Créteil – 24ème Journée d'Actualités en Ventilation Artificielle 2017

Post-extubation: quelle technique pour quel patient ?

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Conflict of interest

*Consultants with honorarium

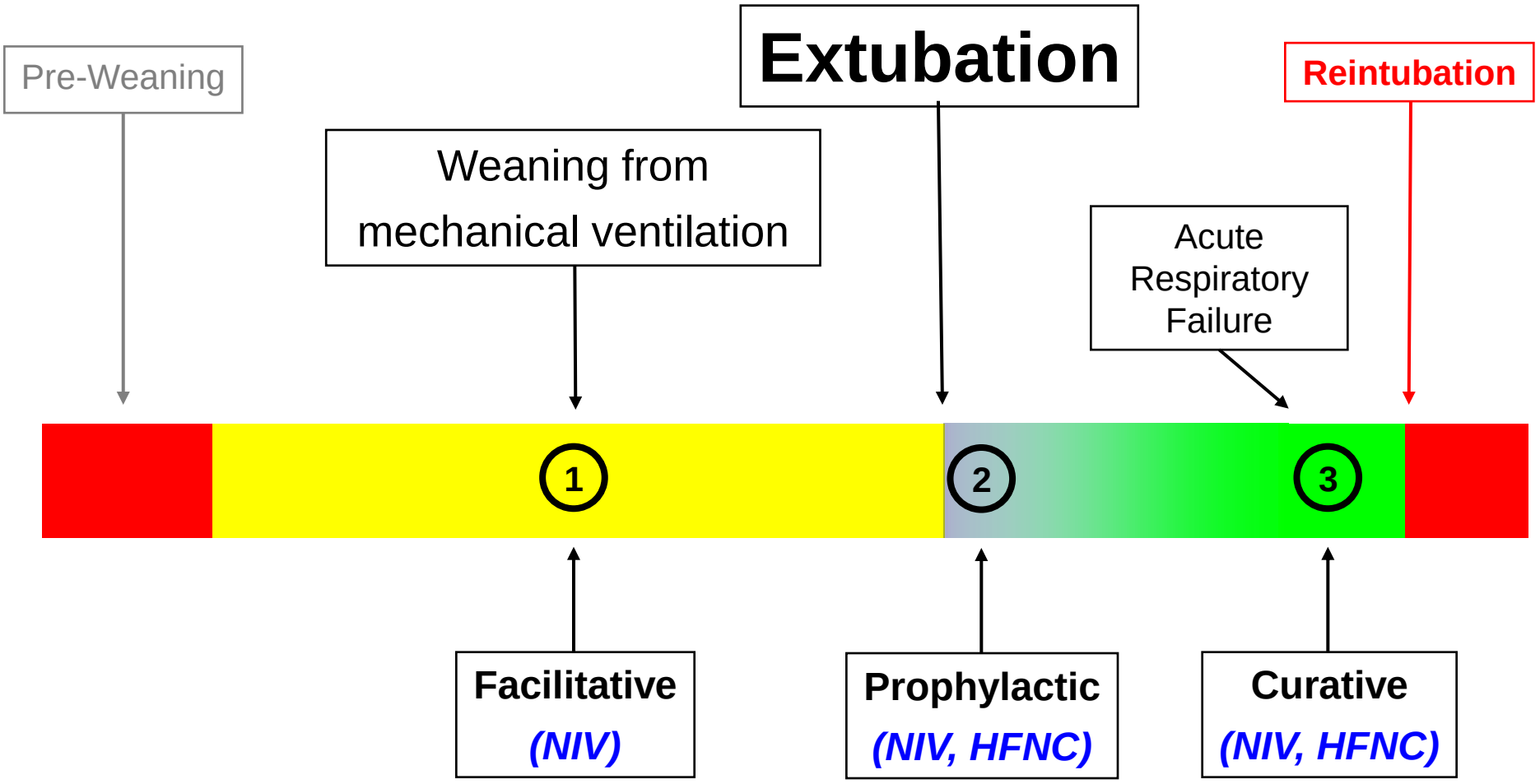
- Dräger
- Xenios
- Fisher-Paykel
- Medtronic

Ventilatory Support after extubation to prevent reintubation

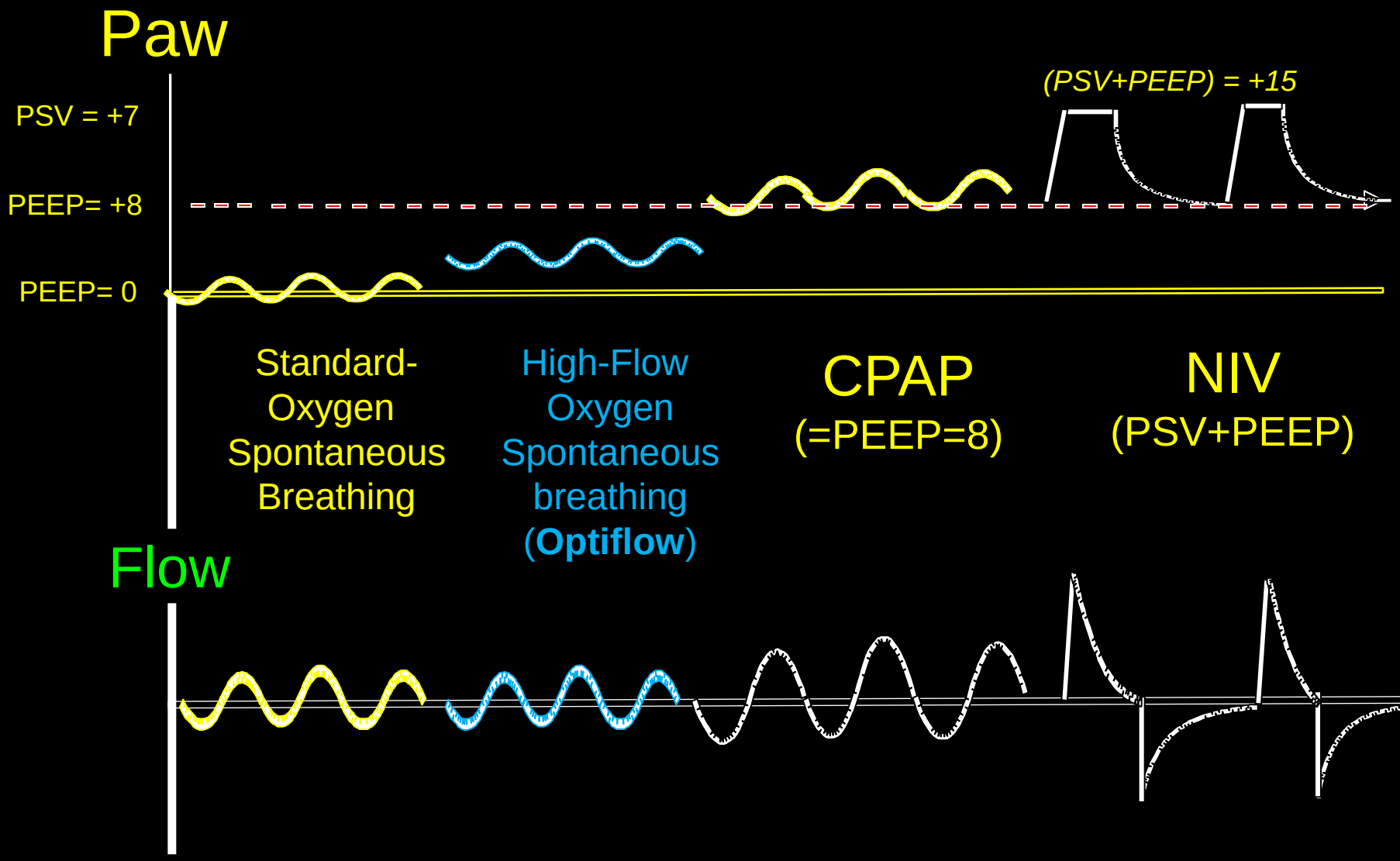
1. Background : preventive and/or curative
2. Rationale for use high-flow oxygen ; CPAP and NIV after extubation

3. In non-selected patients
4. In selected post-operative patients
5. Bedside application : main optimal settings ?

Noninvasive respiratory support during weaning



What are the main Ventilatory Support
after extubation to prevent reintubation ?



Ventilatory Support Management after extubation to prevent reintubation

Curative

Grey zone

Prophylactic (preventive)

ARF : **yes** (Present)

Objectif : to avoid intubation !

ARF : **no** (not present…at risk!)

Objectif : to avoid the development of ARF

Optiflow (1 low pressure)	**CPAP** (1 pressure level)	**NIV** (2 pressure levels)	Optiflow (1 low pressure)	**CPAP** (1 pressure level)	**NIV** (2 pressure levels)

Rationale for use **High-Flow Oxygen Therapy** to prevent or treat acute respiratory failure after extubation

REVIEW

Use of high-flow nasal cannula oxygenation in ICU adults: a narrative review

Laurent Papazian[1,2*], Amanda Corley[3], Dean Hess[4], John F. Fraser[3], Jean-Pierre Frat[5,6], Christophe Guitton[7], Samir Jaber[8], Salvatore M. Maggiore[9], Stefano Nava[10], Jordi Rello[11], Jean-Damien Ricard[12,13,14], François Stephan[15], Rocco Trisolini[16] and Elie Azoulay[17]

ICM 2016

Table 1 Physiological benefits of high-flow nasal cannula oxygenation (HFNCO) compared to conventional oxygen therapy

FiO_2 values are higher and more stable
Because the delivered flow is higher than the spontaneous inspiratory demand and because the difference between the delivered flow rate and the patient's inspiratory flow rate is smaller
The flow must be set to match the patient's inspiratory demand and/or the severity of the respiratory distress
The anatomical dead space is decreased via washout of the nasopharyngeal space
Consequently, a larger fraction of the minute ventilation participates in gas exchange
Respiratory efforts become more efficient
Thoracoabdominal synchrony improves
The work of breathing is decreased
Because HFNCO mechanically stents the airway
Provides flow rates that match the patient's inspiratory flow, and markedly attenuates the inspiratory resistance associated with the nasopharynx, thereby reducing the work of breathing
The gas delivered is heated and humidified
Warm humid gas reduces the work of breathing and improves mucociliary function, thereby facilitating secretion clearance, decreasing the risk of atelectasis, and improving the ventilation/perfusion ratio and oxygenation
The body is spared the energy cost of warming and humidifying the inspired gas (neonates +++)
Warm humid gas is associated with better conductance and pulmonary compliance compared to dry, cooler gas
HFNCO delivers adequately warmed and humidified gas only when the flow is >40 L/min
Positive airway pressures are increased
The nasal cannula generates continuous positive pressures in the pharynx of up to 8 cmH_2O, depending or flow and mouth opening
The positive pressure distends the lungs, ensuring lung recruitment and decreasing the ventilation–perfusion mismatch in the lungs
End-expiratory lung volume is greater with HFNO than with low-flow oxygen therapy
Minimizing leaks around the cannula prongs is of the utmost importance

Principaux effets de « l'optiflow »

1. Haute FiO2
2. Pression Positive – PEP (CPAP-like)
3. Qualité de l'humidification de l'oxygène++
4. Meilleur confort
5. Lavage espace mort
6. Diminution du travail respiratoire
7. Autres…..

Rationale for use
CPAP and NIV (BIPAP)
to prevent or treat acute respiratory failure after extubation

Mécanisme(s) de l'insuffisance respiratoire aigüe ?

