Klíčová úloha respirační péče v medicíně kritických stavů
Key Role of Respiratory Care in Critical Care Medicine

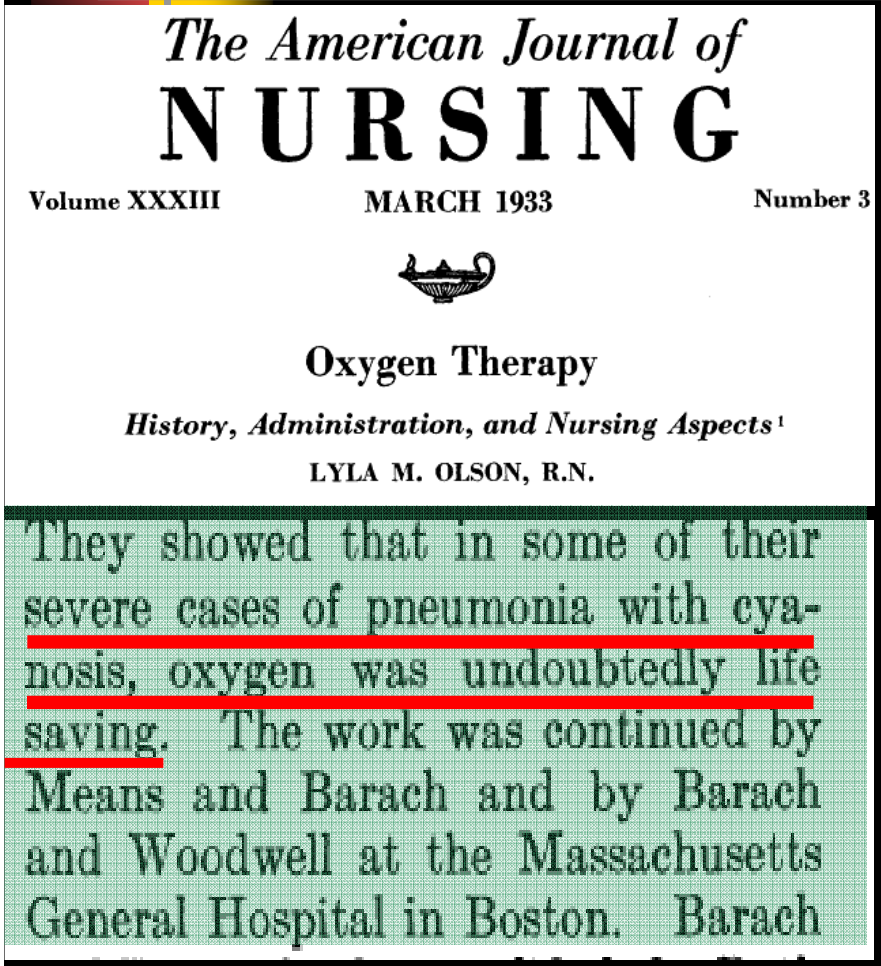
Nové výzvy a širší horizonty po 55 letech
New challenges and horizons after 55 years

Ivan Herold

Anesteziologicko-resuscitační oddělení

Klaudiánova nemocnice
Oblastní nemocnice Mladá Boleslav, a.s.

Early Days of Respiratory Care
Outside of ICU (then non-existed)



The American Journal of
NURSING

Volume XXXIII MARCH 1933 Number 3

Oxygen Therapy

History, Administration, and Nursing Aspects [1]

LYLA M. OLSON, R.N.

They showed that in some of their severe cases of pneumonia with cyanosis, oxygen was undoubtedly life saving. The work was continued by Means and Barach and by Barach and Woodwell at the Massachusetts General Hospital in Boston. Barach

Alvan Barach

Positive Pressure Respiration and Its Application to the Treatment of Acute Pulmonary Edema

Ann. Intern Med. 1938,12,754-7

Homer Stryker
Physiotherapy and Kinetic Therapy in Respiratory Care

Very Early Days Respiratory Care : Iron Lung Ward

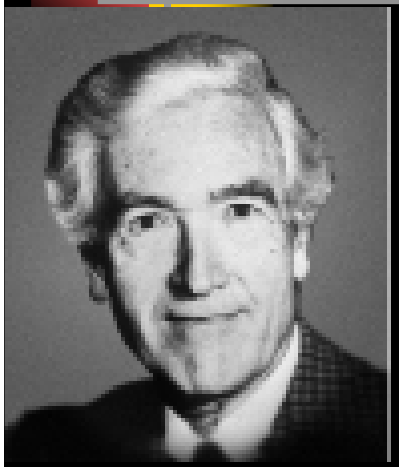
Rancho Los Amigos HospitaL, USA in 1953

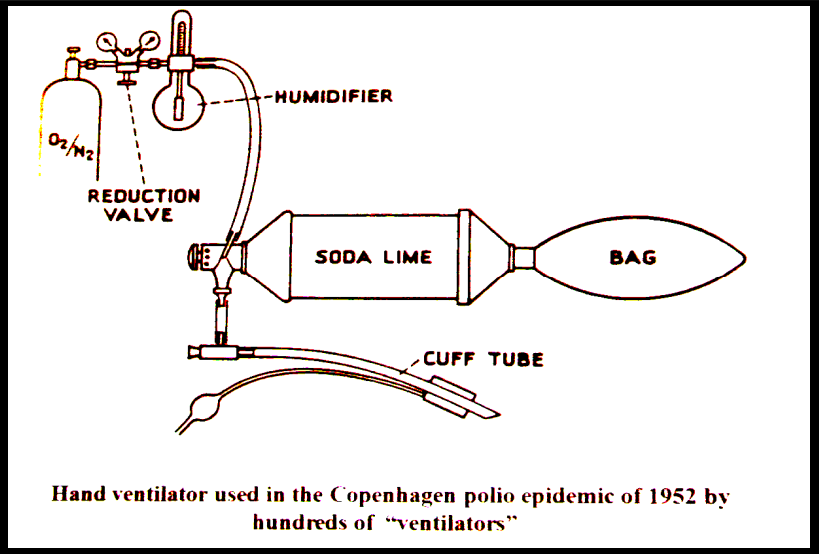
overcrowded and understuffed *30 Emmerson´s currassses /7nurses*

EPIDEMIE POLIO V KODANI (n=31) mortalita 27 (87%)

26. srpna 1952 : první „ICU“ pacientka BLEGDAMSHOSPITAL, COPENHAGEN

Paul Astrup





Hand ventilator used in the Copenhagen polio epidemic of 1952 by hundreds of “ventilators”

Bjorn Ibsen

Impact of the Respiratory Intensive Care Unit on Survival of Patients with Acute Respiratory Failure

