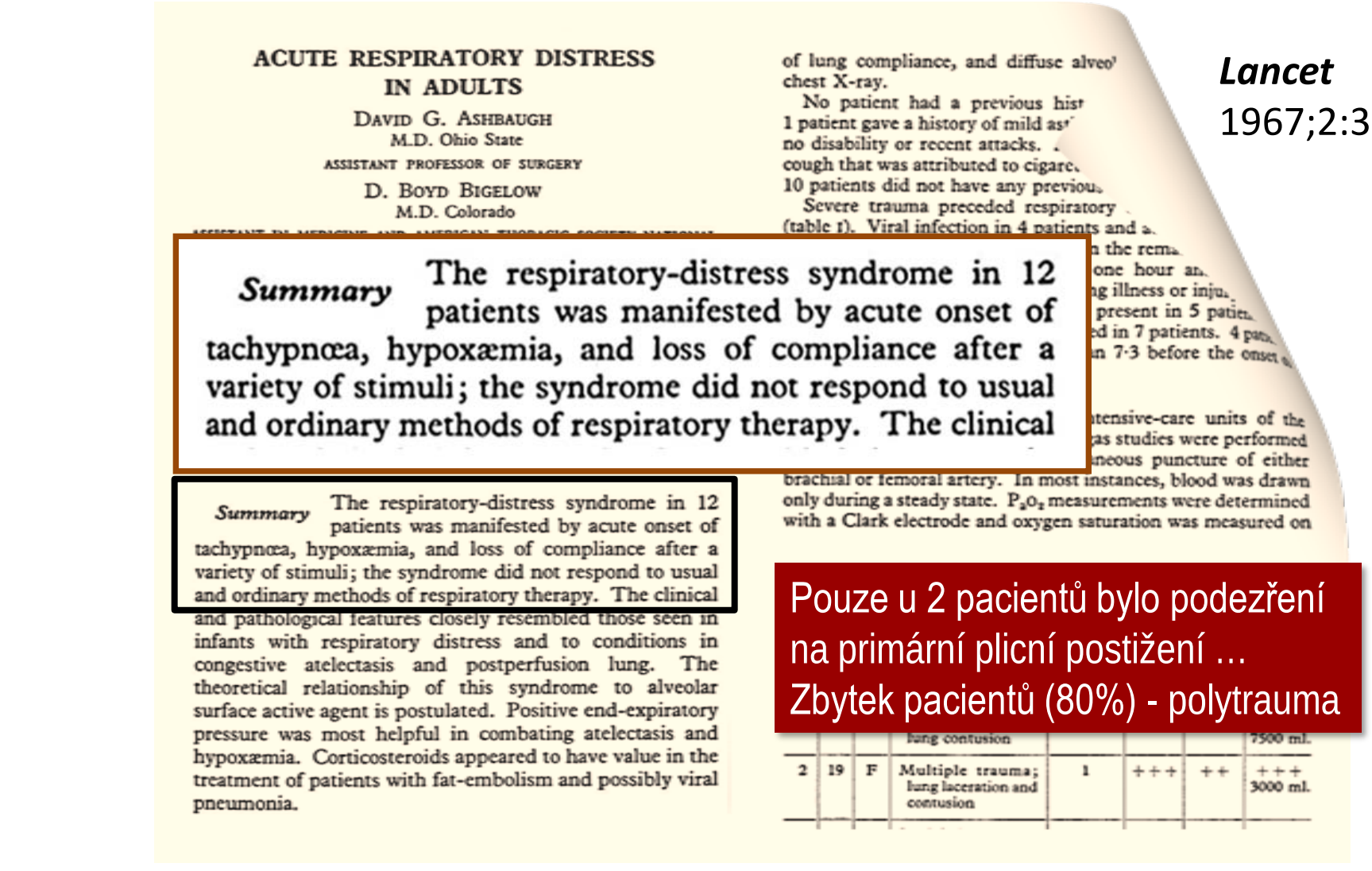
ARDS - **časy se mění ...**

R. Kula (KARIM FN Ostrava)

Happy birthday!

The Lancet *Saturday 12 August 1967*

The Lancet *Saturday 12 August 1967*



ACUTE RESPIRATORY DISTRESS IN ADULTS

DAVID G. ASHBAUGH
M.D. Ohio State
ASSISTANT PROFESSOR OF SURGERY
D. BOYD BIGELOW
M.D. Colorado

Summary The respiratory-distress syndrome in 12 patients was manifested by acute onset of tachypnœa, hypoxæmia, and loss of compliance after a variety of stimuli; the syndrome did not respond to usual and ordinary methods of respiratory therapy. The clinical and pathological features closely resembled those seen in infants with respiratory distress and to conditions in congestive atelectasis and postperfusion lung. The theoretical relationship of this syndrome to alveolar surface active agent is postulated. Positive end-expiratory pressure was most helpful in combating atelectasis and hypoxæmia. Corticosteroids appeared to have value in the treatment of patients with fat-embolism and possibly viral pneumonia.

Summary The respiratory-distress syndrome in 12 patients was manifested by acute onset of tachypnœa, hypoxæmia, and loss of compliance after a variety of stimuli; the syndrome did not respond to usual and ordinary methods of respiratory therapy. The clinical

of lung compliance, and diffuse alveo
chest X-ray.

No patient had a previous hist
1 patient gave a history of mild as
no disability or recent attacks.
cough that was attributed to cigare
10 patients did not have any previou

Severe trauma preceded respiratory
(table I). Viral infection in 4 patients and a
the rema
one hour an
g illness or inju
present in 5 patie
d in 7 patients. 4 pati
n 7·3 before the onset

tensive-care units of the
as studies were performed
neous puncture of either
brachial or femoral artery. In most instances, blood was drawn only during a steady state. P_aO_2 measurements were determined with a Clark electrode and oxygen saturation was measured on

			lung contusion				7500 ml.
2	19	F	Multiple trauma; lung laceration and contusion	1	+++	++	+++ 3000 ml.

Pouze u 2 pacientů bylo podezření na primární plicní postižení …
Zbytek pacientů (80%) - polytrauma

Lancet
1967;2:319-323

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BERNARD E. LEVINE
M.D. Michigan
AMERICAN THORACIC SOCIETY-NATIONAL TUBERCULOSIS ASSOCIATION FELLOW IN PULMONARY DISEASE*

gery and Medicine, Denver, Colorado, U.S.A.

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Severe trauma preceded respiratory (table 1). Viral infection in 4 patients and a 1 patient were precipitating factors in the rema tory distress occurred as early as one hour an ninety-six hours after the precipitating illness or inju of varying degree and duration was present in 5 patien

its of the performed of either was drawn etermined asured on

Possible contributory factors

Hypo-tension	Acidosis	Fluid overload

Case	Age (yr.)	Sex	Illness	Onset of acute respiratory distress (hr. after illness)	Possible contributory factors: Hypo-tension	Acidosis	Fluid overload
1	29	M	Multiple trauma; lung contusion	8	++	++	+++ 7500 ml.
2	19	F	Multiple trauma; lung laceration and contusion	1	+++	++	+++ 3000 ml.

… označení „šoková plíce“

… zdroj poškození leží mimo plic

šok → systém. zánětová odpověď
↓
ARDS ← poškození endotelu

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From the Departments of Surgery and Medicine, University of Colorado Medical Center, Denver, Colorado, U.S.A.

Summary The respiratory-distress syndrome in 12 patients was manifested by acute onset of

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Methods

All patients were admitted to intensive-care units of the surgical or medical services. Blood-gas studies were performed on arterial blood drawn by percutaneous puncture of either brachial or femoral artery. In most instances, blood was drawn only during a steady state. P_aO_2 measurements were determined with a Clark electrode and oxygen saturation was measured on

TORY DISTRESS

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PEEP …

Am J Respir Crit Care Med 2001, 163:602-603

How It *Really* Happened

In the Cards was ARDS

(How We Discovered the Acute Respiratory Distress Syndrome)

THOMAS L. PETTY

Division of Pulmonary Science and Critical Care Medicine, University of Colorado Health Sciences Center, Denver, Colorado; and Rush-Presbyterian/St. Lukes Medical Center, Chicago, Illinois

I helped Mike use the Engstrom for the first time in his training. "What does this knob do?" Mike asked. I said, "I think it is probably useful, since Dave could improve oxygenation in a crushed chest patient a few months ago." I then dialed in a positive end-expiratory pressure of 10 cm (at that time, we called this continu- was dramatic to see a blue patient lying in Trendelenburg, gradually flush to a healthy pink color; blood pressure improved.

… neměli "žádné tvrdé data" a přesto PEEP použili ☺

PEEP …

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THE LANCET
International journal of medical science and practice

Finally, in desperation, we sent the paper to the *Lancet*, and received word within two weeks that our discovery was of such importance, that it would be published as a lead article, without delay

ARDS a ja …

ARDS a ja …

ESICM 1997
PARIS

ARDS a ja …

SIEMENS

Critical care

News

ESICM 1997
PARIS

Professor Luciano Gattinoni

The baby lung concept

Professor Gattinoni's research has in many respects deeply influenced the understanding and the consensus strategy for the treatment of Acute Respiratory Distress Syndrome (ARDS).

In this interview he is asked to comment on the 'baby lung' concept and how it applies to clinical routine.

He stresses among other things that we should treat the lungs more gently according to their own patho-anatomical dimensions.

What is the clinical application of the "baby lung" concept?

"The term 'baby lung' derives from the studies that we have done on ARDS patients with CT scanning. Until the 1980s medical text books described a homogenously patho-anatomical impairment in all parts of the lungs, leading to ARDS. The lung was believed to be stiff, like a stone lung.

"Today, in contrast, with the CT scan in anterior/posterior views you can see very clearly that the lungs are inhomogenously affected. Mostly you will see that the upper lung is almost normal, while large parts of the lung – mainly the lower dependent parts – are affected by the disease."

Three zones

"According to the 'baby lung' concept, using CT scans you can differentiate and describe the ARDS lung in three zones: one part of the lung – the 'baby lung' – is open to gases (Zone H: healthy); other parts of the lung may be recruited functionally and participate in gas exchange (Zone R: recruitable); the third zone describes really diseased non-aerated consolidated parts of the lung (Zone D: diseased).

