Proč compliance a driving pressure mohou být nevhodným cílem při volbě PEEP u pacientů s ARDS?

Pavel Dostál

Klinika anesteziologie, resuscitace a intenzivní medicíny
Univerzita Karlova, Lékařská fakulta v Hradci Králové
Fakultní nemocnice Hradec Králové

Konflikt zájmů

Bez konfliktu zájmů k danému tématu.

Přístupy k optimalizaci PEEP

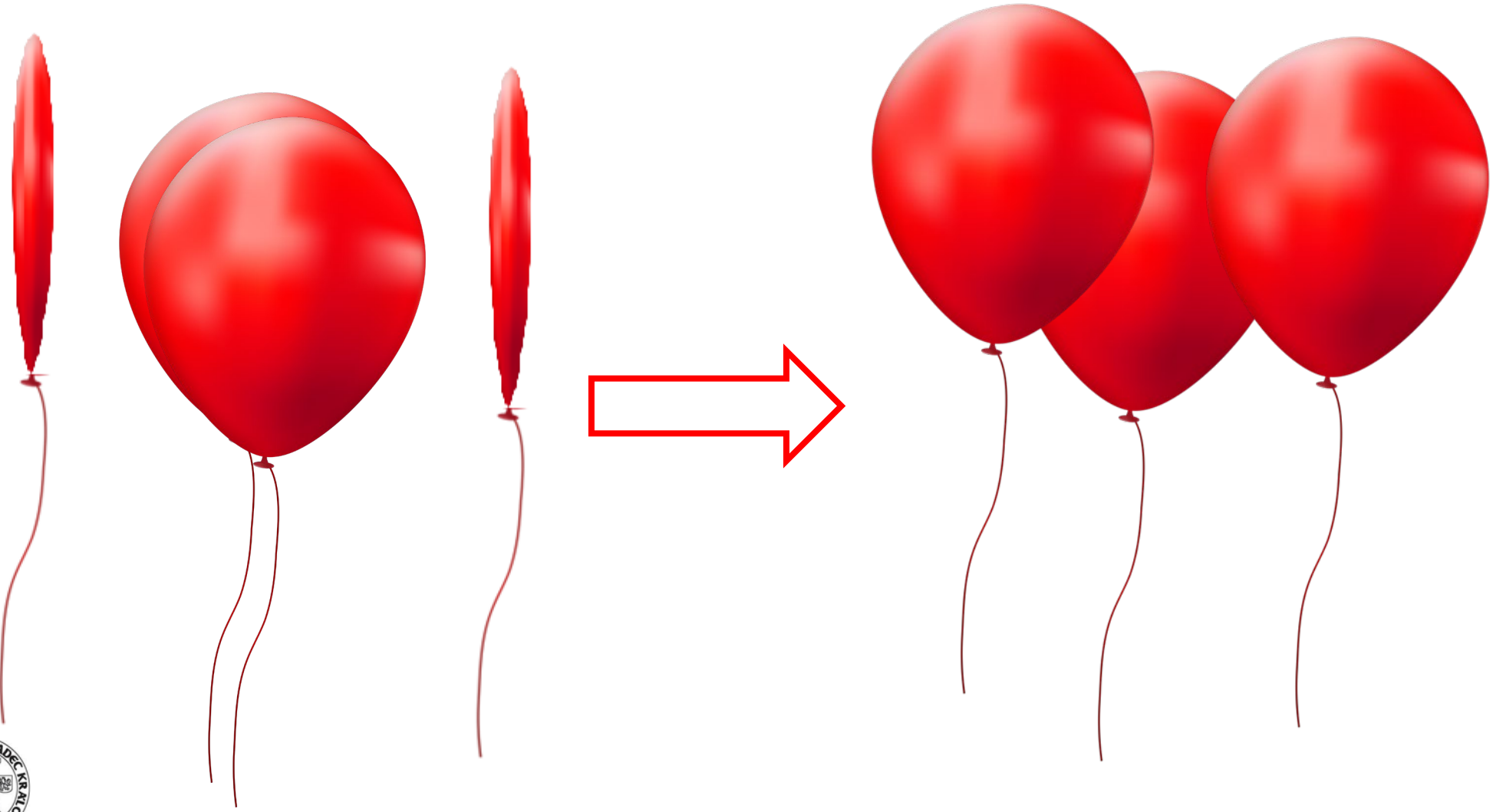
Fixní přístupy

- ARMA trial
- Fixed PEEP levels

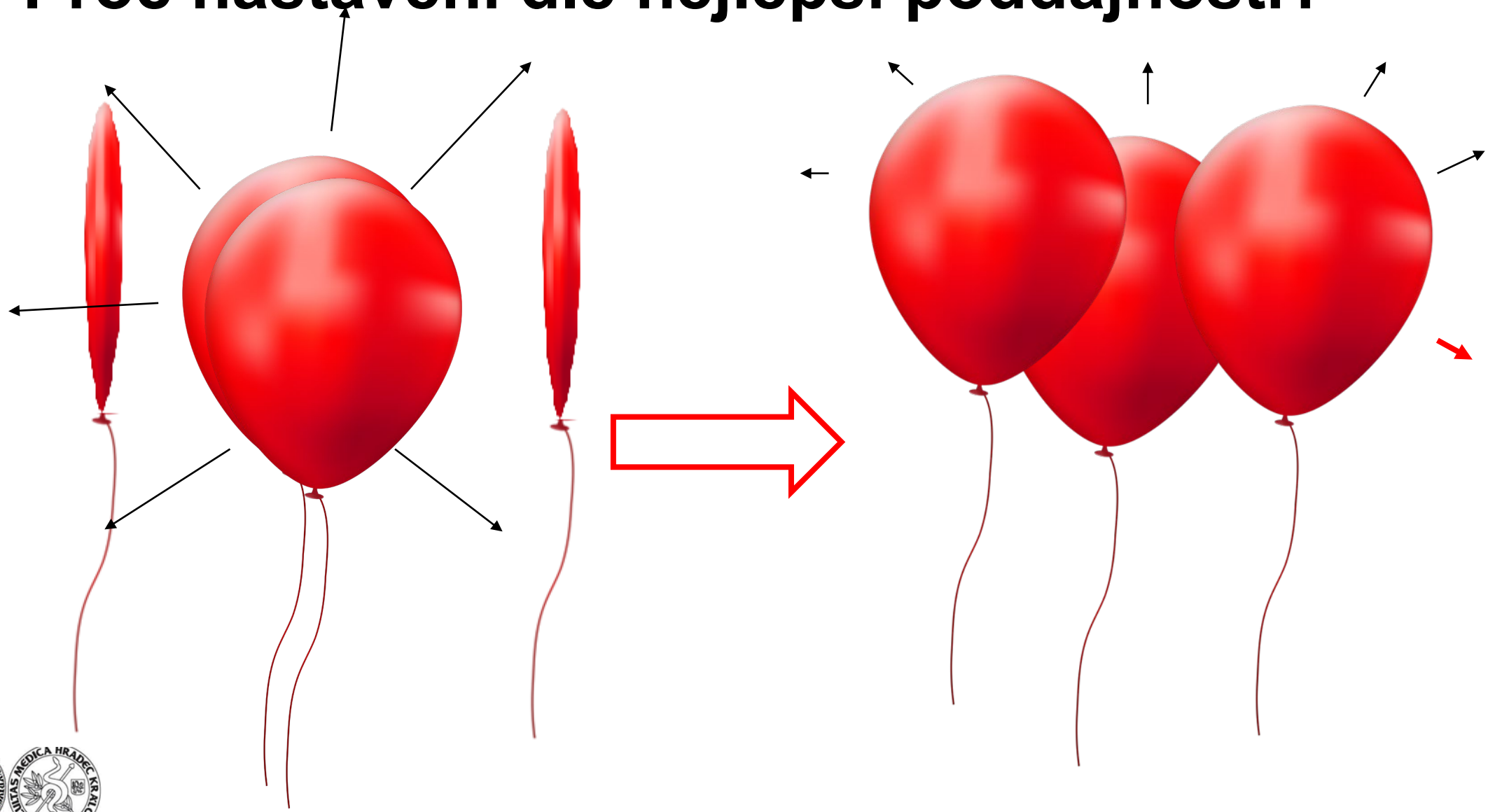
„Personalizované“ přístupy:

- PV loop
- **Decremental PEEP trial – best compliance/time constant**
- Esophageal pressure
- EIT
- VCO_2
- Intratidal compliance
- …..

Proč nastavení PEEP dle nejlepší poddajnosti?



Proč nastavení dle nejlepší poddajnosti?



