Ultrasound Resuscitation

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What is shock ?

- Situation where oxygen transport is inadequate to meet the body's oxygen demand

- Reduced cardiac output, a determinant of oxygen transport

- Clues from the patient's history, physical examination, and key laboratory tests

What is shock ?

- *Hypovolemic shock*
- *Septic shock*
- *Cardiogenic shock*
- *Obstructive shock*
- *Anaphylactic shock*

What is shock ?

- Initially managed with basic resuscitation measures

- Bedside ultrasound should be performed if hemodynamic instability persists or to determine the etiology of shock

Ultrasound

The major ultrasound protocols for medical shock assessment

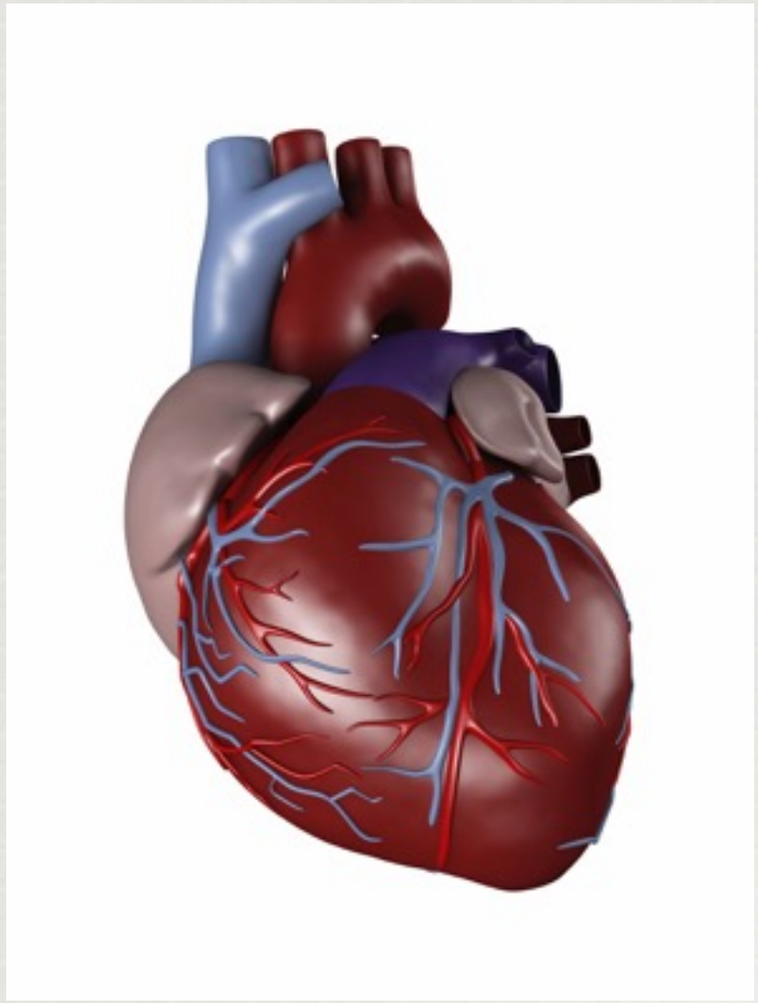
Protocol	FALLS	FATE	FEEL resus	FEER	FREE	POCUS	RUSH-HIMAP	RUSH	Trinity
cardiac	3	1	1	1	1	3	1	1	1
IVC	4					4	2	2	
FAST						1	3	3	
aorta						5	4	7	3
pneumothorax	2					2	5	6	2
pleural eff		2						4	
pul edema	1					6		5	
DVT						7		8	
ectopic preg						8			

Rush Exam

“The Pump”

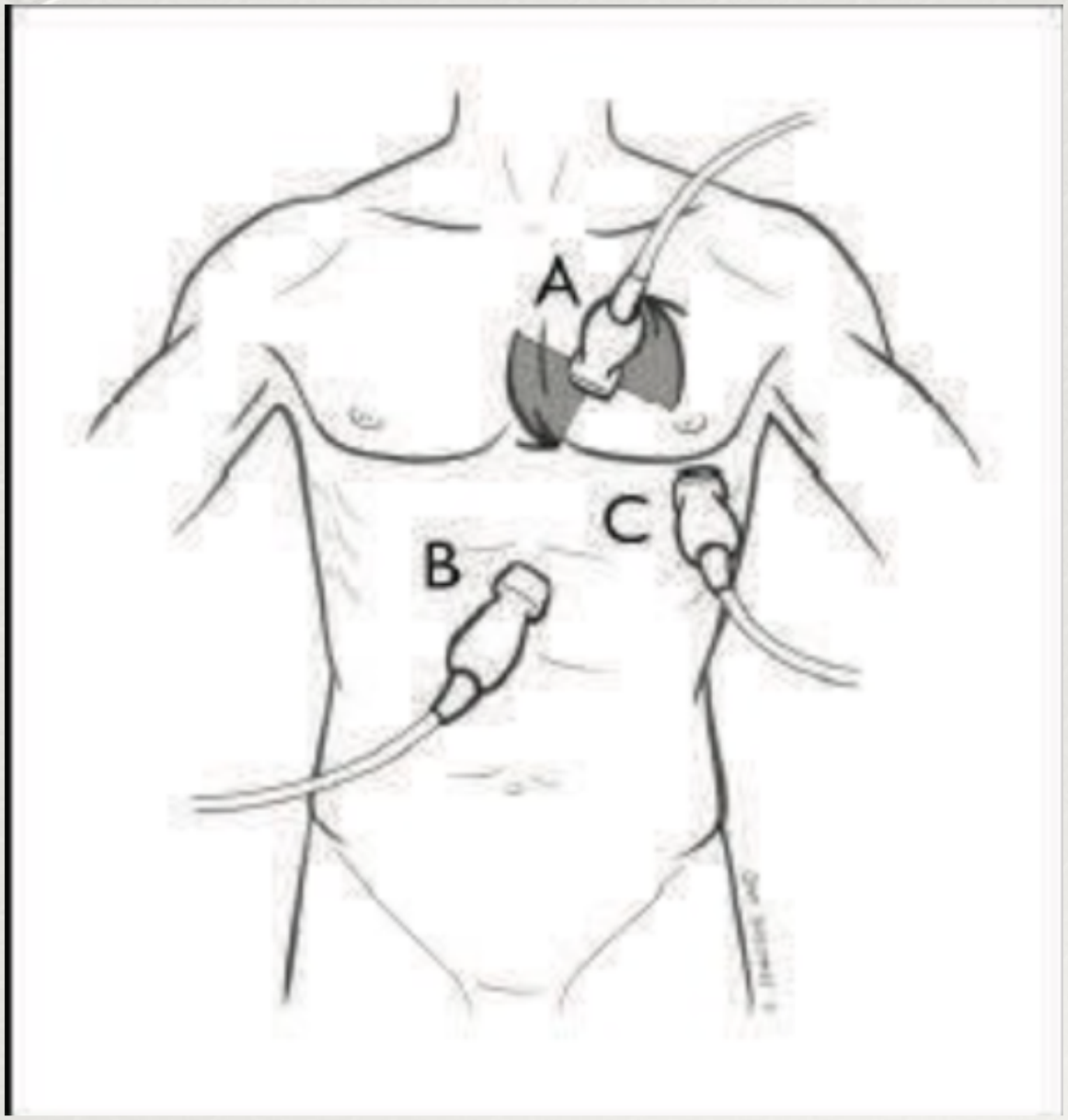
Rush Exam

- *The first step*
- *Goal -directed echocardiogram*
- *Pericardial effusion*
- *LV function*
- *RV dilatation*