Robert M. Rogers, Clare Weiler and Bruce Ruppenthal

Chest 1972;62;94-97
DOI 10.1378/chest.62.1.94

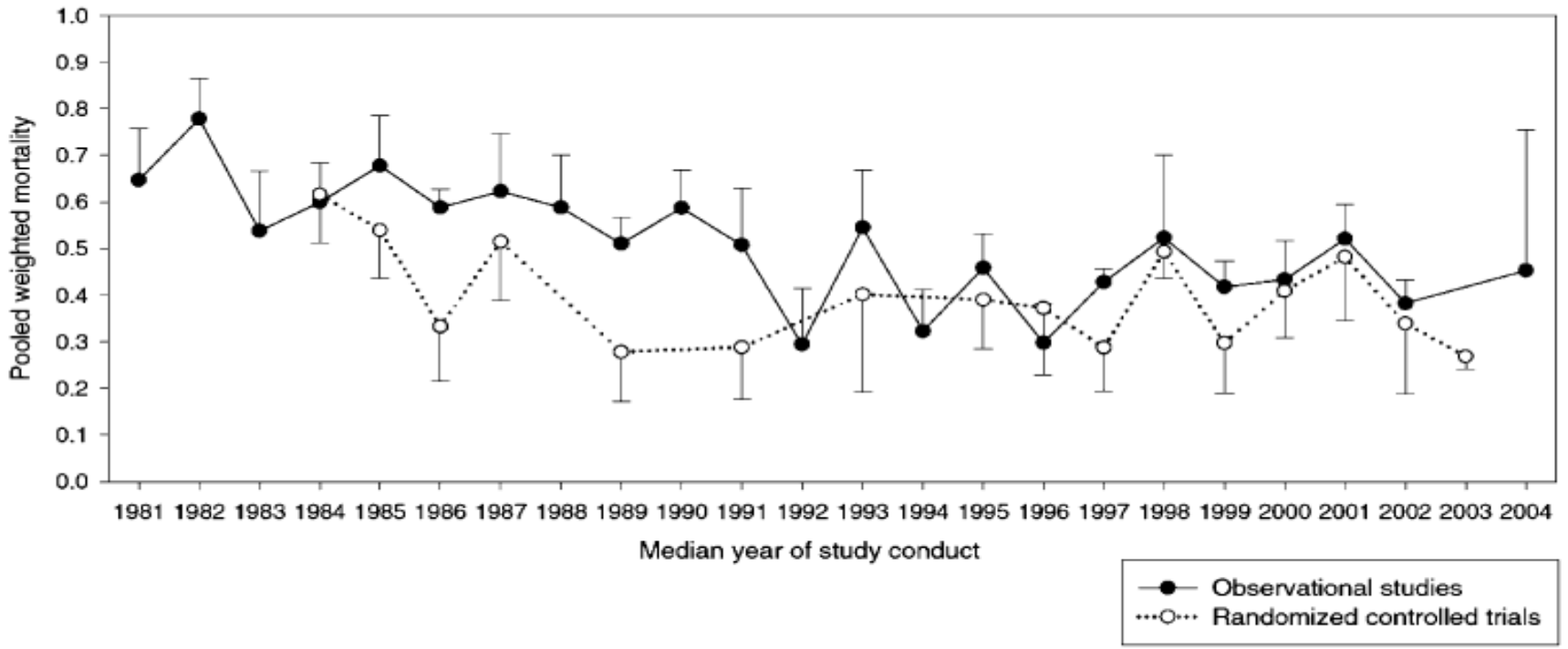
Table 1—*Mortality for Patients Treated with Mechanical Ventilation >12 Hours at the Hospital of the University of Pennsylvania in General Medical and Surgical Care Areas (June, 1965 to A* [illegible]

NA ARDS SE UMÍRALO, ALE POD JINOU DG

	No. Patients	No. Deaths	% Mortality
COPD	11	6	55
Neurologic disorders	46	35	76
Pneumonia	7	5	71
Drug ingestion	6	2	33
Postcp bypass	45	10	22
Post-thoracotomy	21	13	62
Postop others	44	35	80
Miscellaneous	32	28	88
Total	212	134	63

Pooled mortality ARDS 1994-2006 - 44,3%

(18900 patients, 4966 studií) , Phua J et al: AJRCCM 179, 2009, 220-227



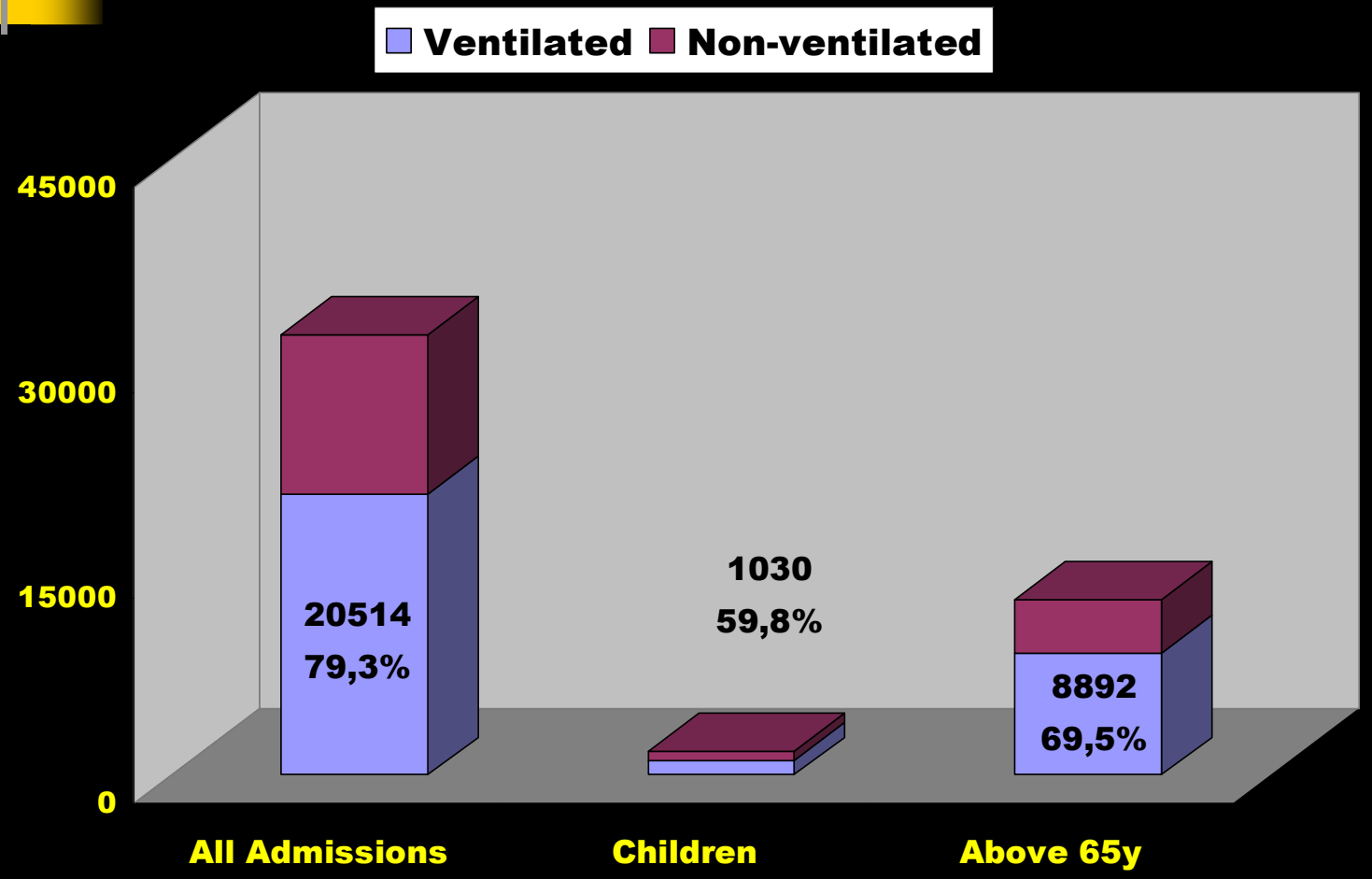
- **Observační studie (53) 44% (CI95 40,1 – 47,5)**
- **Randomizované (36) 362% (CI95 32,1 – 40,5)**

- **Věk pacienta OR 1,36/per additional 10 years (CI 1,07-1,5)**

Mechanical Ventilation in CZ

(Anesthesiology ICU 2006)

Institute of Health Information and Statistics of the Czech Republic

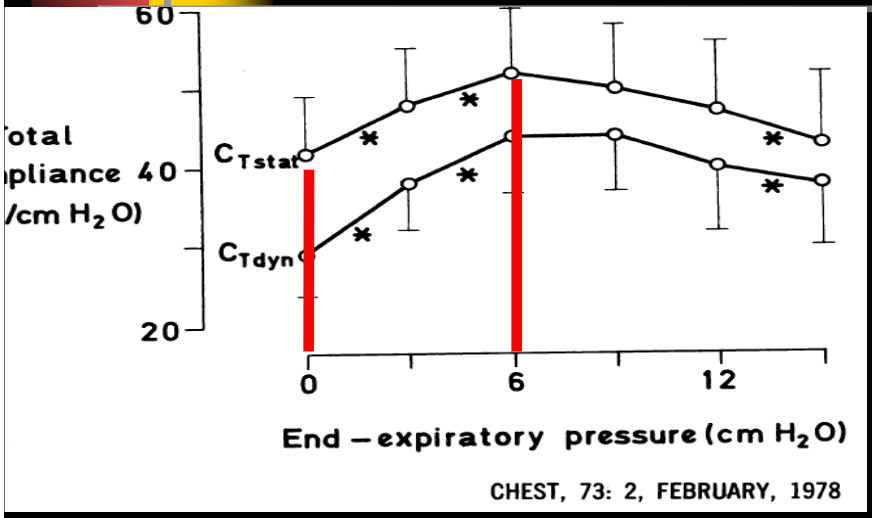


Pine RW et al:
Indidence of Organ Dysfunction and Related Mortality in 106 pateints with intraabdominal Sepsis
Arch Surg 118:242, 1983