1

Insuffisance de l'échangeur gazeux

(poumon)

Hypoxémie isolée

Traitement :

Oxygénation

2

Insuffisance de la pompe ventilatoire

(Diaphragme +/- poumon)

Hypercapnie +/- Hypoxémie

Traitement :

Ventilation

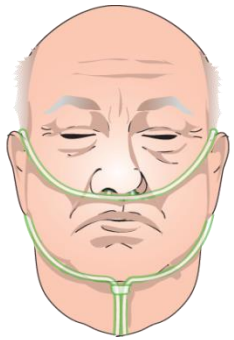
Oxygénation

Ventilatory Support after extubation

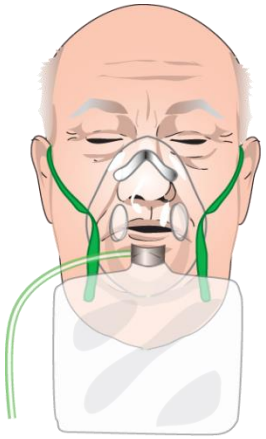
Ventilation
+/-Oxygénation

CPAP
(mask)

Intubation
+
Ventilation invasive

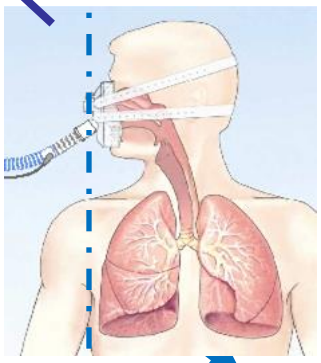


O2
lunettes
(faible débit < 5 L/min)

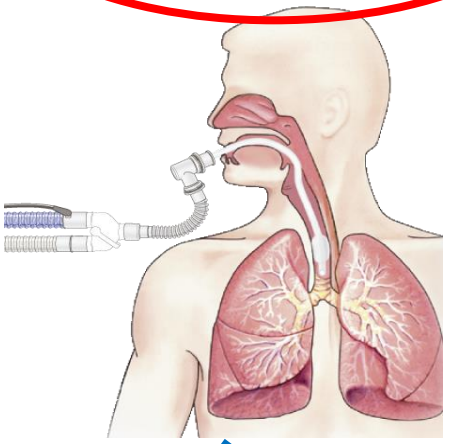


O2
Masque Haute Concentration
(faible débit > 10 L/min)

Optiflow
(haut débit d'oxygène)



VNI



Ventilation Invasive
(sonde d'intubation)

Ventilatory Support after extubation to prevent reintubation

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3. In non-selected patients
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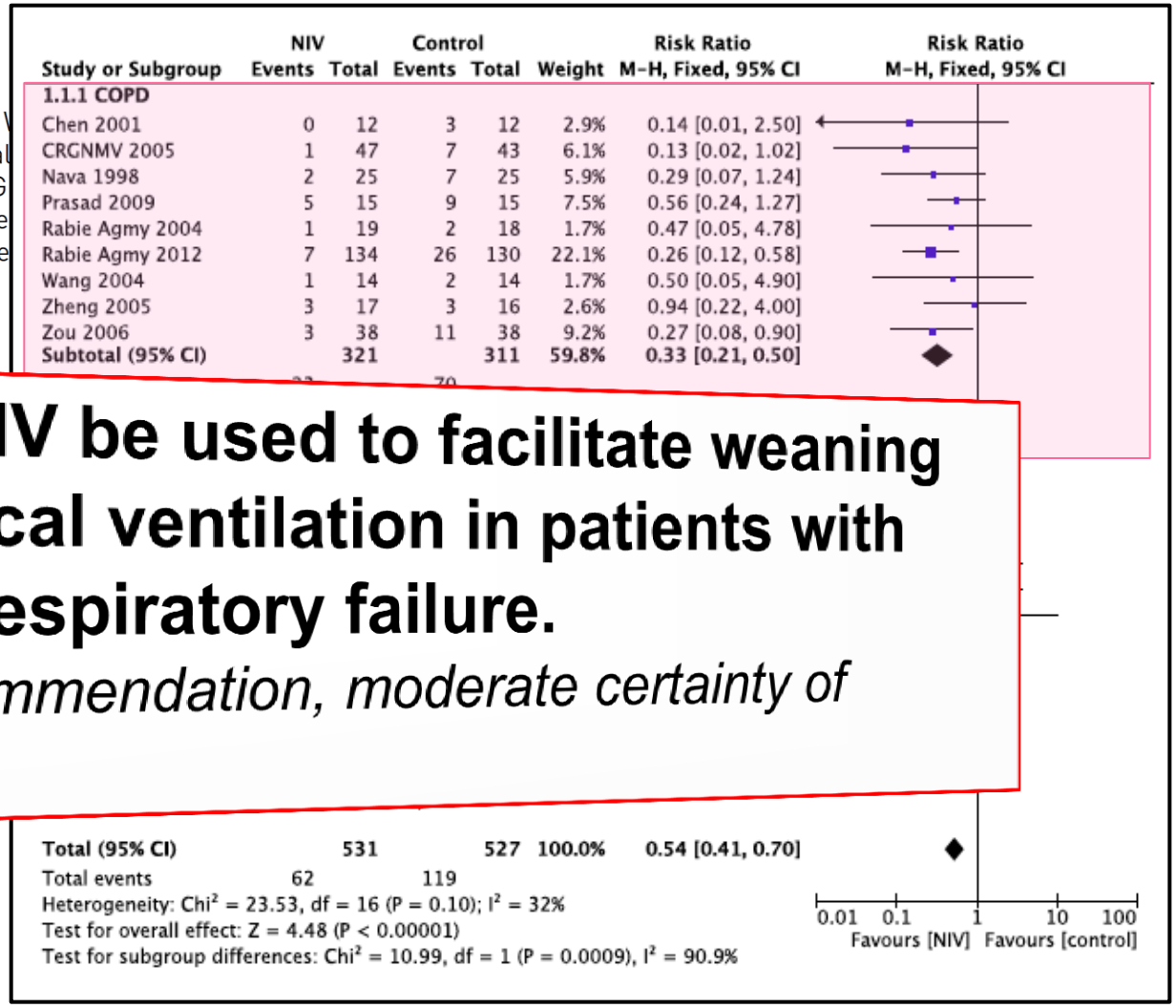
5. Bedside application : main optimal settings ?

Facilitative NIV for weaning in COPD patients

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

Bram Rochwerg[1], Laurent Brochard[2,3], Mark V
Nicholas S. Hill[6], Stefano Nava[7] and Paolo Naval
committee); Massimo Antonelli[9], Jan Brozek[1], G
Kalpalatha Guntupalli[11], Samir Jaber[12], Sean Ke
Sangeeta Mehta[16] and Suhail Raoof[17,18] (membe

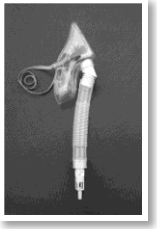
mortality



We suggest NIV be used to facilitate weaning from mechanical ventilation in patients with hypercapnic respiratory failure.

(Conditional recommendation, moderate certainty of evidence)

Optiflow vs Venturi mask after extubation



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]

Inclusion Criteria: mechanical ventilation> 24h, **P/F ≤ 300 at the beginning of SBT**, successful SBT (1 hour: PSV 6-8 cmH2O - PEEP 0, or T-piece)

Exclusion Criteria: tracheostomy, anticipated need for NIV post-extubation (prophylactic), age<18, pregnancy

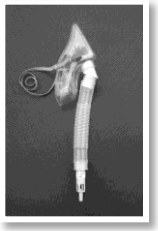
Randomization: NHF vs Venturi mask oxygen therapy after extubation

Settings: FiO2 set to obtain SpO2 92-98% (88-95% in COPD), gas flow 50 L/min (with NHF)

Measurements (at 1, 3, 6, 12, 24, 36, and 48 hours):

arterial blood gases, respiratory rate, discomfort related to the interface and to dryness symptoms (patients's rating on a numerical scale from 0 – min – to 10 – max), incidence of desaturations and interface's displacement, need for reintubation or NIV

Optiflow vs Venturi mask after extubation



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	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

Maggiore SM et al. AJRCCM 2014;190:282-288

Salvatore Maggiore

The RINO Trial (ReINtubation rate after Oxygen therapy)

- Multicenter, randomized, controlled, phase III, open trial (NCT02107183)
- 500 patients
- Nasal high-flow vs Venturi mask after extubation
- Study hypothesis: using Optiflow for delivering oxygen therapy after extubation may reduce the extubation failure rate and the need for reintubation as compared with the Venturi mask

Inclusion : finished 2016 …..
Analysis in progress……..?

Optiflow to prevent reintubation in **low risk** patients

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

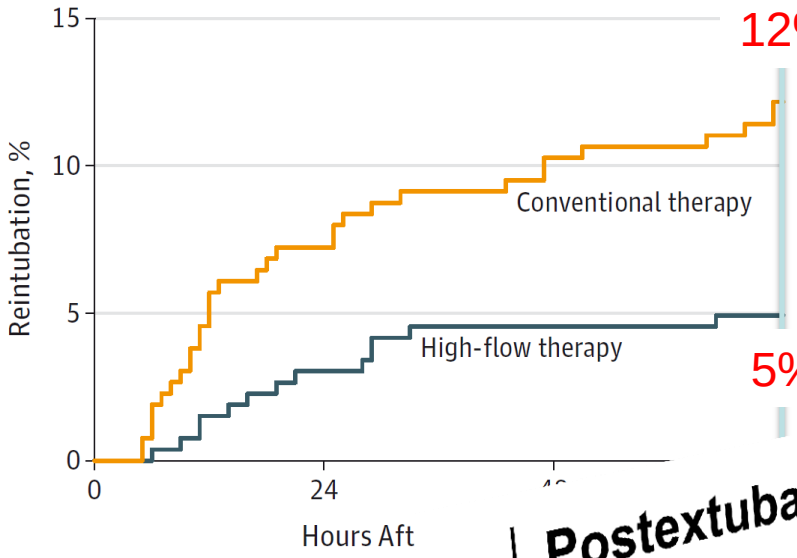
527 patientswith MV>12h:

263 O2 vs. 264 HFNT for 24h (31 L/min)

Low risk for post-extubation ARF:

- Age <65 years
- APACHEII <12 at extubation
- BMI<30
- Adequate secretions management
- Simple weaning
- 0-1 comorbidity
- No heart failure or COPD
- No airway patency problems
- No prolonged MV

Primary outcome: reintubation within 72 h



No. at risk

Conventional therapy	263	244	
High-flow therapy	264	256	251

- ↓ **Postextubation respiratory failure** (8.3 vs. 14.4%)
- ↓ **Laryngeal edema requiring ETI** (0 vs. 3.1%)

Hernandez G et al. JAMA ***2016;315:1354-61***

Optiflow vs NIV to prevent post-ext. ARF **in high risk patiens**

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

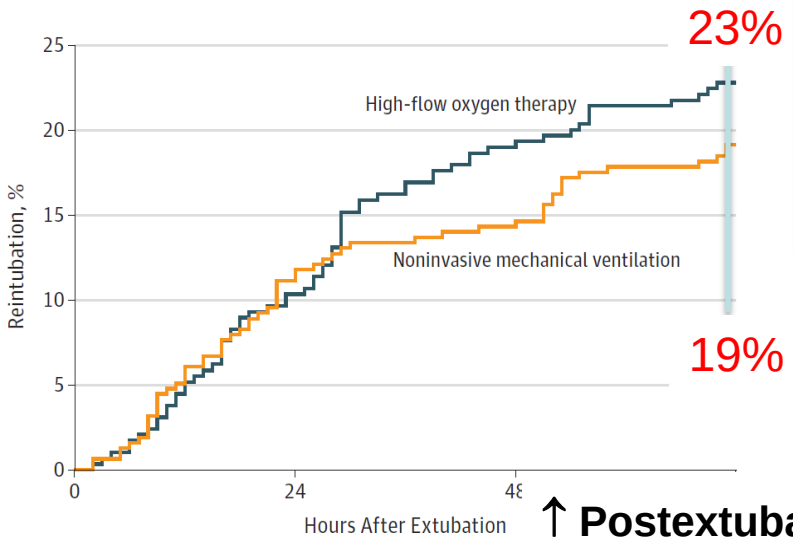
604 patientswith MV>12h:

314 NIV vs. 290 HFNT for 24h (50L/min)

High risk for post-extubation ARF:

- Age >65 years
- APACHEII >12 at extubation
- BMI >30
- Inadequate secretions management
- Difficult or prolonged weaning
- >1 comorbidity
- Heart failure or mod.-sev. COPD
- Airway patency problems
- Prolonged MV

Primary outcome: reintubation within 72 hours & post-extubation ARF (**non-inferiority**)



↑ **Postextubation ARF with NIV** (40% vs. 27%)

Similar hosp. mortality (18% vs. 20%)

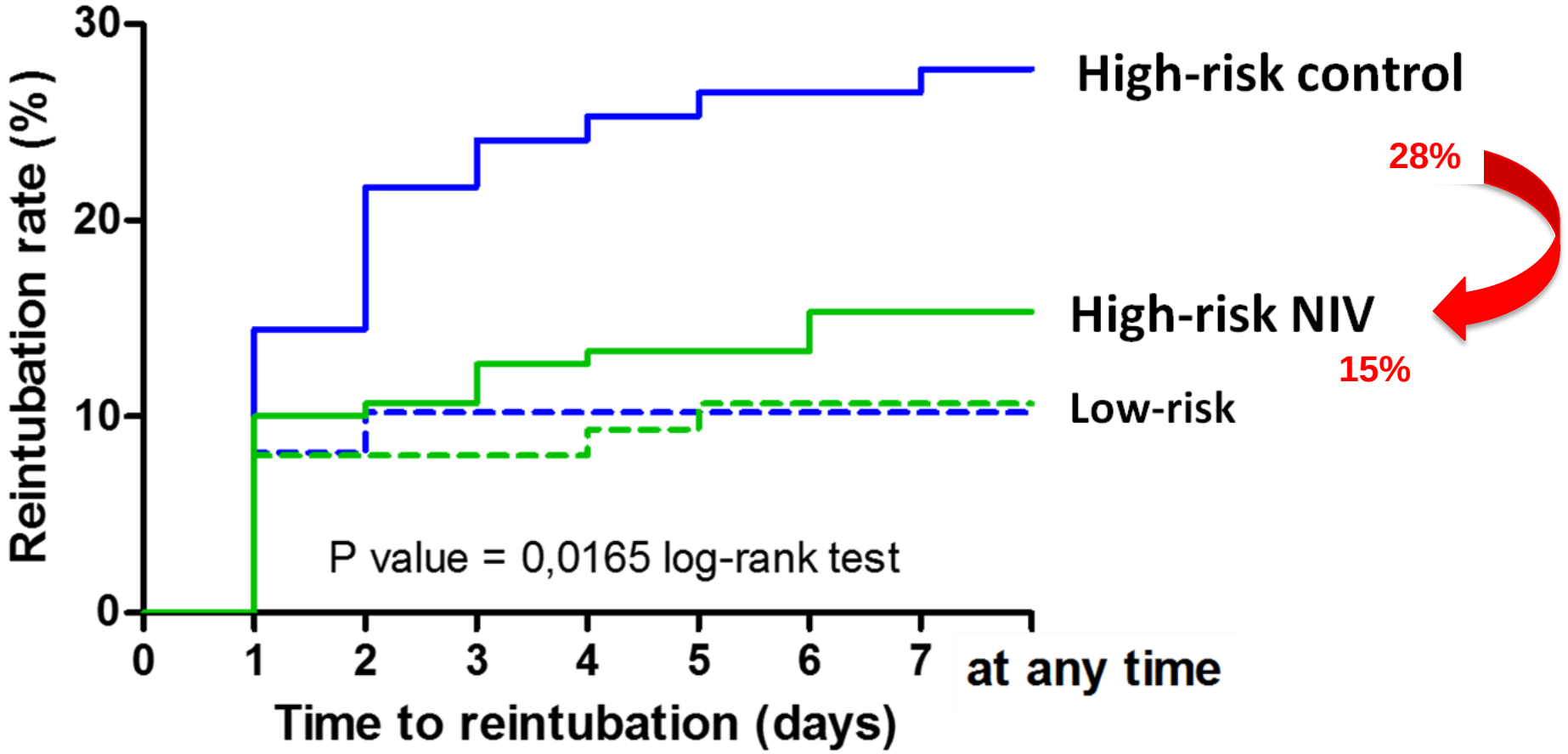
Hernandez G et al. JAMA doi:10.1001/jama.2016.14194, published online October 5, ***2016***

