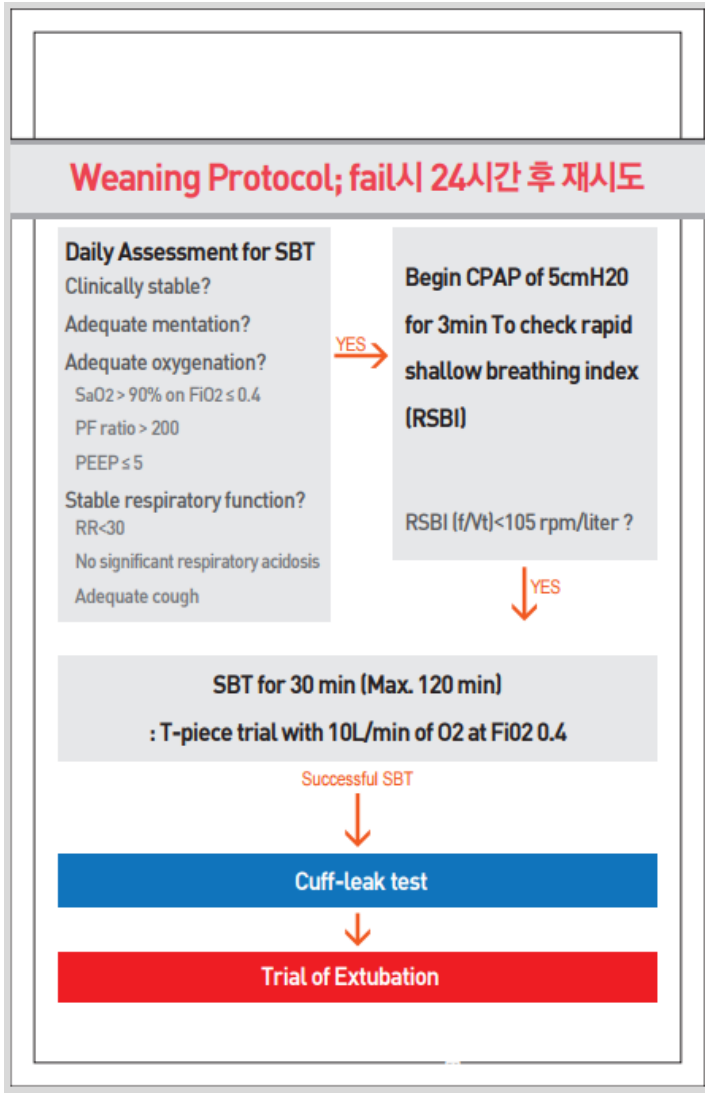
Table 2. Summary of Recommendations

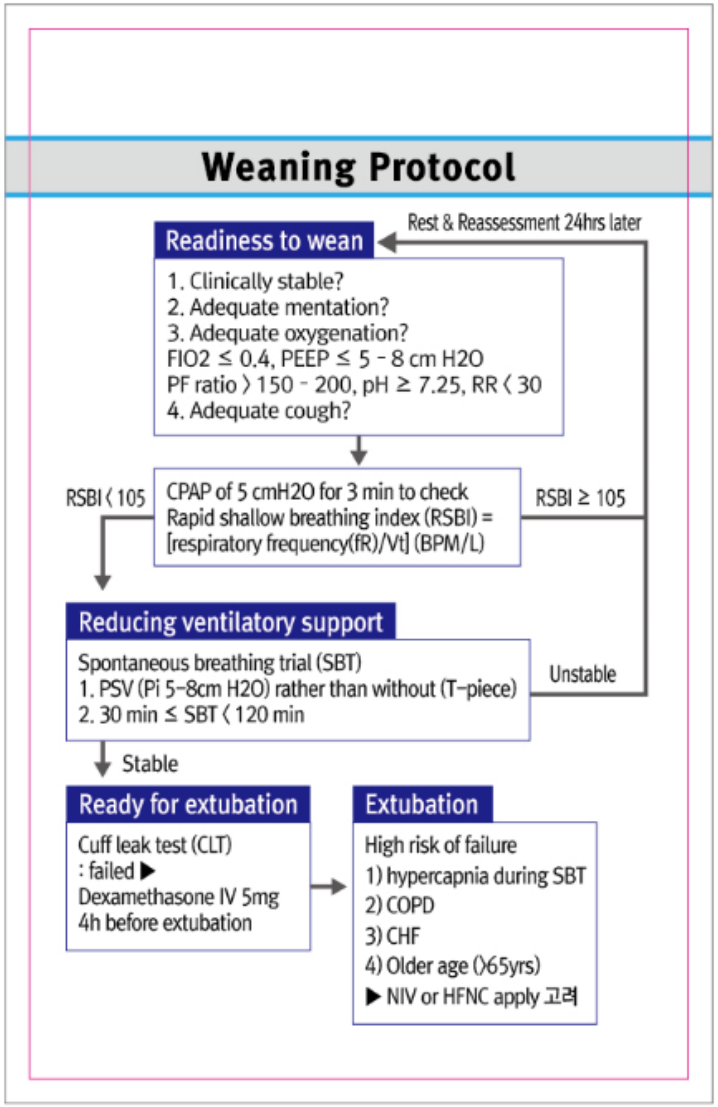
Recommendation	Strength of Recommendation	Certainty in the Evidence (i.e., Quality of Evidence)
1. For acutely hospitalized patients ventilated >24 h, we suggest that the initial SBT be conducted with inspiratory pressure augmentation (5–8 cm H_2O) rather than without (T-piece or CPAP).	Conditional	Moderate certainty in the evidence
2. For acutely hospitalized patients ventilated >24 h, we suggest protocols attempting to minimize sedation.	Conditional	Low certainty in the evidence
3. For patients at high risk for extubation failure who have been receiving mechanical ventilation for >24 h, and who have passed a spontaneous breathing trial, we recommend extubation to preventive NIV.	Strong	Moderate certainty in the evidence
4. For acutely hospitalized patients who have been mechanically ventilated for >24 h, we suggest protocolized rehabilitation directed toward early mobilization.	Conditional	Low certainty in the evidence
5. We suggest managing acutely hospitalized patients who have been mechanically ventilated for >24 h with a ventilator liberation protocol.	Conditional	Low certainty in the evidence
6a. We suggest performing cuff leak test in mechanically ventilated adults who meet extubation criteria and deemed high risk for PES.	Conditional	Very low certainty in the evidence
6b. For adults who have failed a cuff leak test but are otherwise ready for extubation, we suggest administering systemic steroids at least 4 h before extubation. A repeat cuff leak test is not required.	Conditional	Moderate certainty in the evidence

