

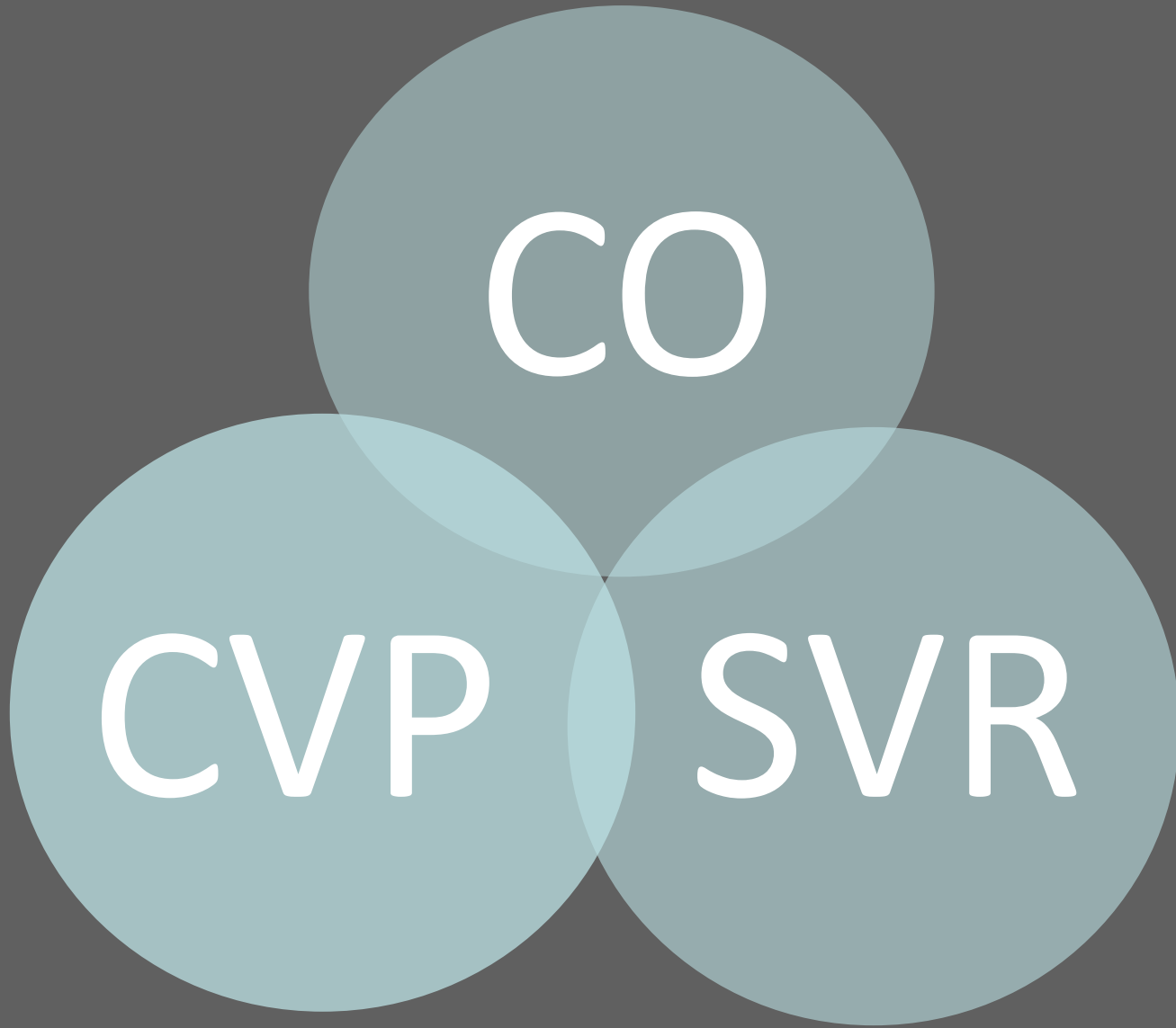
POCUS



Marty Štěpán

Hemodynamické vyšetření pacienta v šoku

Pomocí ultrasonografie hrudníku



Kardiogenní
Hypovolemický
Obstrukční
Distributivní

Různá doporučení a protokoly POCUS

- RUSH - Rapid Ultrasound in SHock in the Evaluation of the Critically Ill
- SHoC - Sonography in hypotension and cardiac arrest (SHoC)

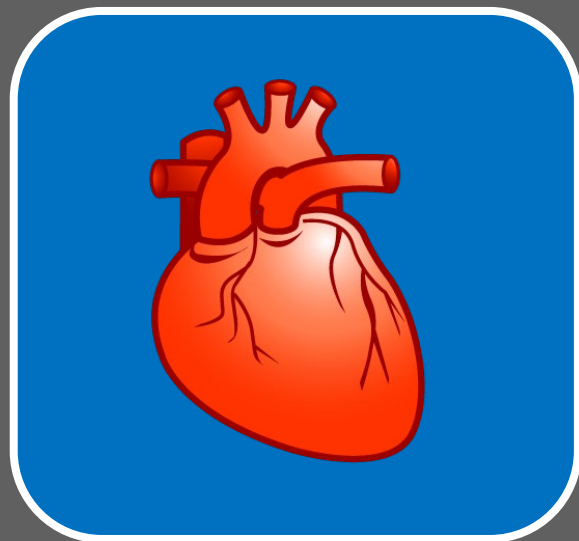
An international consensus on the use of point of care ultrasound for undifferentiated hypotension and during cardiac arrest

Atkinson P et al. CJEM 2017 Nov;19(6):459-470.

Různá doporučení a protokoly POCUS

- **RUSH** - Rapid Ultrasound in SHock in the Evaluation of the Critically Ill
- **SHoC** - Sonography in hypotension and cardiac arrest (SHoC)
- **FALLS** a **SESAME** -Sequential Echographic Scanning Assessing Mechanism or Origin of Sever Shock of Indistinct Cause
- **ACES** - Abdominal and Cardiac Evaluation with Sonography in Shock

Rapid **U**ltrasound in **S**Hock



PUMPA



NÁDRŽ



TRUBKY

The RUSH Exam: Rapid Ultrasound in SHock in the Evaluation of the Critically Ill

Phillips Perera, MD, RDMS, FACEP, Thomas Mailhot, MD, RDMS, David Riley, MD, MS, RDMS, Diku Mandavia, MD, FACEP, FRCPC

RUSH **senzitivita 88 % specifita 96 %** Bagheri-Hariri S et al. The impact of using RUSH protocol for diagnosing the type of unknown shock in the emergency department. Emergency radiology. 2015 Oct;22(5):517-520

ECHO

**Critical care
ultrasonography
(CCUS)**

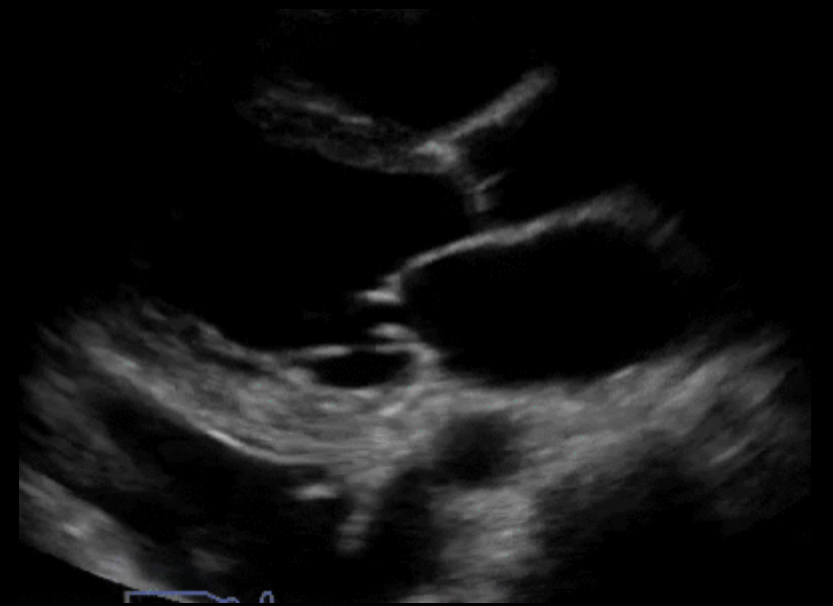
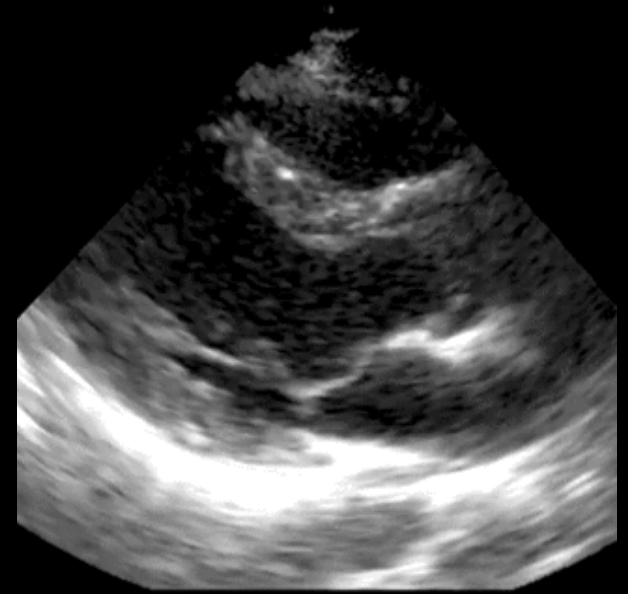
**Lung and
pleural**

Abdominal

Vascular

Jaké jsou srdeční funkce ?

Dobré nebo špatné



Jaké jsou srdeční funkce ?

Dobré nebo špatné

Jaký je intravaskulární objem ?

Relativně vysoký nebo nízký



Jaké jsou srdeční funkce ?

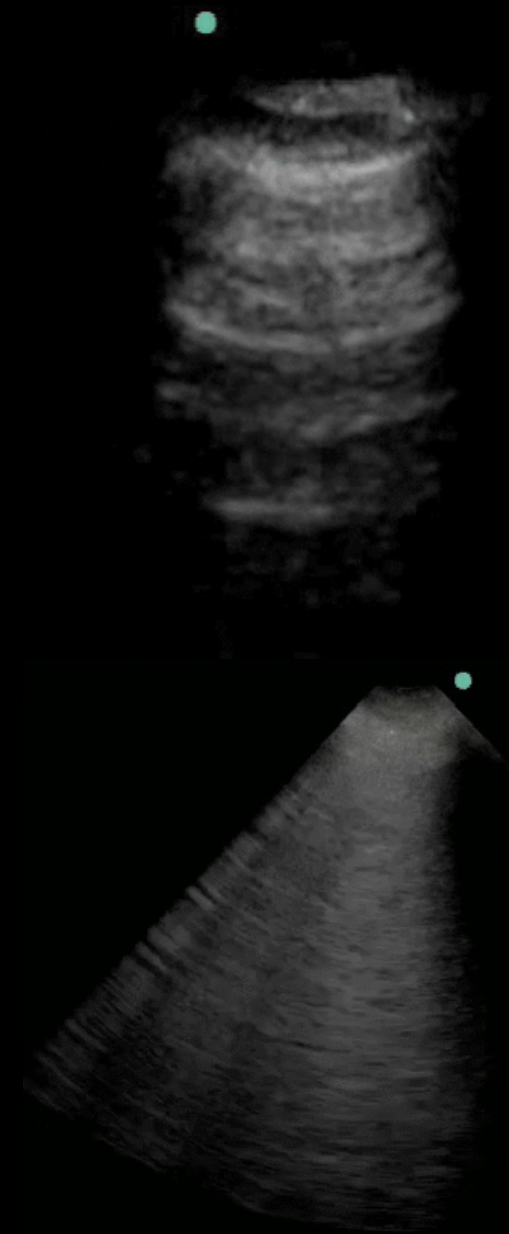
Dobré nebo špatné

Jaký je intravaskulární objem ?

Relativně vysoký nebo nízký

Má plicní patologii ?