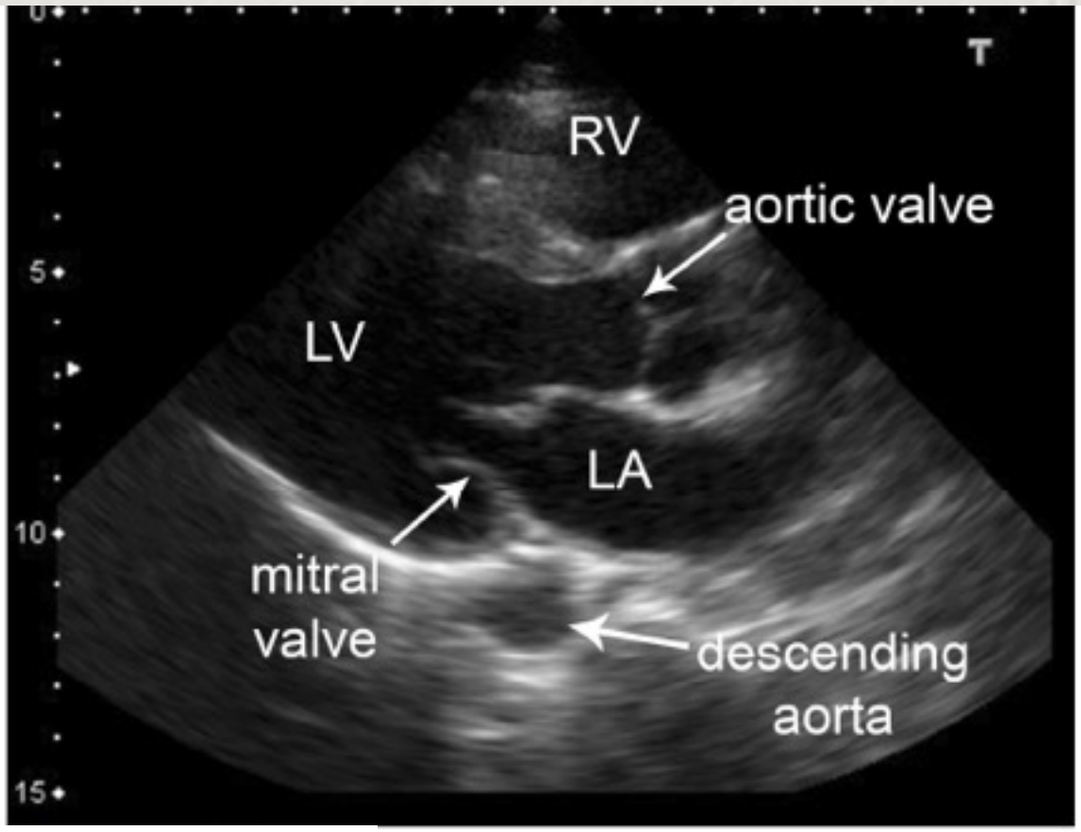


Rush Exam

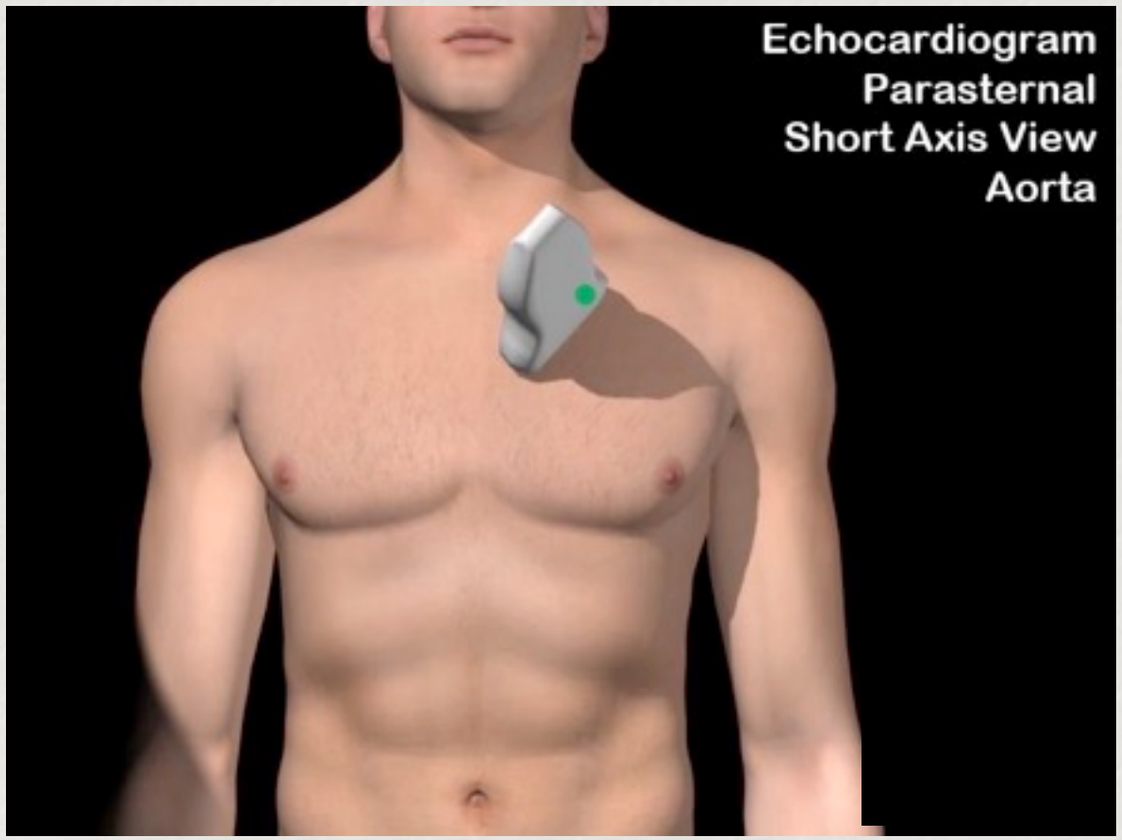
- *Position A*
  - *Parasternal long axis*
  - *Parasternal short axis*
- *Position B*
  - *Subxiphiod*
- *Position C*
  - *Apical view*