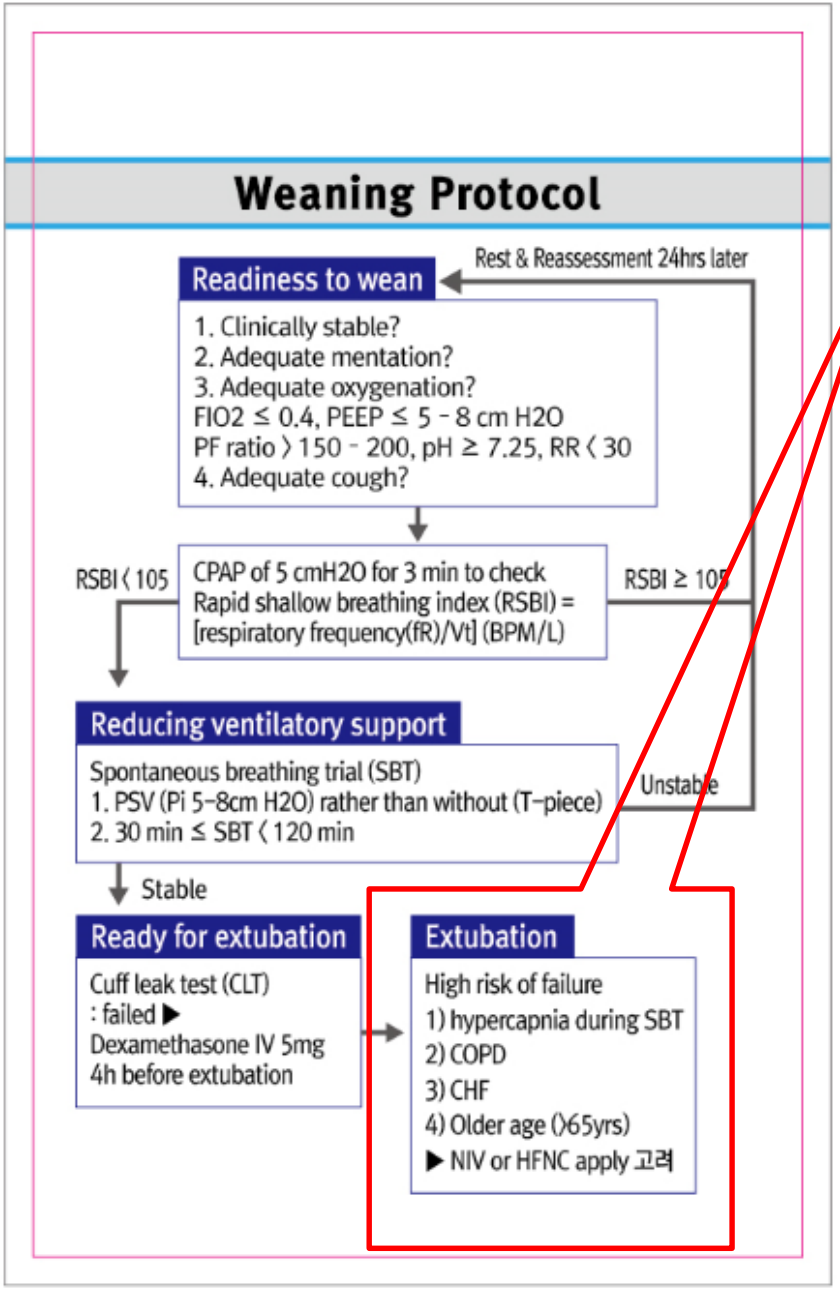
Definition of abbreviations: CPAP = continuous positive airway pressure; NIV = noninvasive ventilation; PES = postextubation stridor; SBT = spontaneous breathing trial.
More detailed discussions of questions 1–3 appear in *Chest* (3) and of questions 4–6 appear in the *American Journal of Respiratory and Critical Care Medicine* (4).

Am J Respir Crit Care Med Vol 195, Iss 1, pp 115–119, Jan 1, 2017

CMC ICU PROTOCOL







3. For patients at high risk for extubation failure who have been receiving mechanical ventilation for >24 h, and who have passed a spontaneous breathing trial, we recommend extubation to preventive NIV.

- QUESTION
  - HFNC ?
    - Role in weaning
  - Patients at high risk of reintubation
    - Older age
    - Comorbidities
      - COPD
      - CHF
      - Hypercapnia **during the SBT**

Contents

- HFNC vs Conventional oxygen therapy (COT)

- HFNC vs NIV

HFNC VS COT

HFNC vs Venturi mask

ORIGINAL ARTICLE

Nasal High-Flow versus Venturi Mask Oxygen Therapy after Extubation

Effects on Oxygenation, Comfort, and Clinical Outcome

Salvatore Maurizio Maggiore[1], Francesco Antonio Idone[1], Rosanna Vaschetto[2], Rossano Festa[1], Andrea Cataldo[1], Federica Antonicelli[1], Luca Montini[1], Andrea De Gaetano[3], Paolo Navalesi[4,5,6], and Massimo Antonelli[1]

[1]Department of Anesthesiology and Intensive Care, Agostino Gemelli Hospital, Università Cattolica del Sacro Cuore, Rome, Italy; [2]Department of Anesthesia and Intensive Care, Maggiore della Carità Hospital, Novara, Italy; [3]Consiglio Nazionale delle Ricerche, Istituto di Analisi dei Sistemi e Informatica "A. Ruberti," Rome, Italy; [4]Department of Translational Medicine, Università del Piemonte Orientale "A. Avogadro," Alessandria-Novara-Vercelli, Italy; [5]Anesthesia and Intensive Care, Sant'Andrea Hospital, Vercelli, Italy; and [6]CRRF Mons. L. Novarese, Moncrivello (VC), Italy

American Journal of Respiratory and Critical Care Medicine Volume 190 Number 3 | August 1 2014

Inclusion criteria

- Mechanically ventilated > 24 hours
- Successfully passed a SBT
- PaO_2 /FIO_2 ≤ 300 at the end of the SBT
- Normal mental status without delirium

Exclusion criteria

- Less than 18
- Pregnancy
- Tracheostomy
- Do-not-intubate status
- **Planned use of noninvasive ventilation (NIV)**
  - More than three consecutive failures of SBT
  - **$PaCO_2$ greater than 45 mm Hg with a respiratory rate greater than 25 per minute just before the spontaneous breathing trial**
- All patients had a normal mental status and none of them had delirium.

Table 1. Characteristics of Patients at Inclusion

	Control Group (*n* = 52)	NHF (*n* = 53)	*P* Value
Age, yr	64 ± 17	65 ± 18	0.9
Male sex, n (%)	35 (67.3)	33 (62.3)	0.73
SAPS II	44 ± 16	43 ± 14	0.73
Type of admission			0.5
Medical, n (%)	31 (60)	35 (66)	
Surgical-trauma, n (%)	21 (40)	18 (34)	
Cause of acute respiratory failure			0.78
Pneumonia, n (%)	24 (46.2)	24 (45.3)	
Multiple trauma, n (%)	12 (23.1)	11 (20.8)	
Atelectasis, n (%)	5 (9.6)	4 (7.5)	
Shock, n (%)	3 (5.8)	5 (9.4)	
Cardiogenic pulmonary edema, n (%)	3 (5.8)	3 (5.7)	
Cardiac arrest, n (%)	2 (3.8)	3 (5.7)	
Other, n (%)*	3 (5.8)	3 (5.7)	
Length of mechanical ventilation before inclusion, d	5.2 ± 3.7	4.6 ± 4.1	0.43
Length of ICU stay before inclusion	5.6 ± 4.4	5.2 ± 4.4	0.67
Pa_{O_2}, mm Hg	93.4 ± 24.2	89.9 ± 19.5	0.41
Pa_{CO_2}, mm Hg	36 ± 7.1	34.7 ± 7.6	0.36
Sa_{O_2}, %	97.2 ± 2.6	96.9 ± 2.0	0.71
FI_{O_2}, %	39 ± 7	38 ± 7	0.47
Pa_{O_2}/FI_{O_2}, mm Hg	241.7 ± 51.1	239.4 ± 42.4	0.8
Respiratory rate, breaths/min	23 ± 6	23 ± 5	0.73
Heart rate, beats/min	91 ± 15	92 ± 19	0.84
Mean arterial pressure, mm Hg	94 ± 15	94 ± 12	0.88

Definition of abbreviations: ICU = intensive care unit; NHF = nasal high-flow oxygen therapy; SAPS II = Simplified Acute Physiologic Score II.
*Other causes of acute respiratory failure were hemoptysis (one patient), diabetic ketoacidosis (one patient), diabetic coma (two patients), and epileptic seizures (two patients).

