KARIM
1.LF UK A VFN V PRAZE

Změna polohy jako ventilační terapie

ČSARIM 2023

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1. lékařská fakulta UK a Všeobecná fakultní nemocnice v Praze
U nemocnice 2, Praha 2

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

1. LÉKAŘSKÁ FAKULTA Univerzita Karlova

POLOHOVÁNÍ
NA POLOZE záleží

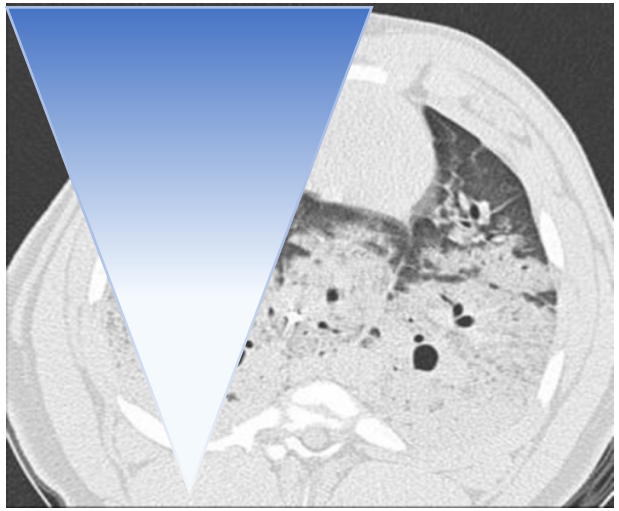
PROČ je polohování důležité???

Protože GRAVITACE!!!

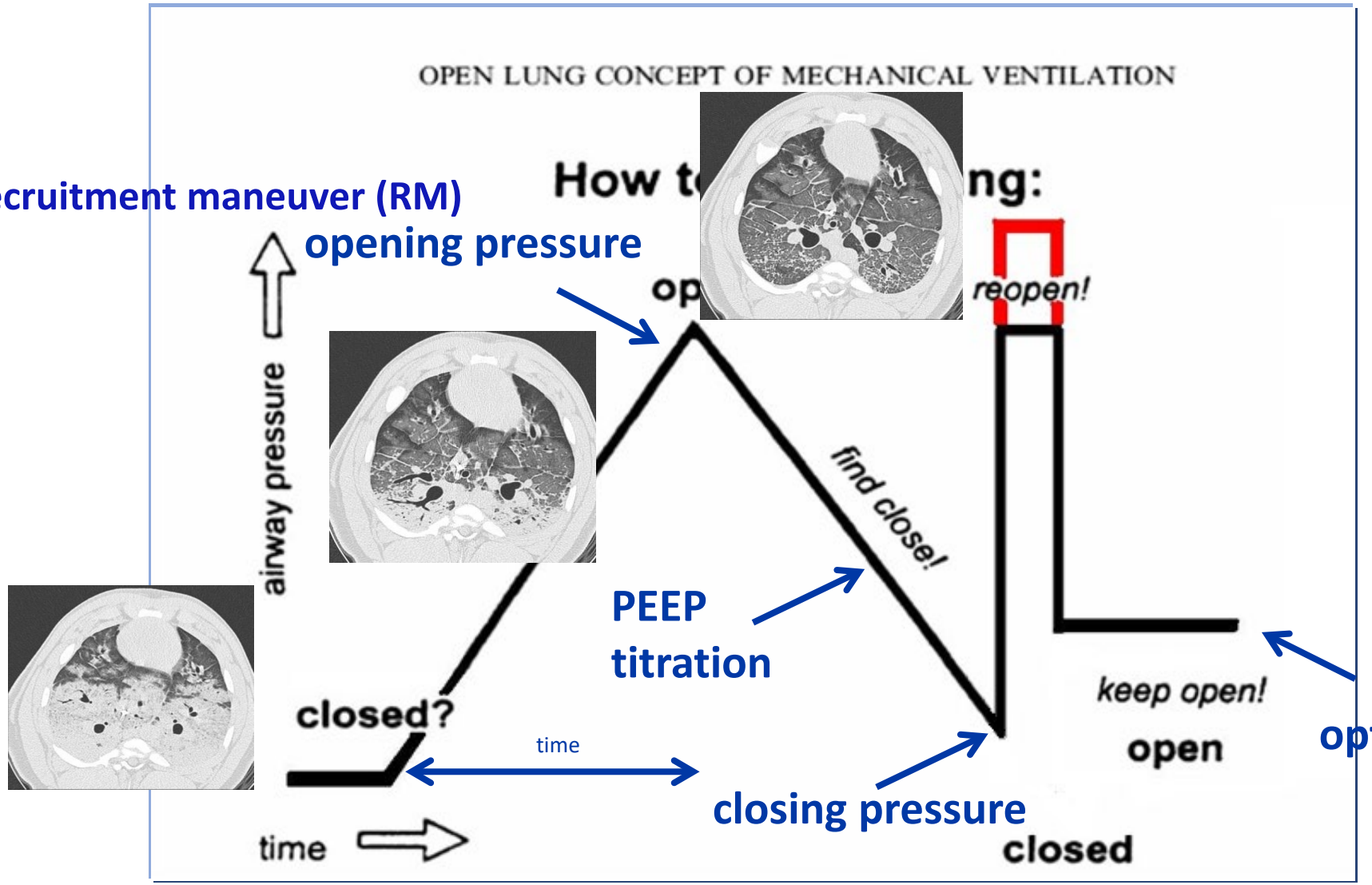
SUCHÁ

GRAVITACE

MOKRÁ

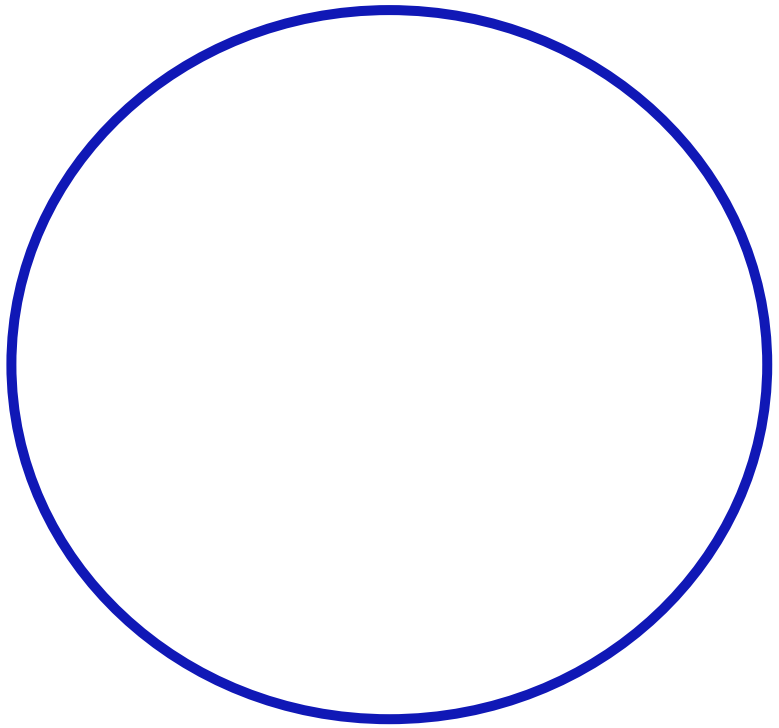


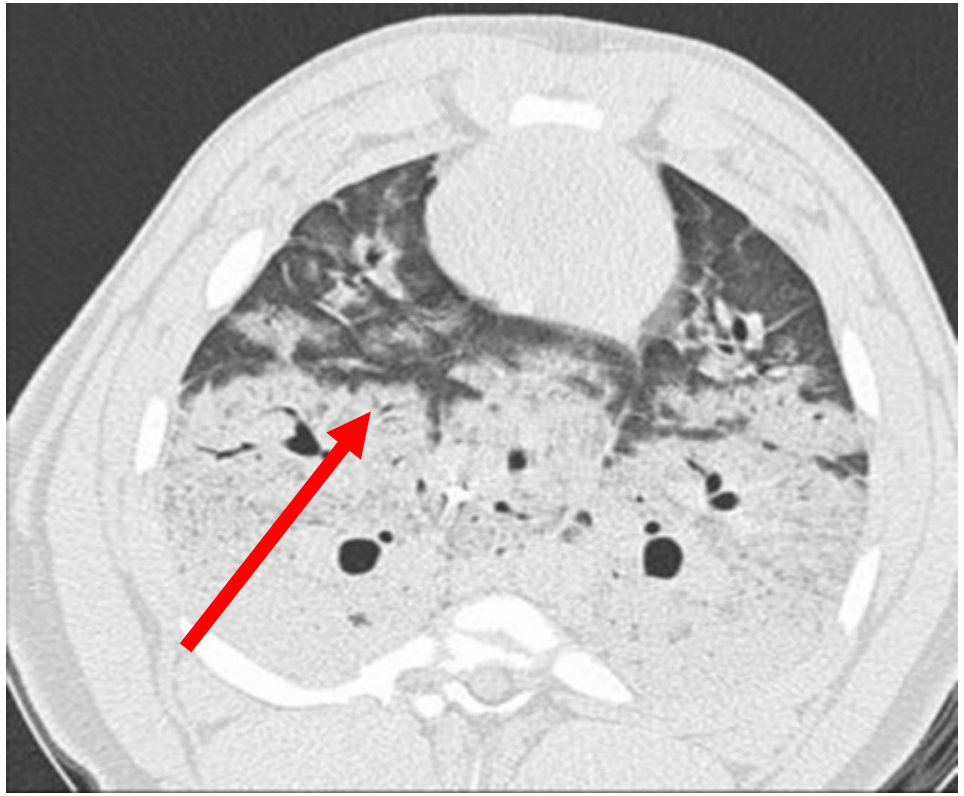
Open up the lung and keep the lung open



Lachmann B, ICM, 1992

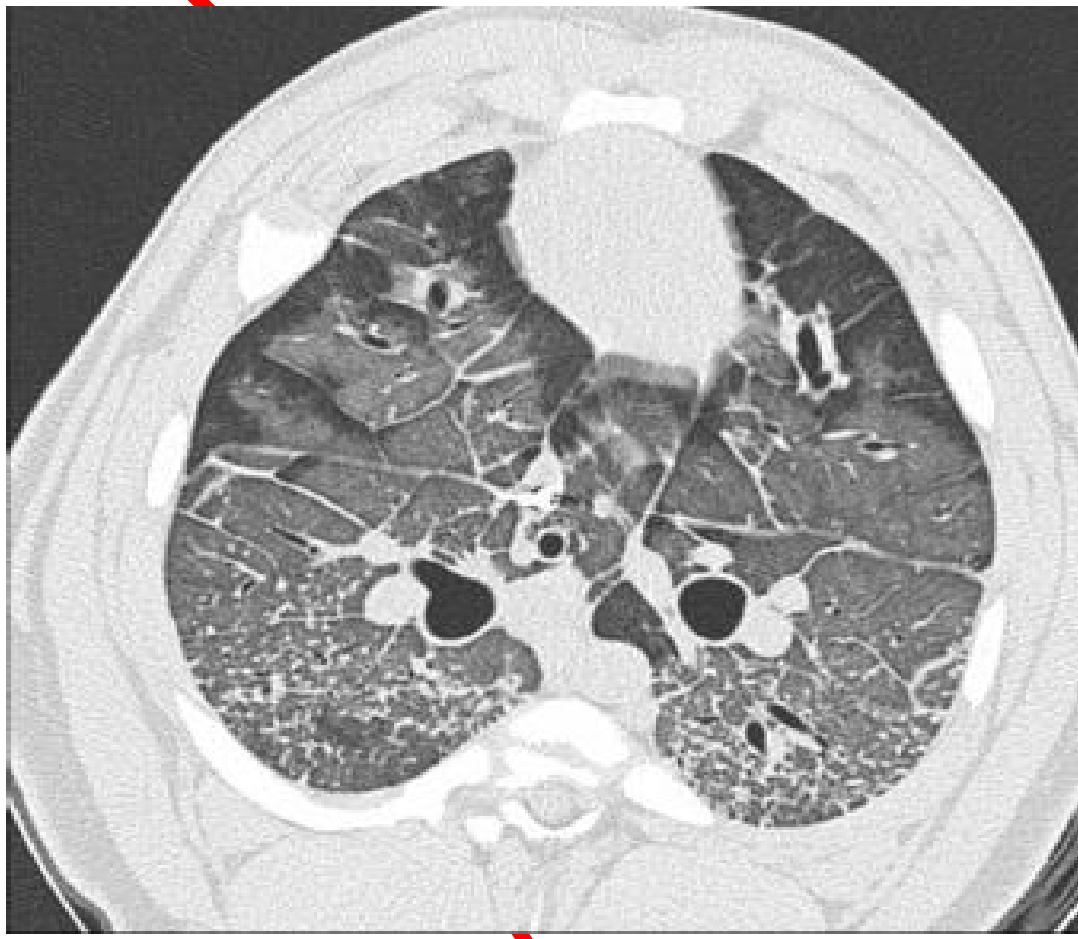
PEEP optimalizace





RM v PRONACI !?!

hyperdistension = volumotrauma

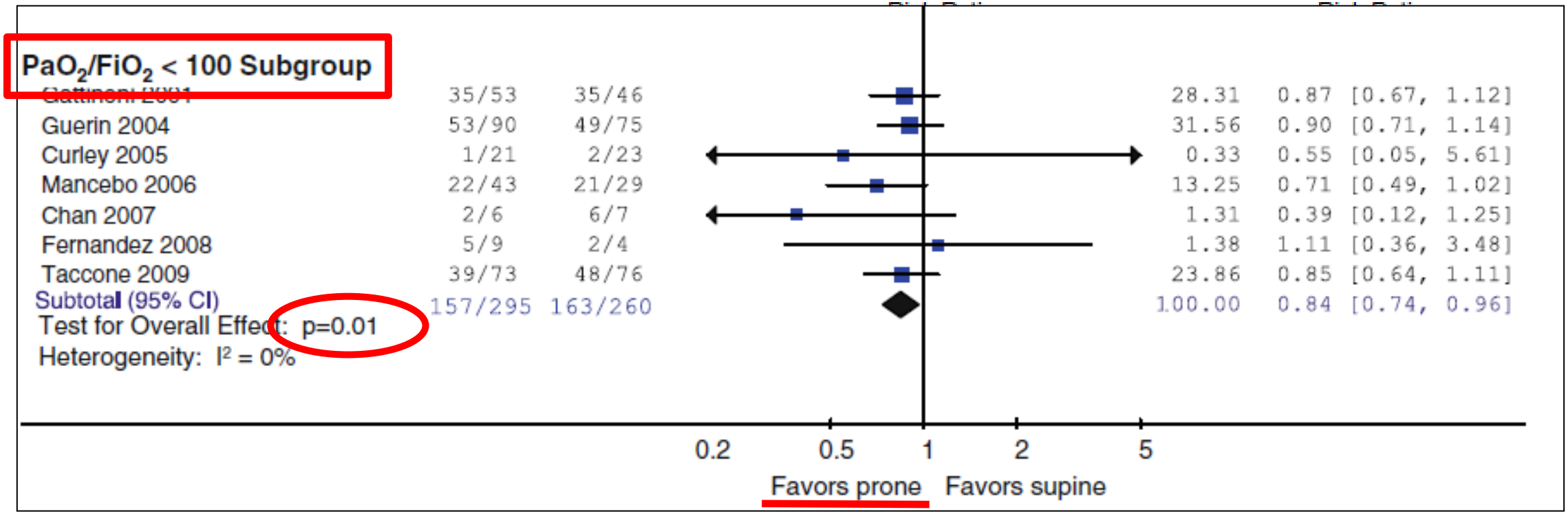


reareation

homogenization

Efekt PRONACE na mortaltitu ARDS

Prone ventilation reduces mortality in patients with acute respiratory failure and severe hypoxemia: systematic review and meta-analysis



Sud, ICM, 2010

PRONACE … PROSEVA trial

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Prone Positioning in Severe Acute Respiratory Distress Syndrome

The NEW ENGLAND JOURNAL of MEDICINE

Claude Guérin, M.D., Ph.D., Jean Reignier, M.D., Ph.D., Jean-Christophe Richard, M.D., Ph.D.,

- **multicenter, prospective, randomized, controlled trial**
- **26 ICUs in France and 1 in Spain, all of which have used prone positioning in daily practice for more than 5 years**
- **237 pts. PRONE / 229 pts. supine group,**
- **Sever ARDS paO2/FiO2 < 150, FiO2 > 0.6**
- **Vt 6ml/kg, Ppeak < 30 cmH2O, pH 7.20 - 7.45**

PEEP (cm H_2O)	5	5	8	8	10	10	10	12	14	14	14	16	18	18-24
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

- stopping prone: improvement in oxygenation
  (Pao2:Fio2 ≥150, with a PEEP of ≤10 cm of water and an Fio2 of ≤0.6)