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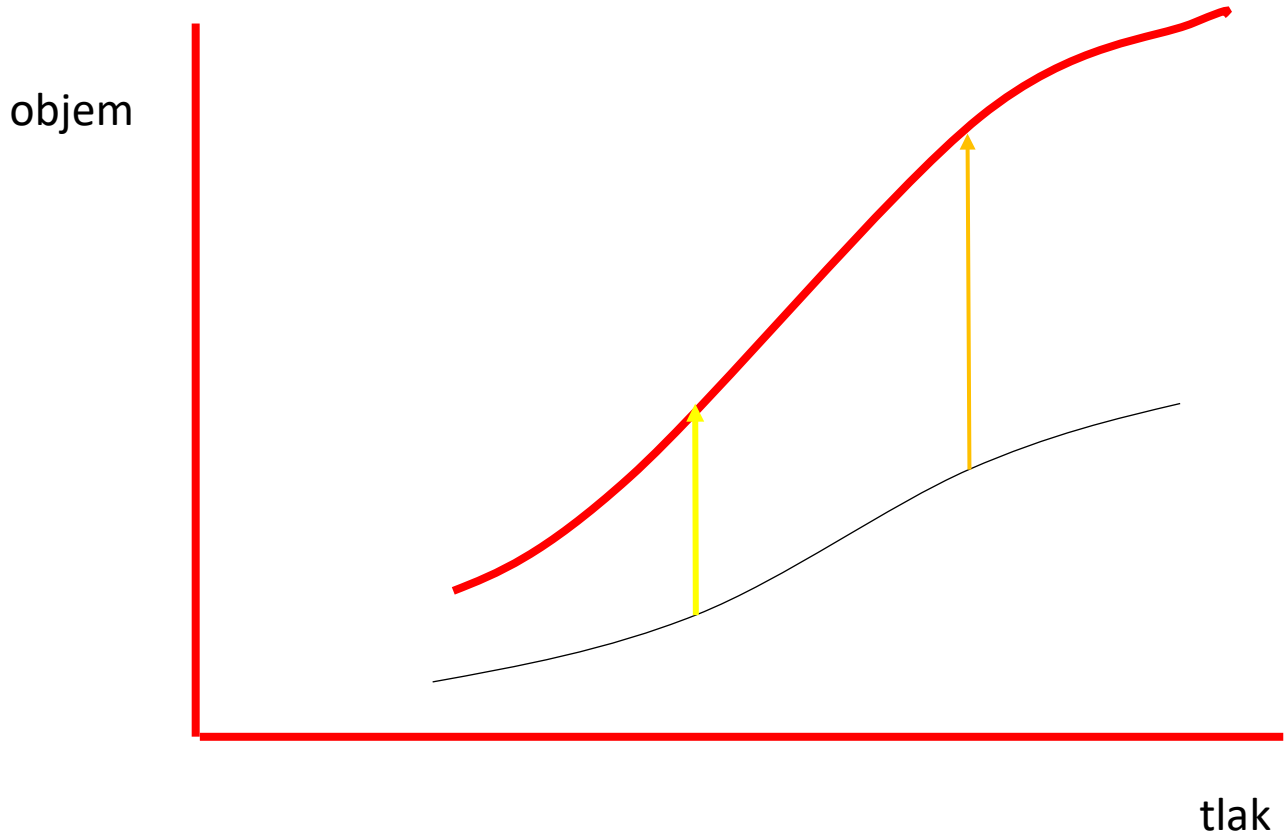
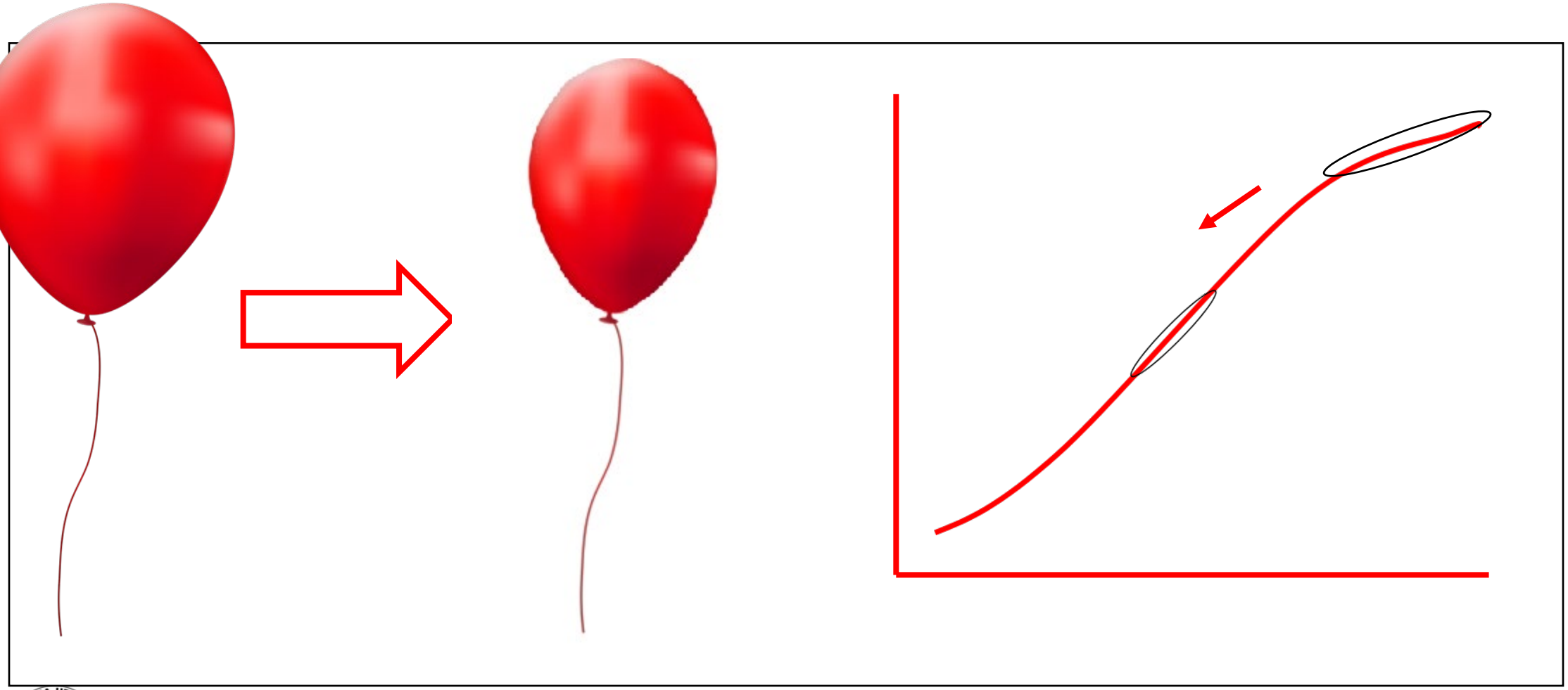
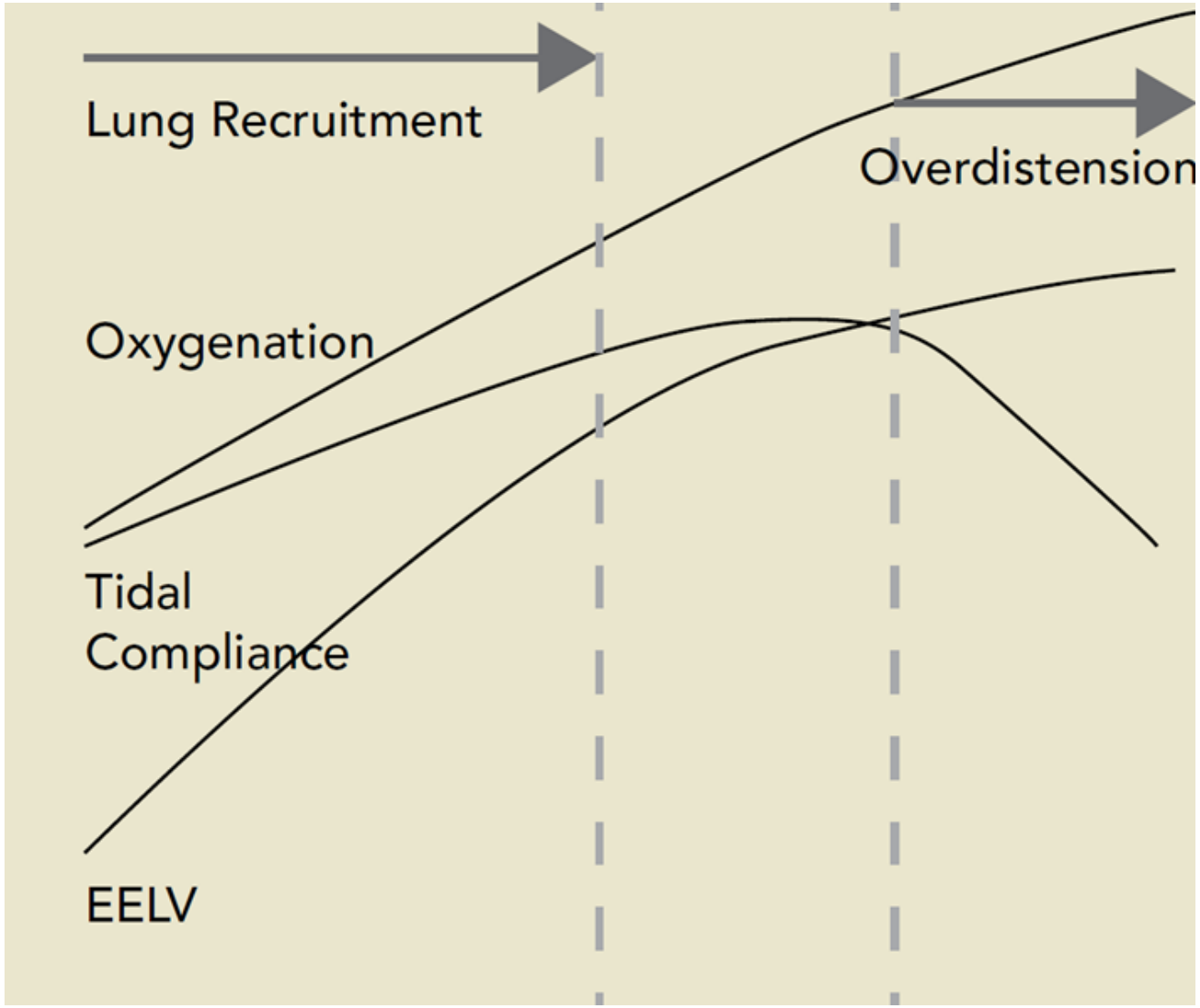





Lung Recruitment
Overdistension
Oxygenation
Tidal
Compliance
EELV
PEEP

Editorial

Open up the lung and keep the lung open

B. Lachmann

Department of Anesthesiology, Erasmus University Rotterdam, The Netherlands

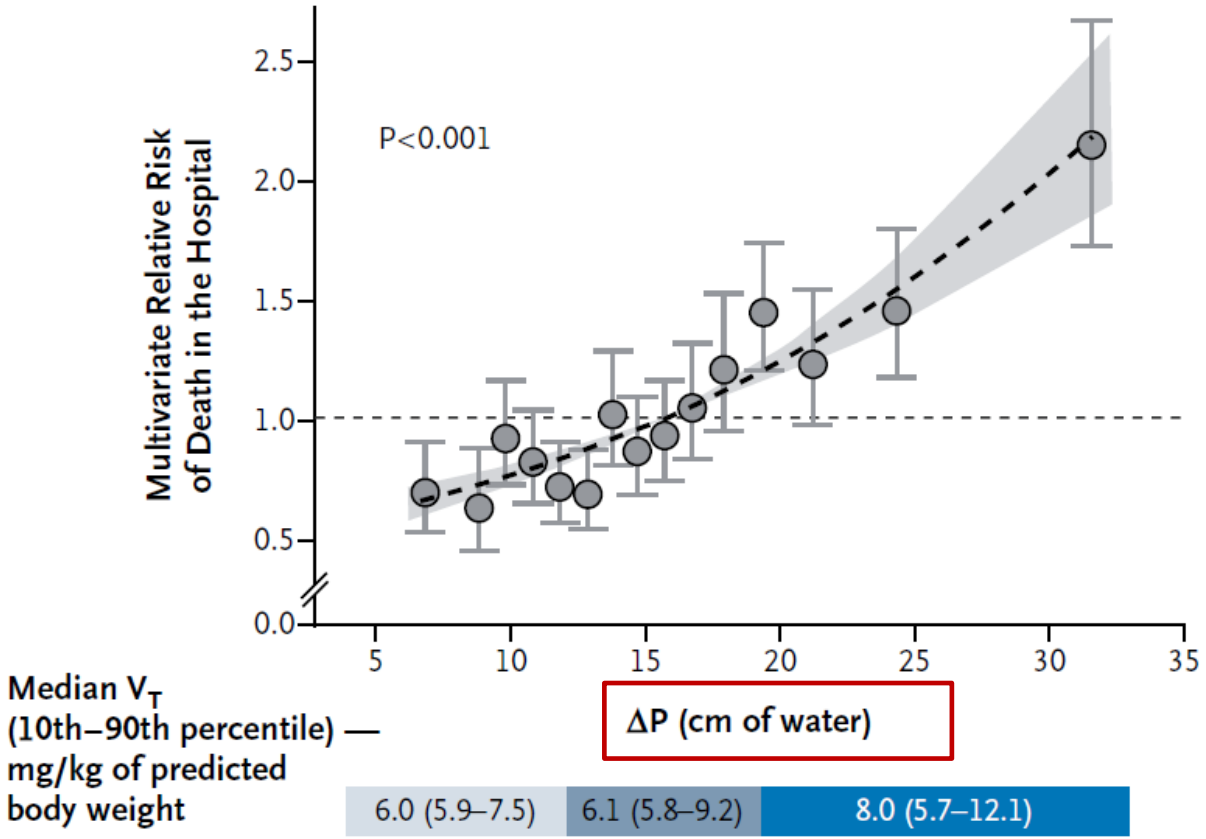
Why is it so important to ventilate lungs with as small as possible pressure amplitude?

Intensive Care Med (1992) 18:319–321

Intensive Care Medicine

Driving Pressure and Survival in the Acute Respiratory Distress Syndrome

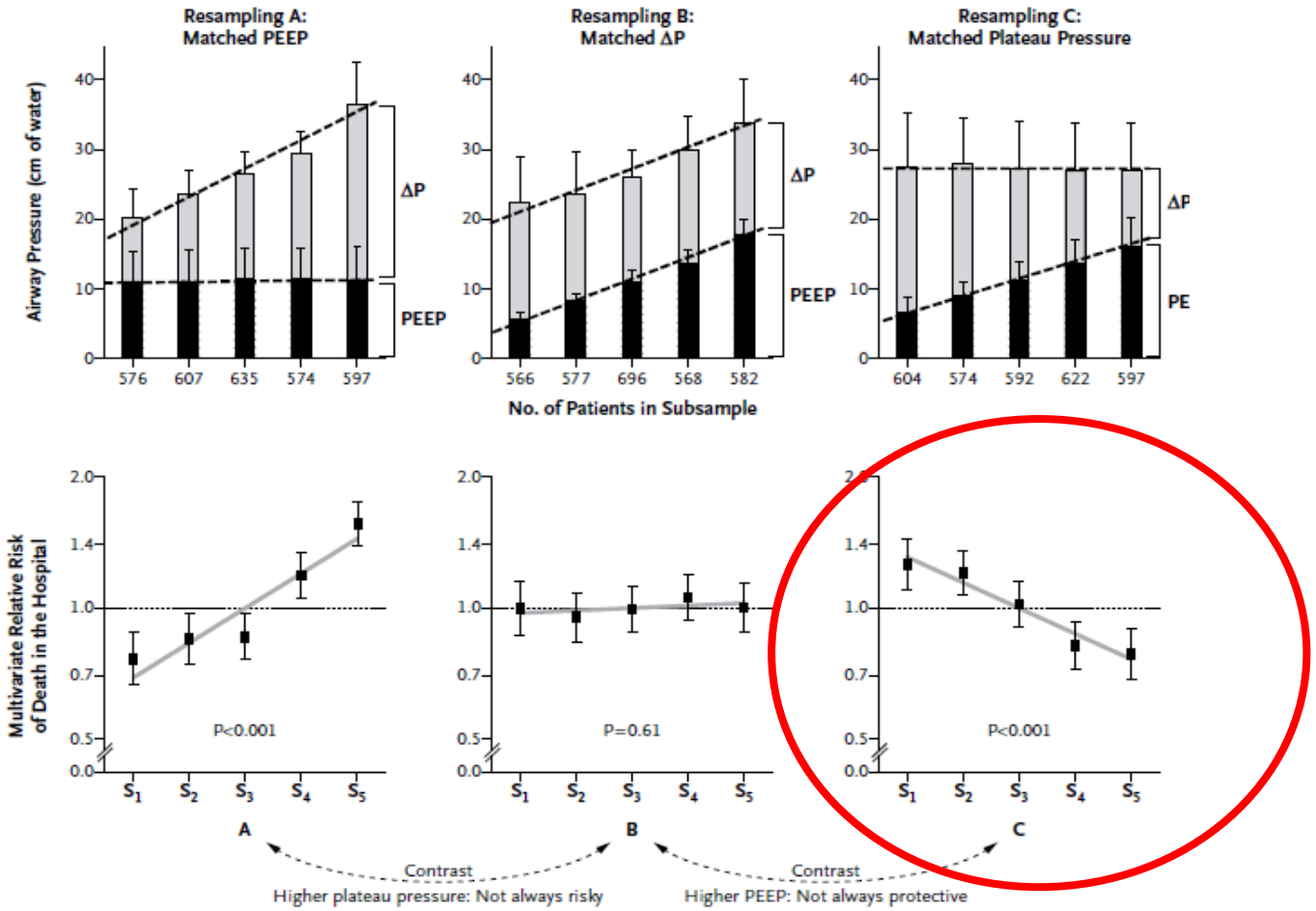
Marcelo B.P. Amato, M.D., Maureen O. Meade, M.D., Arthur S. Slutsky, M.D.,



N Engl J Med 2015;372:747-55.

