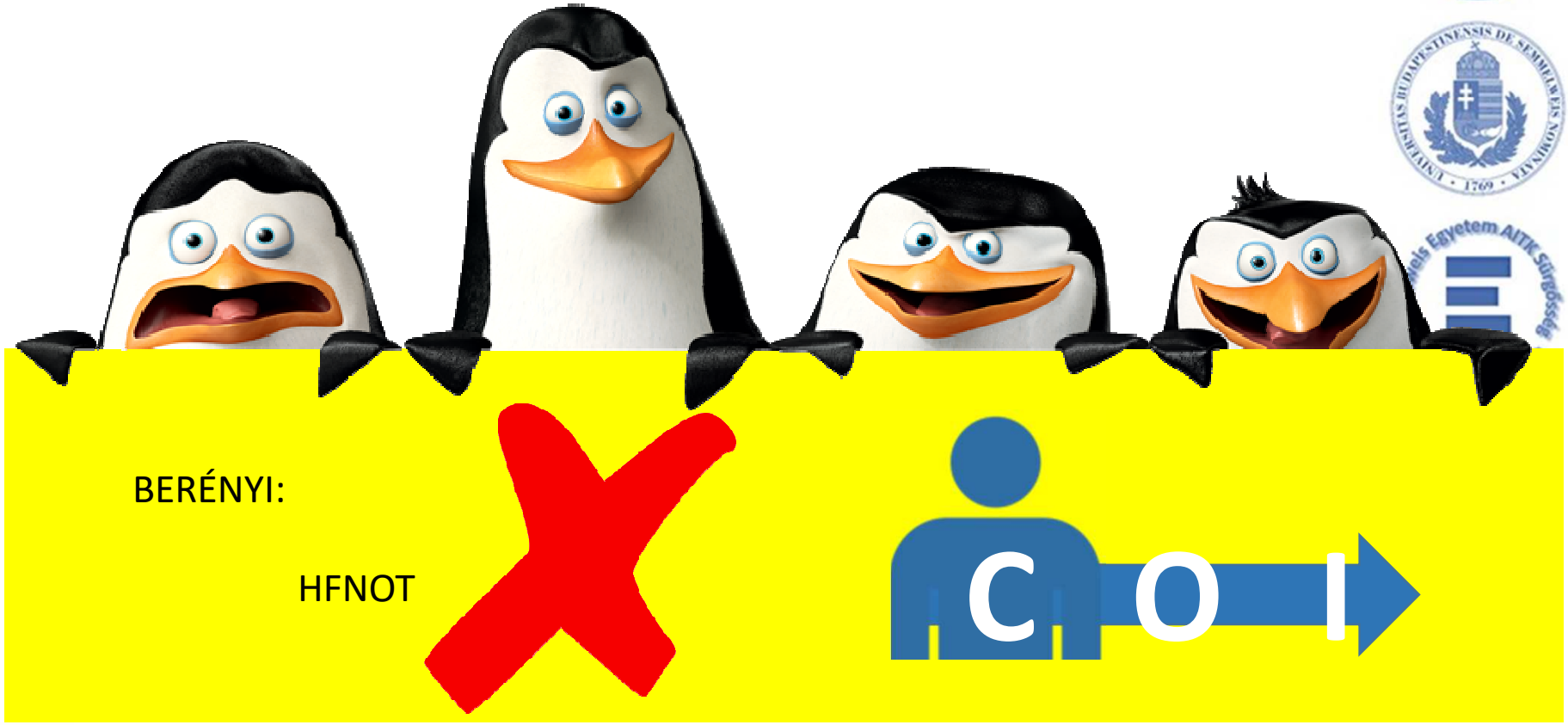
HFNO (HIGH-FLOW NASAL OXYGEN) TERÁPIA LEHETŐSÉGEI A SÜRGŐSSÉGI ELLÁTÁSBAN

BERÉNYI TAMÁS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Journal of Free Radicals in Biology & Medicine, Vol. 2, pp. 289–293, 1986
Printed in the USA. All rights reserved.

0748-5514/86 $3.00 + .00

PREVENTION OF OXYGEN TOXICITY WITH SUPEROXIDE DISMUTASE AND CATALASE IN PREMATURE LAMBS

FRANS J. WALTHER,* CORRIE E. M. GIDDING,* IRENE M. KUIPERS,* DIRK WILLEBRAND,†
EDOUARD M. BEVERS,‡ ABRAHAM ABUCHOWSKI,§ and ANNA T. VIAU§
Departments of Pediatrics,* Pathology,† and Biochemistry,‡ University of Limburg, Maastricht, The Netherlands, and §ENZON, Inc., South Plainfield, New Jersey, USA

(Received 27 October 1986)

Journal of Free Radicals in Biology & Medicine, Vol. 2, pp. 295–298, 1986

MSOTKE

ENDOGENOUS ANTIOXIDANT DEFENSES IN NEONATES

WARREN ROSENFELD* and LUZMINDA CONCEPCION
Department of Pediatrics and Neonatology, Interfaith Medical Center, 1545 Atlantic Avenue, Brooklyn, NY 11213, USA

(Received 27 October 1986)

0748-5514/86 $3.00+

O_2 OXY THERAPY

Stroke July 2017

Multiparametric Model for Penumbral Flow Prediction in Acute Stroke

Michelle Livne, MSc; Tabea Kossen, BSc; Vince I. Madai, MD; Olivier Zaro-Weber, MD; [illegible]tmann, MD; Kim Mouridsen, PhD; Wolf-Dieter Heiss, MD; Jan Sobesky, MD

THE AMERICAN JOURNAL of MEDICINE®

SPECIAL ARTICLE

AMERICAN ACADEMY OF NEUROLOGY

Practice guideline summary: Reducing brain injury following cardiopulmonary resuscitation

Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology

Neurology® 2017;88:2141-2149

REVIEW

Oxygen Therapy for Acute Myocardial Infarction—Then and Now. A Century of Uncertainty

Richard Kones, MD, FAHA, FESC
Cardiometabolic Research Institute, Houston, Tex.

SCIENCE, MEDICINE, AND THE ANESTHESIOLOGIST

Key Papers from the Most Recent Literature Relevant to Anesthesiologists

ANESTHESIOLOGY

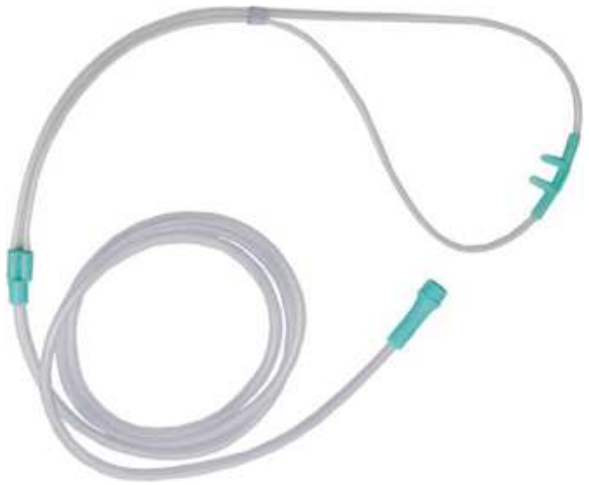
Jean Mantz, M.D., Ph.D., Editor†

The AVOID Study: Air vs. Oxygen in ST-Elevation Myocardial Infarction

End Point: Hospital Discharge	Oxygen (%)	No oxygen (%)	p
Mortality	1.8	4.5	0.11
Recurrent MI	5.5	0.9	<.01
Stroke	1.4	0.4	0.30
Major bleeding	4.1	2.7	0.41
Significant arrhythmia	40.4	31.4	0.05
6 months			
Mortality	3.8	5.9	0.32
Recurrent MI	7.6	3.6	0.07
Stroke	2.4	1.4	0.43
Repeat revascularization	11.0	7.2	0.17

Conclusion: Supplemental oxygen therapy in patients with STEMI but without hypoxia increased myocardial injury, recurrent myocardial infarction, and major cardiac arrhythmia, and was associated with larger myocardial infarct size assessed at six months.

Source: Stub D, Smith K, et al. A Randomized Controlled Trial of Oxygen Therapy in Acute ST-Segment Elevation Myocardial Infarction: The Air Versus Oxygen in Myocardial Infarction (AVOID) study. American Heart Association Scientific Sessions 2014; Nov. 19, 2014; Chicago.