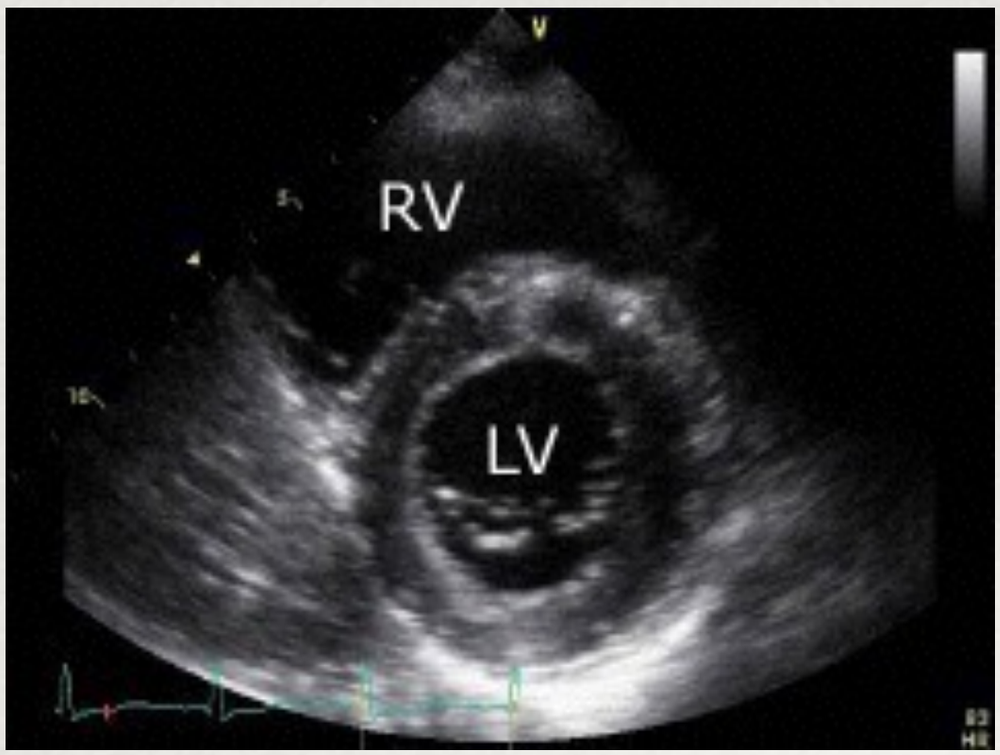


Parasternal long axis



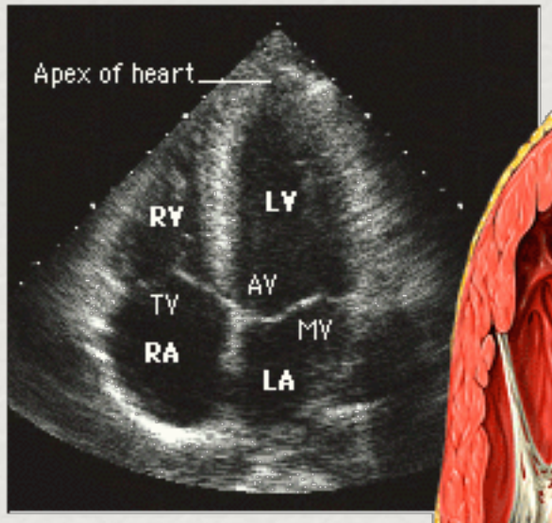
Parasternal short axis





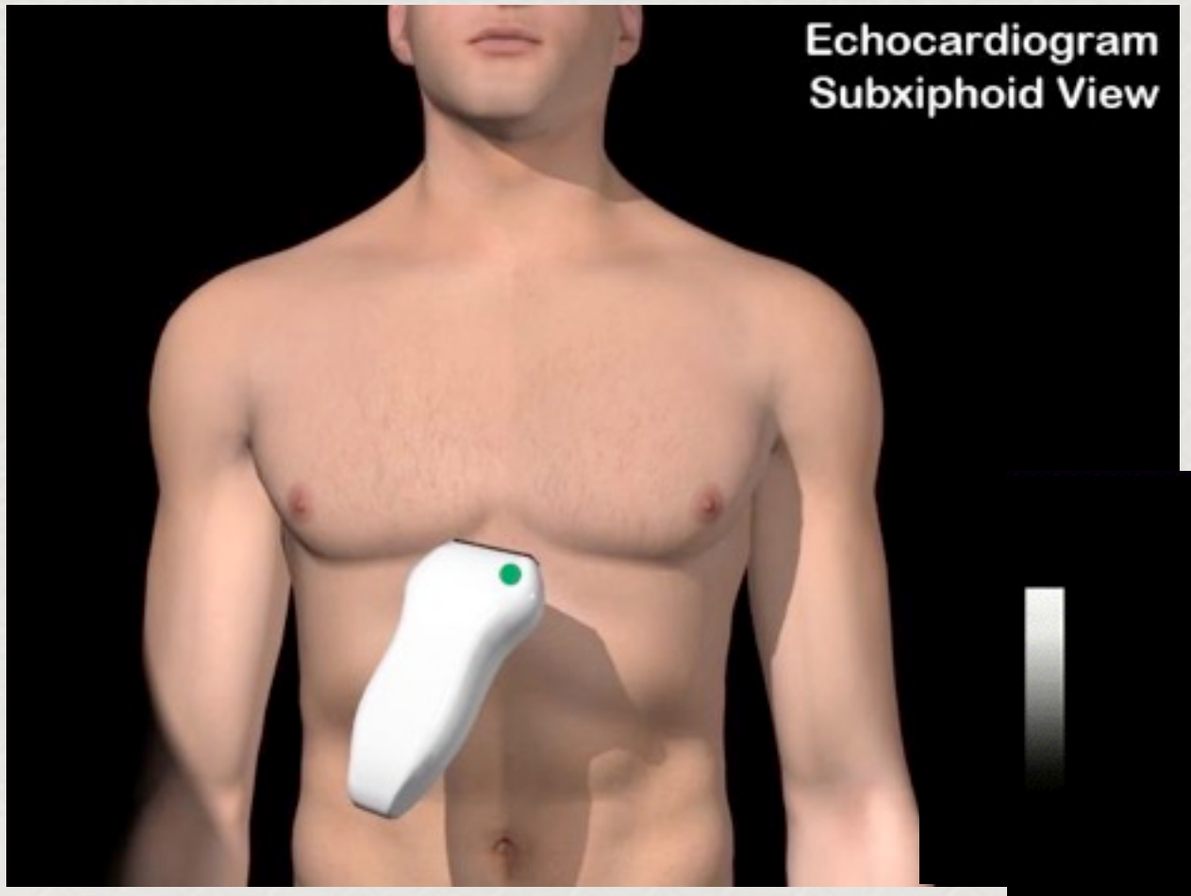
Apical view

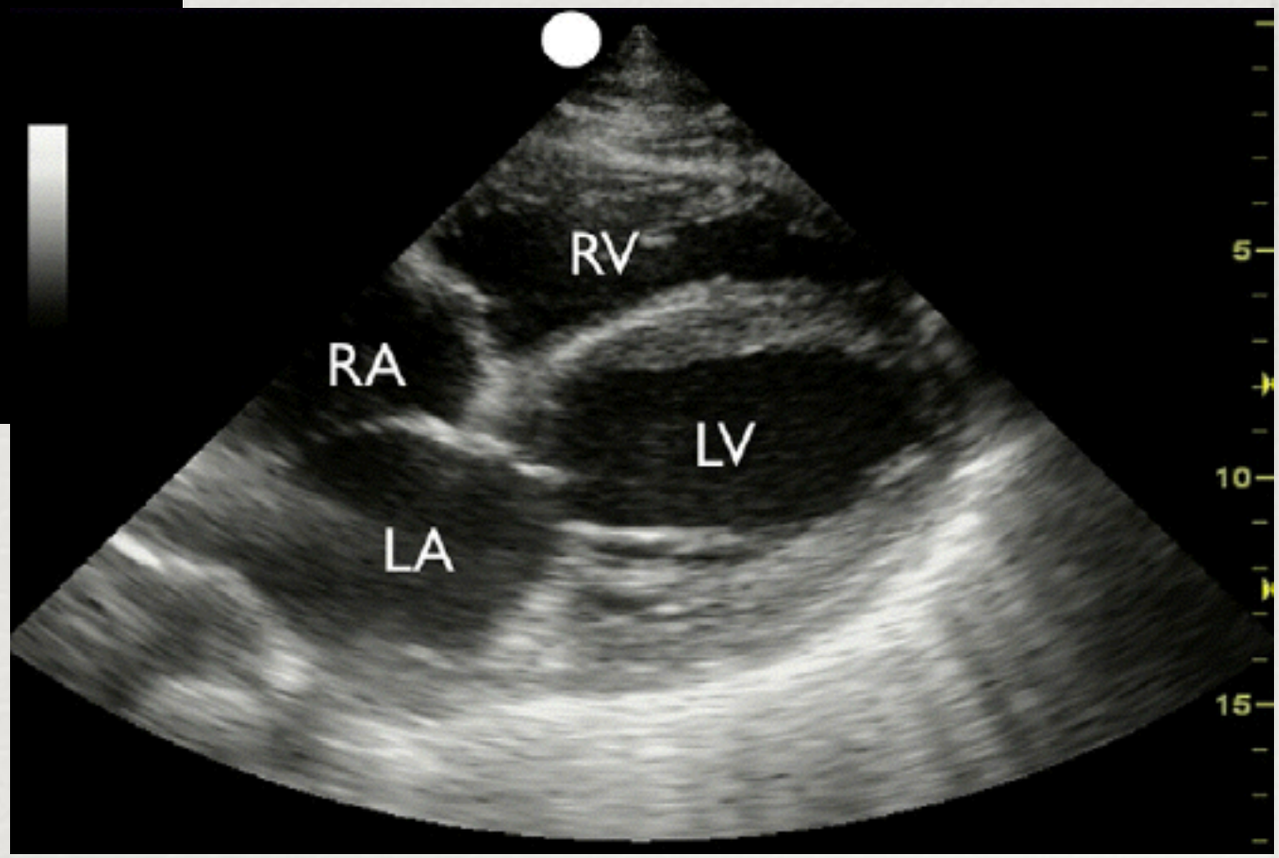

Echocardiogram
Apical View


Apex of heart
RV
LV
AV
TV
MV
RA
LA

Septum
Apex of heart
Papillary muscles
Tricuspid valve
Aortic valve
Mitral valve
Right atrium
Interatrial septum
Left atrium

Subxiphoid view





Pericardial effusion

- First, the pericardial sac should be visualized
- May be confused with a pleural effusion
- The next step is to evaluate the heart for signs of tamponade
- Focuses on the movement of the right atrium and ventricle during
  diastolic filling