Driving Pressure and Survival in the Acute Respiratory Distress Syndrome

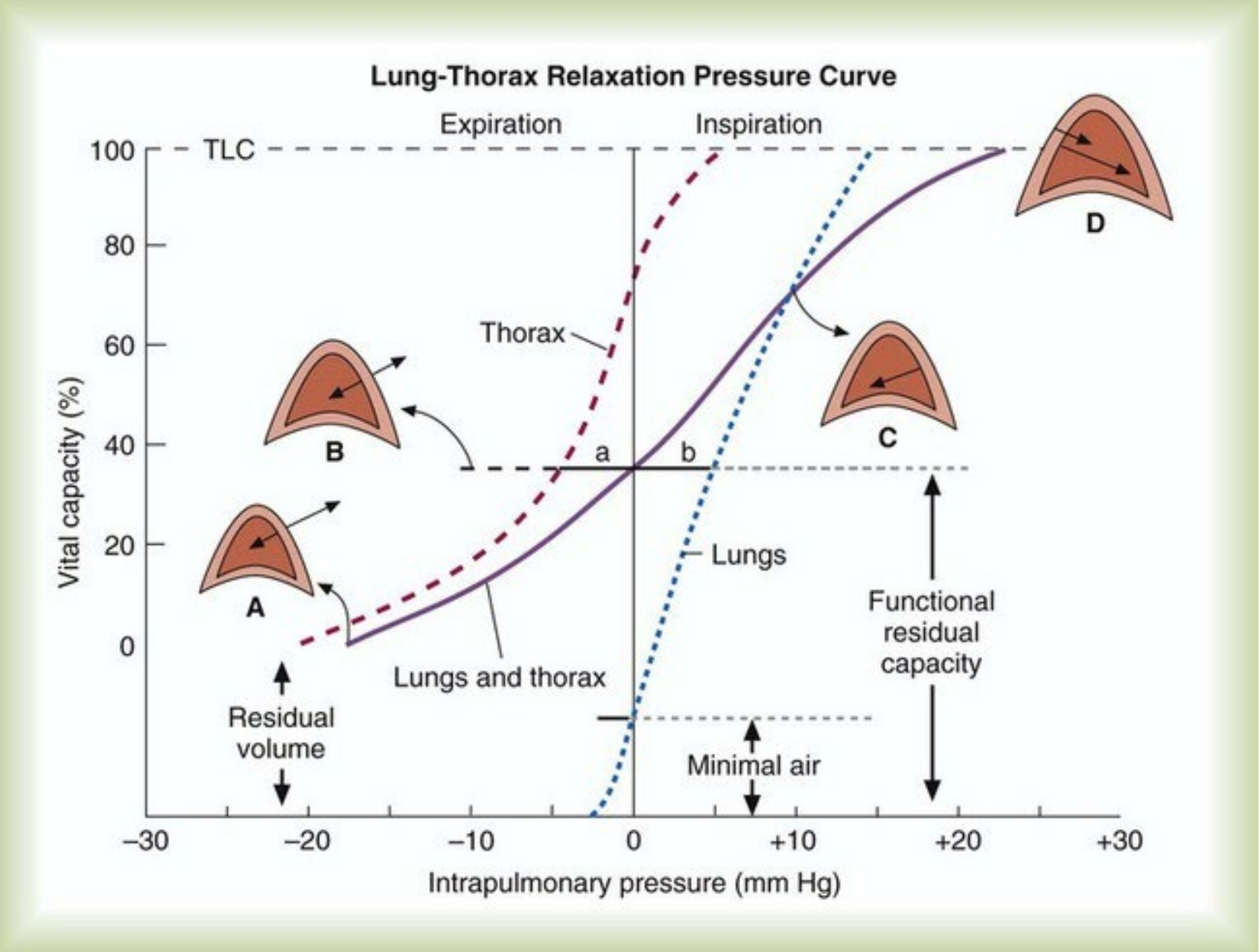
Marcelo B.P. Amato, M.D., Maureen O. Meade, M.D., Arthur S. Slutsky, M.D.,



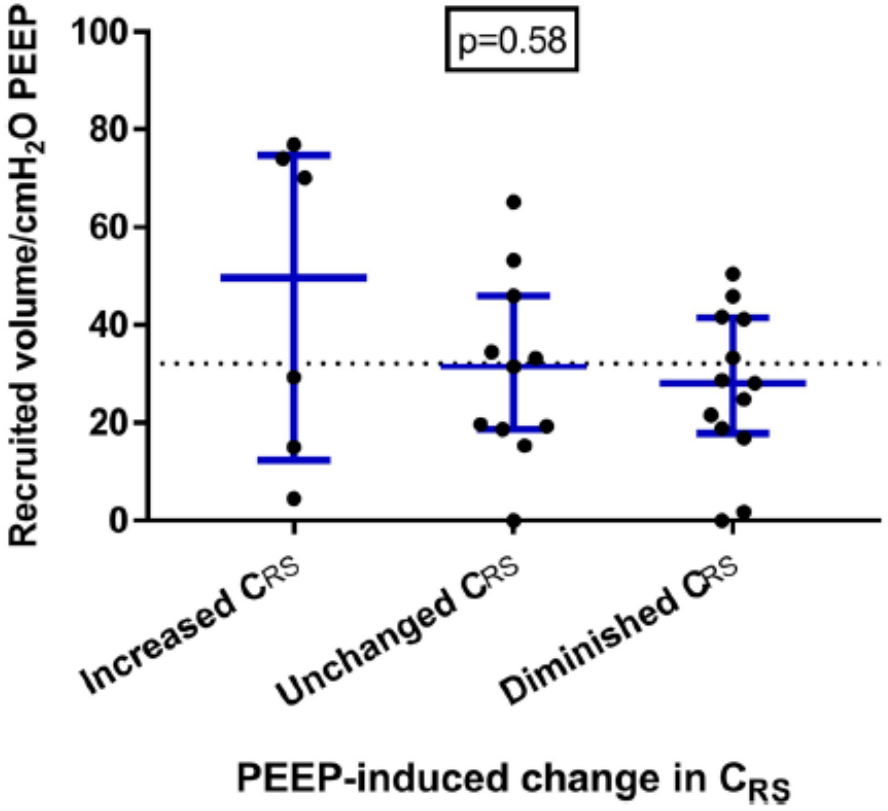
N Engl J Med 2015;372:747-55.

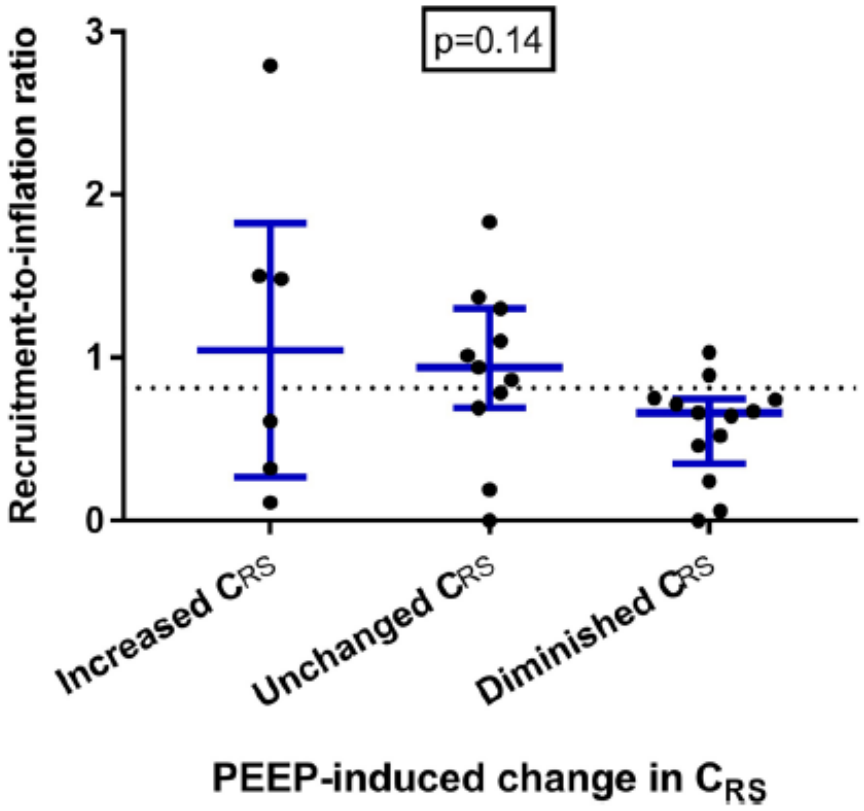
Problémy?

- Odrážejí změny poddajnosti respiračního systému změny poddajnosti plic?
- Je použití poddajnosti vhodné k detekci recruitmentu/derecruitmentu plic?
- Je ventilace s lepší poddajností spojena s lepším klinickým výsledkem?

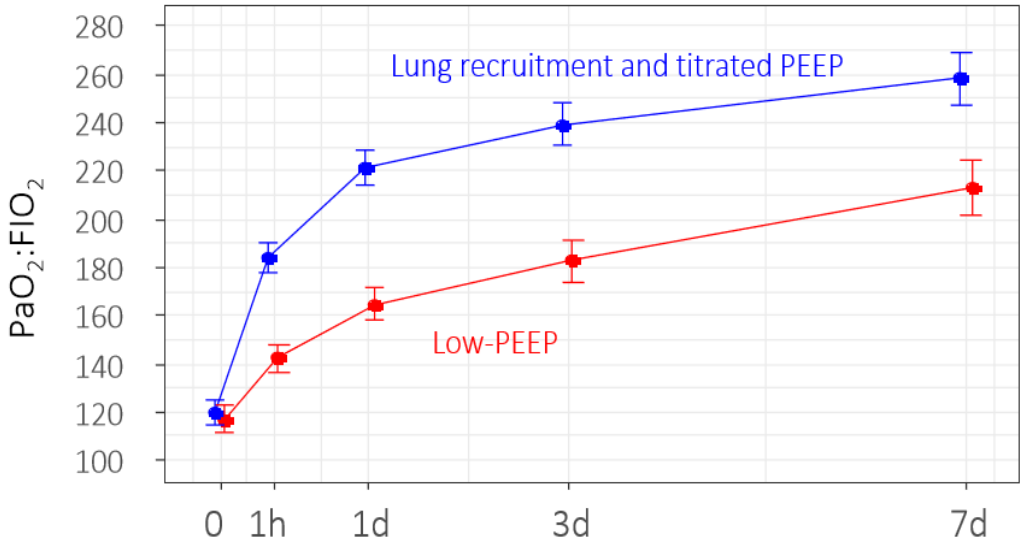


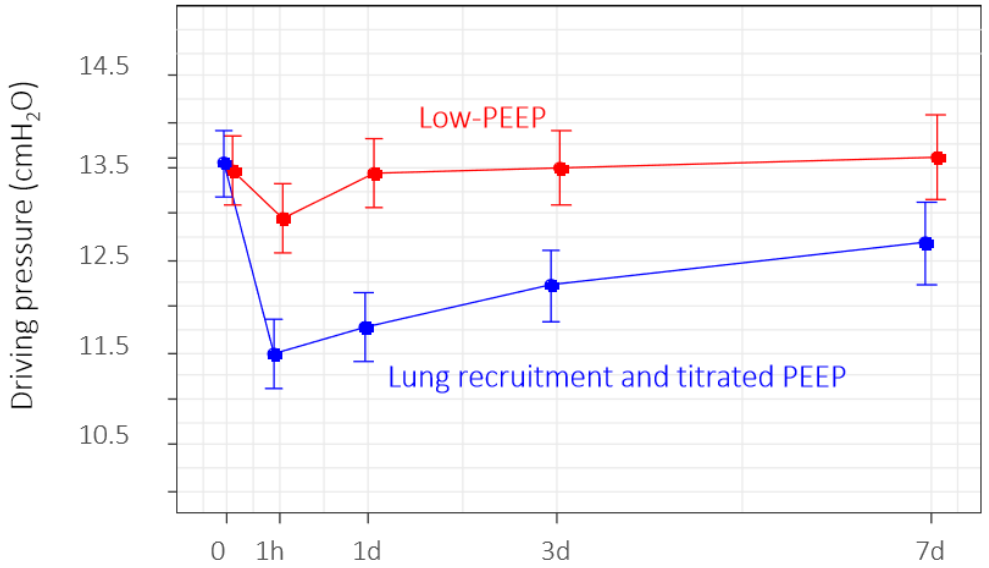
https://thoracickey.com/ventilation/





Grieco *et al. Critical Care* (2022) 26:234
https://doi.org/10.1186/s13054-022-04109-7





https://criticalcarecanada.com/presentations/2017/lung_recruitment_in_ards_the_art_trial.pdf