RESULT

Table 2. Need for Ventilatory Support during the 48-Hour Study Period

	Control Group (*n* = 52)	NHF (*n* = 53)	*P* Value
Noninvasive ventilation, n (%)	8 (15.4)	2 (3.8)	0.042
Endotracheal intubation, n (%)	11 (21.2)	2 (3.8)	0.005
Cause of endotracheal intubation			
Hypercapnia with respiratory acidosis, n (%)	0	0	N/A
Changes in mental status, n (%)	1 (1.9)	1 (1.9)	0.989
Oxygen desaturation or hypoxia, n (%)	6 (11.5)	1 (1.9)	0.047
Unbearable dyspnea with respiratory muscle failure, n (%)	4 (7.7)	1 (1.9)	0.162
Persistent hypotension, n (%)	2 (3.8)	0	0.149
Inability to clear secretions, n (%)	6 (11.5)	1 (1.9)	0.047

Definition of abbreviation: NHF = nasal high-flow oxygen therapy.

American Journal of Respiratory and Critical Care Medicine Volume 190 Number 3 | August 1 2014

Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Postextubation High-Flow Nasal Cannula vs Conventional Oxygen Therapy on Reintubation in Low-Risk Patients

A Randomized Clinical Trial

Gonzalo Hernández, MD, PhD; Concepción Vaquero, MD; Paloma González, MD; Carles Subira, MD; Fernando Frutos-Vivar, MD; Gemma Rialp, MD; Cesar Laborda, MD; Laura Colinas, MD; Rafael Cuena, MD; Rafael Fernández, MD, PhD

JAMA. 2016;315(13):1354-1361.

COT IN THIS STUDY

- Nasal cannula
- Nonrebreather facemask

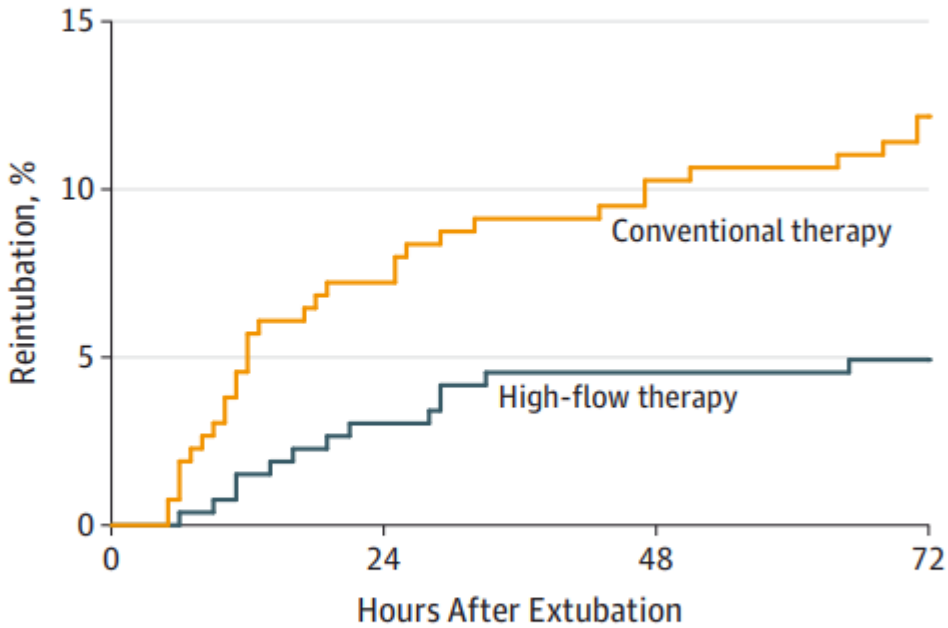
→ Adjusted to maintain SpO_2 > 92%.

Table 2. Primary and Secondary Outcomes

Variable	Oxygen Therapy: High-Flow (n = 264)	Oxygen Therapy: Conventional (n = 263)	Difference Between Groups (95% CI)	*P* Value
Primary Outcome				
All-cause reintubation, No. (%)	13 (4.9)	32 (12.2)	7.2 (2.5 to 12.2)	.004[a]
Secondary Outcomes				
Postextubation respiratory failure, No. (%)	22 (8.3)	38 (14.4)	6.1 (0.7 to 11.6)	.03[a]
Respiratory infection, No. (%)	6 (2.3)	13 (4.9)	2.7 (−0.6 to 6.2)	.07[a]
Ventilator-associated tracheobronchitis	3 (1.1)	7 (2.6)	1.5 (−1.0 to 4.4)	.22[a]
Ventilator-associated pneumonia	3 (1.1)	6 (2.3)	1.2 (−1.3 to 3.9)	.31[a]
Causes of postextubation respiratory failure, No. (%)				
Respiratory acidosis[c]	1 (4.5)	4 (10.5)		
Hypoxia[c]	7 (31.8)	6 (15.8)		
Unbearable dyspnea	9 (40.9)	14 (28.9)		.10[b]
Decreased level of consciousness	2 (9)	0		
Inability to clear secretions	3 (13.6)	14 (36.8)		

JAMA. 2016;315(13):1354-1361.

Figure 2. Kaplan-Meier Analysis of Time From Extubation to Reintubation



No. at risk				
Conventional therapy	263	244	236	231
High-flow therapy	264	256	252	251

JAMA. 2016;315(13):1354-1361.