Pericardial effusion

Intrapericardial p > Intracardiac p

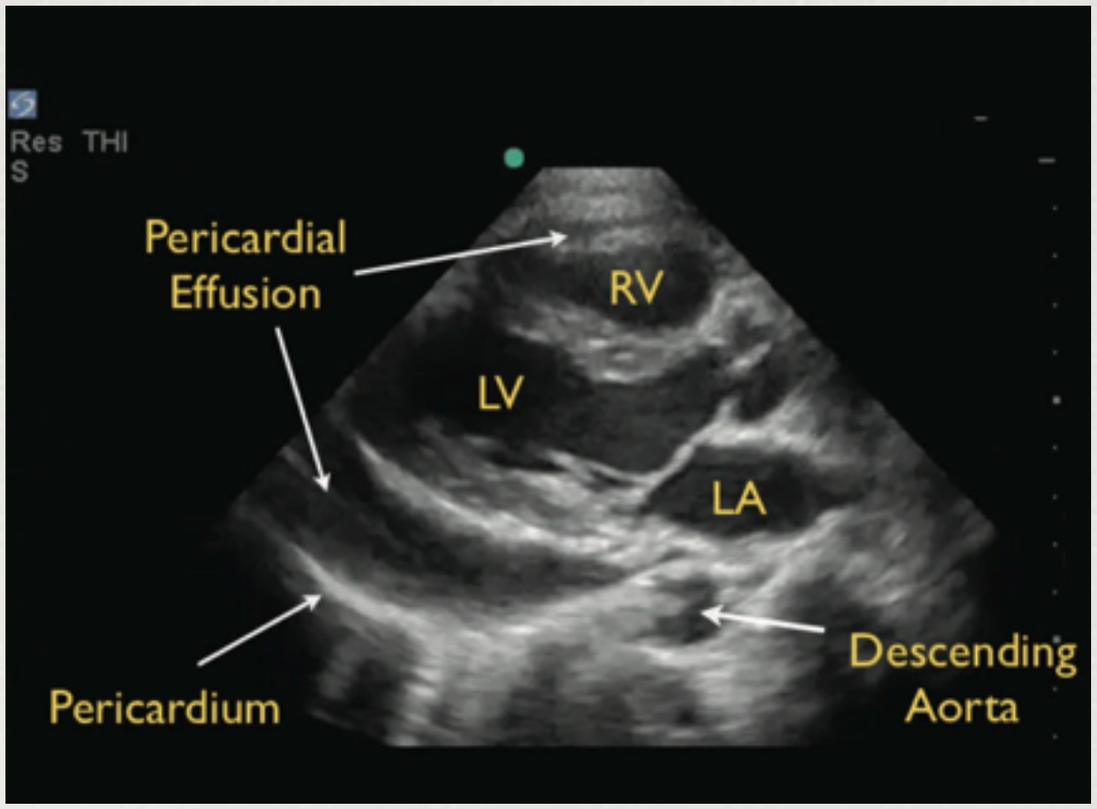
intrapericardial p > RA diastolic p

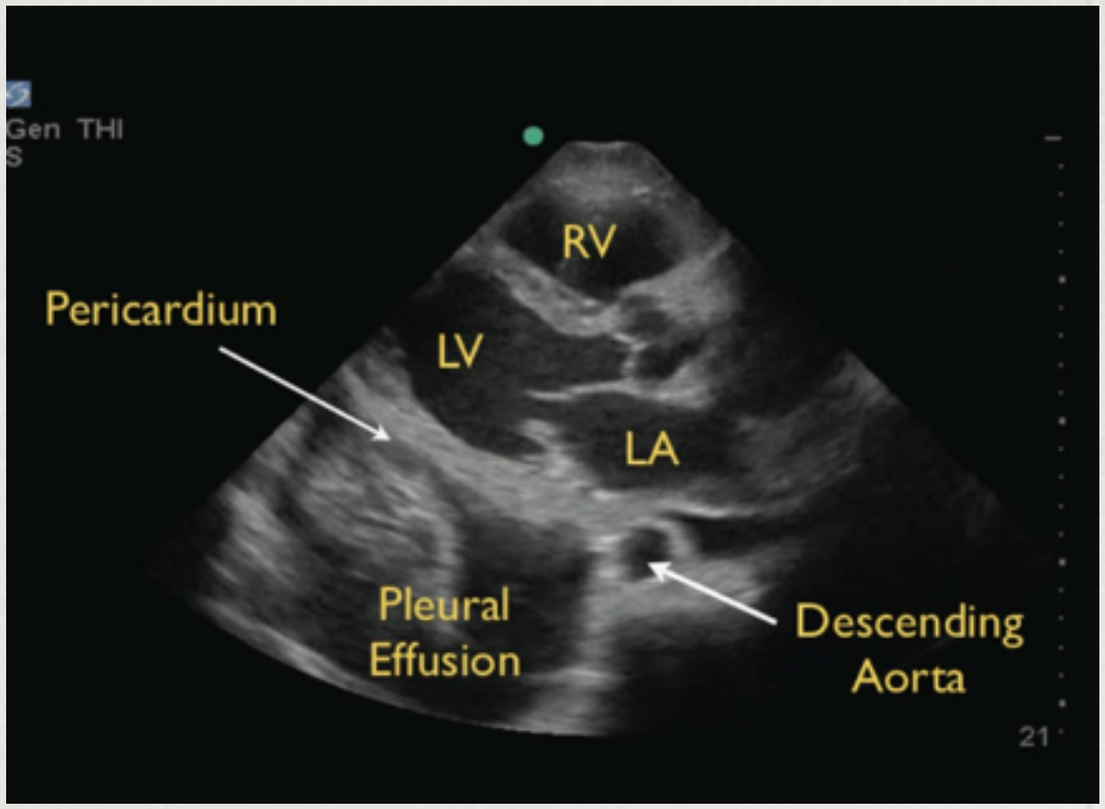
Late diastolic RA inversion

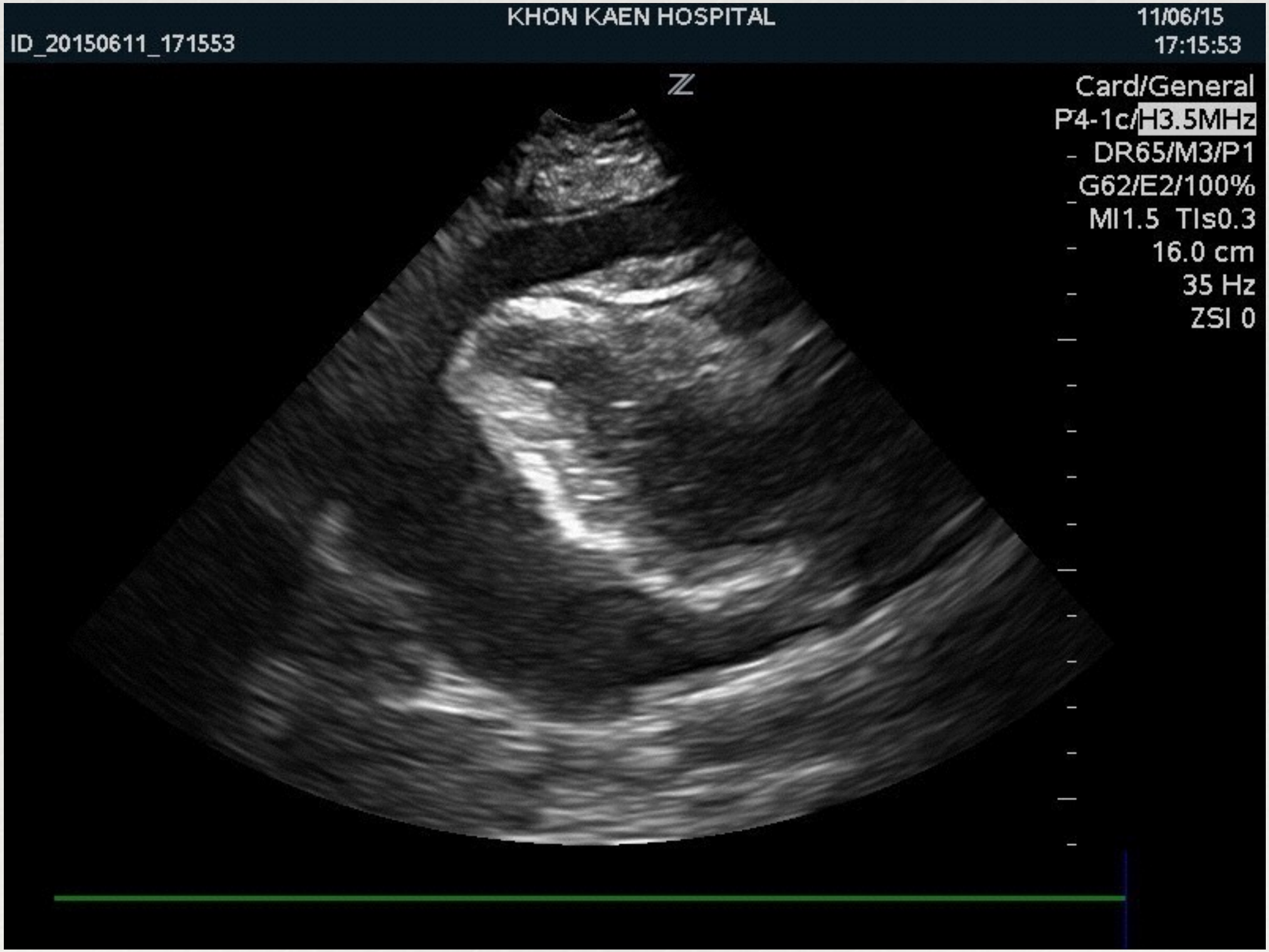