FiO_2

1-6 l/min 24-40%

6-10 l/min 35-50%

< 8 l/min

12 10 8 6 4 2l/min

50% 40% 35% 31% 28% 24%

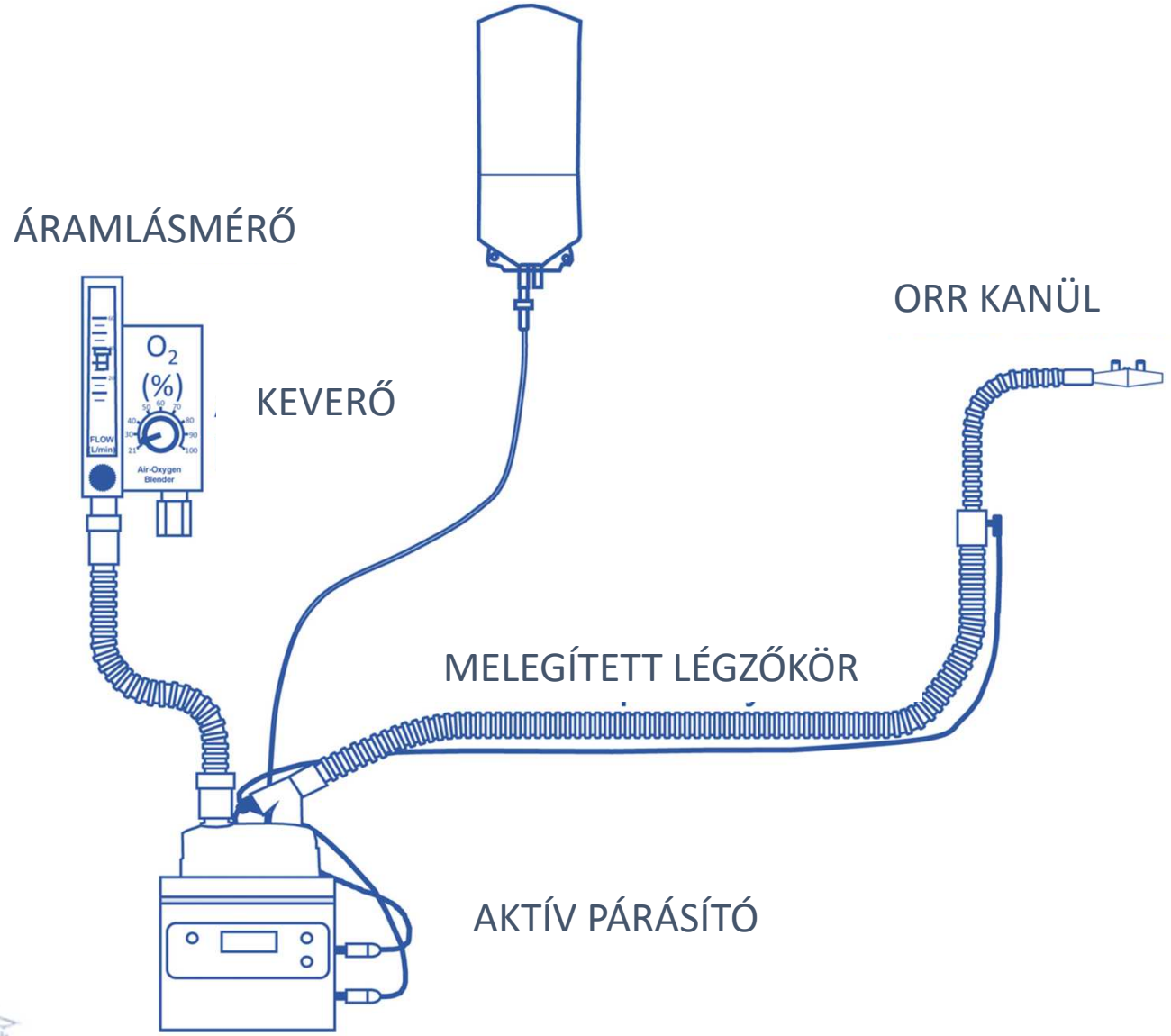
FiO_2

12-15 l/min

80-100%

LOW FLOW SYSTEM

HIGH FLOW SYSTEM


ÁRAMLÁSMÉRŐ
KEVERŐ
ORR KANÜL
MELEGÍTETT LÉGZŐKÖR
AKTÍV PÁRÁSÍTÓ
O_2
(%)
FLOW
L/min
Air-Oxygen
Blender

Respiratory Medicine (2009) 103, 1400–1405

available at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/rmed

REVIEW

Research in high flow therapy: Mechanisms of action

Kevin Dysart [a,b,c,*], Thomas L. Miller [a,d], Marla R. Wolfson [e,f],

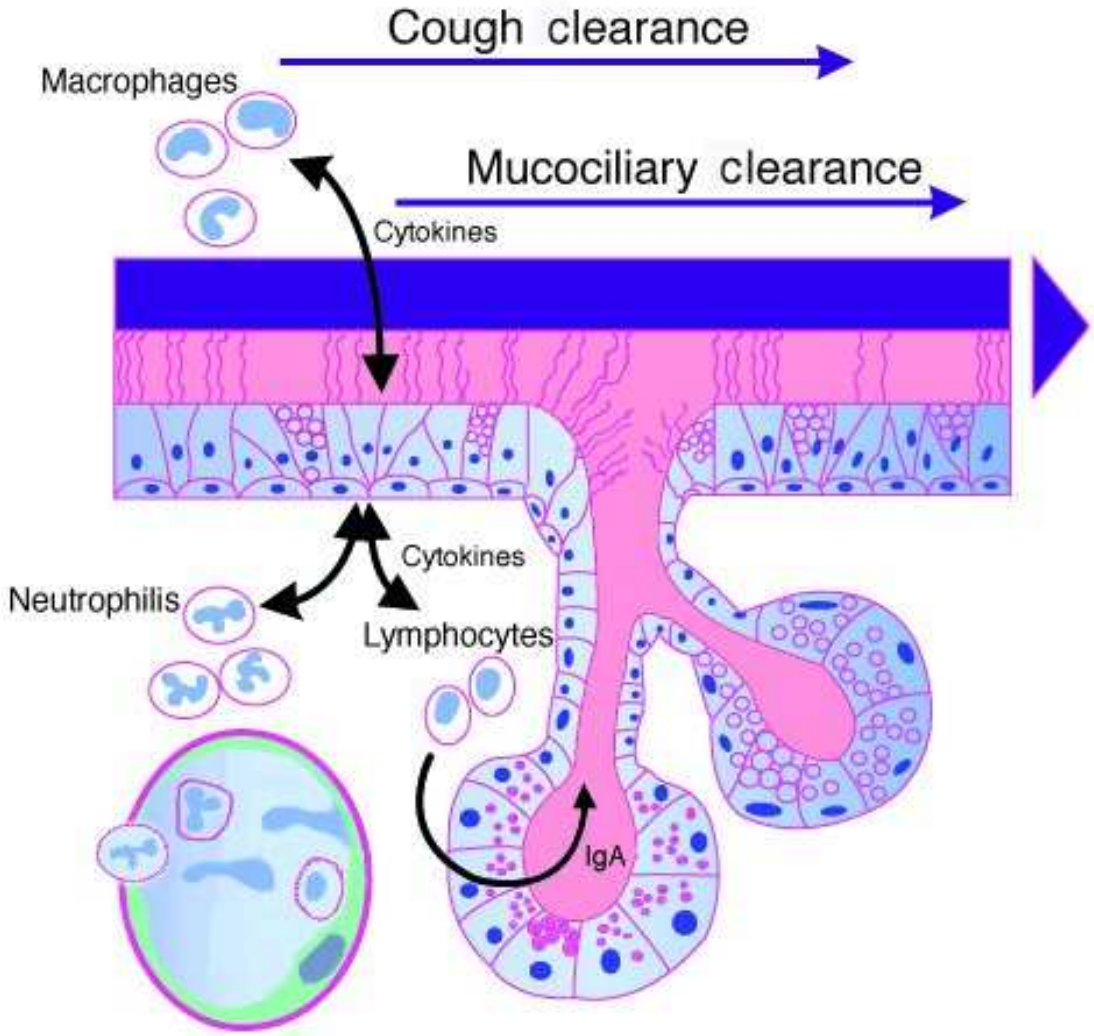
Washout of nasopharyngeal dead space

Reduction of inspiratory resistance (work of breathing) by providing adequate flow