Guerin, NEJM, 2013

PRONACE … PROSEVA trial

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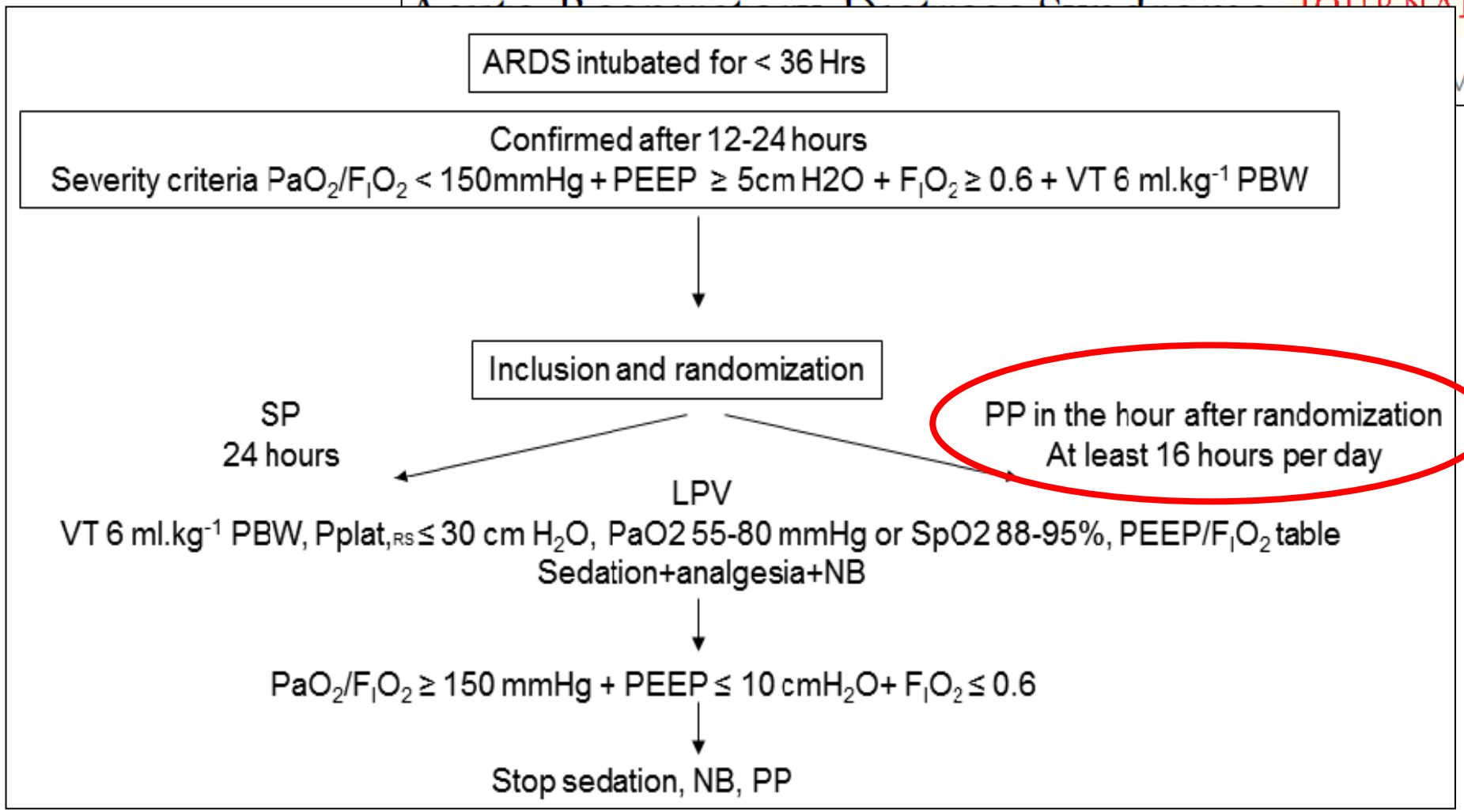
Prone Positioning in Severe

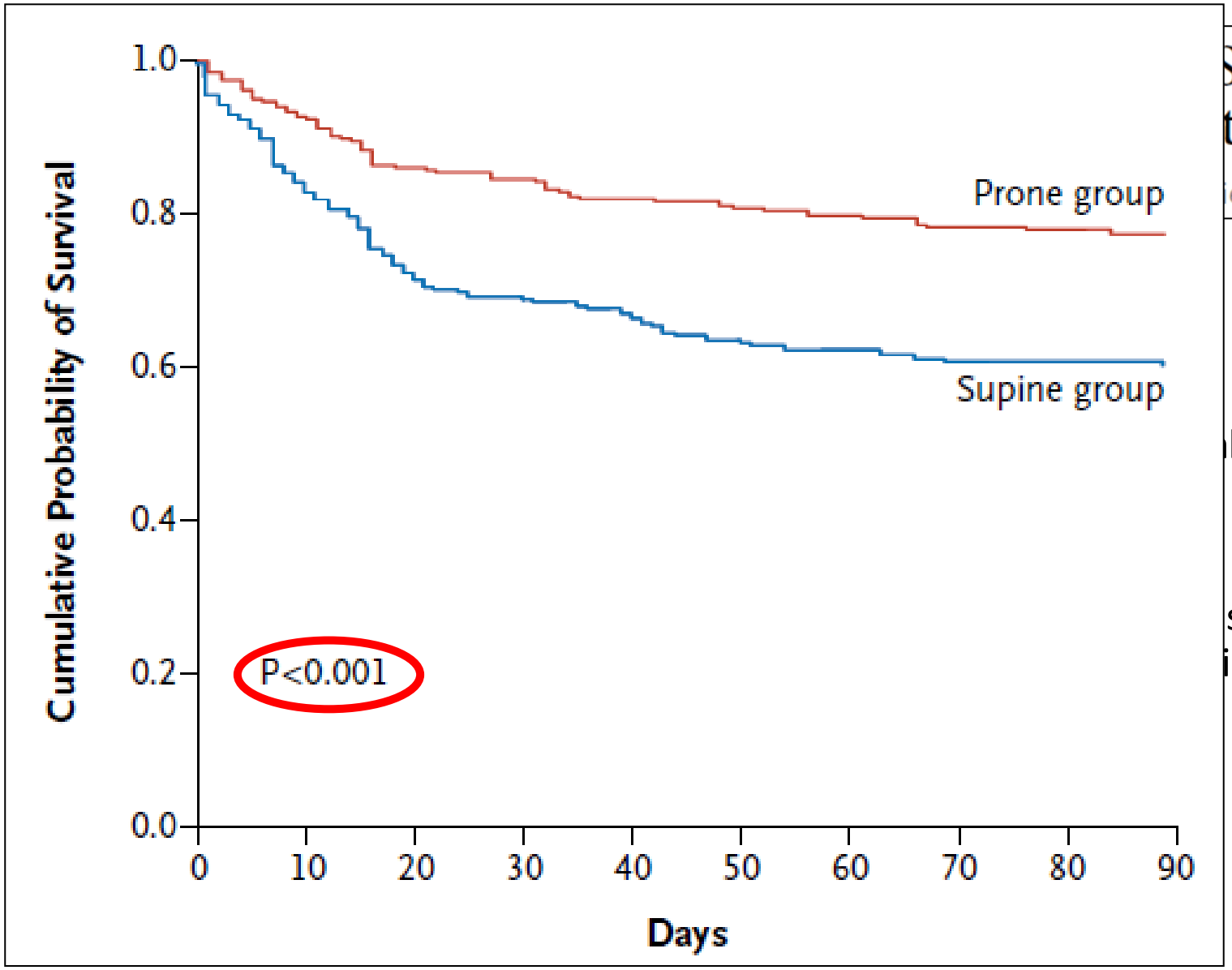
The NEW ENGLAND JOURNAL of MEDICINE

M.D., Ph.D.,



Guerin, NEJM, 2013

PRONACE … PROSEVA trial



Severe
tress Syndrome

The NEW ENGLAND JOURNAL of MEDICINE

er, M.D., Ph.D., Jean-Christophe Richard, M.D., Ph.D.,

P 16.0% vs. S 32.8% (P<0.001)

lity **P 23.6% v.s. S 41.0% (P<0.001)**

s did not differ significantly between the
idence of cardiac arrests, which was higher in

Guerin, NEJM, 2013

Efekt SEMI-PRONE 135° / lateral 90°

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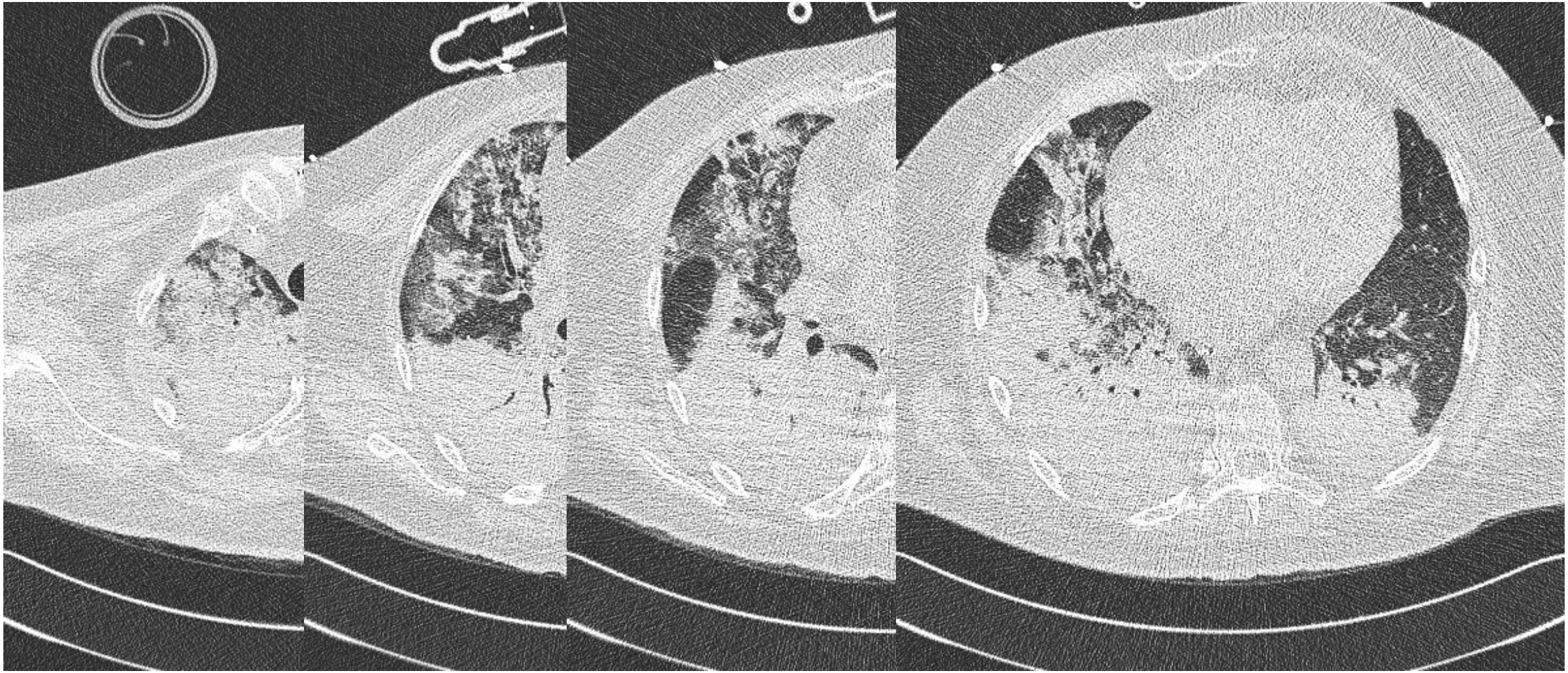
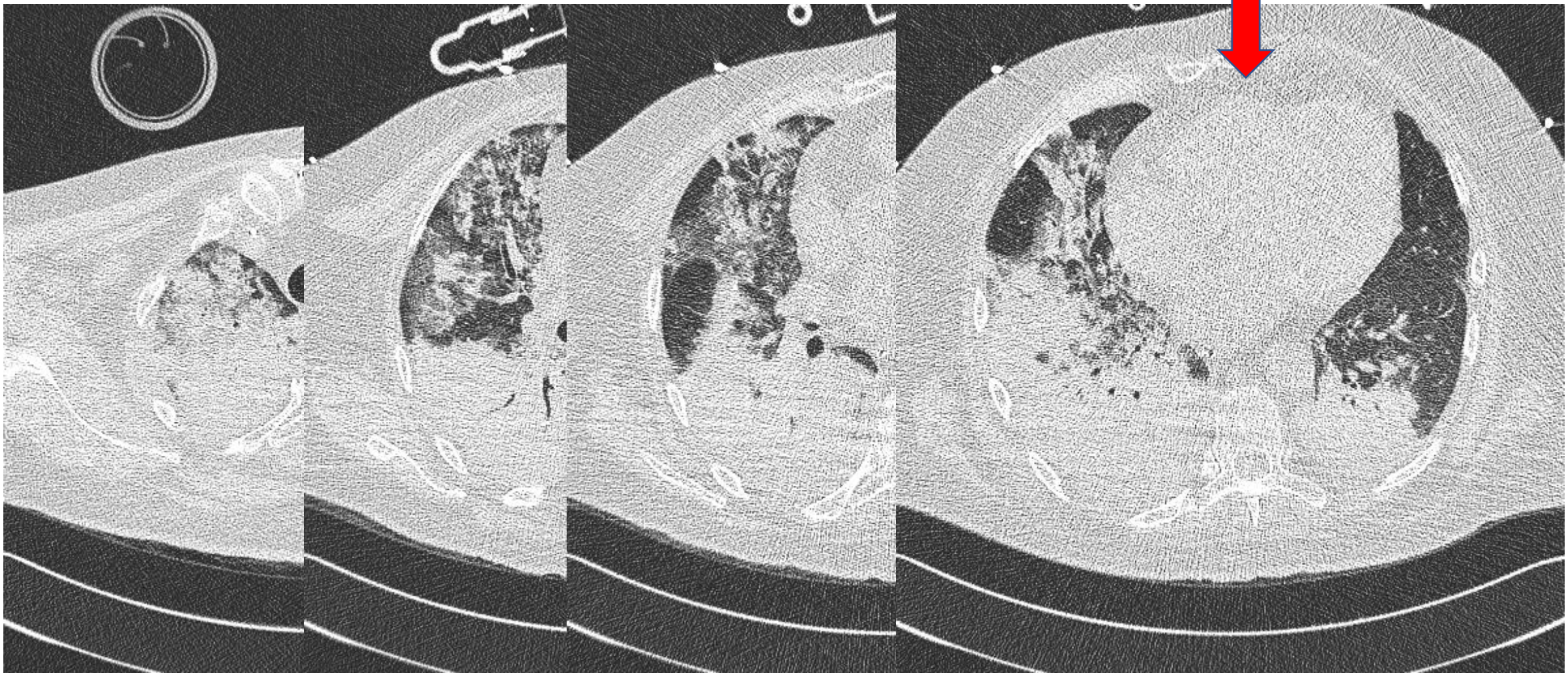
VŠEOBECNÁ FAKULTNÍ
NEMOCNICE V PRAZE



Efekt SEMI-PRONE 135° / lateral 90°

KARIM
1.LF UK A VFN V PRAZE

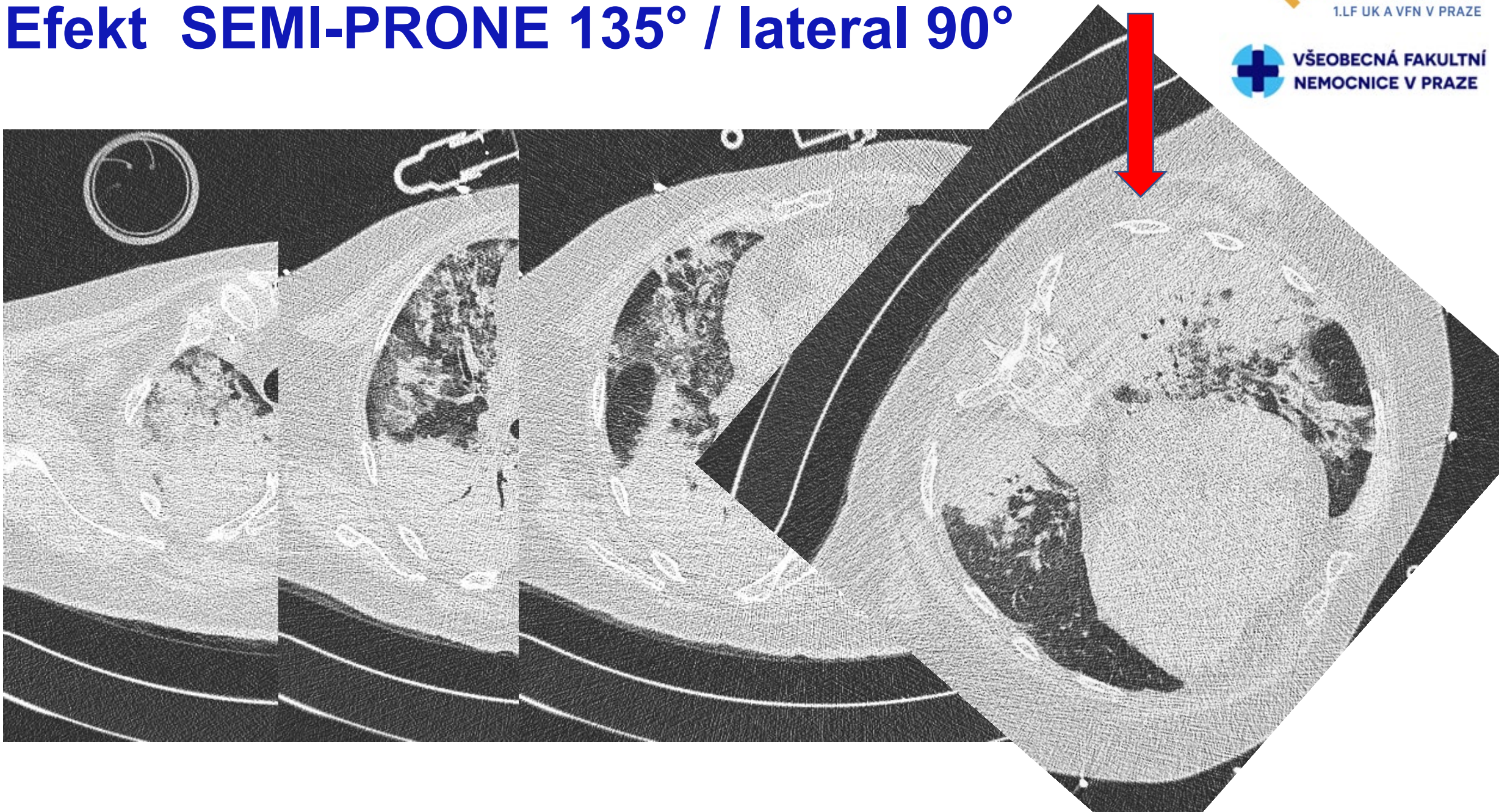
VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE



Efekt SEMI-PRONE 135° / lateral 90°

KARIM
1.LF UK A VFN V PRAZE

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE



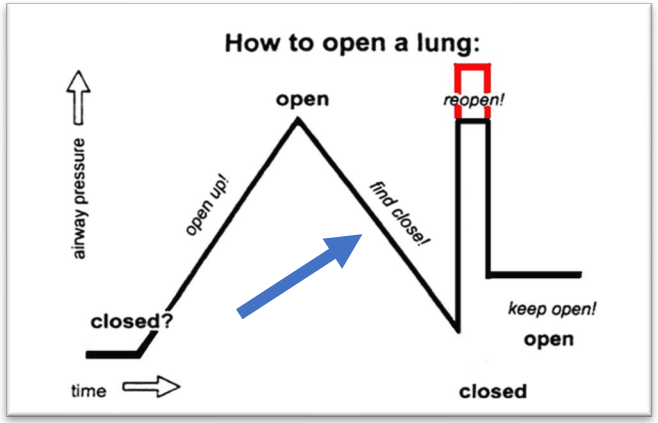
Efekt SEMI-PRONE 135° / lateral 90°

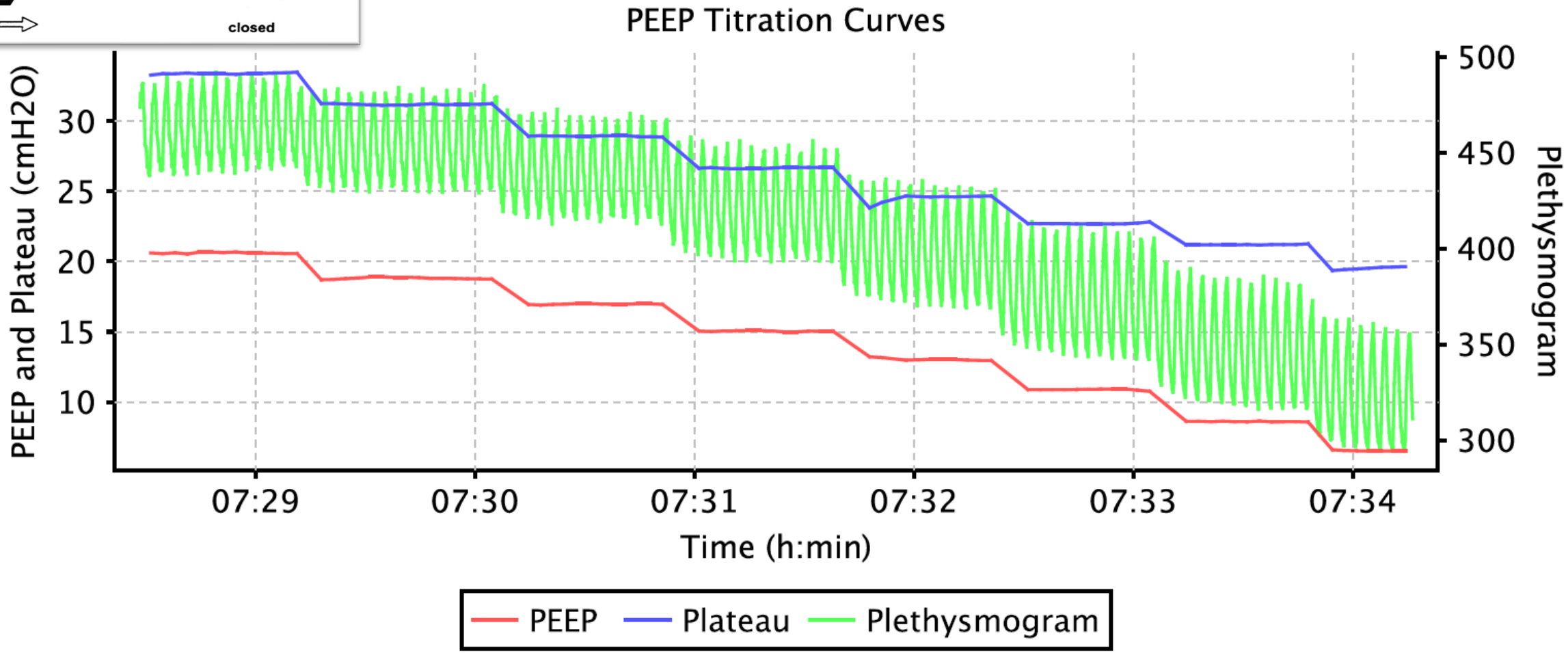
na luzku

za 48 hodin

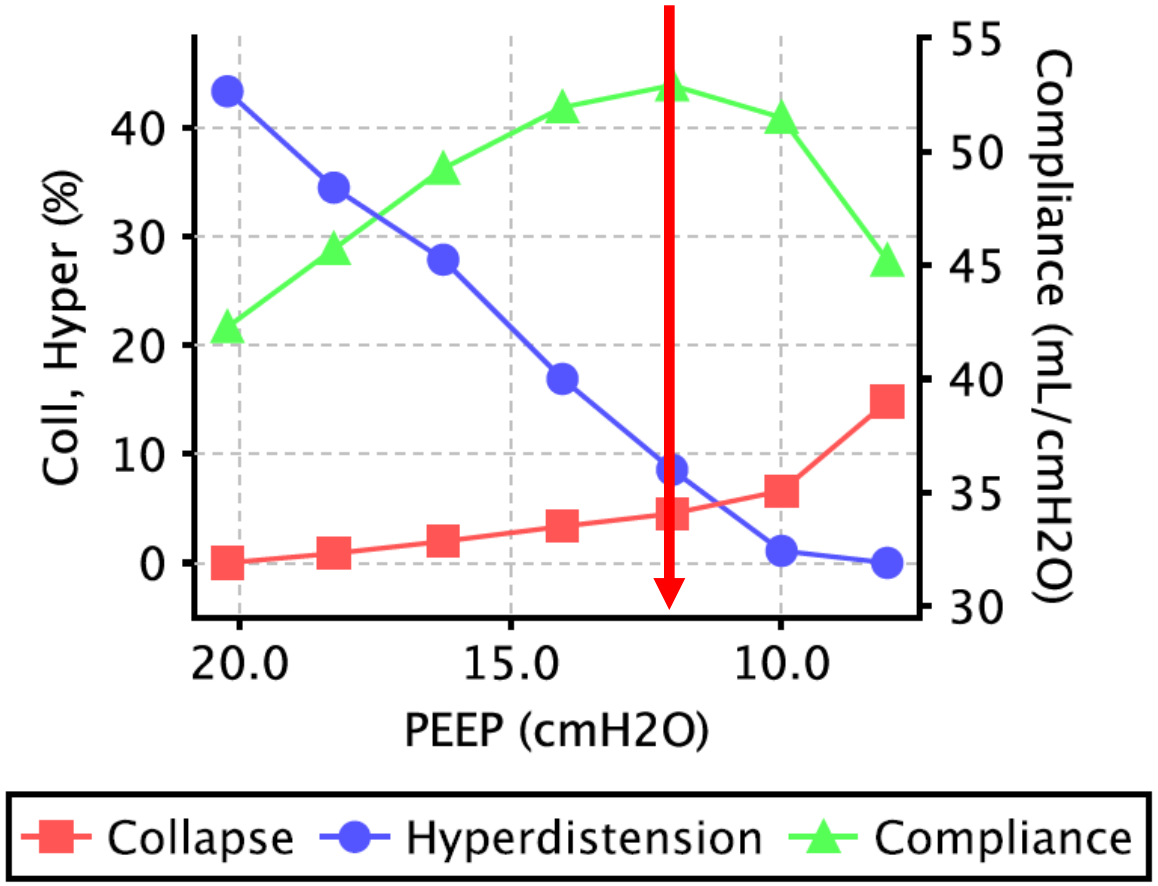
Optimalizace UPV pomocí CÍLENÉHO POLOHOVÁNÍ

PEEP titrace





PEEP titrace – GLOBÁLNÍ parametry



PEEP (cmH_2O)	Compliance (mL/cmH_2O)	Hyperdist. (%)	Collapse (%)
20.2	42	43.3	0.0
18.3	46	34.5	0.9
16.2	49	27.9	2.0
14.0	52	16.9	3.4
12.0	53	8.6	4.5
10.0	51	1.1	6.6
8.0	45	0.0	14.8

EIT - PEEP titrace – REGIONÁLNÍ distribuce

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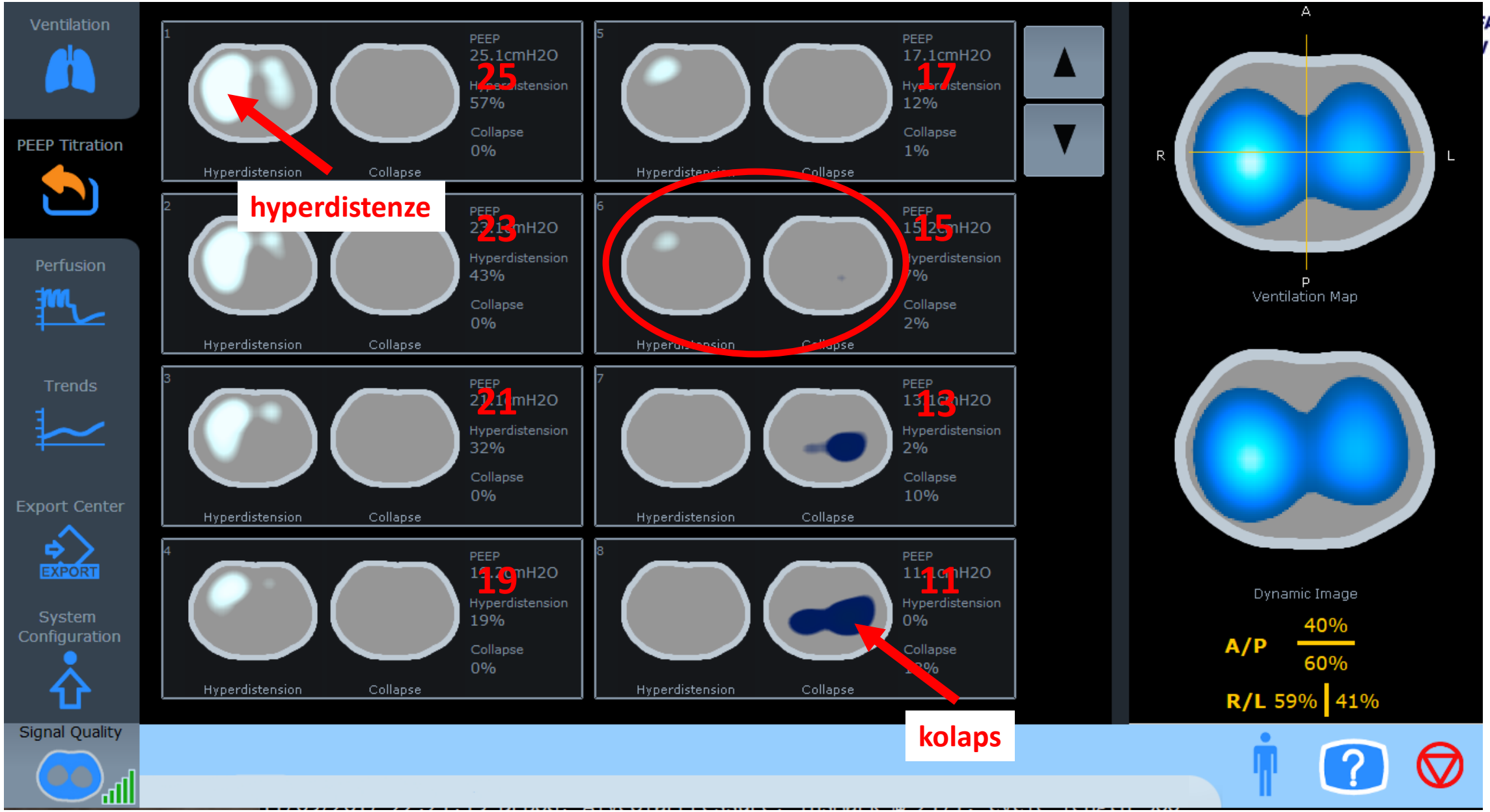

PEEP titrace pomocí EIT

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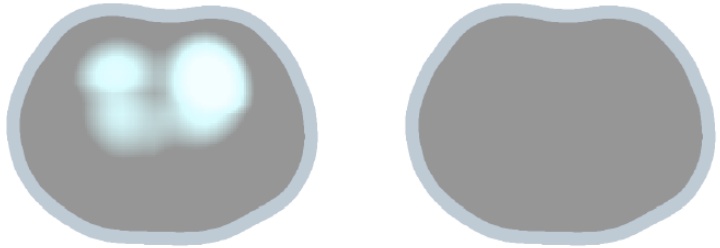
1.LF UK A VFN V PRAZE

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

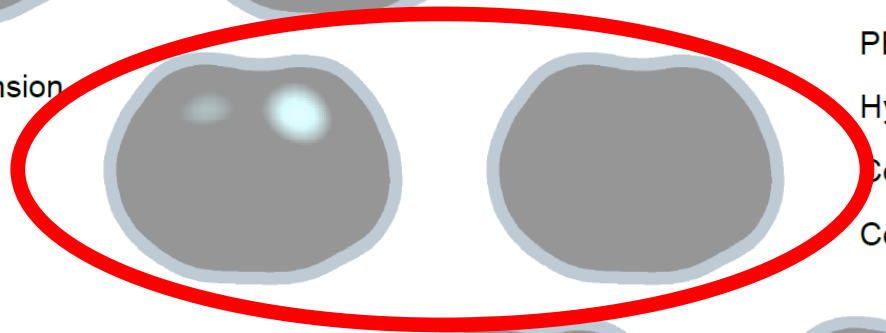


Hyperdistension

PEEP: 18.4 cmH_2O
Hyperdistension: 27.8%
Collapse: 0.1%
Compliance: 32.2 mL/cmH_2O

Hyperdistension

PEEP: 16.2 cmH_2O
Hyperdistension: 20.1%
Collapse: 0.1%
Compliance: 35.9 mL/cmH_2O

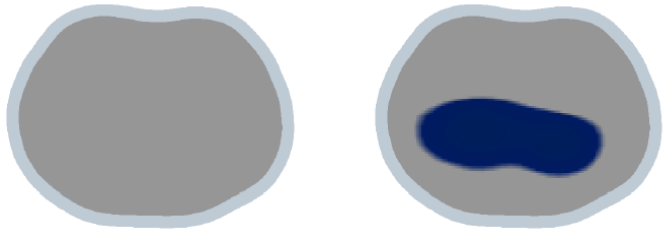


Hyperdistension

PEEP: 14.2 cmH_2O
Hyperdistension: 9.7%
Collapse: 0.3%
Compliance: 40.2 mL/cmH_2O

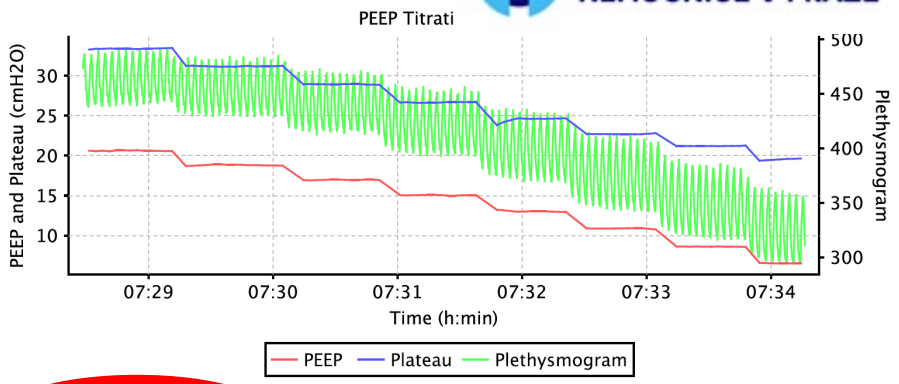
Hyperdistension

PEEP: 12.1 cmH_2O
Hyperdistension: 7.5%
Collapse: 9.6%
Compliance: 41.0 mL/cmH_2O



Hyperdistension

PEEP: 10.1 cmH_2O
Hyperdistension: 3.4%
Collapse: 17.5%
Compliance: 38.7 mL/cmH_2O



Optimal PEEP:
Minimální hyperdistenze
Minimální kolaps (do 5%)

PEEP titrace pomocí EIT tentýž pacient

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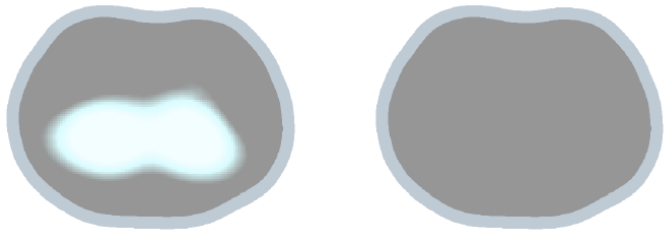
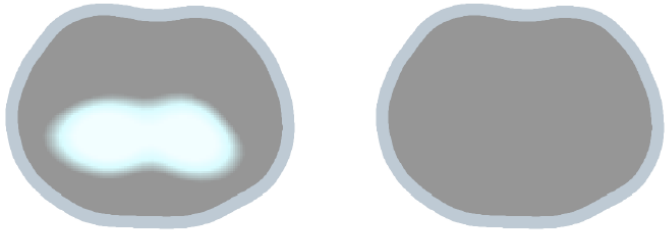
VŠEOBECNÁ FAKULTNÍ



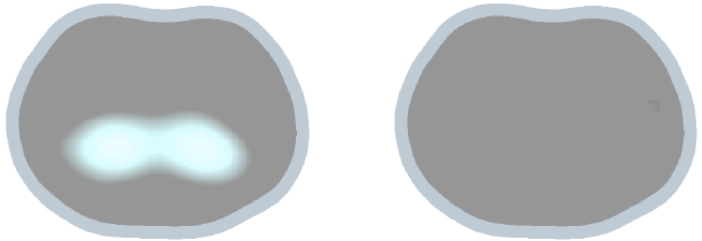
PEEP: 18.2 cmH_2O
Hyperdistension: 36.9%
Collapse: 1.0%
Compliance: 28.8 mL/cmH_2O

Hyperdistension



PEEP: 16.2 cmH_2O
Hyperdistension: 31.6%
Collapse: 1.5%
Compliance: 32.3 mL/cmH_2O

Hyperdistension

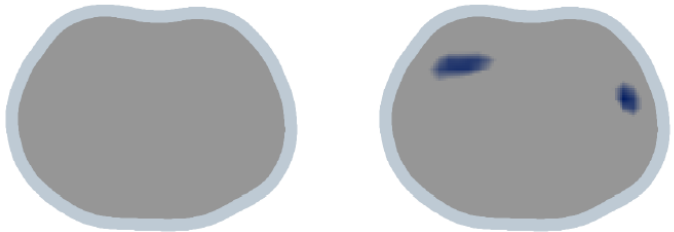


PEEP: 14.3 cmH_2O
Hyperdistension: 19.5%
Collapse: 2.3%
Compliance: 36.5 mL/cmH_2O

