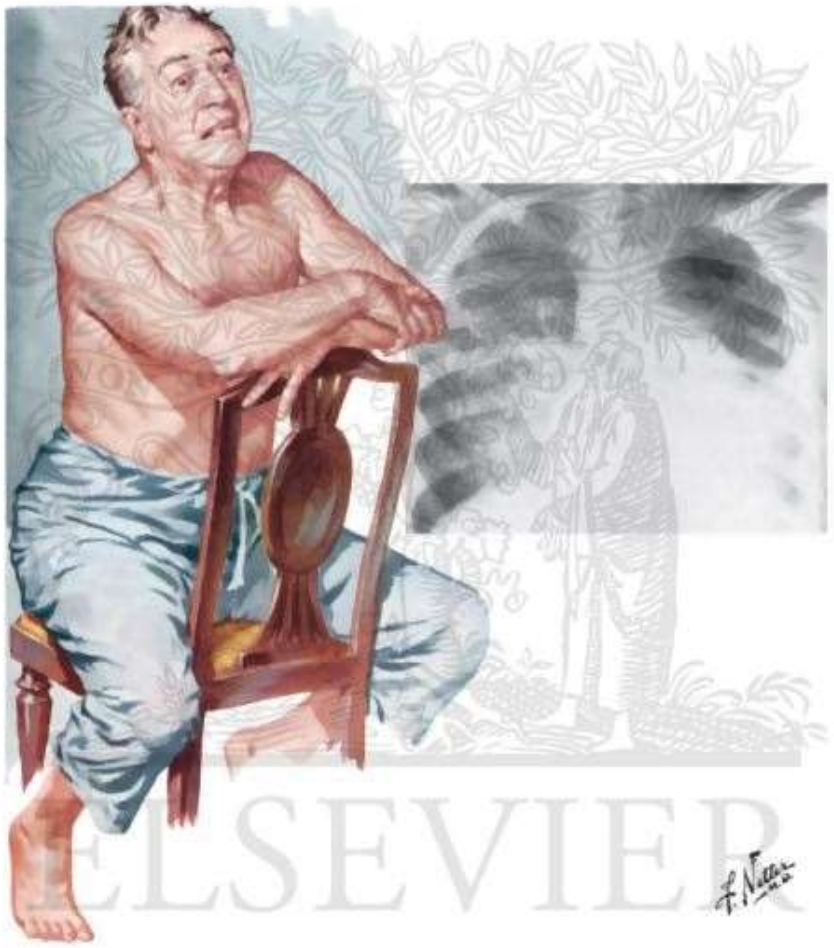
Course n°: 2. Cardiovascular system
Date: *(18-20 of September 2013)*
Language: Romanian
City: Târgu Mures
Country: Romania
Speaker: Adrian BELÎI, PhD (Republic of Moldova)

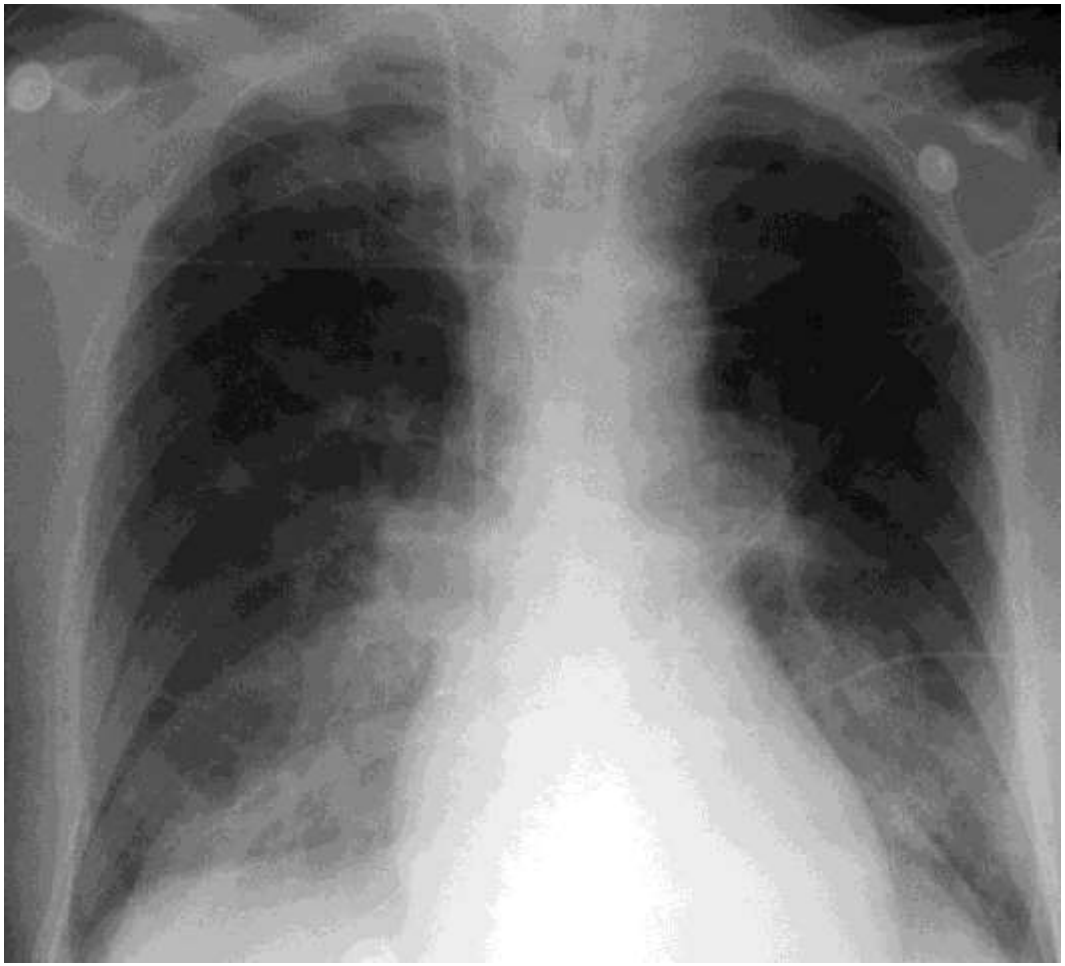
Volume replacement in patients with acute pulmonary edema

Un caz clinic tipic de…



- Pacient de 70 de ani
- DZ tip II, HTAE si ICC NYHA III
- Prezinta, cu debut acut:
  - Senzatie de sufocare;
  - Respiratie suieratoare;
  - Anxietate;
  - Tuse cu sputa spumoasa
  - Transpirație excesivă
  - Piele palidă
  - Dureri în piept
  - Palpitații
  - Presiune arteriala scazuta

Rx Th la pacientul dat ar putea arata astfel:

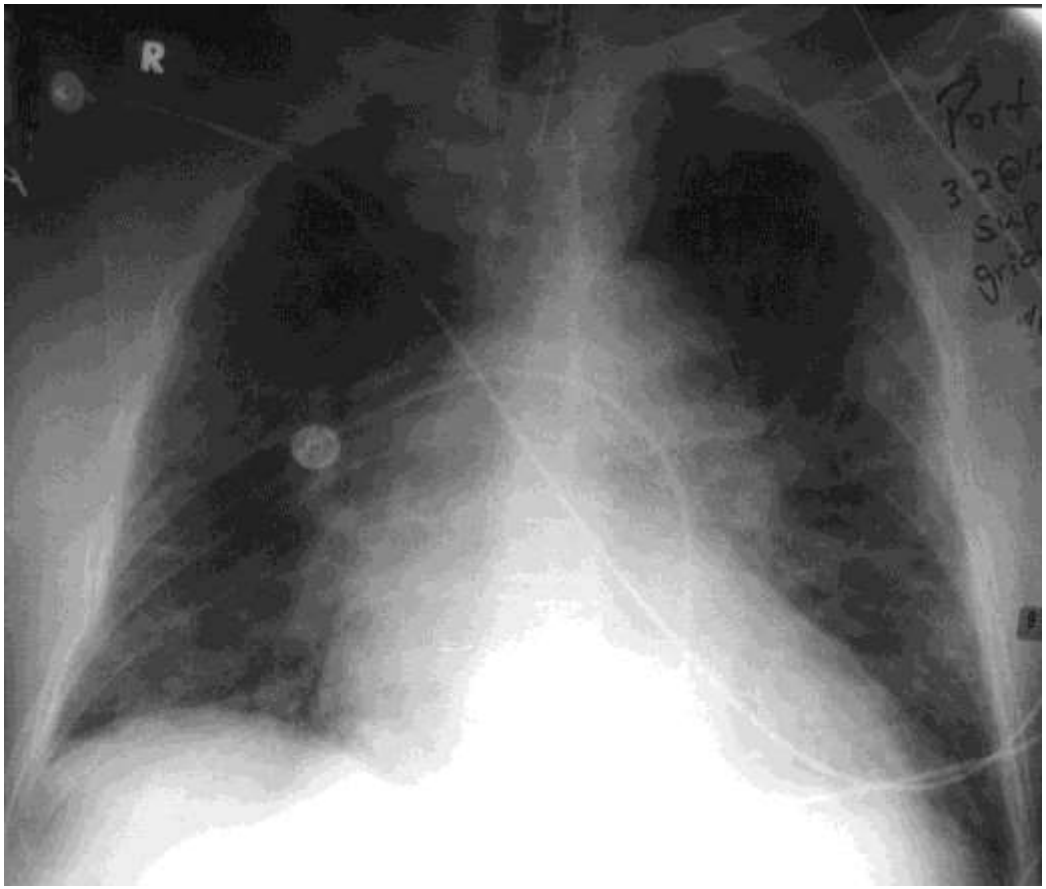


http://emedicine.medscape.com

Edem pulmonar acut la un pacient cu IMA anterior.