Improved mechanics by supplying adequately warmed and humidified gas

Reduction in the metabolic cost of gas conditioning

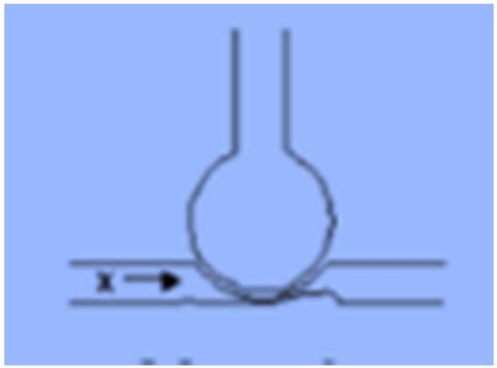
Provision of distending pressure

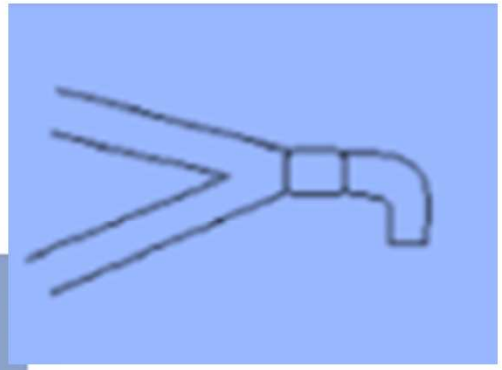


Secreted antimicrobial substances

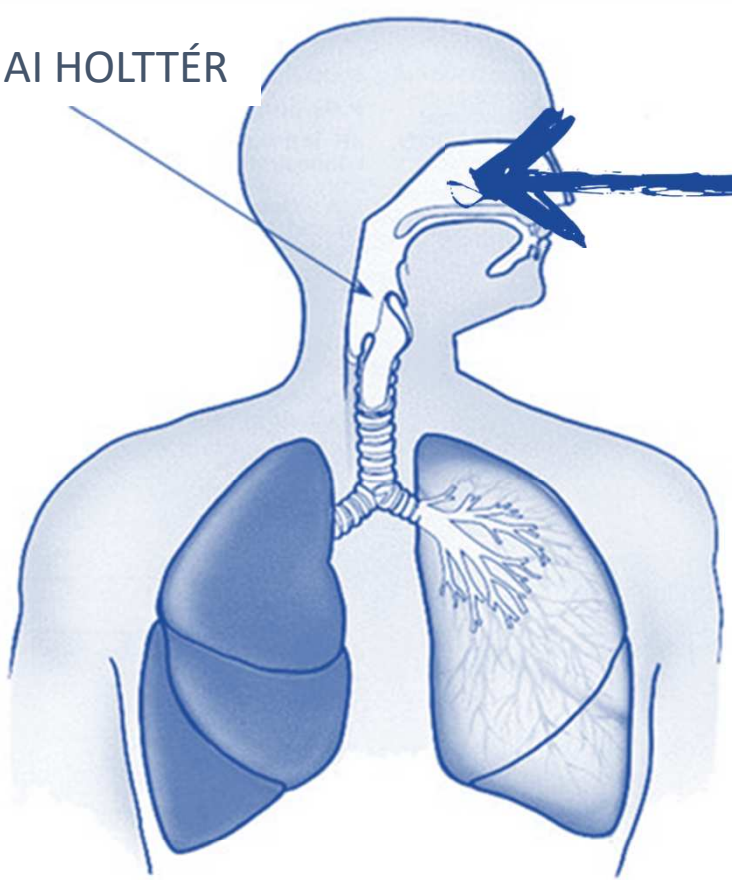
- lysozyme
- lactoferrin
- SLPI
- phospholipase A_2
- defensins (hBD-1, hBD-2)
- cathelicidin (LL-37)
- surfactant proteins
- antiproteases
- proteases
- complement
- IgA

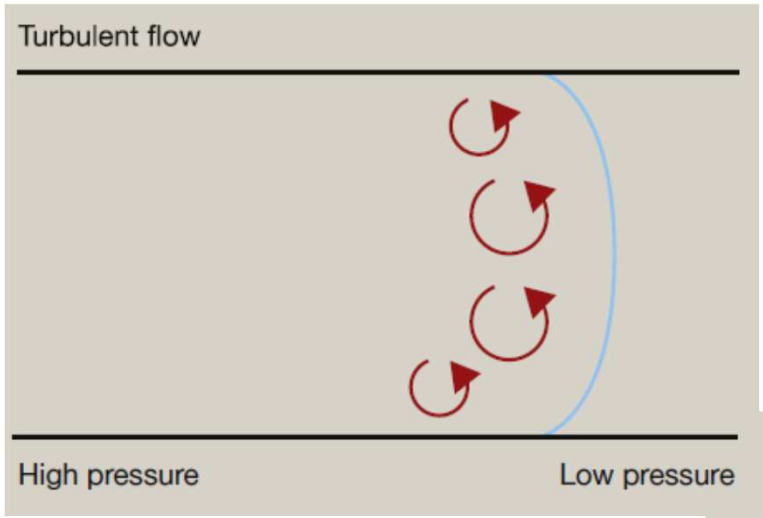
JCI The Journal of Clinical Investigation