RESEARCH Open Access

Easily identified at-risk patients for extubation failure may benefit from noninvasive ventilation: a prospective before-after study

Arnaud W. Thille[1,2,3,4*], Florence Boissier[1,2,3,4†], Hassen Ben-Ghezala[4†], Keyvan Razazi[4], Armand Mekontso-Dessap[4], Christian Brun-Buisson[4] and Laurent Brochard[5,6]

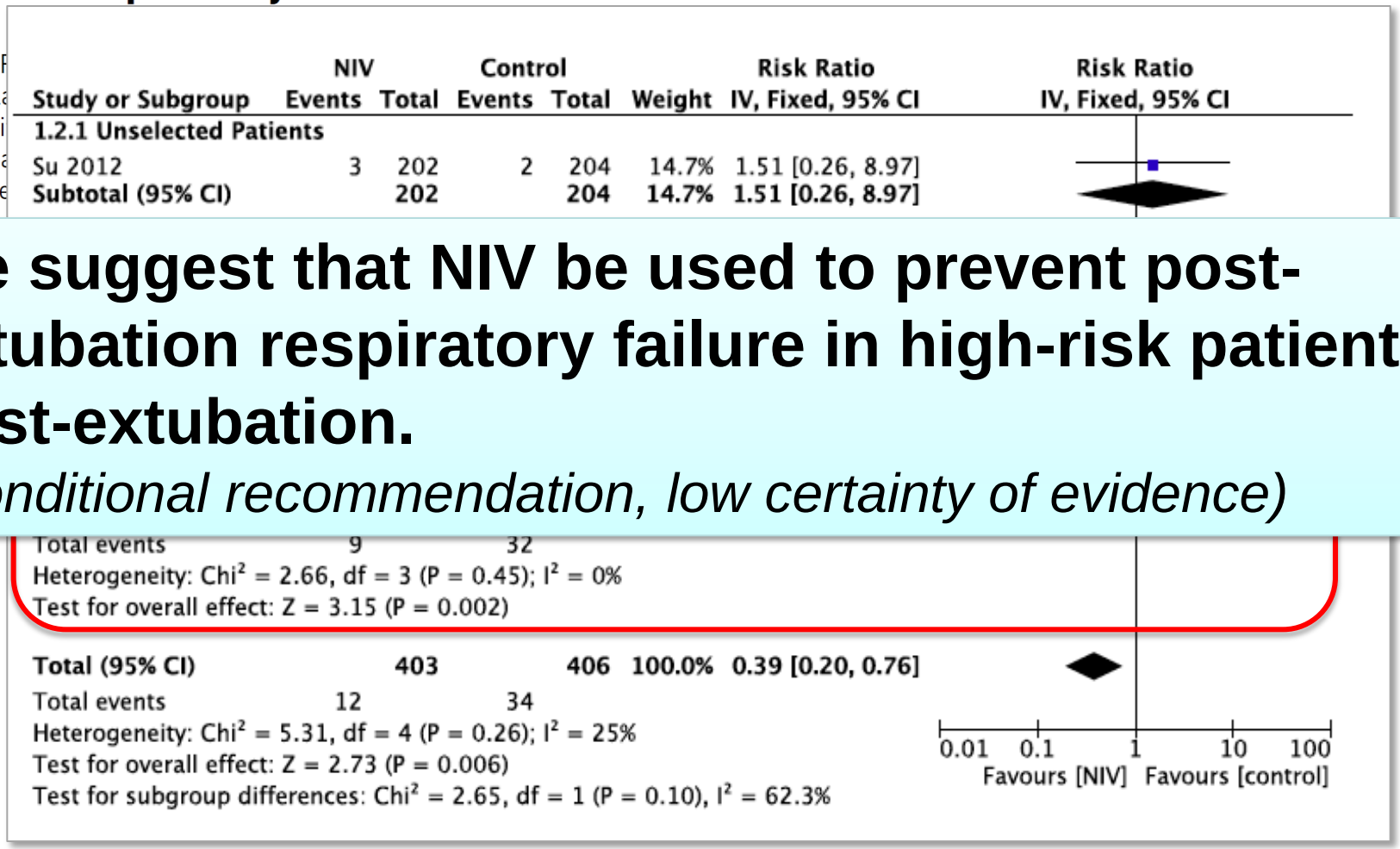
Patients with age ≥ 65y or underlying cardiac/respiratory disease



Prophylactic NIV only in patients at risk

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

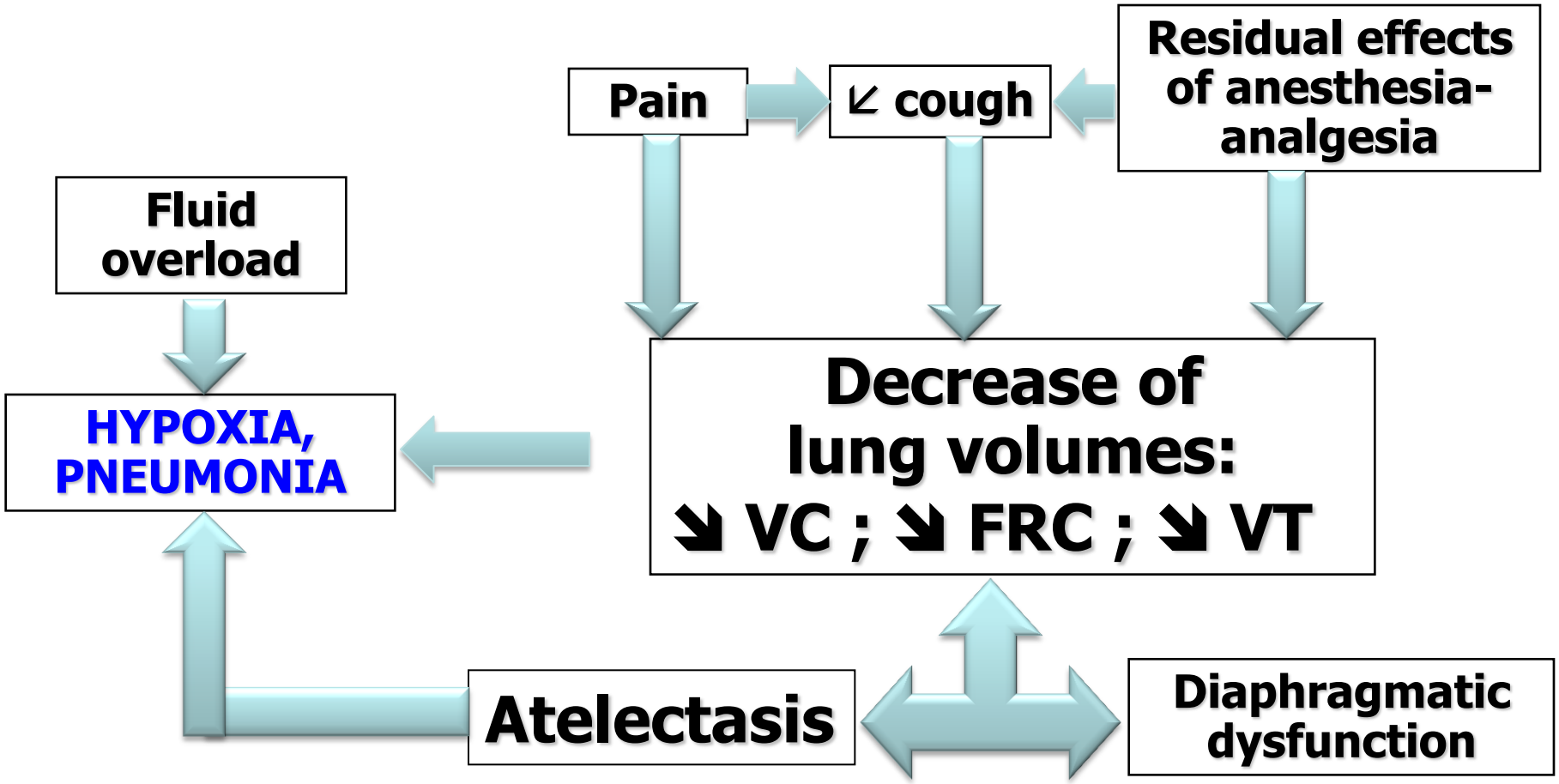
mortality



We suggest that NIV be used to prevent post-extubation respiratory failure in high-risk patients post-extubation.

(Conditional recommendation, low certainty of evidence)

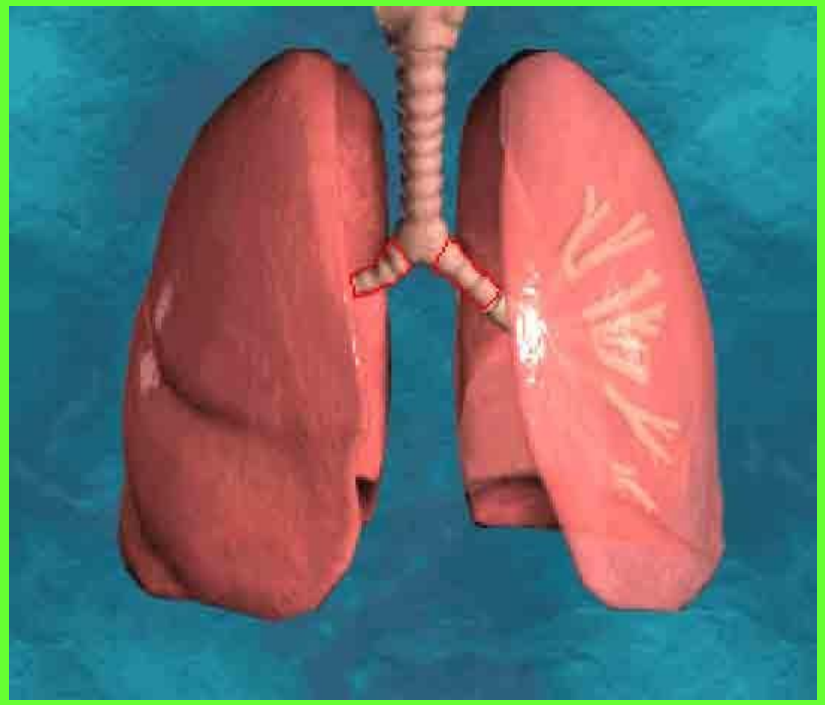
Post-operative period = Modifications of respiratory function