"The conceptual model has changed completely because of the realization that in ARDS a residual lung remains open and has to handle all the gas exchange. The dimension of this lung in very severe ARDS corresponds to the lung of a 4–5 year old 'baby' weighing 20 kg who must support the burden of the respiratory gas exchange in an adult body of 80 kg."

The 'baby lung' dimensions

"Our studies have shown that although the baby lung is small, its intrinsic elasticity is fairly normal from the beginning, while the affected parts of the lung cannot be reached.

"When we try to blow gases into the baby lung in excess of its limited capacity then the baby lung becomes overdistended and stone-like. This is a simplified explanation because the reality is somewhat more complex.

"However, there are important clinical consequences. Everybody realizes the dangers of putting a liter of tidal volume into the lungs of a normal baby. The insufflation pressure would be increased and there could be a great risk of barotrauma associated with rupture of pulmonary parenchyma. So the message of the baby lung concept is simple: treat the lungs more gently according to their own patho-anatomical dimension. This really is the 'Columbus' egg' as we say in Italy!" (See page 6.)

How do recent CT scans fit into the framework of this concept?

"10–15 years ago CT scanning in intensive care was considered unnecessary and costly. Today more and more ARDS patients are taken to the CT scan because it provides invaluable information. Knowing the structural dimensions of the baby lung allows us to explore the capabilities of recruitment.

"When in our research we first tried to correlate pulmonary CT scan findings with the anatomy of the lung and the lung mechanics, our hypothesis was that the bigger the diseased part of the lung, the more impaired the lung mechanics would be. To our surprise this proved untrue. In fact, compliance is a direct measure only of the parts of the lung that are still workable and open to gases – not of the stiff, diseased parts. These parts are simply not reached by the measurement since they are not open to gases.

"For example, if you have 20 ml/cm H_2O compliance in an adult patient approximately 20% of the original lung is open and 80% is diseased and not participating in the gas exchange. If compliance were 50 ml/cm H_2O it would mean that 50% of the original lung is not working. But in the latter case you usually have no problems in ventilating the patient. The problems arise with the genuine 'baby lung' – i.e., a compliance that drops to 30, 25, 20, 15 ml/cm H_2O."

"You can model ARDS in three zones: **one**, the baby lung which is open; **two**, the part of the lung which may be recruited functionally and then has to be kept open; **three**, a non-aerated zone." CT scan of an ARDS lung

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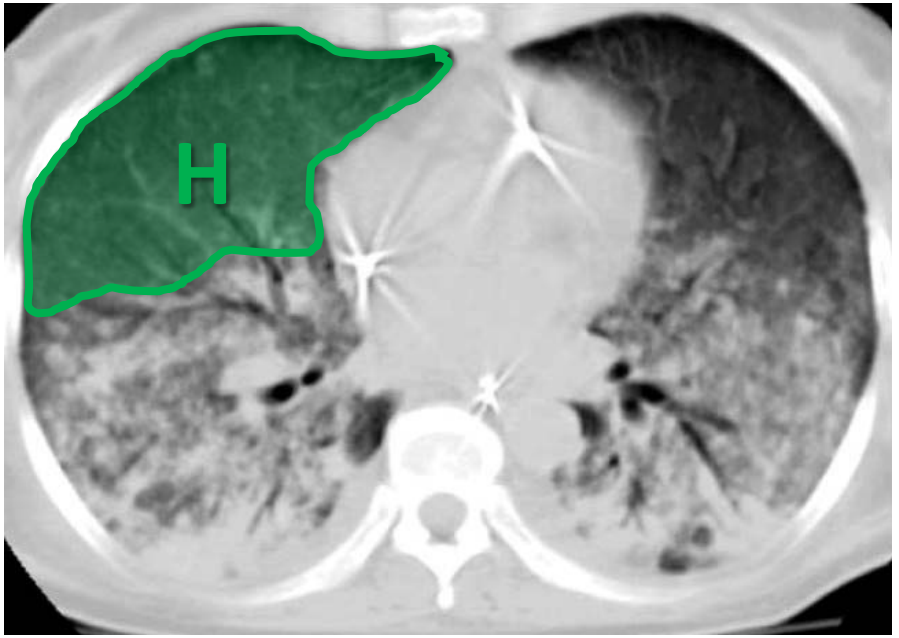
4

„Baby lung“ …

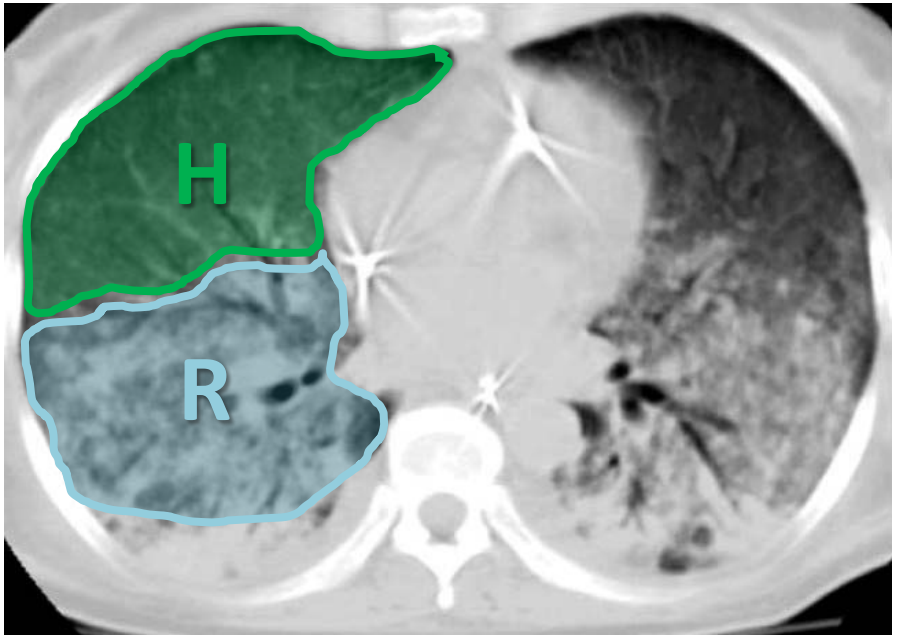
CT obraz ARDS (brušná sepsa)



Gattinoni L, Pesenti A (1987) **ARDS: the non-homogeneous lung;** facts and hypothesis. *Intensive Crit Care Dig* 6:1–4

„Baby lung“ …

CT obraz ARDS (břišní sepse)



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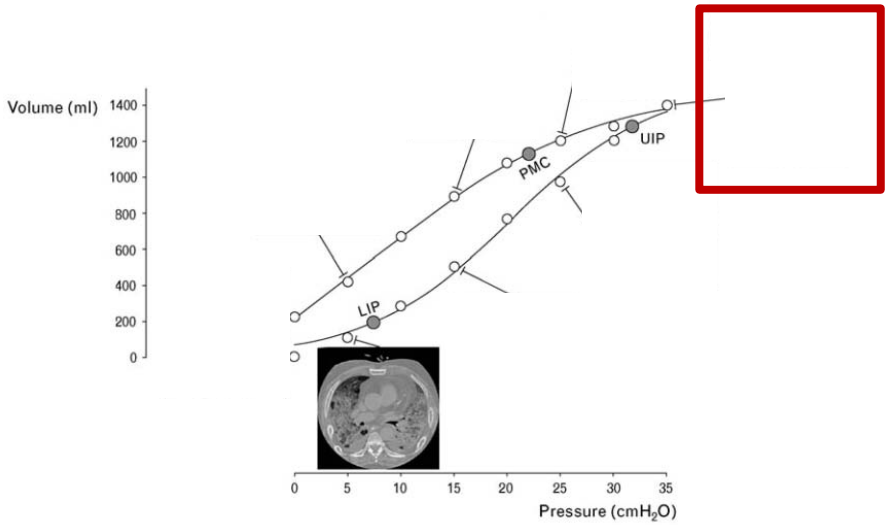
„Baby lung“ …

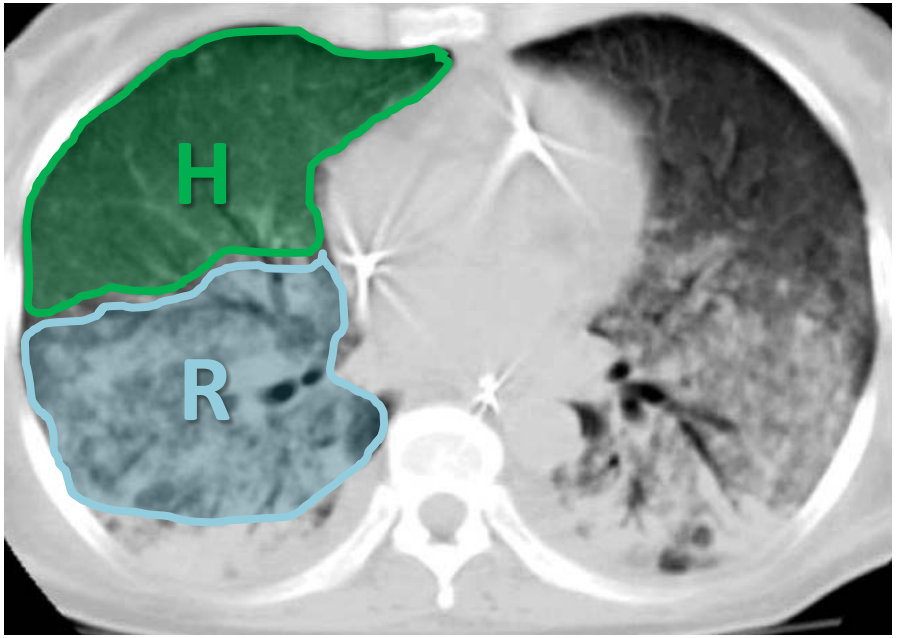
Zóna „RECRUITABLE“

- otevřená na konci inspíria., na konci expíria kolabuje



Albaiceta G et al.
Current Opinion in Critical Care 2008, 14:80–86

CT obraz ARDS (břišní sepse)