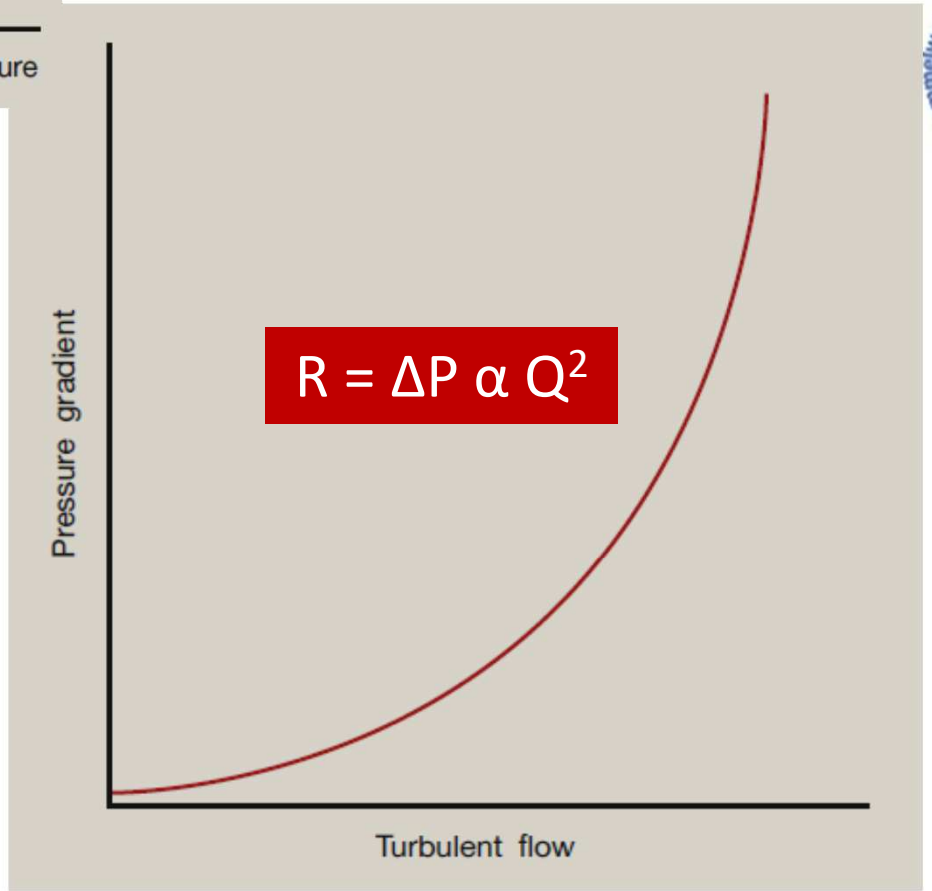




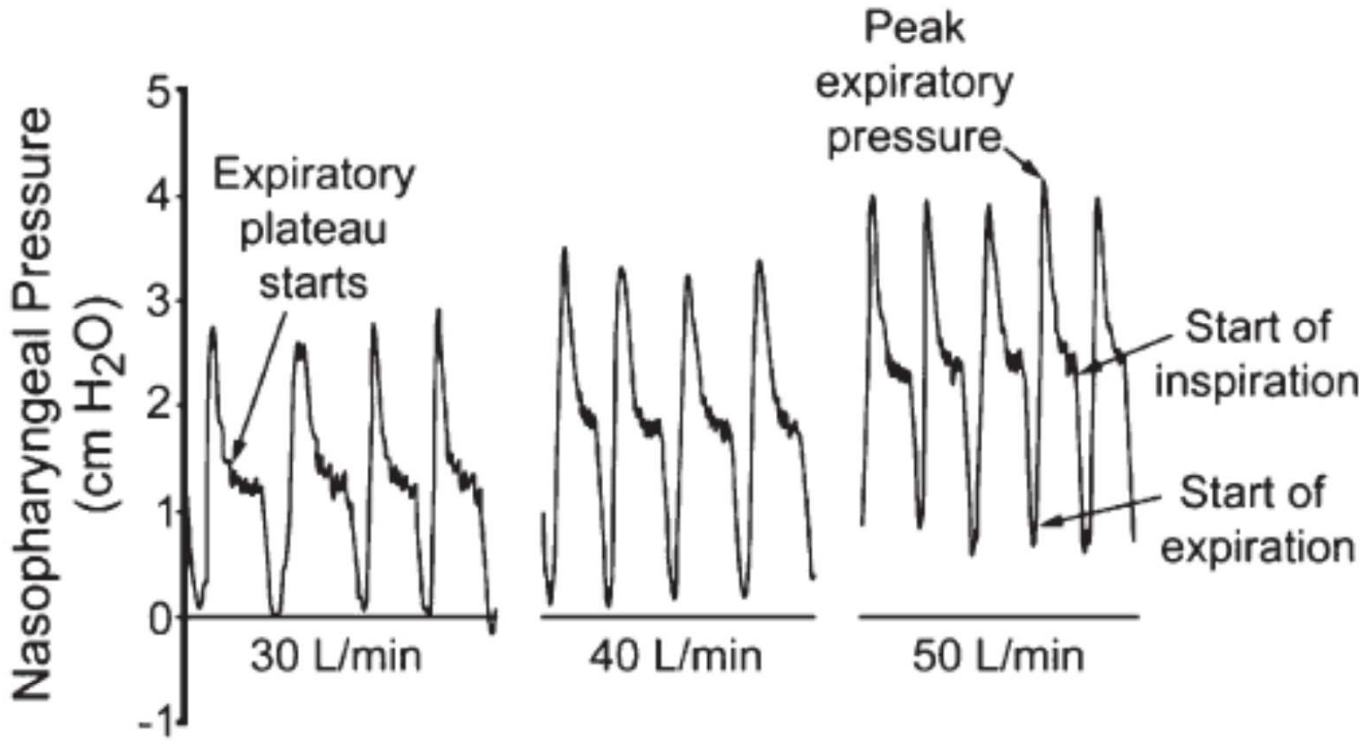
ANATÓMIAI HOLTTÉR



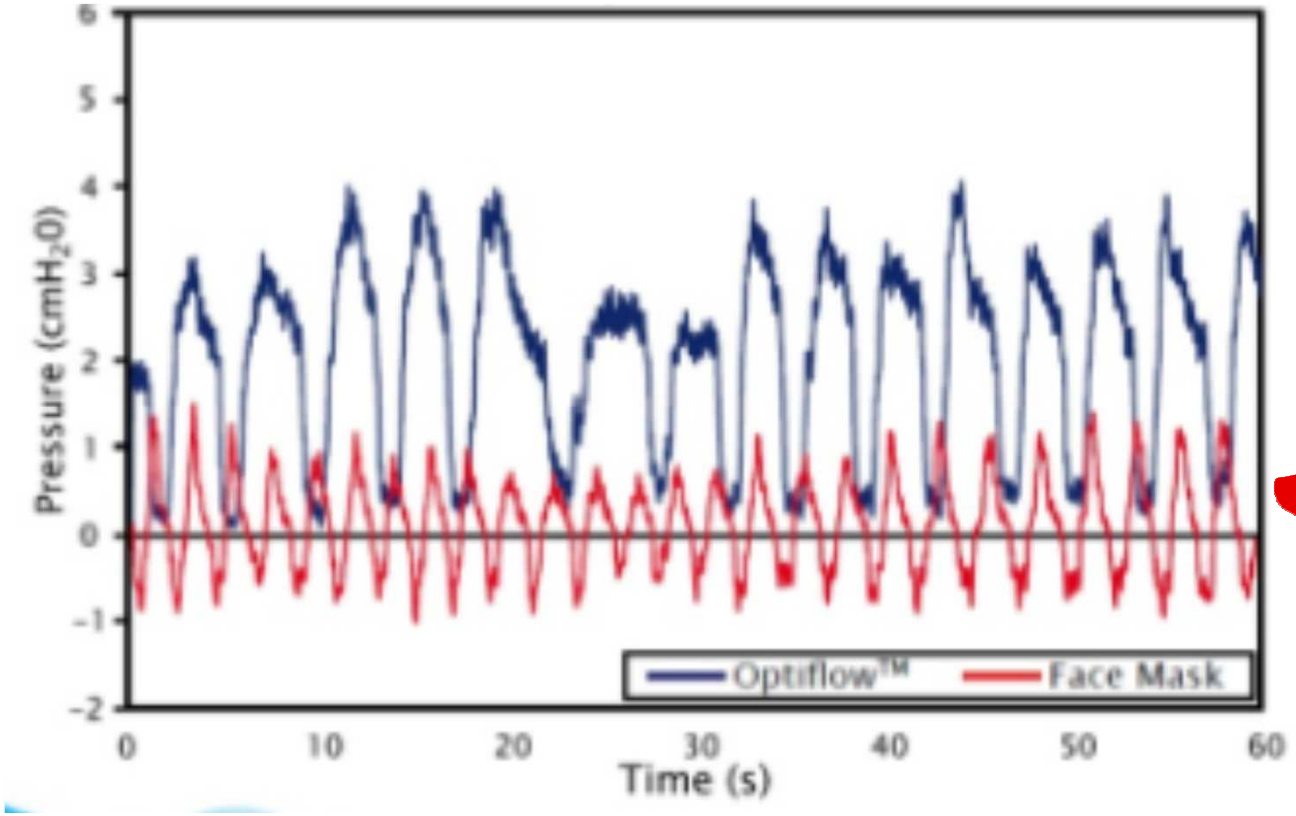




$$R = \Delta P \, \alpha \, Q^2$$



CHEST 2015; 148(1):253-261


Pressure (cmH2O)
6
5
4
3
2
1
0
-1
-2
0
10
20
30
40
50
60
Time (s)
Optiflow™
Face Mask