- Infiltrate alveolare
- Redistribuire vasculara
- Hiluri pulmonare “sterse”

Rx Th la pacientul dat ar putea arata astfel:

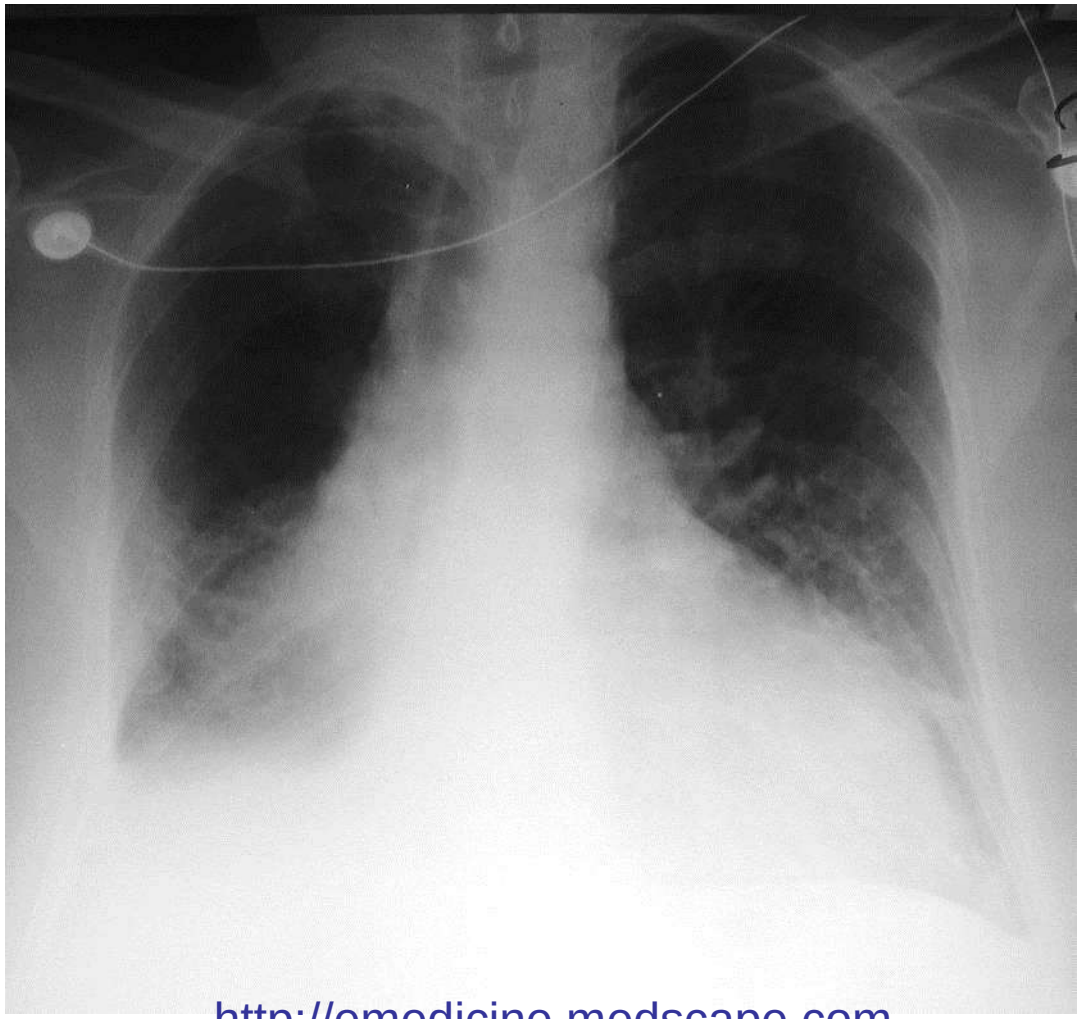


EPA la un pacient cu cardiomiopatie ischemica

- Lobii superiori:
  liniile Kerley A
- Lobii inferiori:
  liniile Kerley B
  (1 mm latime, 1 cm lungime)

http://emedicine.medscape.com

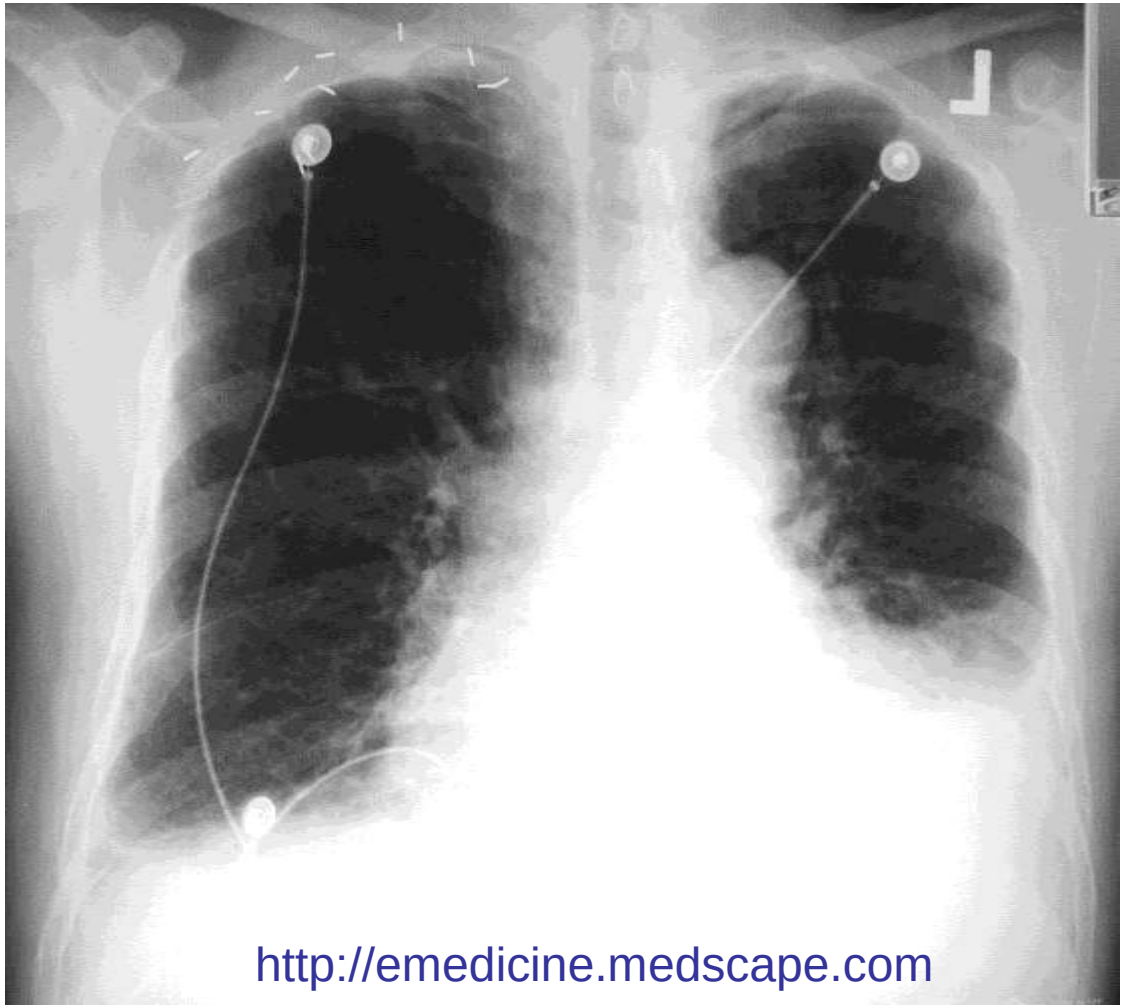
Rx Th la pacientul dat ar putea arata astfel:



http://emedicine.medscape.com

Cardiomegalie, efuziuni pleurale bilaterale, opacitate alveolara la un pacient cu EPA

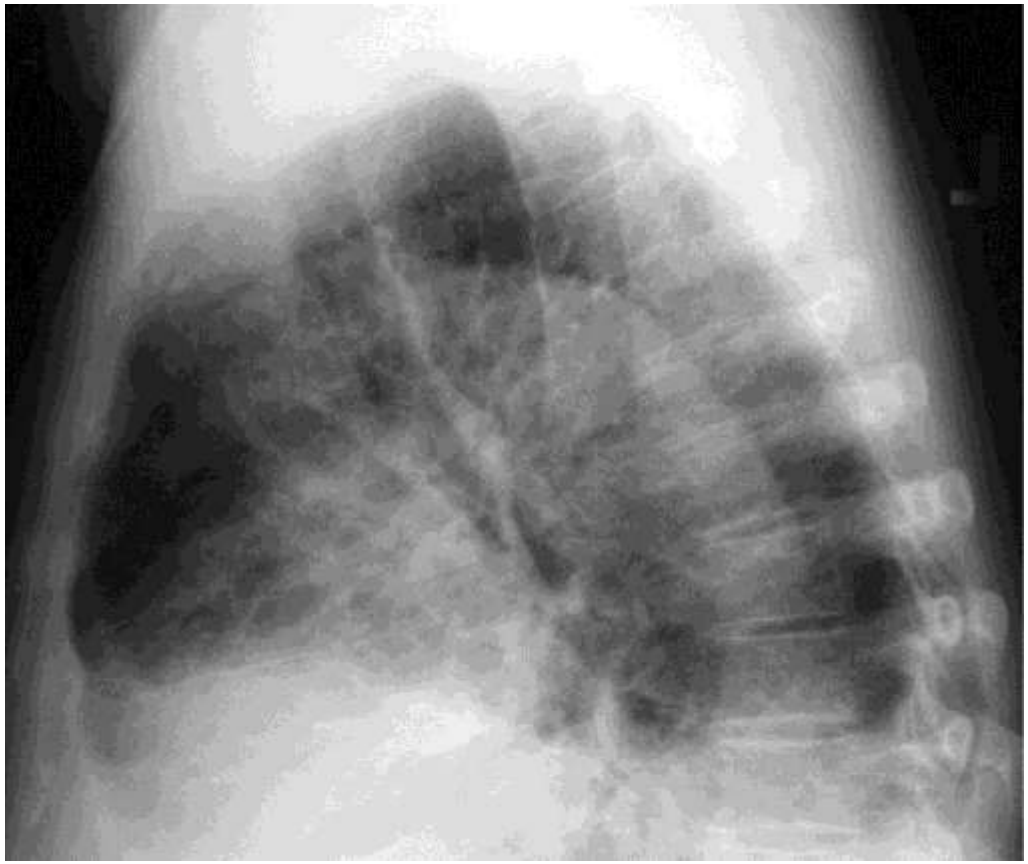
Rx Th la pacientul dat ar putea arata astfel:



http://emedicine.medscape.com

Edem pulmonar interstitial, cardiomegalie si efuziune pleurala pe stanga (debut de EPA)

Rx Th la pacientul dat ar putea arata astfel:



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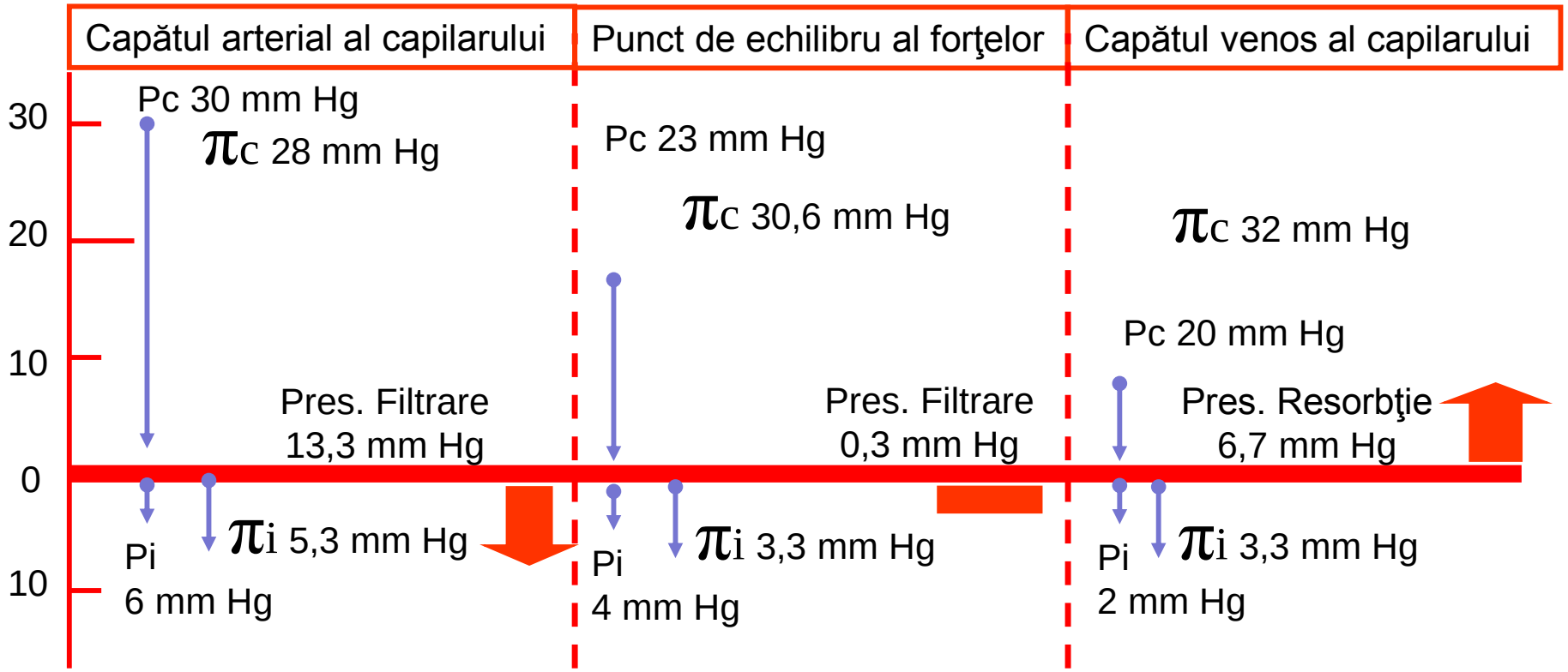
Edem pulmonar interstitial cu efuziune pleurala

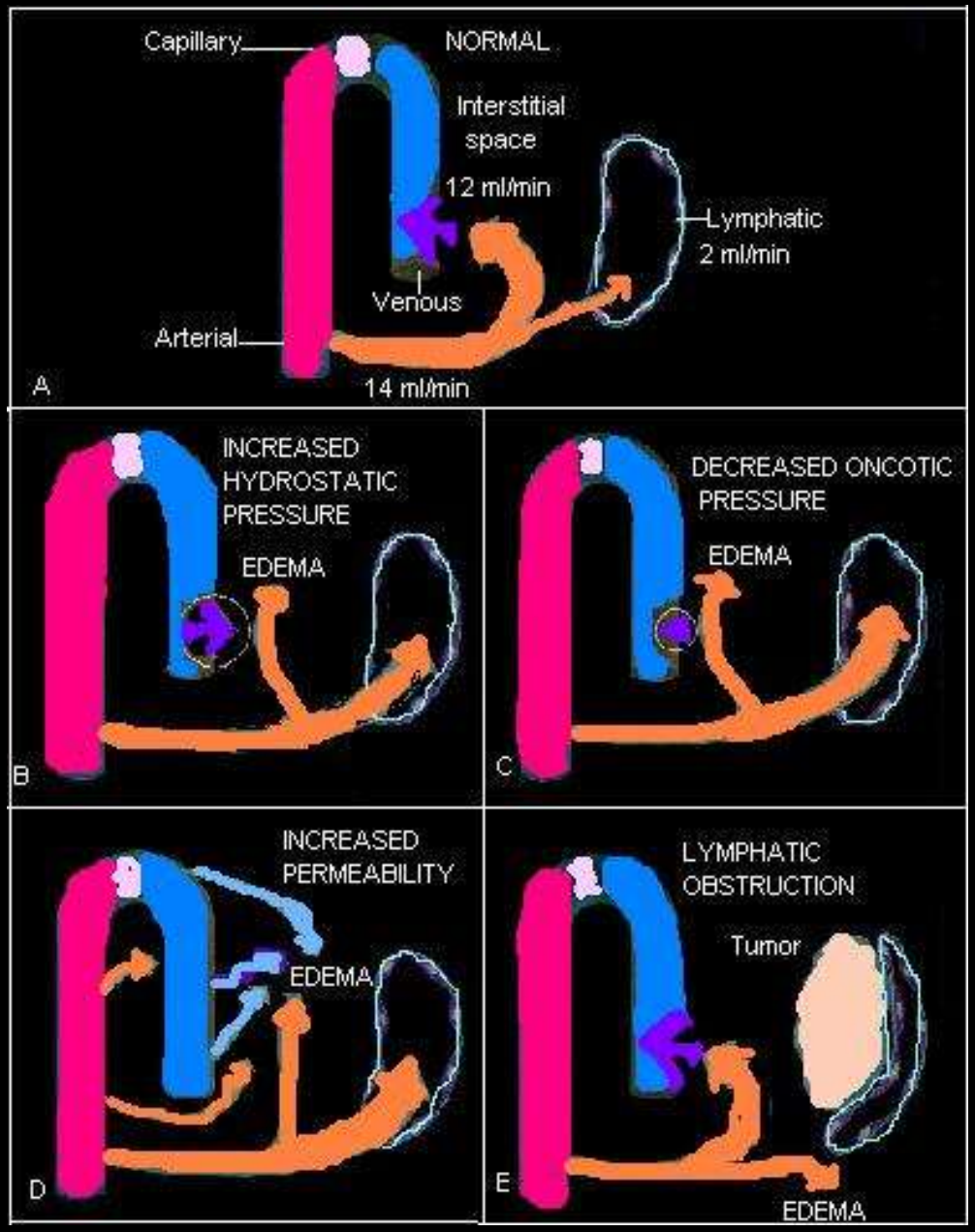
Mecanismele edemului pulmonar acut (1)

Echilibrul Starling - Pappenheimer - Staverman

$$Q = Kf \times [(Pc - Pi) - \sigma (\pi c - \pi i)]$$



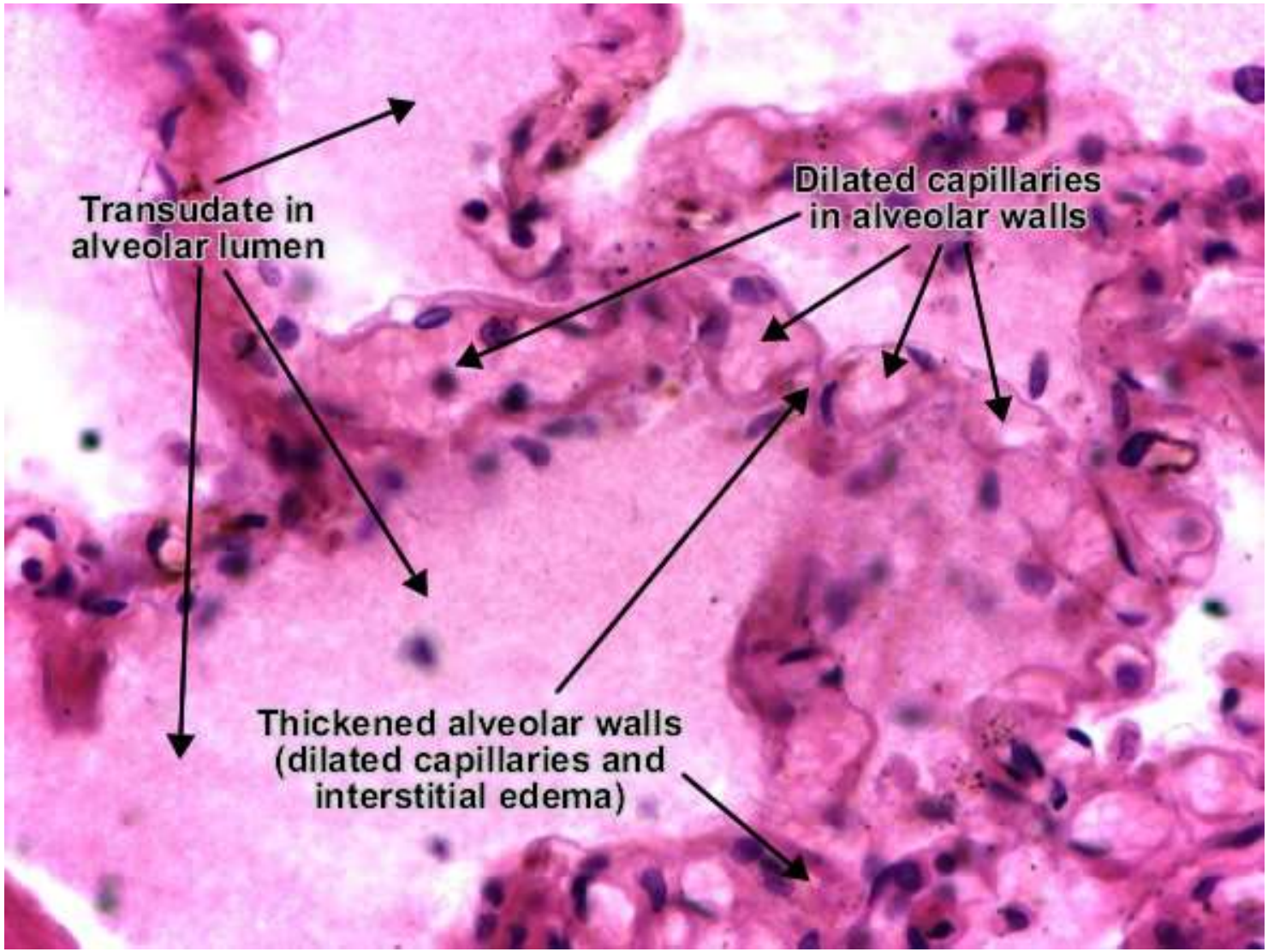
Mecanismele edemului pulmonar acut (2)