Effect of Lung Recruitment and Titrated Positive End-Expiratory Pressure (PEEP) vs Low PEEP on Mortality in Patients With Acute Respiratory Distress Syndrome

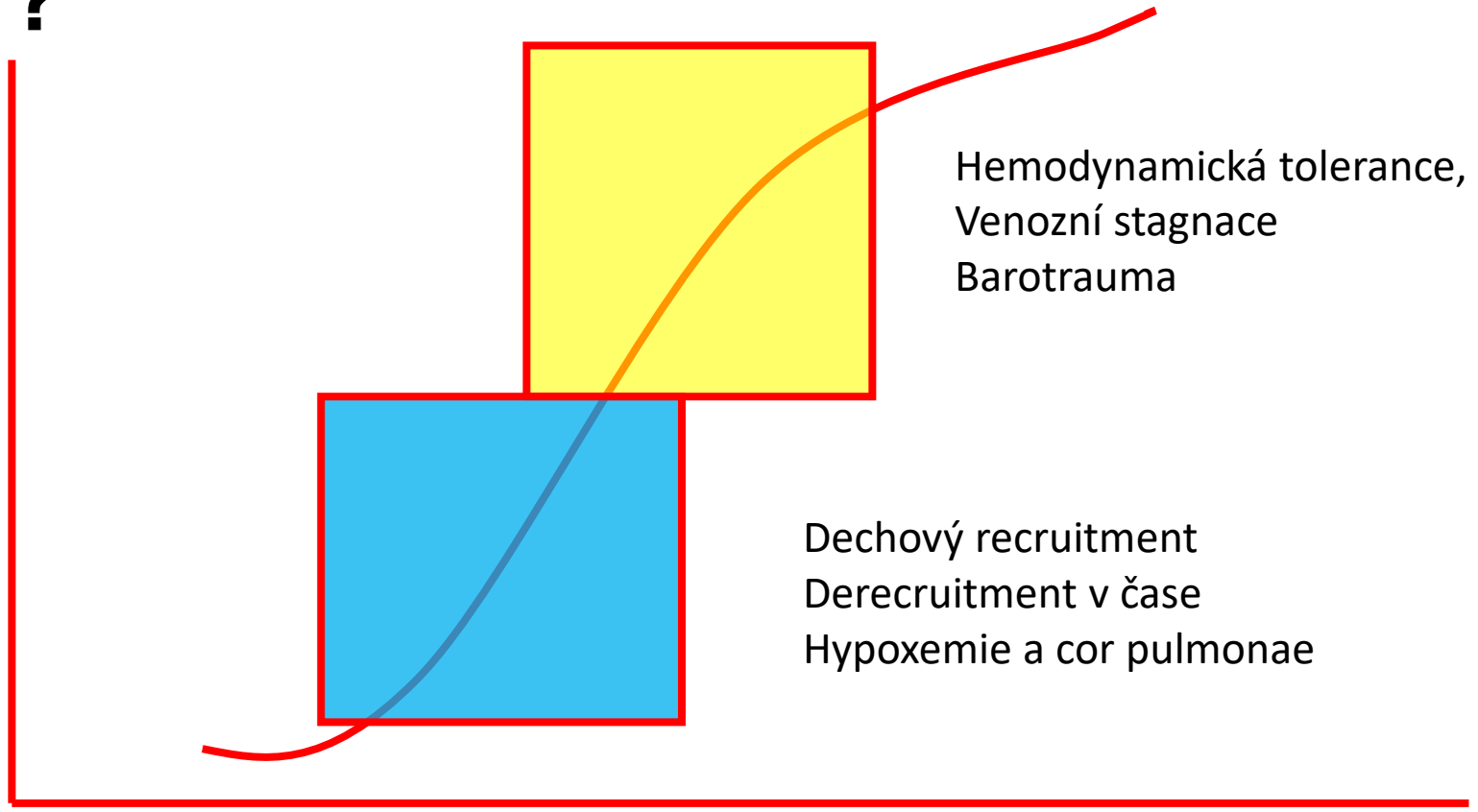
A Randomized Clinical Trial

Writing Group for the Alveolar Recruitment for Acute Respiratory Distress Syndrome Trial (ART) Investigators

RESULTS A total of 1010 patients (37.5% female; mean [SD] age, 50.9 [17.4] years) were enrolled and followed up. At 28 days, 277 of 501 patients (55.3%) in the experimental group and 251 of 509 patients (49.3%) in the control group had died (hazard ratio [HR], 1.20; 95% CI, 1.01 to 1.42; *P* = .041). Compared with the control group, the experimental group strategy increased 6-month mortality (65.3% vs 59.9%; HR, 1.18; 95% CI, 1.01 to 1.38; *P* = .04), decreased the number of mean ventilator-free days (5.3 vs 6.4; difference, −1.1; 95% CI, −2.1 to −0.1; *P* = .03), increased the risk of pneumothorax requiring drainage (3.2% vs 1.2%; difference, 2.0%; 95% CI, 0.0% to 4.0%; *P* = .03), and the risk of barotrauma (5.6% vs 1.6%; difference, 4.0%; 95% CI, 1.5% to 6.5%; *P* = .001). There were no significant differences in the length of ICU stay, length of hospital stay, ICU mortality, and in-hospital mortality.

JAMA. 2017;318(14):1335-1345. doi:10.1001/jama.2017.14171

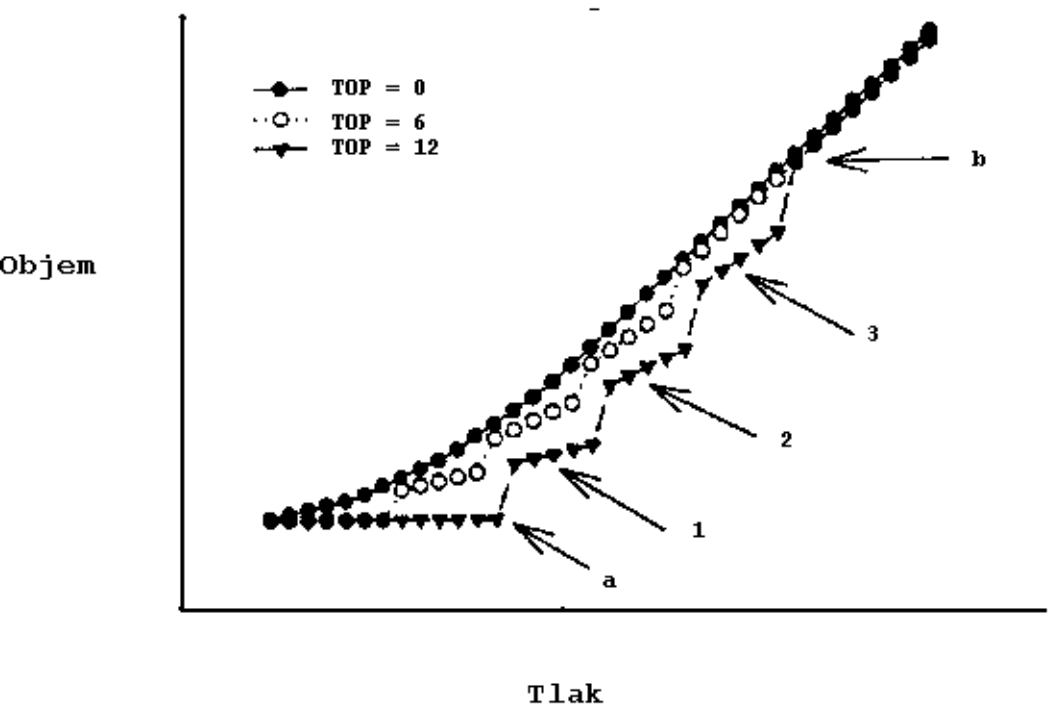
Příčiny?