PEEP


I'M GETTING OUT OF MY COMFORT ZONE!
MARK SZORADY

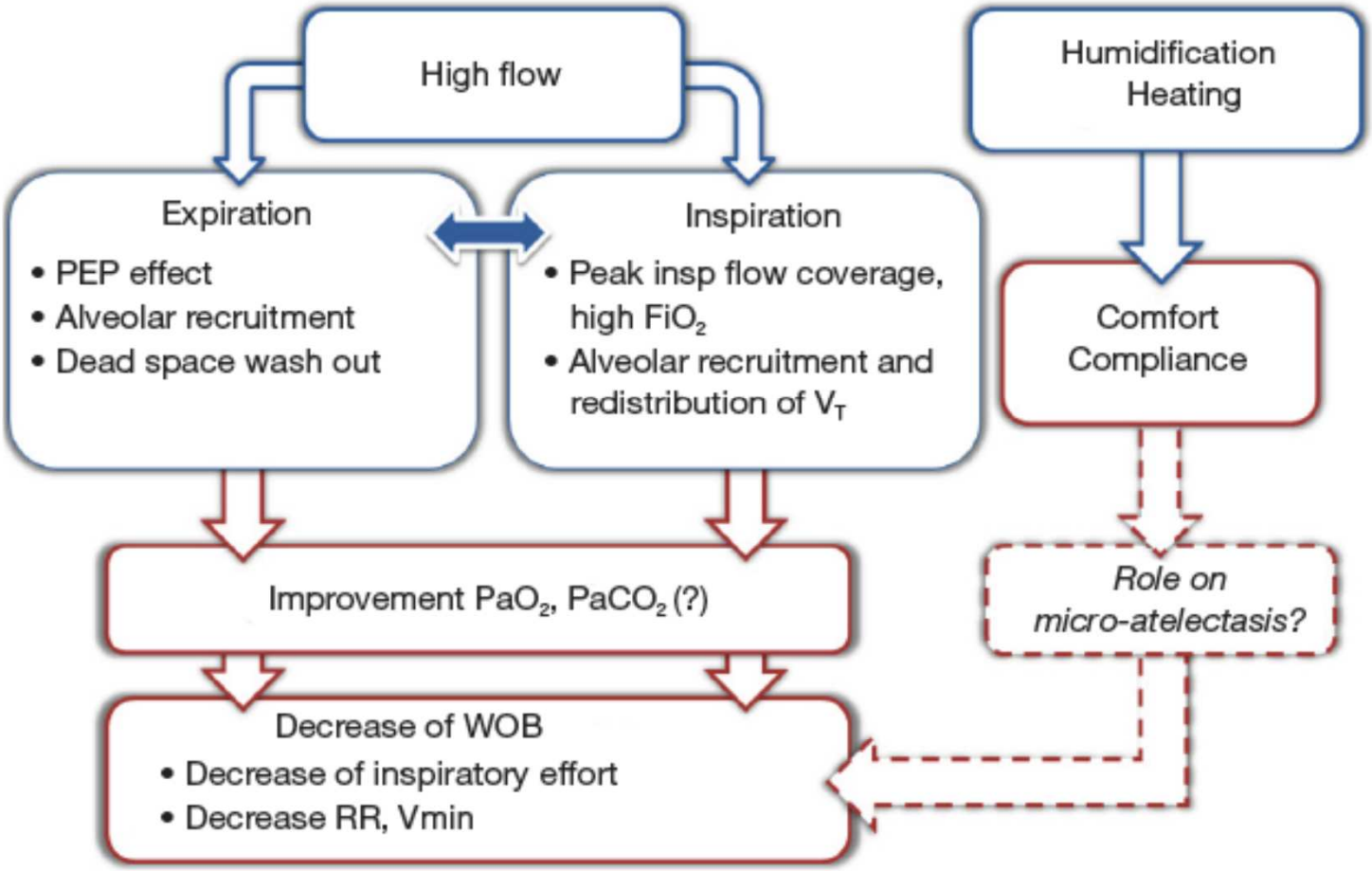

High flow
Humidification
Heating
Expiration
• PEP effect
• Alveolar recruitment
• Dead space wash out
Inspiration
• Peak insp flow coverage, high FiO_2
• Alveolar recruitment and redistribution of V_T
Comfort
Compliance
Improvement PaO_2, $PaCO_2$ (?)
Role on micro-atelectasis?
Decrease of WOB
• Decrease of inspiratory effort
• Decrease RR, Vmin

TABLE 1] Potential Mechanisms of Clinical Benefit During HFNC Use

Mechanism	Clinical Benefit
Small, loose-fitting nasal prongs	Enhanced comfort[5-7]
Heat and humidification	Enhanced comfort[5-7]
Increased water content of mucus	Facilitated secretion removal Avoidance of desiccation and epithelial injury[8,9]
Decreased metabolic cost of breathing	Reduced work of breathing[10,11]
High nasal flow rate	Reduced inspiratory entrainment of room air if mouth closed; more reliable delivery of FIO_2[12-14]
Washout of upper airway dead space	Improved efficiency of ventilation[15-17] Enhanced oxygen delivery[18]
PEEP[12,19-24]	Counterbalance auto-PEEP Decreased work of breathing

HFNC = high-flow nasal cannula; PEEP = positive end-expiratory pressure.

TABLE 2] Potential Clinical Applications of High-Flow Nasal Oxygen

Application	Benefits
Procedures	Enhanced oxygenation during endoscopy[44]
Hypoxemic respiratory failure	
ARDS	Mild and early[45]
Pneumonia	Enhanced oxygenation[5,16]
Idiopathic pulmonary fibrosis	Lower respiratory rate[24]
Cardiogenic pulmonary edema	Enhanced oxygenation Reduced dyspnea[45]
Postoperatively	
Cardiothoracic and vascular	Improved thoracoabdominal synchrony[46]
Cardiac surgery	Increased end-expiratory lung volume[36] Less escalation of therapy[26]
Postextubation	Improved oxygenation and ventilation[47] Enhanced comfort[6,7] Less displacement of interface[47] Less escalation of therapy to noninvasive ventilation or intubation[47]
Do-not-intubate patients	Improved oxygenation and respiratory mechanics[48]

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

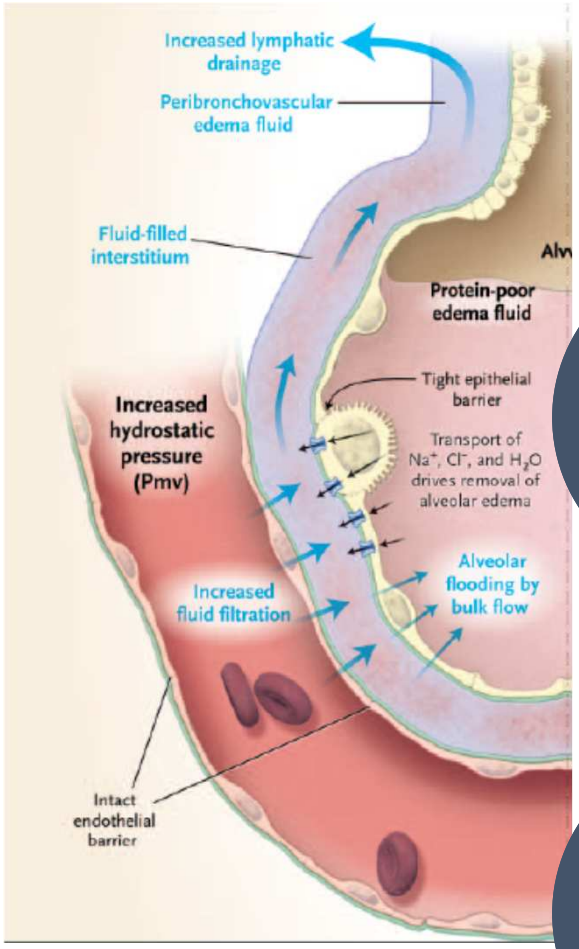
PICO = population–intervention–comparison–outcome