- Întoarcere venoasa excesiva (↑ presarcina)
- RVS ↑ (postsarcina ↑)
- Disfunctia VS
  - disfunctie sistolica
  - disfunctie diastolica
  - insuficienta contractila
- Dereglari de ritm si frecventa

! VD continua sa pompeze, în timp ce VS e în disfunctie

Mecanismele edemului pulmonar acut (3)



Tratamentul conventional al EPA…

- O2
- VNI/VPA + PEEP

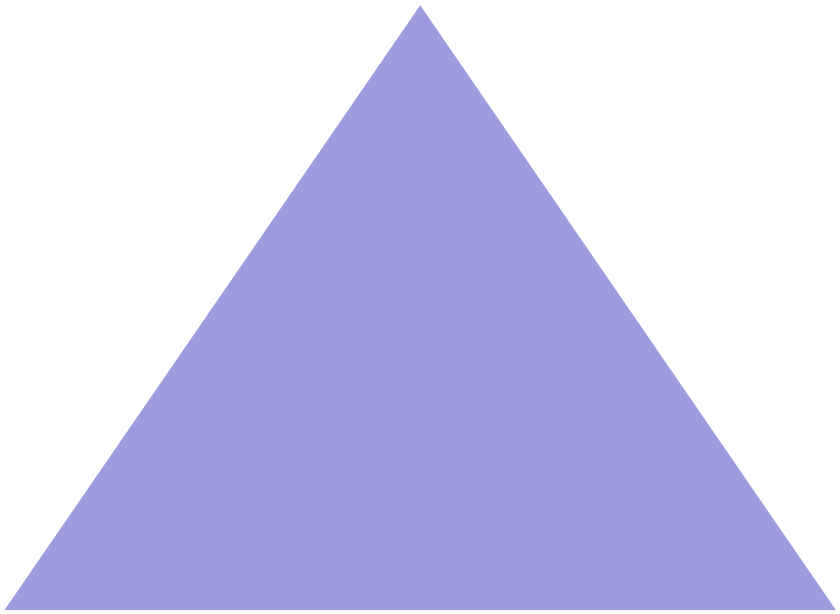
↑ contractilitatii

Dopamina
Dobutamina
Milrinona
Norepinefrina

NTG
Furosemd
Morfina

Nitroprusiatul
Hidralazina
NTG

↓ presarcinii



↓ postsarcinii

EBM despre tratamentul conventional al EPA…

Reducerea presarcinii: morfina

Avantaje

- Histaminoeliberarea reduce presarcina
- Anxioliza scade catecolaminele circulante
- Reduce postsarcina

Dezavantaje

- Nu e demonstrat efectul de reducere a presarcinii
- Poate deprima respiratia
- Rush/urticarie
- Greata/voma
- Efect cardiodepresor
- Reduce presiunea venoasa, insa acest fapt nu coreleaza cu presarcina (PICP)
- Creste presiunea de umplere cardiaca si reduce DC

Timmis, et al (Br Med J, 1980)
Vismara, er al (Circulation, 1976

EBM despre tratamentul conventional al EPA…

Reducerea presarcinii: morfina

Dezavantaje

- 38% dintre pacienti: deteriorare subiectiva dupa morfina
- 46% dintre pacienti: deteriorare obiectiva dupa morfina
- Nicio deteriorare a starii dupa NTG fara morfina

Hoffman et al., (Chest, 1987)

- Riscul de IOT dupa morfina: OR=5

Sachetti, et al. (Am J Emerg Med, 1999

- Mortalitatea dupa morfina: OR=4,84

Peacock, et al. (Emerg Med. J., 2008)

Benzodiazepine în loc de morfina

EBM despre tratamentul conventional al EPA…

Reducerea presarcinii: furosemidul

Avantaje (?)

Dezavantaje

- În EPA: RFG ~20% din N
- Efect diuretic peste 30-120 min
- Venodilatare în 5-10 min, insa nu coreleaza cu ↓PICP (presarcina VS)
- Eficient doar la cei cu diureza pastrata
- ↓DC cu 17% în primele 90 min (normalizare dupa diureza)
- ↑ PAS, PAD si AV in primele 30 min (normalizare dupa diureza)
- Activeaza sistemul RAA (↑↑ renina, NE, arginin-vasopresina);
- Creste tranzitor (~15 min) PICP (nu si la premedicarea cu NTG si IEC)

Kiely et al. (Circulation, 1973); Ikram, et al. (Clin Sci, 1980); Pickkers, et al. (Circulation, 1997): Nelson, et al (Eur Heart J, 1983); Francis, et al (Ann Intern Med, 1985)

EBM despre tratamentul conventional al EPA…

Reducerea presarcinii: nitroglicerina

Avantaje

- Reducere rapida si semnificativa a presarcinii;
- Reduce RVS in doze ≥moderate
- ↑↔ DC si FEVS
- T1/2 scurt
- Multiple forme de administrare
- Sublingual ~ intravenos

Dezavantaje

! Hipotensiune

! insuf. mitrala acuta

! stenoza Ao

! HTP

! Viagra

EBM despre tratamentul conventional al EPA…

Suportul inotrop (+): dopamina, dobutamina

Avantaje

- ↑↑ DC

Dezavantaje

- ↑ RMO2, AV, ischemia
- Aritmogene la doze mari
- Catecolaminemia pacientului dezvolta rapid toleranta fata de D.

EBM despre tratamentul conventional al EPA…

Suportul inotrop (+): iPDE – milrinona

Avantaje

- Independente de adrenoreceptori
- Independente de catecolaminemie
- Nu dezvolta toleranta
- Nu afecteaza RMO2
- ↑ DC: milrinona ≥ Dopa, Dobut.
- ↓ PICP: milrinona ≥ Dopa, Dobut.

Dezavantaje

- Amrinona - proscrisa
- Nu reduce mortalitatea
- Cost inalt
- Ocazional - aritmii

Volemia, insuficienta cardiaca si edemul pulmonar

Paradoxul nr. 1 – secretia AVP

- **Scaderea osmolaritatii plasmatice cu 1-2% suprima secretia AVP**
- **Hipervolemia: suprima secretia AVP**

Dar, în cazul insuficientei cardiace

- **Stimularea secretiei AVP, produsa de hipovolemia arteriala este mai puternica decât inhibitia secretiei AVP, produsa de hiposodemie si/sau hipervolemia venoasa**

Hipervolemie venoasa — **Hipovolemie arteriala**

Noi tratamente pentru EPA… EBM absenta.

Rezolvarea paradoxului 1: derivatii ANP

Nesiritida (B-ANP recombinat)

- ↓↓ PICP si RVS
- ↑↑ natriureza si DC
- ↔ AV
- Ameliorare timp de 1 ora

Mills, et al (J Am Coll Cardiol, 1999)
Colucci, et al (N Engl J Med, 2000)

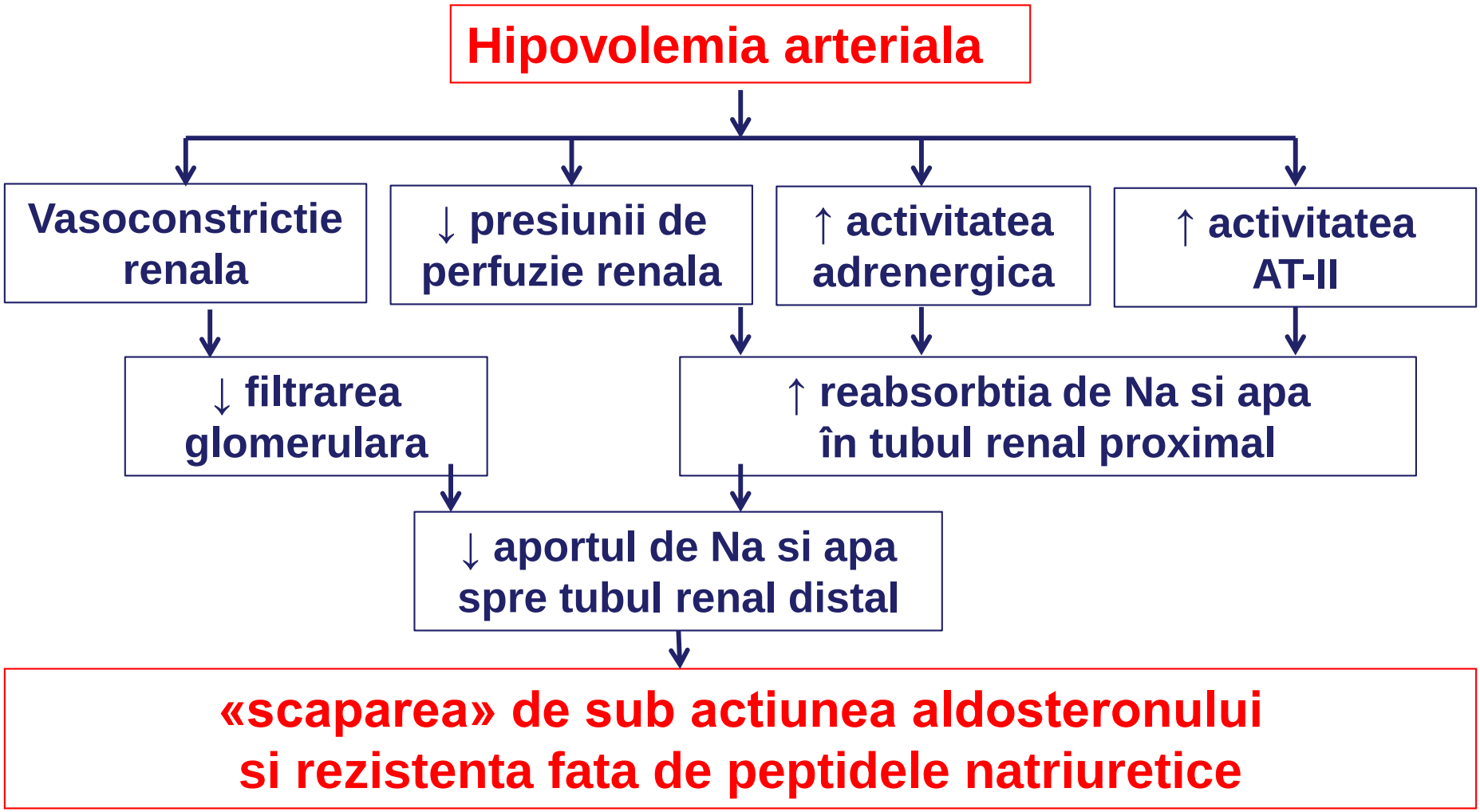
Dezavantaje

- Studii sponsorizate de producator
- Cost: 40 x NTG (~456$/fiola)
- Creste durata de spitalizare cu 2 zile, dar… scade readmisia in spital a supravietuitorilor
- Suspectata cresterea mortalitatii (19% N vs 13 NTG la 90 zile)