Ano/ne



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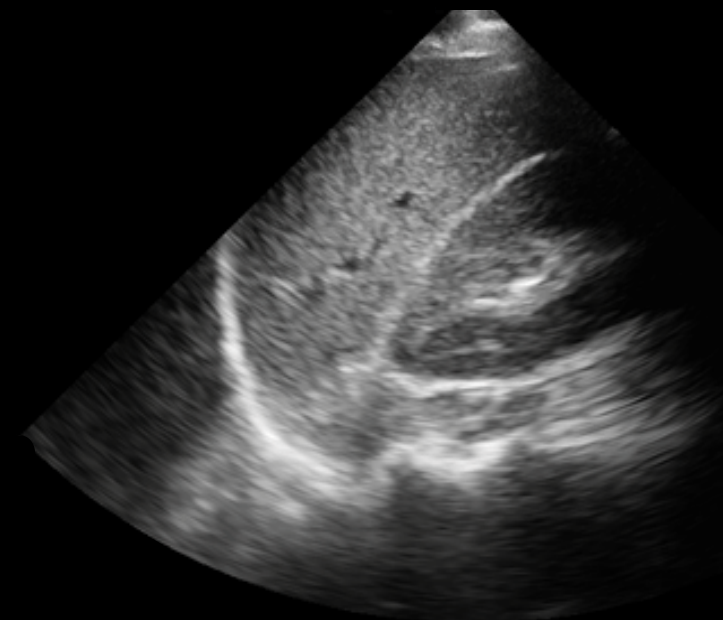
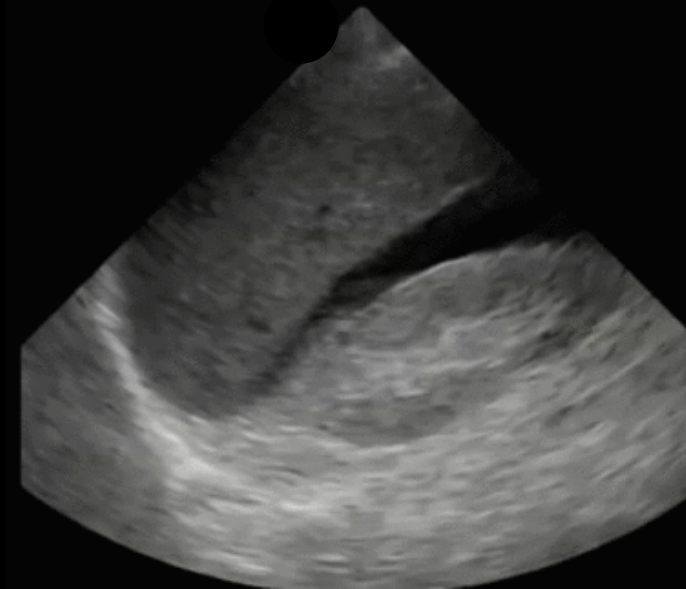
Relativně vysoký nebo nízký

Má plicní patologii ?

Ano/ne

Tekutina v dutině břišní ?

Ano/ne





Dušný s hypotenzií

DF 28

SpO₂ 85 s O₂

Tk 90/50 mmHg

TF 75/min (FIS)

Concor

Amlozek

Furon



Velikost komor a kontraktilita LK?



Velikost komor a kontraktilita LK ?
Náplň DDŽ ?



A linie? B linie? Konsolidace? Výpotek? FAST?

Jaké jsou srdeční funkce ?

Dobré nebo špatné

Jaký je intravaskulární objem ?

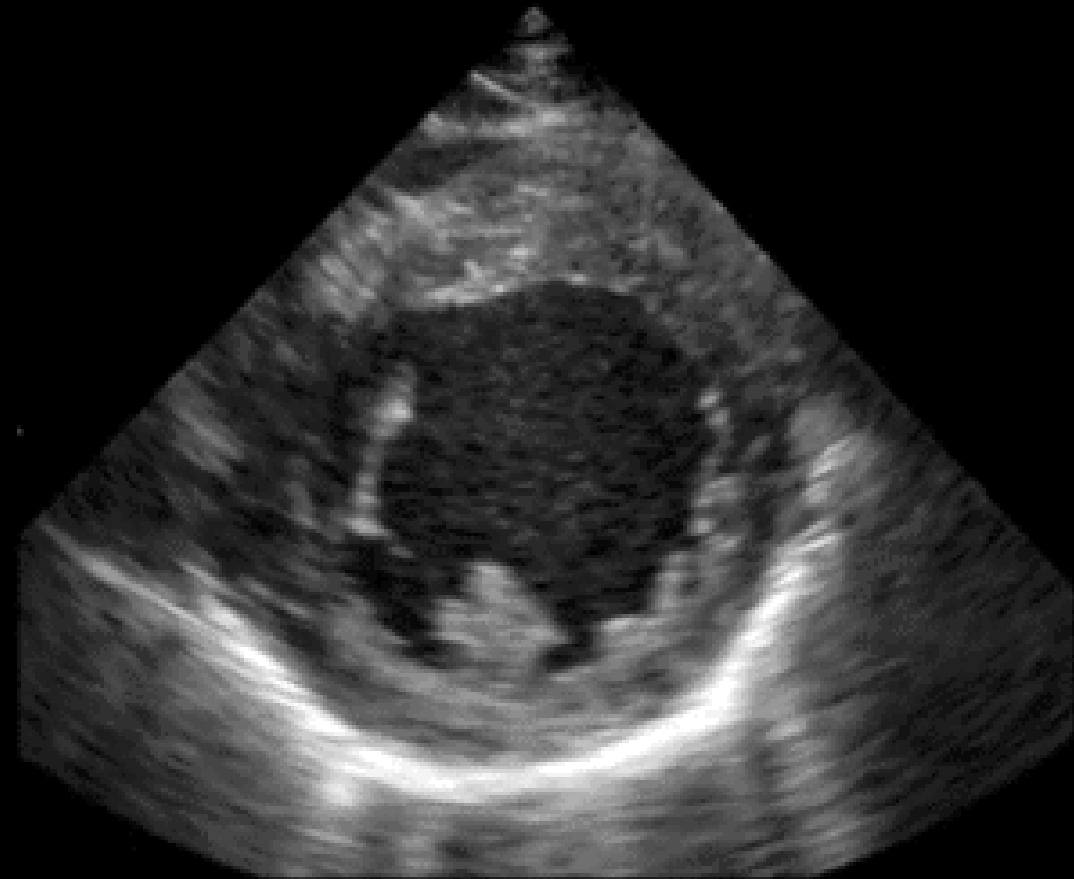
Relativně vysoký nebo nízký

Má plicní patologii ?

Ano/ne

Tekutina v dutině břišní ?

Ano/ne





Dušný s hypotenzí

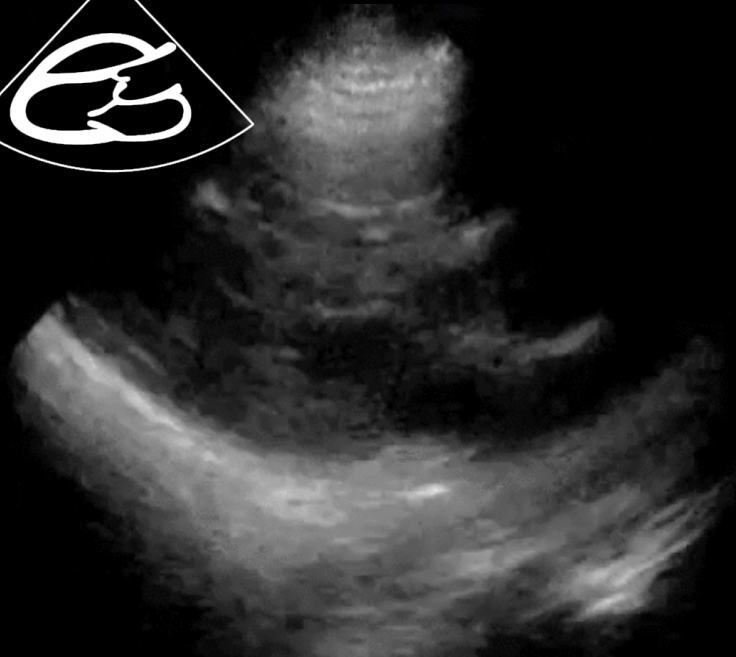
DF 25

SpO2 94

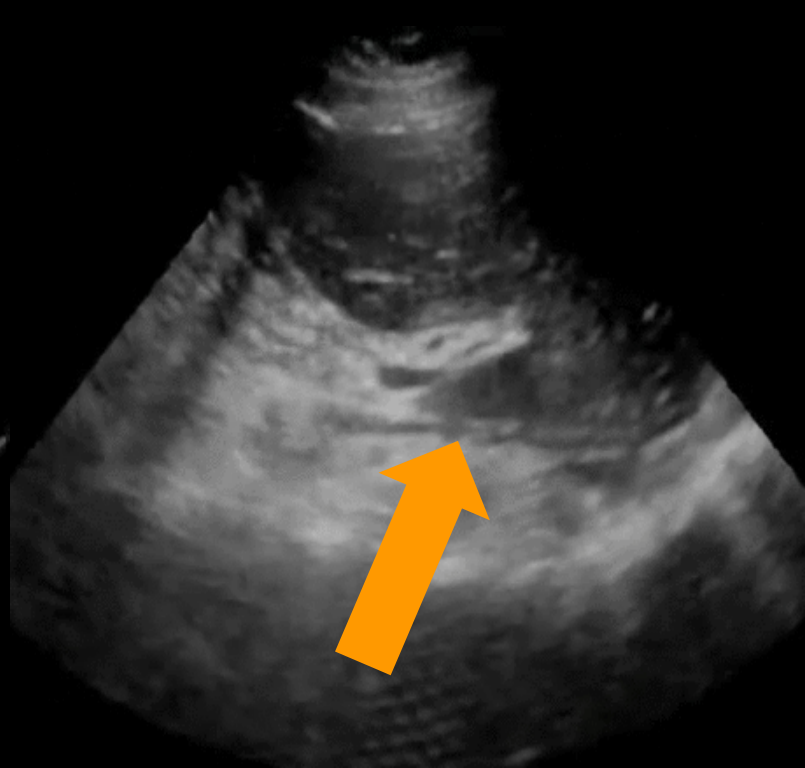
(O2 6l/min)

Tk 70/30

TF 130



Velikost komor a kontraktilita LK?



Náplň DDŽ ?

Plicní LUS patologie?

Jaké jsou srdeční funkce ?

Dobré nebo špatné

Jaký je intravaskulární objem ?

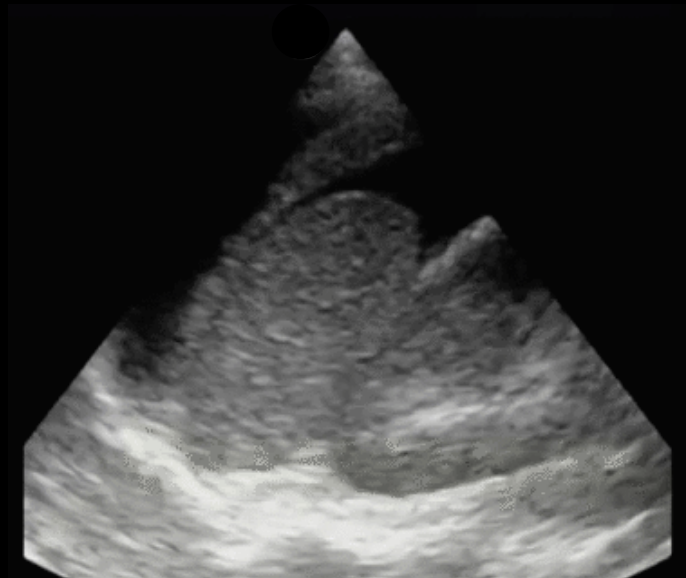
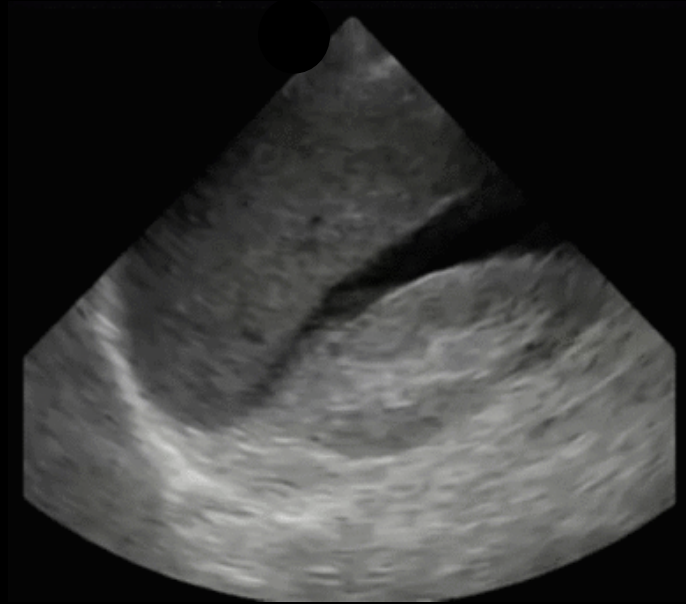
Relativně vysoký nebo nízký

Má plicní patologii ?

Ano/ne

Tekutina v dutině břišní ?