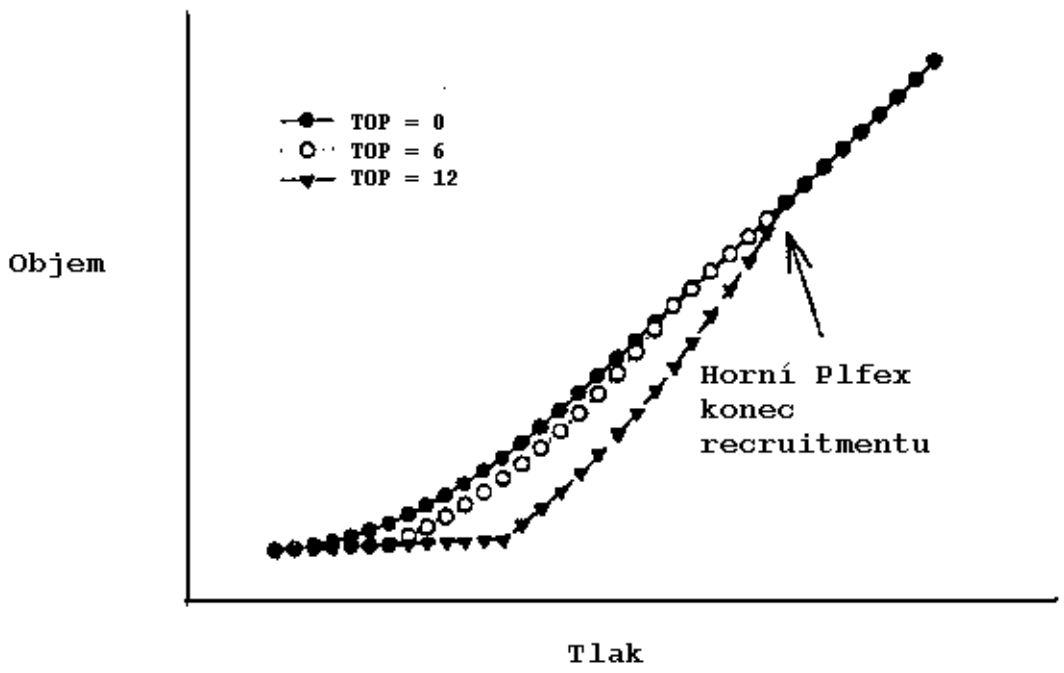


Hemodynamická tolerance, cor pulmonale
Venozní stagnace
Barotrauma

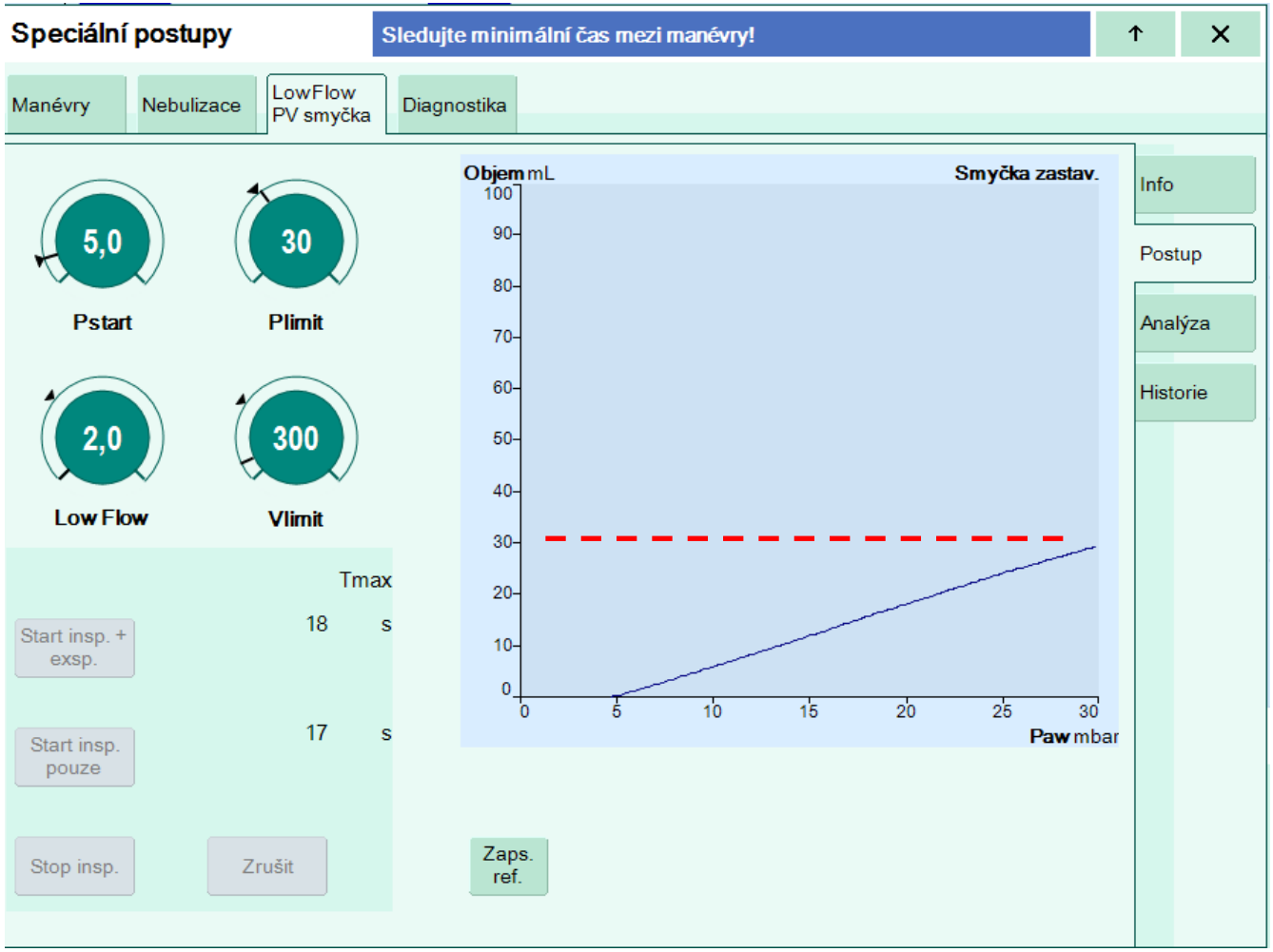
Dechový recruitment
Derecruitment v čase
Hypoxemie a cor pulmonae