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



N ENGL J MED 353;26 WWW.NEJM.ORG DECEMBER 29, 2005

KAMARAI ÜRÜLÉS
↓
RELAXATIO↓
CO↓

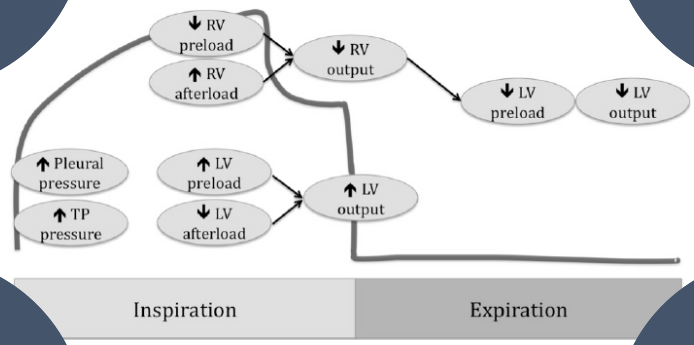
EDV ↑
EDP ↑
LAP ↑
PVP ↑

Phydr ↑ > Ponc +
LYMPH.DRAIN
OEDEMA KÉPZŐDÉS
↑

GÁZCSERE↓
HYPOXIA↑
LÉGZÉSIMUNKA↑

CATHECOLAMIN
↑
RAA ACTIVATIO ↑

SVR ↑
PRE- AFTERLOAD
↑
SZÍV OXYGEN
IGÉNYE ↑

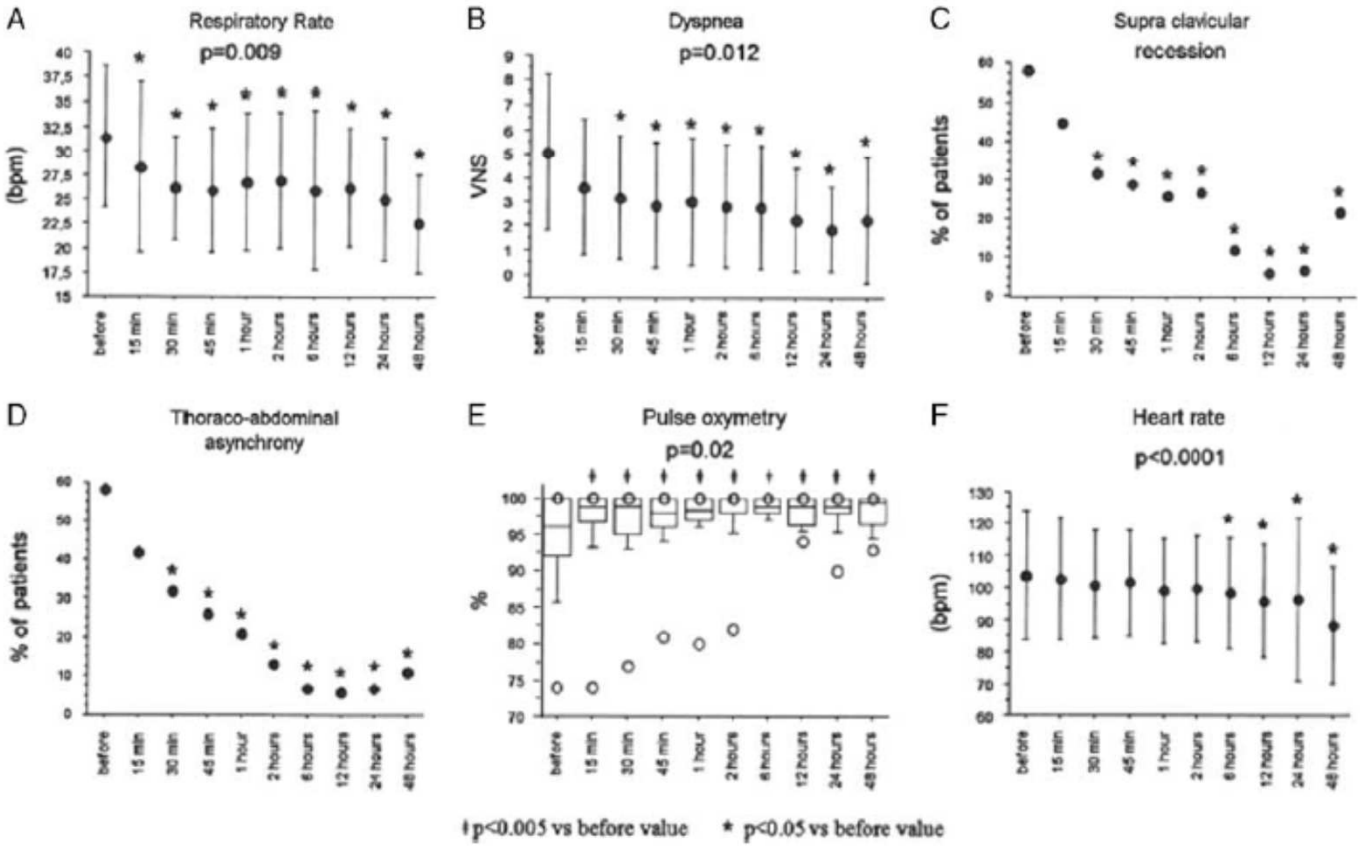


Teboul (2000)

High-Flow Nasal Cannula Therapy in Adults

Alanna Hare, MA, MBBS, MRCP, Med

Clinical Pulmonary Medicine • Volume 24, Number 3, May 2017



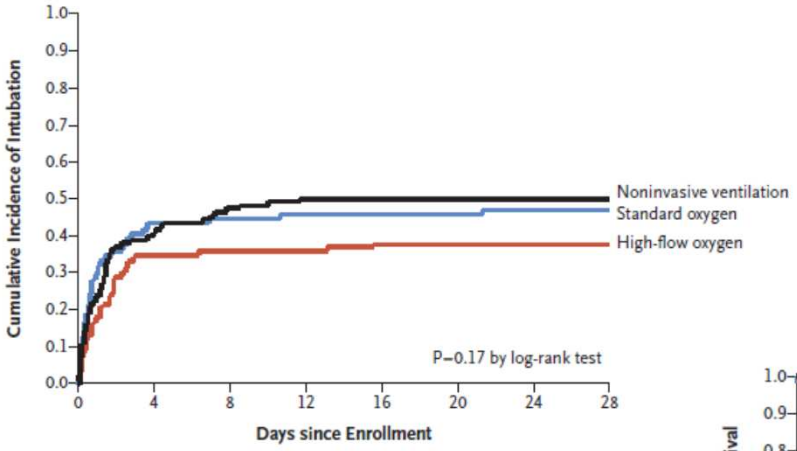
The NEW ENGLAND JOURNAL of MEDICINE

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

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

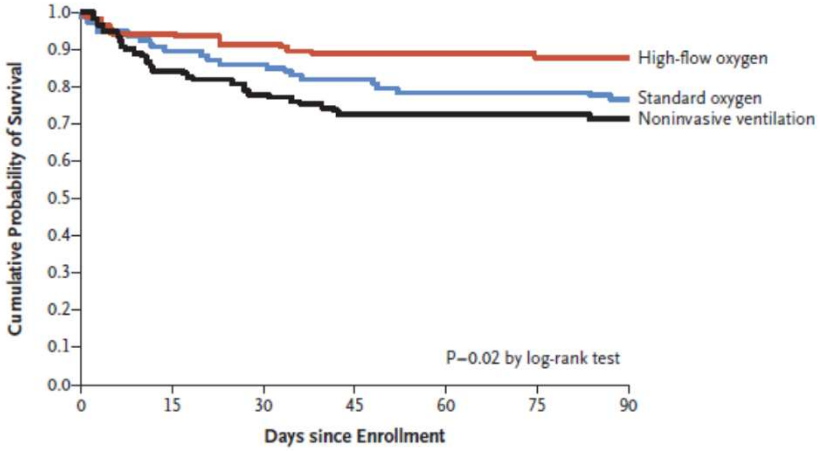
Jean-Pierre Frat, M.D., Arnaud W. Thille, M.D., Ph.D., Alain Mercat, M.D., Ph.D., Christophe Girault, M.D., Ph.D.,

A Overall Population



Study Group

High-Flow Oxygen (N=106)	Standard Oxygen (N=94)	Noninvasive Ventilation (N=110)



Respiratory Medicine 121 (2016) 100–108

Contents lists available at ScienceDirect

Respiratory Medicine

journal homepage: www.elsevier.com/locate/rmed

Review article

High flow nasal cannula versus conventional oxygen therapy and non-invasive ventilation in adults with acute hypoxemic respiratory failure: A systematic review

12 STUDIES

- ☞ **OXYGENISATIOS MUTATÓK**
- ☞ **WoB**
- ☞ **ESCALATIOS SZÜKSÉGLET**
- ☞ **MORTALITÁS**
- ☞ **KOMFORT (DYSPNOE)**

5. Conclusion

The present review suggests that HFNC offers an advantage over COT in patients with AHRF in terms of oxygenation, patient comfort, and possibly work of breathing. Additionally, HFNC may be associated with decreased mortality; however, this issue is far from conclusively demonstrated, with all the data being obtained from a single randomized controlled trial, with significant confounders. Regardless, the present review demonstrates that it may be reasonable to consider HFNC as an intermediate level of respiratory support, in between conventional therapy (nasal cannulae and face masks) and non-invasive ventilation. Thus, it is a reasonable option for patients who fail COT and may aid in avoiding intubation in nearly half of patients who fail COT. However, this potential benefit must be balanced against the potential mortality increase associated with delayed intubation and institution of invasive mechanical ventilation. Regardless, further research is needed to examine the clinical impact of HFNC.