Low risk patients ;
Inculsion criteria of this study

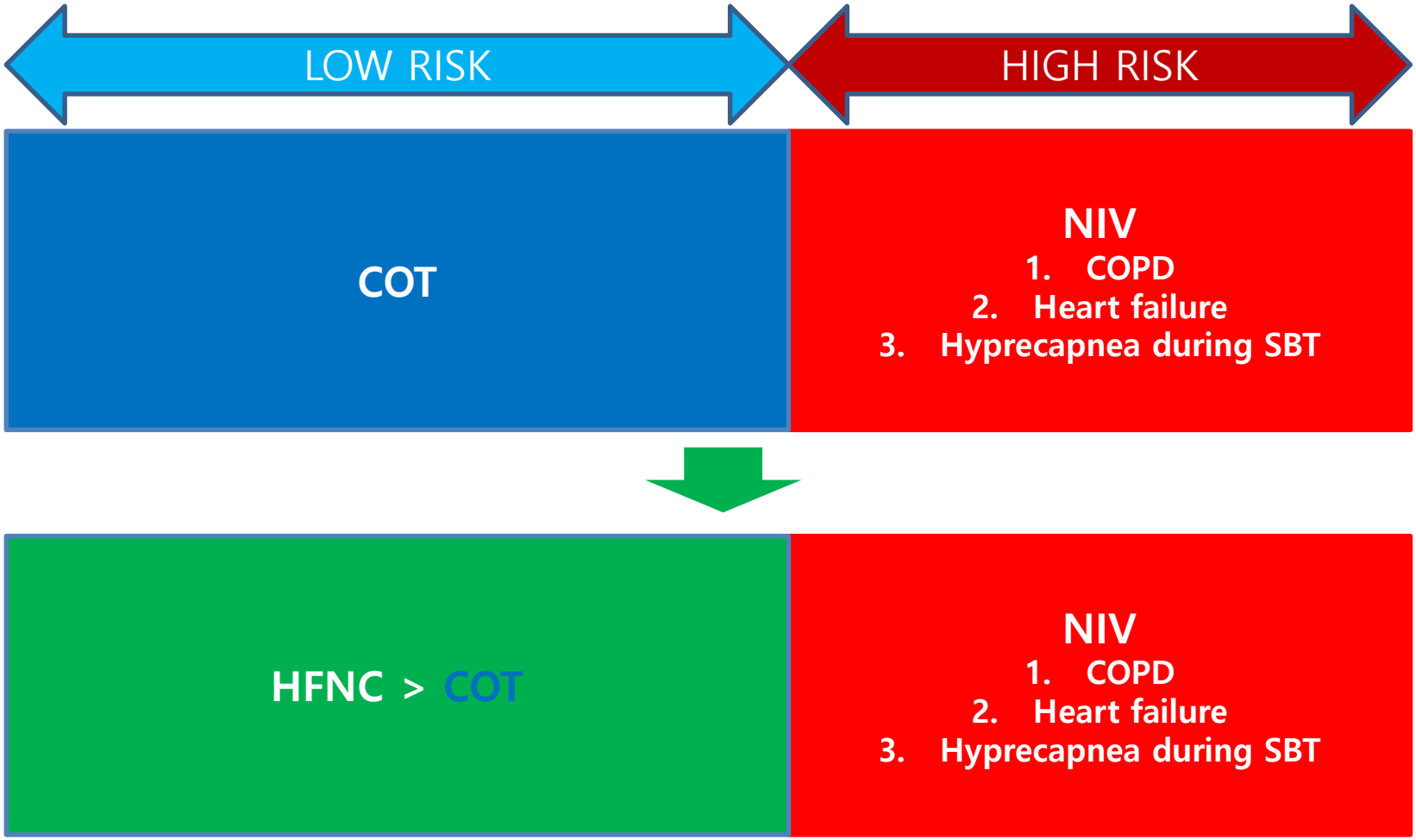
- All adult patients
  - Mechanical ventilation longer than 12 hours
  - Ready for scheduled extubation
    - tolerance of SBT

- Only the first extubation episode

Low risk patients ; Exclusion criteria of this study

- Patients <18 years old.
- Pregnant patient.
- Patients with do-not-resuscitate orders.
- Tracheostomized patients.
- **Hypercapnic during the spontaneous breathing trial.**
- Accidentally extubated or self-extubated.
- Presence of any of the following high-risk factors for extubation failure:
  - Age greater than 65 years.
  - Heart failure as the primary indication for mechanical ventilation.
  - Moderate-to-severe COPD.
  - An Acute Physiology and Chronic Health Evaluation (APACHE) II >12 points on extubation day.
  - Body mass index >30 kg/m2
  - Airway patency problems, including high risk of developing laryngeal edema
  - Inability to deal with respiratory secretions (inadequate cough reflex or suctioning >2 times within 8 hours before extubation).
  - Difficult or prolonged weaning.
  - Two or more comorbidities (according to the Charlson Comorbidity Index).
  - Prolonged mechanical ventilation, defined as longer than 7 days.

SUPPORTIVE STRATEGY AFTER EXTUBATION



HFNC VS NIV

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Postextubation High-Flow Nasal Cannula vs Noninvasive Ventilation on Reintubation and Postextubation Respiratory Failure in High-Risk Patients

A Randomized Clinical Trial

Gonzalo Hernández, MD, PhD; Concepción Vaquero, MD; Laura Colinas, MD; Rafael Cuena, MD; Paloma González, MD; Alfonso Canabal, MD, PhD; Susana Sanchez, MD; Maria Luisa Rodriguez, MD; Ana Villasclaras, MD; Rafael Fernández, MD, PhD

JAMA. 2016;316(15):1565-1574.

Table 3. Exploratory Outcomes and Between-Group Differences in Physiologic Variables

	Noninvasive Mechanical Ventilation (n = 314)	High-Flow Conditioned Oxygen Therapy (n = 290)	Difference Between Groups (95% CI)[a]
Exploratory outcomes, No. (%)			
Respiratory-caused reintubation	50 (15.9)	49 (16.9)	1 (−4.9 to 6.9)
Physiologic variables			
FIO_2 12 h postextubation, median (IQR)	40 (35 to 50)	35 (30 to 40)	5 (−1.7 to 8.3)[b]
Gas-flow 12 h postextubation, mean (SD), L/min		50 (5)	
Length of NIV, median (IQR), h	14 (8-23)		
PaO_2:FIO_2, mean (SD), mm Hg[c]	104 (32)	99 (2)	P = .83[b]
$PaCO_2$, mean (SD), mm Hg[c]	47 (2.8)	46 (3.1)	P = .67[b]
Arterial pH, mean (SD)[c]	7.37 (0.03)	7.38 (0.05)	P = .57[b]

Abbreviations: IQR, interquartile range; NIV, noninvasive mechanical ventilation.

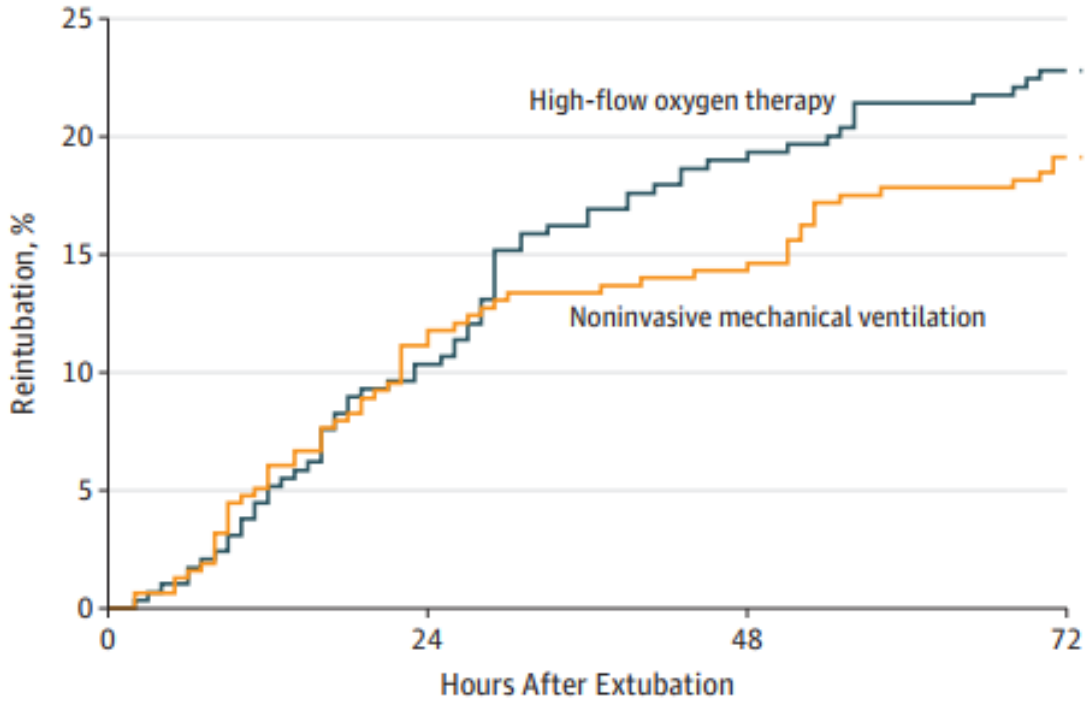
[a] Data are expressed as difference (95% CI) except as otherwise indicated.