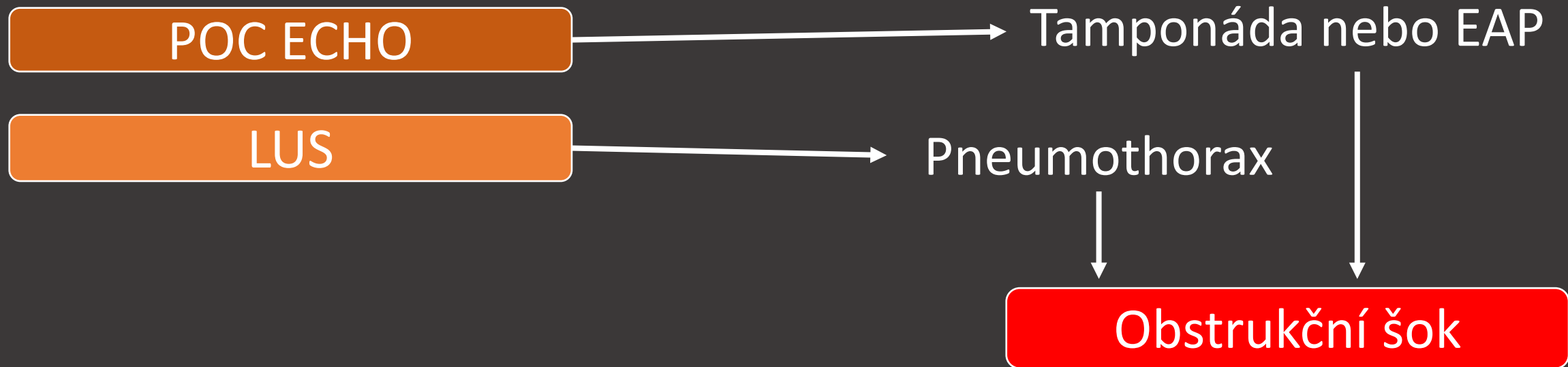
Ano/ne



ECHO & LUS for SHOCK



FALLS Protocol – Lichtenstein, 2012.



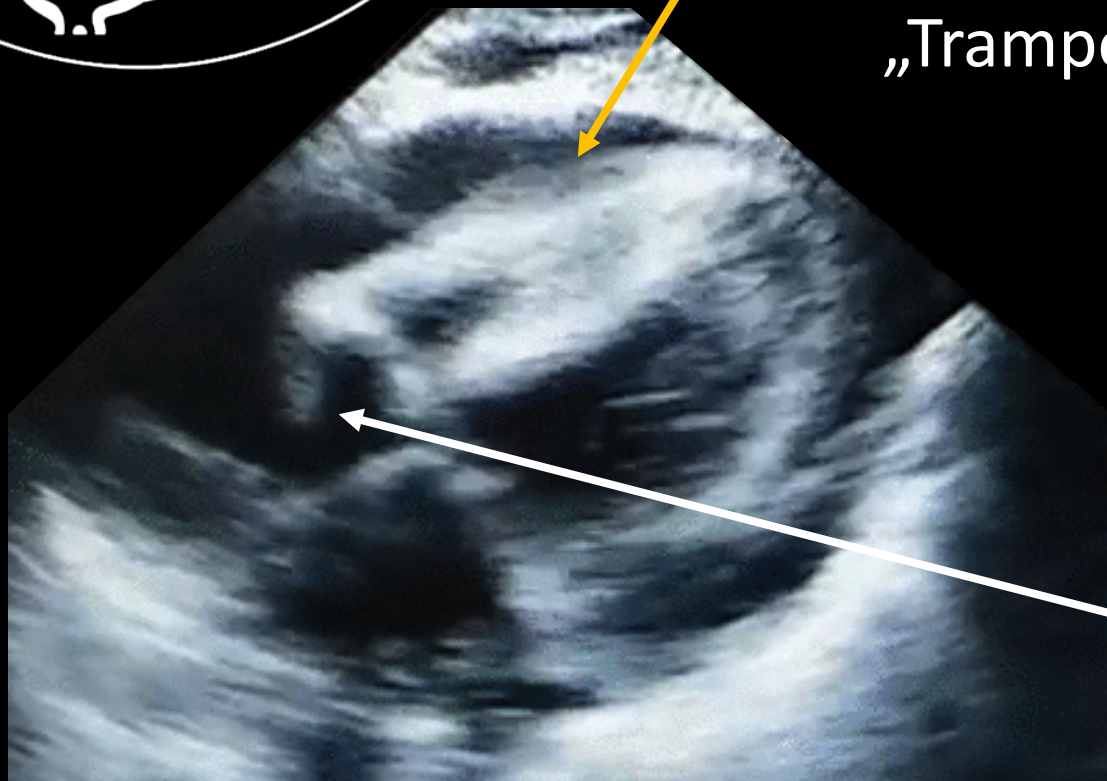
POC ECHO

Tamponáda nebo EAP

Obstrukční šok

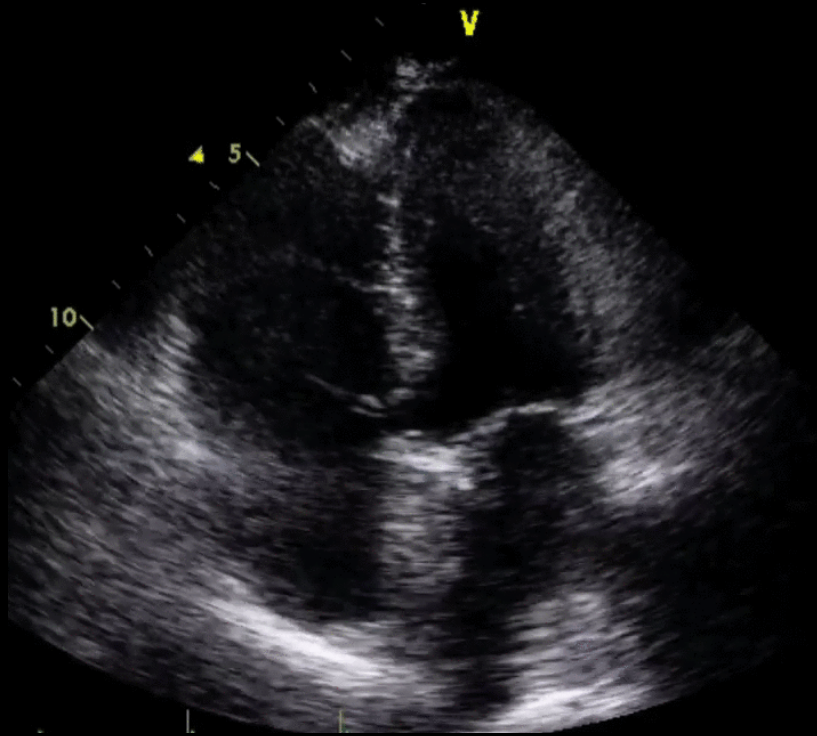
„Prolomení“
laterální stěny PK
„Trampolína“