Dechový recruitment a compliance

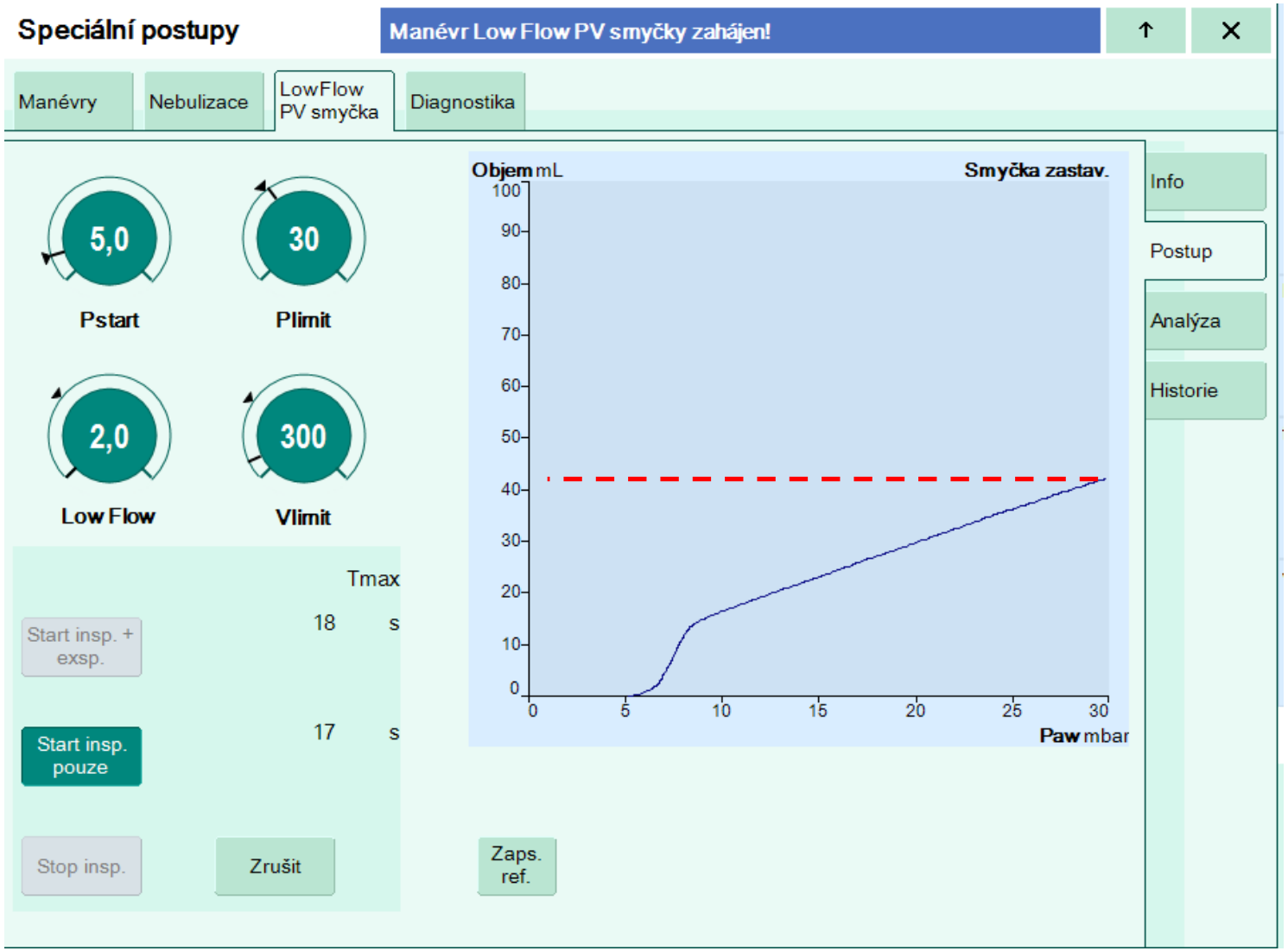




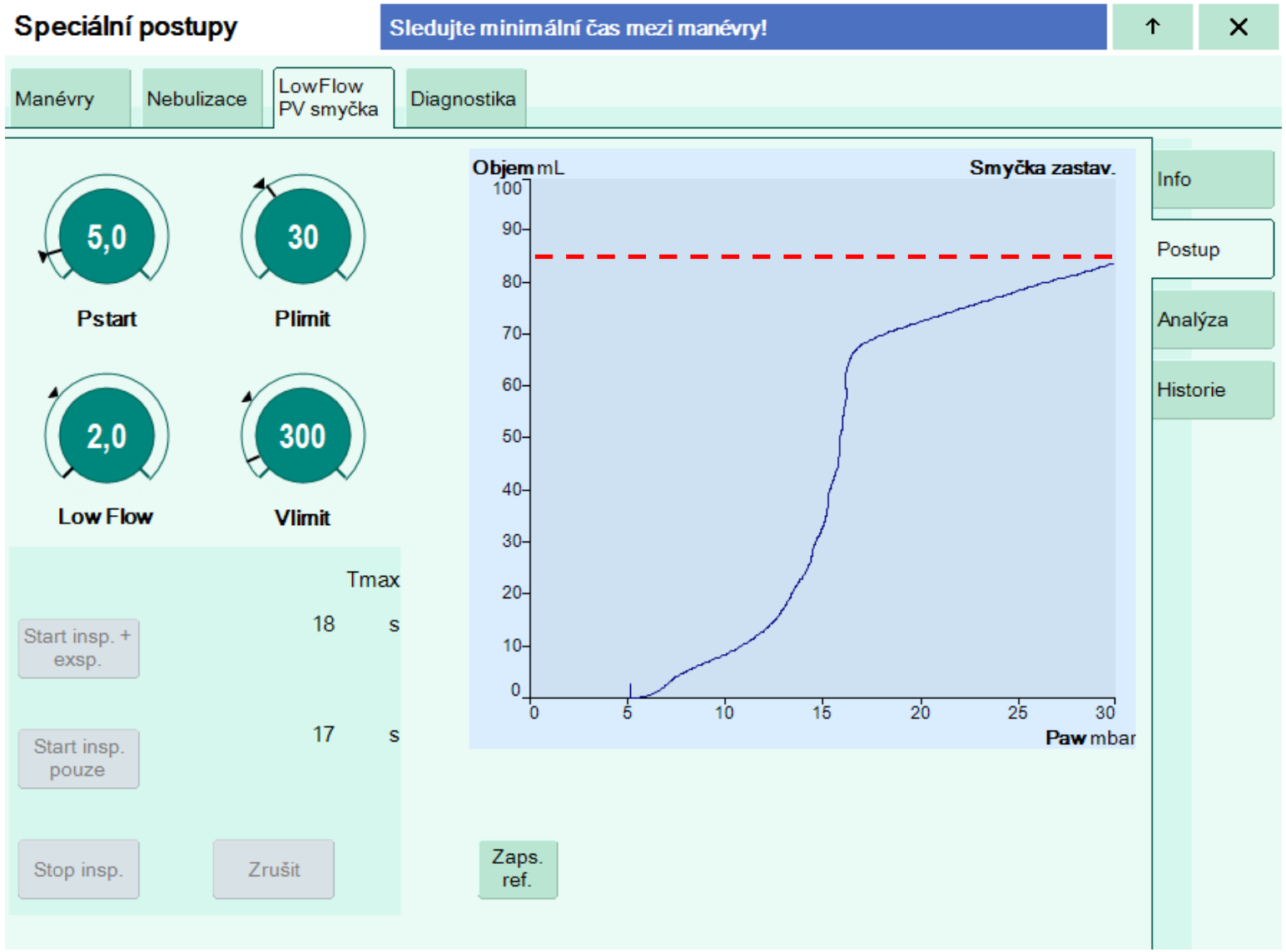
Hickling, 1998



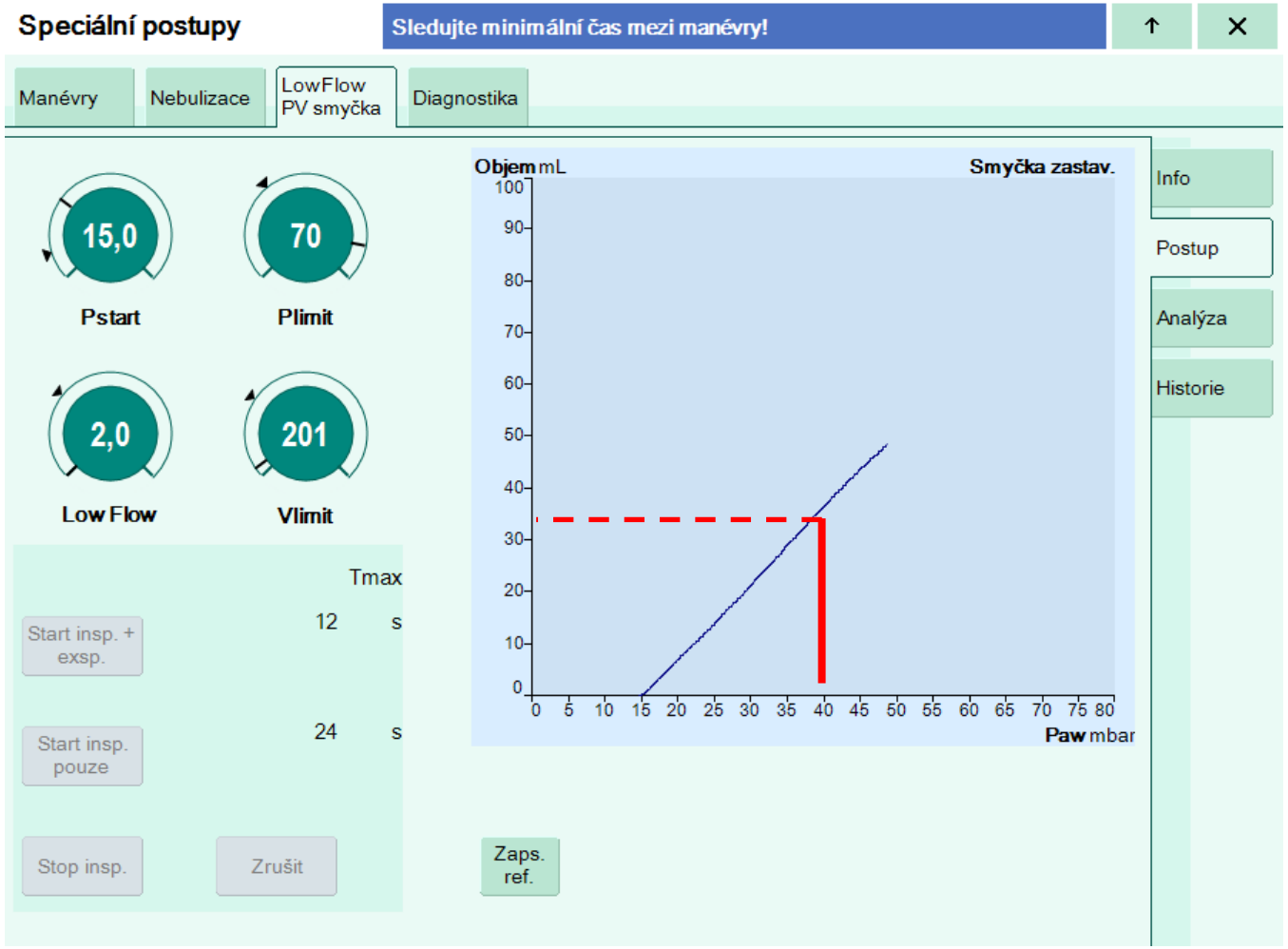
C = deltaV/delta P = 30/25 = 1,2 ml/cm H_2O



C = deltaV/delta P = 43/25 = 1,72 ml/cm H_2O



C = deltaV/delta P = 85/25 = 3,4 ml/cm H_2O

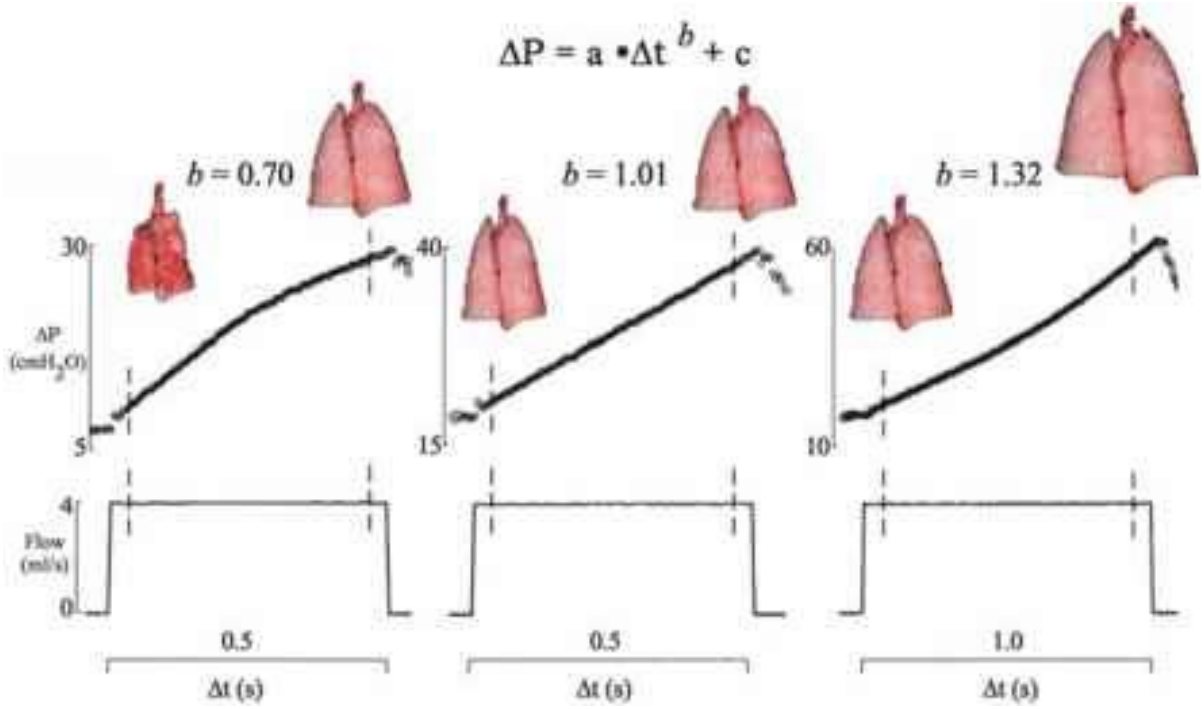


C = deltaV/delta P = 34/25 = 1,36 ml/cm H_2O

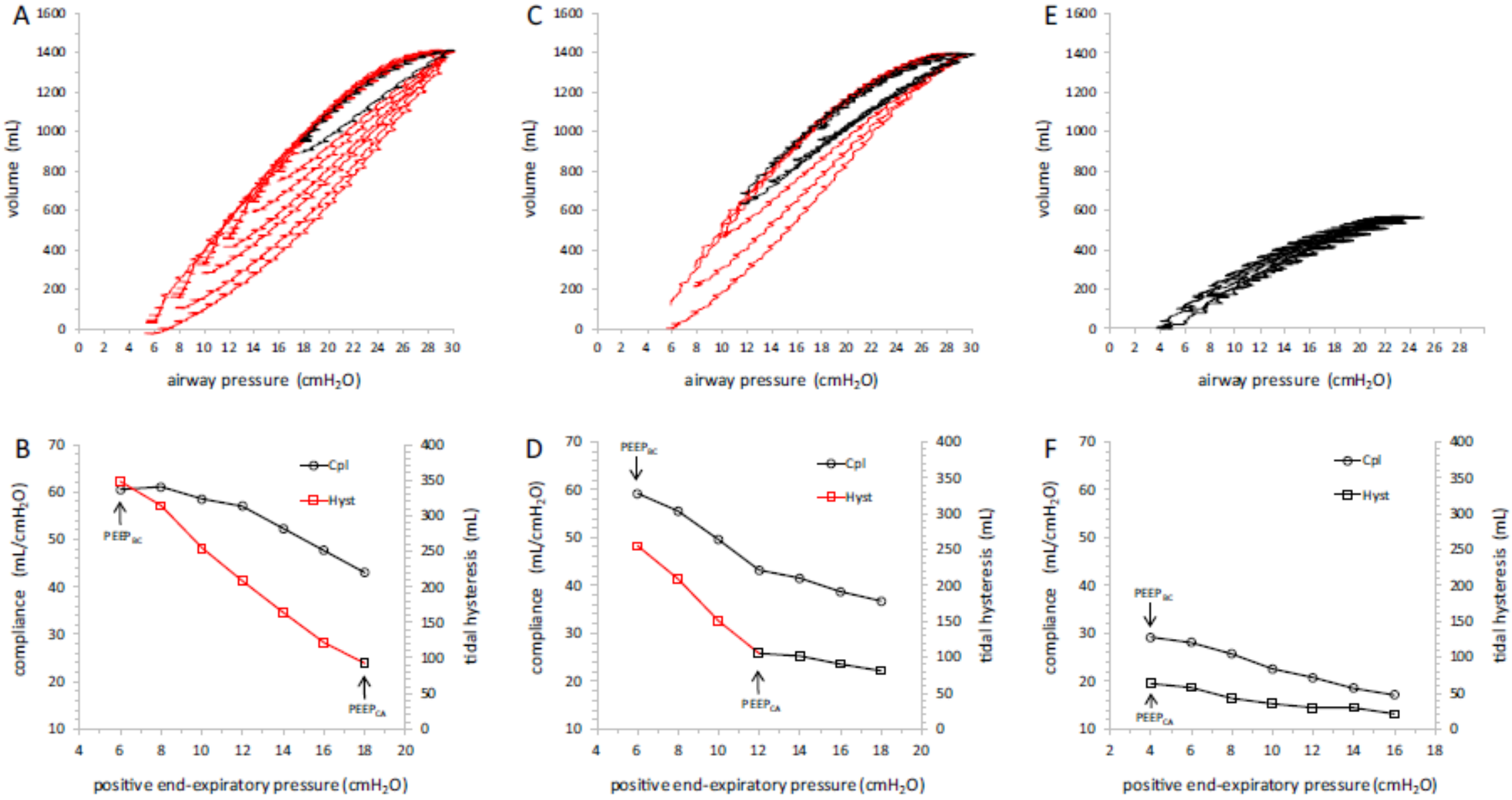
Identifikace dechového recrutimentu

- Auskultace plic
- UZ
- Stress index
- Hystereze low flow PV křivky

Stress index



Grasso S, Terragni P, Mascia L, Fanelli V, Quintel M, Herrmann P, Hedenstierna G, Slutsky AS, Ranieri VM. Airway pressure-time curve profile (stress index) detects tidal recruitment/hyperinflation in experimental acute lung injury. Crit Care Med. 2004 Apr;32(4):1018-27.



Mojoli *et al. Critical Care* (2023) 27:233

Table 3 Mechanical effects of different PEEP strategies in all patients and in subgroups with different mechanical patterns

	All patients $N=38$ (100.0%)	High tidal-recruiters $N=10$ (26.3%)	Biphasic tidal-recruiters $N=16$ (42.1%)	Low tidal-recruiters $N=12$ (31.6%)	*P* value
Clinical setting					
PEEP (cmH_2O)	15.3 ± 2.5 §	16.3 ± 2.8 # §	15.3 ± 2.5 §	14.4 ± 2.2 # §	0.220
Cpl (mL/cmH_2O)	37.1 ± 13.7 §	50.3 ± 11.2 # §	39.8 ± 7.9 §	22.5 ± 6.6 # §	< 0.001
Hyst (mL)	105.1 ± 50.2 §	162.5 ± 32.7 # §	105.4 ± 33.6 §	57.0 ± 22.8 # §	< 0.001
Dissipated E (J)	0.2 ± 0.1 §	0.2 ± 0.1 # §	0.2 ± 0.1 §	0.1 ± 0.0 # §	< 0.001
Best Cpl approach					
PEEP (cmH_2O)	10.0 ± 3.2 ^ §	11.5 ± 3.5 ^ §	9.8 ± 3.0 ^ §	8.9 ± 2.7 §	0.156
PEEP change * (n)	0/1/37 ^	0/1/9 ^	0/0/16 ^	0/0/12	0.946
Cpl (mL/cmH_2O)	44.8 ± 17.2 ^ §	58.7 ± 16.0 ^ §	49.1 ± 11.7 ^ §	27.5 ± 8.5 §	< 0.001
Hyst (mL)	204.7 ± 110.0 ^ §	312.0 ± 110.2 ^ §	227.3 ± 49.2 ^ §	85.3 ± 27.0 §	< 0.001
Dissipated E (J)	0.4 ± 0.2 ^ §	0.6 ± 0.2 ^ §	0.5 ± 0.1 ^ §	0.1 ± 0.1 §	< 0.001
Combined approach					
PEEP (cmH_2O)	14.6 ± 5.0 ^	19.5 ± 3.1 ^ #	15.7 ± 2.5 ^	8.9 ± 2.7 #	< 0.001
PEEP change * (*n*)	13/9/16 ^	8/2/0 ^	5/7/4 ^	0/0/12	< 0.001
Cpl (ml/cmH_2O)	36.4 ± 10.1 ^	42.8 ± 7.3 ^ #	39.1 ± 8.2 ^	27.5 ± 8.5 #	< 0.001
Hyst (mL)	92.7 ± 20.9 ^	100.6 ± 20.0 ^ #	93.2 ± 14.8 ^	85.3 ± 27.0 #	0.235
Dissipated E (J)	0.1 ± 0.1 ^	0.1 ± 0.0 ^ #	0.1 ± 0.0 ^	0.1 ± 0.1 #	0.268

*PEEP change results are expressed as the absolute number of patients in whom it was suggested to increase/keep constant/decrease PEEP by the best compliance or the combined approach. *PEEP* Positive end-expiratory pressure, *Cpl* Respiratory system compliance, *Hyst* Tidal lung hysteresis, *Dissipated E* Dissipated energy per breath. *P* values in the table are related to the comparison among the three patterns. ^ $p < 0.01$ best compliance approach vs. combined approach; # $p < 0.01$ combined approach vs. clinical PEEP; § $p < 0.01$ best compliance approach vs. clinical PEEP

Med Klin Intensivmed Notfmed 2018 · 113 (Suppl 1):S7–S12
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Received: 9 October 2017
Accepted: 16 October 2017
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M. Quintel, Göttingen; L. Gattinoni, Milan.