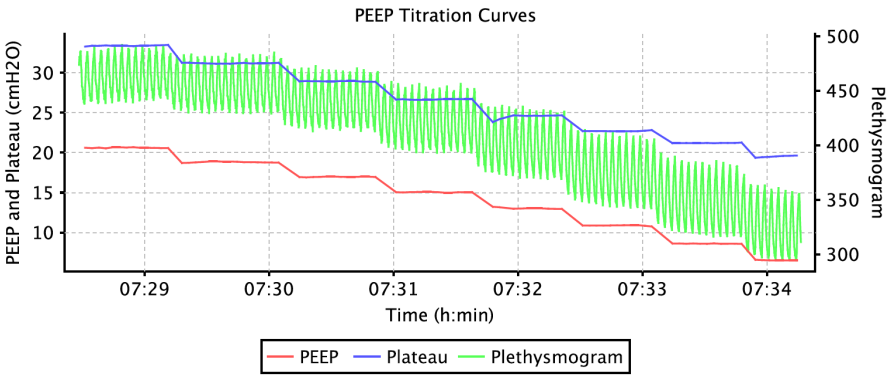
Hyperdistension

PEEP: 12.4 cmH_2O
Hyperdistension: 13.0%
Collapse: 3.7%
Compliance: 38.5 mL/cmH_2O

Hyperdistension



PEEP: 10.6 cmH_2O
Hyperdistension: 6.2%
Collapse: 5.7%
Compliance: 42.1 mL/cmH_2O



PRONACE

Homogenizace

PRONACÍ

PEEP titrace pomocí EIT

KARIM
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PEEP: 16.0 cmH_2O
Hyperdistension: 15.5%
Collapse: 0.0%
Compliance: 42.4 mL/cmH_2O

Hyperdistension

PEEP: 14.1 cmH_2O
Hyperdistension: 14.2%
Collapse: 1.4%
Compliance: 41.8 mL/cmH_2O

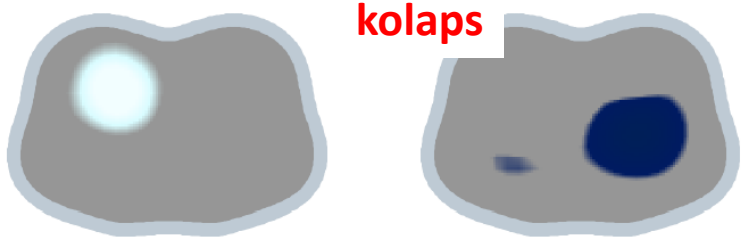
Hyperdistensic

PEEP: 11.9 cmH_2O
Hyperdistension: 14.2%
Collapse: 8.8%
Compliance: 40.7 mL/cmH_2O

hyperdistenze

Hyperdistension

kolaps



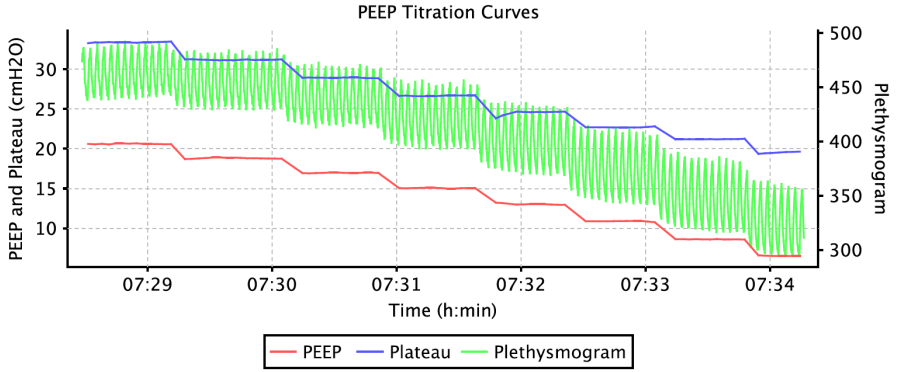
PEEP: 10.3 cmH_2O
Hyperdistension: 13.2%
Collapse: 10.7%
Compliance: 109.7 mL/cmH_2O

Hyperdistension

Hyperdistension

Cumulative Collapse

PEEP: 8.1 cmH_2O
Hyperdistension: 12.9%
Collapse: 17.3%
Compliance: 37.7 mL/cmH_2



Optimal PEEP:
Nejmíň hyperdistenze
Nejmíň kolapsu (do 5%)

PEEP titrace pomocí EIT tentýž pacient

KARIM
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Hyperdistension

PEEP: 16.0 cmH_2O
Hyperdistension: 12.2%
Collapse: 0.5%
Compliance: 42.7 mL/cmH_2O

Hyperdistensio

PEEP: 14.0 cmH_2O
Hyperdistension: 9.6%
Collapse: 1.9%
Compliance: 40.6 mL/cmH_2O

Hyperdistension

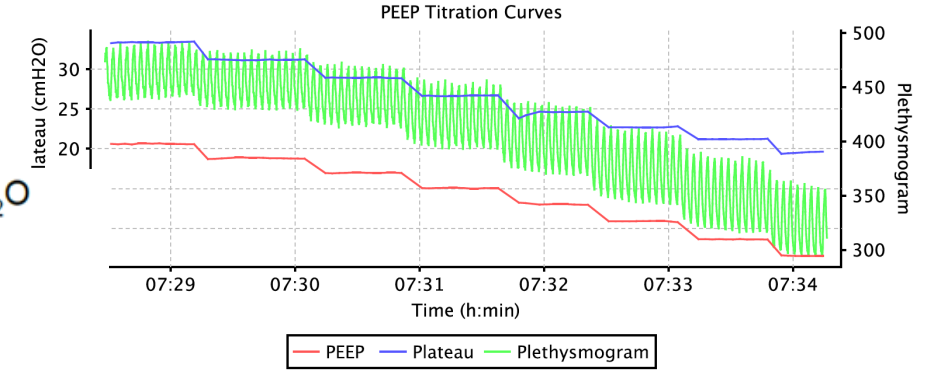
PEEP: 12.1 cmH_2O
Hyperdistension: 4.4%
Collapse: 4.3%
Compliance: 41.4 mL/cmH_2O

Hyperdistension

PEEP: 9.9 cmH_2O
Hyperdistension: 4.1%
Collapse: 6.5%
Compliance: 40.3 mL/cmH_2O

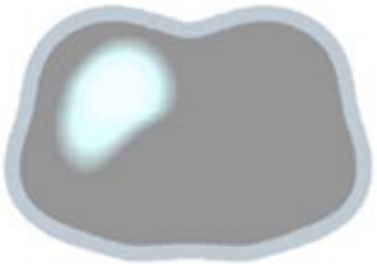
Hyperdistension Cumulative Collapse

PEEP: 8.1 cmH_2O
Hyperdistension: 0.1%
Collapse: 13.2%
Compliance: 41.4 mL/cmH_2O



Homogenizace pomocí ALT

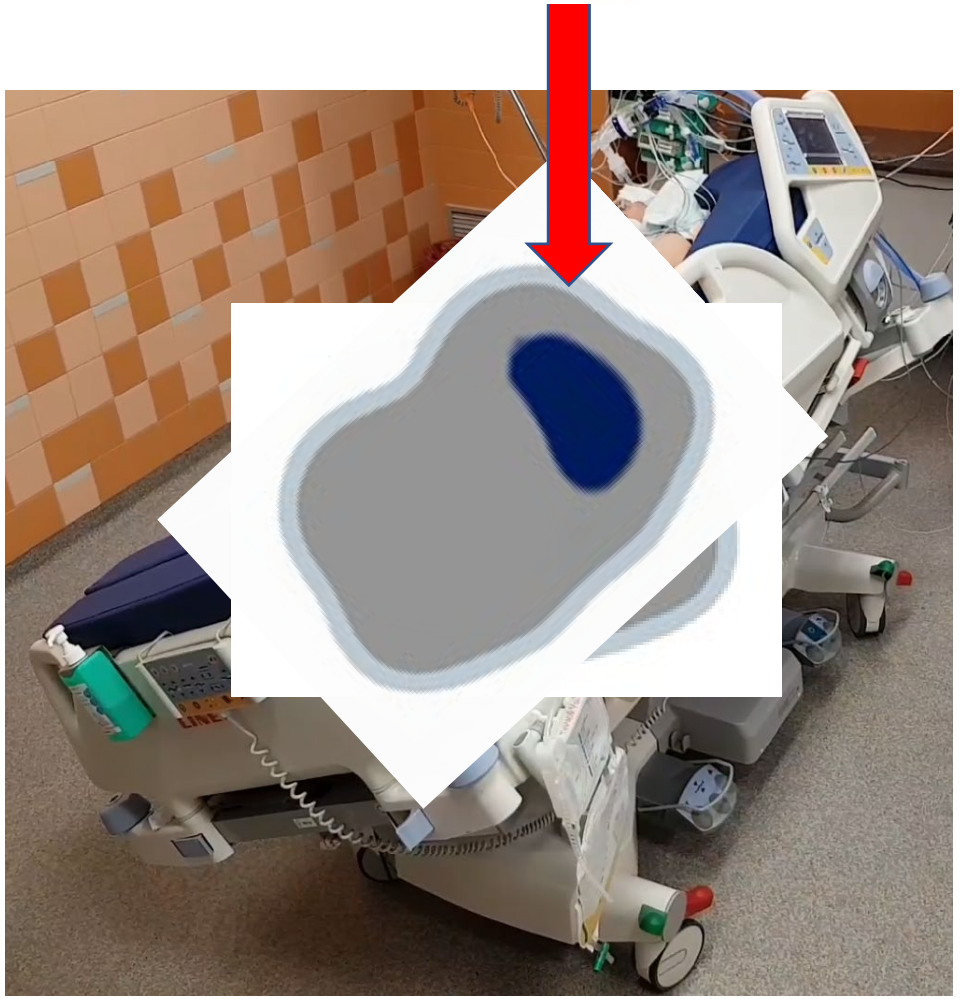
PEEP titrace EIT −► cílená ALT



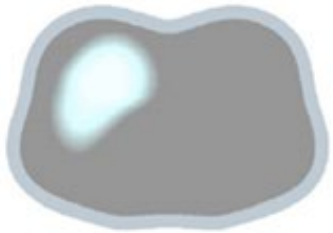
Hyperdistension

Cumulative Collapse

PEEP:	12.2 cmH_2O
Hyperdistension:	15.5%
Collapse:	11.3%
Compliance:	31.2 mL/cmH_2O



PEEP titrace EIT −► cílená ALT

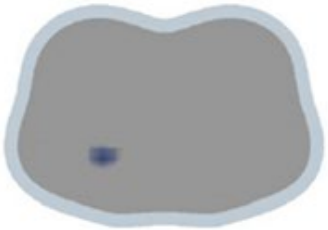


Hyperdistension

Cumulative Collapse

PEEP: 12.2 cmH_2O
Hyperdistension: 15.5%
Collapse: 11.3%
Compliance: 31.2 mL/cmH_2O

Hyperdistension

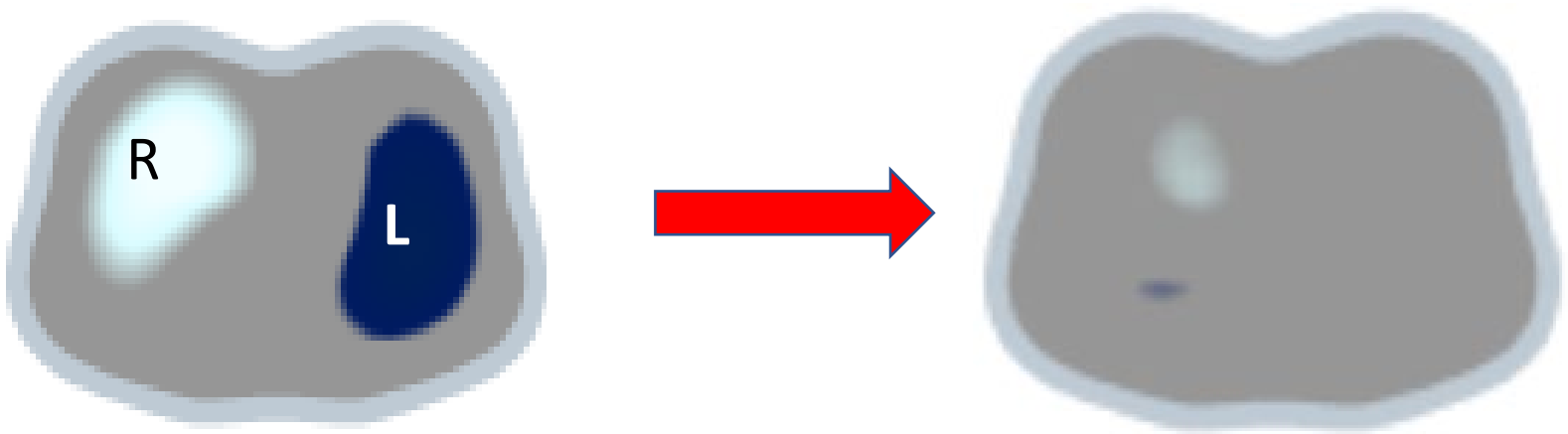


Cumulative Collapse

PEEP: 12.1 cmH_2O
Hyperdistension: 4.4%
Collapse: 4.3%
Compliance: 41.4 mL/cmH_2O

po 15 hodinách ALT - R 30° / záda

PEEP titrace EIT −► cílená ALT



na stejném PEEPu:

redukce hyperdistenze
71%

redukce kolapsu
82%

zvýšení kompliance
28%

po 15 hodinách ALT - R 30° / záda

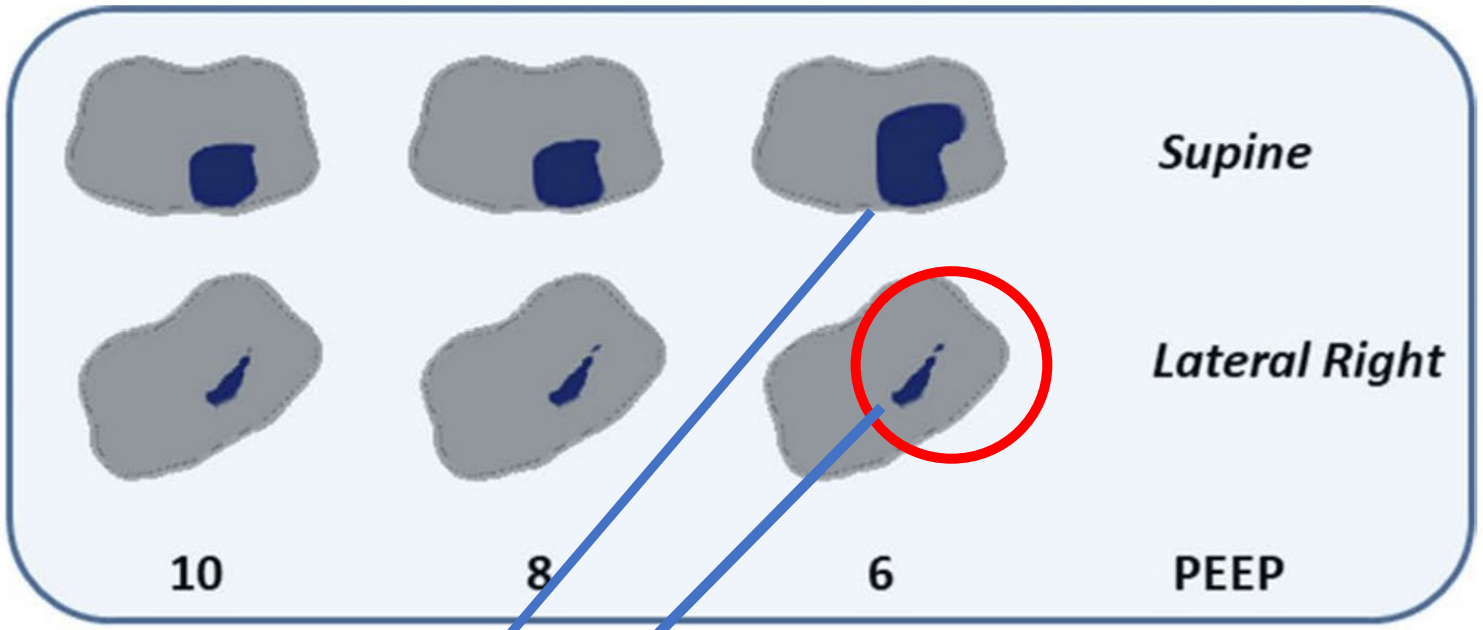
Cílené POLOHOVÁNÍ – ALT

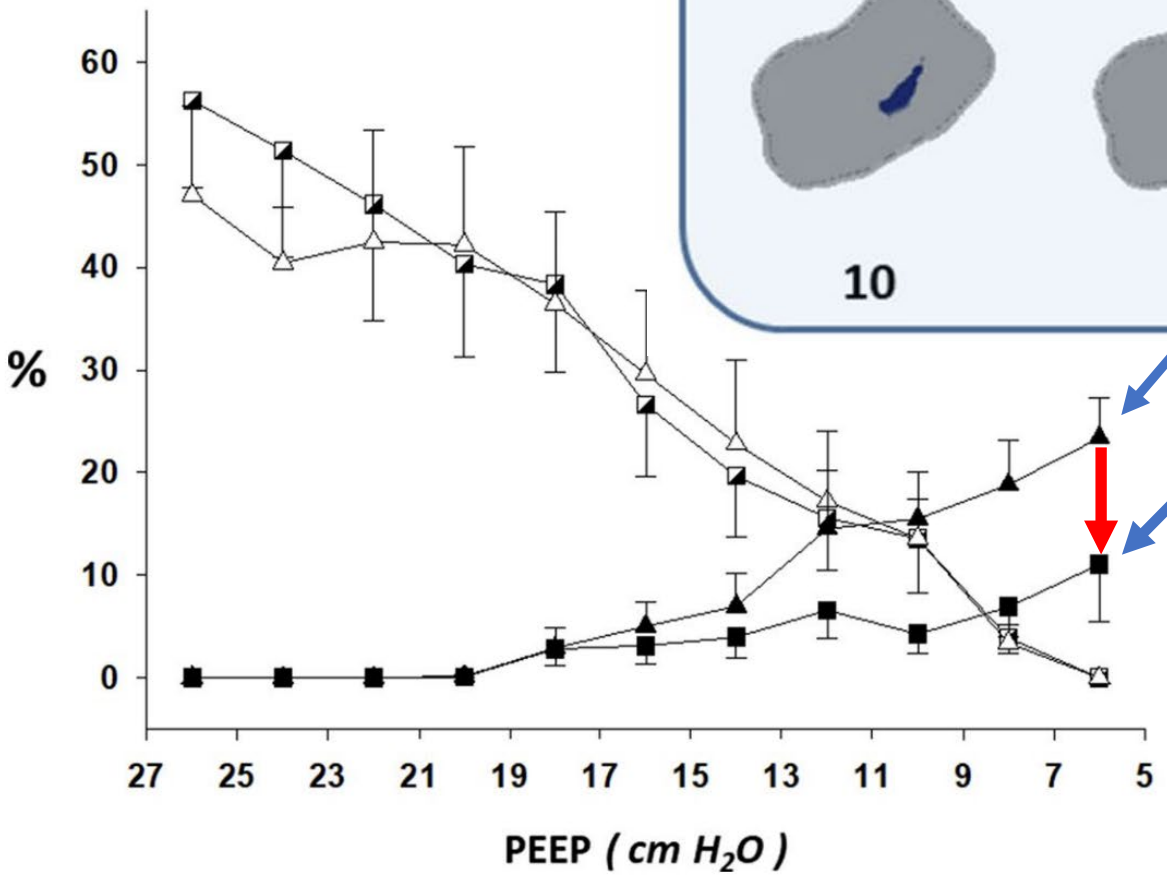
KARIM
1.LF UK A VFN V PRAZE

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

g decreases
ension
DS

le Cristina Alcala[3].
to[3] and Otomar Kittnar[1]
l. BMC Pulm Med (2021) 21:133



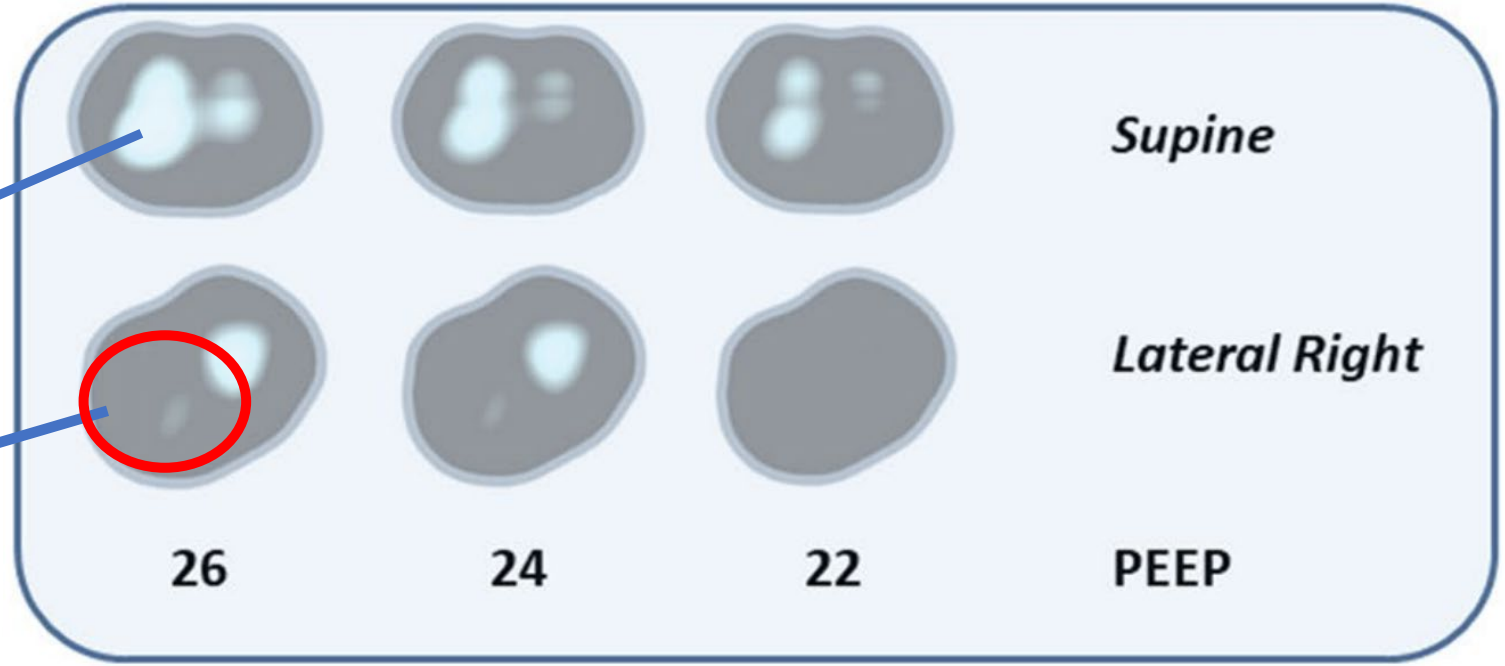


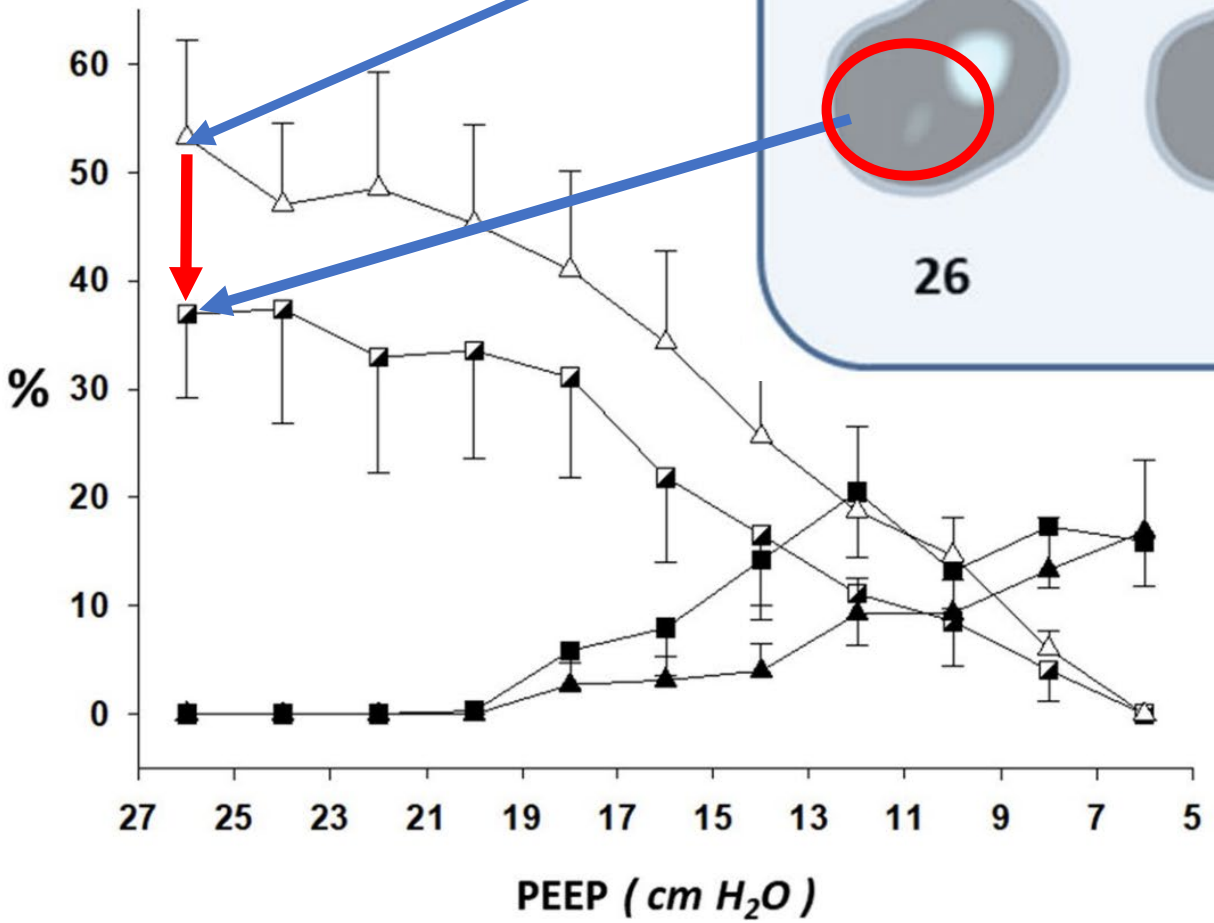
Left Lung

less collapse P=0.014

Mlček, BMC Pulm Med, 2021

Cílené POLOHOVÁNÍ – ALT





Right Lung

less overdistension P=0.005

ecreases
ion

ina Alcala[3].
Otomar Kittnar[1]
m Med (2021) 21:133

Mlček, BMC Pulm Med, 2021

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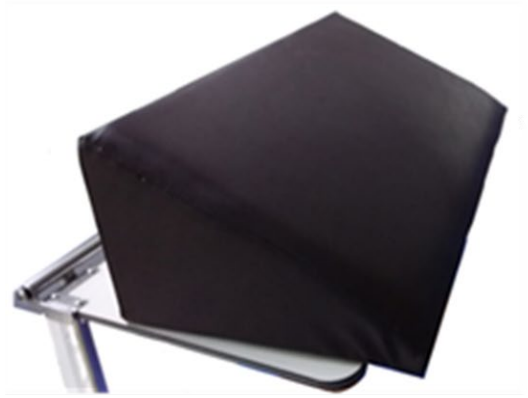
30° support cushion



equential lateral positioning as a new lung
cruitment maneuver: an exploratory study
early mechanically ventilated Covid-19 ARDS
atients

Annals of Intensive Care

lin Roldán[1,2,3], Shalim Rodriguez[1,2], Fernando Barriga[1,2], Mauro Tucci[3], Marcus Victor[3,4], Glasiele Alcala[3],
nán Villamonte[1,2], Fernando Suárez-Sipmann[5,6,7], Marcelo Amato[3], Laurent Brochard[8,9*] and
rardo Tusman[10]

to SpO2 92–97%

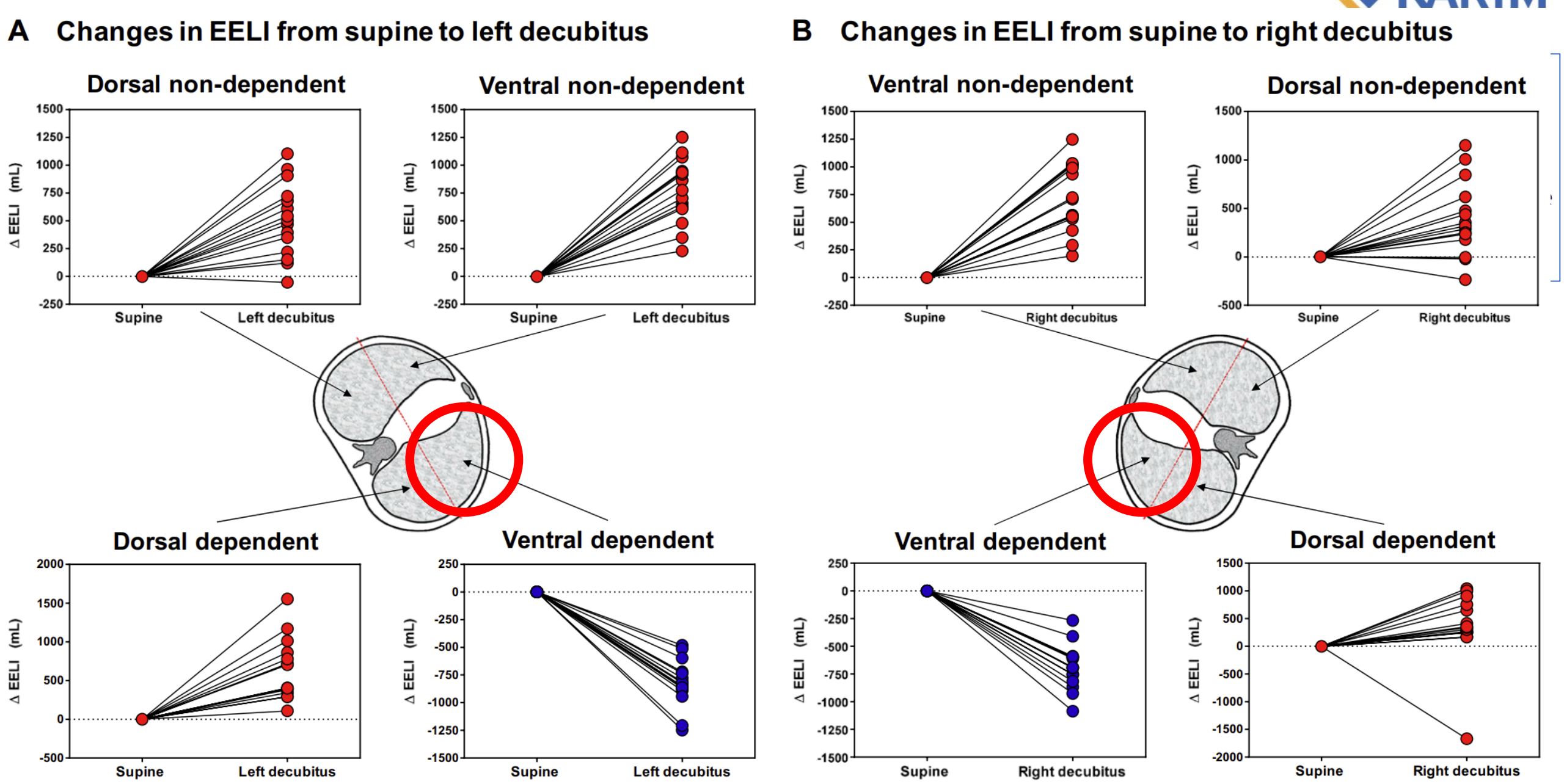
re ≤15 cmH2O,

which patients received
O for R/I ratio>0.5

- five sequentially applied positions for 30 min each:

  Supine-baseline; Lateral-1st side; 2nd Supine; Lateral-2nd side; Supine-fnal

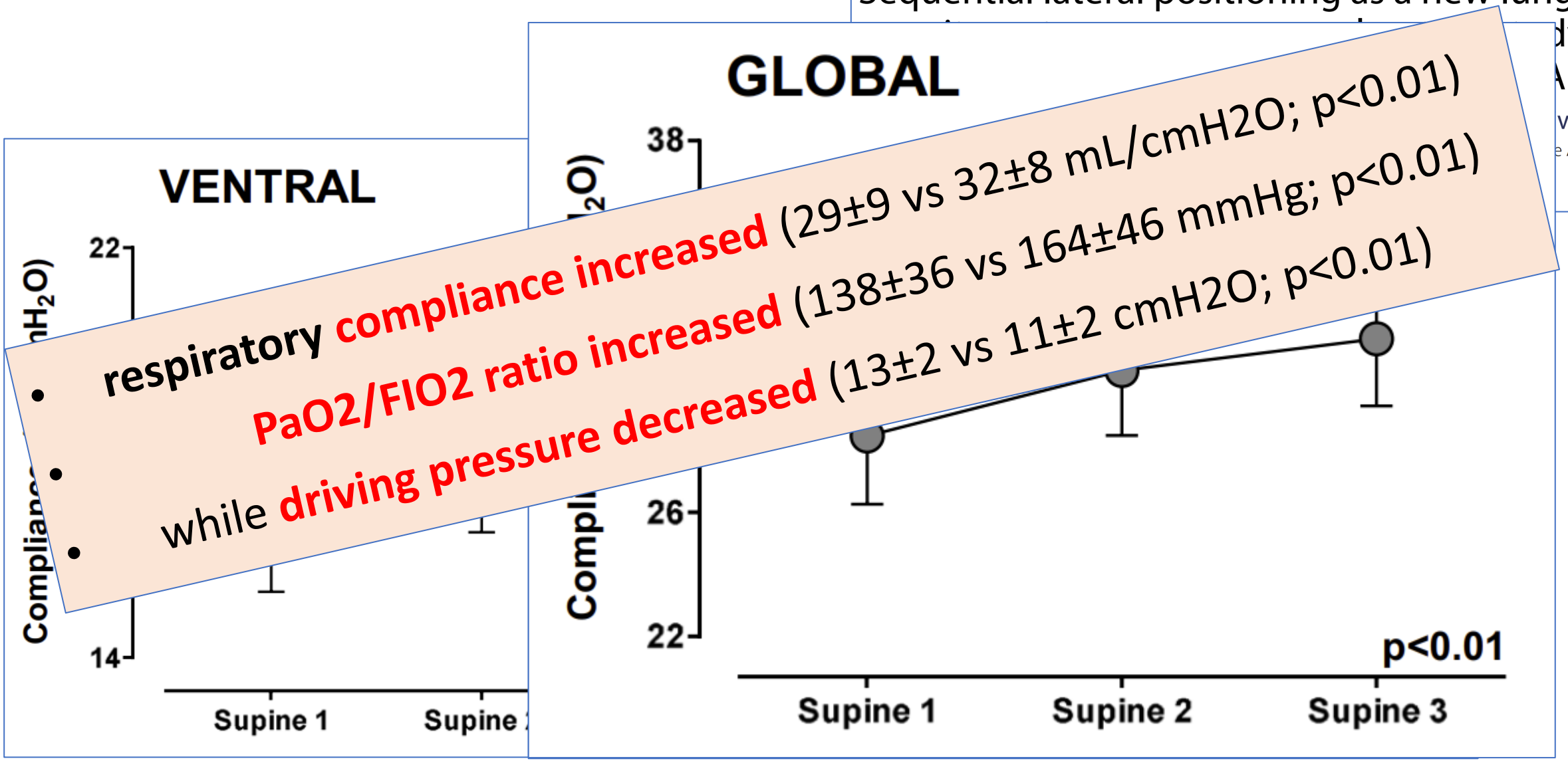
Roldán, Annals of Intensive Care, 2022



Roldán, Annals of Intensive Care, 2022

Polohování jako forma RM

Sequential lateral positioning as a new lung
dy
ARDS
ve Care
e Alcala[3],



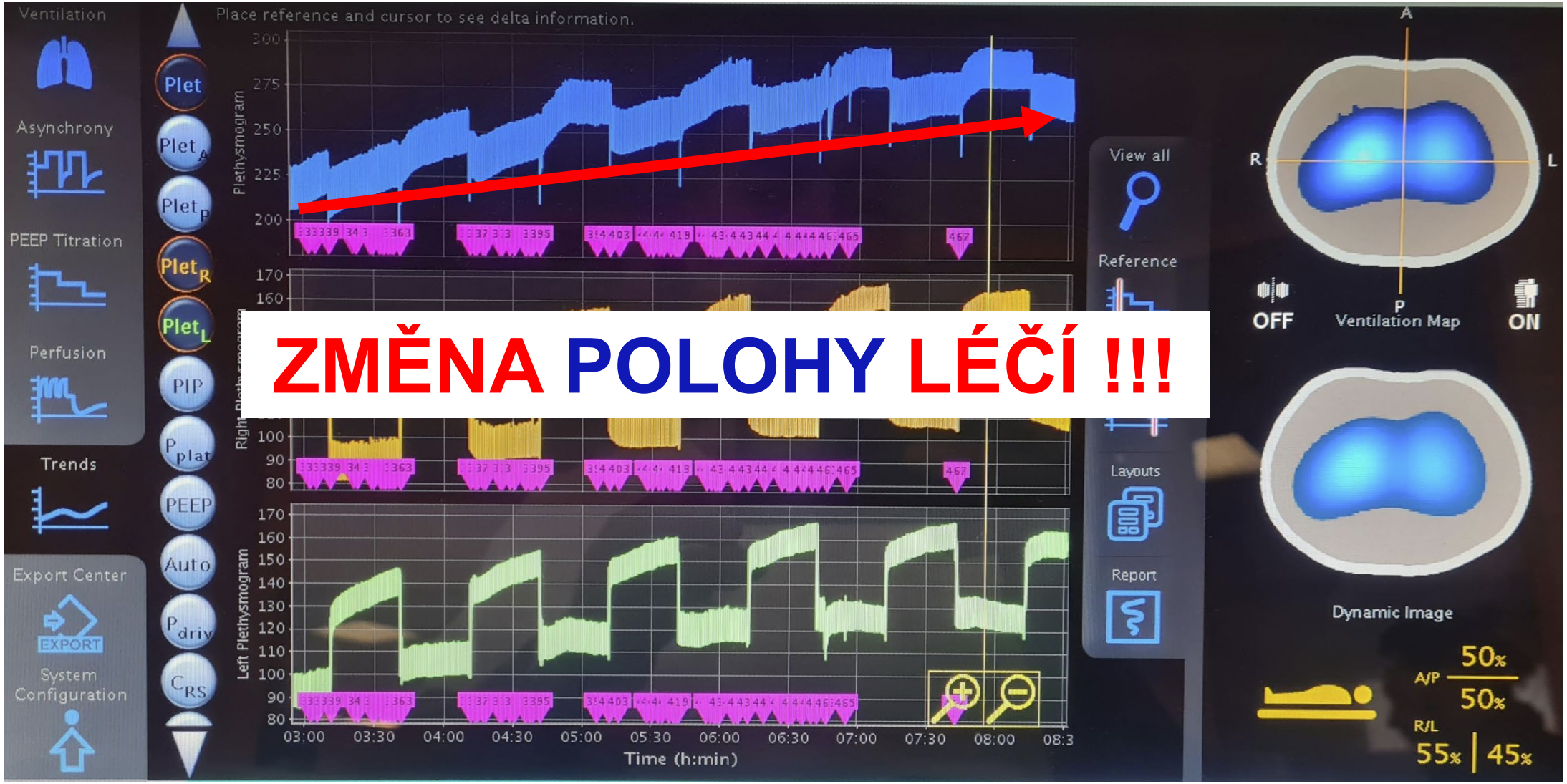
- respiratory **compliance increased** (29±9 vs 32±8 mL/cmH2O; p<0.01)
- **PaO2/FIO2 ratio increased** (138±36 vs 164±46 mmHg; p<0.01)
- while **driving pressure decreased** (13±2 vs 11±2 cmH2O; p<0.01)

Roldán, Annals of Intensive Care, 2022

Cílené POLOHOVÁNÍ – ALT

KARIM
1.LF UK A VFN V PRAZE

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

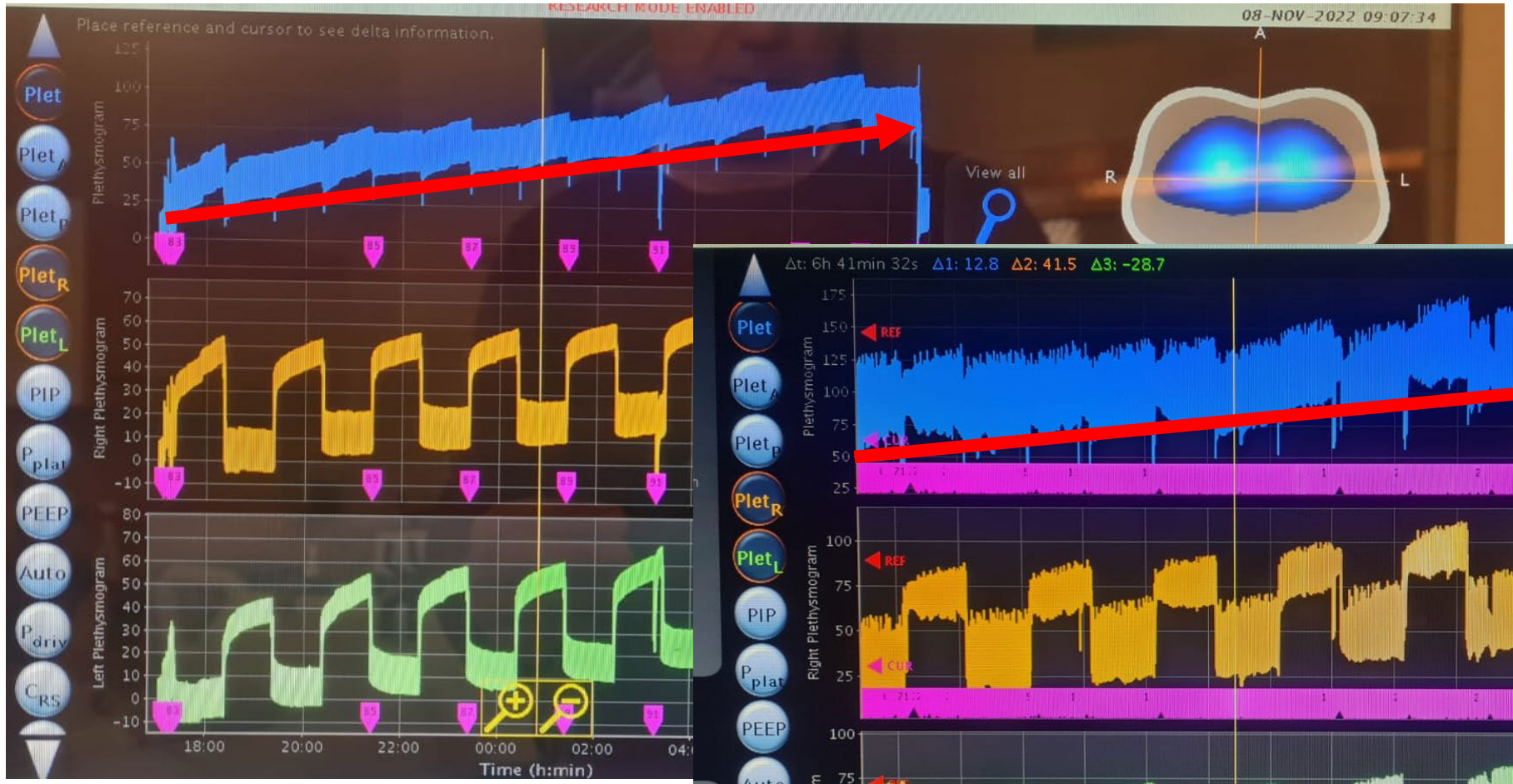


ZMĚNA POLOHY LÉČÍ !!!

Cílené POLOHOVÁNÍ – ALT

KARIM
1.LF UK A VFN V PRAZE

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE



COMPLETE care … co musíme udělat před RM?

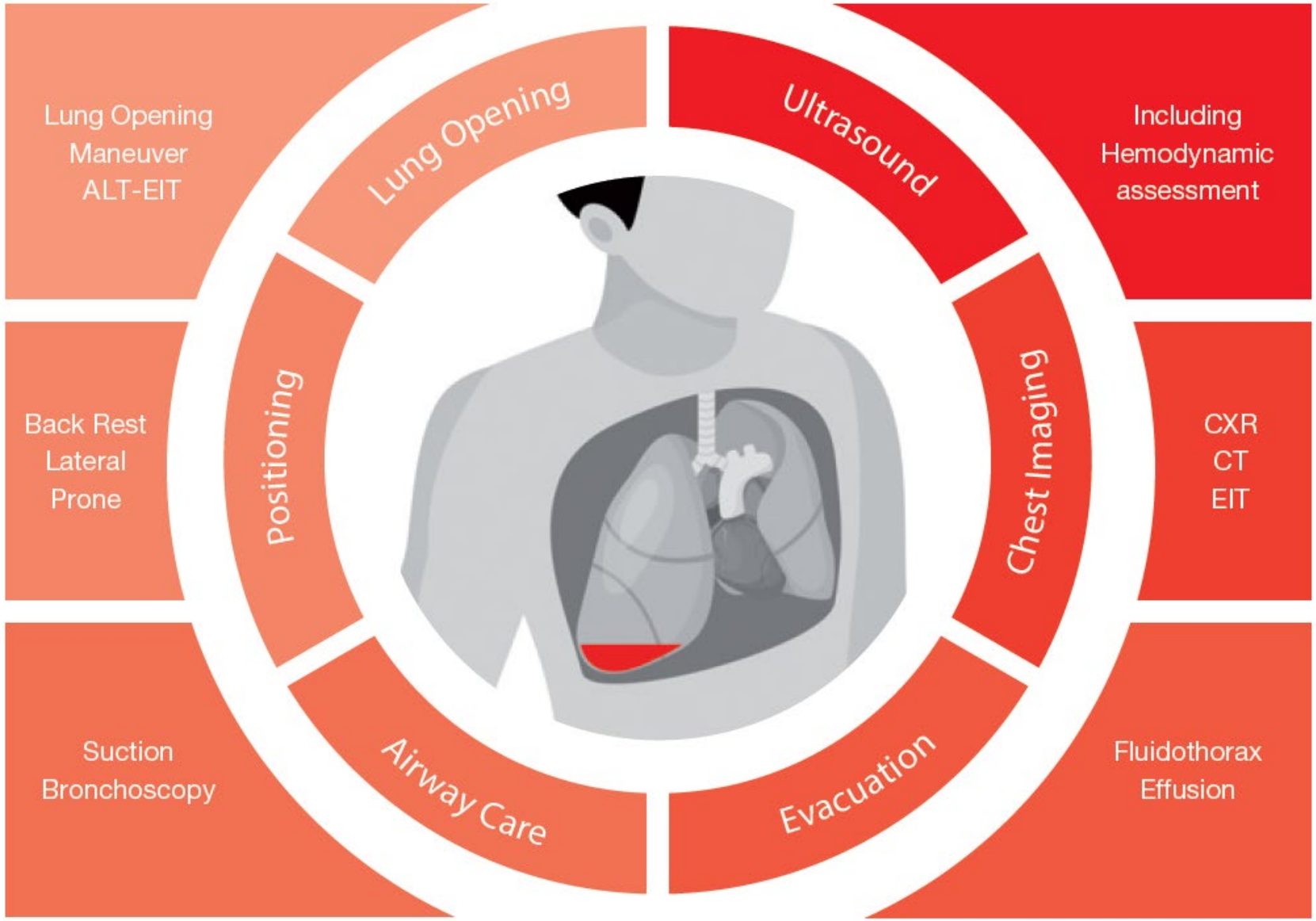
KARIM
1.LF UK A VFN V PRAZE

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

RM

POZICE

FOB

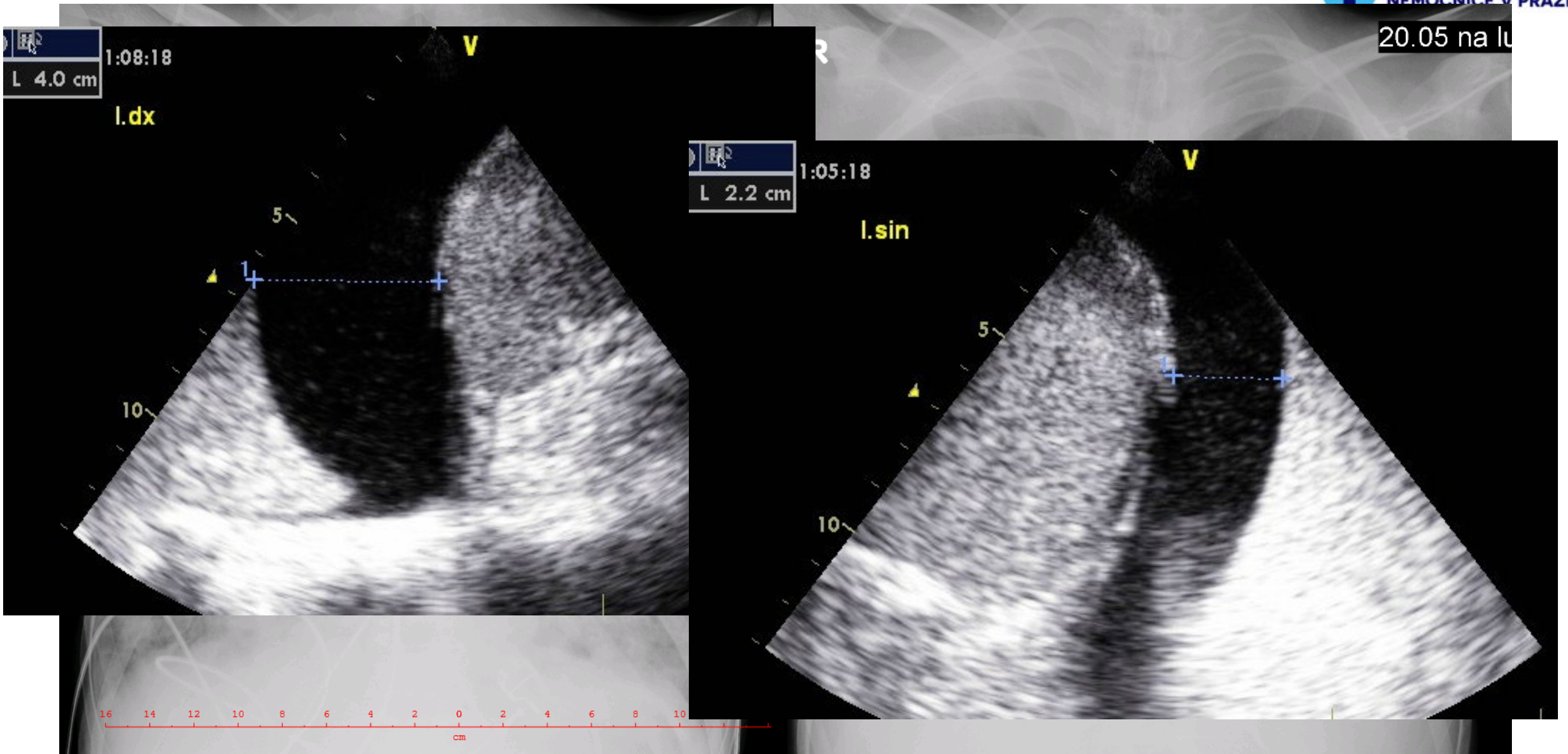


HEMO

FLUIDO

PCV RM - VIZUALIZACE monitorace UZ

PCV RM - VIZUALIZACE monitorace UZ



PCV RM - VIZUALIZACE monitorace UZ

KARIM
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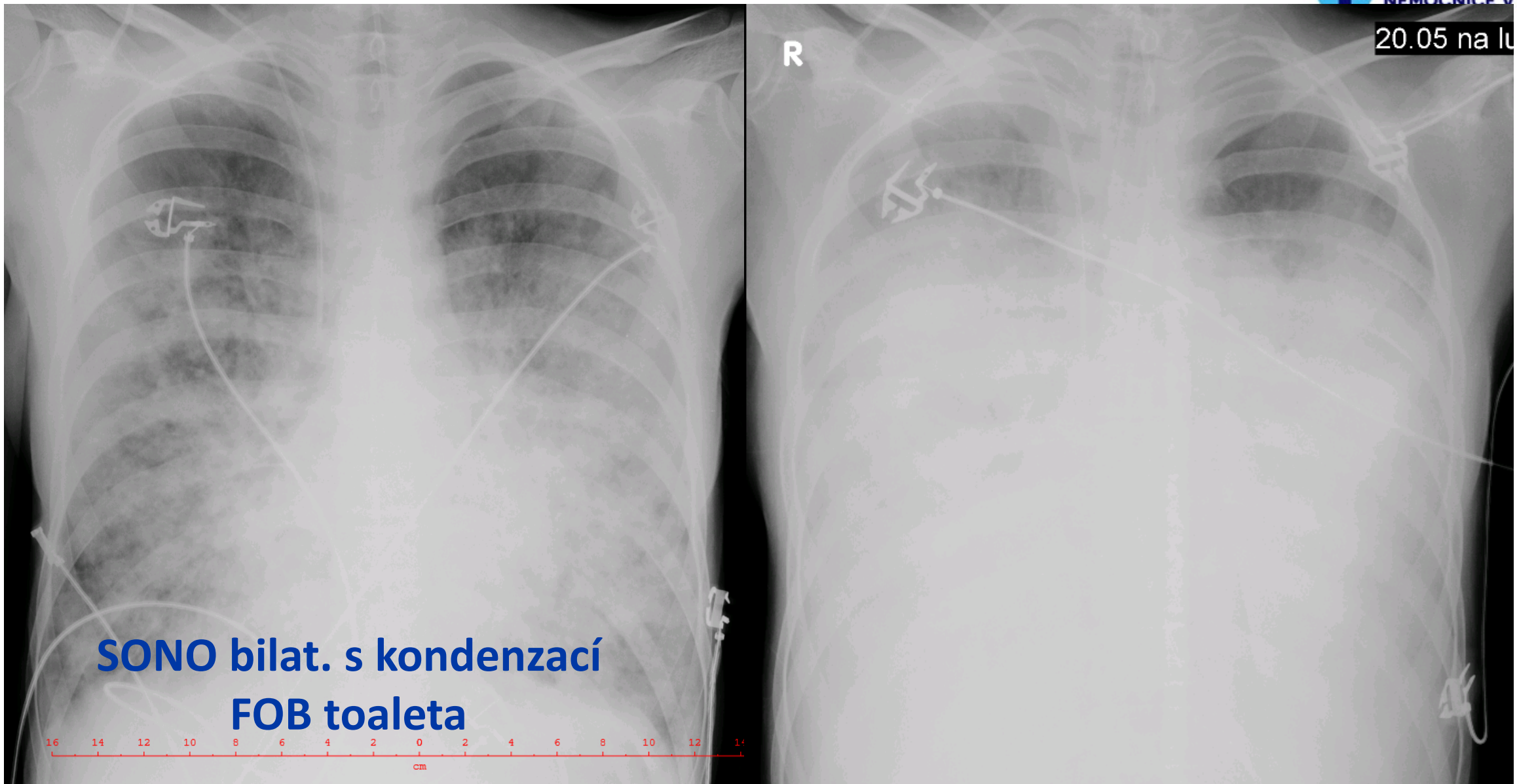
VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE



PCV RM - VIZUALIZACE monitorace UZ

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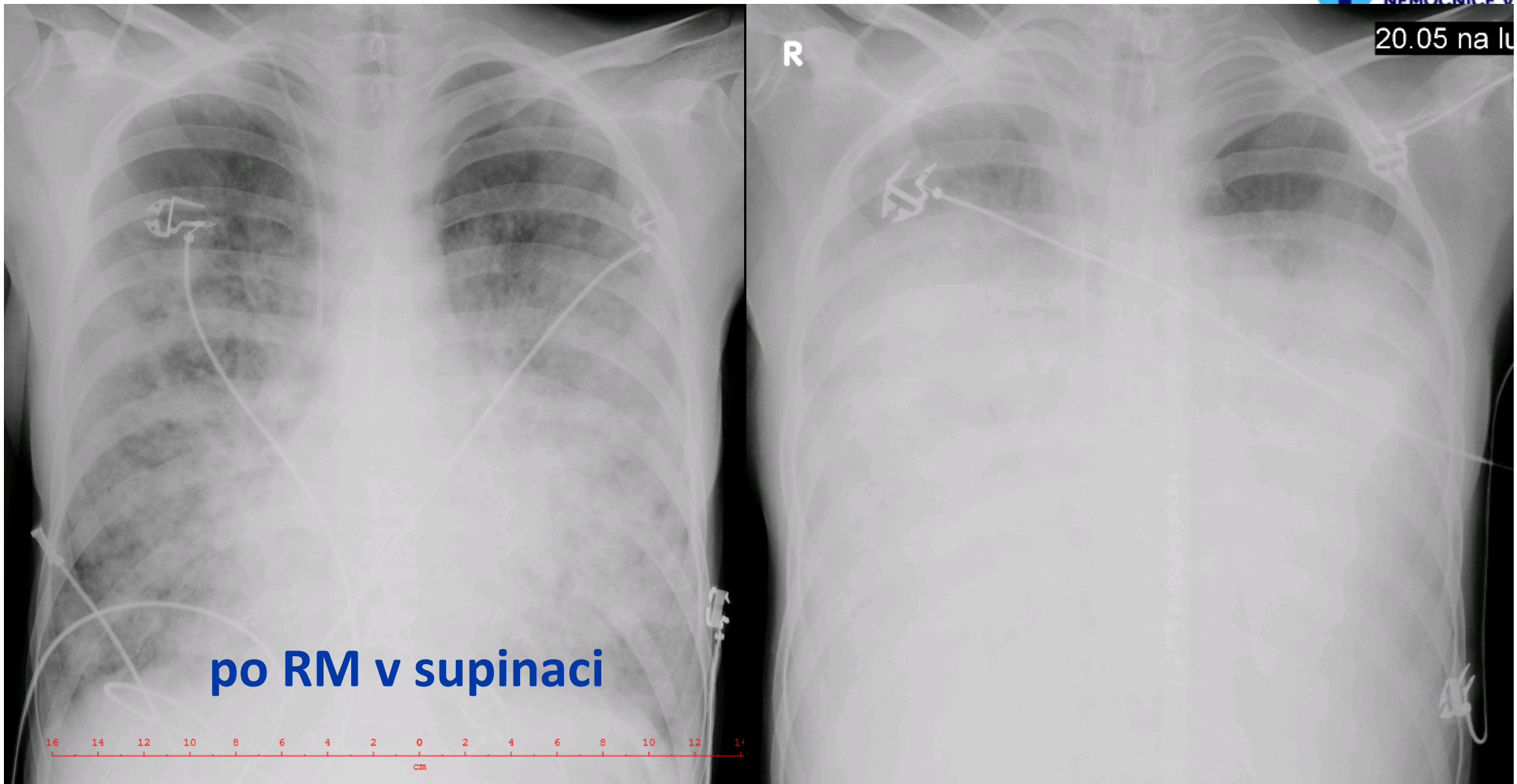

PCV RM - VIZUALIZACE monitorace UZ

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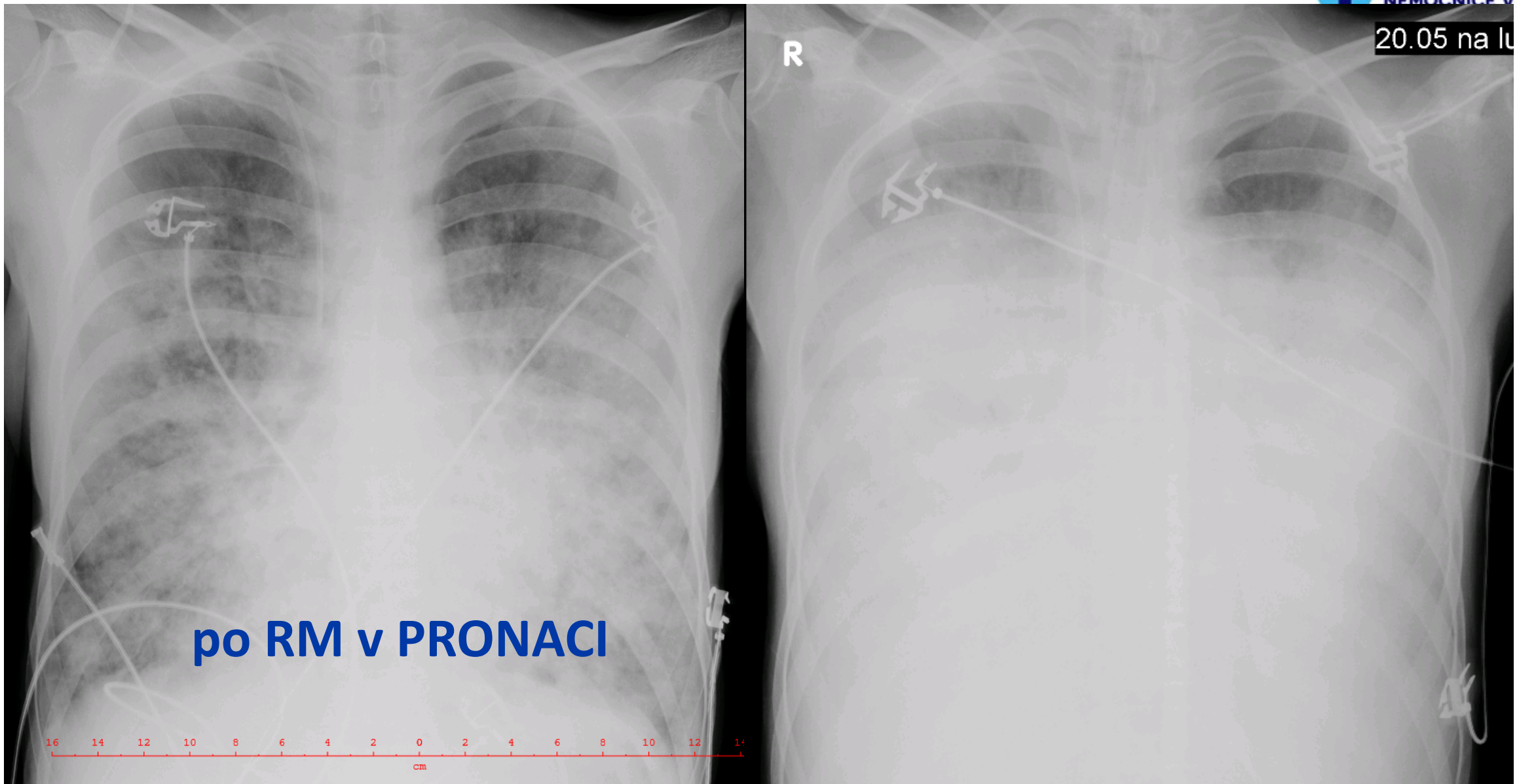
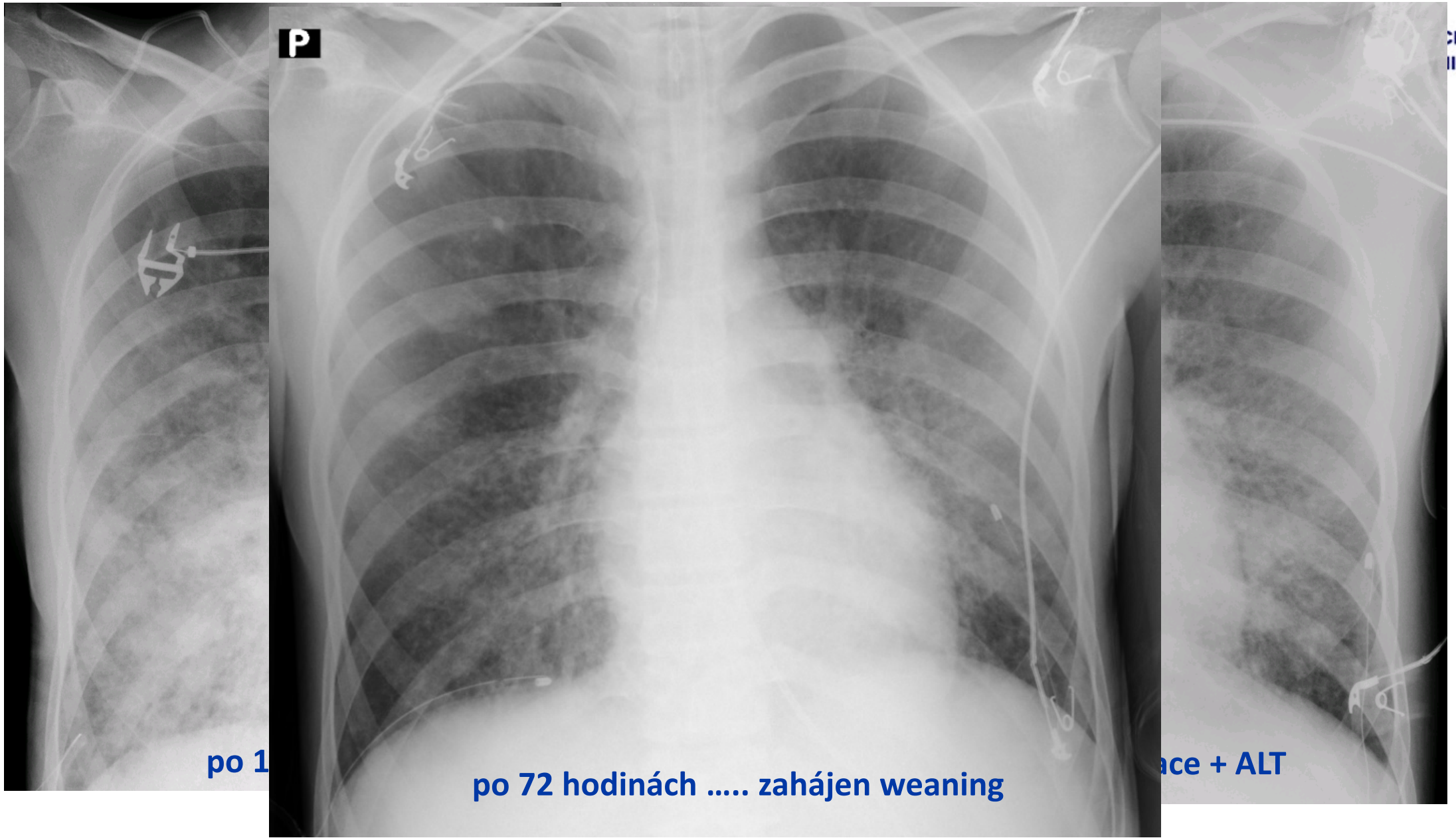


PCV RM monitorace UZ



po 1

po 72 hodinách ….. zahájen weaning

ace + ALT

Monitorace perfůze ….

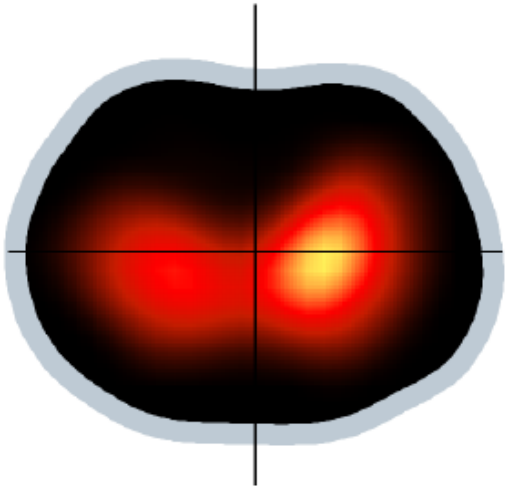
OPTIMALIZACE V/Q

změnou polohy

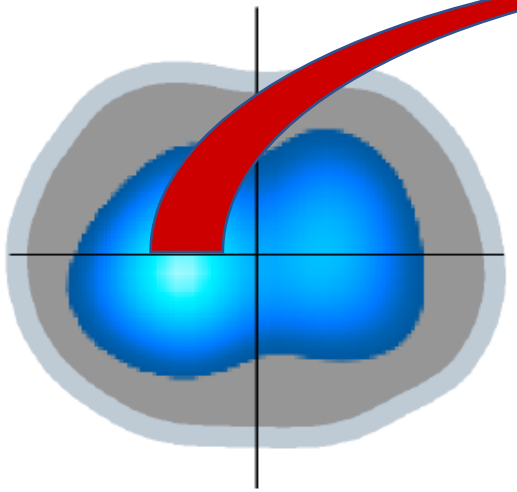
KARIM
1.LF UK A VFN V PRAZE

SUPINACE

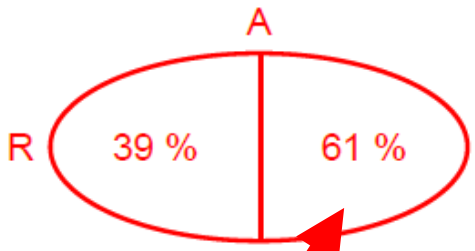
Perfusion map:

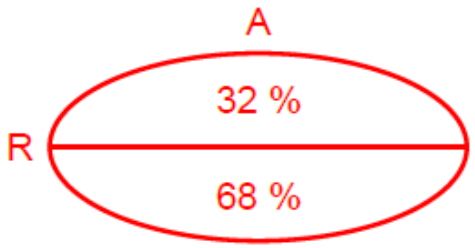


Ventilation map:



Perfusion distributions:





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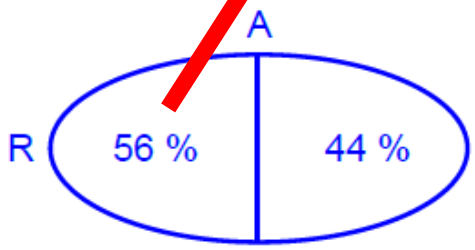
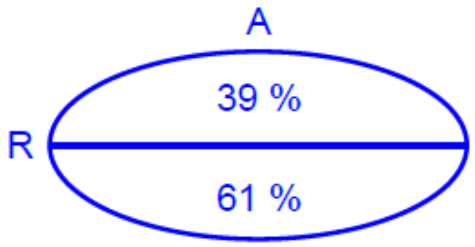
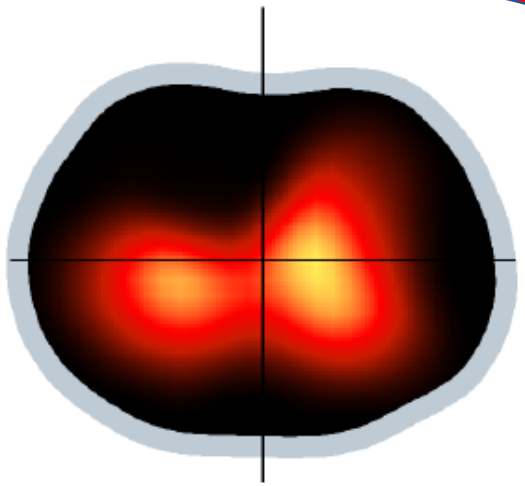




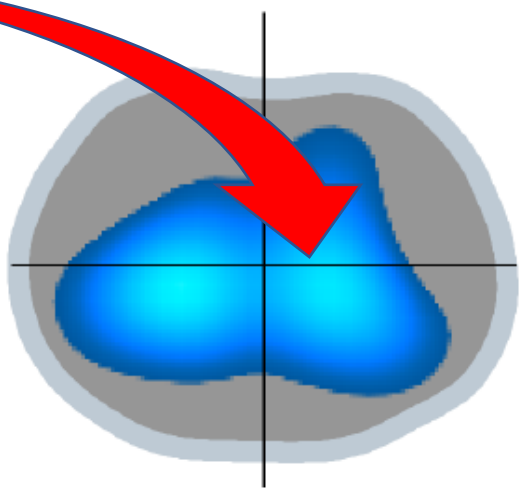
V ≠ Q

PRONACE

Perfusion map:



Ventilation map:



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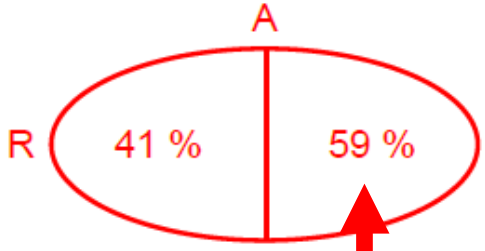

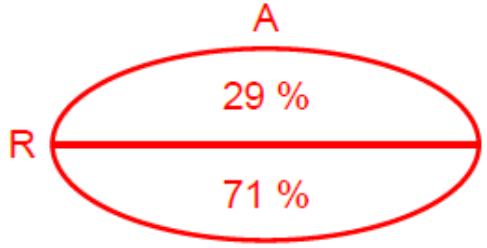

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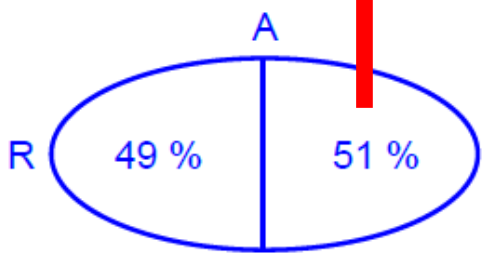
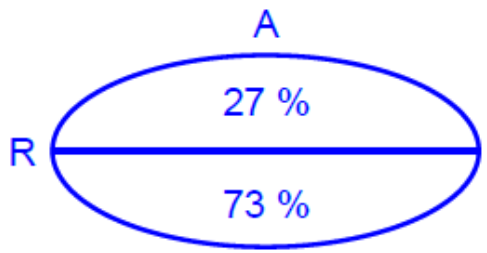