Dysfunction	Patients	%	Deaths	%
Lungs	30	28	19	19
Kidneys	16	15	12	75
Heart	11	10	11	100
Liver	9	8	9	100
CNS	10	9	10	100

Effect of Tidal Volume and Positive End-Expiratory Pressure on Compliance during Mechanical Ventilation*

*Peter M. Suter, M.D.;** H. Barrie Fairley, M.B., B.S.;† and Michael D. Isenberg, M.D.‡*



CHEST, 73: 2, FEBRUARY, 1978

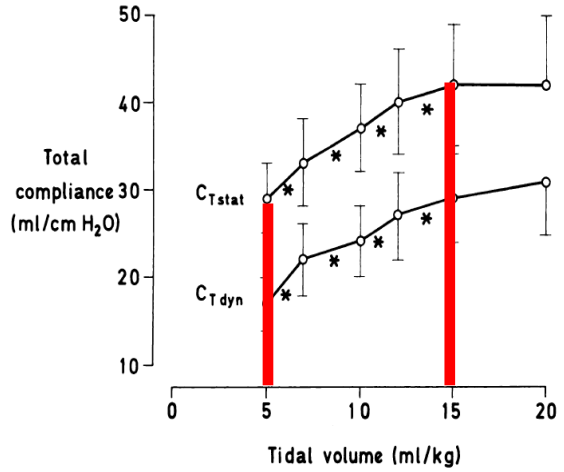


FIGURE 3. Relationship between TV, total Cst (C_{Tstat}) and Cdyn (C_{Tdyn}). Indicated are mean values ± SE. Measurements were made at zero end-expiratory pressure. Statistically significant differences between adjacent means ($P < 0.05$) are indicated by *asterisks*.

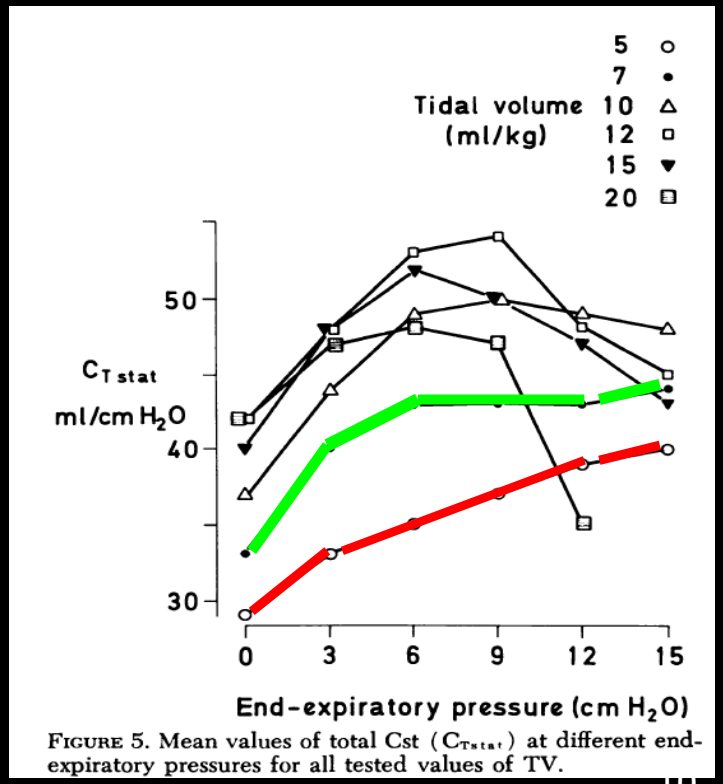


FIGURE 5. Mean values of total Cst (C_{Tstat}) at different end-expiratory pressures for all tested values of TV.

Top Ten List In Mechanical Ventilation

LUNG PROTECTIVE VENTILATION & NON-INVASIVE & WEANING

B.Krieger, Chest 2002, 122,1797-1800

LUNG PROTECTIVE VENTILATION STRATEGY

Lower tidal volumes vs traditional tidal volumes for ALI and the ARDS.
NEJM 2000; 342:1301-1308

Influence of tidal volume Recruitment and derecruitment during ARF
AJRCCM 2001; 164:131-140

~

Effect of prone positioning on the survival of patients with acute respiratory failure.
NEJM 2001, 345, 568-573

NON INVASIVE VENTILATION

(REPIRATORY PROTECTIVE STRATEGY)
AJRCCM 2001; 164:638-641

WEANING

Daily interruption of sedative infusions in critically ill patients undergoing MV.
NEJM 2000; 342:1471-1477

Evidence-based guidelines for weaning and discontinuing VS:
Chest 2001; 120(suppl):375S-395S

Outcomes in post-ICU mechanical ventilation: a therapist-implemented weaning protocol.
Chest 2001; 119:236-242

ARMA protokol ventilace nízkými objemy:
ARDSnet 2000

- **OBJEM** **(4)-6-(8) ml kg/ predikované-ideální t.hm**
- **TLAK** **< 30 (28??) cm H2O**
- **(FREKVENCE)** **6-35(??) d/min**

- **FiO2/PEEP** **(???)**
- **HYPERKAPNIE [PERMISIVNÍ]** **only *innocent bystander* ?**

Tab. FiO2/PEEP (ARMA protokol) [1,3]

F_iO_2	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.9	0.9	0.9	1.0
PEEP	5	5	8	8	10	10	10	12	14	14	14	16	18	20-24
PEEP*	12-14	14	16	18	18-20	20	20	20	20	20-22	20-22	22	22	22-24

PEEP* ARMA/ALVEOLI [3]

Nepoužívat ARMA protokol je jako „objevit kolo a nejezdit na něm.... „
M.Ranieri

Mikkelsen ME

Potential reasons why physicians uderuse LPV: a retrospective cohort study using physician documentation. Respiriatory care 2008, 53, 455-461

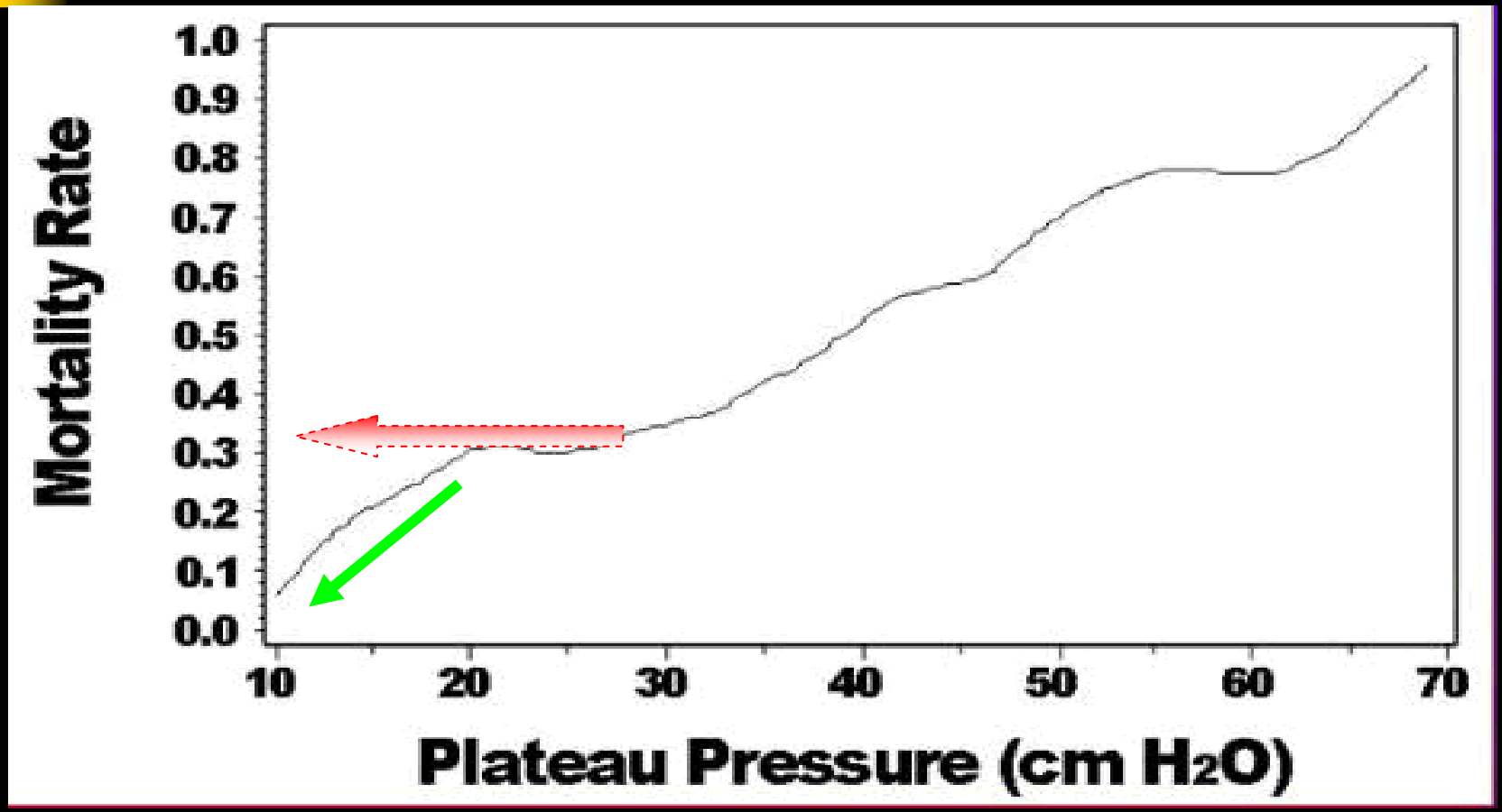
Table 3. LPV Use (n = 75)