Sackner-Bernstein, et al. (Circulation, 2005)
VMAC trial (JAMA, 2002)

Volemia, insuficienta cardiaca si edemul pulmonar

Paradoxul nr. 2 – efectul « aldosterone escape »



Schrier R, Abraham W., NEJM, 1999; 341: 577

Rezolvarea paradoxului 2: administrarea de IEC

Avantaje

- Reduc activitatea SRAA
- ↓ Catecolaminele si postsarcina
- Amelioreaza relaxarea VS
- Aplicabil in acutizarea ICC
- ↓ PICP in ≤10 min 25 mg captopril
- ↔ PAM si AV
- ↑↑↑ RFG si diureza

Barnett, et al (Curr Ther Res, 1991)
Langes, et al (Curr Ther Res, 1993)
Variale, et al (Clin Cardiol, 1993)

Avantaje

- Odds IOT = 0,28
- ↔ hipotensiunea
- ↔ necesitatea vasopresorilor
- ↓↓↓ durata UTI (29 vs. 78 ore)
- Sinergic cu NTG
- Alternativa NTG

Sacchetti, et al (Am J Emerg Med, 1999)
Southall, et al (Acad Emerg Med, 2004)

Conceptul «miscarii lichidelor» (« liquid shifting »):
- reducerea hipervolemiei venoase
- compensarea hipovolemiei arteriale

Cum ramane cu perfuzarea i.v. de lichide în cazul EPA /IC ?

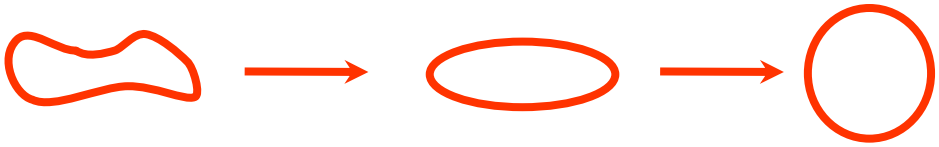
- 50% dintre pacientii cu EPA nu sunt încarcati cu lichide;
- Mai curând – disfunctie vasculara
- Diureticele – deseori inutile (insa, sunt supra-utilizate)

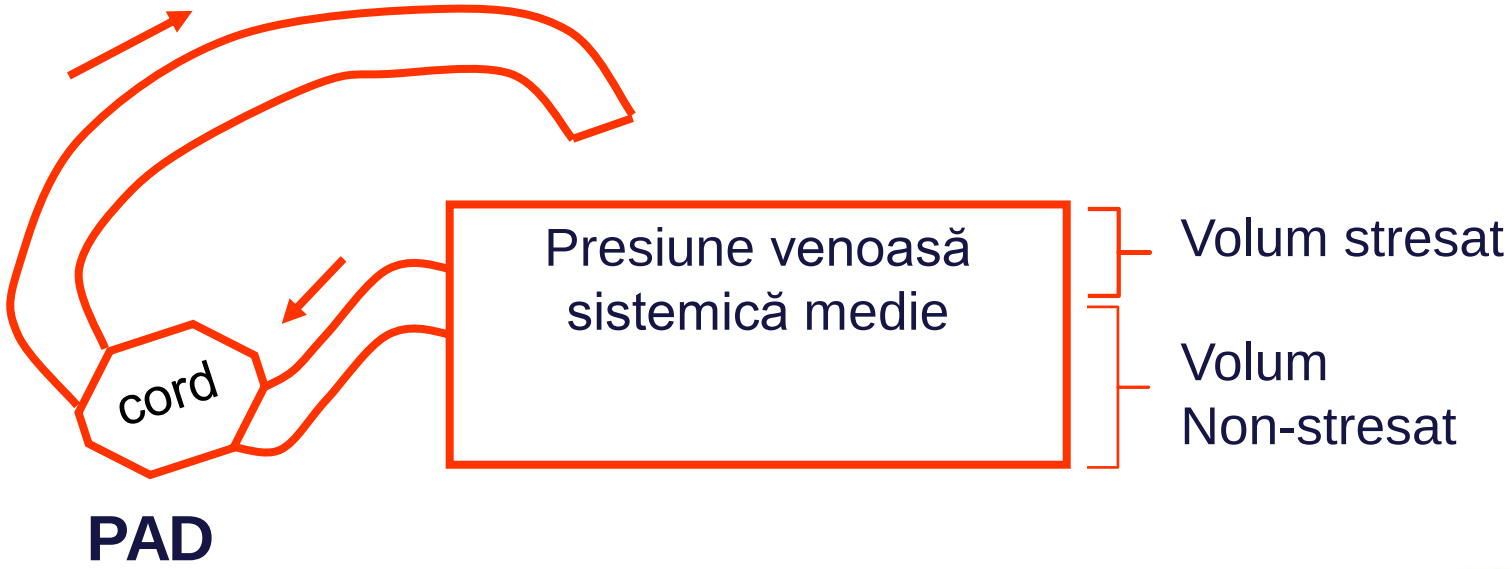
Cotter, et al. (Am Hearth J, 2008) and Collins et al. (Am Emerg Med, 2008)