Diastolický kolaps pravé síně

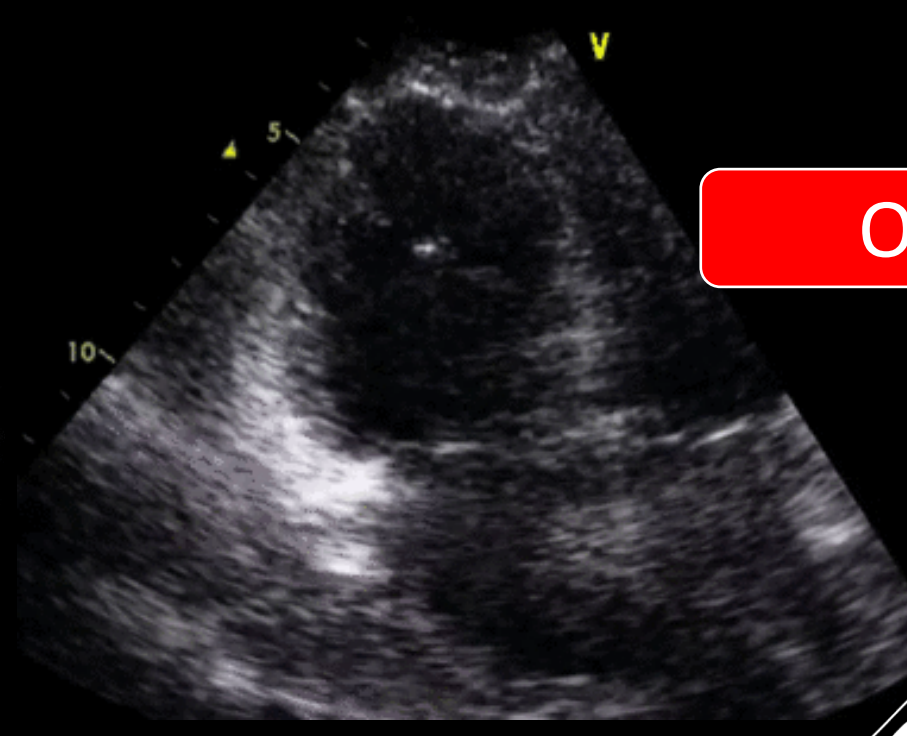


POC ECHO

Tamponáda nebo EAP

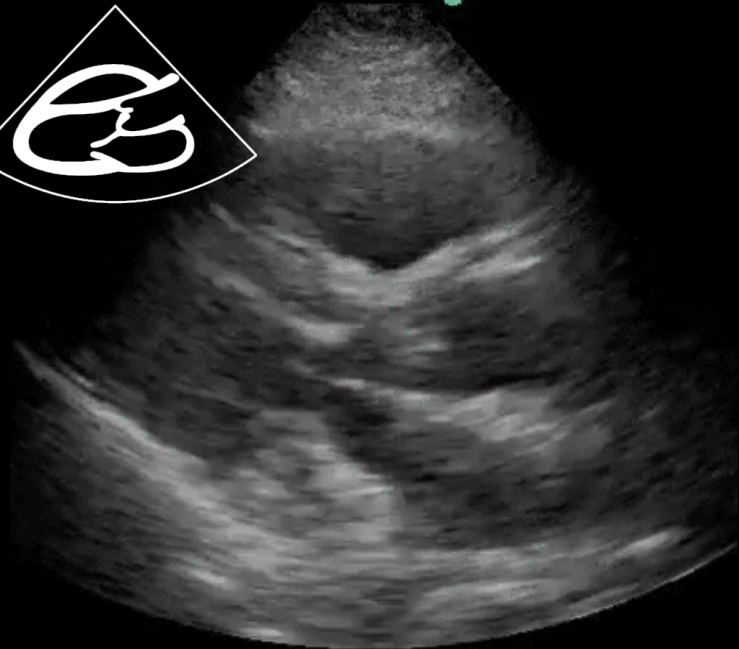


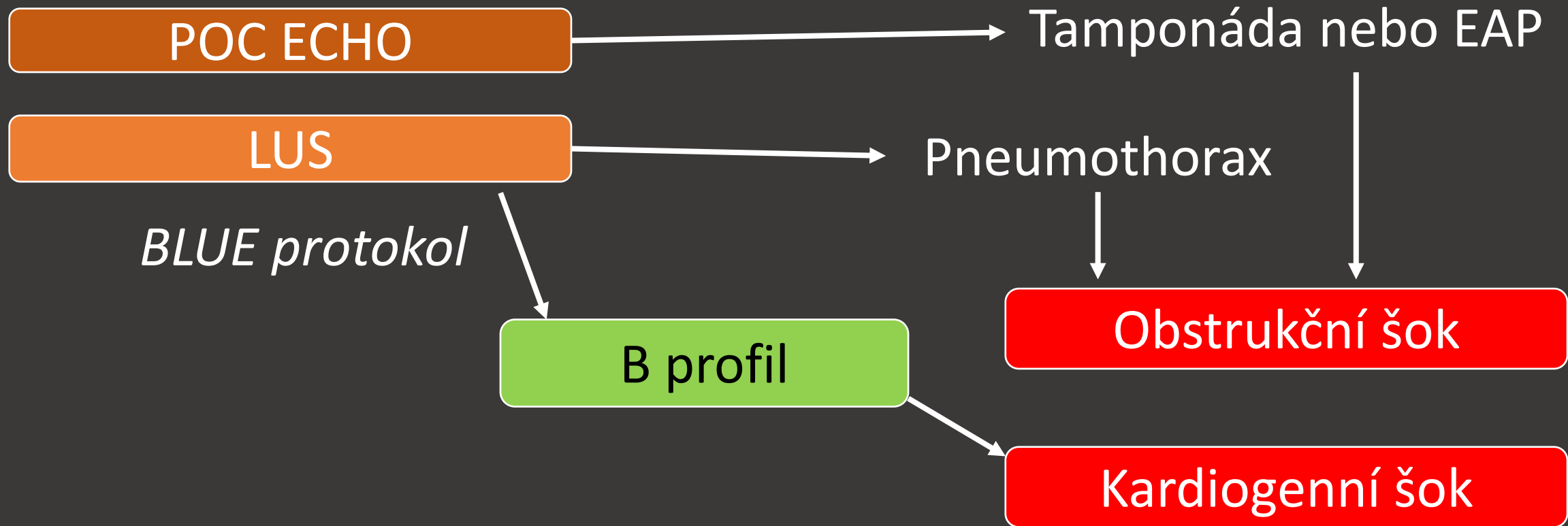
McConnell's sign



Obstrukční šok









Dušný s hypotenzí

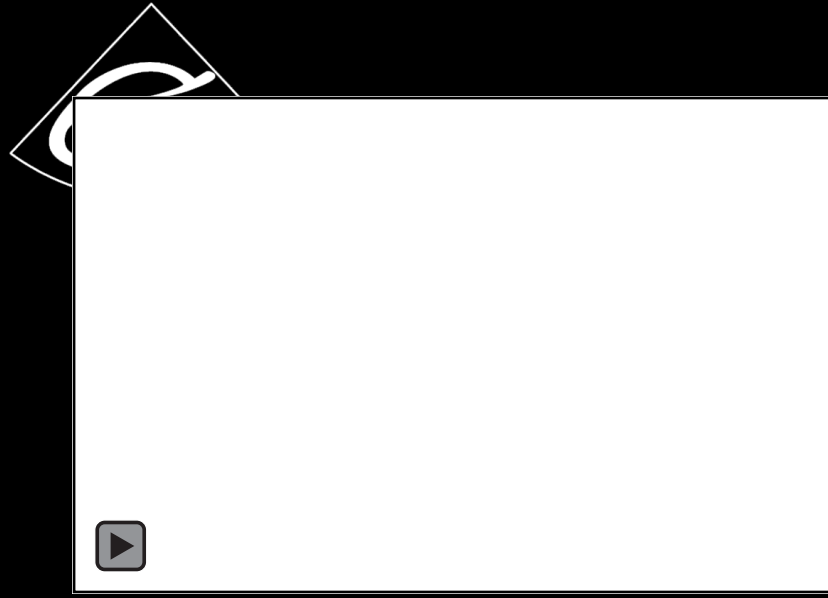
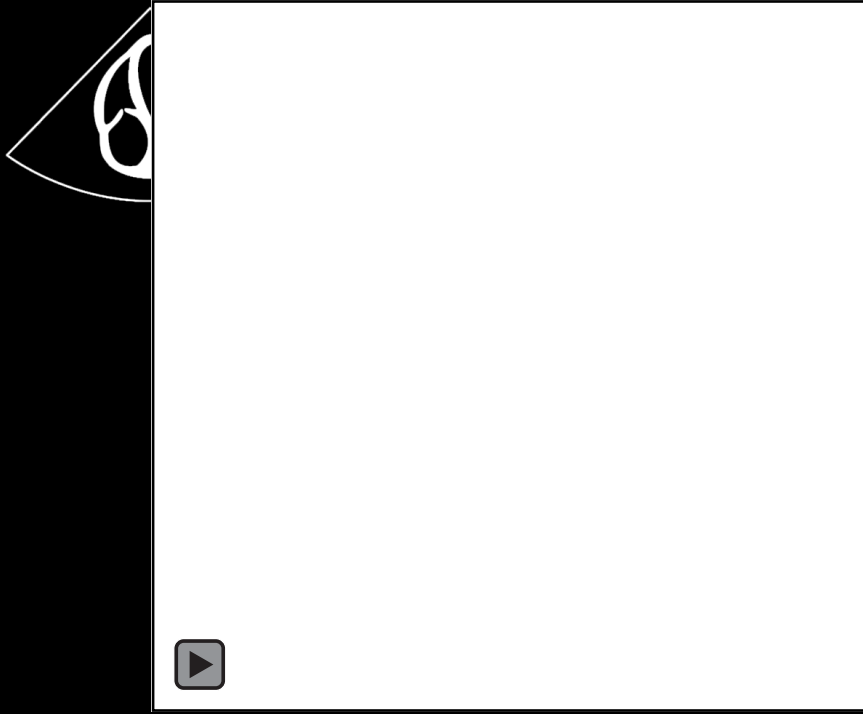
DF 30

SpO₂ 88

(O₂ 6l/min)

Tk 80/30

TF 120

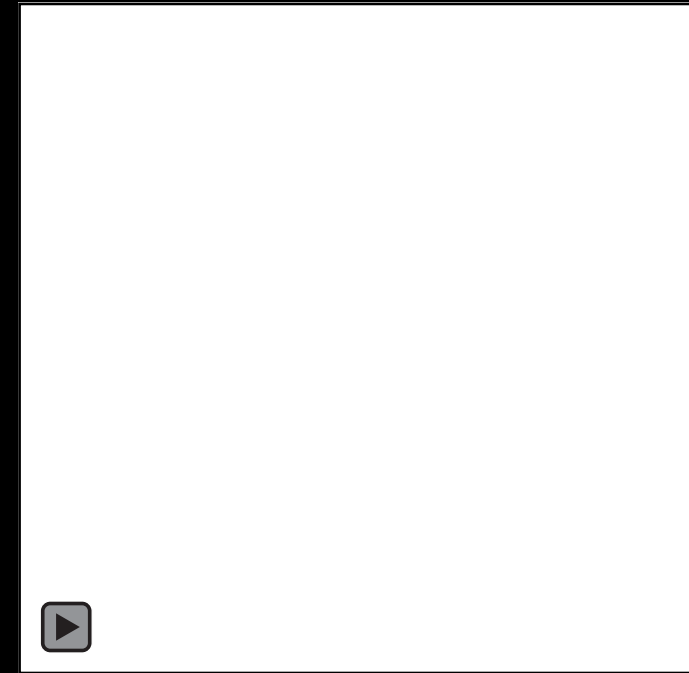
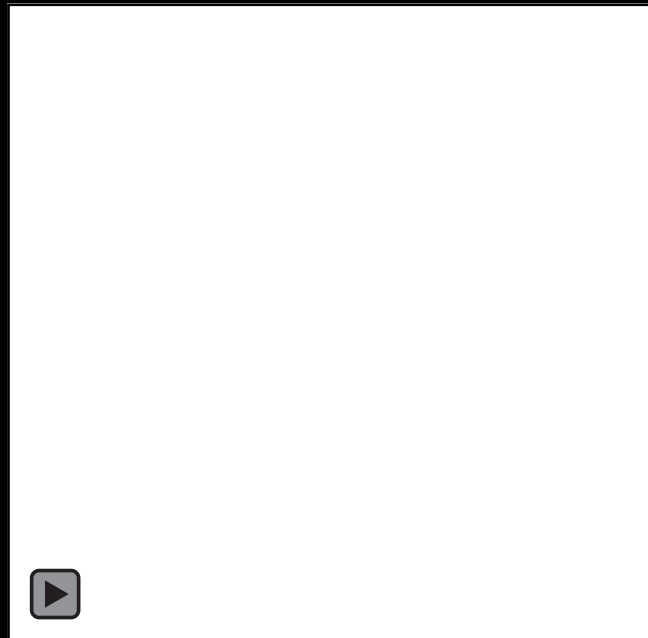