LPV sustained (on LPV at 48 h) (%)	32
LPV used transiently (%)	16
Reason LPV not used (%)	
Diagnostic uncertainty	18.7
No documented explanation	16
Implementation failure	8
Change in clinical status*	6.7
Relative contraindication (metabolic acidosis)	2.7

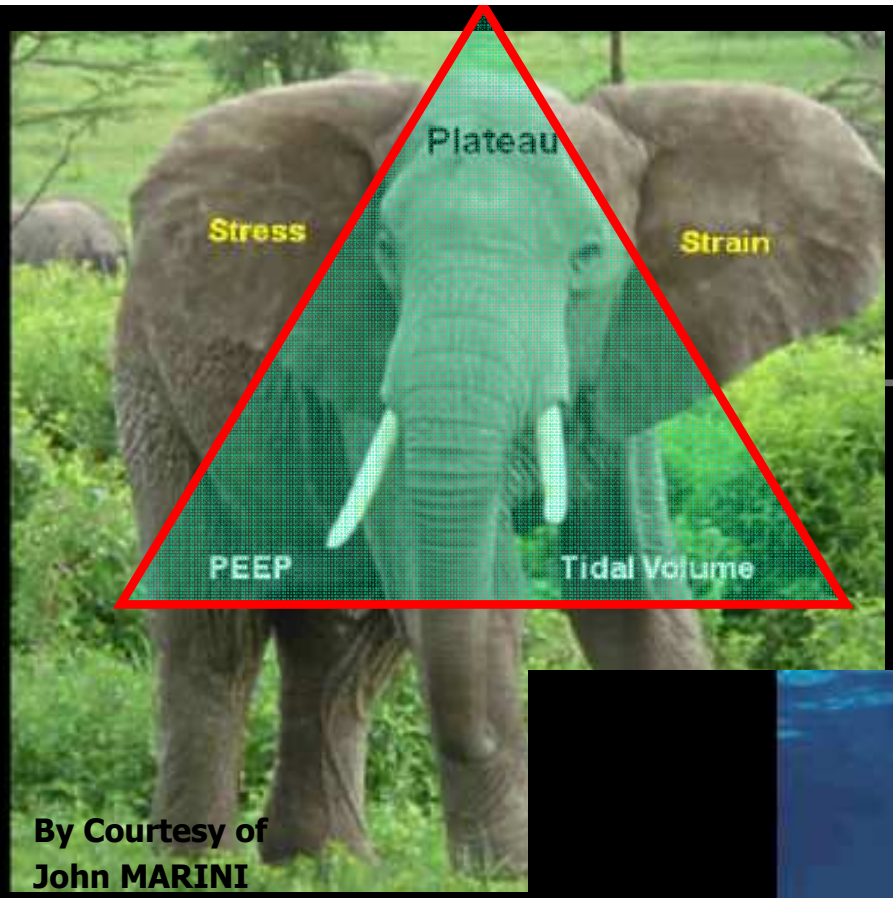
* Includes 4 patients who rapidly improved and 1 patient who transitioned to comfort care

LPV = lung-protective ventilation (tidal volume ≤ 7.5 mL/kg of predicted body weight)

Neexistuje *safe limit* pro Pplat



Gattinoni´s
Stress and Strain Concept



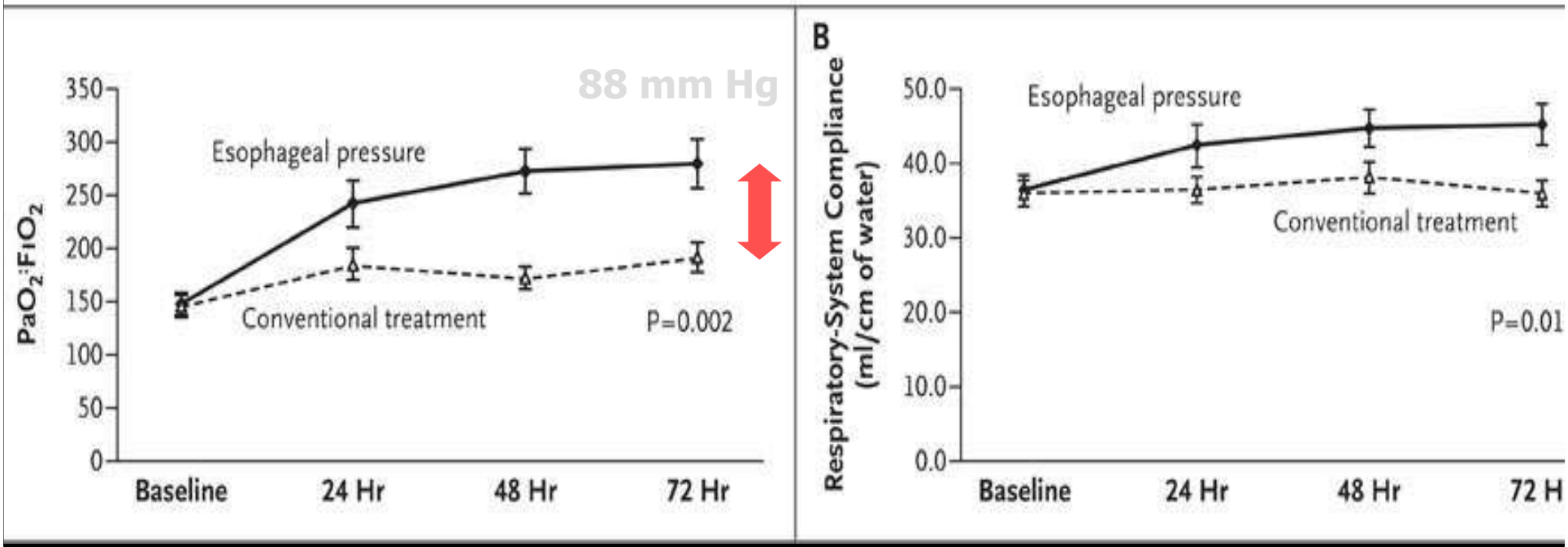
By Courtesy of
John MARINI

Palv = 200 cm H20

Plateau Pressure, PEEP, and Tissue Strain…
What *Surrounds* the Lung is Important!

Mechanical Ventilation Guided by Esophageal Pressure in ALI

Daniel Talmor et al NEJM, 2008, **359:2095-2104**



It is transpulmonary (translung) pressure that really matters...