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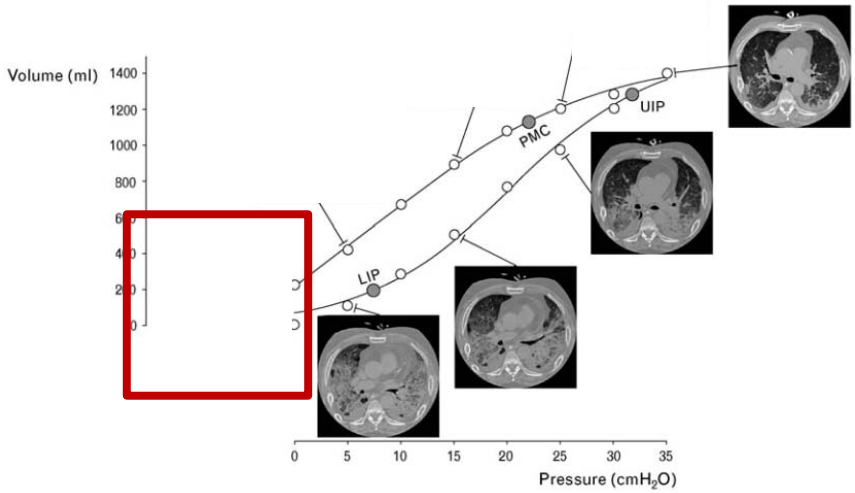

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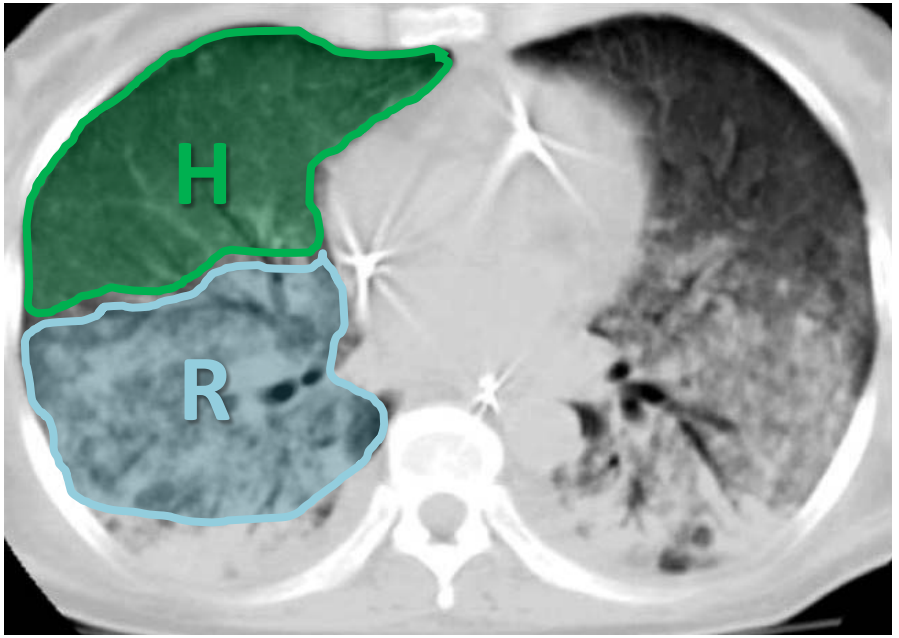

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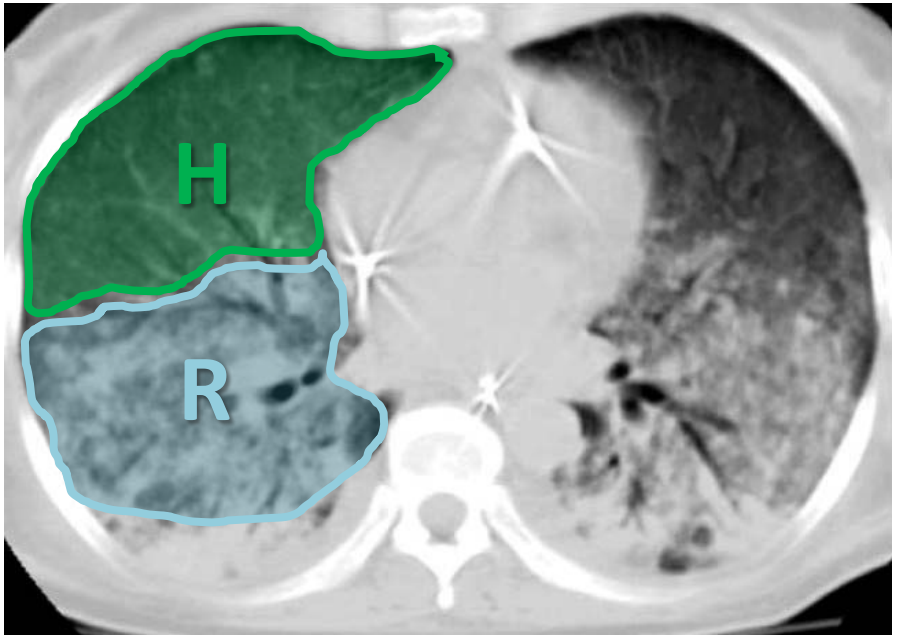

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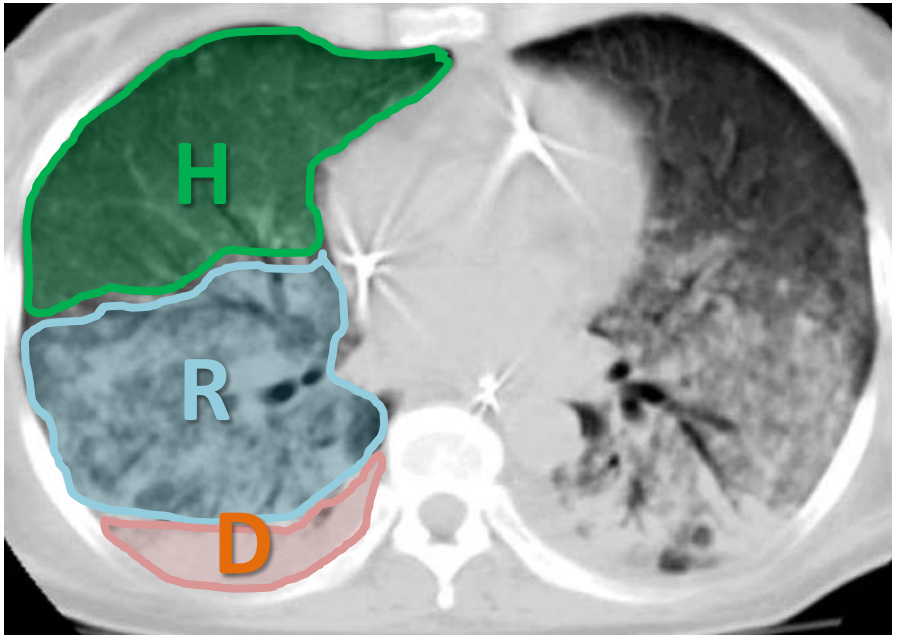

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„Baby lung“ …

Tvorba zón …

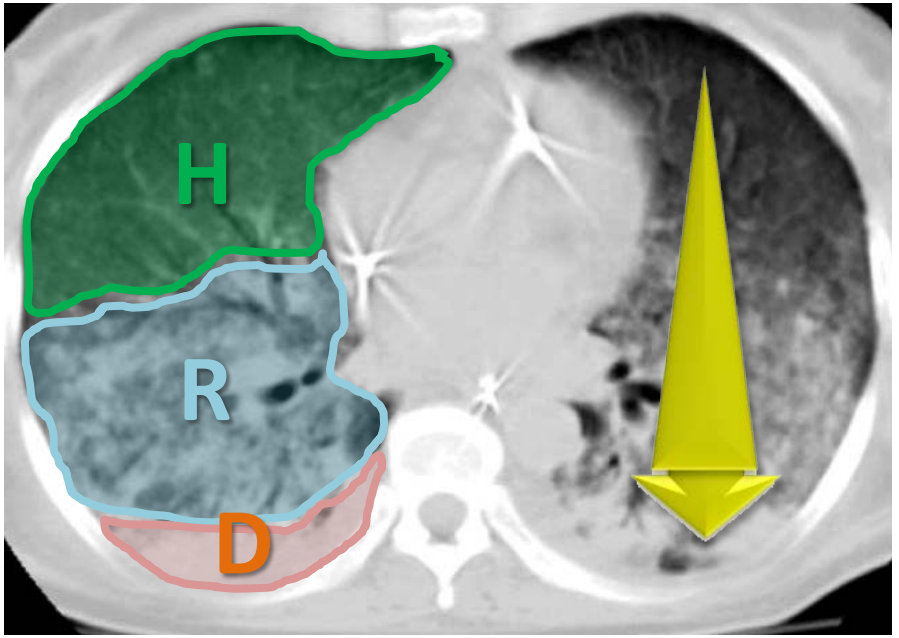
„HEALTHY“

„RECRUITABLE“

„DISEASED“

… je výsledkem vlastního gravitačního působení edémem postižené plicní tkáně (**„sponge lung“**)

CT obraz ARDS (břišní sepse)