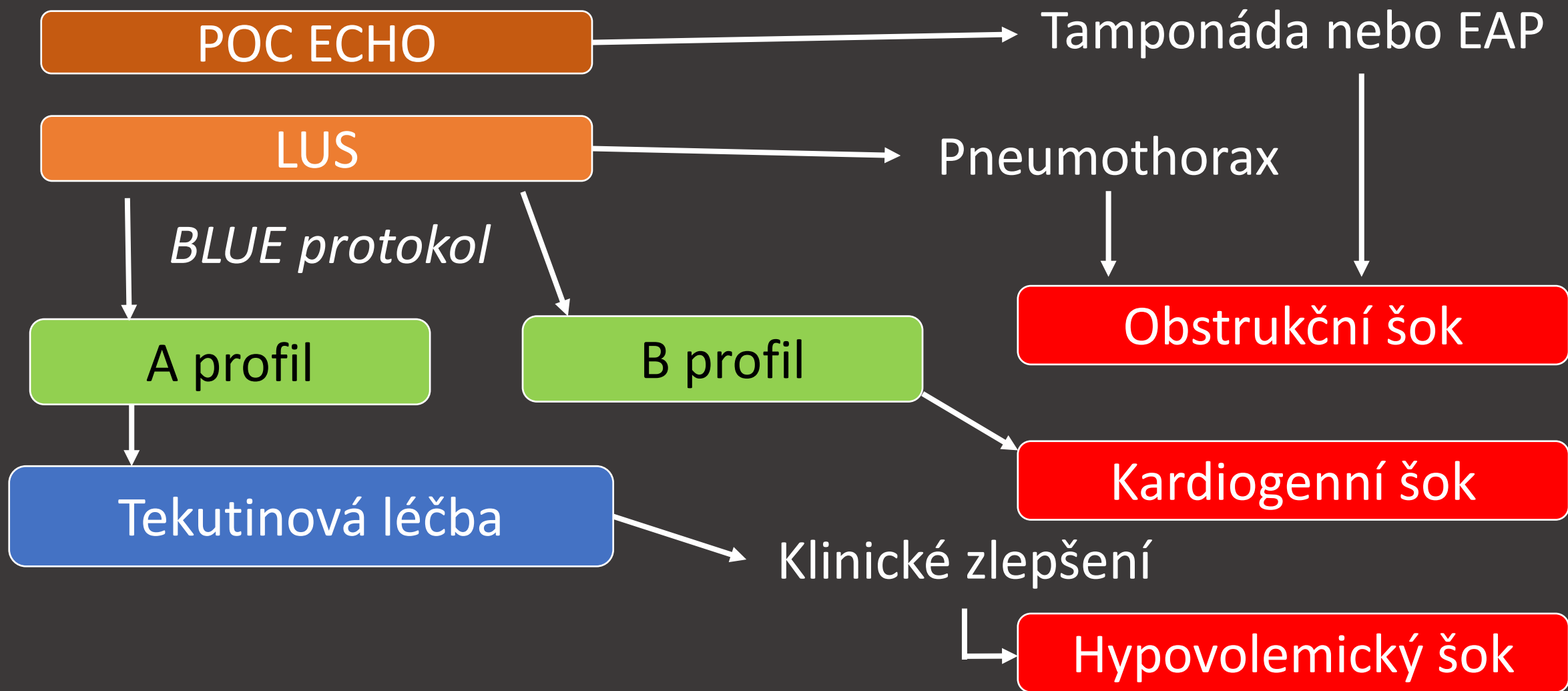
Akutní MR

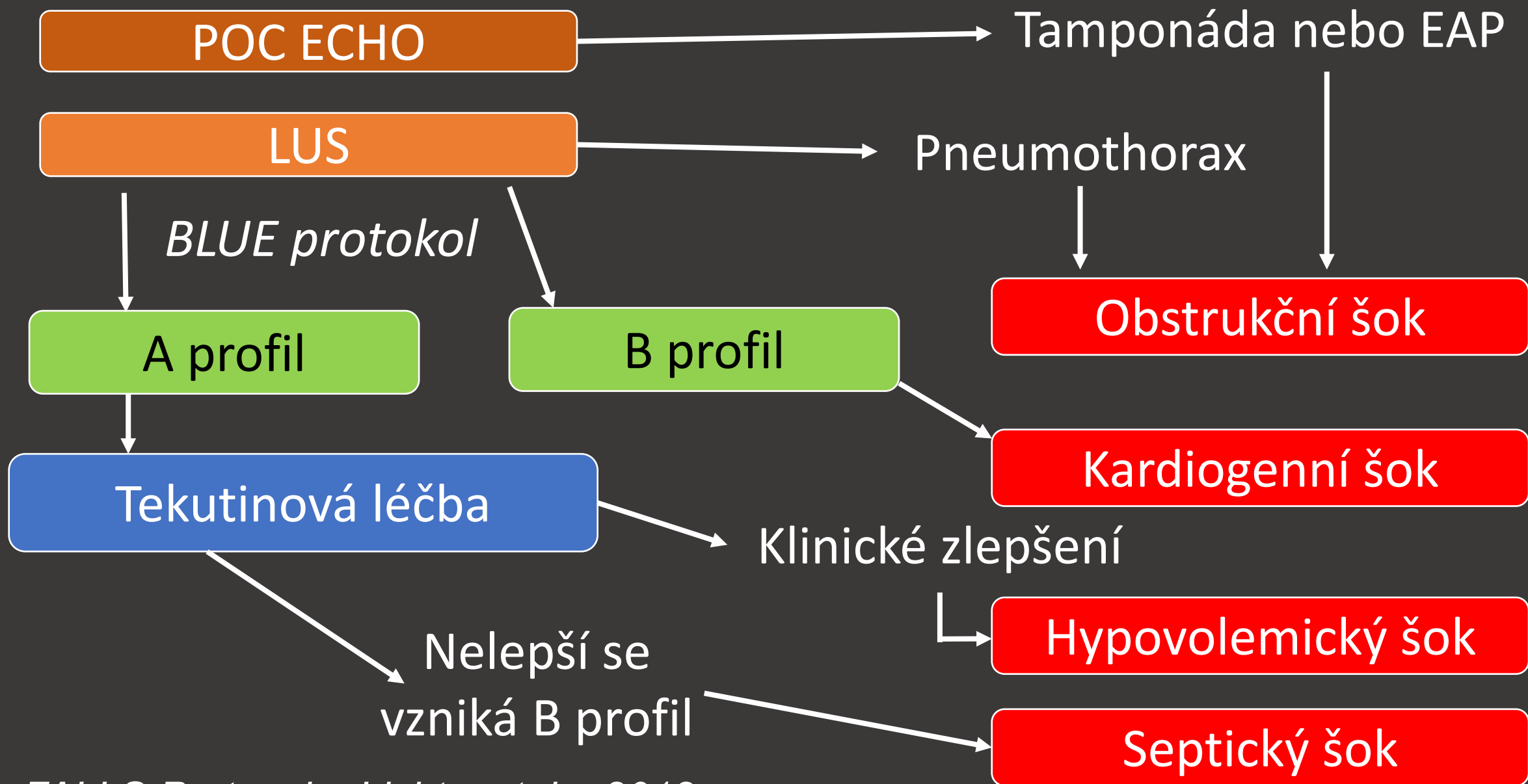
Mortalita neoperované
akutní MR

75% 24 hodin

95% 48 hodin







FALLS Protocol – Lichtenstein, 2012



Dušný s hypotenzí

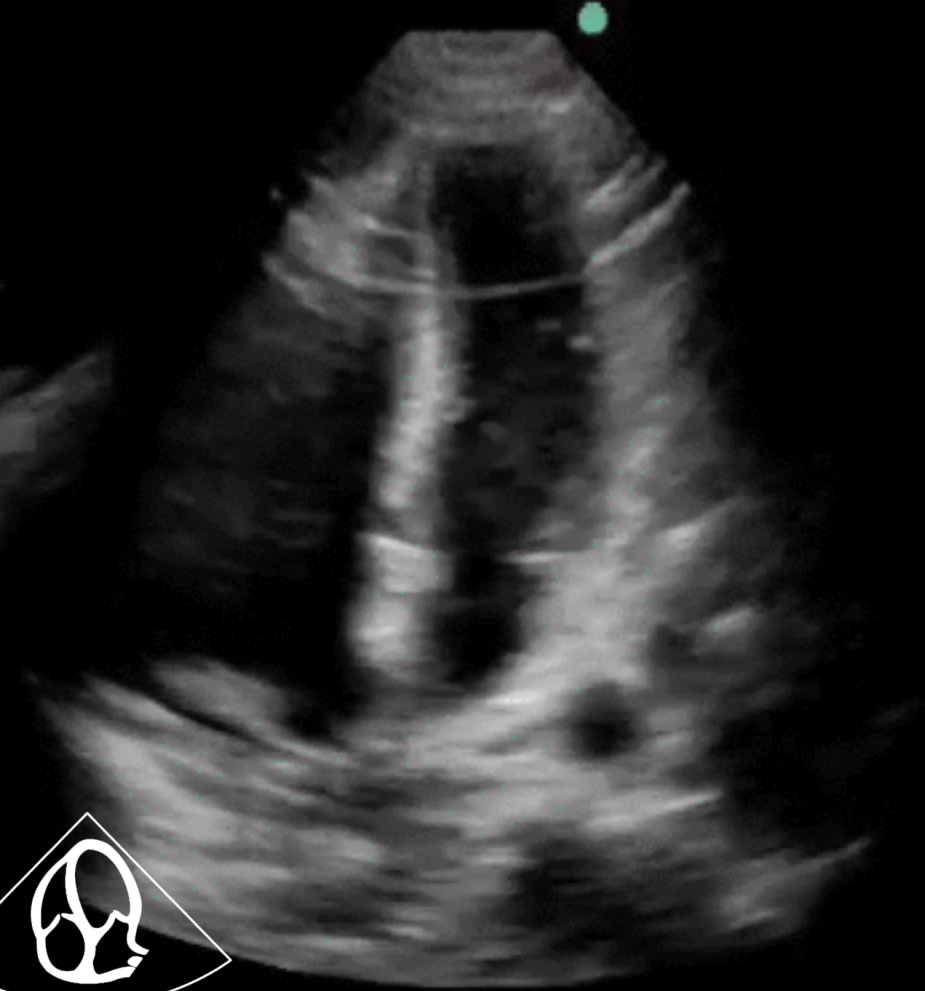
DF 28

SpO2 94

(O2 6l/min)

Tk 80/40

TF 120



Velikost a kontraktilita komor ?



Odhad CVP u spontánně ventilujících



VCI velikost (cm)	Kolaps VCI v inspiriu (%)	Odhad CVP (mmHg)
<1.5 cm	> 50%	0-5 mmHg
1,5-2,5 cm	> 50%	5-10 mmHg
1,5-2,5 cm	< 50%	10-15 mmHg
>2.5 cm	< 50%	15-20 mmHg

„přesnost“

43%

Reappraisal of the use of inferior vena cava for estimating right atrial pressure

J Matthew Brennan



ACS po PCI

UPV DF 14

FiO₂ 40%/PEEP 8

SpO₂ 96

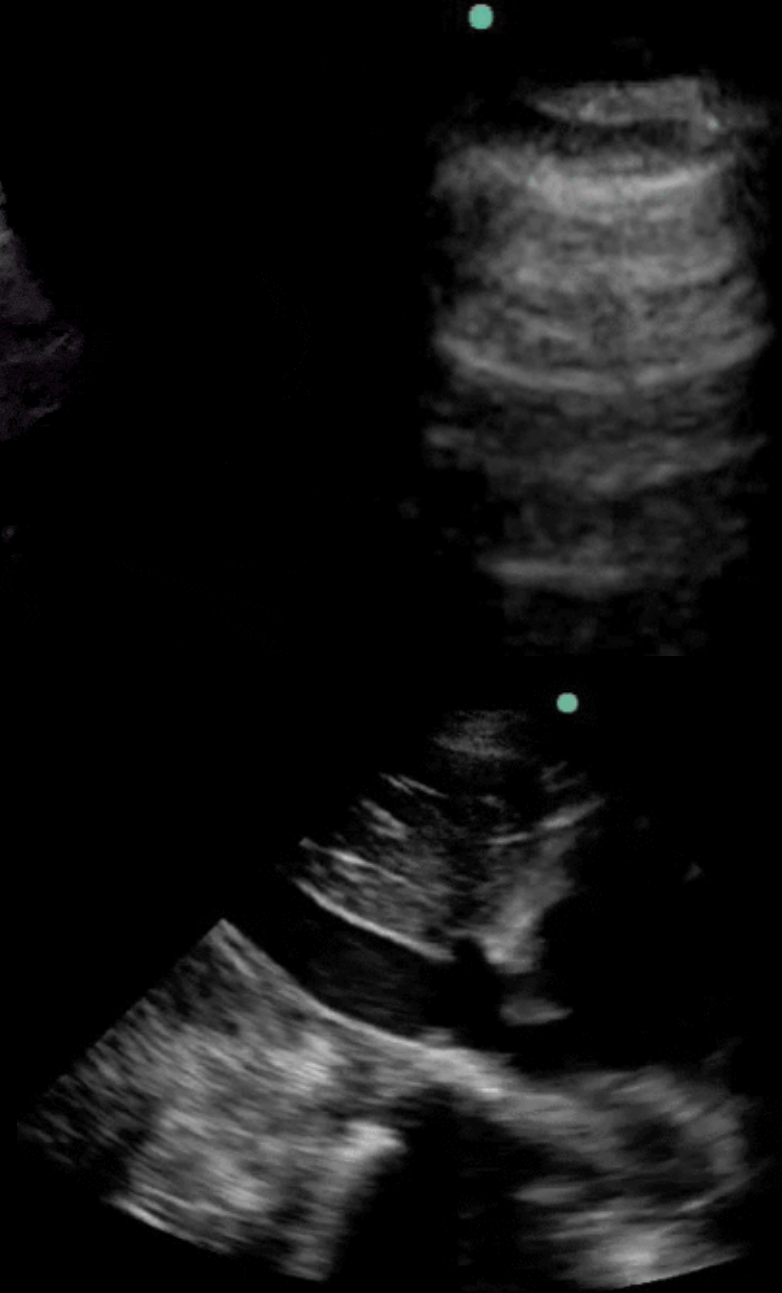
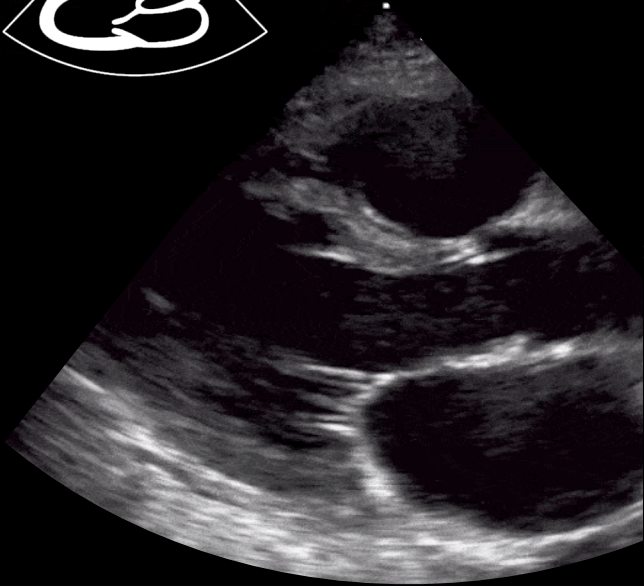
Tk 90/60


TF 90

NA 4mg/20 ml na
14 ml/hod

Laktát 4,5

CRP/PCT roste



A close-up photograph of an elderly woman wearing a yellow and brown patterned headscarf and a dark jacket. She has a surprised or questioning expression on her face. A white speech bubble with a black border is positioned to her right, containing text in Czech. The background is a blurred indoor setting.

KARDIOGENNÍ ŠOK
ŘIKÁTE ?
A NEMÁ VON TAKY
SEPSI ?

Co na to intenzivisté...?

Kardiogenní šok - stav nízkého srdečního výdeje se známkami tkáňové hypoperfúze při dostatečné intravaskulární náplni

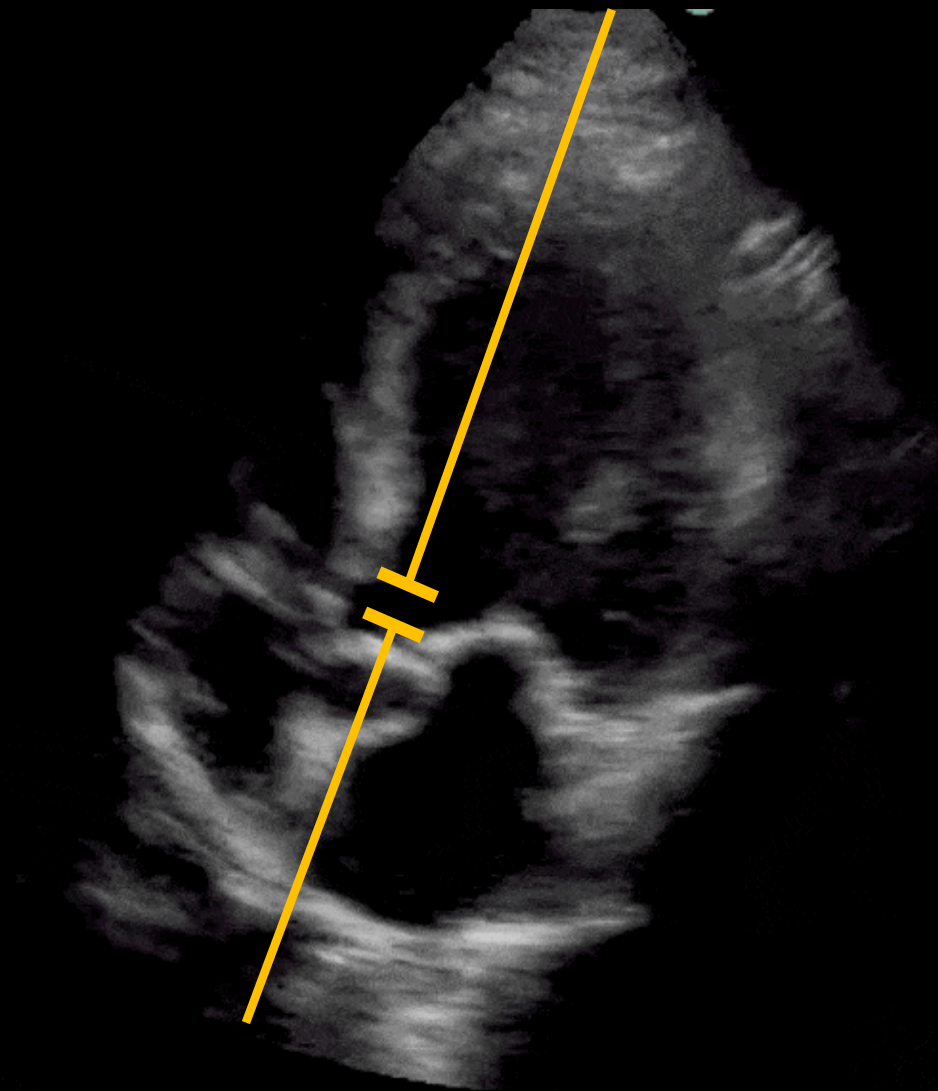
- low cardiac index ($< 2.2 \text{ L/min/m}^2$)
- elevated filling pressures LV (pulmonary capillary wedge pressure [PCWP] $>15 \text{ mmHg}$)
- right (central venous pressure [CVP] $>10 \text{ mmHg}$)
- decreased mixed venous oxygen saturation