Excessive tidal volume from breath stacking during lung-protective ventilation for acute lung injury*

Mark C. Pohlman, MD; Kathryn E. McCallister, BS; William D. Schweickert, MD; Anne S. Pohlman, MSN; Celerina P. Nigos, BSN; Jerry A. Krishnan, MD, PhD; Jeff T. Charbeneau, MS; Brian K. Gehlbach, MD; John P. Kress, MD; Jesse B. Hall, MD

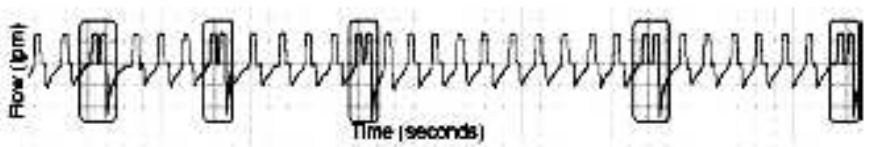
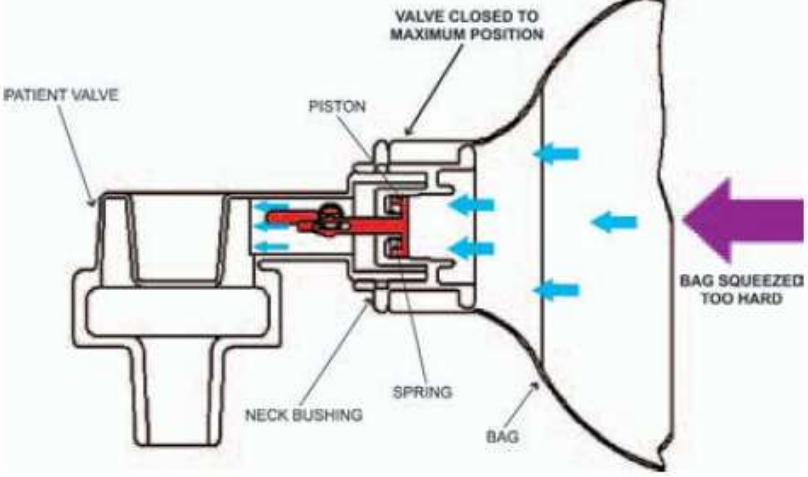


Figure 1. Flow-time waveform over 1 min. This example represents five stacked breaths per minute. Percent stacked breaths is the number of stacked breaths divided by the total number of breaths (a stacked breath counting as single breath) occurring in 1 min. In this example, five stacked breaths are divided by 30 total breaths resulting in 16.7% stacked breaths.

Figure 2. Area under the curve calculation. Area under the flow-time waveform is the volume of the delivered breath. Computer software was used to calculate the area. The area under the curve (volume) in *panel a* is $a + b$. The area under the curve (volume) in *panel b* is $(a + b) - c$. Note that the expiratory flow between breaths is subtracted. Pressure waveforms are included.

- Nízký V_T nevylučuje hyperinflaci
- Rizika spontánní dechové aktivity
- Rizika ambuingu



PATIENT WITH NORMAL COMPLIANCE AND RESISTANCE

Flowrate is restricted by the SMART BAG® MO to maintain a low airway pressure. The visual Indicator will move forward into the patient valve reminding the rescuer to reduce the force being applied to the bag.

Perspective strategies that failed
(mostly primarly end-points)

INTERVENTION	INDICATION	INFLUENCE 0		*2008*
v. jugularis vs femor	Cannula CRRT	BSI	*Parienti*	*JAMA*
Coloids (10% starch)	Sepsis	Outcome	*Brunkhorst*	*NEJM*
Vasopresin	Septic shock	Outcome	*Russel*	*NEJM*
Insulin	Sepsis	Outcome		
Fluconazole	Persistent febrile	Outcome	*Shustet*	*AnnInterMed*
Hydrocortison	Refract.sep.shock	Mortality	*Sprung*	*NEJM 2008*
Hypertonic solution	Traumatic shock	ARDS free days	*Bulger*	*Ann Surg*
High Volume CRRT	AKF	Outcome	*Palevsky*	*NEJM 2008*
Nutrition guidelines	Critically ill	Outcome	*Doig*	*NEJM 2008*
Hypothermie	KCP u dětí	Outcome	*Hutchison*	*NEJM 2008*

Protokoly RCT, které nesnížily mortalitu, ale ....

Meade MO et al: Ventilation Strategy Using Low Tidal Volumes, **Recruitment Maneuvres and High PEEP** (LOVSstudy) for ALI. (RCT)
JAMA 2008,299, 637-645

Component Variables	Control Ventilation Strategy	Lung Open Ventilation Strategy
Ventilator mode	Volume-assist control	Pressure control
Tidal volume target, mL/kg predicted body weight	6	6
Tidal volume range, mL/kg predicted body weight	4-8	4-8
Plateau airway pressure, cm H_2O	≤30	≤40

	Kontrola	LOVS	P
PEEP	9,8	14,6	<0.001
Mortalita	40,9	36,4	0,19
Barotrauma	9,1	11,2	0,33
Refrakterní hypoxemie	10,2	4,6	0,03
Smrt na refrakterní hypoxemii	8,9	4,2	0.01
Rescue postupy	9,3	5,1	0.03

Trial Registration clinicaltrials.gov Identifier: NCT00182195
JAMA. 2008;299(6):637-645

Research

Ventilation in the prone position: For some but not for all?

Luciano Gattinoni MD, Alessandro Protti MD

- **Není indikovaná pro rutinní použití u ALI**
- **Lze ji použít jako rescue postup**
- **Experimentální data ukazují na její použitelnost jako prevence VILI**
- **Krátkodobé použití ?**
  - **Krátké několikahodinové cykly zlepší oxygenaci, ale neovlivní outcome**

Změna praktického způsobu provádění UPV 1998* vs 2004**)

* ESTEBAN, JAMA,2002,345-355
** ESTEBAN , NEJM 2008

Evolution of Mechanical Ventilation in Response to Clinical Research

Andrés Esteban[1], Niall D. Ferguson[2], Maureen O. Meade[3], Fernando Frutos-Vivar[1], Carlos Apezteguia[4], Laurent Brochard[5], Konstantinos Raymondos[6], Nicolas Nin[1], Javier Hurtado[7], Vinko Tomicic[8], Marco González[9],

- **ARDS**
  - **Snížení VT (7,4 vs 9,1 ml/kg)**
  - **Minimální změny použití PEEP (8,7 vs 7,7cm H2O , p=0,02)**
- **Neinvazivní ventilace**
  - **Četnější NIV11,1% vs 4,4% p< 0,001**
  - **Zvýšené využití v léčbě CHOPN**
  - **Zvýšené využití v léčbě AHRF**
- **Weaning**
  - **Častější využití testu SBT**
  - **Častější využití PSV vs SIMV při postupném odvykání**
- **Timing tracheostomie ???**

Efficacy of Early Tracheostomy to Reduce Incidence of Ventilator Acquired Pneumonia (VAP)

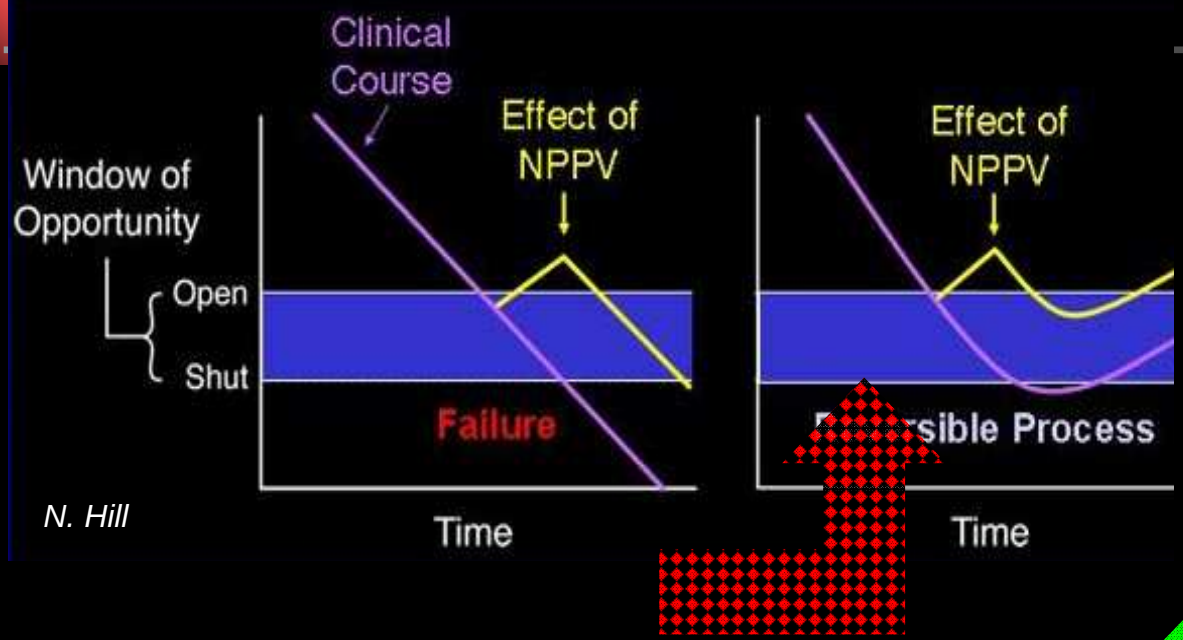
This study has been completed.