intrapericardial p > RV diastolic p

Early diastolic RV collapse

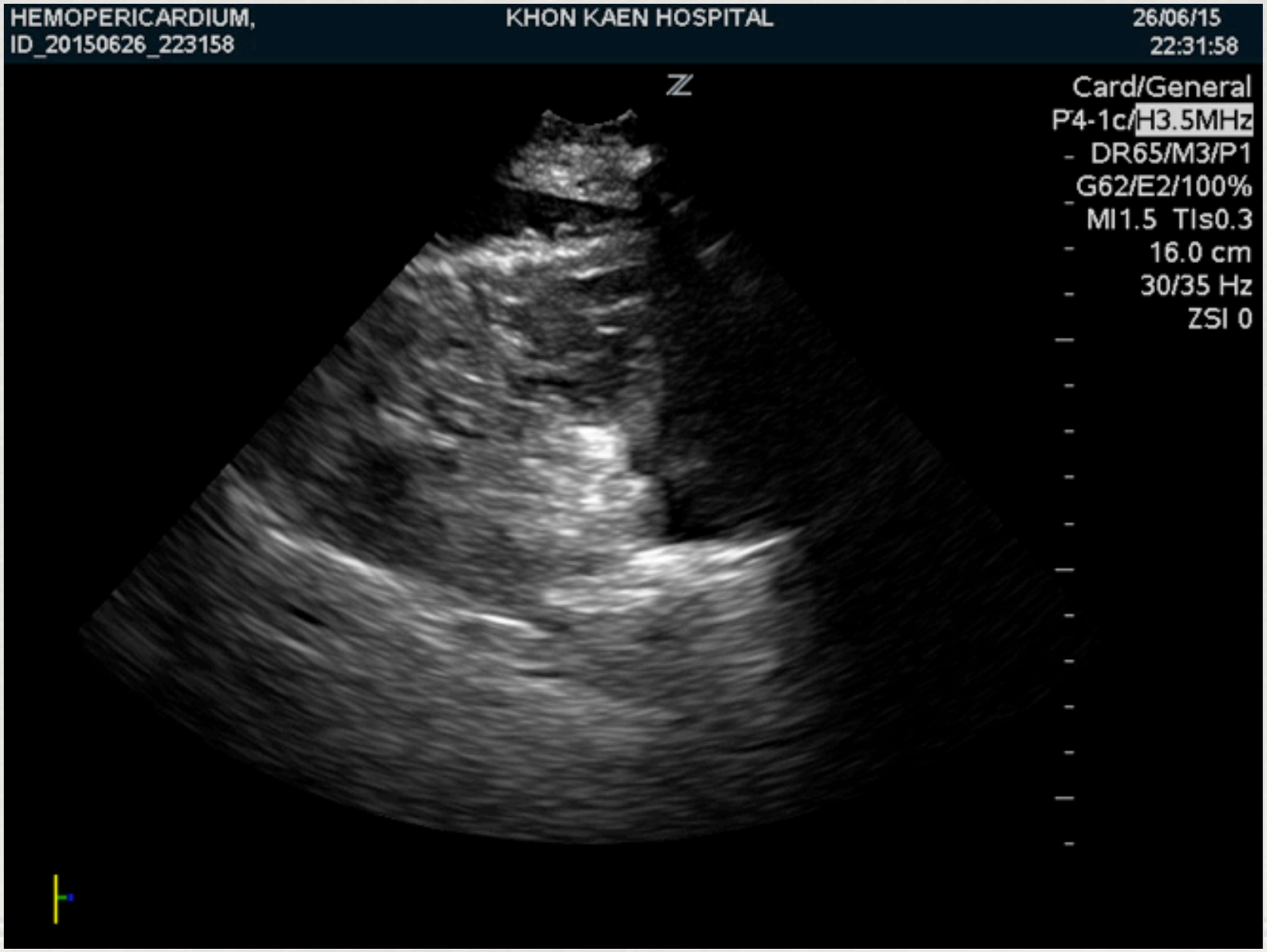
Pericardial effusion






KHON KAEN HOSPITAL
ID_20150611_171553
11/06/15
17:15:53
Card/General
P4-1c/H3.5MHz
DR65/M3/P1
G62/E2/100%
MI1.5 TIs0.3
16.0 cm
35 Hz
ZSI 0