Stroke Volume SV

Spektrální
doplerometrie

PW do LVOT

paralelně s proudem



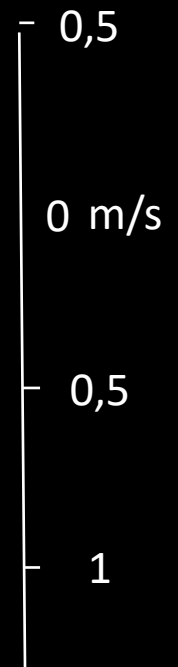
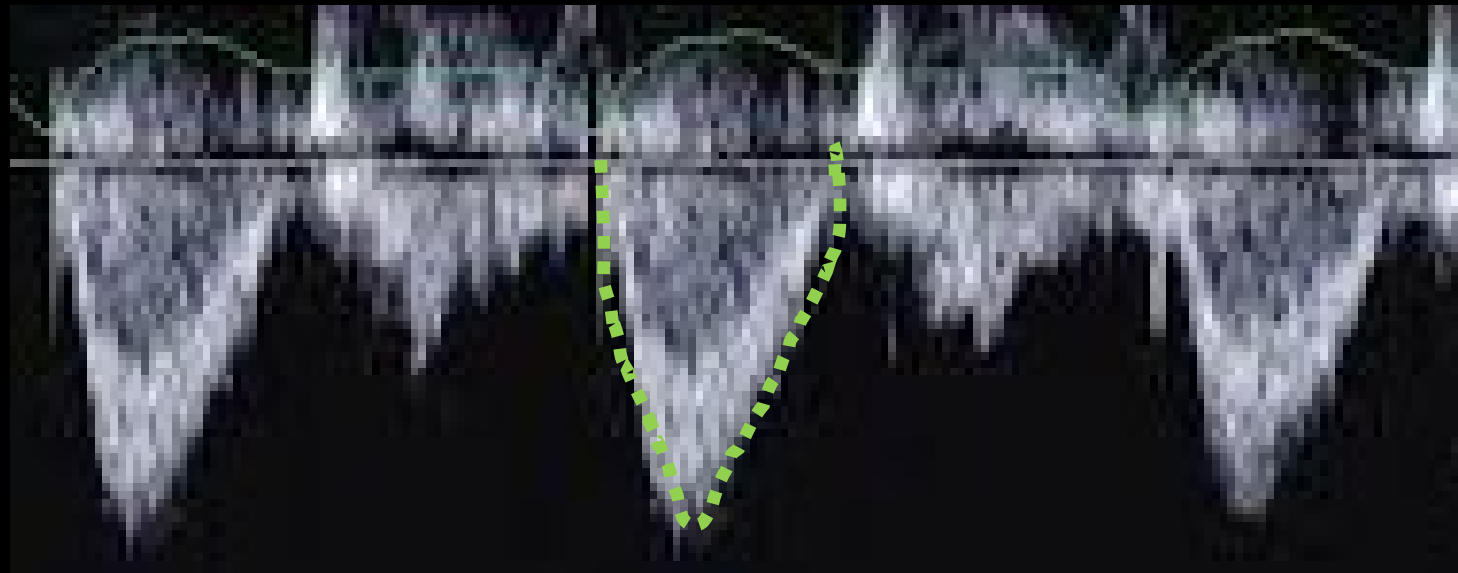
PWD AV VTI

VTI 13,2 cm

Vmax 72,6 cm/s

PG 2,11 mmHg

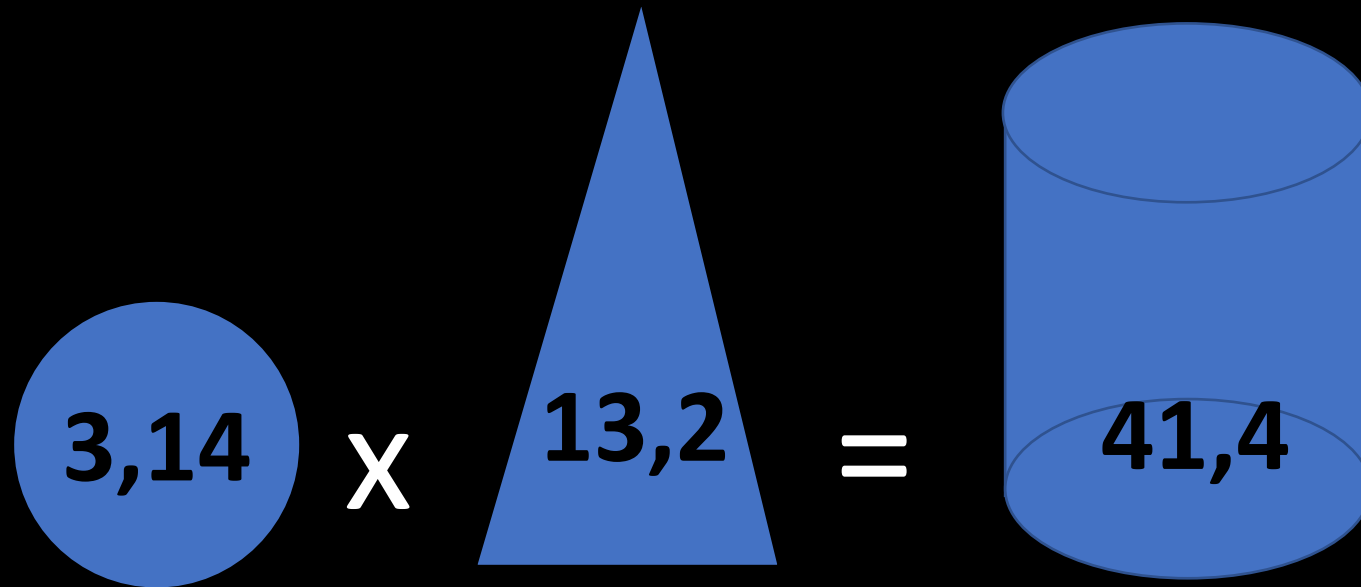
VTI 13,2 cm



ECHO kalkulace tepového objemu SV

$$\text{LVOT CSA} \times \text{LVOT VTI} = \text{SV}$$

$$\text{SV} = 41,4 \text{ ml}$$



Correlates with measures of cardiac output obtained by thermodilution ($r=0.95$) with a tendency to underestimate it by about 0.24 l/min.

Srdeční výdej je jen jeden parametr...

$$CO = SV \times HR$$

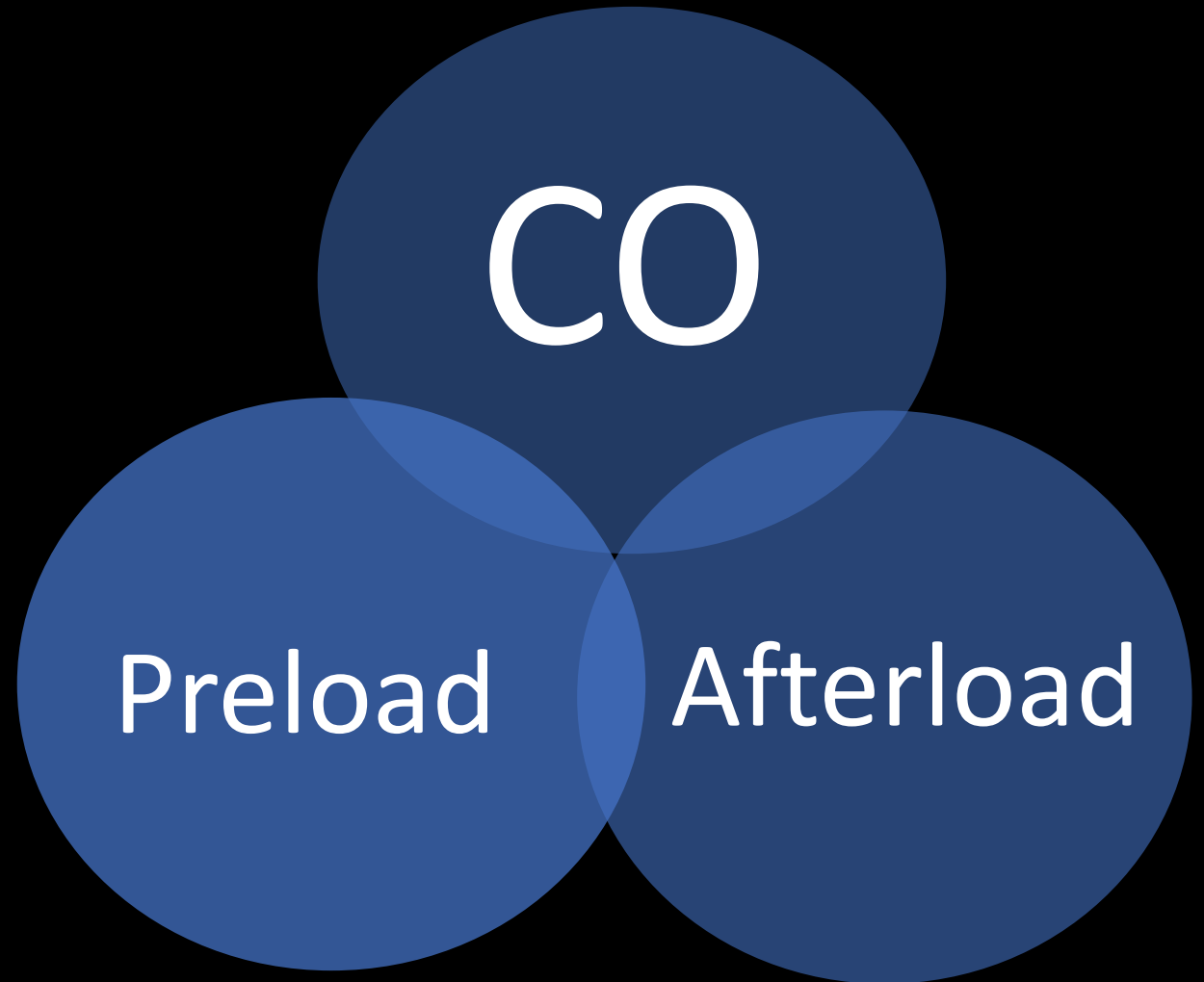
$$CO = 42 \times 90$$

$$CO = 3,7 \text{ l/min}$$

$$BSA = 3958$$

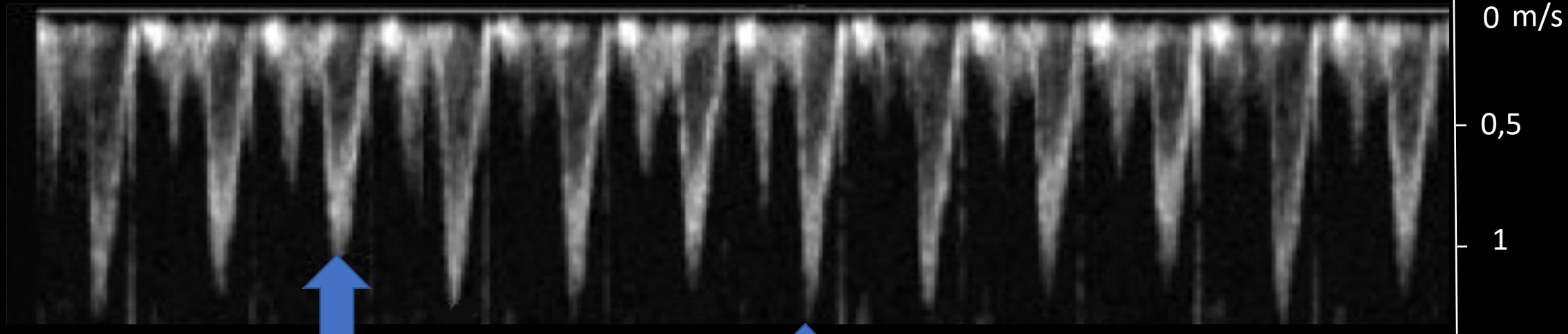
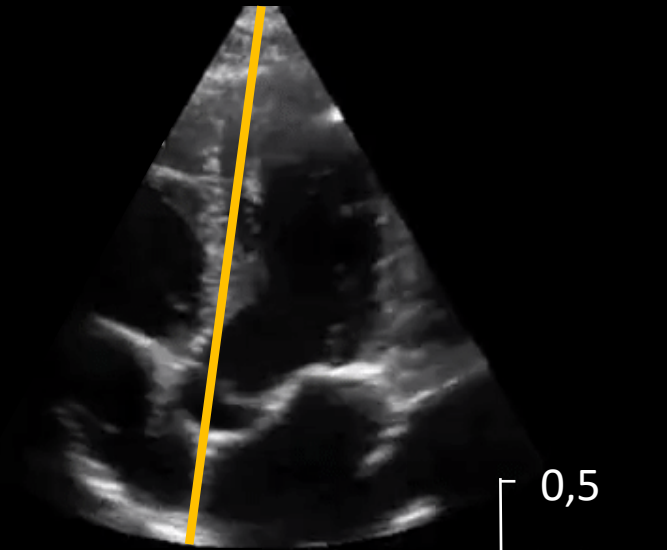
$$CO/BSA = CI$$

$$1,67 \text{ l/min/m}^2$$



Variace VTI LVOT nad 12% predikuje pozitivní odpověď na tekutiny

Na UPV, TV 8 ml/kg



Variace tepového objemu

Kardiogenní šok ?