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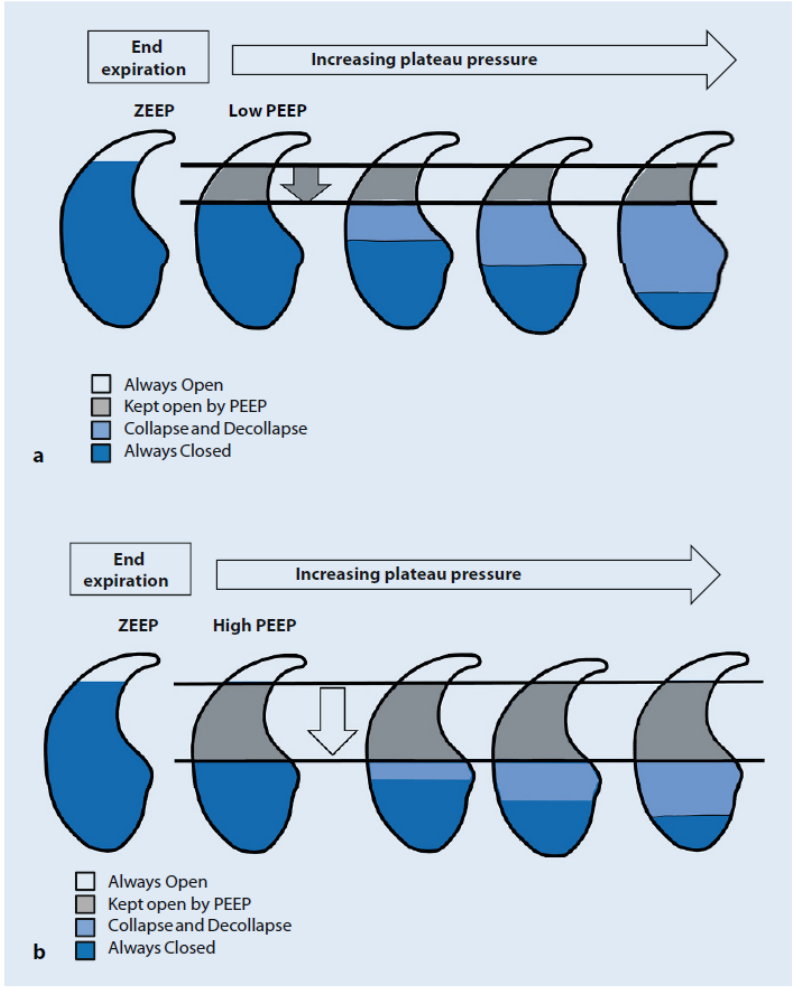
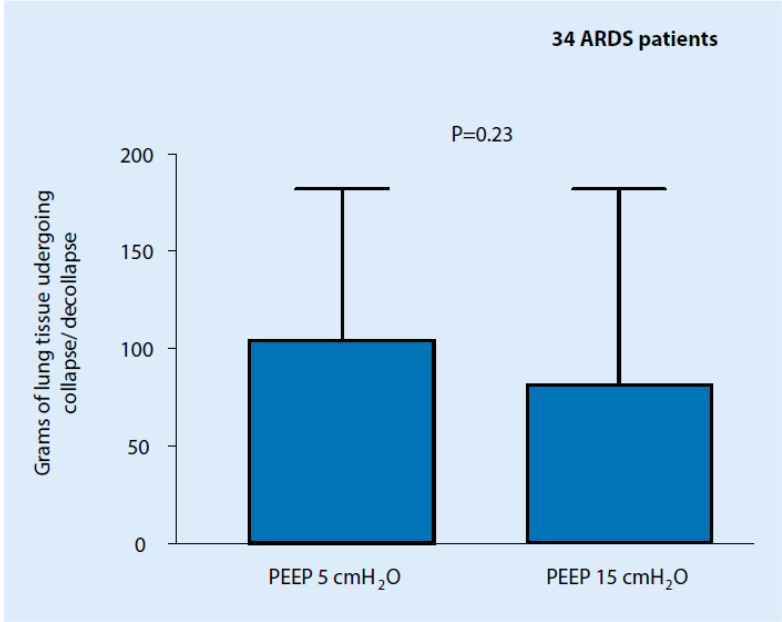
[4] Department of Anesthesiology, Emergency and Intensive Care Medicine, University of Göttingen, Göttingen, Germany

Does high PEEP prevent alveolar cycling?

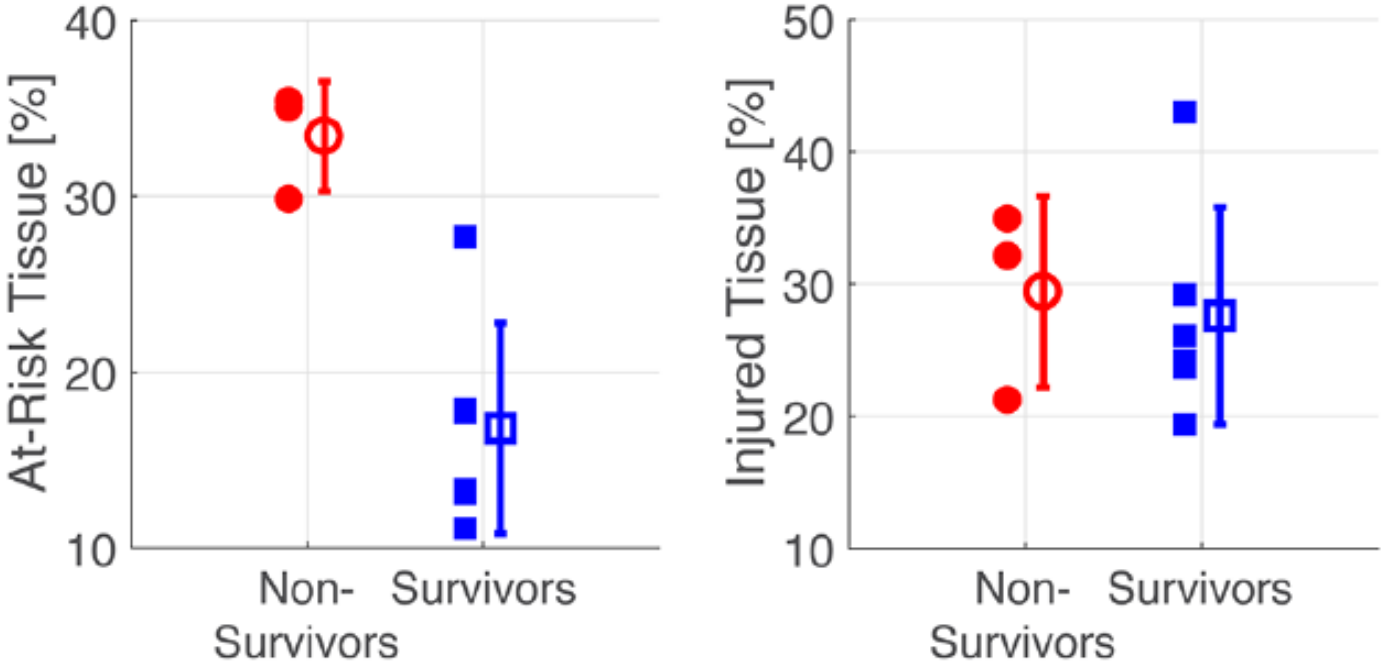




Tidal changes on CT and progression of ARDS

Maurizio Cereda,[1] Yi Xin,[2] Hooman Hamedani,[2] Giacomo Bellani,[3] Stephen Kadlecek,[2] Justin Clapp,[1] Luca Guerra,[4] Natalie Meeder,[1] Jennia Rajaei,[2] Nicholas J Tustison,[5] James C Gee,[2] Brian P Kavanagh,[6,7] Rahim R Rizi[2]

Results In experimental studies, regions of lung with unstable inflation (ie, partial or reversible airspace filling reflecting local strain) were the areas in which subsequent progression of injury was greatest in terms of progressive infiltrates (R=0.77) and impaired compliance (R=0.67, p<0.01). In patients with ARDS, a threshold fraction of tissue with unstable inflation was apparent: >28% in all patients who died and ≤28% in all who survived, whereas segregation of survivors versus non-survivors was not possible based on oxygenation or lung mechanics.

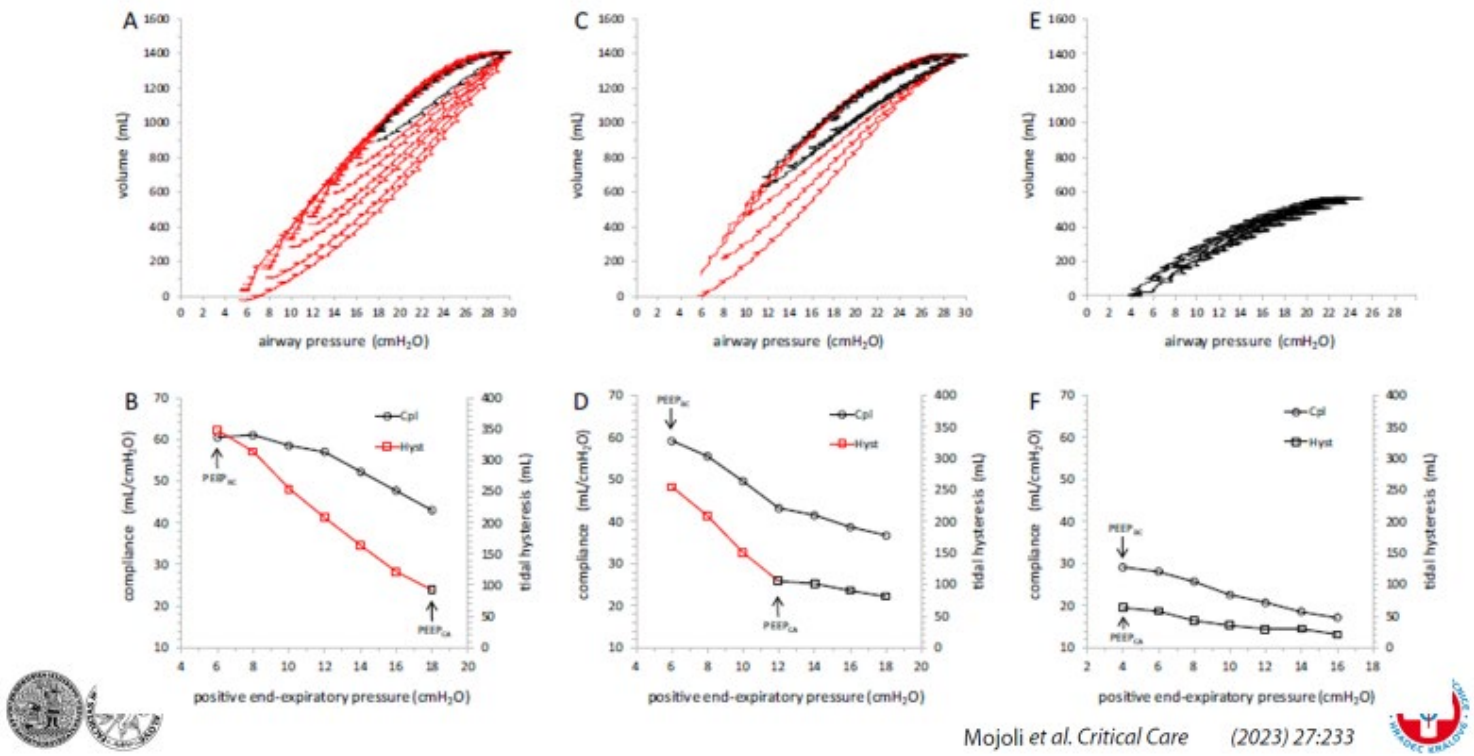


Cereda M, *et al*. *Thorax* 2017;**72**:981–989. doi:10.1136/thoraxjnl-2016-209833

Co dělat v reálném životě?