Relaţia dintre volemie şi performanţa cardiacă
Modelul Magder

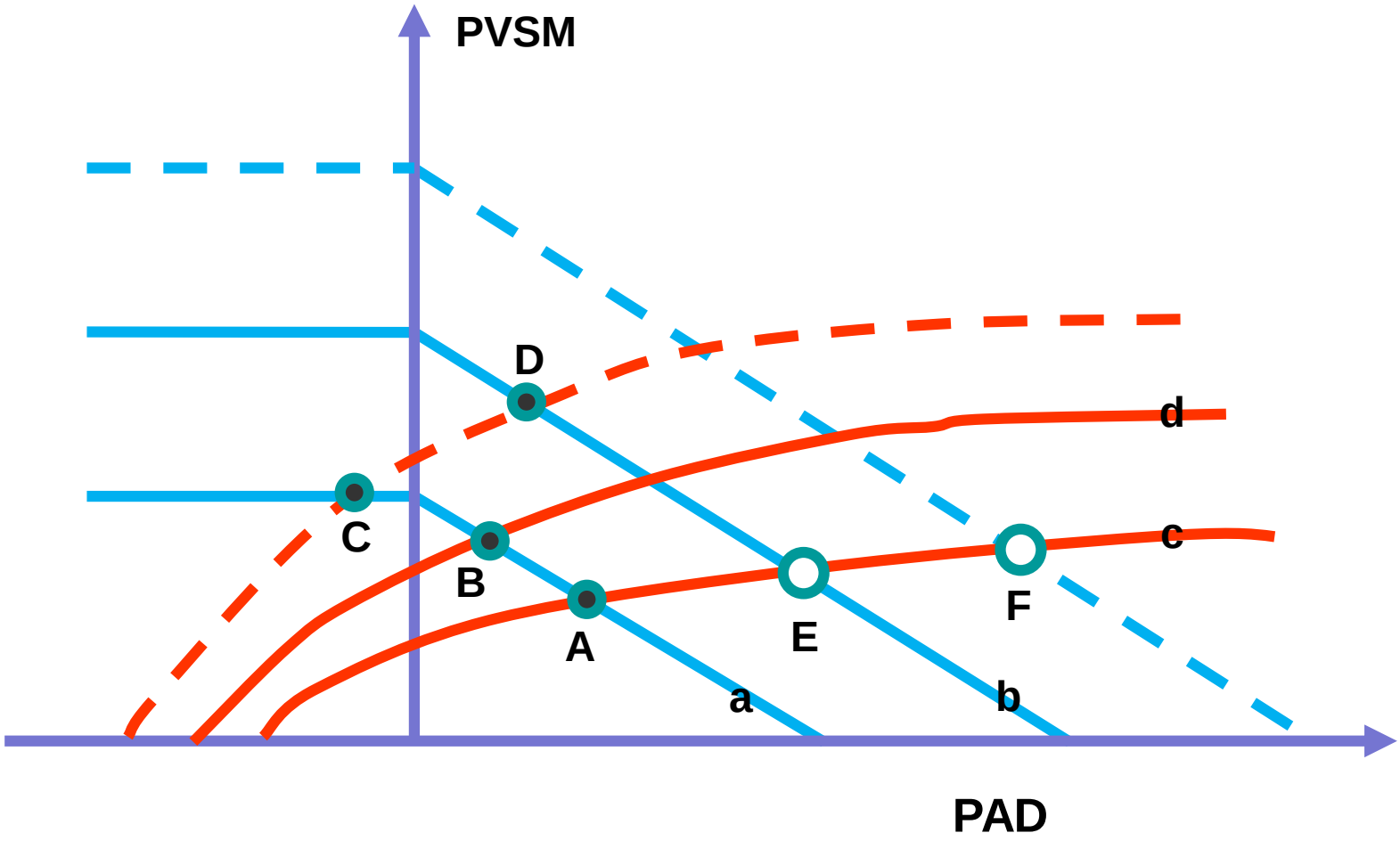
Presiunea transmurală = 0

Presiunea transmurală >0





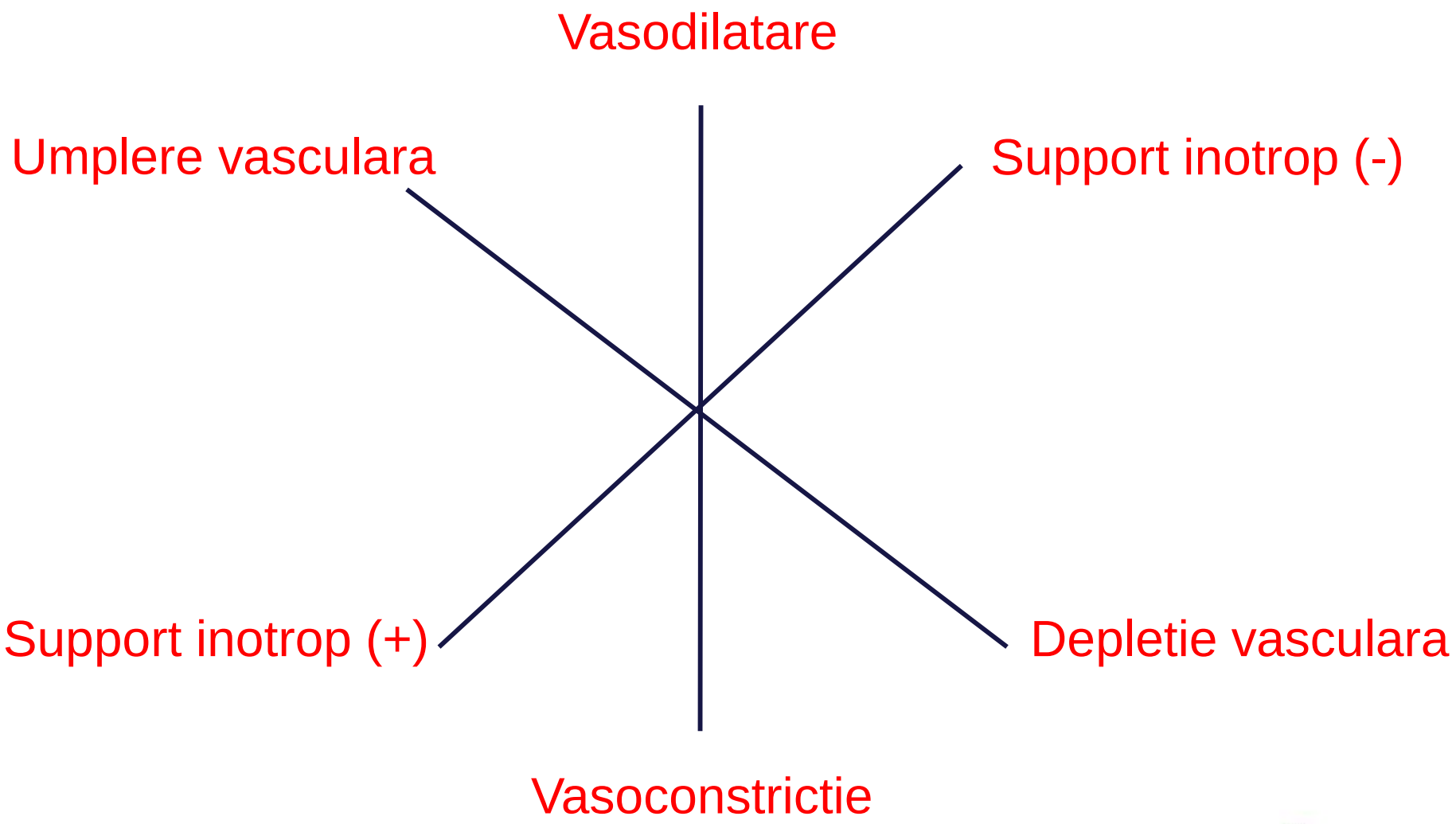
Relaţia dintre volemie şi performanţa cardiacă
Modelul Gyton: relaţia retur venos - PAD - DC



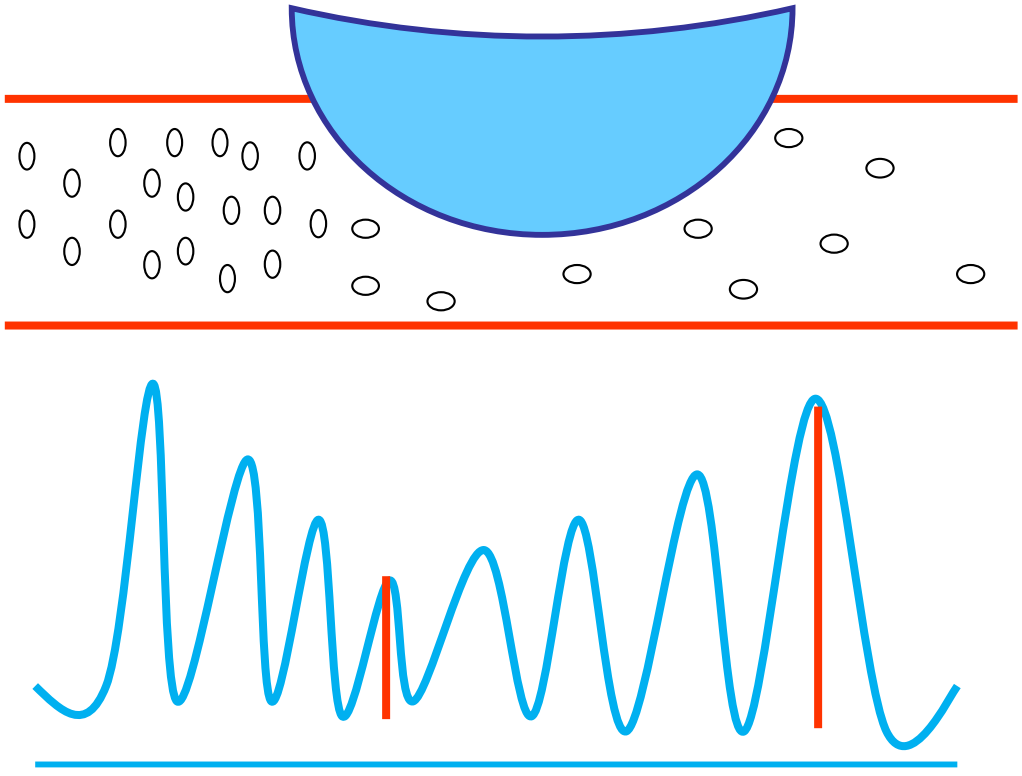
Abordarea functiei cardiace la pacientul cu EPA

1. **Este presarcina actuală optimală, iar administrarea i.v. de volum va conduce la creşterea DC sau nu ?**
2. **Frecvenţa şi ritmul cardiac sunt în limite fiziologice?**
3. **Care stare a RVS – vasoconstricţie, vasodilatare sau tonus normal vor contribui la optimizarea (creşterea) debitului cardiac?**
4. **Este oare balanţa de oxigen (DO_2-VO_2) echilibrată?**
5. **Care este starea contractilităţii miocardice ?**

Dirijarea functiei cardiace in caz de EPA

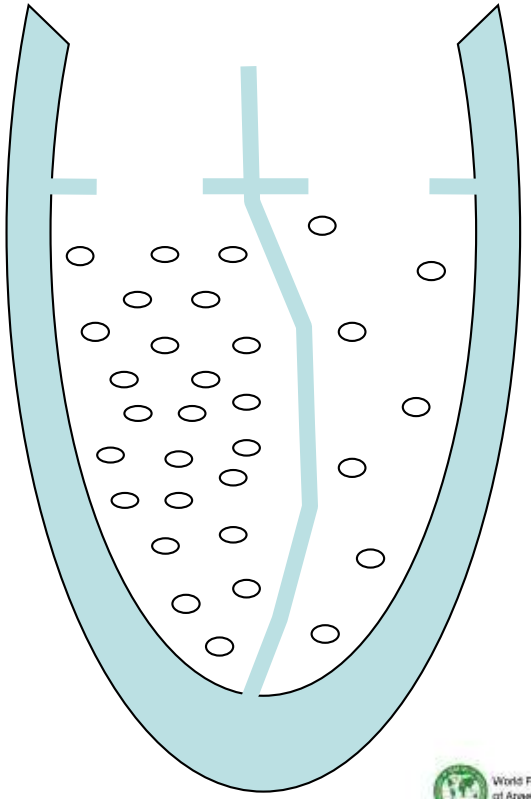


Relaţia dintre volemie şi performanţa cardiacă
Volemia şi interferenţa cord-pulmon



1 ciclu respirator

ΔPP ≥13%

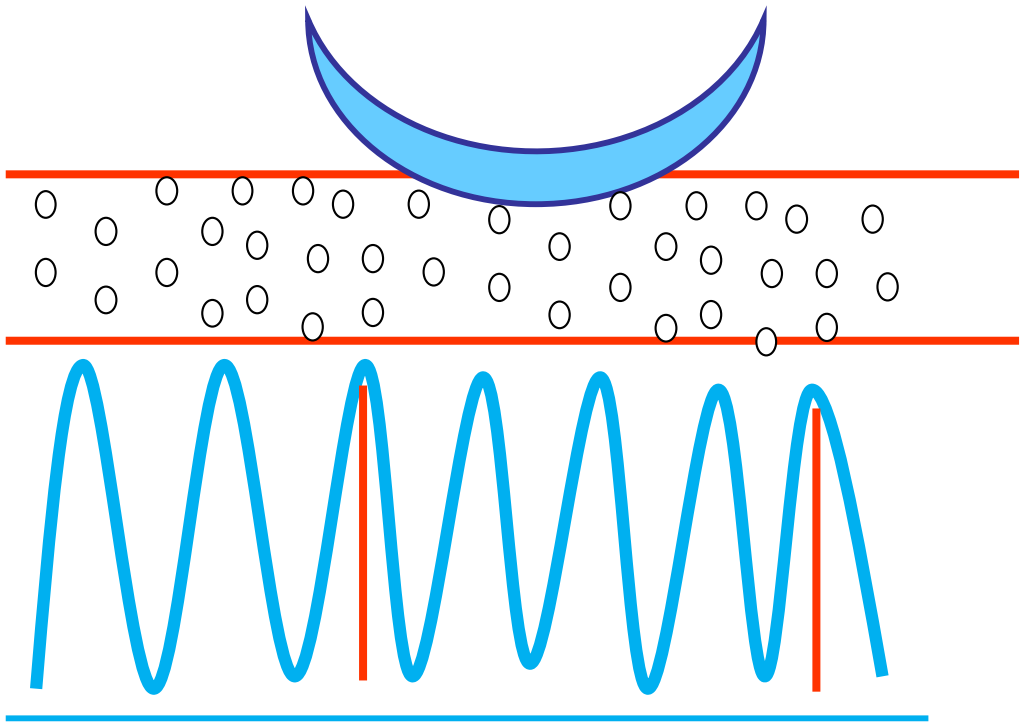


Relaţia dintre volemie şi performanţa cardiacă
Volemia şi interferenţa cord-pulmon

$$\Delta PP(\%) = \frac{(PP_{max} - PP_{min}) \times 2}{(PP_{max} + PP_{min})} \times 100$$