$$CO = SV \times HR$$

$$CO = 42 \times 90$$

$$CO = 3,7 \text{ l/min}$$

$$BSA = 3958$$

$$CO/BSA = CI$$

$$1,67 \text{ l/min/m}^2$$

- low cardiac index ($< 2.2 \text{ L/min/m}^2$)
- elevated filling pressures LV (pulmonary capillary wedge pressure [PCWP] $> 15 \text{ mmHg}$)
- right (central venous pressure [CVP] $> 10 \text{ mmHg}$)
- decreased mixed venous oxygen saturation

Kardiogenní šok ?

- $E/e' > 14$ – vysoké plnicí tlaky LK (PCWP)

E/e' je relativně nezávislé na volemii

*e' septální < 7 a laterálně < 10
porucha relaxace*

- TR Vmax $> 2,8$ m/s ?

- low cardiac index (< 2.2 L/min/m²)
- elevated filling pressures LV (pulmonary capillary wedge pressure [PCWP] > 15 mmHg)
- right (central venous pressure [CVP] > 10 mmHg)
- decreased mixed venous oxygen saturation

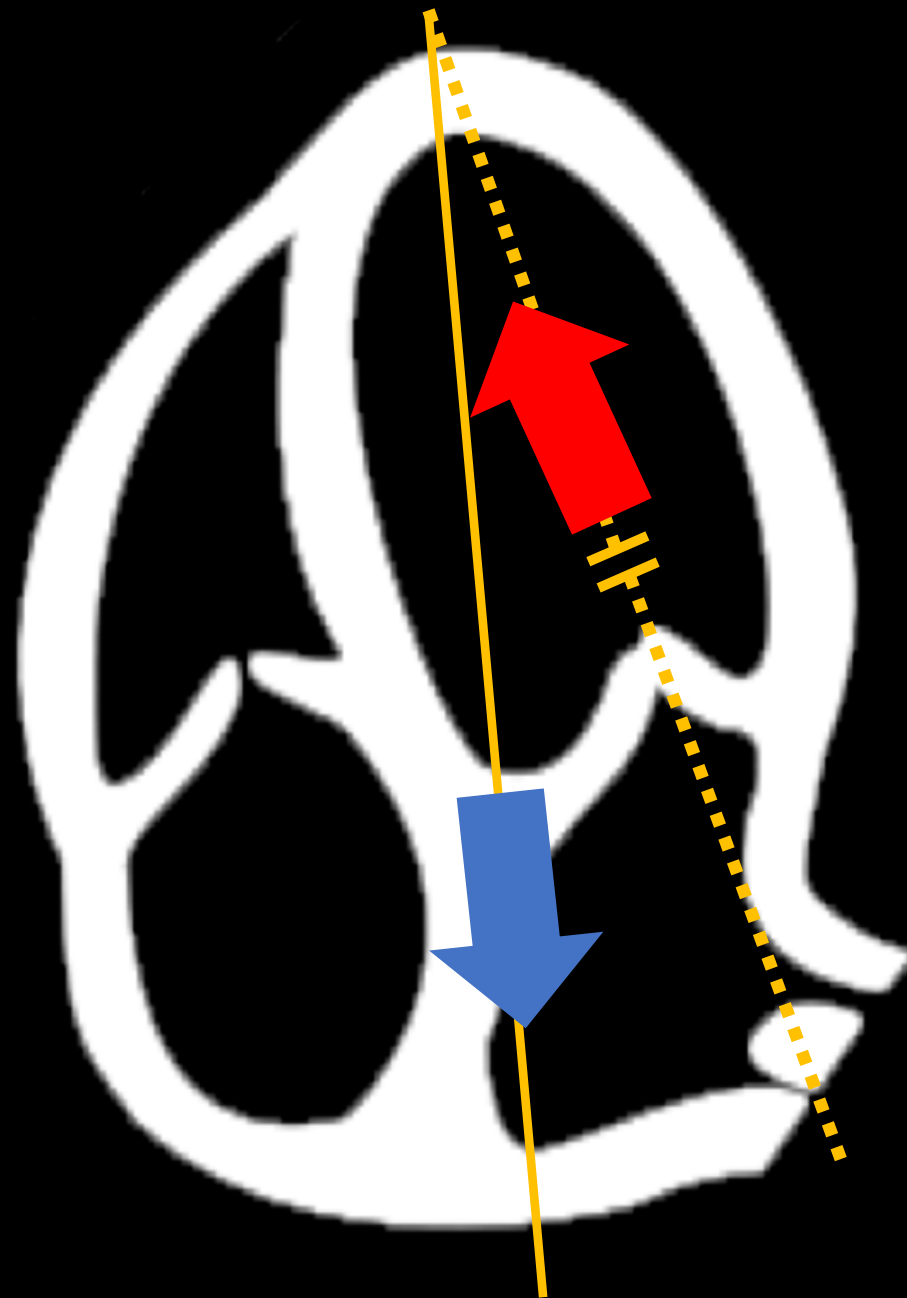
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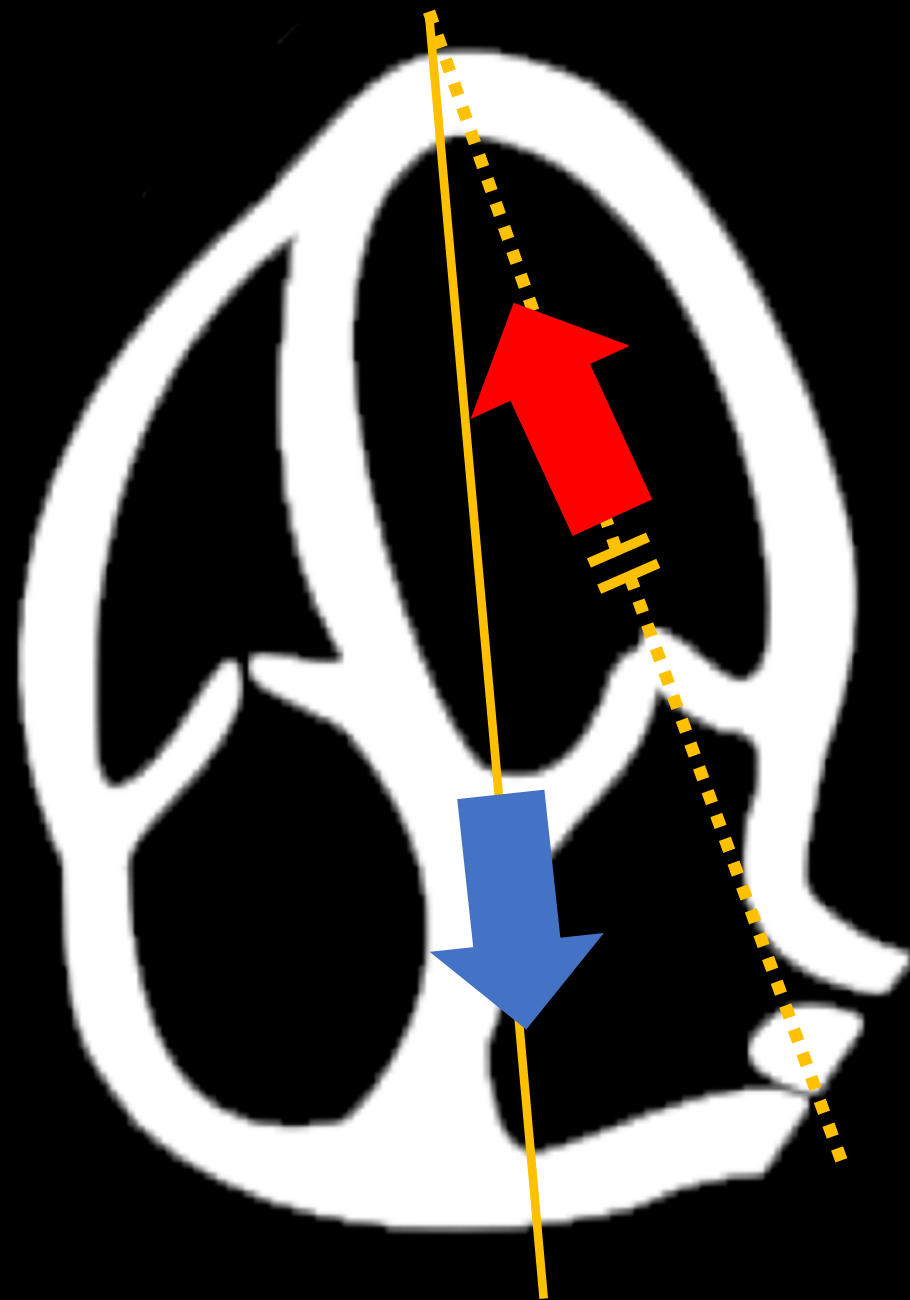
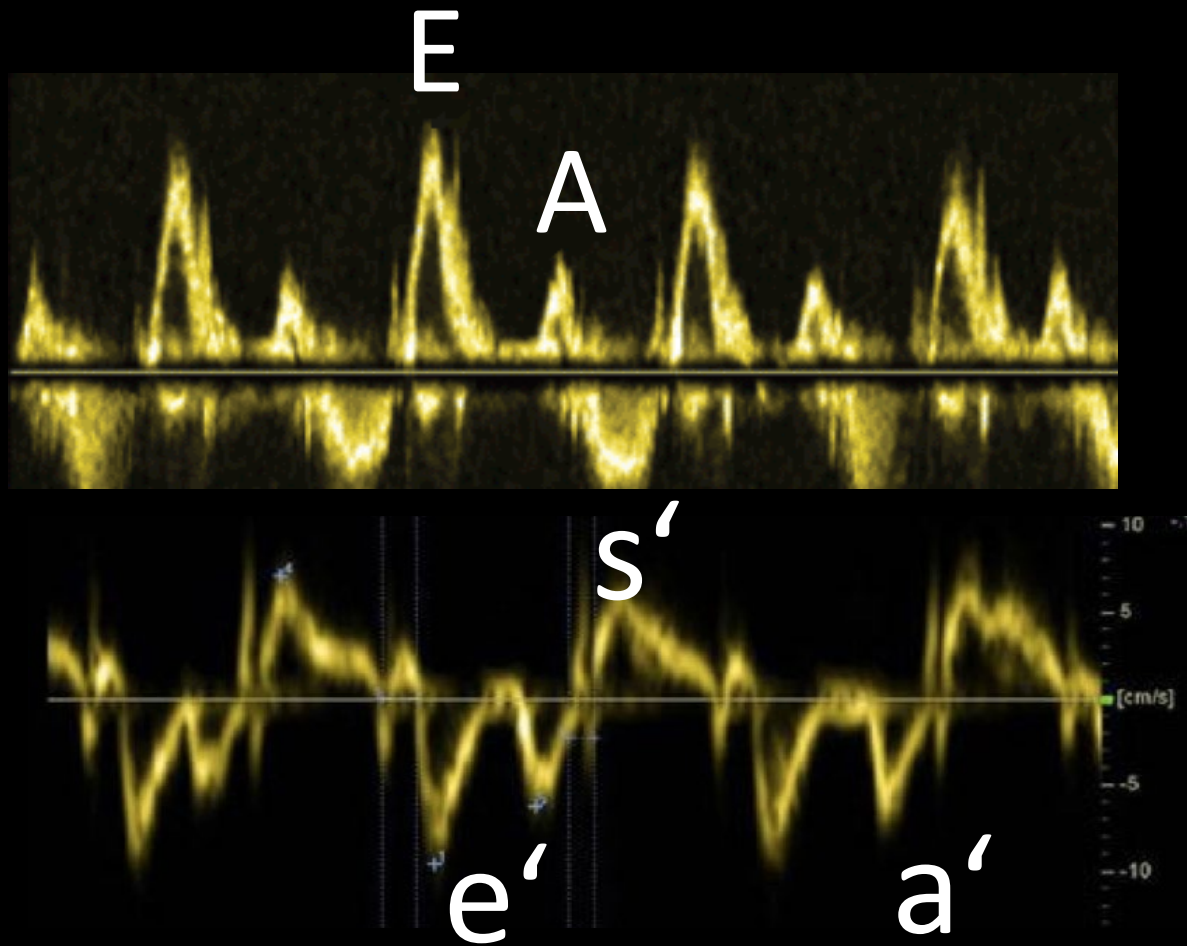
- TR Vmax $> 2,8$ m/s ?