The Effect of High-Flow Nasal Cannula Oxygen Therapy on Mortality and Intubation Rate in Acute Respiratory Failure: A Systematic Review and Meta-Analysis

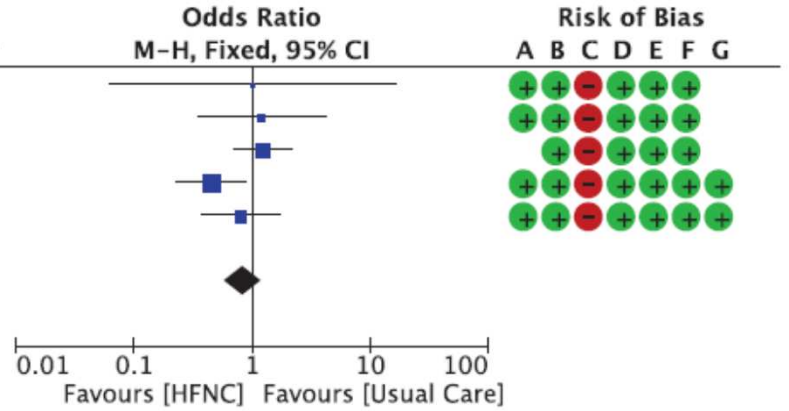
(*Crit Care Med* 2017; 45:e449–e456)

Thalia Monro-Somerville, MBBS[1]; Malcolm Sim, MD[2]; James Ruddy, MBBS[3]; Mark Vilas, MBChB[2]; Michael A. Gillies, MD[1]

14 STUDIES

Study or Subgroup	HFNC Events	HFNC Total	Usual Care Events	Usual Care Total	Weight	Odds Ratio M-H, Fixed, 95% CI	Year
Parke 2013	1	169	1	171	1.4%	1.01 [0.06, 16.31]	2013
Maggiore 2014	6	53	5	52	6.5%	1.20 [0.34, 4.20]	2014
Stephan 2015	28	414	23	416	30.8%	1.24 [0.70, 2.19]	2015
Frat 2015	12	106	45	204	39.3%	0.45 [0.23, 0.90]	2015
Hernandez 2016	13	264	16	263	22.0%	0.80 [0.38, 1.70]	2016
Total (95% CI)		**1006**		**1106**	**100.0%**	**0.83 [0.58, 1.17]**	
Total events	60		90				

Heterogeneity: $Chi^2 = 5.31$, df = 4 (P = 0.26); $I^2 = 25\%$
Test for overall effect: Z = 1.06 (P = 0.29)



Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

answer this question definitively. A qualitative analysis suggests that this therapy was well tolerated and may improve dyspnea scores and patient comfort. Future trials should identify the populations most likely to benefit from this treatment and define safe limits of therapy.

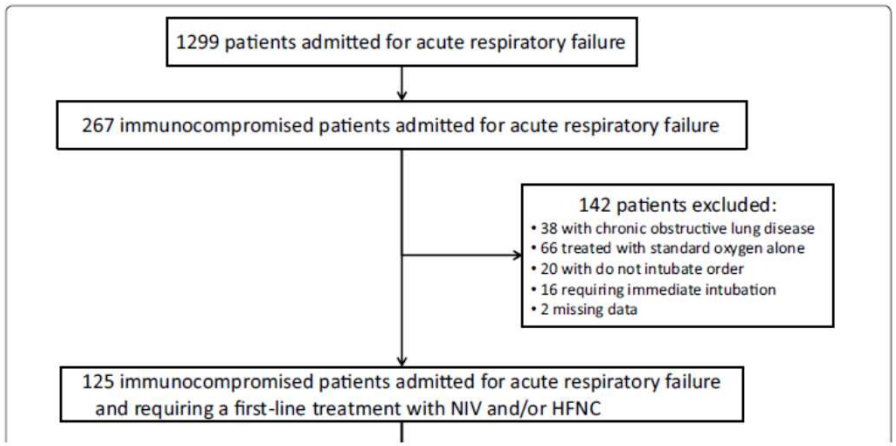
Coudroy et al. Ann. Intensive Care (2016) 6:45
DOI 10.1186/s13613-016-0151-7

Annals of Intensive Care

RESEARCH Open Access

High-flow nasal cannula oxygen therapy versus noninvasive ventilation in immunocompromised patients with acute respiratory failure: an observational cohort study

Rémi Coudroy[1,2*], Angéline Jamet[1], Philippe Petua[1], René Robert[1,2], Jean-Pierre Frat[1,2] and Arnaud W. Thille[1,2]



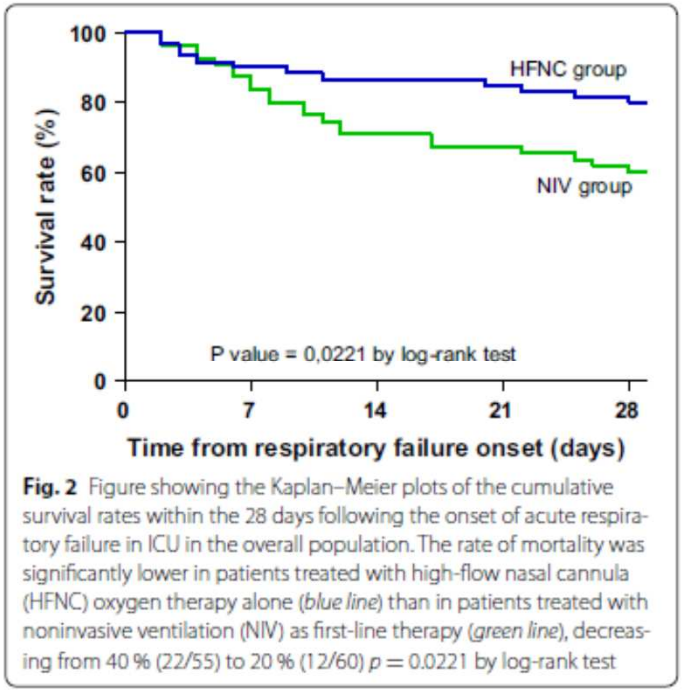


Fig. 2 Figure showing the Kaplan–Meier plots of the cumulative survival rates within the 28 days following the onset of acute respiratory failure in ICU in the overall population. The rate of mortality was significantly lower in patients treated with high-flow nasal cannula (HFNC) oxygen therapy alone (*blue line*) than in patients treated with noninvasive ventilation (NIV) as first-line therapy (*green line*), decreasing from 40 % (22/55) to 20 % (12/60) $p = 0.0221$ by log-rank test

Transplantation Proceedings, 49, 1325–1330 (2017)

High-flow Nasal Cannula Versus Noninvasive Ventilation for Treatment of Acute Hypoxemic Respiratory Failure in Renal Transplant Recipients

G. Tu[a], H. He[a], K. Yin[b], M. Ju[a], Y. Zheng[a], D. Zhu[a,*], and Z. Luo[a]

Table 4. Adverse Events During the ICU Stay, *n* (%)

Parameter	HFNC ($n = 20$)	NIV ($n = 18$)	*P* Value
Pneumothorax	0	4 (22.2)	.042
Intolerance	0	2 (16.7)	.218
Aspiration	0	2 (11.1)	.218
VAP	0	3 (16.7)	.329
CRBSI	2 (10.0)	2 (11.1)	1.000
Cardiac dysfunction	1 (5.0)	1 (5.6)	1.000
Renal failure	1 (5.0)	2 (11.1)	.595
Gastrointestinal bleeding	0	1 (5.6)	.474
Skin breakdown	0	4 (22.2)	.042

Note. Data are presented as *n* (%).

Abbreviations: VAP, ventilator-associated pneumonia; CRBSI, catheter-related bloodstream infection; others as in Tables 1 and 3.

High-Flow Nasal Cannula Versus Conventional Oxygen Therapy in Emergency Department Patients With Cardiogenic Pulmonary Edema: A Randomized Controlled Trial

Onlak Makdee, MD; Apichaya Monsomboon, MD; Usapan Surabenjawong, MD; Nattakarn Praphruetkit, MD;

[Ann Emerg Med. 2017;70:465-472.]

Editor's Capsule Summary

What is already known on this topic

High-flow nasal cannula oxygen therapy is useful in respiratory failure.

What question this study addressed

Compared with conventional oxygen therapy, does emergency department (ED) high-flow nasal cannula improve cardiogenic pulmonary edema outcomes?

What this study adds to our knowledge

In this randomized controlled trial of 128 patients in Thailand, high-flow nasal cannula improved 60-minute respiratory rate but not rates of admission, noninvasive ventilation, intubation, or mortality.