Warner. Anesthesiology 2000

Jaber Anesthesiology 2011

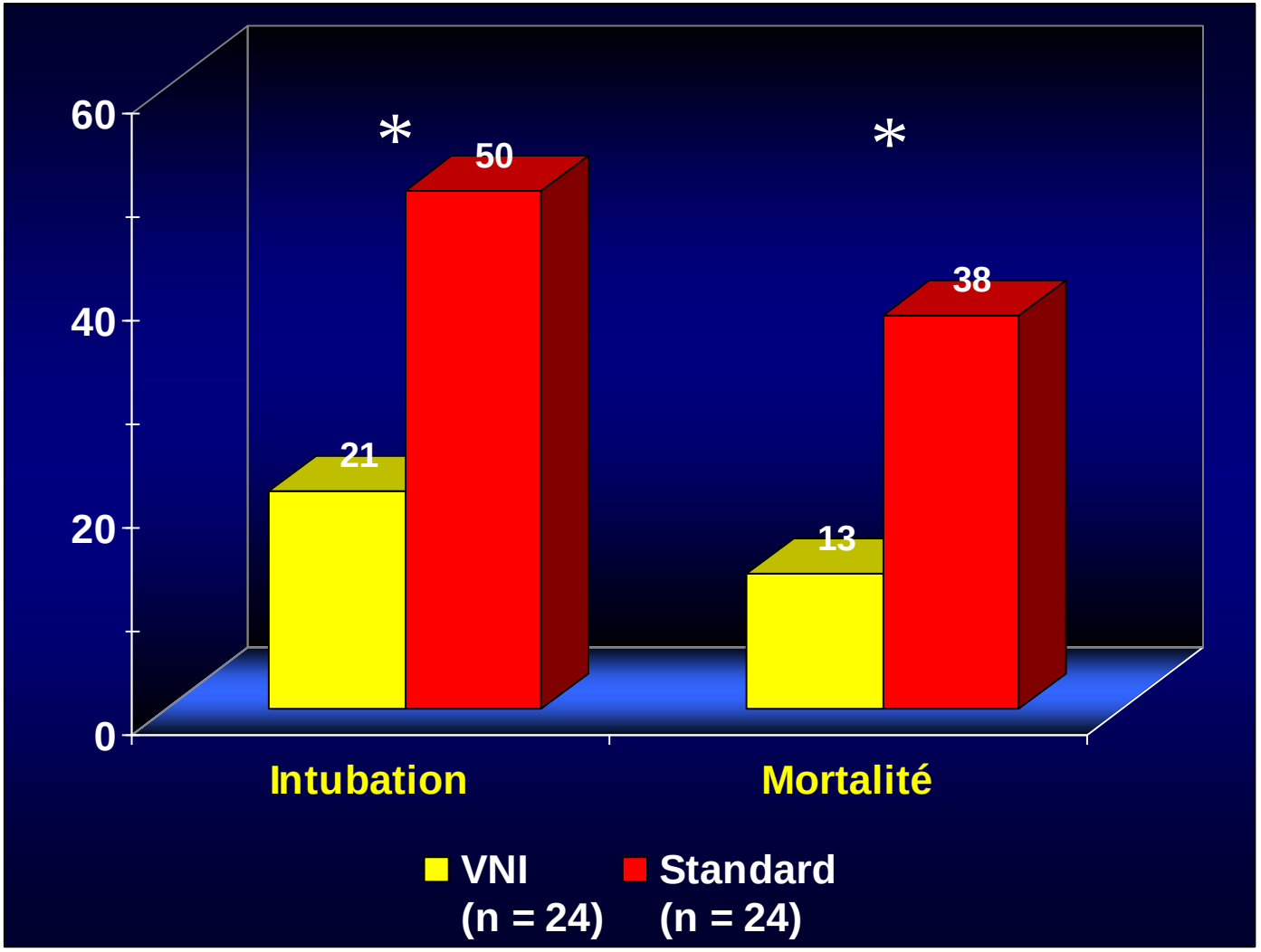
Thoracic Surgery



Noninvasive Ventilation Reduces Mortality in Acute Respiratory Failure following Lung Resection

IGOR AURIANT, ANNE JALLOT, PHILIPPE HERVÉ, JACQUES CERRINA, FRANCOIS LE ROY LADURIE, JEAN LAMET FOURNIER, BERNARD LESCOT, and FRANCOIS PARQUIN

Am J Respir Crit Care Med Vol 164. pp 1231–1235, 2001

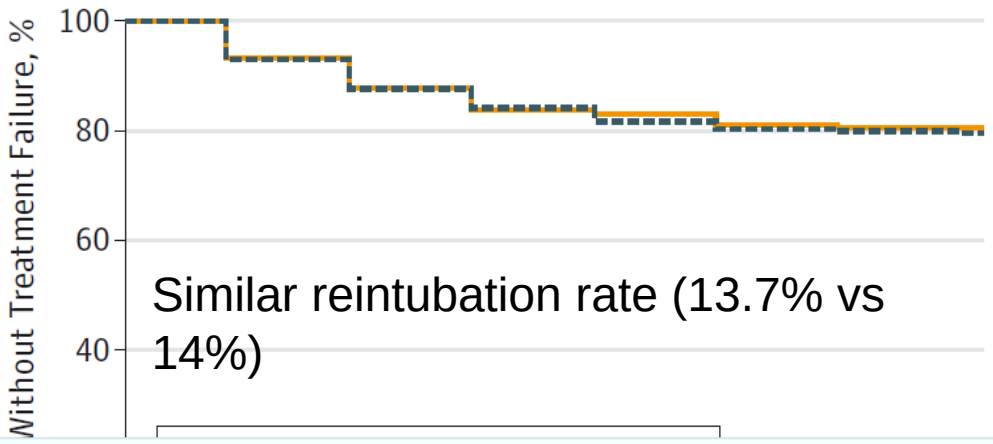


Optiflow vs NIV after cardiothoracic surgery

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

- Multicenter, randomized, noninferiority trial
- 830 pts after cardiothoracic surgery
- 1. Pts with post-extubation ARF *(curative strategy)*, or
  2. pts at risk for developing ARF *(preventive strategy)*
- HFNT (50 L/min) or NIV (i8/e4)



Post-hoc analysis

Curative strategy: similar treatment failure rate (27% vs 28%)

Preventive strategy: lower treatment failure with optiflow (6% vs 13%)

BiPAP	416	385	363	348	339	333	331	329
High-flow oxygen therapy	414	385	361	346	342	334	333	331

Stéphan F et al. JAMA 2015;313:2331-2339

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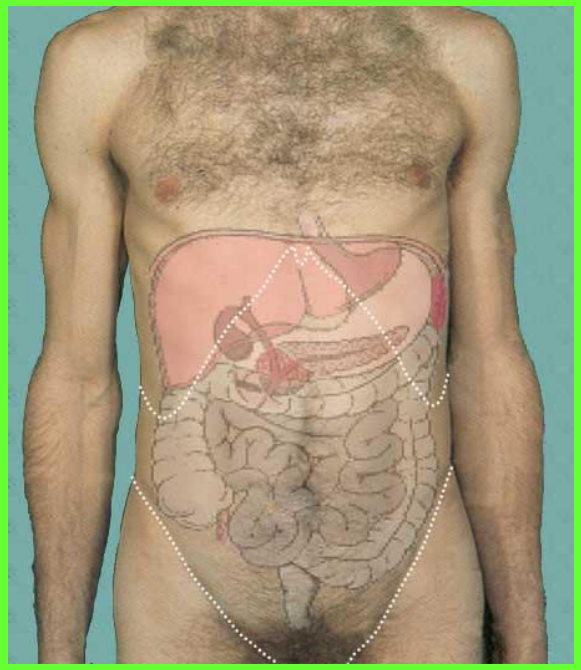
Abdominal Surgery



Oxygenation

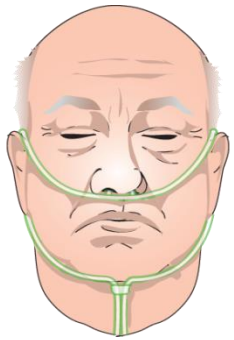
Post-Operative Ventilatory Support after abdominal surgery (RCT)

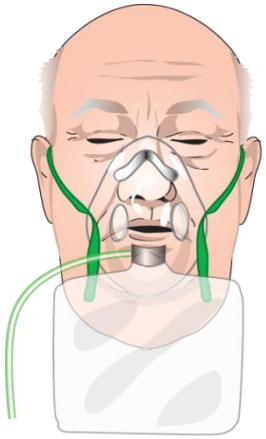
Oxygenation + ventilation

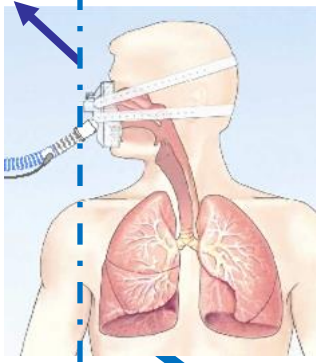
Squadrone Study JAMA 2005

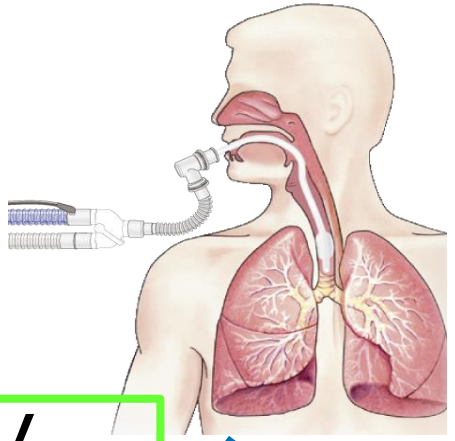
CPAP
(mask)

Intubation + Invasive ventilation









O_2 canulae
(Low flow < 5 L/min)

O_2
Mask high
Concentration
(High flow > 10 L/min)

Optiflow
(High Flow Oxygen)

NIV
(Bi-PAP)

Invasive
Ventilation
(Intubation-tube)

OPERA study
(ICM 2016 dec)

NIVAS study
(JAMA 2016 april)

OPERA study
(ICM 2016 dec**)**

Optiflow after abdominal surgery

(High Flow Oxygen)

ORIGINAL

Effect of early postextubation high-flow nasal cannula vs conventional oxygen therapy on hypoxaemia in patients after major abdominal surgery: a French multicentre randomised controlled trial (OPERA)

Emmanuel Futier[1,2], Catherine Paugam-Burtz[3], Thomas Godet[1], Linda Khoy-Ear[3], Sacha Rozencwajg[3], Jean-Marc Delay[4], Daniel Verzilli[4], Jeremie Dupuis[1], Gerald Chanques[4,6], Jean-Etienne Bazin[1], Jean-Michel Constantin[1,2], Bruno Pereira[5], Samir Jaber[4,6*] and OPERA study investigators

Intensive Care Med (2016) 42:1888–1898

To test the hypothesis that direct (preventive) application of HFNC after elective extubation, compared with standard oxygen therapy, can decrease the incidence of hypoxemia after major abdominal surgery

Study Outcomes

- **<u>Primary outcome:</u> Hypoxemia (defined as an PaO2/FiO2<300) 1 hour after extubation and at the end of allocated treatment**

- **Secondary outcomes**

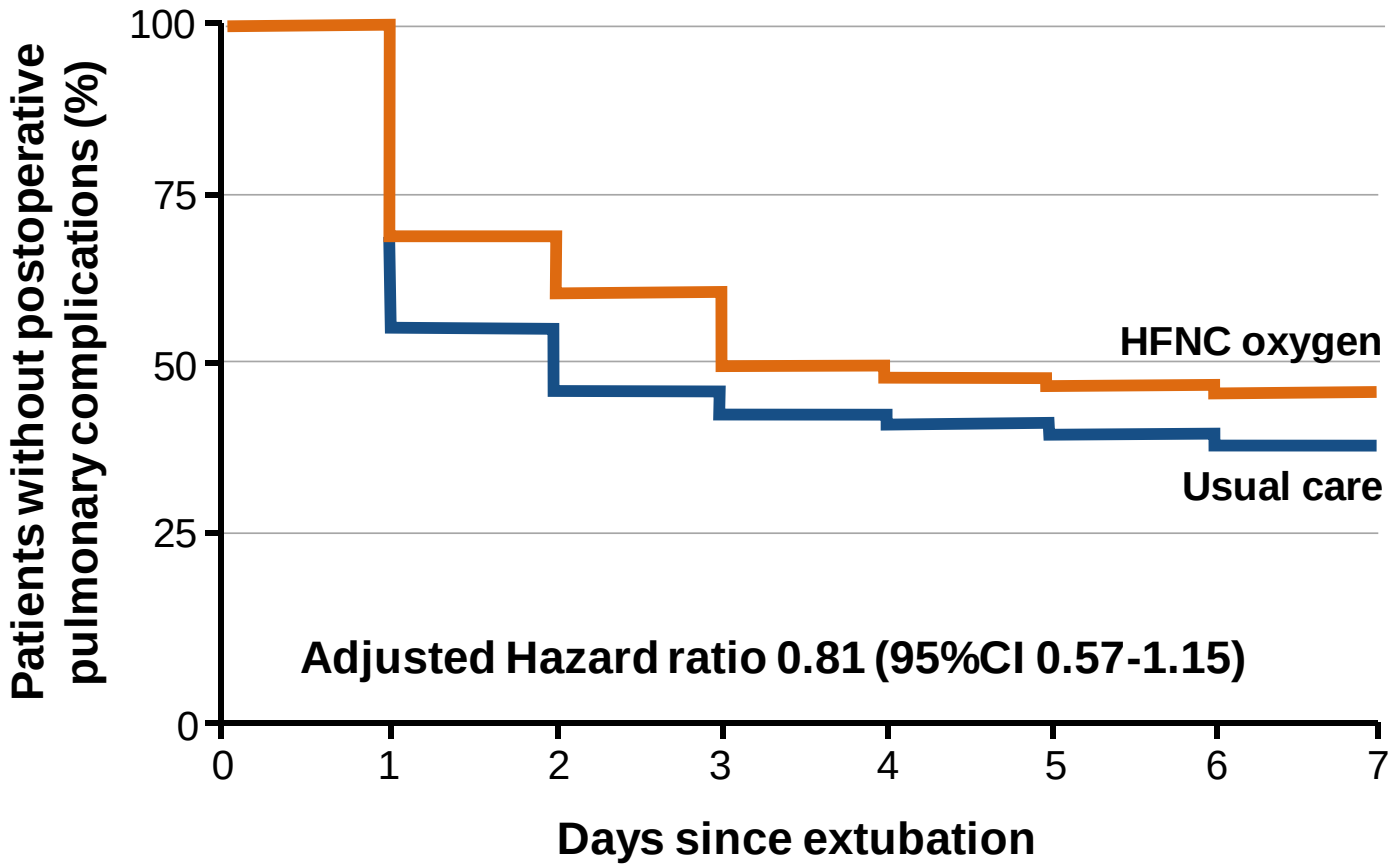
  - Postoperative pulmonary complications due to any cause
  - Need for additional oxygen therapy after day 1
  - Reintubation and/or use of curative NIV because of postoperative respiratory failure
  - Postoperative gas exchange after discontinuation of the treatment
  - Respiratory comfort
  - Unexpected intensive care unit (ICU) admission or readmission
  - ICU and hospital length of stays
  - In-hospital mortality