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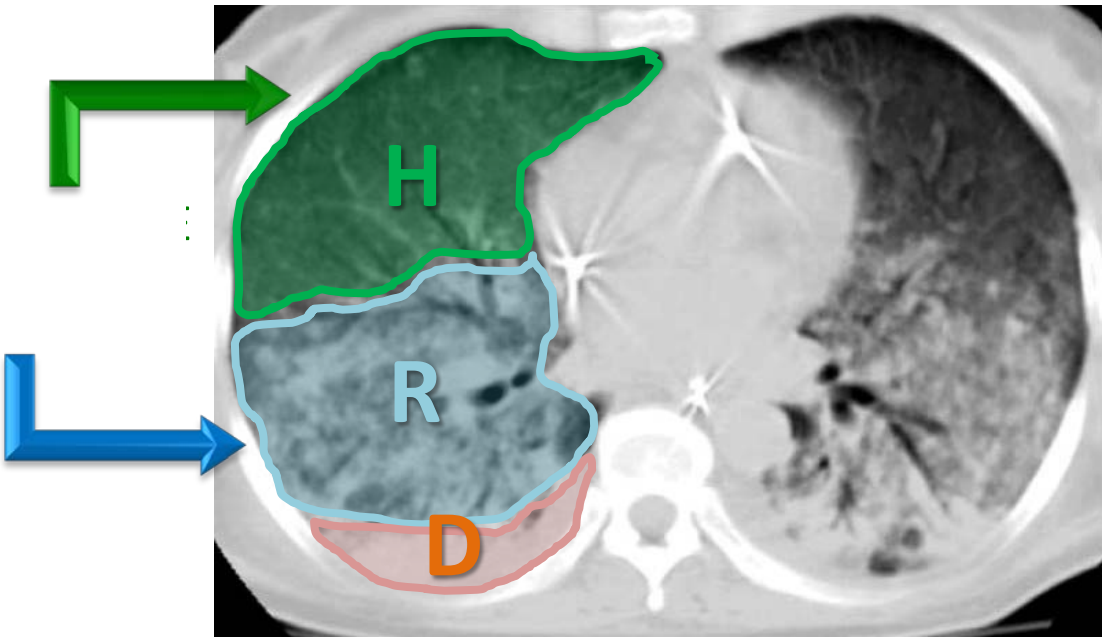
Jak ventilovat ? …

Jak ventilovat ? …

Respektuj vždy jednoduché zásady **protektívní plicní ventilace** …

CT obraz ARDS (břišní sepse)



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Dosud se takto univerzálně vysvětluje **protektivní ventilační režim** ve všech učebnicích …

Jednoduché, že ?

Jenomže všechno má své ALE … !!

Etiopatogeneza ARDS …

Etiopatogeneza ARDS …

Do roku 2000 …

- drtivá většina článků popisuje ARDS, jako **sekundární plicní poškození** v důsledku excesívní zánětové odpovědi na různé inzulty:

  - **extrapulmonální infekcii (> 40%)**
  - **pankreatitídu**
  - **polytraumu/popáleninu**
  - **šokový stav**

Etiopatogeneza ARDS …

Do roku 2000 … téměř **80% všech případů** mělo charakter **ARDS$_{epl}$**

- drtivá většina článků popisuje ARDS, jako **sekundární plicní poškození** v důsledku excesívní zánětové odpovědi na různé inzulty:

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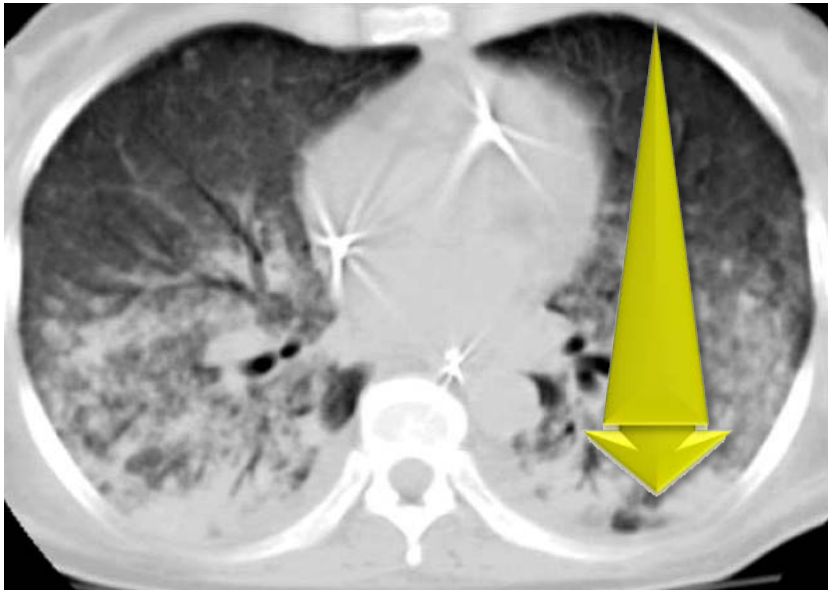
  - **pankreatitídu**
  - **polytraumu/popáleninu**
  - **šokový stav**

- primárně je poškozen **plicní endotel** s následní hyperpermeabilitou a rozvojem nekardiogenného plicního edému

EXTRAPULMONÁLNÍ FORMA ARDS

typický CT obraz ARDS$_{epl}$



… gravitační tvorba atelektáz

Etiopatogeneza ARDS …

Po roku 2000 …

- stoupá počet údajů o ARDS v důsledku **těžkého primárního plicního poškození**, kde na prvním místě stojí:

  - **těžká pneumonie**

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Příčina ARDS - rok 2000	
Pneumonie	**36%**
Sepse	26%

The NEW ENGLAND JOURNAL of MEDICINE

VOLUME 342 MAY 4, 2000 NUMBER 18

VENTILATION WITH LOWER TIDAL VOLUMES AS COMPARED WITH TRADITIONAL TIDAL VOLUMES FOR ACUTE LUNG INJURY AND THE ACUTE RESPIRATORY DISTRESS SYNDROME

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Příčina ARDS - rok 2016	
Pneumonie	**59%**
Sepsa	16%

JAMA 2016;315:788-800

Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Epidemiology, Patterns of Care, and Mortality for Patients With Acute Respiratory Distress Syndrome in Intensive Care Units in 50 Countries

Giacomo Bellani, MD, PhD; John G. Laffey, MD, MA; Tài Pham, MD; Eddy Fan, MD, PhD; Laurent Brochard, MD, HDR; Andres Esteban, MD, PhD; Luciano Gattinoni, MD, FRCP; Frank van Haren, MD, PhD; Anders Larsson, MD, PhD; Daniel F. McAuley, MD, PhD; Marco Ranieri, MD; Gordon Rubenfeld, MD, MSc; B. Taylor Thompson, MD, PhD; Hermann Wrigge, MD, PhD; Arthur S. Slutsky, MD, MASc; Antonio Pesenti, MD; for the LUNG SAFE Investigators and the ESICM Trials Group

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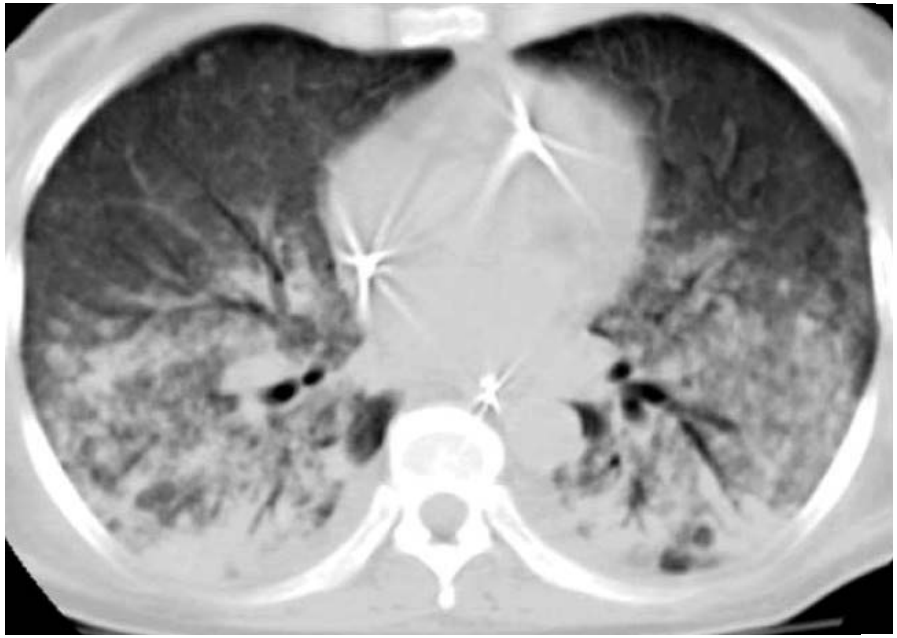
OMG! ARDS$_{epl}$ *vs* …. pl