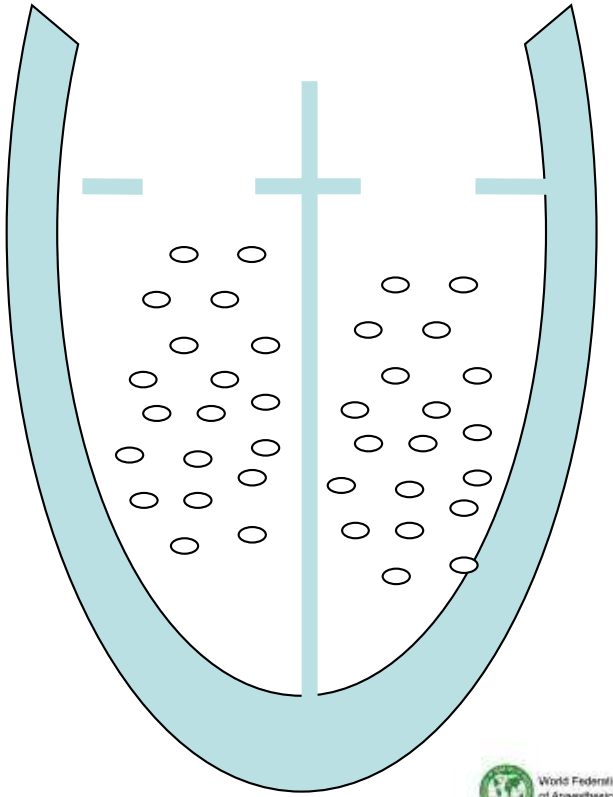
$$PP_{min} = PAS_{min} - PAD_{min}$$

$$PP_{max} = PAS_{max} - PAD_{max}$$

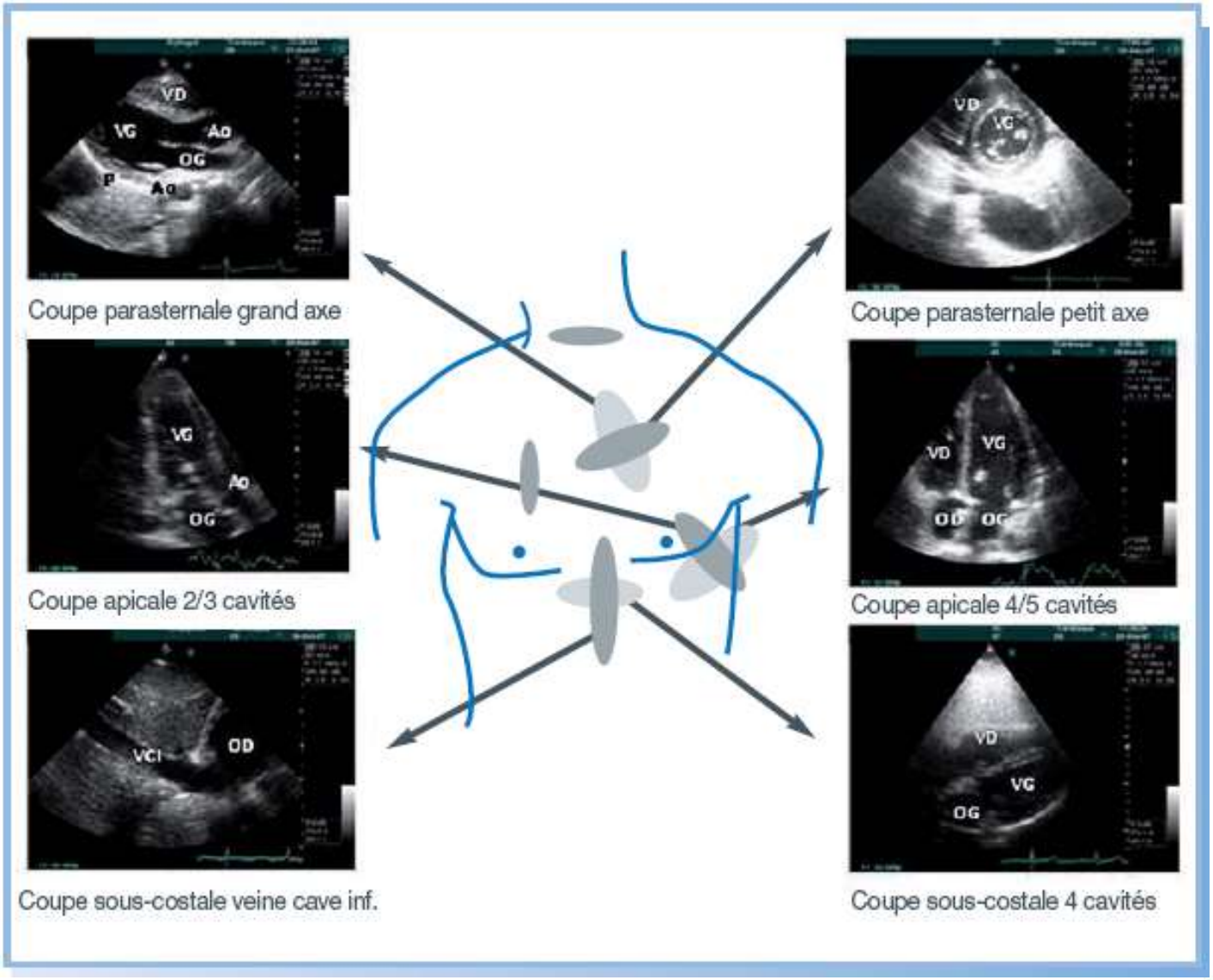


1 ciclu respirator

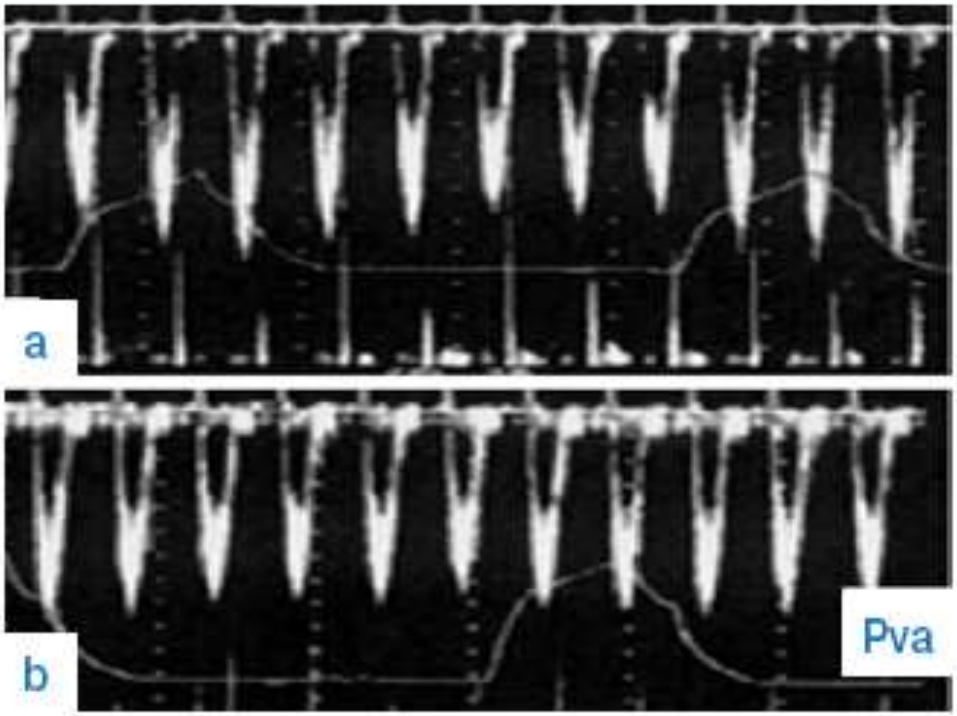
ΔPP <13%



Ecocardiografia – un instrument util pentru testarea responsivitatii DC la umplerea vasculara



Ecocardiografia – un instrument util pentru testarea responsivitatii DC la umplerea vasculara



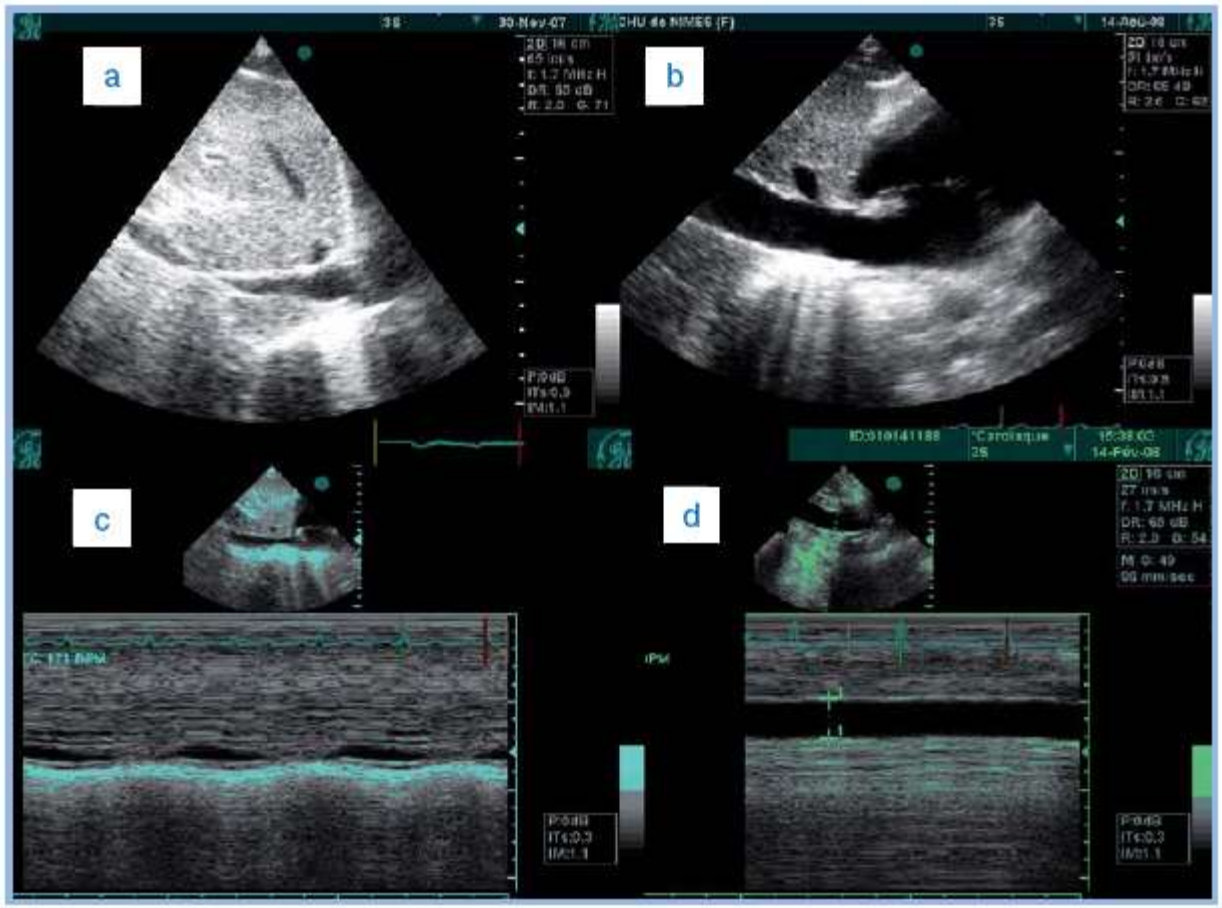
Variatiile respiratorii a velocitatii fluxului subaortic (∆Vpeak):

a. (∆Vpeak) >12% - dependenta de presarcina → umplere vasc. necesara
b. (∆Vpeak)<12% - independenta de presarcina (x)