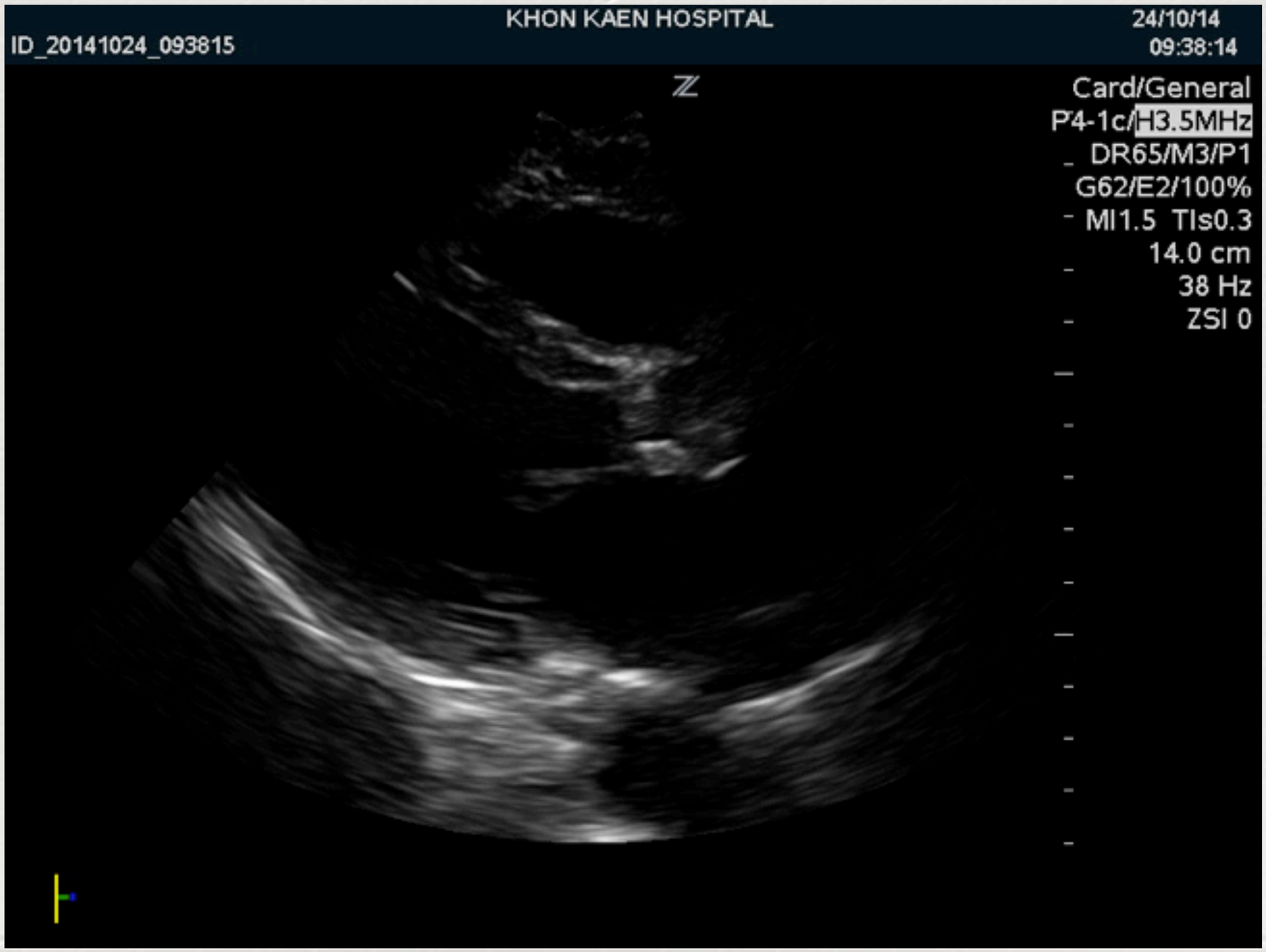
Pericardial effusion

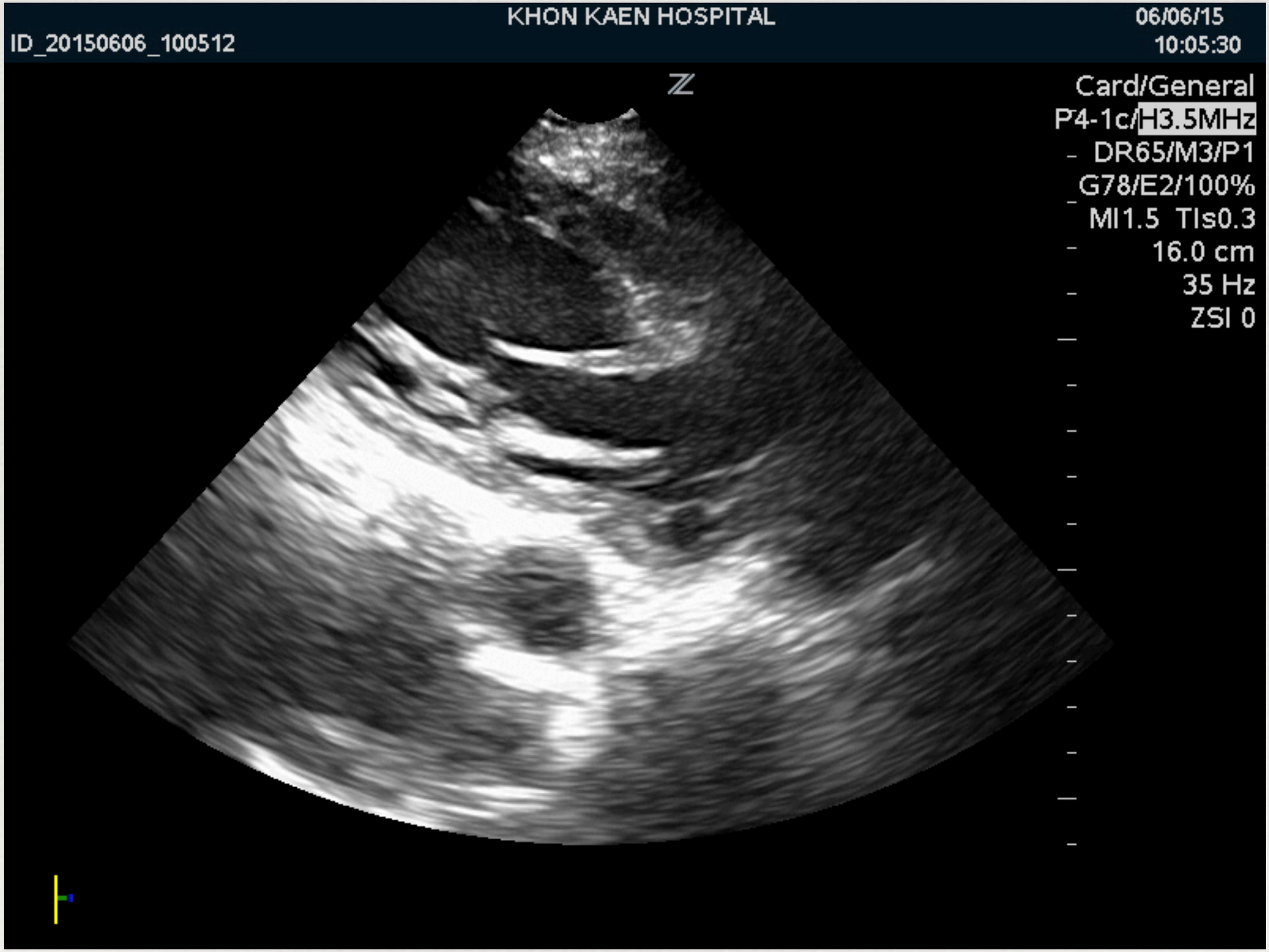


LV contractility

- *Rapid determination of the strength of the pump*
- *Visual estimation of the volume change from diastole to systole*
- *Normal, mild-moderately decreased, or severely decreased and hyperkinetic*
- *The anterior mitral leaflet can be seen in the parasternal long-axis view touching or closely approaching the septal endocardium in early diastole*

LV contractility

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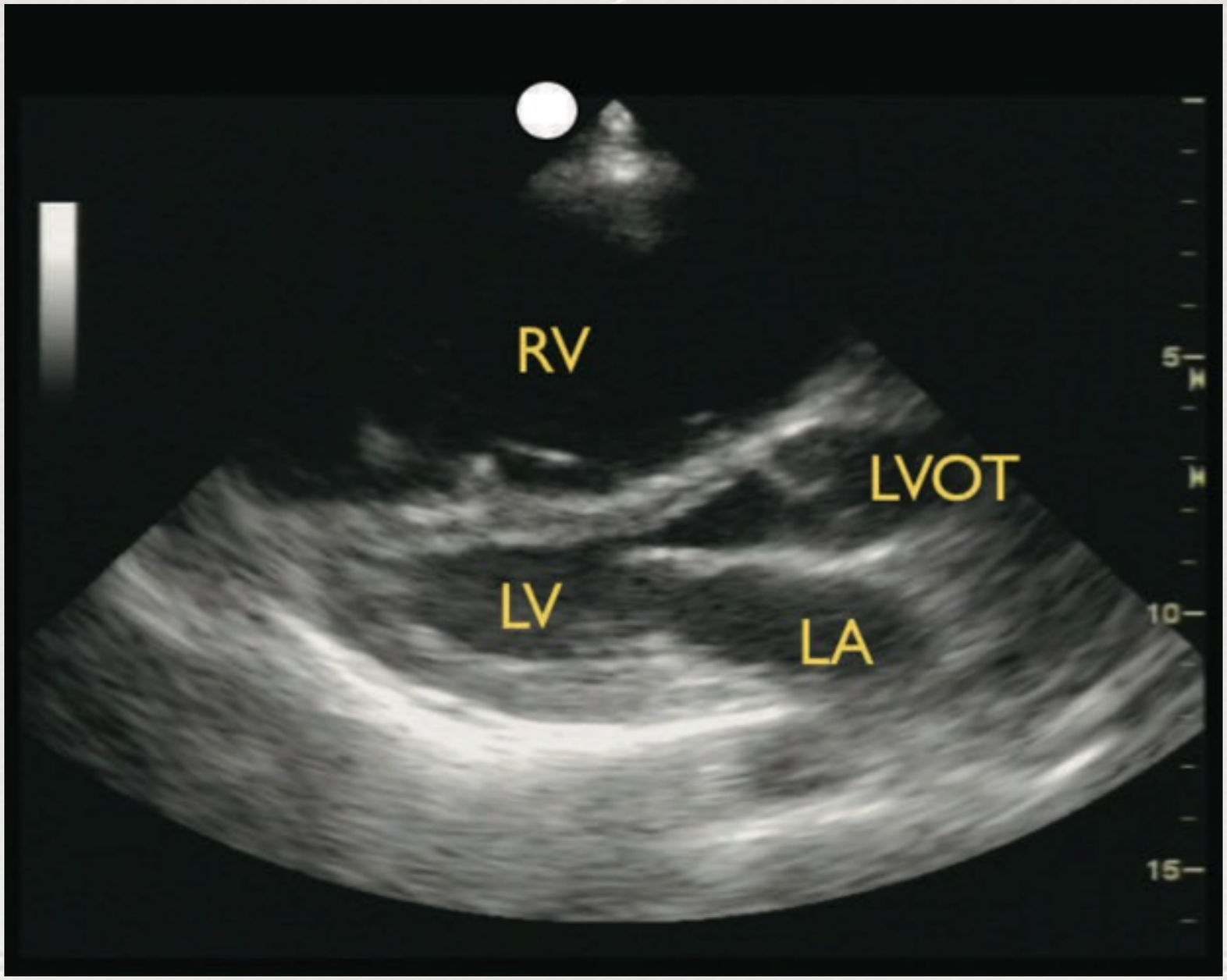
Card/General
P4-1c/H3.5MHz
DR65/M3/P1
G78/E2/100%
MI1.5 TIs0.3
16.0 cm
35 Hz
ZSI 0