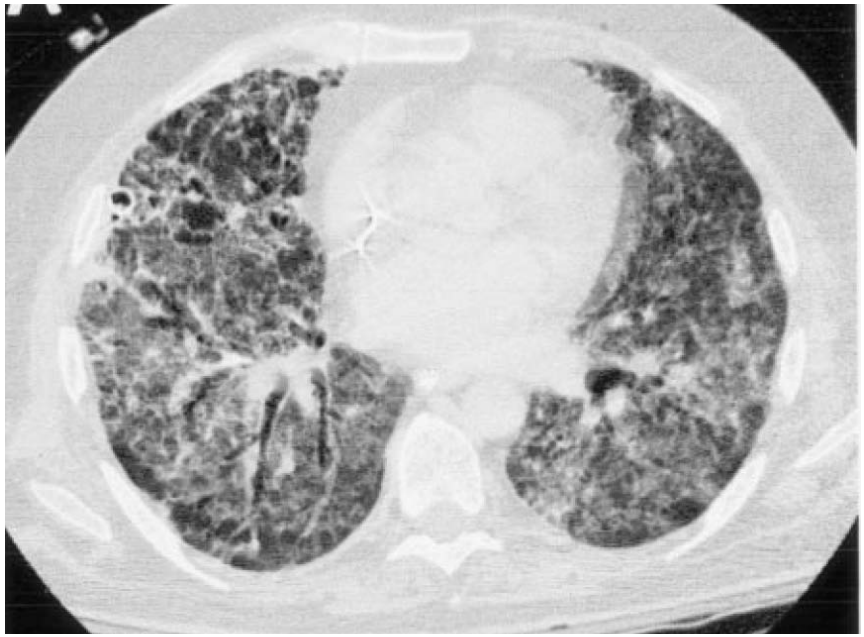
Do roku 2000 …

typický CT obraz ARDS$_{epl}$



Po roku 2000 …

typický CT obraz ARDS$_{pl}$

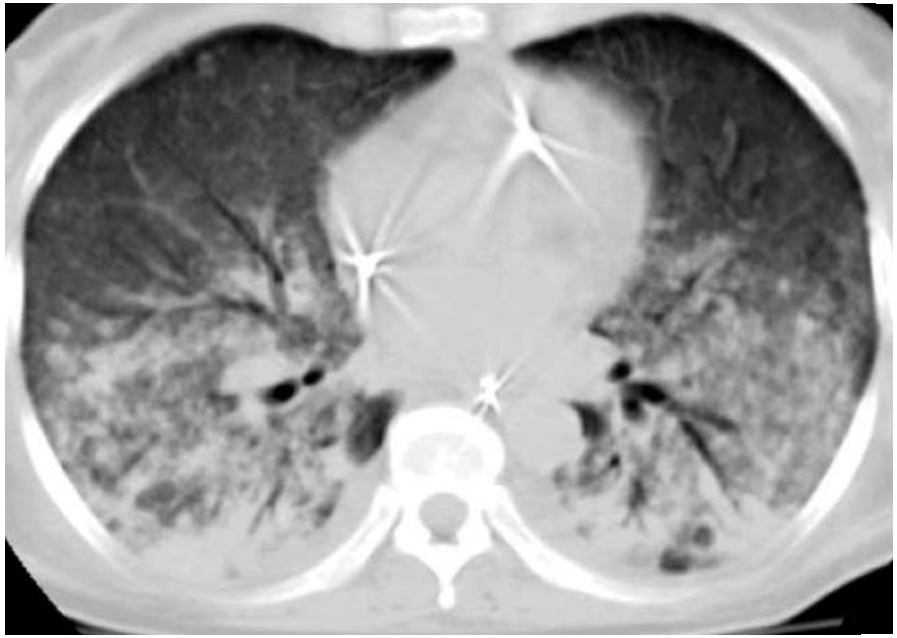


Máte pocit, že jde o stejné nosologické jednotky ???

OMG! $ARDS_{epl}$ *vs* …. $_{pl}$

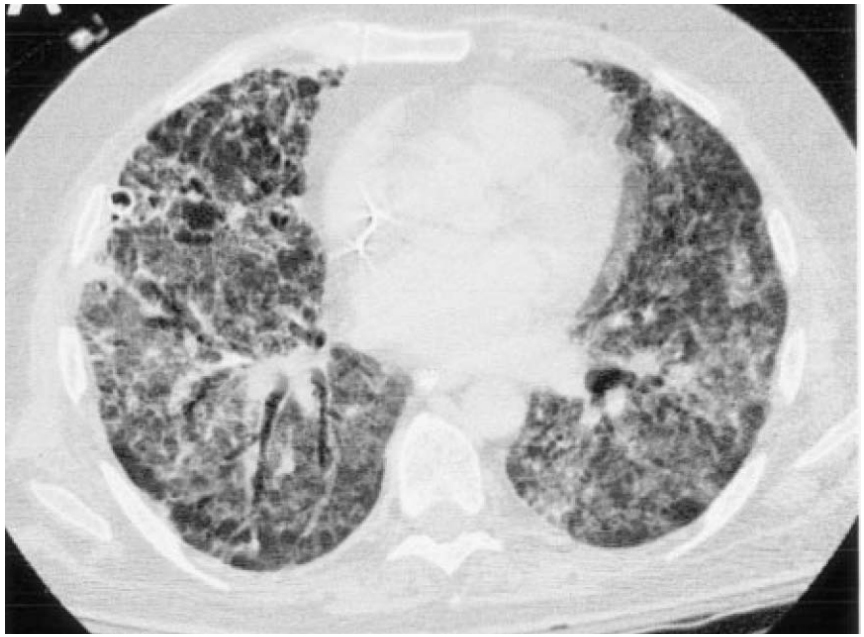
Do roku 2000 …

typický CT obraz $ARDS_{epl}$



Po roku 2000 …

typický CT obraz $ARDS_{pl}$

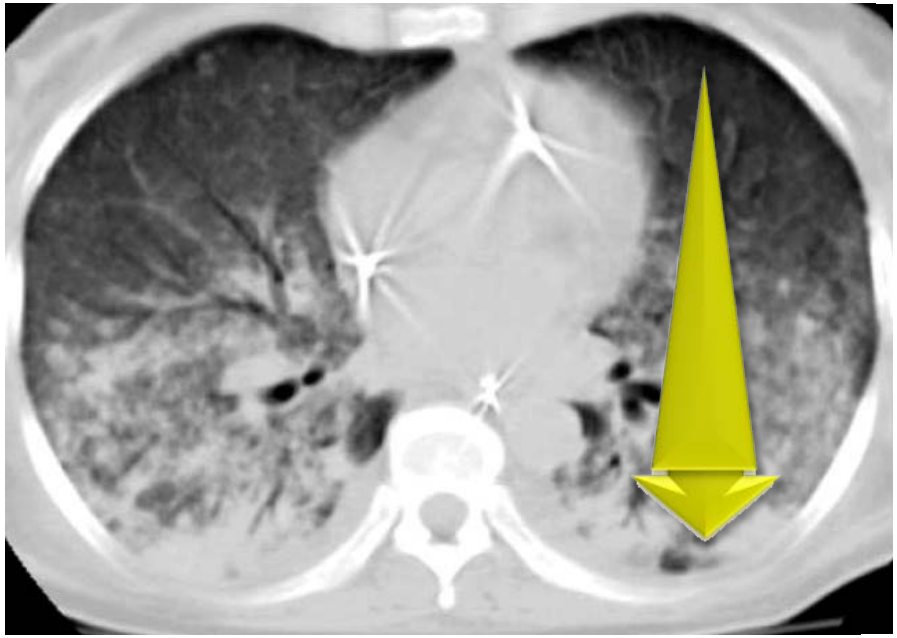


Přesto se u obou doporučuje stejný léčebný postup ???