First Received: December 5, 2005 Last Updated: January 9, 2009 History of Changes

Italská multicentrická studie , Ranieri et al , ESICM 2009
(600 pacientů, 419 randomizováno)

	EARLY=D3-5 (209)	LATE > 10-12 (210)	
VAP%	14	21*	
MechVen(days)	16±1	19 ±18*	
ICU(days)	21±1	23 ±1*	p < 0,05
Mortality 28D	23	30	p = 0,08
Total Cost (EUROS)	31,7	37,7	
Sedativa	257	402*	
ATB	526	554	

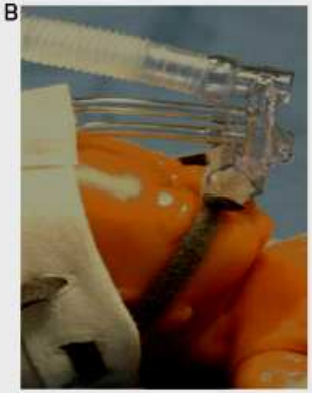
KEY ELEMENTS FOR SUCCESSFULL IMPLEMENTATION OF NPPV?
CLINICAL EVALUATIONS OF RISK AND BENEFITS



- **Time factor** *not too early, not too late*
- **Cause of ARF** *COPD, CHF or other ??*
- **Reversibility of illness** ***hours/days***
  - ***Speed of healing process***
  - ***Extent of lung damage***
  - ***Derangment of lung function***

RESPIRATORY CARE • SEPTEMBER 2009 VOL 54 NO 9

NASAL CPAP FOR THE RESPIRATORY CARE OF THE NEWBORN INFANT



nt Flow continuous positive airway pressure (CPAP) system. A: The Infant Flow driver. B: Infant Flow gene
al mask. (Courtesy of Cardinal Health.)

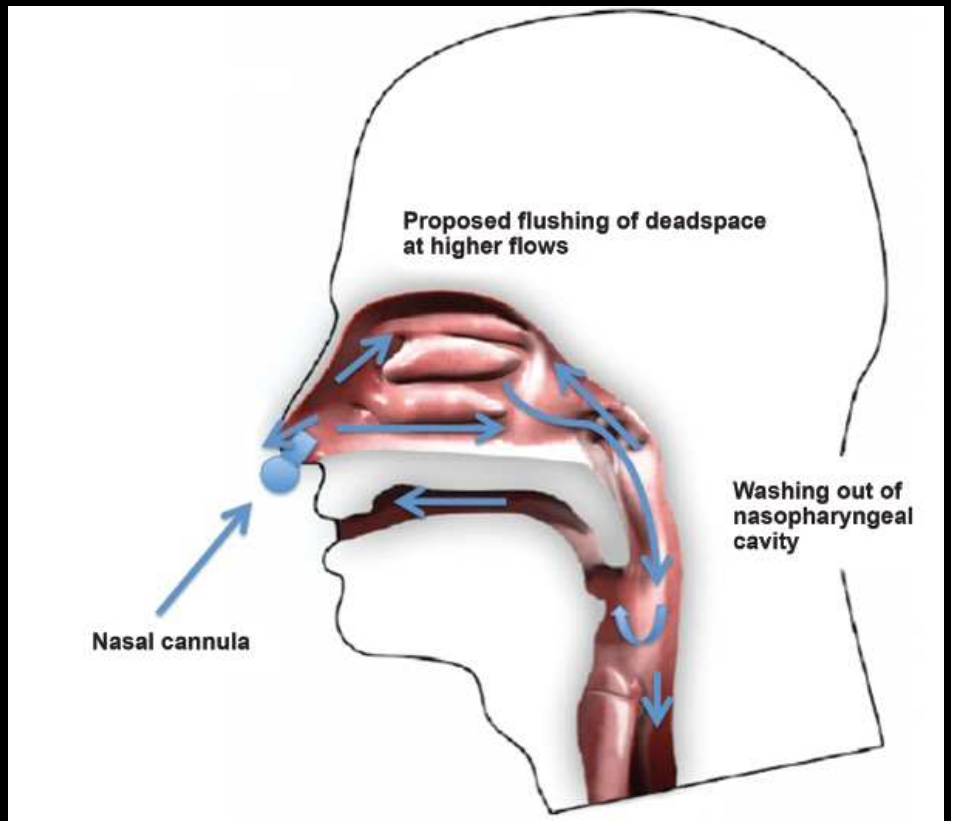


Fig. 3. Proposed reduction in nasopharyngeal dead space that leads to improving alveolar ventilation with high-flow nasal cannula.

Intensive Care Med (2009) 35:192–194
DOI 10.1007/s00134-008-1351-x

EDITORIAL

Alexandre Demoule

Non-invasive ventilation: how far away from the ICU?

Luca Cabrini
Cristina Idone
Sergio Colombo
Giacomo Monti
Pier Carlo Bergonzi
Giovanni Landoni
Davide Salaris
Carlo Leggieri
Giorgio Torri

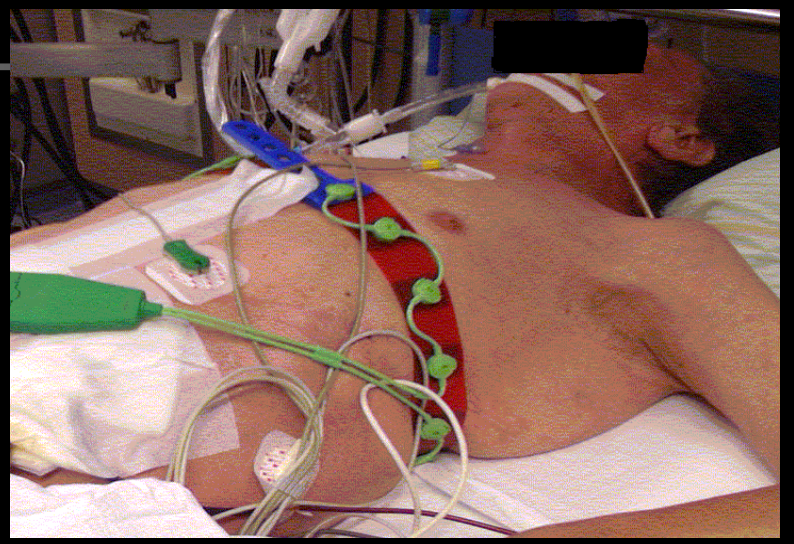
Medical emergency team and non-invasive ventilation outside ICU for acute respiratory failure

Biomedicínské inovace

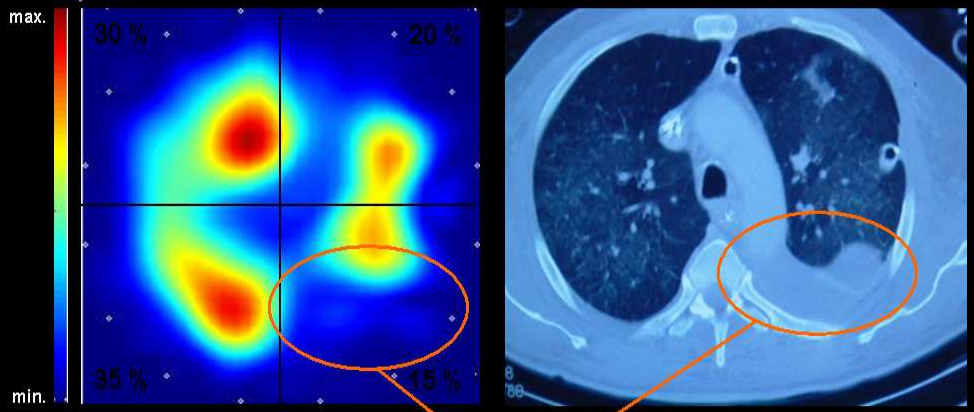
Electric Impedance Tomography
Future Xmas Wish List of Intensivist ?
ICM, *2008, 4,2,400-401*

Diagnostika

- **Laboratorní (NT-proBNP, SvO2)**
- **Mechanika (PV tool, Peso)**
- **Volumetrická kapnometrie**
- **EIT**
- **EVLW**