[b] Mann-Whitney *U* test.

[c] Analysis including postextubation respiratory failure and reintubated patients only.

JAMA. 2016;316(15):1565-1574.

Figure 2. Kaplan-Meier Analysis of Time From Extubation to Reintubation



No. at risk				
High-flow oxygen therapy	290	260	234	223
Noninvasive mechanical ventilation	314	279	269	253

JAMA. 2016;316(15):1565-1574.

NONINFERIORITY TRIALS

- Intended to show that the effect of a **new treatment (HFNC)** is not worse than that of an **active control (NIV)** by more than a **specified margin (10%)**.

Evidence of NIV (Active control)

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.

Eur Respir J 2017; 50: 1602426

High risk patients ; Inculsion criteria of this study

- Age greater than 65 years.
- Heart failure as the primary indication for mechanical ventilation
- Moderate-to-severe COPD
- An Acute Physiology and Chronic Health Evaluation (APACHE) II >12 points on extubation day.
- Body mass index >30 kg/m^2
- Airway patency problems, including high risk of developing laryngeal edema.
- Inability to deal with respiratory secretions
  - inadequate cough reflex or suctioning >2 times within 8 hours before extubation
- Difficult or prolonged weaning.
- Two or more comorbidities (according to the Charlson Comorbidity Index).
- Prolonged mechanical ventilation, defined as longer than 7 days.

High risk patients ; Benefit from the active control intervention (NIV) ?

- Age greater than 65 years.
- Heart failure as the primary indication for mechanical ventilation

JAMA, December 28, 2005—Vol 294, No. 24

- Moderate-to-severe COPD

Am J Respir Crit Care Med Vol 173. pp 164–170, 2006

- An Acute Physiology and Chronic Health Evaluation (APACHE) II >12 points on extubation day.
- Body mass index >30 kg/m^2

Davidson AC, *et al*. *Thorax* 2016;**71**:ii1–ii35.

- Airway patency problems, including high risk of developing laryngeal edema.
- Inability to deal with respiratory secretions
  - inadequate cough reflex or suctioning >2 times within 8 hours before extubation

Contraindication!?

- Difficult or prolonged weaning.
- Two or more comorbidities (according to the Charlson Comorbidity Index).
- Prolonged mechanical ventilation, defined as longer than 7 days.

High risk patients ; Exclusion criteria of this study

- Patients <18 years old
- Pregnant patient
- Patients with do-not-resuscitate orders
- Tracheostomized patients
- Hypercapnic during the SBT

Am J Respir Crit Care Med Vol 173. pp 164–170, 2006

- Accidentally extubated or self-extubated.

High risk factor

	No. (%)	
	Noninvasive Mechanical Ventilation (n = 314)	High-Flow Conditioned Oxygen Therapy (n = 290)
High-risk factors for reintubation		
>65 y	182 (58)	166 (57.2)
Heart failure as the primary indication for MV	31 (9.9)	16 (5.5)
COPD	65 (20.7)	51 (17.6)
APACHE II >12 on extubation day[a]	128 (40.8)	131 (45.2)
Body mass index >30[c]	62 (19.7)	63 (21.7)
Airway patency problems	10 (3.2)	7 (2.4)
Inability to deal with respiratory secretions	66 (21)	66 (22.8)
Difficult or prolonged weaning[d]	87 (27.7)	73 (25.2)
≥2 Comorbidities	218 (69.4)	204 (70.3)
Prolonged mechanical ventilation	120 (38.2)	101 (34.8)

JAMA. 2016;316(15):1565-1574.

EVIDENCE OF NIV

DURING WEANING AND POST-EXTUBATION

ORIGINAL ARTICLE

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 2004;350:2452-60.

Table 1. Baseline Characteristics of the Patients, According to Study Group.*

Characteristic	Non-invasive Ventilation (N=114)	Standard Medical Therapy (N=107)	P Value
Age — yr	61±17	58±19	0.25
Female sex — no. (%)	47 (41)	47 (44)	0.68
Simplified Acute Physiology Score II on admission†	37±13	36±10	0.77
Reason for initiation of mechanical ventilation			0.65
Acute respiratory failure — no. (%)			
Pneumonia	28 (25)	20 (19)	
Postoperative respiratory failure	20 (18)	23 (21)	
Sepsis	13 (11)	11 (10)	
Trauma	11 (10)	7 (7)	
Cardiac failure	8 (7)	12 (11)	
Acute respiratory distress syndrome	4 (4)	8 (7)	
Other	12 (11)	10 (9)	
Acute-on-chronic respiratory failure — no. (%)			
Chronic obstructive pulmonary disease	14 (12)	9 (8)	
Asthma	1 (1)	3 (3)	
Neuromuscular disease — no. (%)	3 (3)	4 (4)	

N Engl J Med 2004;350:2452-60.

Table 4. Reasons for Reintubation, as Defined in the Protocol Guidelines, According to Study Group.

Reason	Non-invasive Ventilation (N=55)	Standard Medical Therapy (N=51)	P Value
	no. (%)		
Lack of improvement in signs of muscle fatigue	25 (45)	23 (45)	0.97
Hypoxemia	9 (16)	15 (29)	0.11
Copious secretions	5 (9)	6 (12)	0.65
Lack of improvement in pH or partial pressure of carbon dioxide	8 (15)	3 (6)	0.13
Changes in mental status	4 (7)	2 (4)	0.45
Hypotension	4 (7)	2 (4)	0.45

N Engl J Med 2004;350:2452-60.