OMG! $ARDS_{epl}$ *vs* …. $_{pl}$

Do roku 2000 …

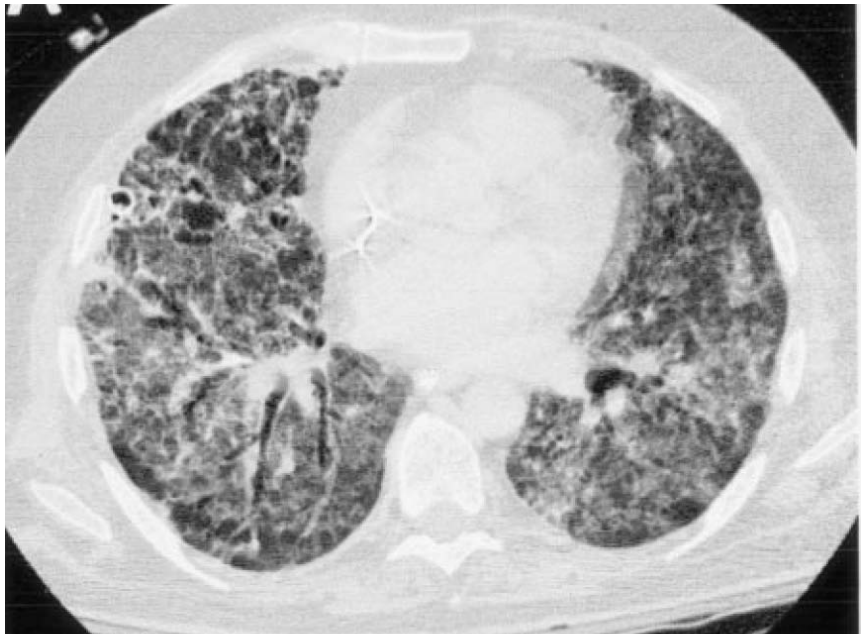
typický CT obraz $ARDS_{epl}$



… gravitační tvorba atelektáz

Po roku 2000 …

typický CT obraz $ARDS_{pl}$

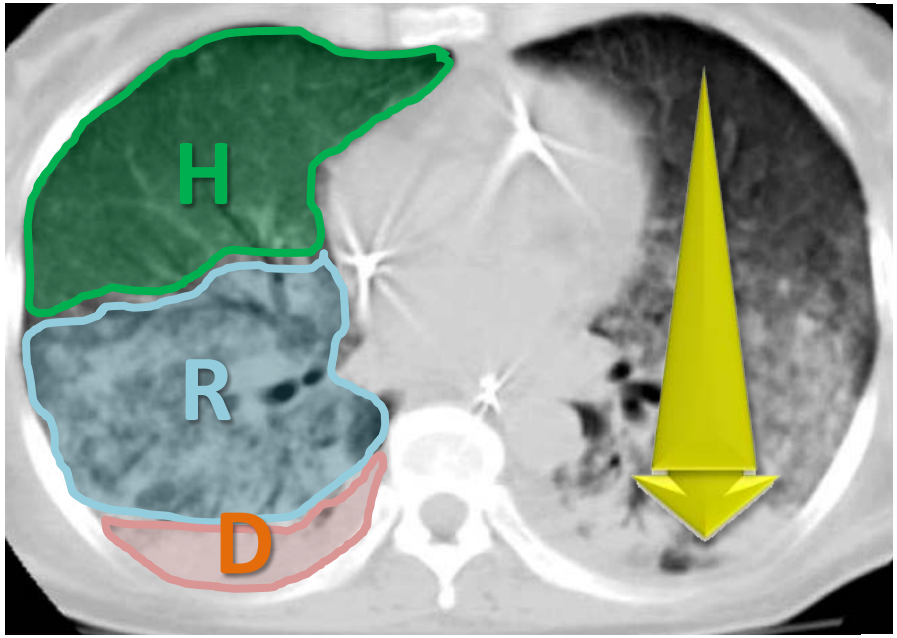


… **chybí** gravitační tvorba atelektáz

OMG! ARDS$_{epl}$ *vs* …. pl

Do roku 2000 …

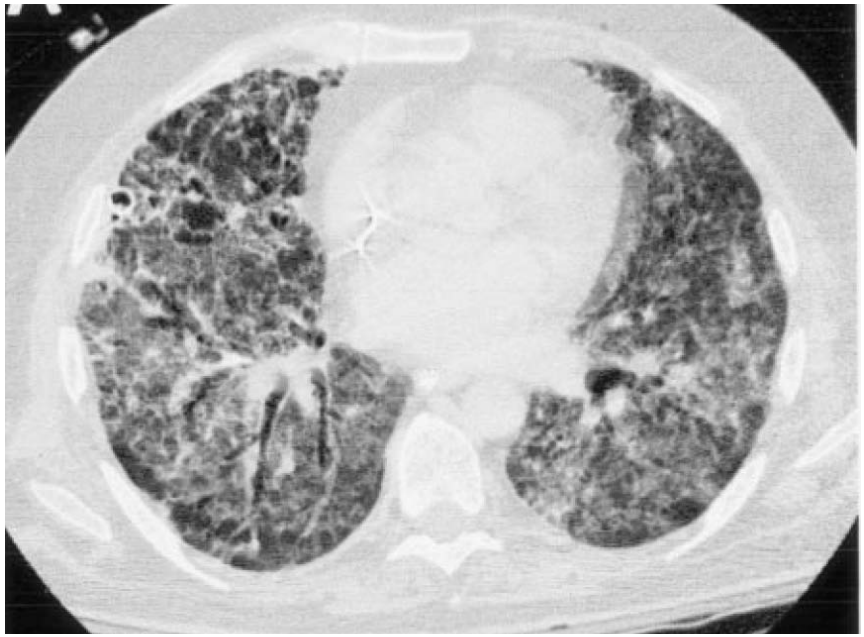
typický CT obraz ARDS$_{epl}$



… jsou přítomné zóny H, R, D

Po roku 2000 …

typický CT obraz ARDS$_{pl}$

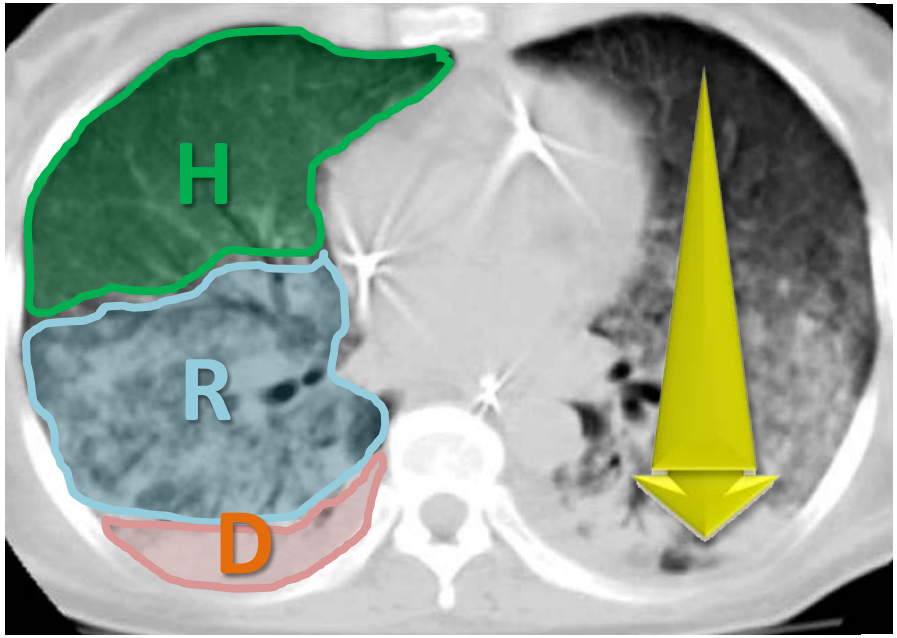


… **chybí** zóny H, R, D

OMG! $ARDS_{epl}$ *vs* …. $_{pl}$

Do roku 2000 …

typický CT obraz $ARDS_{epl}$



… umím protektivně ventilovat

Po roku 2000 …

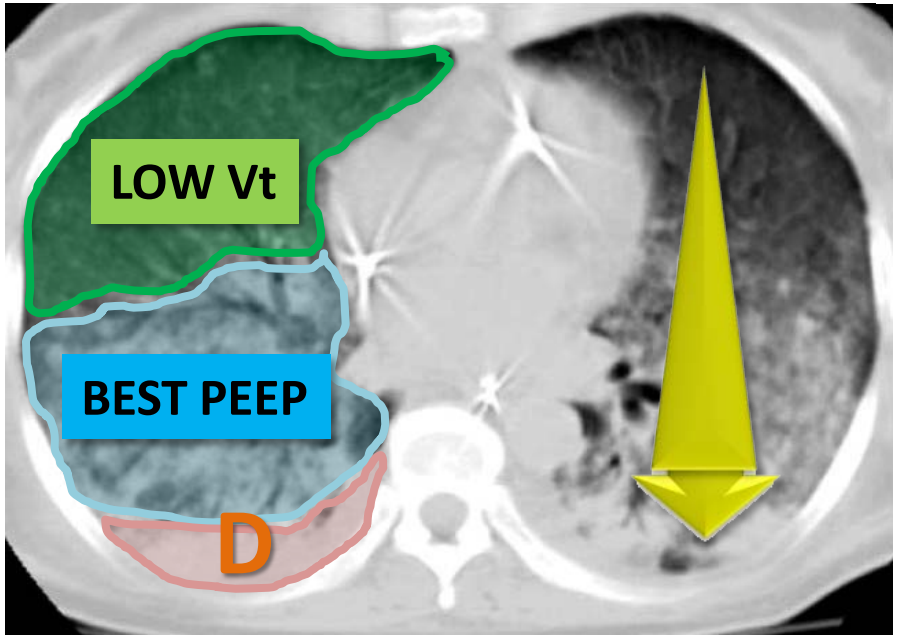
typický CT obraz $ARDS_{pl}$

… **neumím** protektivně ventilovať

OMG! $ARDS_{epl}$ *vs* …. $_{pl}$

Do roku 2000 …

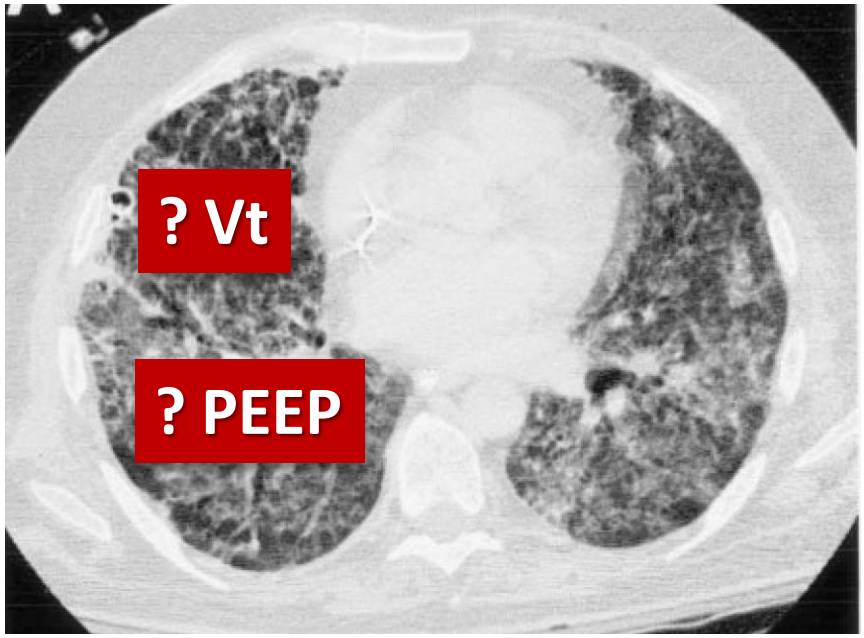
typický CT obraz $ARDS_{epl}$