Kontinuální kvantitavní vyhodnocení regionální ventilace



Pelurální efuse pri rupture bránice

Biomedicine innovations

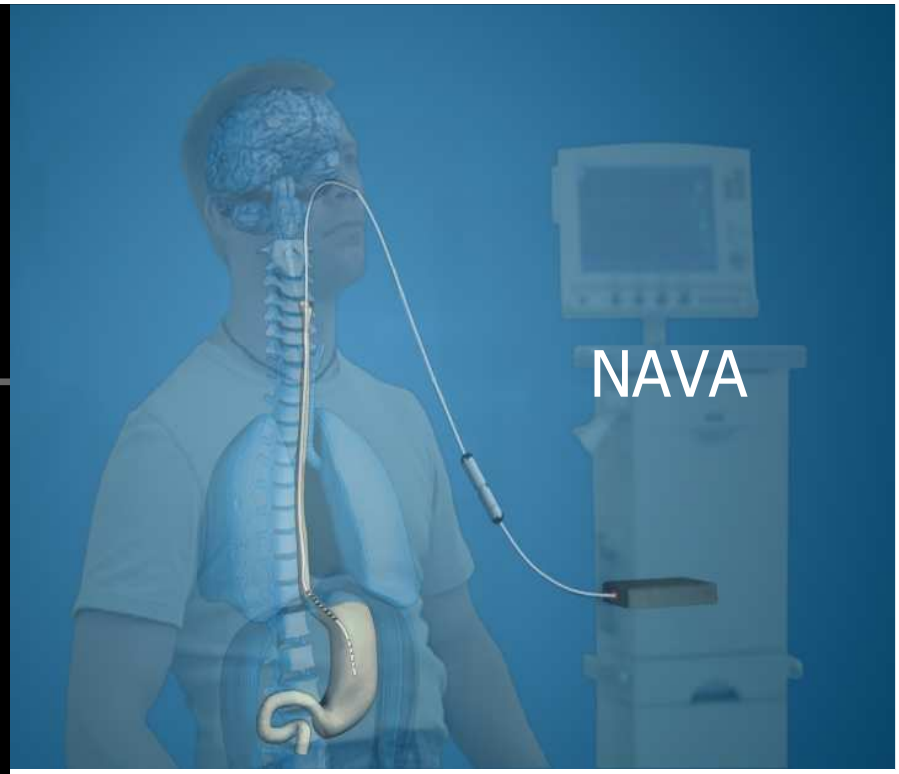
New Ventilatory Technylogy

- CPAP systems in neonatology
- HFOV , Percussive ventilation
- Closed loop : ASV, PAV
- Noisy PSV
- Weaning : ATC, NAVA, SmartCare
- Oesophageal pressure
- New media
  - HELIOX, iNO, i CO

The Evolution of Carbon Monoxide Into Medicine

Leo E Otterbein PhD

RESPIRATORY CARE • JULY 2009 VOL 54 NO 7



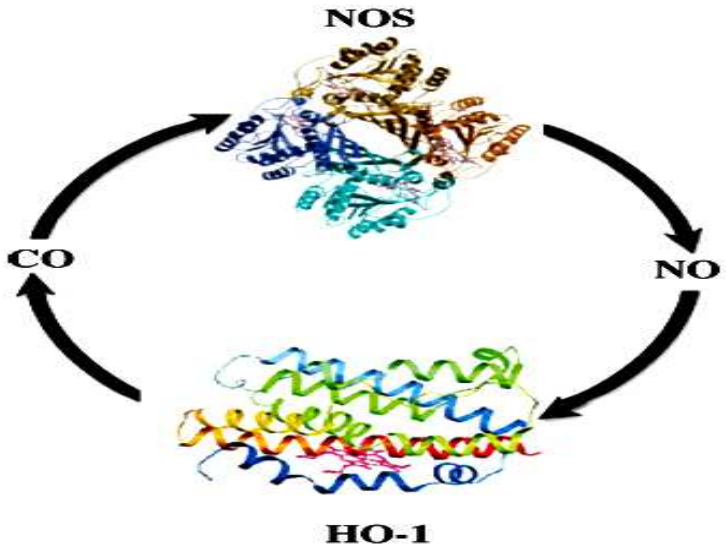
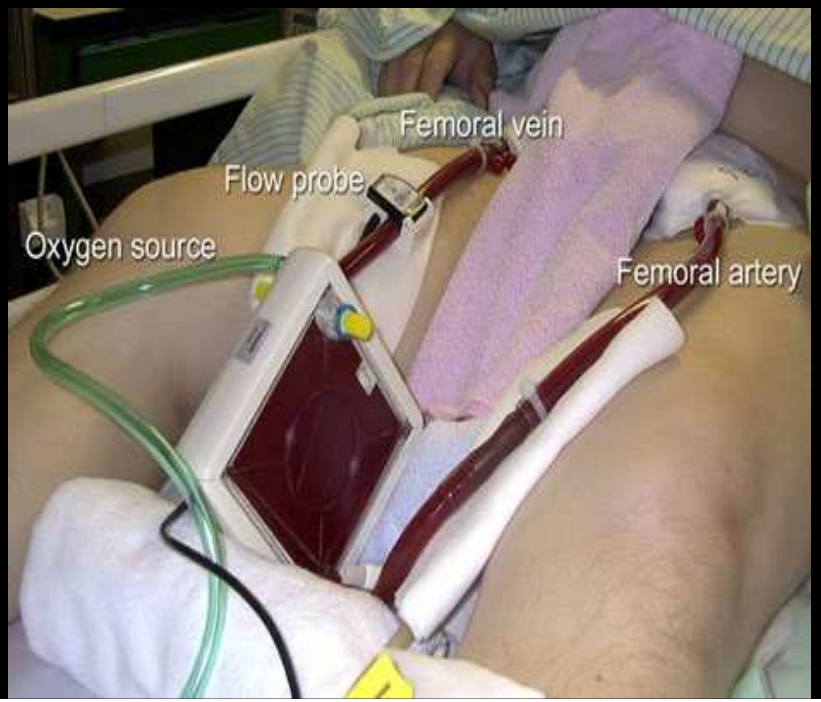


Fig. 3. Hypothetical carbon monoxide (CO) and nitric oxide (NO) gas cycle. The enzymes nitric oxide synthase (NOS) and heme oxygenase 1 (HO-1) produce NO and CO, respectively, and NO and CO may can enhance or inhibit enzyme activity, as dictated by cellular need.

Non-ventilatory orientated strategies

influencing outcome of ventilated patients

- **Sedation/NMBA (protocols)**
- **Air-way management**
  - **Alternative in emergencies**
  - **New materials**
- **Fluid therapy**
- **TRALI and Transfusion Threshold**
- **Intravascular Lung Assitance**
- **Prevence VAP**
- **Nutriční intervence**