Ecocardiografia – un instrument util pentru testarea responsivitatii DC la umplerea vasculara

i.v. → OK

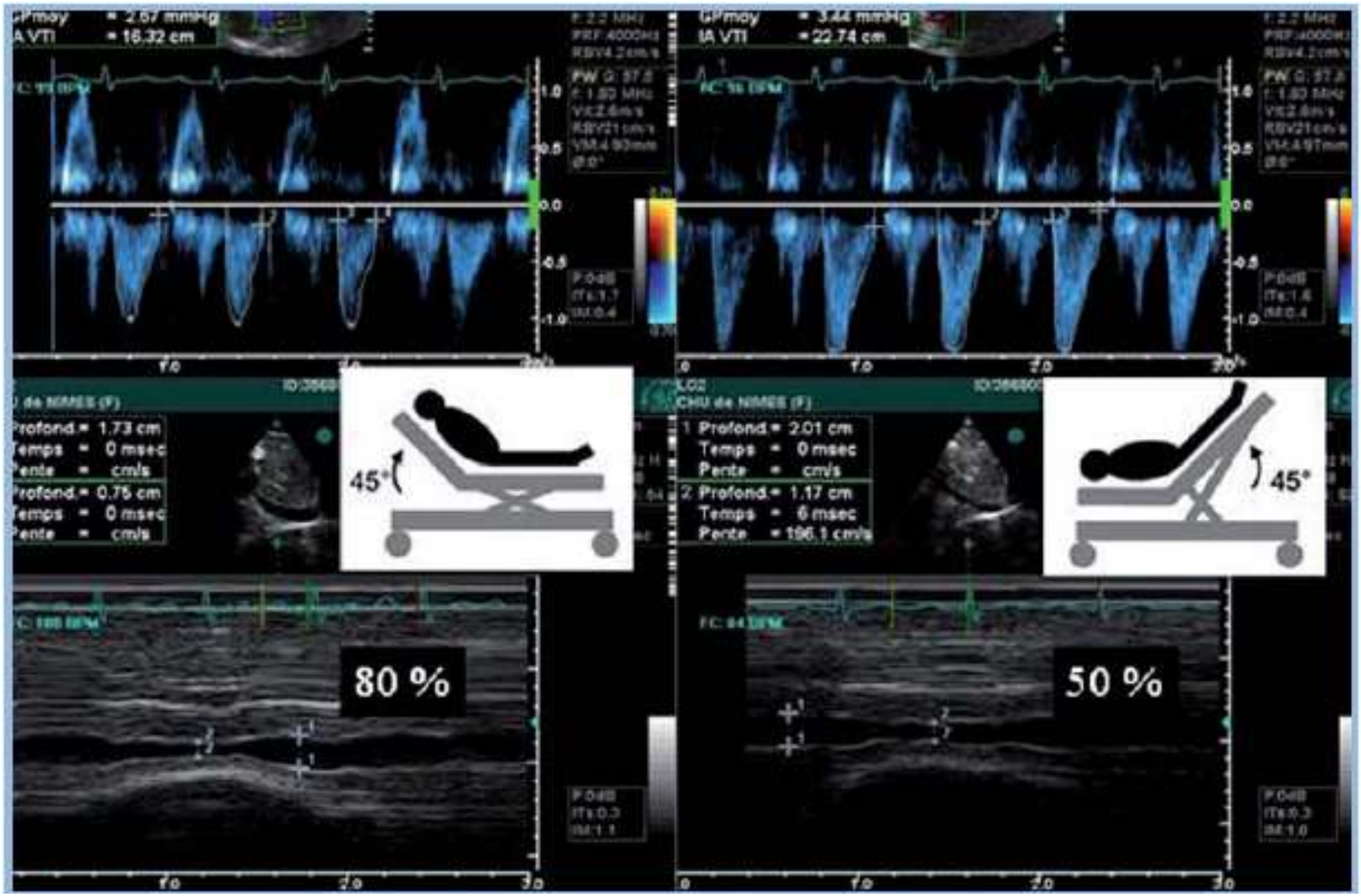
i.v. → STOP



i.v. → STOP

i.v. → OK

Testul ridicarii pasive a picioarelor



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Clinical Study

Extravascular Lung Water Does Not Increase in Hypovolemic Patients after a Fluid-Loading Protocol Guided by the Stroke Volume Variation

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Why Do We have to Move Fluid to be Able to Breathe?

Martin Fronius,[1,*] Wolfgang G. Clauss,[1] and Mike Althaus[1]

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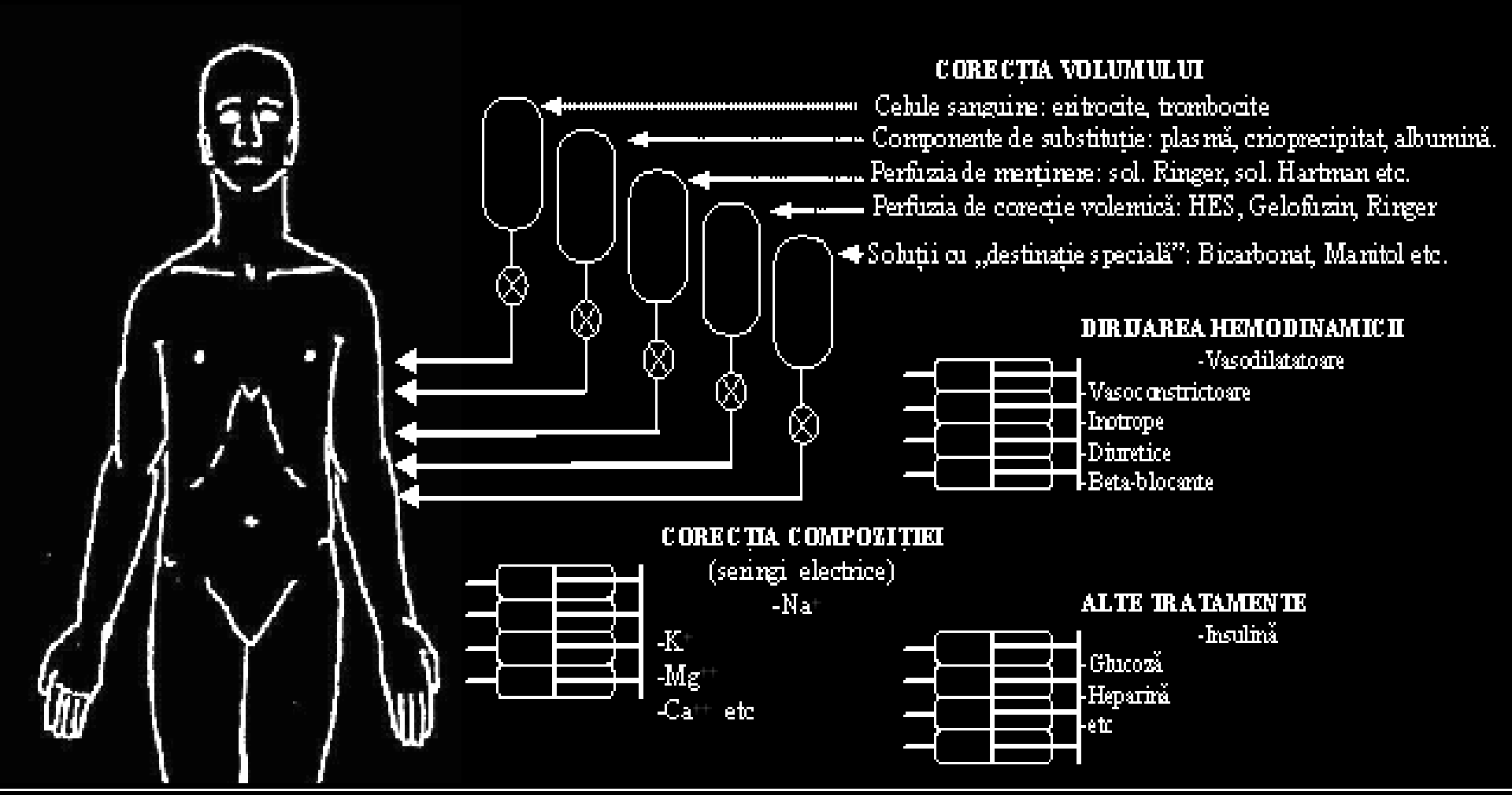
Abstract

Go to:

The ability to breathe air represents a fundamental step in vertebrate evolution that was accompanied by several anatomical and physiological adaptations. The morphology of the air-blood barrier is highly conserved within air-breathing vertebrates. It is formed by three different plies, which are represented by the alveolar epithelium, the basal lamina, and the endothelial layer. Besides these conserved

Schema de principiu pentru realizarea unui program de perfuzie



Concluzii

1. Pacientul cu EPA deseori este hipovolemic;
2. Edemele si hipervolemia venoasa pot coexista cu hipovolemia arteriala;
3. Reechilibrarea relatiei Starling-Pappenheimer-Staverman nu intotdeauna va conduce la rezolvarea EPA;
4. Hipervolemia venoasa (= «rezerva interna») poate fi sursa compensarii lente a hipovolemiei arteriale in EPA si IC.
5. Perfuzarea intravenoasa de lichide in EPA se face doar in cazul unui test (+) de responsivitate la umplere (ΔPP, SVV…)
6. Ce solutii perfuzabile? – Asteptam decizia FDA…

CEEA

European Society of Anaesthesiology ESA

World Federation of Societies of Anaesthesiologists