CONCLUSIONS

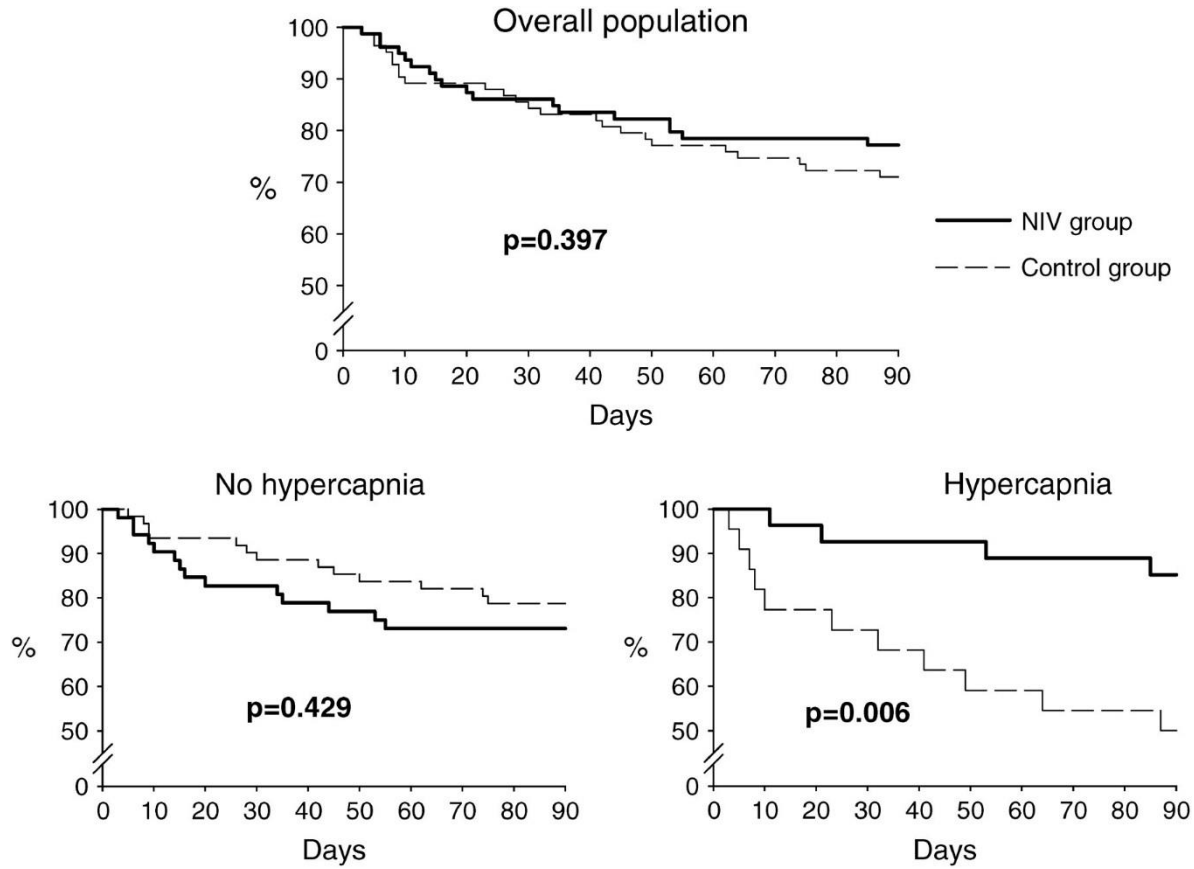
Noninvasive positive-pressure ventilation does not prevent the need for reintubation or reduce mortality in unselected patients who have respiratory failure after extubation.

Early Noninvasive Ventilation Averts Extubation Failure in Patients at Risk

A Randomized Trial

Miquel Ferrer, Mauricio Valencia, Josep Maria Nicolas, Oscar Bernadich, Joan Ramon Badia, and Antoni Torres

Unitat de Cures Intensives i Intermèdies, Servei de Pneumologia, Institut Clínic del Tòrax; and Área de Vigilància Intensiva, Hospital Clinic, Institut d'Investigacions Biomèdiques August Pi i Sunyer, Universitat de Barcelona, Barcelona, Spain



Am J Respir Crit Care Med Vol 173. pp 164–170, 2006

High risk patients ;
Exclusion criteria of this study

- Patients <18 years old
- Pregnant patient
- Patients with do-not-resuscitate orders
- Tracheostomized patients
- Hypercapnic during the SBT

  GOOD Indication for NIV

  Eur Respir J 2017; 50: 1602426

  Am J Respir Crit Care Med Vol 173. pp 164–170, 2006
- Accidentally extubated or self-extubated.

NIV

HFNC

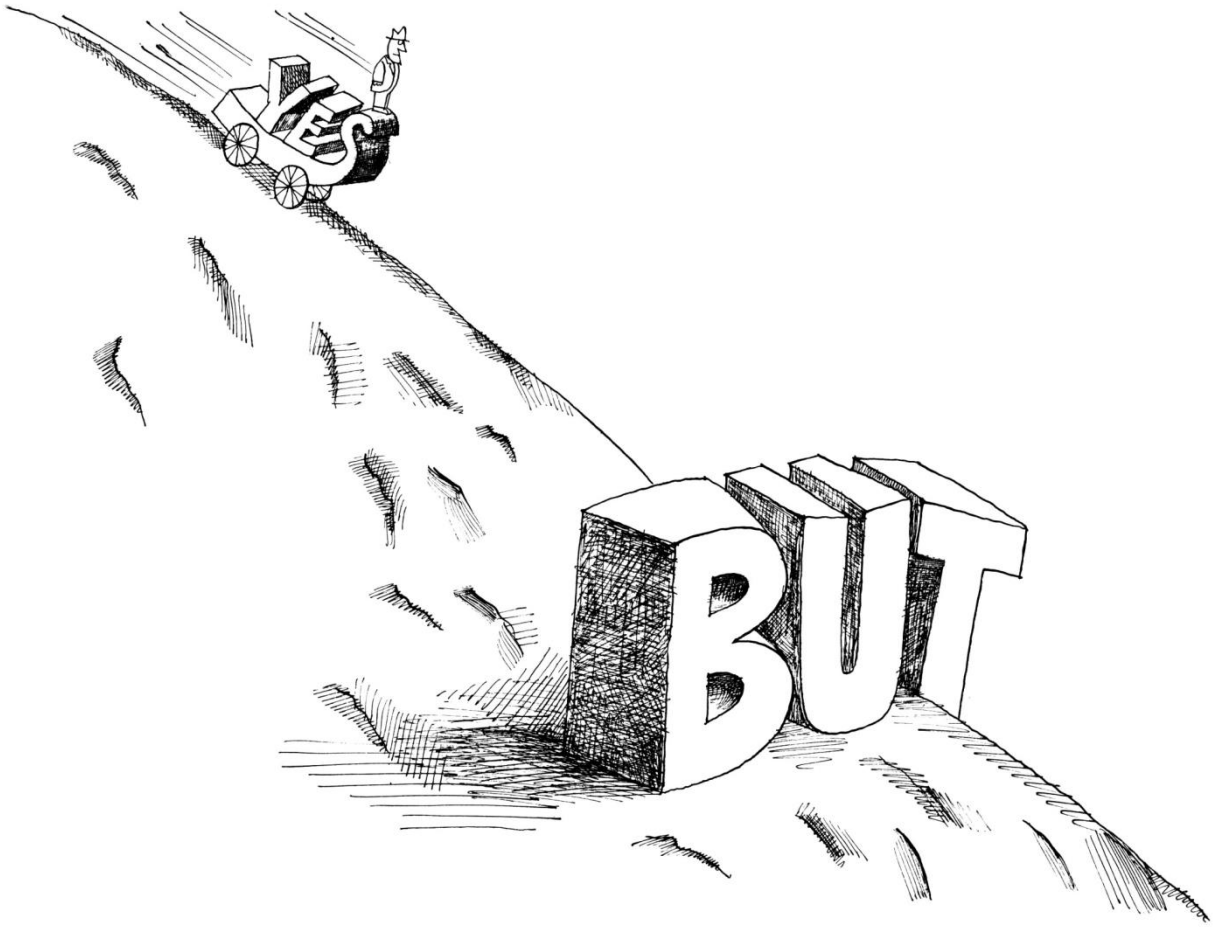
Limitation

- Patient population
  - Too broad to interpret
  - Unclear benefit from the active control intervention (NIV)