$E/e' > 14(15)$ – vysoké plnící tlaky LK

PCWP > 20 mmHg

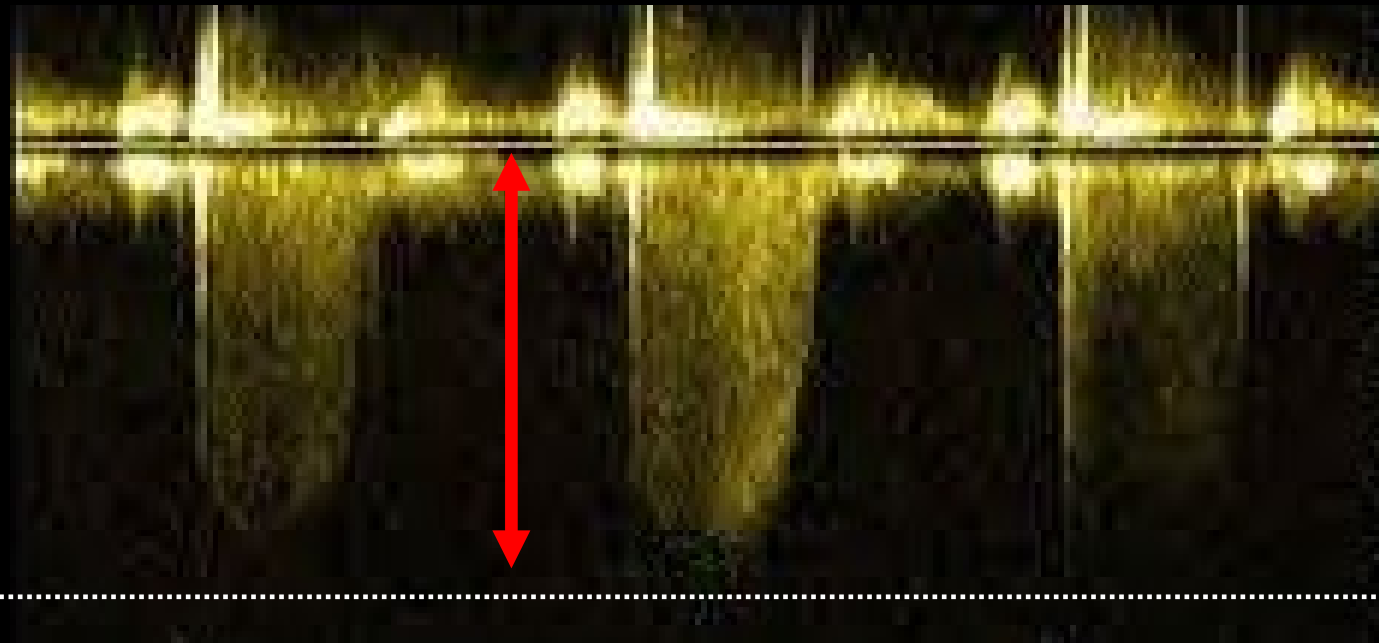
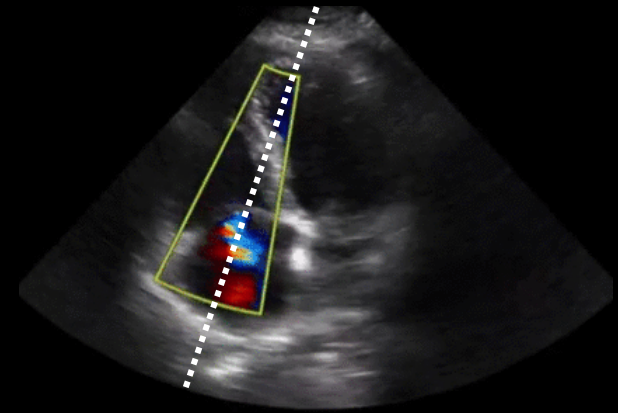
$E/e' < 8$ normální plnící tlaky



TR Vmax

TR Vmax 2,64 m/s

TR Vmax PG 27,93mmHg



m/s

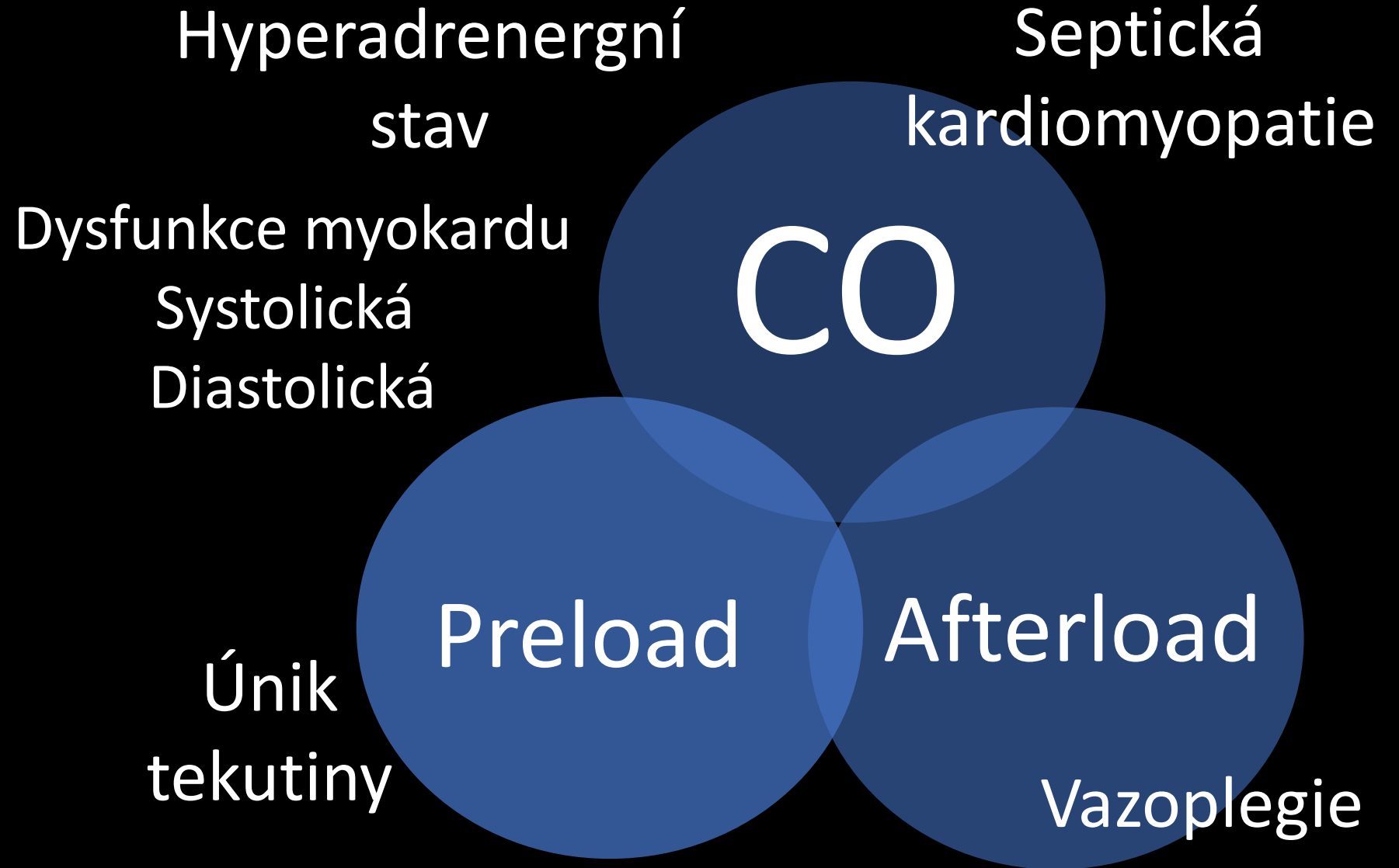
1

2

3

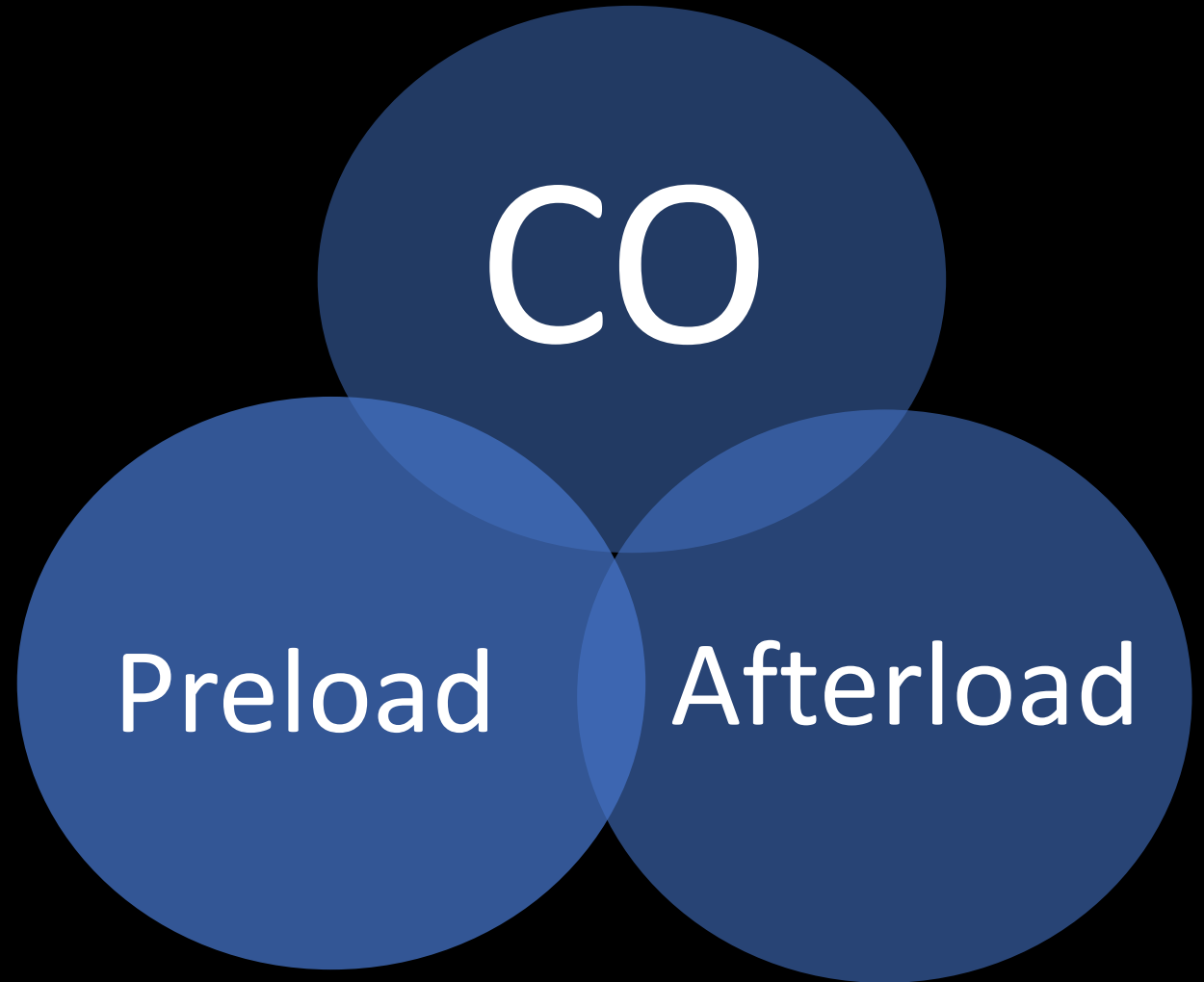
-

Sepse....



Sepse ...

EF
CO
SVV
LAVI
PAP
E/A
E/e'
e'/s'
GLS







POC ECHO alespoň na úrovni
FATE/FEEL/RACE



LUS v rozsahu BLUE protokolu



S ultrazvukem je to lehké 😊
Děkuji za pozornost