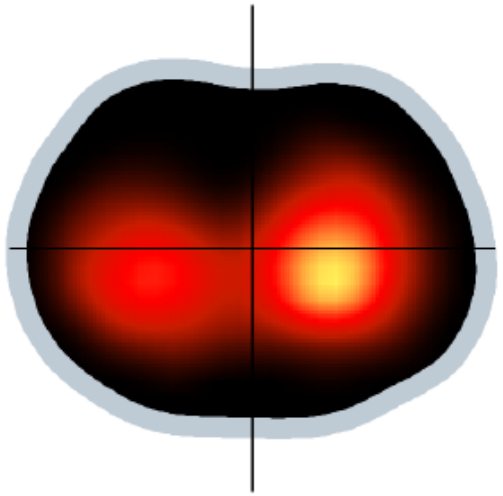


V ≈ Q

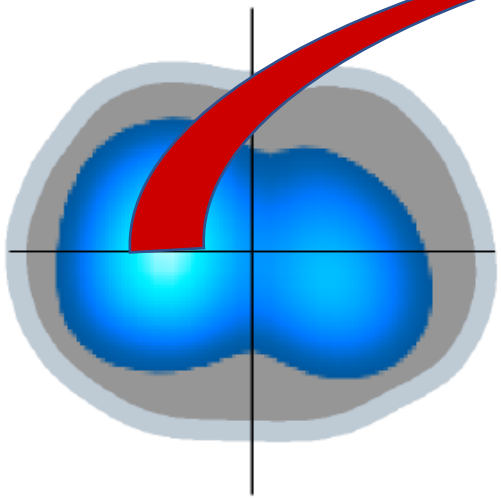
SUPINACE

R – LAT 30°

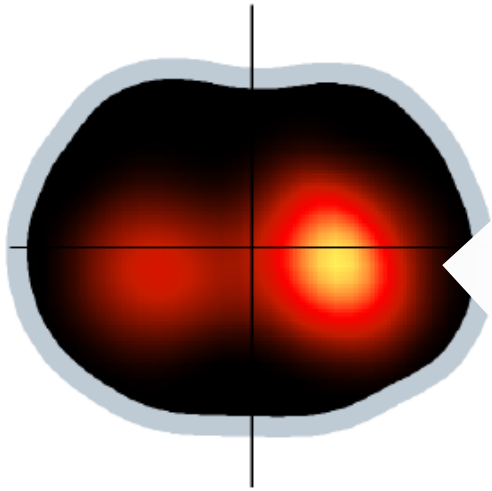
Perfusion map:

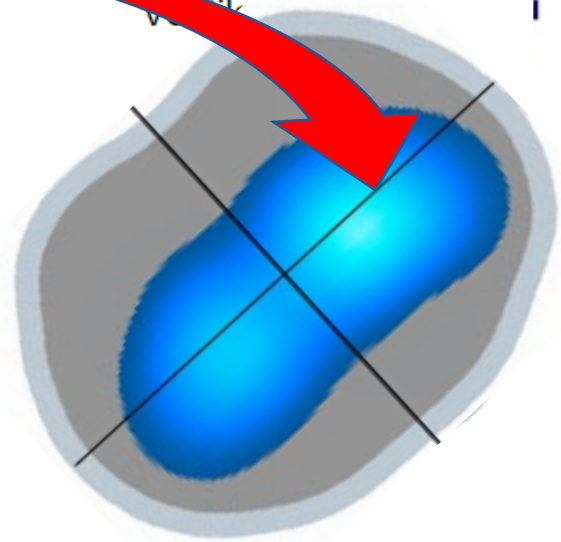


Ventilation map:



Perfusion map:





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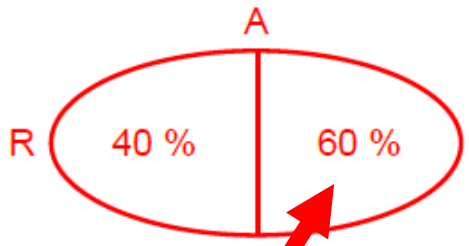
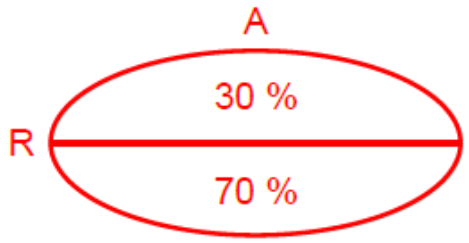
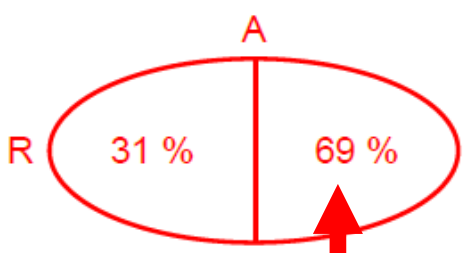
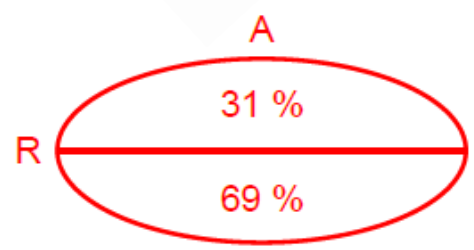




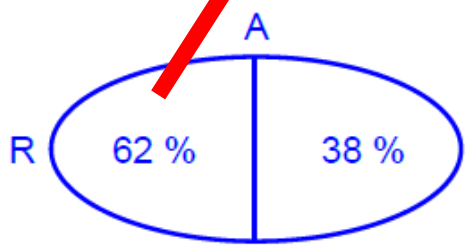
Perfusion distributions:

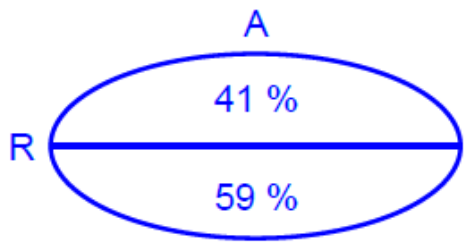




V ≠ Q

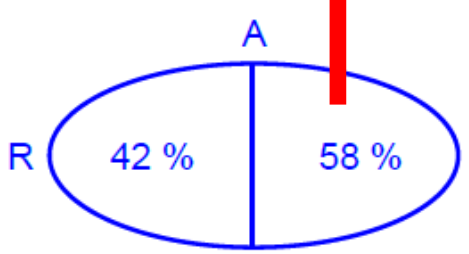
Ventilation distributions:

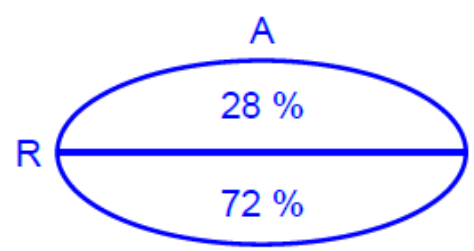




V ≈ Q

Ventilation distributions:





Změna polohy léčí nejen v SUPINACI …

Pronace / VV ECMO

Pronace při VV-ECMO

KARIM
1.LF UK A VFN V PRAZE

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

Prone-Positioning for Severe Acute Respiratory Distress Syndrome Requiring Extracorporeal Membrane Oxygenation

Critical Care Medicine
Society of Critical Care Medicine

Petit, Matthieu MD[1]; Fetita, Catalin PhD[2]; Gaudemer, Augustin MD[3]; Treluyer, Ludovic MD[4]; Lebreton,
Critical Care Medicine: February 2022 - Volume 50 - Issue 2 - p 264-274

- Retrospective, single-center study **over 8 years**, twenty-six bed ICU in a tertiary center
- Among **298 VV-ECMO** treated adults with severe ARDS **64 were PRONE**

- 90-day **probability of being weaned-off ECMO and alive was higher**
  (**0.75 vs 0.54, $p = 0.03$**; subdistribution hazard ratio [95% CI], 1.54 [1.05–2.58])

- 90-day **mortality was lower (20% vs 42%, $p < 0.01$)** than that for no prone-positioning ECMO ptstients.

- Extracorporeal membrane oxygenation–related **complications were comparable for the two** groups

Pronace / EIT optimalizace u VV-ECMO

KARIM
1.LF UK A VFN V PRAZE
VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

Prone positioning monitored by electrical impedance tomography in patients with severe acute respiratory distress syndrome on veno-venous ECMO

Annals of Intensive Care

Guillaume Franchineau[1,2], Nicolas Bréchot[1,2], Guillaume Hekimian[1,2], Guillaume Lebreton[1,3], Simon Bourcier[1,2],

Franchineau *et al. Ann. Intensive Care* (2020) 10:12

- monocentric study, ECMO-supported severe ARDS patients,
- **PCV 14-cmH2O driving pressure** and EIT-based "optimal PEEP"

- before, during and after a 16-h PP session
- subgroup analyses were performed in patients **(PCG+)** increased their static compliance by≥3 mL/cmH2O after 16 h of PP.
- For all patients (n=21), **EIT-based optimal PEEP was signifcantly lower in PP than in supine position**
- **Median (IQR) optimal PEEP decreased from 14 (12–16) to 10 (8–14) cmH2O**

- 62% patients increased their static compliance by≥3 mL/cmH2O after PP on ECMO.

Franchineau et al. Ann. Intensive Care, 2020

Pronace / EIT optimalizace u VV-ECMO

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VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

Prone positioning monitored by electrical impedance tomography in patients with severe acute respiratory distress syndrome

nnals of Intensive Care

me Lebreton[1,3], Simon Bourcier[1,2],

eau *et al. Ann. Intensive Care* (2020) 10:12

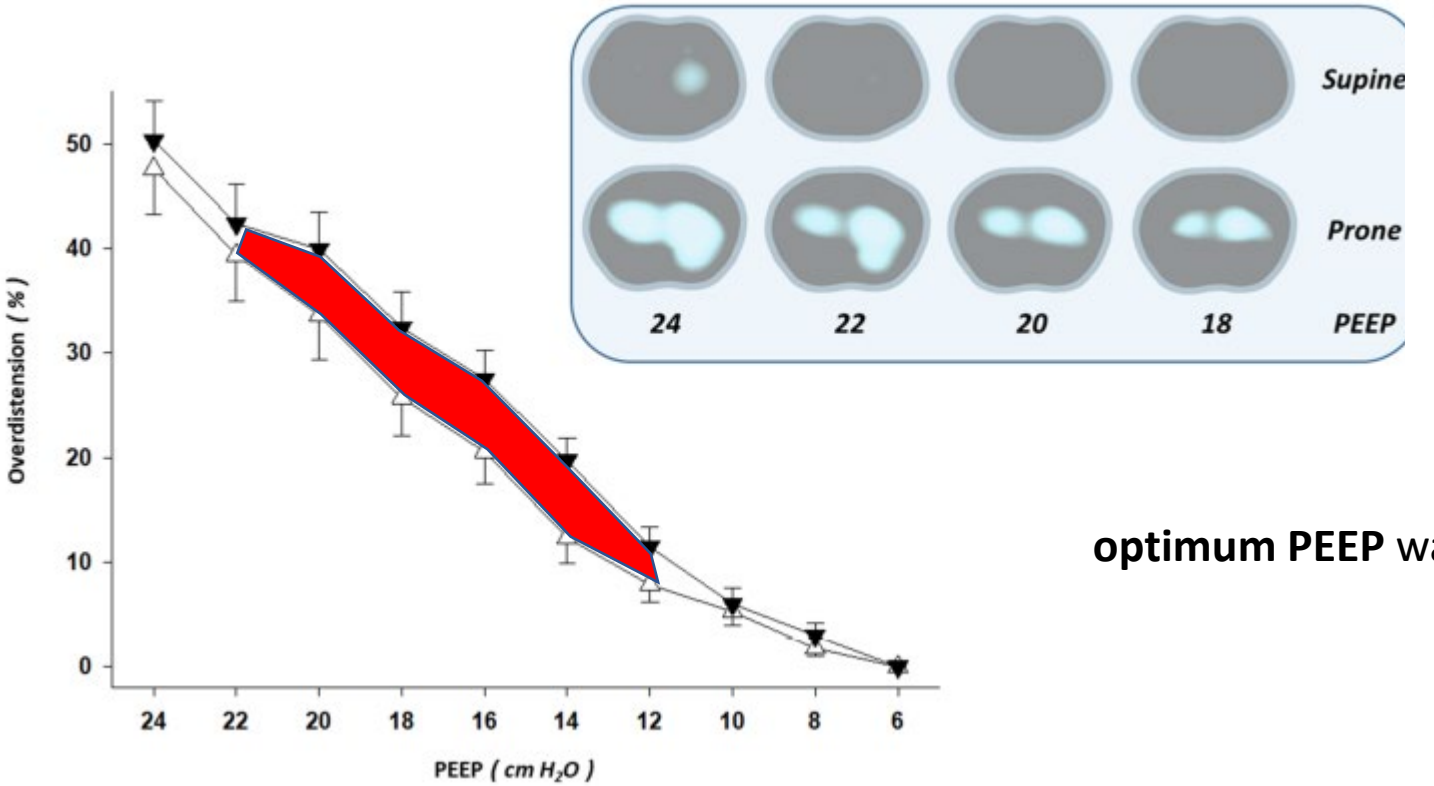
Table 1 Characteristics and outcomes according to PP-responder status

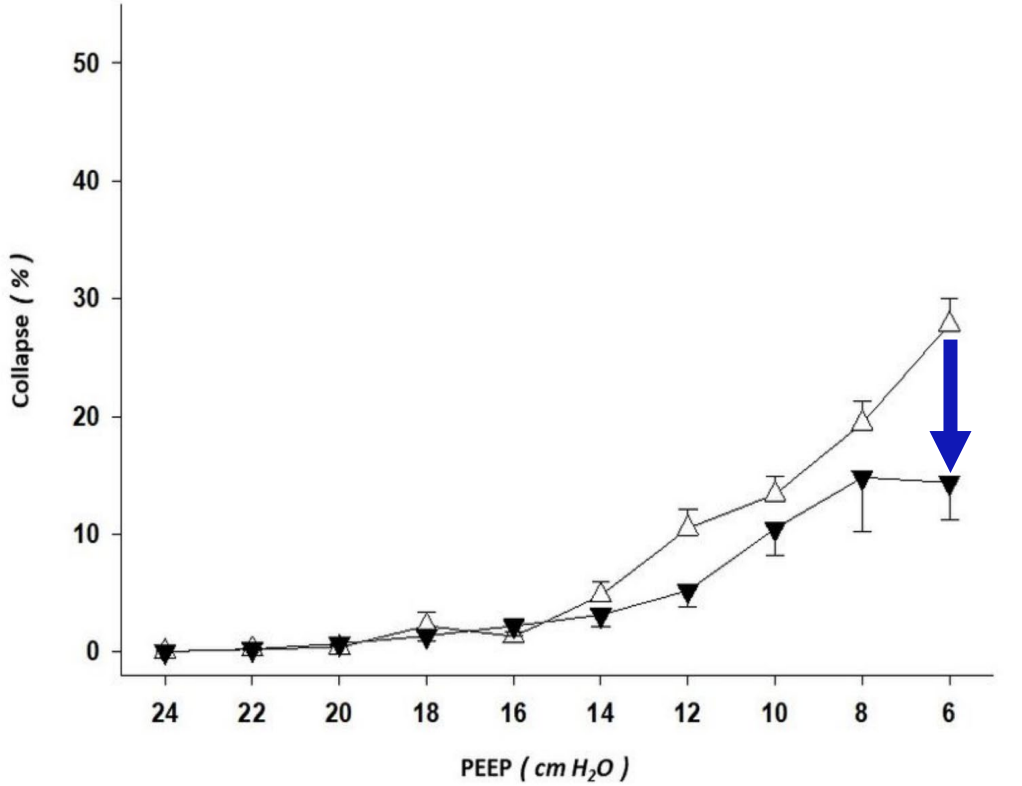
Characteristic	All patients ($n=21$)	PP responders ($n=13$)	PP non-responders ($n=8$)	*P*
BMI (kg/m^2)	29 (27–39)	30 (29–40)	27 (23–34)	0.046
ARDS-risk factor				
Viral pneumonia	12 (57)	9 (69)	3 (38)	0.004
Bacterial pneumonia	4 (19)	4 (31)	0	
MV duration before inclusion (d)	8 (6–11)	7 (5–9)	12 (5–28)	0.13
MV duration (d)	43 (27–62)	34 (27–55)	59 (46–82)	0.06
ECMO duration (d)	16 (11–23)	13 (10–19)	28 (13–65)	0.046
ICU Length of stay (d)	58 (59–71)	42 (28–64)	69 (59–92)	0.02

Franchineau et al. Ann. Intensive Care, 2020

Pronace / EIT optimalizace u NON-ECMO

prone body position, when compared with supine body position, **decreased lung collapse** at low PEEP levels, but **increased lung overdistension at PEEP levels greater than 10 cm H2O**, (P= 0.042)





optimum PEEP was **13.7±4.5 cmH2O** in **supine** position and **10.8±4.3 cmH2O** in **prone**

Otáhal, Scientifc Reports, 2022

Polohování jako součást nastavení UVP / INDIVIDUALIZACE péče

KARIM
1.LF UK A VFN V PRAZE

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

- Prevence **PSILI – časná intubace / weaning**

- **PROTEKTIVNÍ ventilace – prevence VILI**

  Vt 6ml/kg/ PBW ….. ΔP<=15 (13) ….. Ppeak < 30/27cm H2O

  Mechanical power < 12j/min??? ……. **lepší zvyšovat DF**

- **Optimalizace PEEPu**
  homogenizace / RM? …. reareace / minimalizace overdistenze

- **POLOHOVÁNÍ …. PRONACE symetrické**
  / asymetrické …. CÍLENÉ ….. EIT/ALT

Protektivní UVP / INDIVIDUALIZACE

KARIM
1.LF UK A VFN V PRAZE

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

Není optimální / protektivní nastavení UPV

bez optimální POLOHY

KARIM
1.LF UK A VFN V PRAZE

VŠEOBECNÁ FAKULTNÍ NEMOCNICE V PRAZE

Na POLOZE

ZÁLEŽÍ

ZMĚNA POLOHY LÉČÍ !!!


Děkuji za pozornost