… umím protektivně ventilovat

Po roku 2000 …

typický CT obraz $ARDS_{pl}$

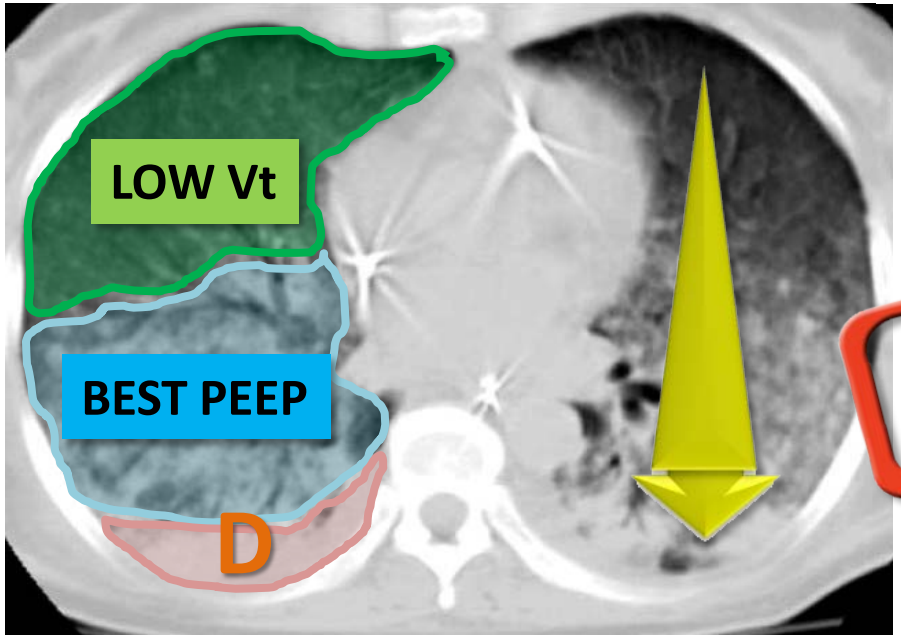


… **neumím** protektivně ventilovať

OMG! $ARDS_{epl}$ *vs* …. $_{pl}$

Do roku 2000 …

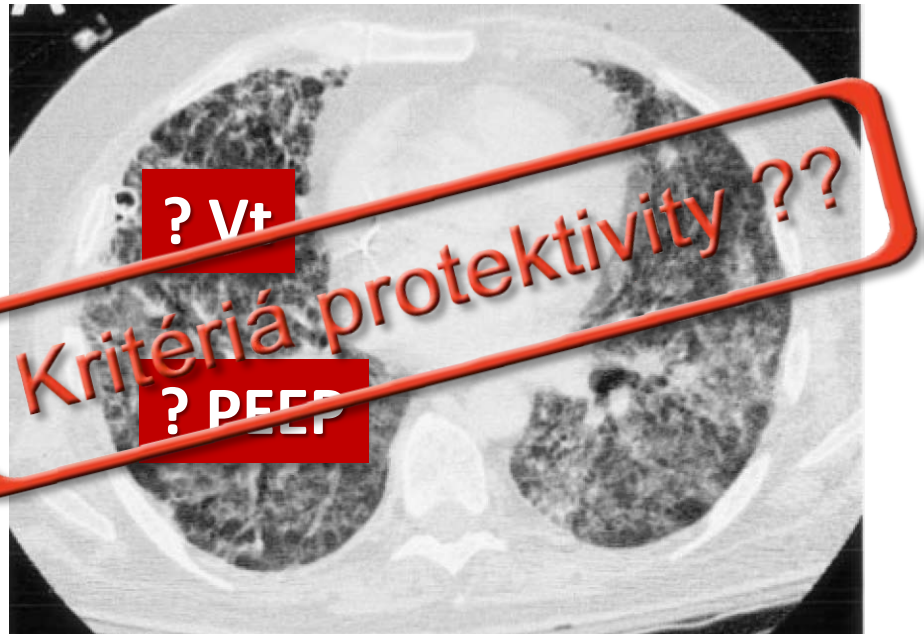
typický CT obraz $ARDS_{epl}$



… umím protektívně ventilovat

Po roku 2000 …

typický CT obraz $ARDS_{pl}$

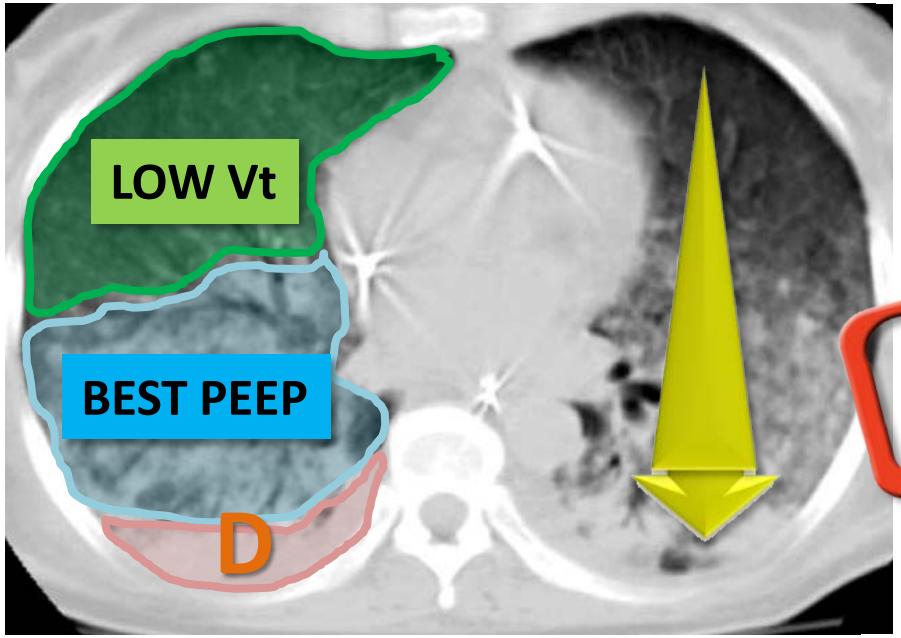


… **neumím** protektivně ventilovať

OMG! $ARDS_{epl}$ *vs* …. $_{pl}$

Do roku 2000 …

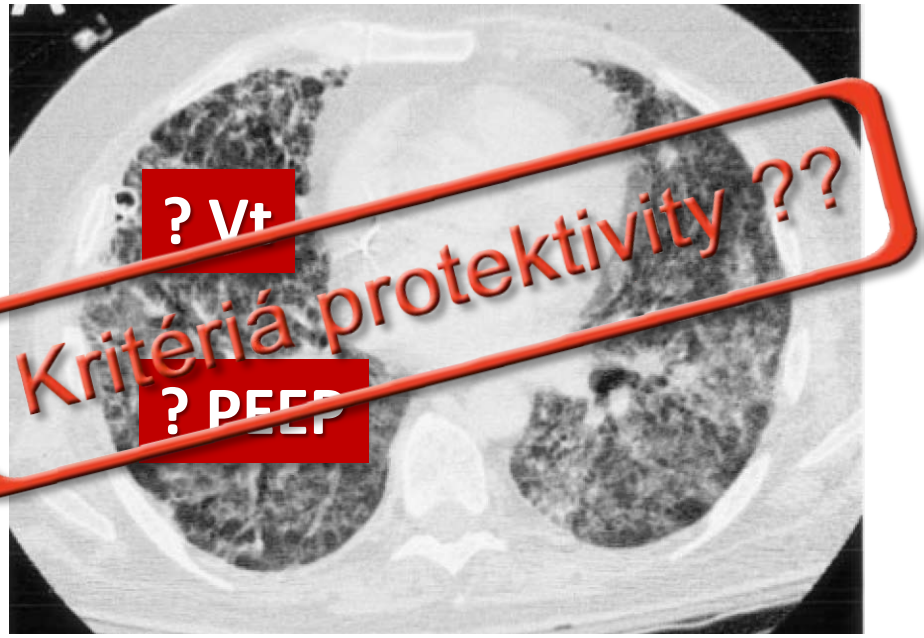
typický CT obraz $ARDS_{epl}$



… umím protektívně ventilovat

Po roku 2000 …

typický CT obraz $ARDS_{pl}$

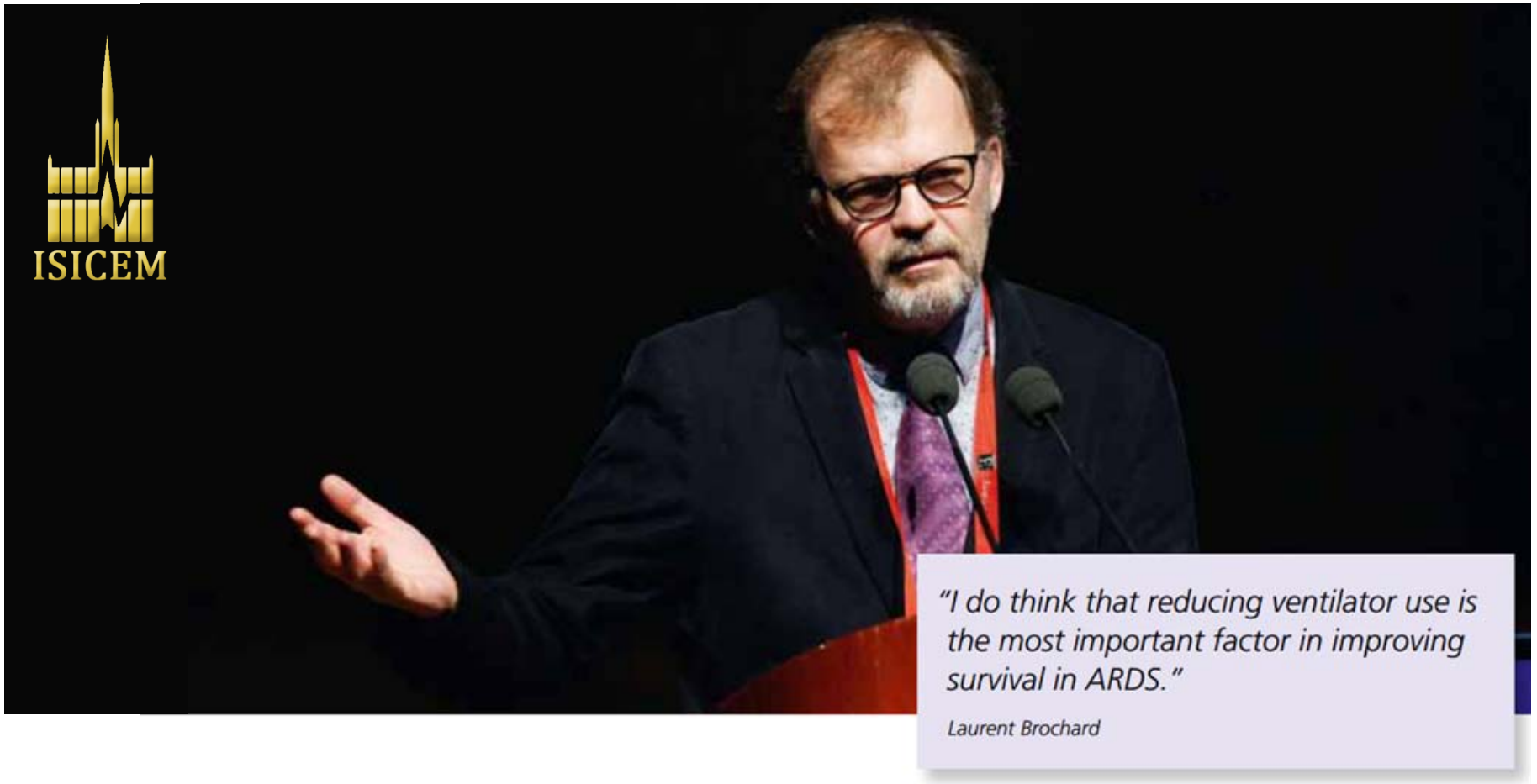


… **nerozumím patofyziologii** UPV tak, aby byla bezpečná „at the bed-side“

OMG! ARDS$_{epl}$ *vs* …. $_{pl}$

Do roku 2000 …

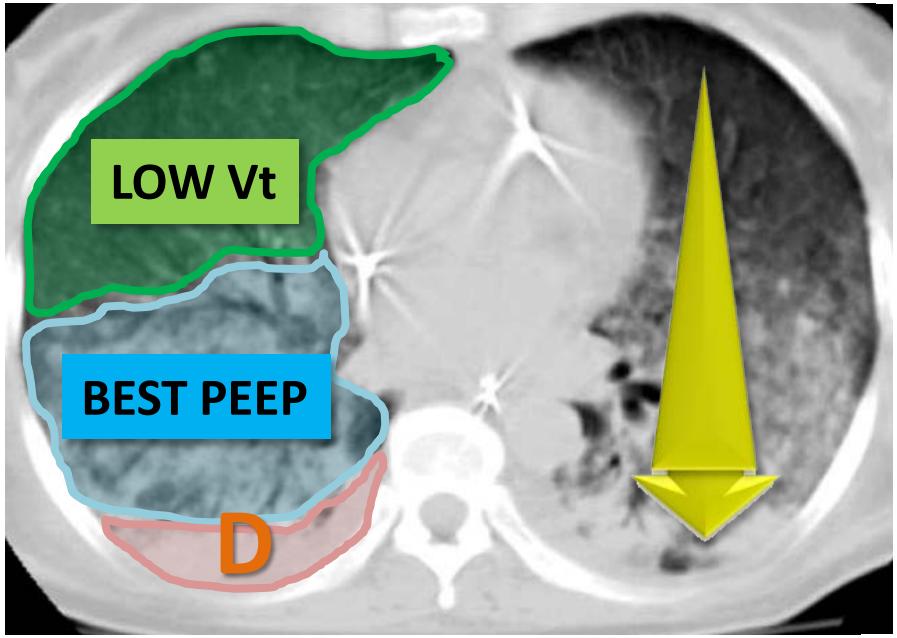
Po roku 2000 …



OMG! ARDS$_{epl}$ *vs* …. pl

Do roku 2000 …