No Effect on Primary Outcome

	No./Total No. (%)			
	Usual care (n=112)	HFNC oxygen therapy (n=108)	Absolute risk reduction (95%CI)	p value
Postoperative hypoxemia				
1 hour after extubation	27/112 (24%)	23/108 (21%)	-3 (-14 to 8)	0.62
After discontinuation of the study treatment	34/112 (30%)	29/108 (27%)	-4 (-15 to 8)	0.57

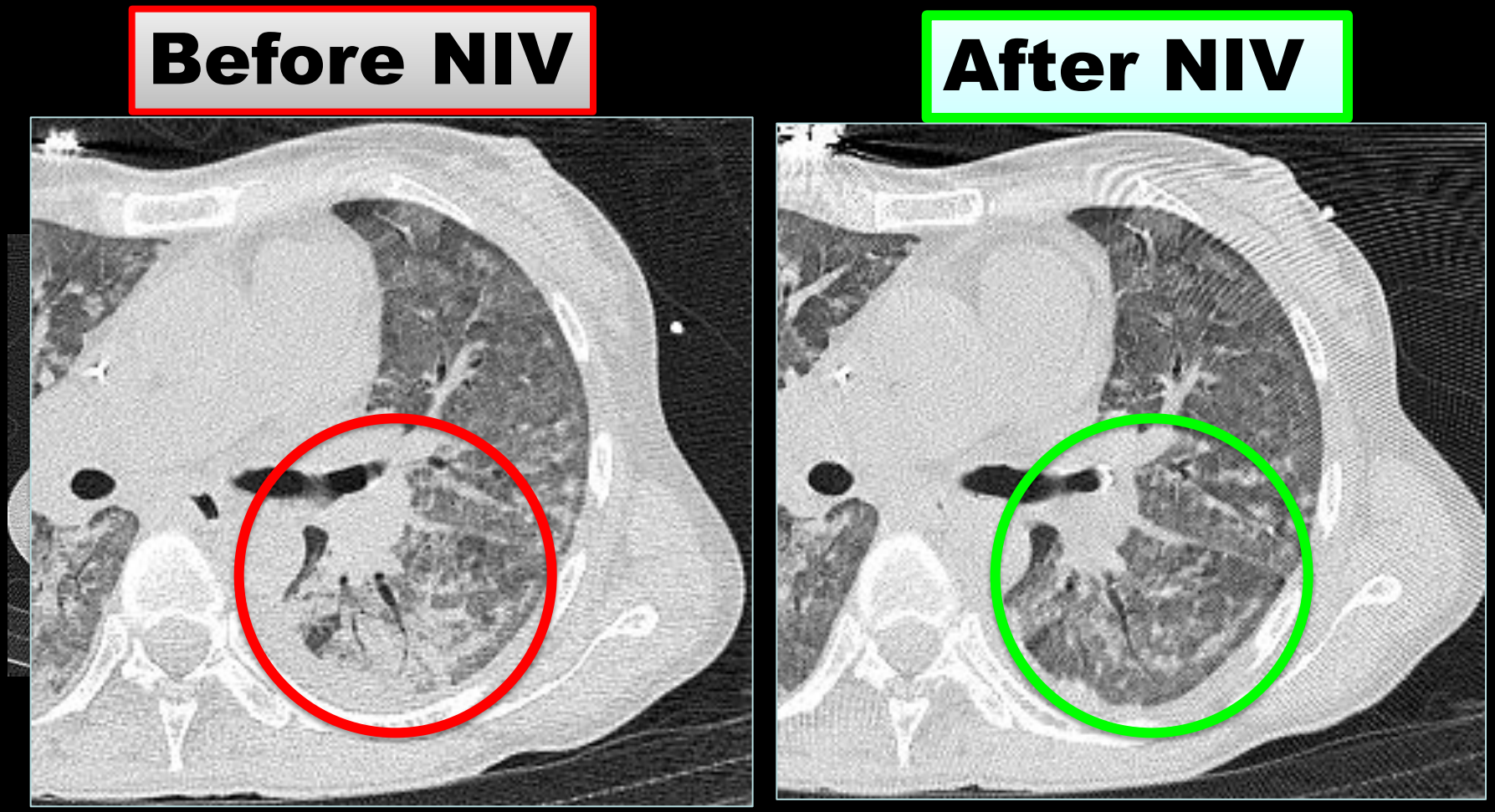
- The effect remains non significant after adjustment on baseline covariates: unadjusted relative risk [RR] 0·88, (95% CI 0·44-1·52); adjusted RR 0·87, 95% CI 0·53-1·43; p=0·58

Patients without any pulmonary complications until day 7



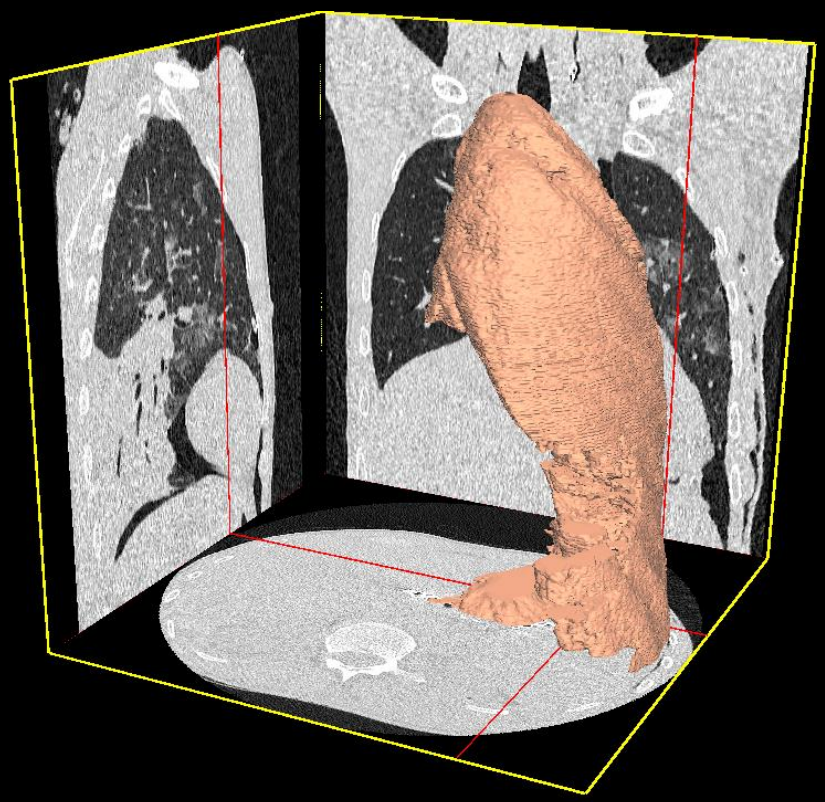
No. at risk								
Usual care	112	62	52	48	47	45	44	44
HFNC oxygen therapy	108	75	66	55	53	52	51	50

NIV effects (30 min - PSV+15; PEEP+5) on pulmonary volumes (recruitement - atelectasis) in a patient with ARDS at D3 peritonitis surgery