Right Ventricular size

- *Left- to-Right ventricle is 1 : 0.6*
- *Dilation of the right ventricle*
- *Inter-ventricular septum toward the left ventricle*
- *Evaluation of the leg veins for a deep vein thrombosis*

Right Ventricular size



Right Ventricular size

“The Tank”

The Tank

- **Position A**

  - IVC

- **Position B**

  - FAST / RUQ/ Pleural

- **Position C**

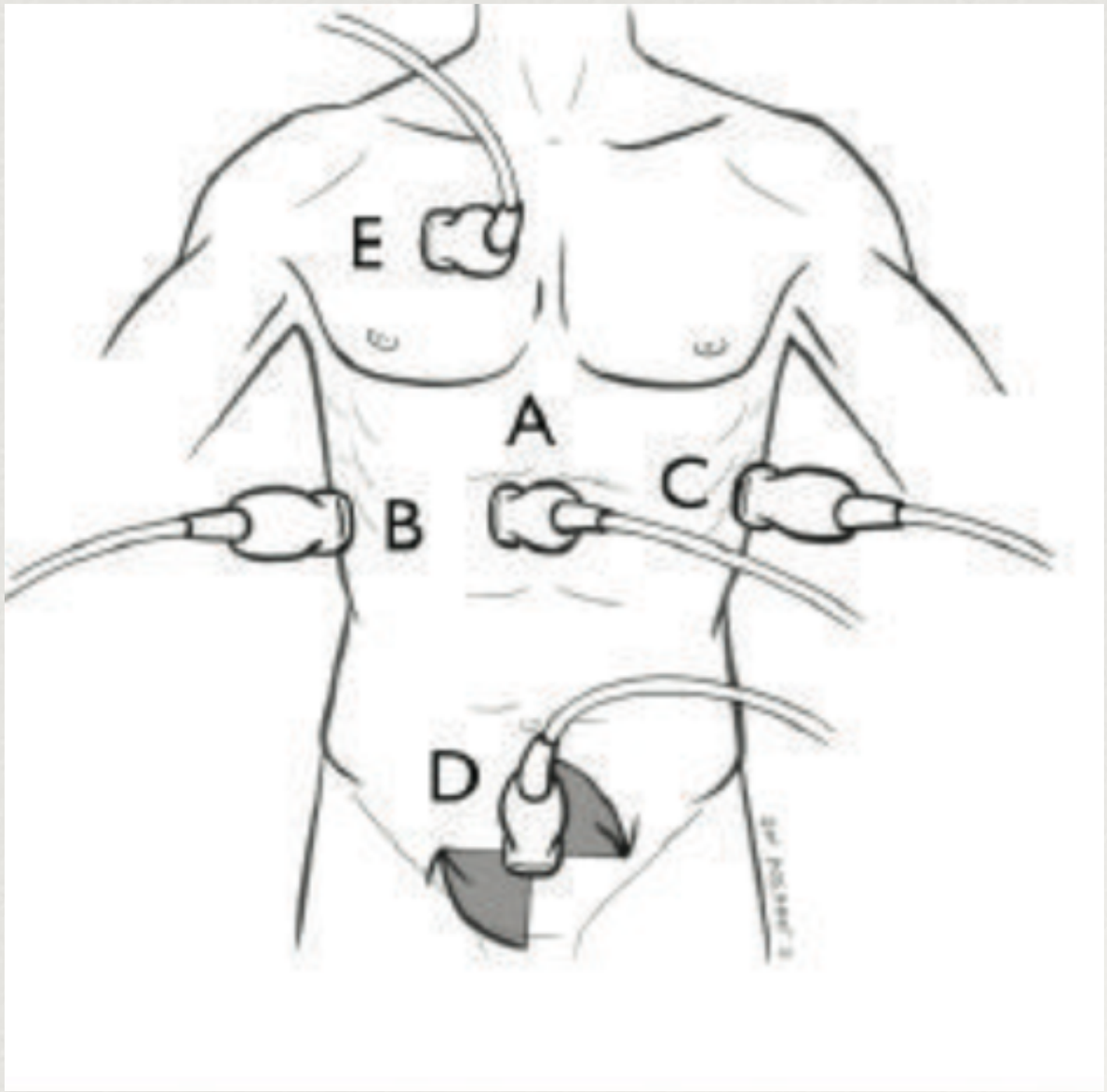
  - FAST/LUQ/Pleural

- **Position D**

  -FAST/Pelvis

- **Position E**

  -Lungs



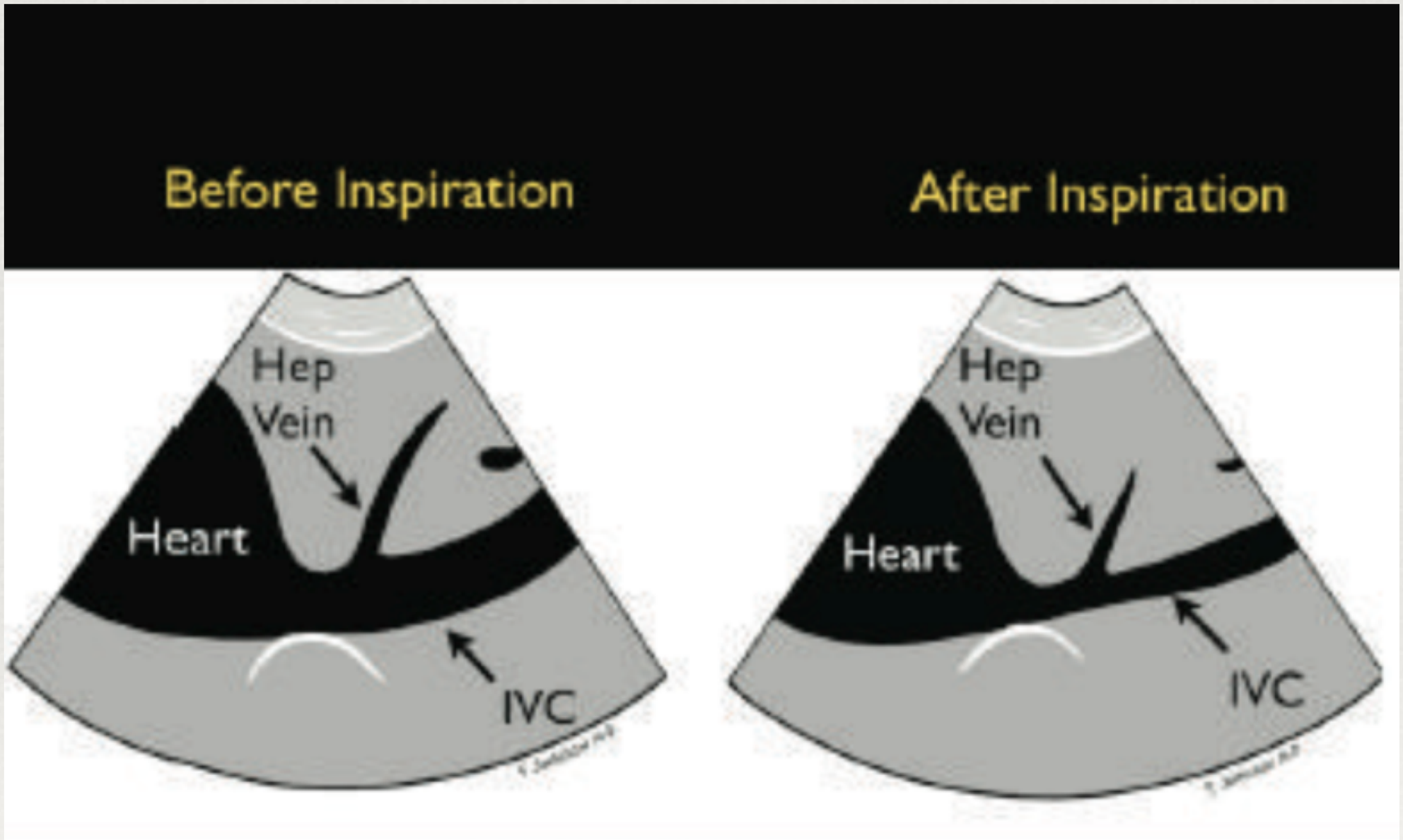
The Tank

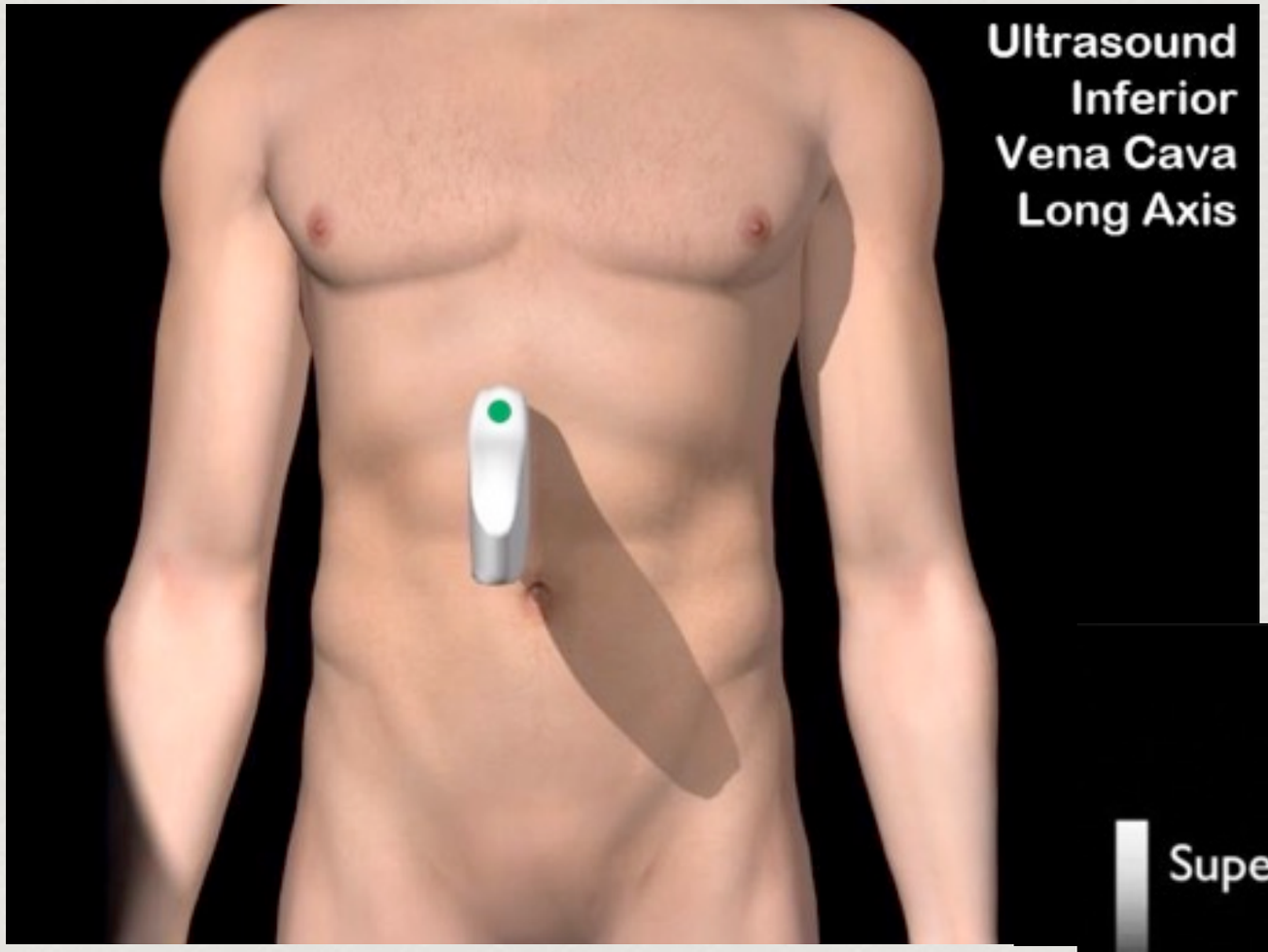
- *Fullness of the tank*
- *Respiratory dynamics of IVC*
- *Estimate the central venous pressure (CVP)*
- *Approximately 2 cm from the junction of the right atrium and the IVC*