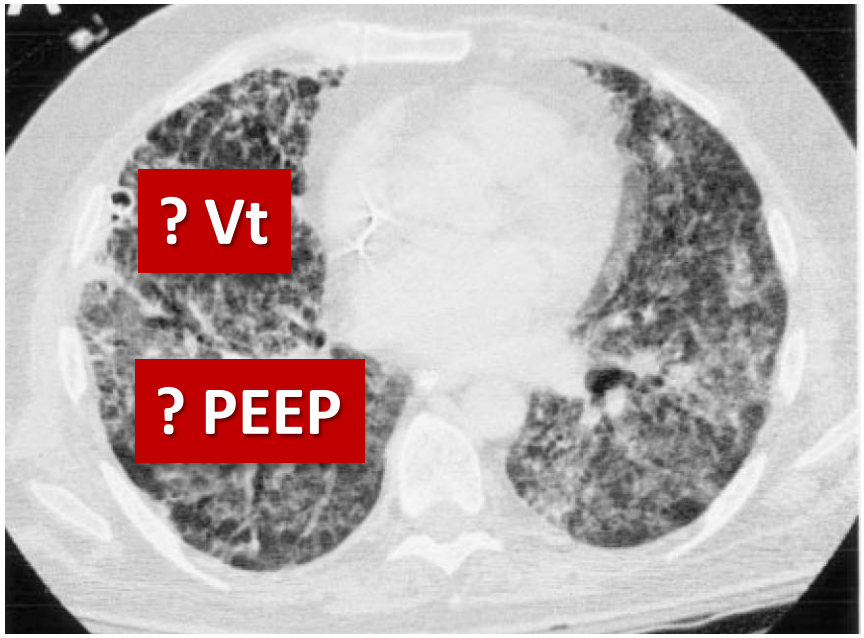
typický CT obraz ARDS$_{epl}$



… umím protektívně ventilovat
konvenčním ventilátorem

Po roku 2000 …

typický CT obraz ARDS$_{pl}$

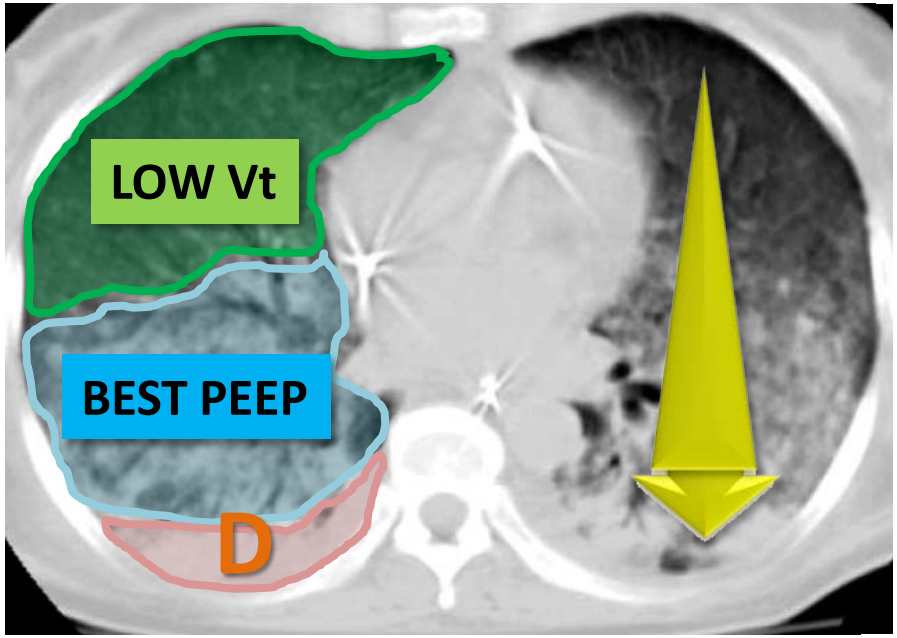


… **vysoký potenciál traumatizace plic**
při použití **konvečního ventilátoru**

OMG! $ARDS_{epl}$ *vs* …. $_{pl}$

Do roku 2000 …

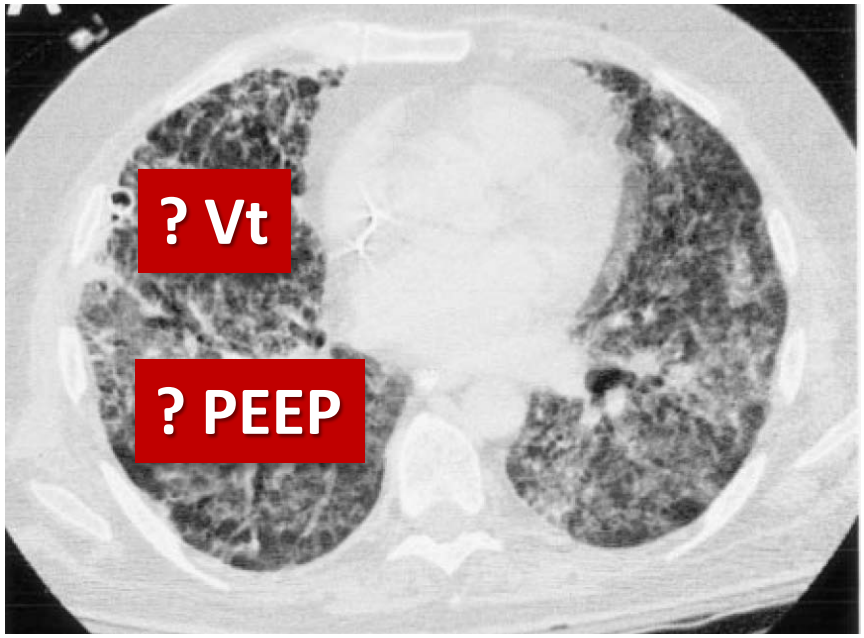
typický CT obraz $ARDS_{epl}$



… stačí ventilační režim s jedním ventilačním vzorcem

Po roku 2000 …

typický CT obraz $ARDS_{pl}$

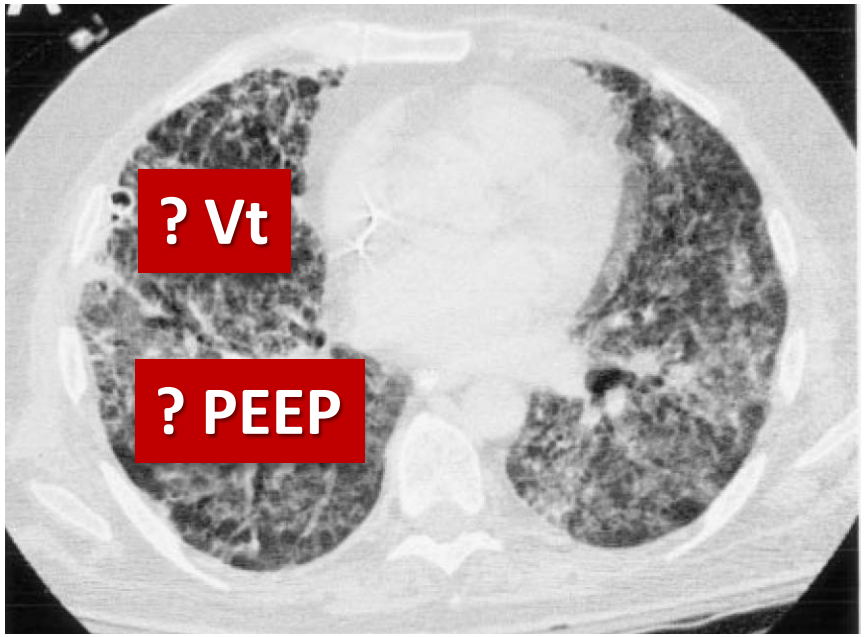


… zřejmě bude potřeba ventilační režim **s měnícím se ventilačním vzorcem ?**

Co dělat u $ARDS_{pl}$? …

Po roku 2000 …

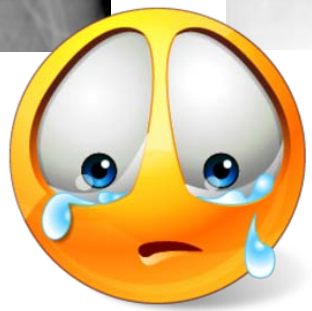
typický CT obraz $ARDS_{pl}$



… **nerozumím patofyziologii** UPV tak, aby byla bezpečná „at the bed-side“

RTG obrazy ARDS …

RTG obraz $ARDS_{pl}$



RTG obraz $ARDS_{epl}$