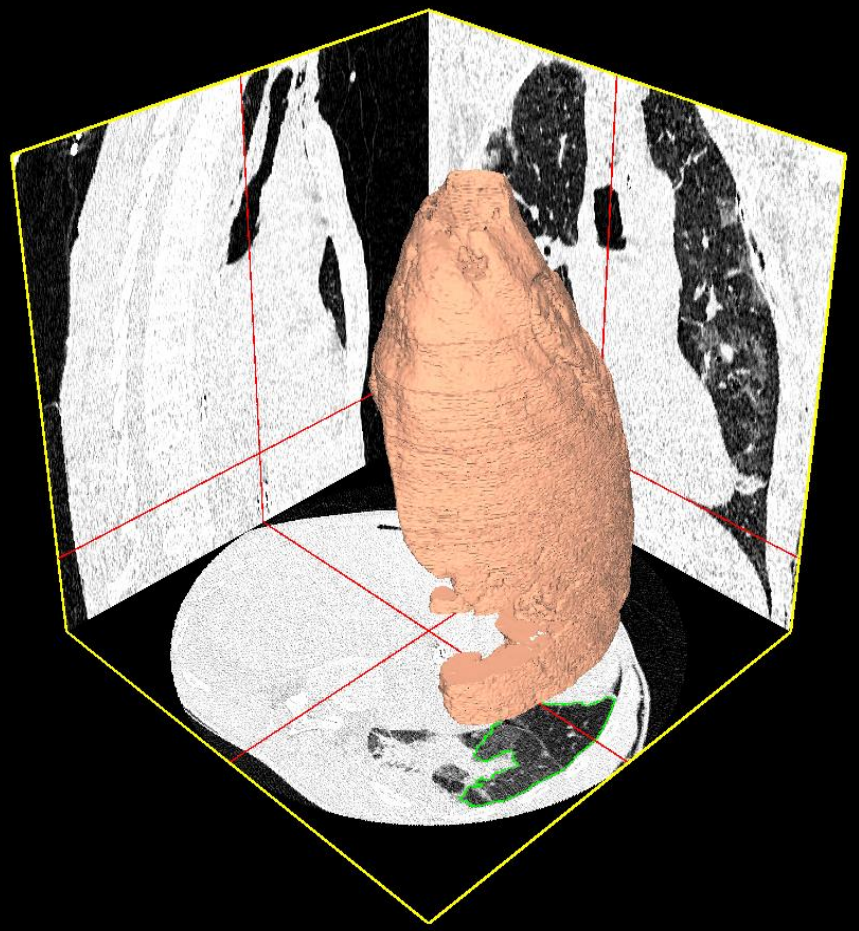


Jaber . Anesthesiology 2010

Volumetric analysis of the CT-scans



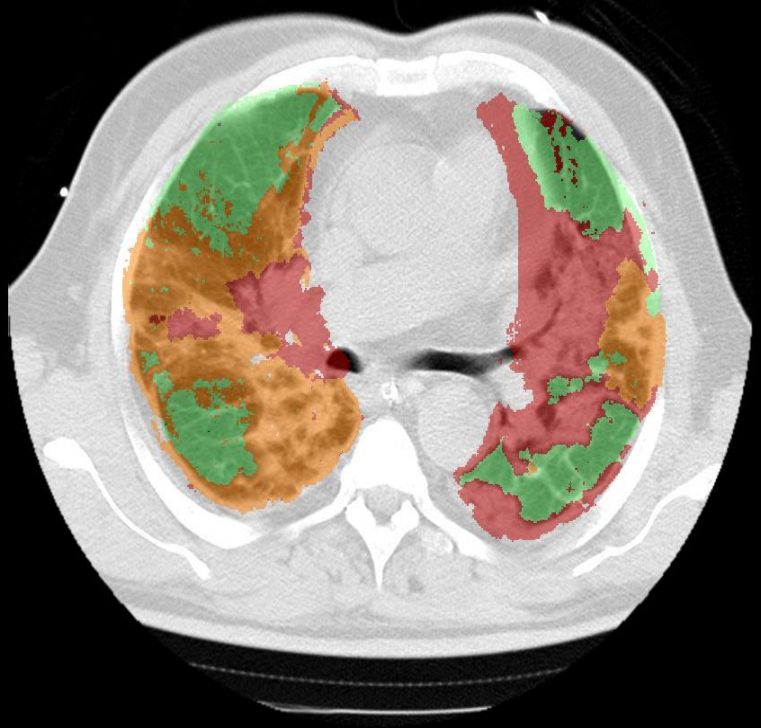
Before NIV



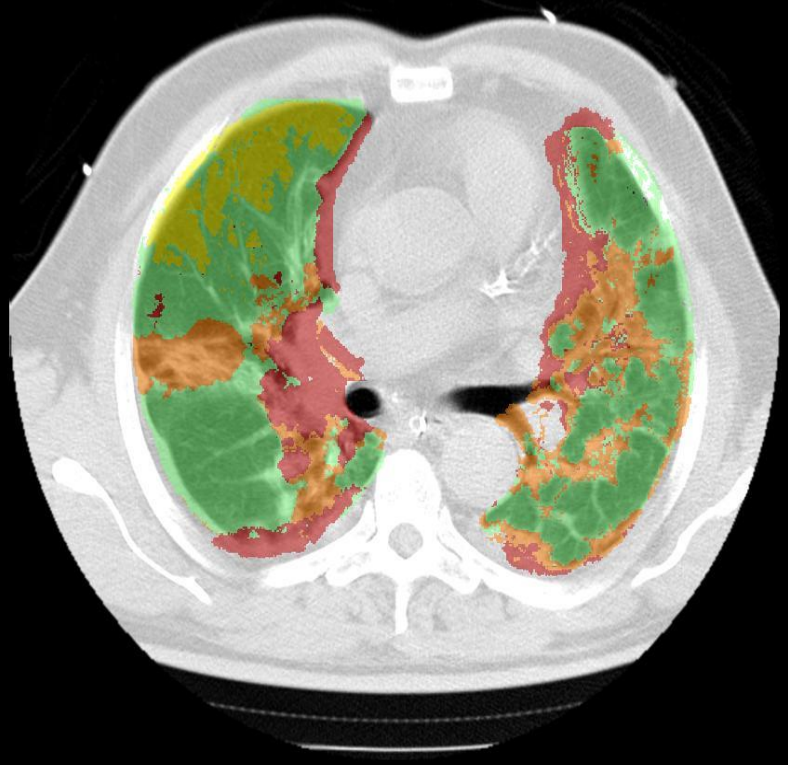
After NIV

Jaber . Anesthesiology 2010

Before NIV



After NIV



-1000 / -900 : Hyperinflated

-900 / -500 : Normally aerated

-500 / -100 : Poorly aerated

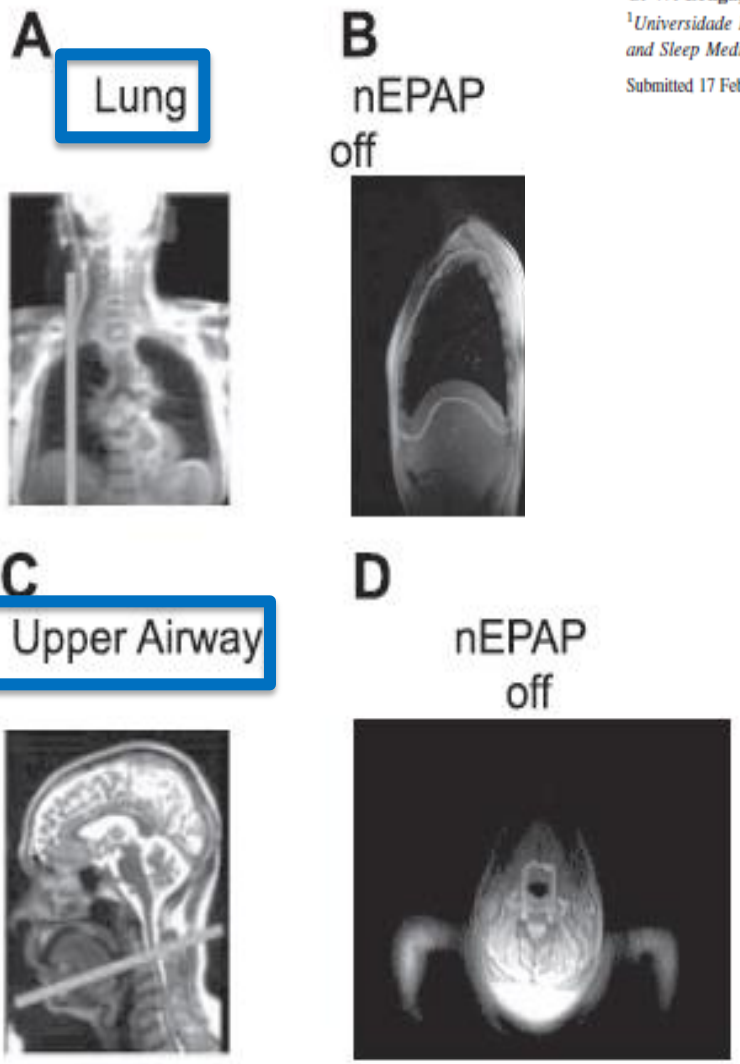
-100 / +100: Non aerated

J Appl Physiol 111: 1400–1409, 2011.
First published July 28, 2011; doi:10.1152/japplphysiol.00218.2011.

Changes in lung volume and upper airway using MRI during application of nasal expiratory positive airway pressure in patients with sleep-disordered breathing

C. W. Braga,[1] Q. Chen,[2] O. E. Burschtin,[2] D. M. Rapoport,[2] and I. Ayappa[2]
[1]*Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brasil; and* [2]*Division of Pulmonary, Critical Care, and Sleep Medicine, New York University School of Medicine, New York, New York*

Submitted 17 February 2011; accepted in final form 25 July 2011

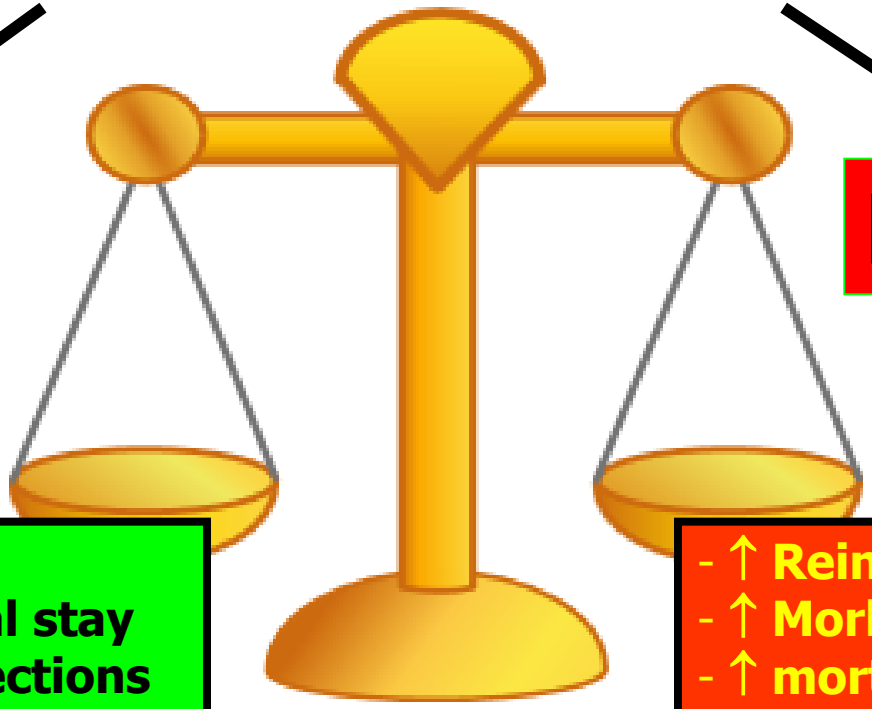


Impact of PEEP on :

1. Lung

2. Upper Airway

Post-extubation NIV in Acute Respiratory Failure (ARF)



Positive

- ↓ Reintubation
- ↓ ICU and Hospital stay
- ↓ Nosocomial Infections

Improve outcome ?

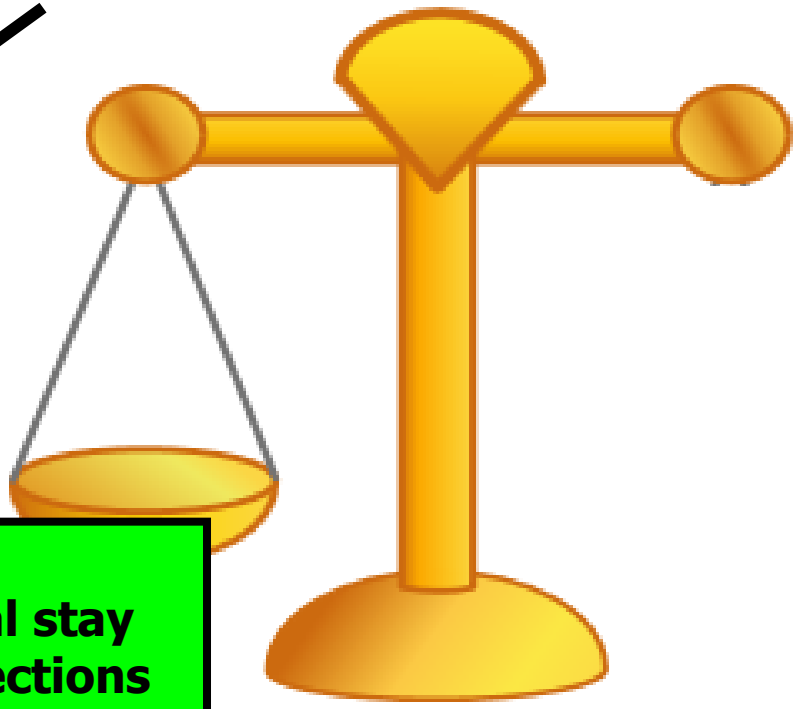
Negative

- ↑ Reintubation delay
- ↑ Morbidity ?
- ↑ mortality ?

Worsen outcome ?

Post-extubation NIV in Acute Respiratory Failure (ARF)

Positive



- ↓ **Reintubation**
- ↓ **ICU and Hospital stay**
- ↓ **Nosocomial Infections**

Improve outcome ?

Vincenzo Squadrone, MD
Massimiliano Coha, MD
Elisabetta Cerutti, MD
Maria Maddalena Schellino, MD
Piera Biolino, MD
Paolo Occella, MD
Giuseppe Belloni, MD
Giuseppe Vilianis, MD
Gilberto Fiore, MD
Franco Cavallo, MD
V. Marco Ranieri, MD

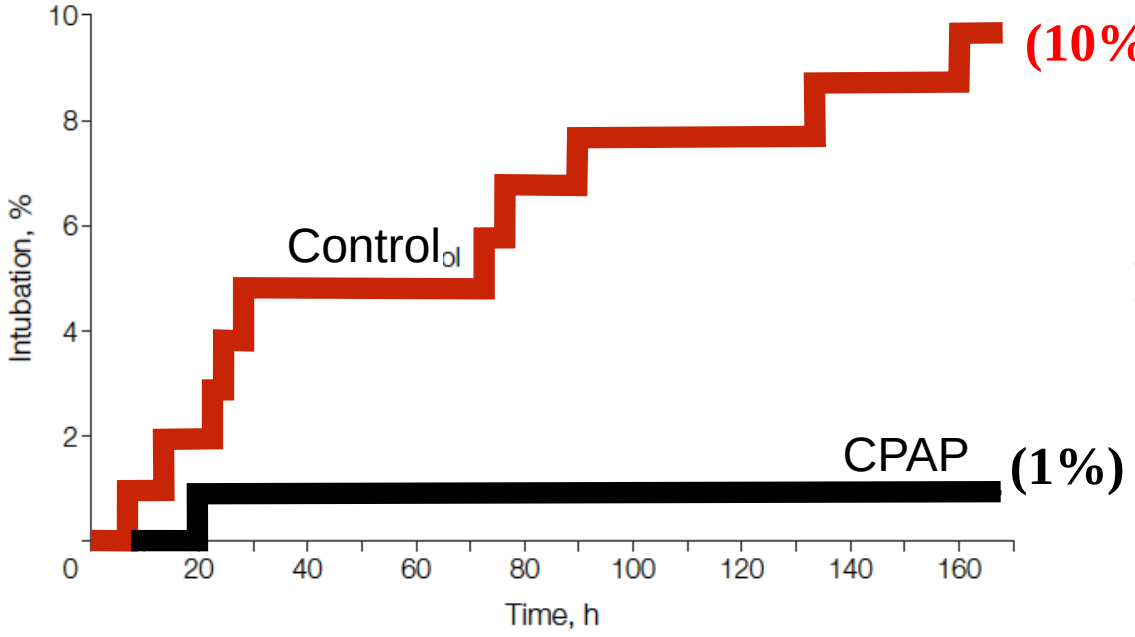
Continuous Positive Airway Pressure for Treatment of Postoperative Hypoxemia

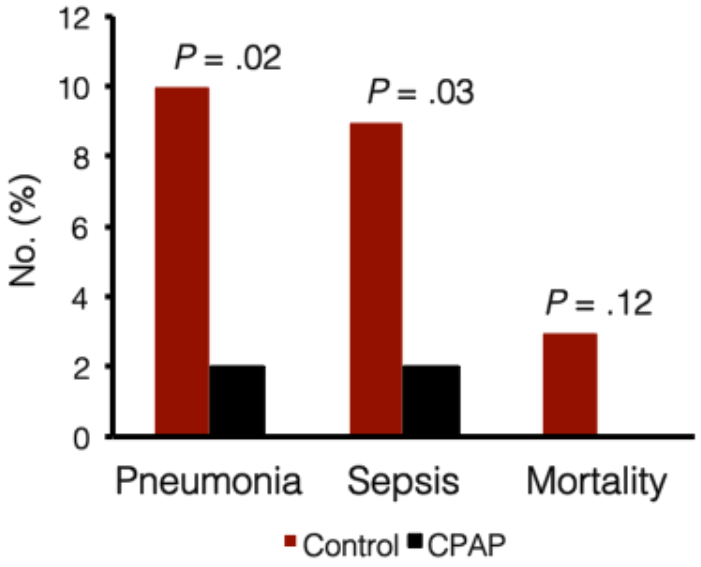
A Randomized Controlled Trial

JAMA 2005

CPAP Preventive

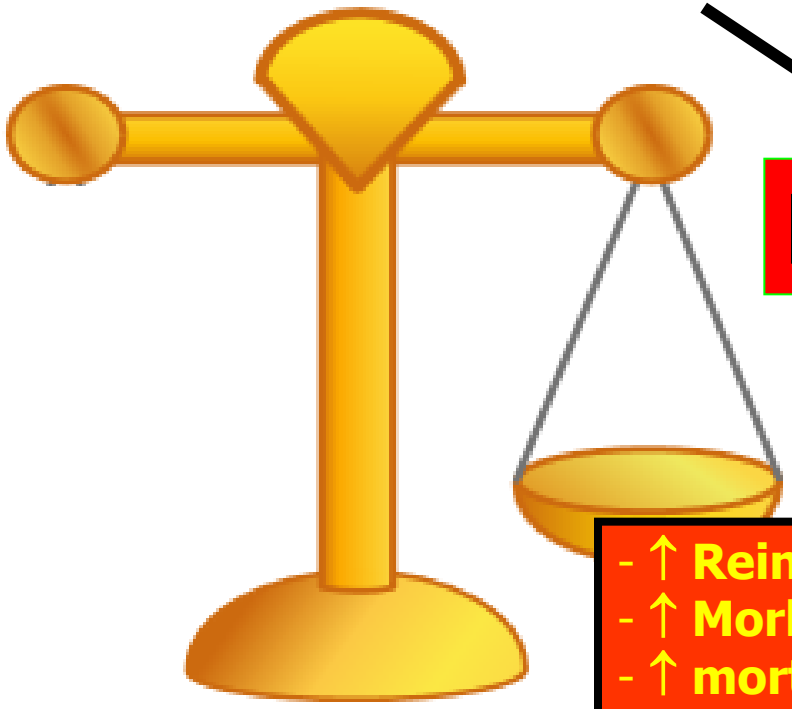
- N=209 postoperative patients with postoperative hypoxemia (= PaO_2/FiO_2<300)
- CPAP 7.5 cmH_2O for 6 hours





« Early » application of CPAP may decrease the incidence of endotracheal intubation and other severe complications in patients who develop hypoxemia after elective major abdominal surgery.