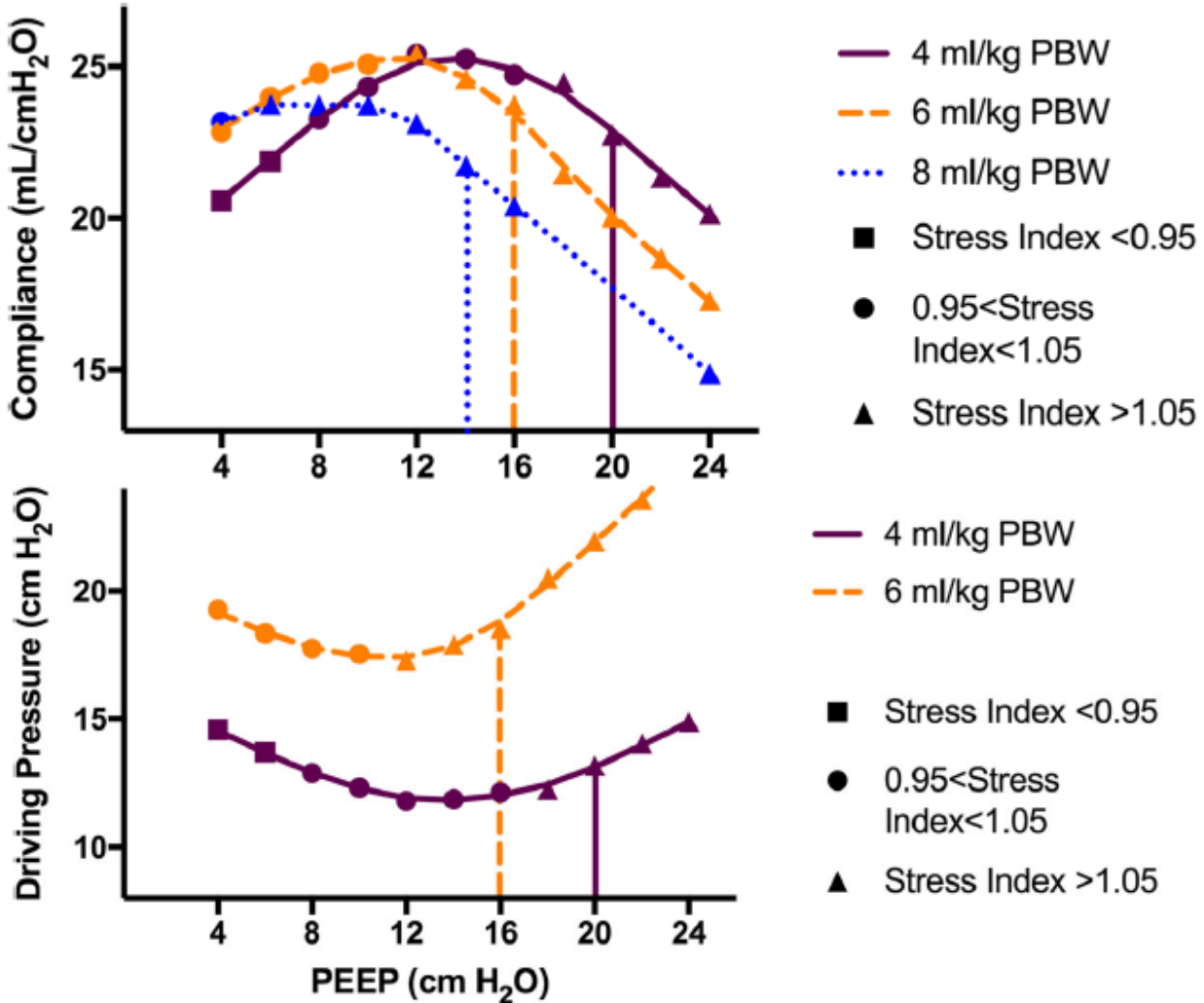
Rutinní ponechání PEEP nad úrovní PEEP s nejlepší poddajností?

31



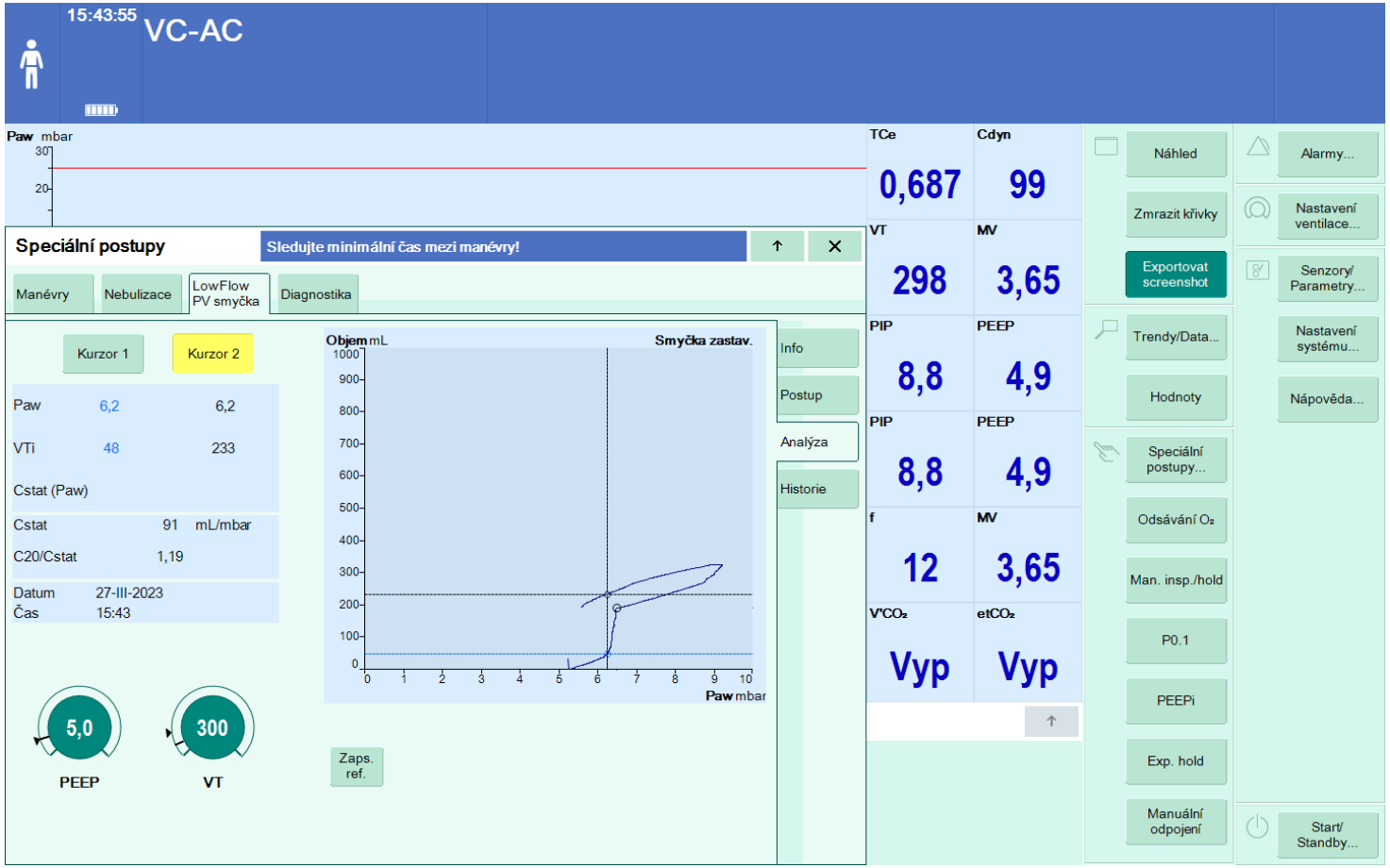
Mojoli *et al. Critical Care* (2023) 27:233

Doplnit hodnocení Crs o sledování SI?



McKown *et al. Critical Care* (2018) 22:115
https://doi.org/10.1186/s13054-018-2047-4

Doplnit hodnocení Crs o sledování hystereze?



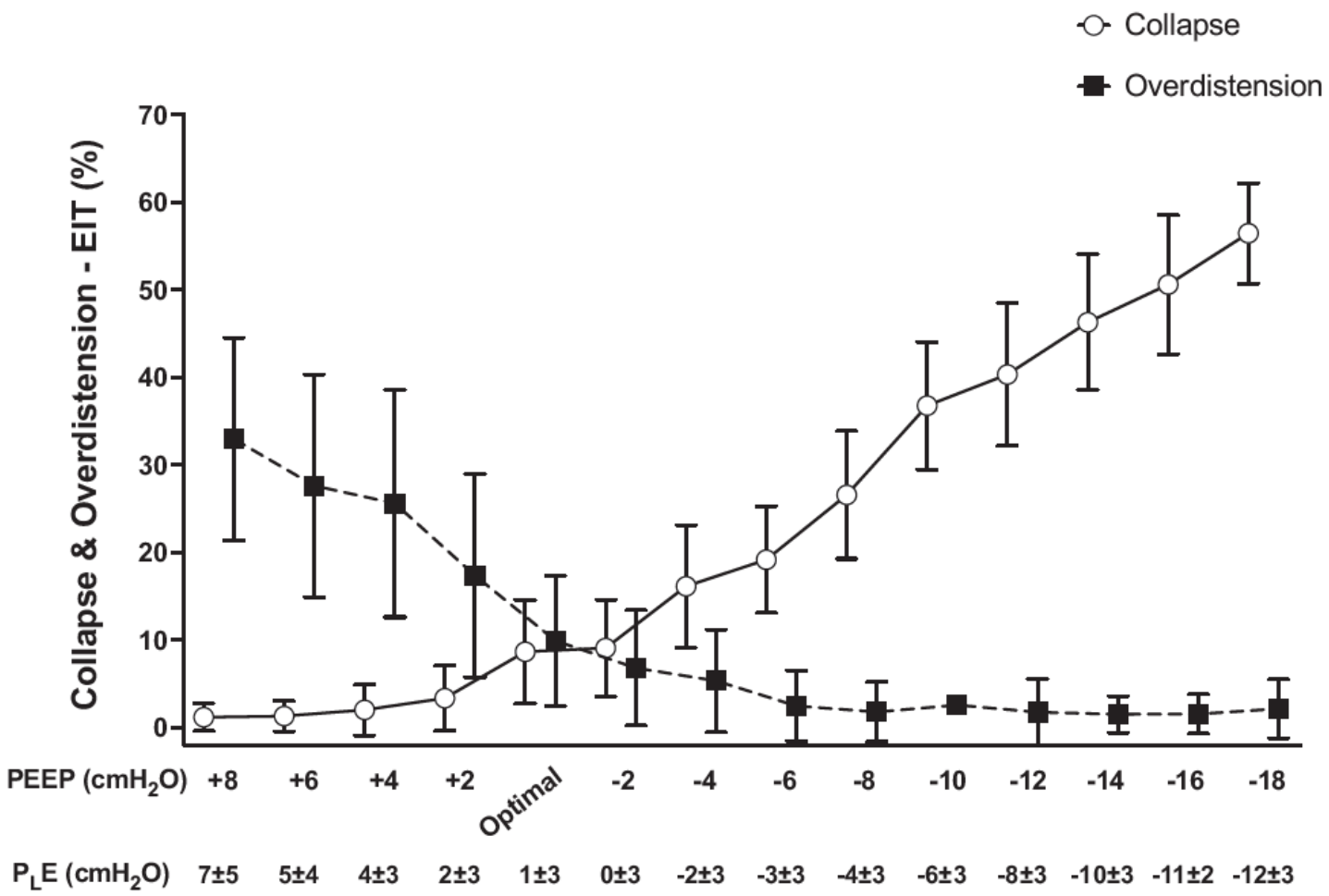
Nutná svalová relaxace

ANESTHESIOLOGY

Lung Recruitment in Obese Patients with Acute Respiratory Distress Syndrome

Jacopo Fumagalli, M.D., Roberta R. S. Santiago, M.D., Ph.D., Maddalena Teggia Droghi, M.D., Changsheng Zhang, M.D., Ph.D., Florian J. Fintelmann, M.D., Fabian M. Troschel, Cand. Med., Caio C. A. Morais, R.R.T., Ph.D., Marcelo B. P. Amato, M.D., Ph.D., Robert M. Kacmarek, R.R.T., Ph.D., Lorenzo Berra, M.D., on behalf of the Lung Rescue Team Investigators*

ANESTHESIOLOGY 2019; 130:791–803



EIT?
Jícnová tonometrie?

Závěry

- Přítomnost masivního dechového recruitmentu by měla být aktivně detekována, pravděpodobnost stoupá s recruitabilitou plíce

- Nastavení PEEP na hodnotu s nejlepší Crs může být u nemocných s výrazným dechový recruitmentem rizikové

- Kombinované hodnocení poddajnosti a dalších parametrů může snížit rizikovost umělé plicní ventilace

pavel.dostal@fnhk.cz