JAMA February 28, 2017 Volume 317, Number 8

- Proven benefit of NIV apply
  - COPD
  - CHF
  - Hypercapnia during the SBT

ROUTINE HFNC AFTER EXTUBATION



Evidence of NIV (Active control)

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Eur Respir J 2017; 50: 1602426

Hypoxemic patients After Cardiothoracic Surgery

Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

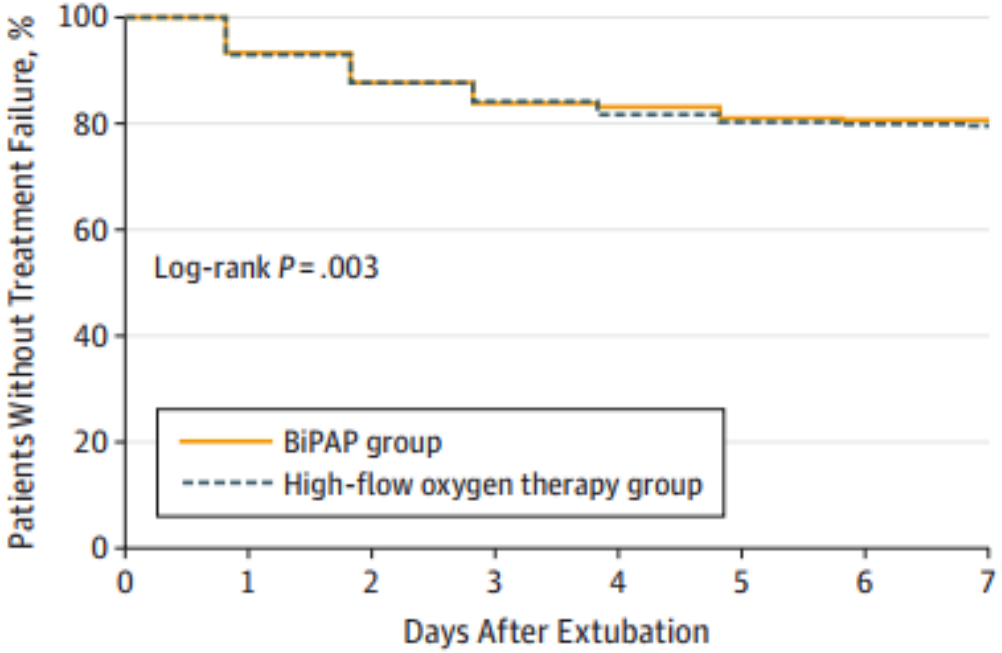
High-Flow Nasal Oxygen vs Noninvasive Positive Airway Pressure in Hypoxemic Patients After Cardiothoracic Surgery

A Randomized Clinical Trial

François Stéphan, MD, PhD; Benoit Barrucand, MD; Pascal Petit, MD; Saida Rézaiguia-Delclaux, MD; Anne Médard, MD; Bertrand Delannoy, MD; Bernard Cosserant, MD; Guillaume Flicoteaux, MD; Audrey Imbert, MD; Catherine Pilorge, MD; Laurence Bérard, MD; for the BiPOP Study Group

JAMA. 2015;313(23):2331-2339.

Figure 2. Postoperative Patients Without Treatment Failure After Extubation



No. at risk								
BiPAP	416	385	363	348	339	333	331	329
High-flow oxygen therapy	414	385	361	346	342	334	333	331

JAMA. 2015;313(23):2331-2339.

Obese,
After Cardiothoracic Surgery

High-Flow Nasal Cannula Therapy Versus Intermittent Noninvasive Ventilation in Obese Subjects After Cardiothoracic Surgery

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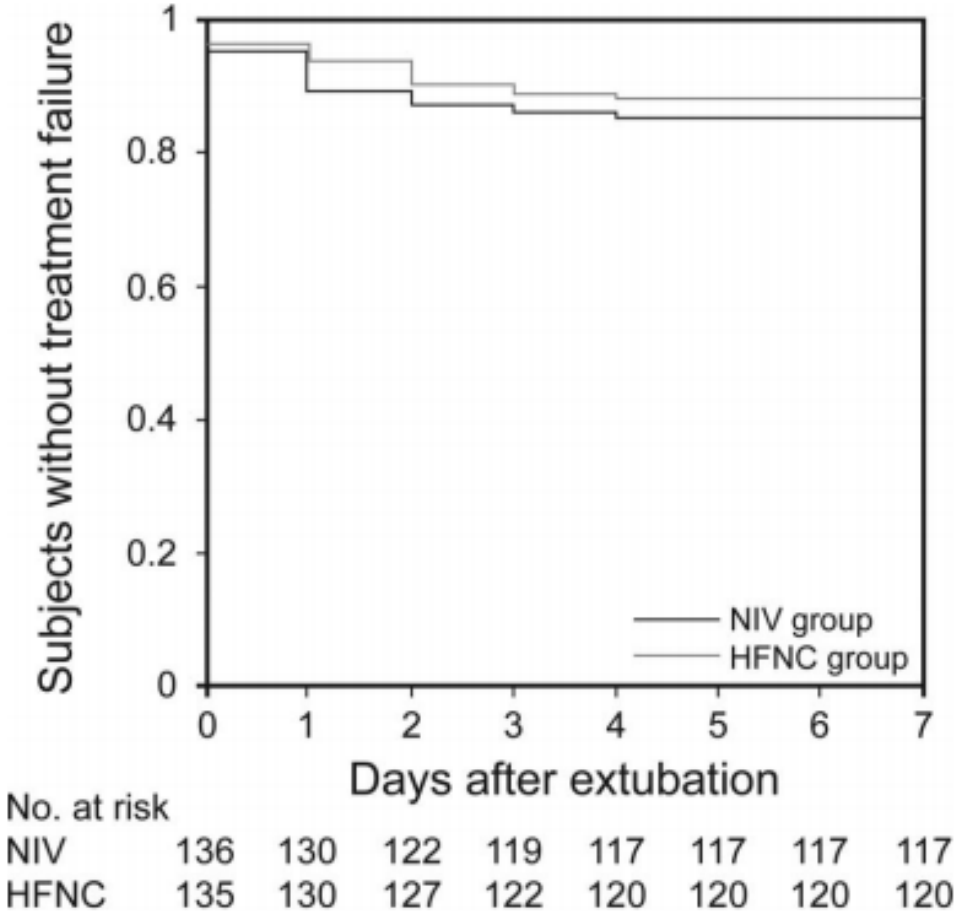
Table 1. Subject Characteristics