How this is relevant to clinical practice

Although not improving patient outcomes, ED high-flow nasal cannula oxygen therapy may decrease dyspnea severity in cardiogenic pulmonary edema.

American Journal of Emergency Medicine 35 (2017) 1177–1183

Contents lists available at ScienceDirect

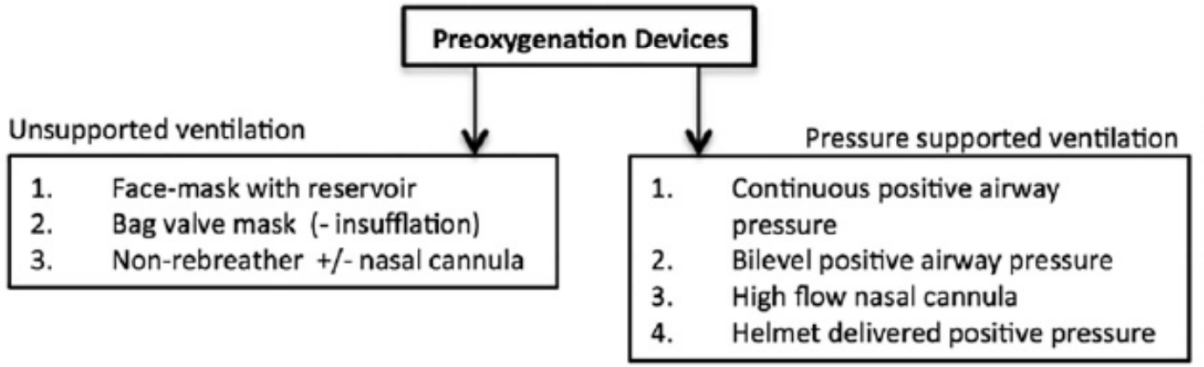
American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Review

Pre-oxygenation: Implications in emergency airway management

Ali Pourmand, MD, MPH, RDMS *, Chelsea Robinson, BS, Kelsey Dorwart, MS, Francis O'Connell, MD



Increased use of high-flow nasal oxygen during bronchoscopy

Beatrice La Combe, Jonathan Messika, Muriel Fartoukh, Jean-Damien Ricard

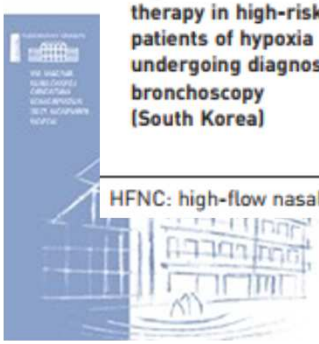
European Respiratory Journal 2016 48: 590-592; **DOI:** 10.1183/13993003.00565-2016

EUROPEAN RESPIRATORY *journal*
FLAGSHIP SCIENTIFIC JOURNAL OF ERS

TABLE 1 Summary of studies, ongoing or not yet open, investigating high-flow oxygen therapy during bronchoscopy

	Design	Inclusion criteria	Intervention arm	Control arm	Outcomes assessed	Estimated enrolment	Status
NCT02606188 Modified HFNC oxygen in patients undergoing bronchoscopy (China)	Randomised trial	Bronchoscopy required; baseline S_{pO_2} ⩾90%	Modified high-flow nasal cannula oxygen therapy	Conventional nasal cannula oxygen therapy	Time of bronchoscopy; lower S_{pO_2} during bronchoscopy	136 subjects	Not open
NCT02253706 Oxygen supplementation during bronchoscopy: high-flow *versus* low-flow oxygen (Israel)	Randomised trial	Scheduled bronchoscopy for diagnostic purpose	High-flow nasal oxygen therapy with 50 L·min^{-1} flow, and F_{iO_2} of 0.35	Low-flow nasal oxygen	Oxygen desaturation of 4%; S_{pO_2} cumulative time below 88%; number of bradycardia and tachycardia episodes; changes in expired end-tidal CO_2; time with S_{pO_2} <88%; patient comfort during procedure	100 subjects	Not open
NCT01650974 High-flow nasal oxygen therapy in high-risk patients of hypoxia undergoing diagnostic bronchoscopy (South Korea)	Randomised trial	P_{aO_2} <60 mmHg or S_{pO_2} <90% in room air and S_{pO_2} ⩾95% or P_{aO_2} ⩾75 mmHg with low flow oxygen; need for a diagnostic bronchoscopy	High flow nasal oxygen therapy with a 40 L·min^{-1} flow, and a F_{iO_2} of 0.4	Conventional nasal oxygen therapy with nasal prongs, with F_{iO_2} of approx. 0.4; sham comparator: high-flow device with low-flow settings, and F_{iO_2} 0.4	Success rate of bronchoscopy; total duration of hypoxia; frequency of hypoxia; switch to oxygen therapy method; change in respiratory symptoms	152 subjects	Recruiting

HFNC: high-flow nasal cannula S_{pO_2}: pulse oxygen saturation; F_{iO_2}: inspiratory oxygen fraction; P_{aO_2}: arterial oxygen tension.



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Case Report

High-flow nasal cannula oxygen supply as treatment in hypercapnic respiratory failure☆,☆☆

67 ♂ COPD/NIC
FLU-A (H1N1)
PNEUMONIA
SOMNOLENTIA
ARF
NIV → $paCO_2$↑

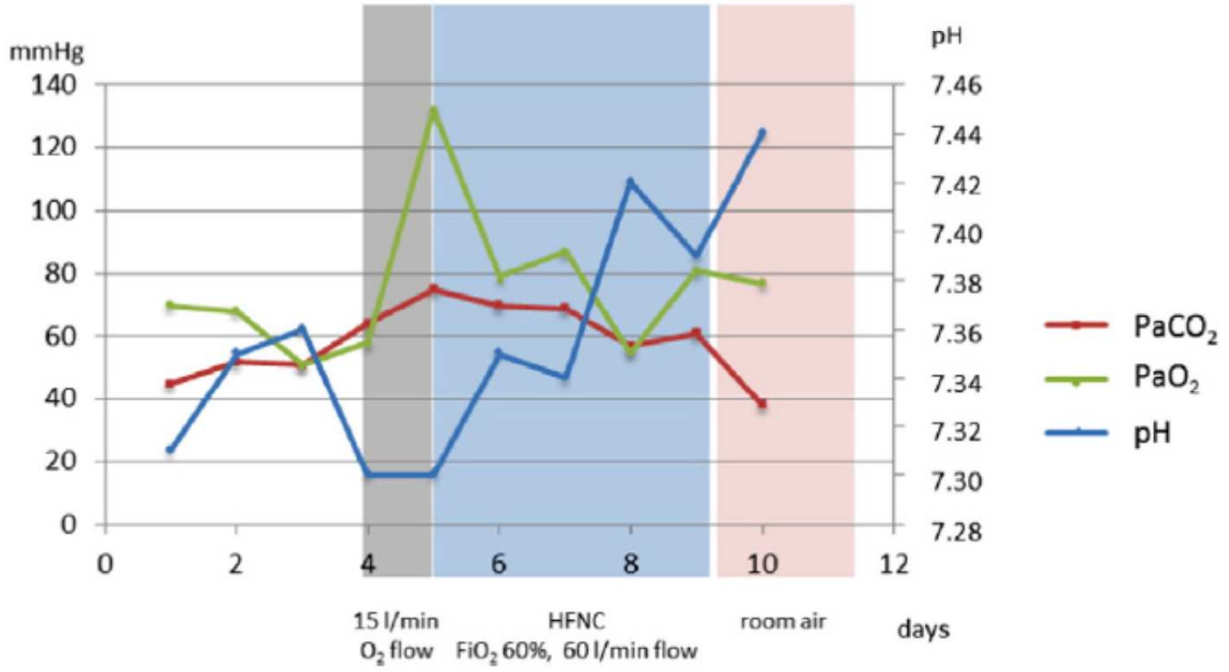

Figure. Arterial blood gases, at admission and during hospital stay.

HFNOT

NIV

- HOLTTÉR ↓
- KONSTANS FLOW → VÁLTOZÓ NYOMÁS
- Vt – INDIREKT MÓDOSUL

- HOLTTÉR ↑
- KONSTANS NYOMÁS, VOLUMEN ← VÁLTOZÓ FLOW
- Vt – ÁLLÍTHATÓ