Post-extubation NIV in Acute Respiratory Failure (ARF)



Negative

- ↑ Reintubation delay
- ↑ Morbidity ?
- ↑ mortality ?

Worsen outcome ?

The NEW ENGLAND JOURNAL of MEDICINE

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.

Danger of death

In non selected mixed patients

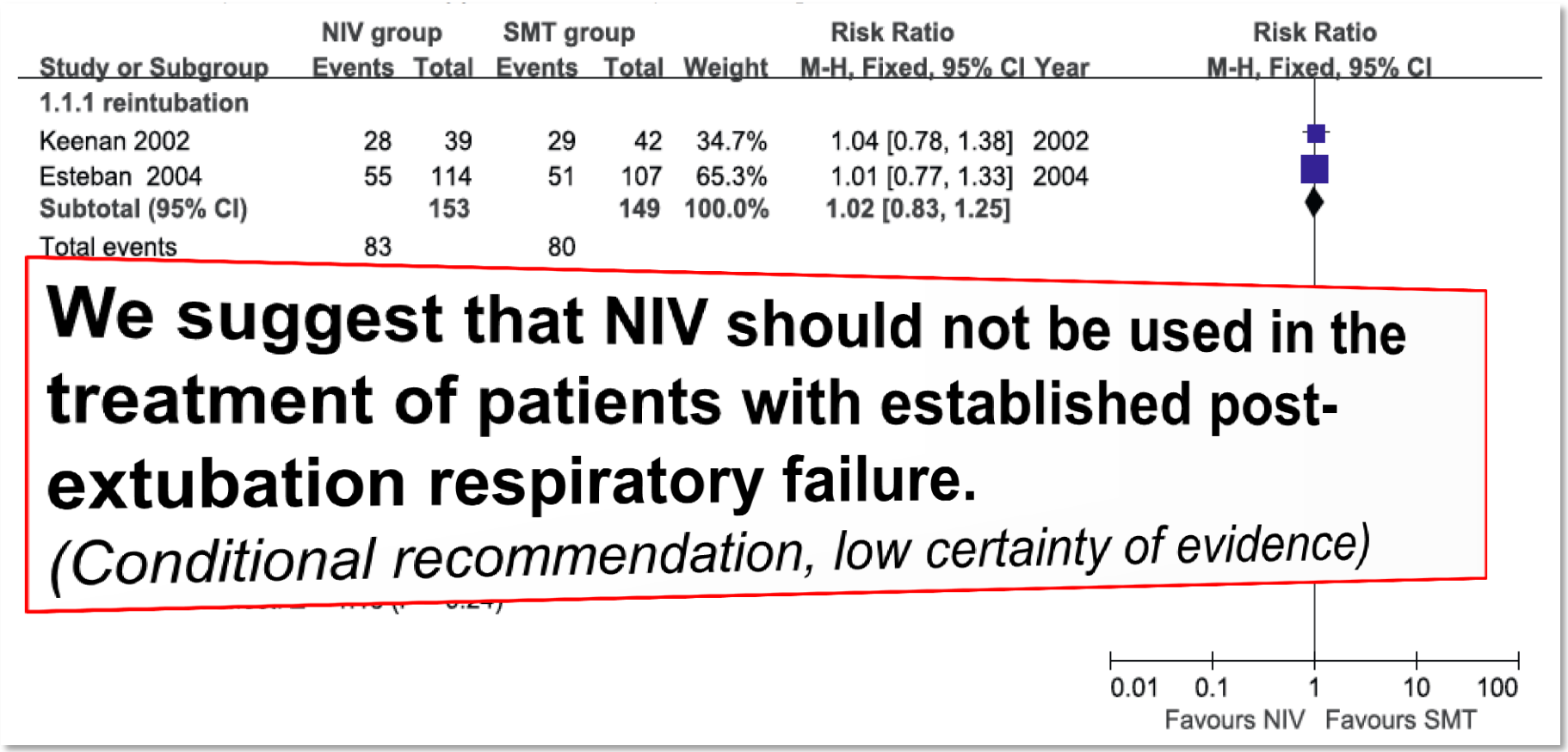
VNI (n=114)

Standard (n=107)

NIV to treat post-extubation ARF in **non selected patients**

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

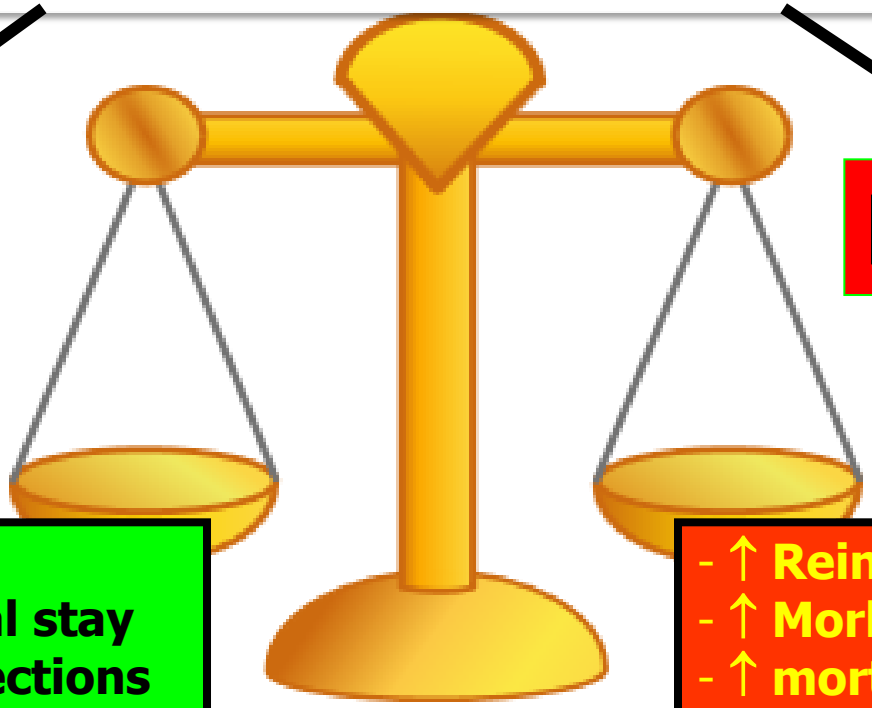
mortality



We suggest that NIV should not be used in the treatment of patients with established post-extubation respiratory failure.

(Conditional recommendation, low certainty of evidence)

Post-extubation NIV in Acute Respiratory Failure (ARF)



Positive

- ↓ Reintubation
- ↓ ICU and Hospital stay
- ↓ Nosocomial Infections

Improve outcome ?

Negative

- ↑ Reintubation delay
- ↑ Morbidity ?
- ↑ mortality ?

Worsen outcome ?

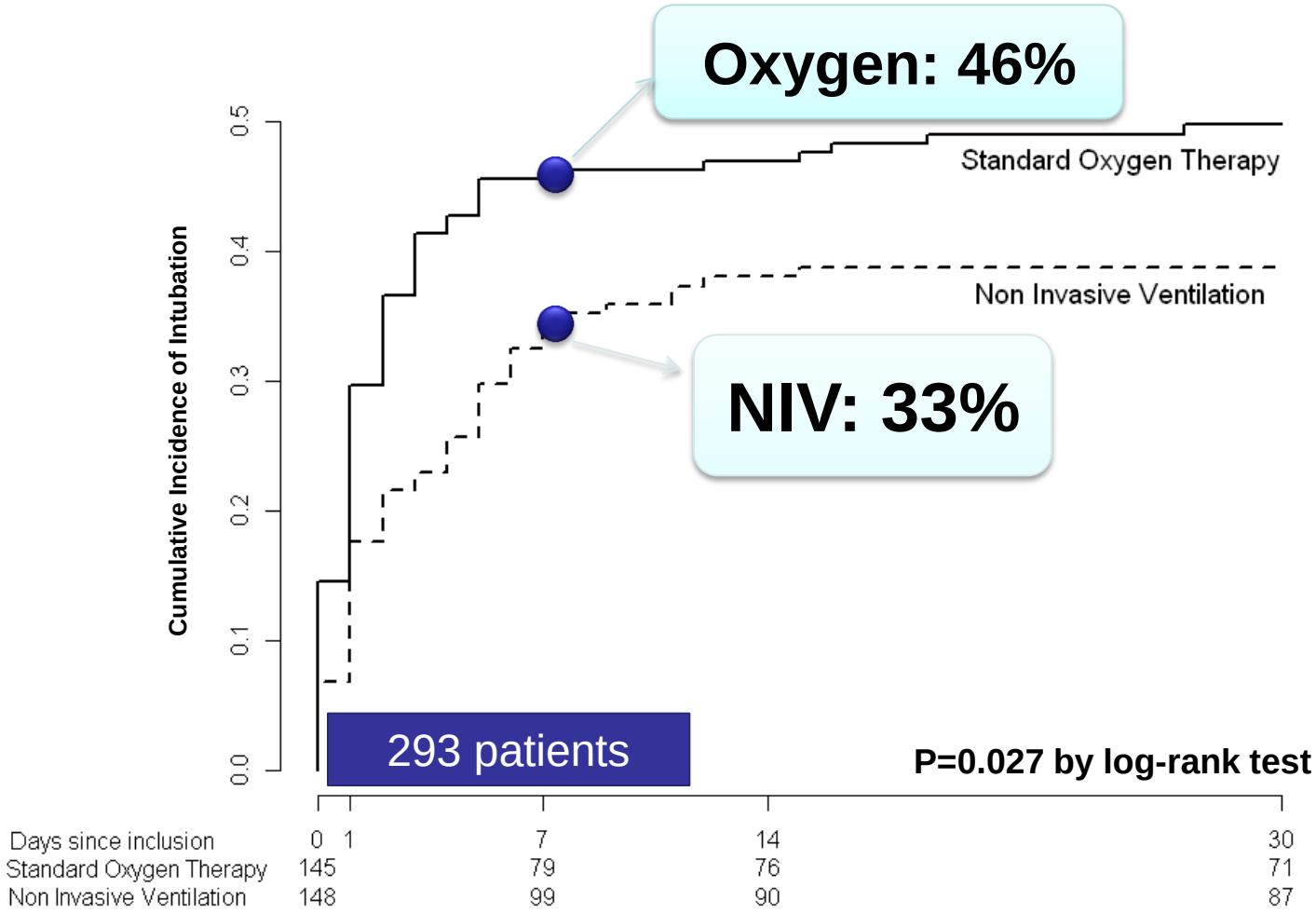
curative NIV on outcome in patients who developed ARF in postoperative period after abdominal surgery

Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

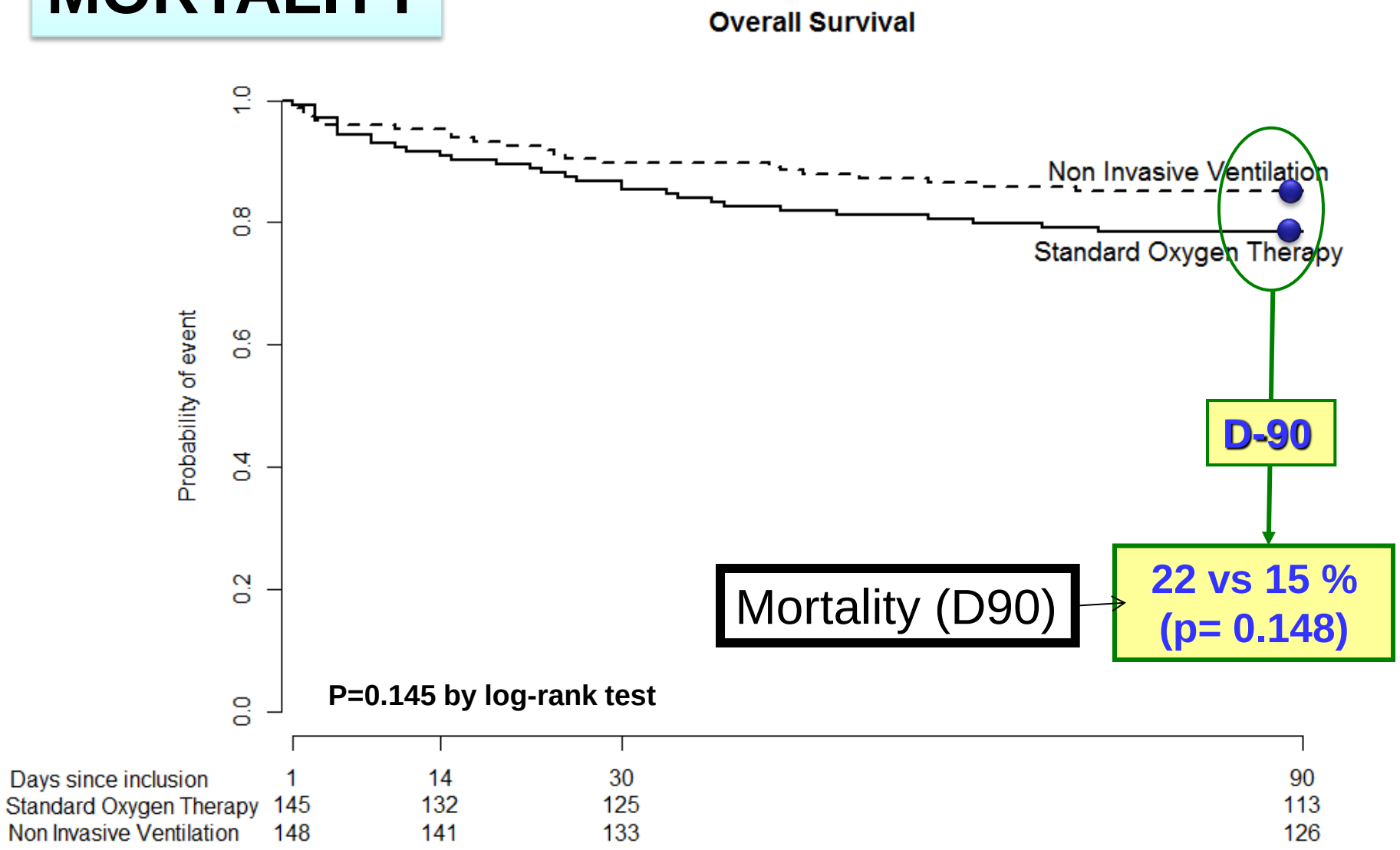
Effect of Noninvasive Ventilation on Tracheal Reintubation Among Patients With Hypoxemic Respiratory Failure Following Abdominal Surgery

A Randomized Clinical Trial

Jaber et al., JAMA 2016; 315:1345-1353.



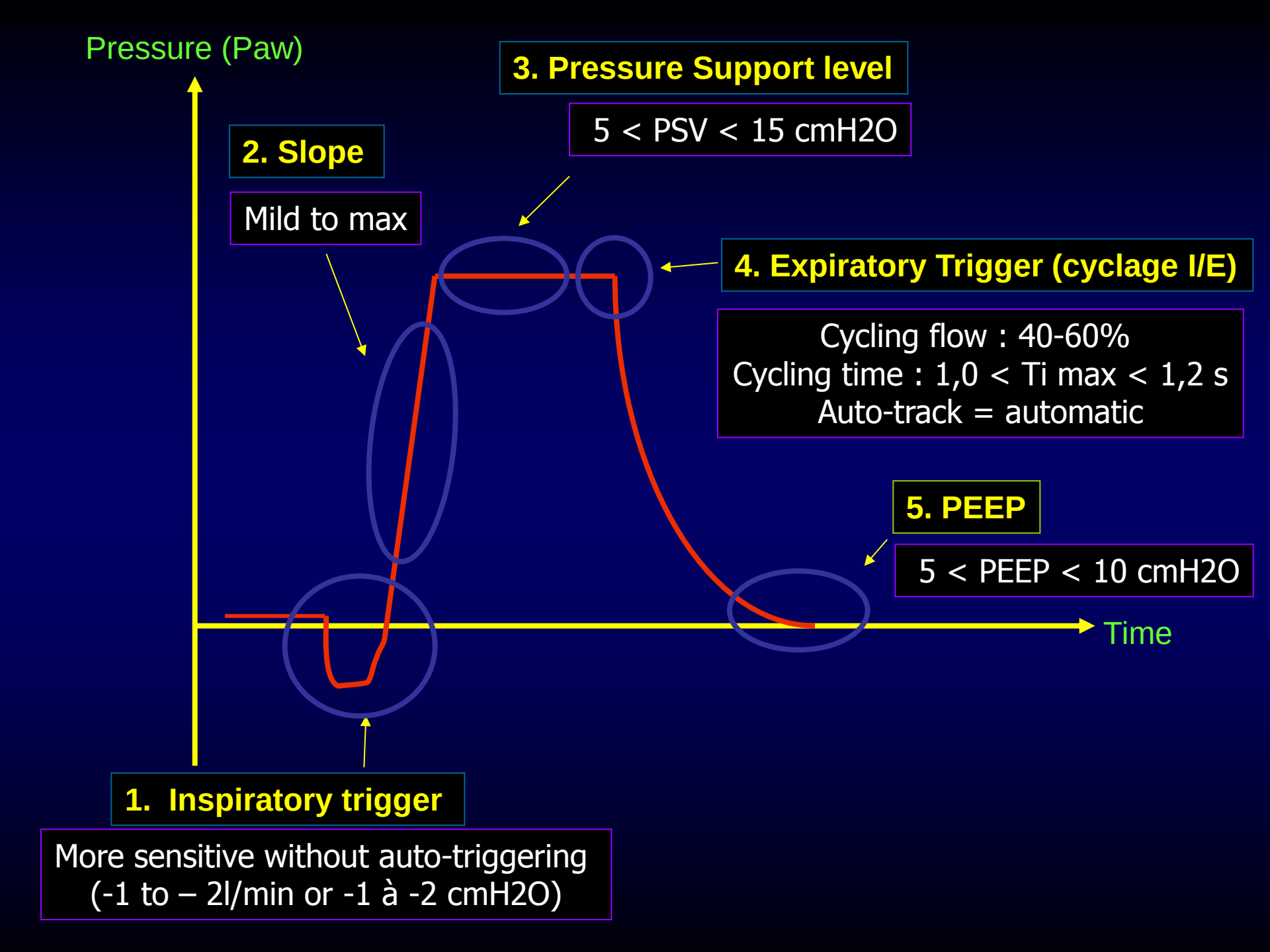
MORTALITY


Overall Survival
Probability of event
0.0
0.2
0.4
0.6
0.8
1.0
Non Invasive Ventilation
Standard Oxygen Therapy
D-90
Mortality (D90)
22 vs 15 %
(p= 0.148)
P=0.145 by log-rank test
Days since inclusion 1 14 30 90
Standard Oxygen Therapy 145 132 125 113
Non Invasive Ventilation 148 141 133 126

Ventilatory Support after extubation to prevent reintubation

1. Background : preventive and/or curative
2. Rationale for use high-flow oxygen ; CPAP and NIV after extubation

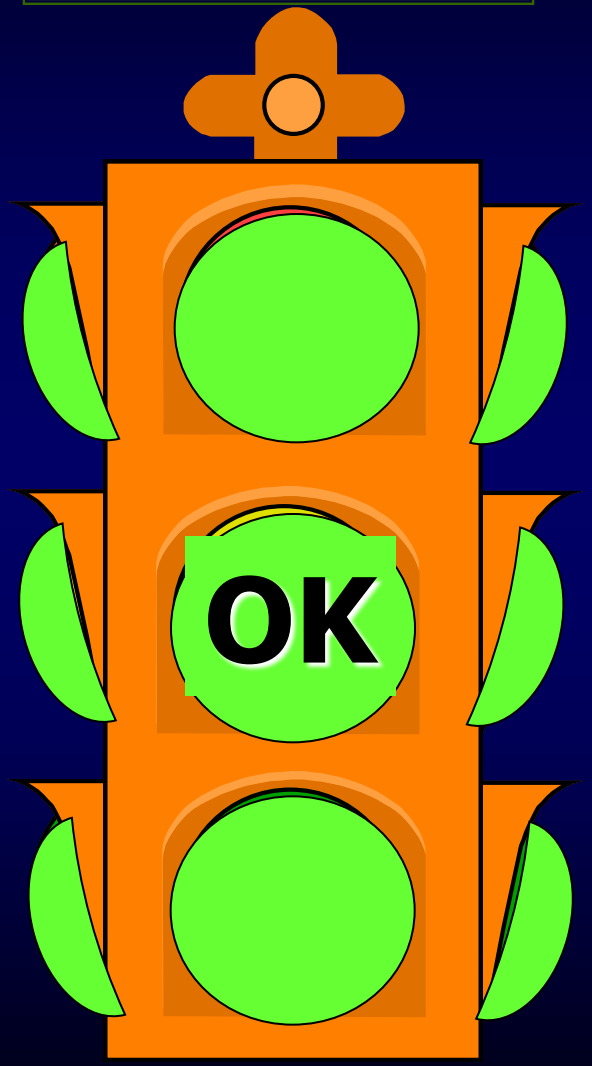
3. In non-selected patients
4. In selected post-operative patients
5. Bedside application : main optimal settings ?

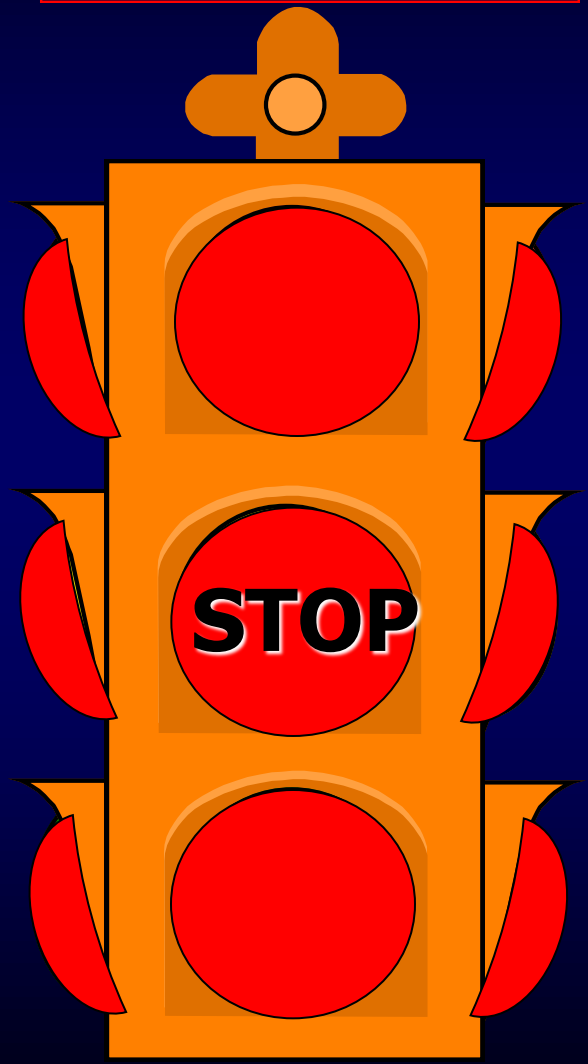

Pressure (Paw)
3. Pressure Support level
5 < PSV < 15 cmH2O
2. Slope
Mild to max
4. Expiratory Trigger (cyclage I/E)
Cycling flow : 40-60%
Cycling time : 1,0 < Ti max < 1,2 s
Auto-track = automatic
5. PEEP
5 < PEEP < 10 cmH2O
Time
1. Inspiratory trigger
More sensitive without auto-triggering
(-1 to – 2l/min or -1 à -2 cmH2O)

Clinical and gas exchange improvement

NIV ?

NO Clinical and gas exchange improvement





Take Home Message

Post-extubation: quelle technique pour quel patient

?

Ventilatory Support Management after extubation to prevent reintubation

Prophylactic

Optiflow

1) low-risk pts,
2) moderately hypoxemic pts
3) postoperative pts at risk (cardiac and thoracic surgery)

NIV

1) high-risk pts

Curative

Optiflow

1) alternative to NIV in cardio-thoracic pts
2) high-risk ICU pts

NIV

1) postoperative pts (thoracic and abdominal surgery)

Take Home Message (1/2)

1. **NIV (BIPAP)** requires **training** and motivation of all the medical teams (surgeons and others) and paramedical teams (nurses,kine, physiotherapists…)

2. **CPAP** more easy to use and could be first-line therapy to prevent and/or treat "hyopxemia"

3. **Optiflow** could be proposed
   - As first-line therapy to prevent and/or treat "hyopxemia"
   - As an alternative to CPAP/BIPAP in selected patients
   - Studies are needed ?

Take Home Message (2/2)

- **Post-operative ARF = always eliminate a surgical complication**

- Optiflow and/or NIV should not delay "the time of reintubation"