Intensive Care Med (2008) 34:1145–1149
DOI 10.1007/s00134-008-1016-9

PHYSIOLOGICAL AND TECHNICAL NOTES

Alberto Zanella
Massimo Cressoni
Myra Epp
Mario Stylianou
Theodor Kolobow

A double-layer tracheal tube cuff designed to prevent leakage: a bench-top study

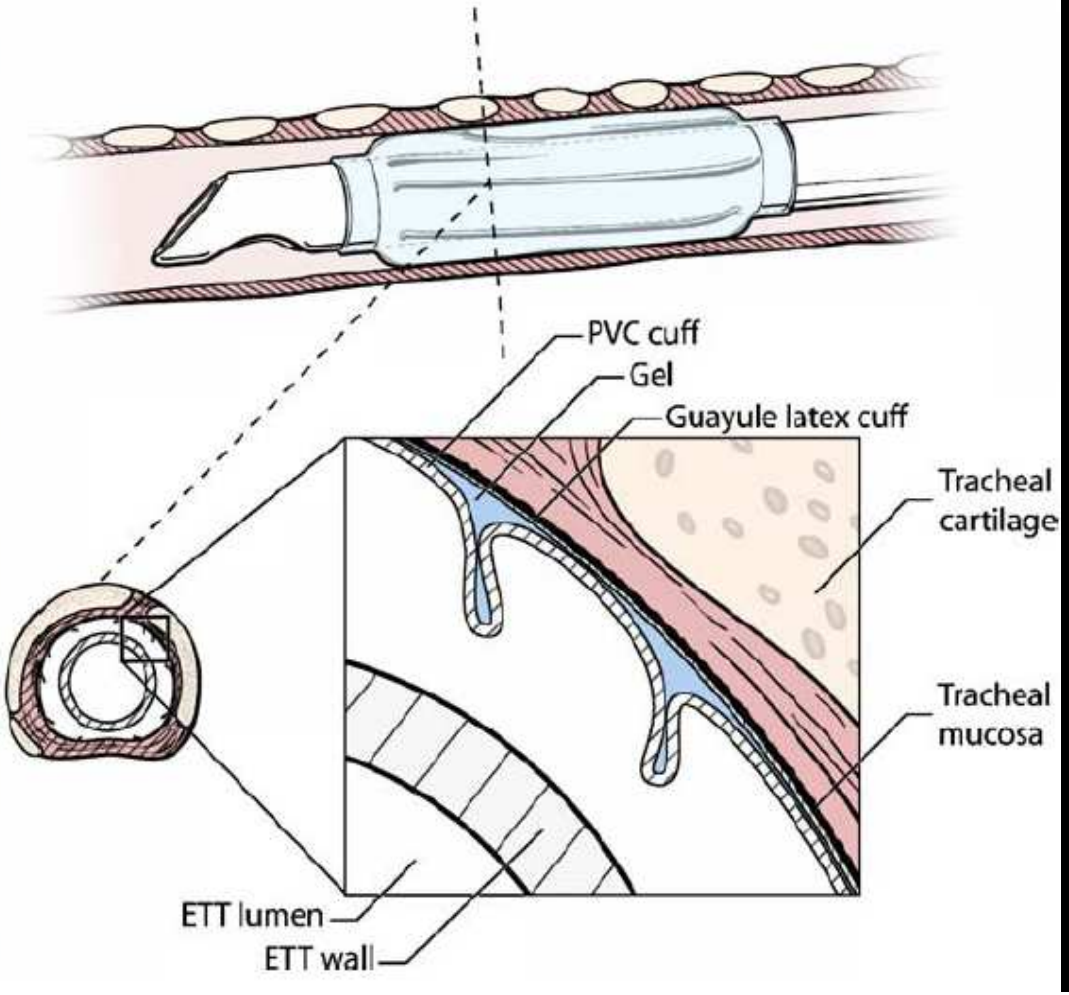


Fig. 1 *Left* The guayule latex prototype cuff inflated at 20 cmH_2O of pressure in a cylindrical glass tube (ID 20 mm) shows no fold and no dye leaking. *Right* The guayule latex prototype cuff is a standard endotracheal tube with a high-volume low-pressure cuff, draped by a very thin, highly compliant guayule latex cuff; 0.5 ml gel is introduced between the two cuffs

Silver-Coated Endotracheal Tubes and Incidence of Ventilator-Associated Pneumonia: The NASCENT Randomized Trial

Marin H. Kollef; Bekele Afessa; Antonio Anzueto; et al.

JAMA. 2008;300(7):805-813 (doi:10.1001/jama.300.7.805)

http://jama.ama-assn.org/cgi/content/full/300/7/805

- Délka UPV n.s.
- ICU LOS n.s.
- mortalita n.s.

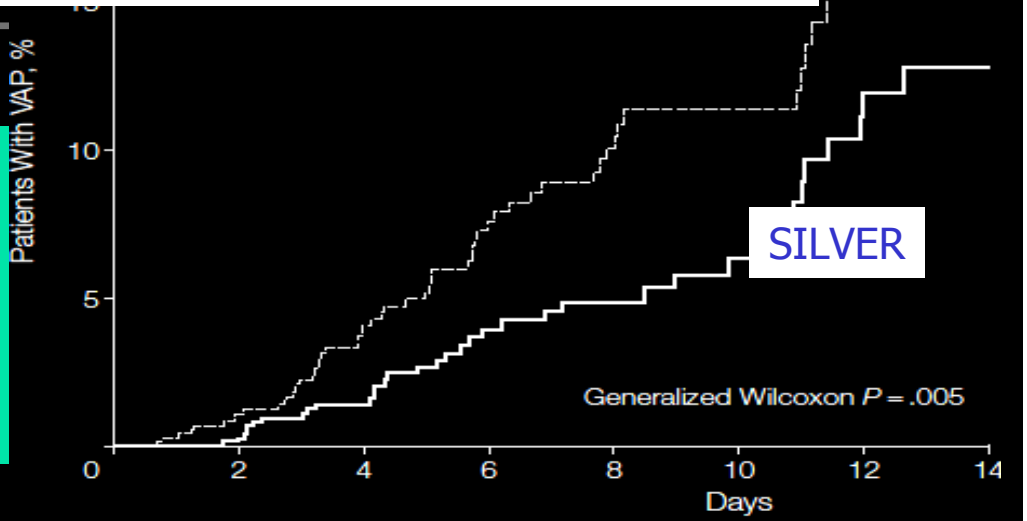


Table 2. Incidence of Microbiologically Confirmed Ventilator-Associated Pneumonia (VAP)[a]

	Evaluable Patients With VAP, No./Total (%) [95% CI]			
	Silver-Coated Tube	Uncoated Tube	RR Reduction, % (95% CI)	*P* Value
VAP at any time				
Intubated ≥24 h	37/766 (4.8) [3.4-6.6]	56/743 (7.5) [5.7-9.7]	35.9 (3.6-69.0)	.03
All intubated	37/968 (3.8) [2.7-5.2]	56/964 (5.8) [4.4-7.5]	34.2 (1.2-67.9)	.04
VAP within 10 d of intubation				
Intubated ≥24 h	27/766 (3.5) [2.3-5.1]	50/743 (6.7) [5.0-8.8]	47.6 (14.6-81.9)	.005
All intubated	27/968 (2.8) (1.9-4.0)	50/964 (5.2) (3.9-6.8)	46.2 (12.6-81.1)	.007

Nejčastější respirační onemocnění

Diagnosis	Number of Diagnosed Individuals	Estimated Undiagnosed Individuals	Estimated Cost of Care ($)	Facts
Chronic obstructive pulmonary disease	12 million	12 million	$37 billion (2004)	Fourth most common cause of death.[17,18]
Asthma	22 million	Unknown	$19 billion	Rising prevalence in younger individuals. Falling death rate: 4,000–5,000 deaths per year.[19]
Obstructive sleep apnea	18 million	Unknown	Unknown	Drowsiness causes 100,000 accide and 40,000 injuries per year.[20,21]
Lung cancer	2.2 million	Unknown	Unknown	Falling incidence since 1994. 150,000 deaths in 2004.[22,23]
Interstitial fibrosis	200,000	Unknown	Unknown	Industrial exposure and idiopathic are common etiologies.[24,25]
Cystic fibrosis	30,000	Unknown	Unknown	Increasing diagnosis with neonatal [26]

Očekávané změny systému respirační péče po roce 2015 v USA

(B. Kaczmarek, Respiratory Care 2009)

- **Bude poskystována komplexněji a ubikviterněji**
- **Bude více protokolizovaná**
- **Nemocniční týmy jako MET budou i mimo nemocnici**
- **Invaze nových technologií - TELE-TECHNOLOGIE**
- **Hnací motor pozitivních změn**
  - **EKONOMIKA VEŘEJNÉHO ZDRAVOTNICTVÍ**
  - **PANDEMIE**
  - **POTREBY ARMÁDY (NASA)**

HealthCast 2020: Creating a Sustainable Future

Table 9. Key Points From the Price Waterhouse Coopers Health Research Institute Report "HealthCast 2020: Creating a Sustainable Future"[96]

- ✓ Both private and government sources will be needed to fund health care.
- ✓ Consumerism will change the way care is delivered.
- ✓ Focus will shift to wellness and prevention.
- ✓ Pay-for-performance will become the new paradigm.
- ✓ Information technology will form the backbone of care.
- ✓ Innovative, flexible care models will emerge.

Budoucnost respirační léčby i mimo kritické stavy

(B. Kaczmarek, Respiratory Care 2009)

- **Aerosolová léčba**
  - heparin — fibrosa, astma
  - Furosemid — dušnost
  - opioidy — dušnost
  - Insulin — diabetes
  - Calicitonin — osteoporisis
  - LSH,FSG — neplodnost
  - GSG — růst
  - Interferon — hepatitis
- **Genomika**
  - Genová léčba alfa- antitrypsin defecience, cystická fibrosa
  - Variabilta odpovědí na beta 2 a steroidy při ARDS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