Characteristics	NIV (n = 136)	HFNC (n = 135)	P
Age, years, mean ± SD	63.4 ± 11.8	64.5 ± 11.3	.40
Men, n (%)	87 (63.9)	81 (60.0)	.50
Body mass index, kg/m^2, mean ± SD	34.4 ± 3.8	34.2 ± 3.4	.60
Body mass index > 40 kg/m^2, n (%)	9 (6.6)	6 (4.4)	.40
Smoking, n (%)			.66
Former	69 (50.7)	70 (51.8)	
Current	27 (19.8)	22 (16.3)	
SAPS II score at admission, mean ± SD	25.4 ± 12.9	25.9 ± 11.1	.80
Acute respiratory failure at inclusion, n (%)	51 (37.5)	45 (33.3)	.47
P_{aO_2}/F_{IO_2} ratio < 200 at inclusion, n (%)	50 (36.8)	45 (33.3)	.55
Surgical procedures, n (%)			.59
Coronary arterial bypass grafting	40 (29.4)	54 (40.0)	
Valvular surgery	41 (30.2)	31 (23.0)	
Combined cardiac surgery with coronary arterial bypass grafting	9 (6.6)	8 (5.9)	
Thoracic aorta	9 (6.6)	6 (4.4)	
Pulmonary thromboendarterectomy	19 (14.0)	15 (11.1)	
Lung resection	6 (4.4)	9 (6.7)	
Heart, lung, heart-lung transplantations	0	2 (1.5)	
Others	12 (8.8)	10 (7.4)	
Cardiopulmonary bypass, n (%)	118 (86.8)	108 (80.0)	.14
Time on cardiopulmonary bypass, min, mean ± SD	120 ± 66	110 ± 60	.20
Time from surgery to randomization, days, median (IQR)	1.0 (0.0–1.0)	1.0 (0.0–1.0)	.58
Duration of mechanical ventilation at randomization, h, median (IQR)	9.0 (5.0–20.0)	8.0 (5.0–16.5)	.92

Spirometry results were available for 181 subjects: 94 (69.1%) in the NIV group and 87 (64.4%) in the high-flow nasal O_2 group. According to the spirometry classification, COPD was mild-to-moderate in 19 (13.9%) subjects in the NIV group and in 13 (14.9%) subjects in the high-flow nasal O_2 group (P = .41).
NIV = noninvasive ventilation
HFNC = high-flow nasal cannula
SAPS II = Simplified Acute Physiology Score version II
IQR = interquartile range



Log-rank test = 0.49.

Exclusion criteria in this study

- Obstructive sleep apnea
- Tracheostomy
- Do-not-intubate status
- Delirium
- Nausea and vomiting,
- Bradypnea
- Impaired consciousness
- Hemodynamic instability

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CONCLUSION

VS

Open access Protocol

BMJ Open

High-flow nasal cannula oxygen therapy [redacted] non-invasive ventilation during the weaning period after extubation in ICU: the prospective randomised controlled HIGH-WEAN protocol

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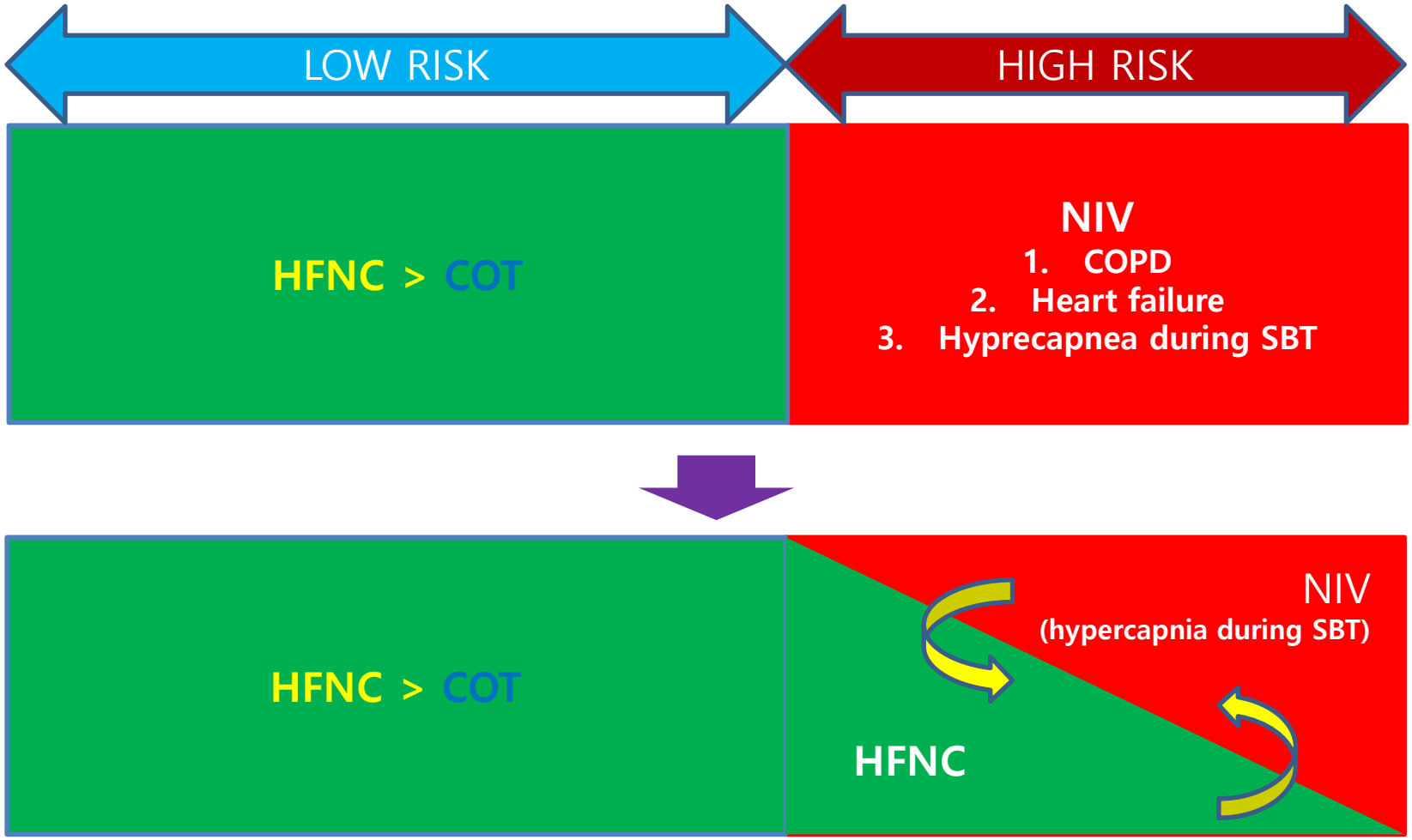
Thille AW, *et al*. *BMJ Open* 2018;**8**:e023772.

A NEW GREAT FRIEND FOR WEANING, HFNC

SUPPORTIVE STRATEGY AFTER EXTUBATION



AND…
HFNC tracheostomy interface

경청해 주셔서 감사합니다.

溫故知新

溫 : 익힐 온/故 : 옛 고/知 : 알 지/新 : 새 신

By viewing the old we learn the new!