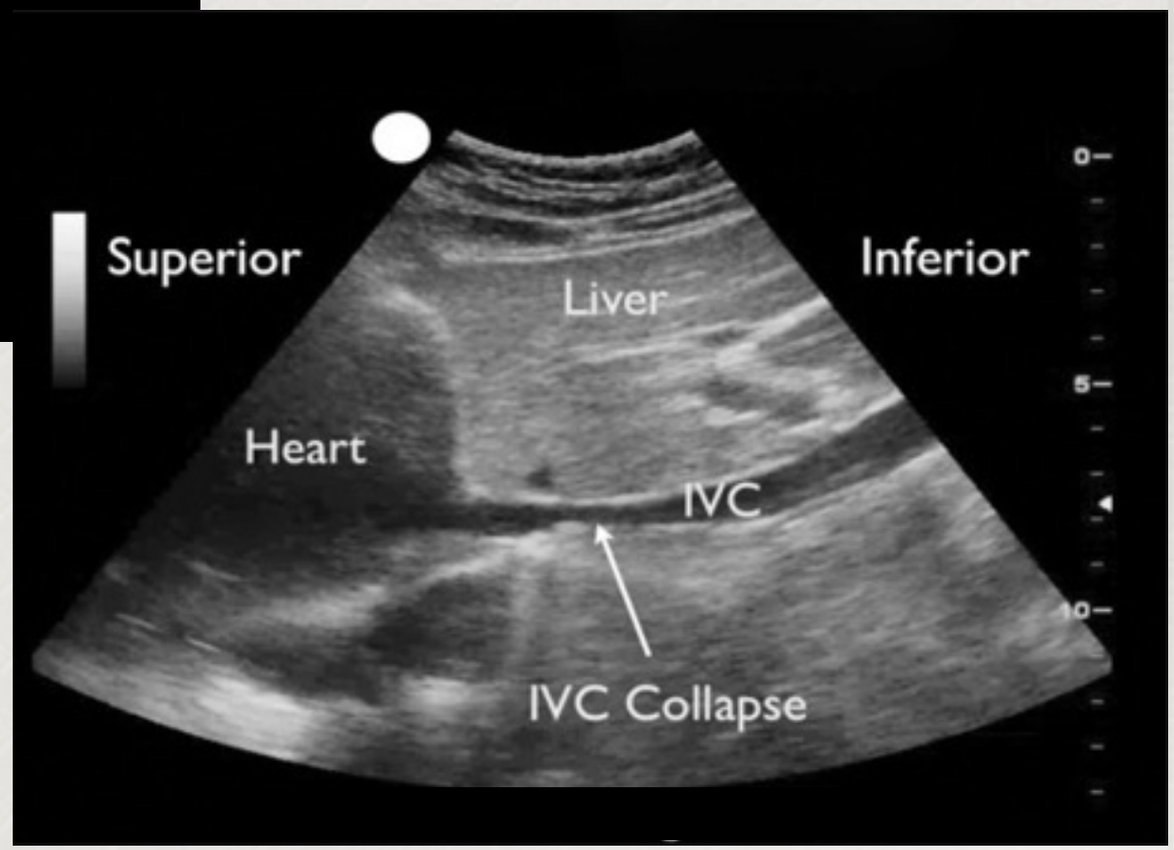
The tank

- *M-mode sonography of the IVC provides an excellent means to measure*
- *The intubated patient , the respiratory dynamics of the IVC will be reversed*

The tank


Before Inspiration
Hep
Vein
Heart
IVC
After Inspiration
Hep
Vein
Heart
IVC


Ultrasound
Inferior
Vena Cava
Long Axis


Superior
Inferior
Liver
Heart
IVC
IVC Collapse
0
5
10

IVC collapsibility index

Collapsibility index : (Dmax-Dmin/Dmax)*100

RAP and IVC collapse index

IVC diameter (cm)	*IVC collapse (%)*	Mean RAP (mmHg)
< 2.1	> 50%	0-5
>2.1	<50%	10-20
>2.1**	>50%	5-10

RAP and IVC collapse index

Advantage

IVC dimensions are obtainable from the subcostal view

Disadvantage

Not accurately in ventilator dependent patients

MV-controlled ventilation

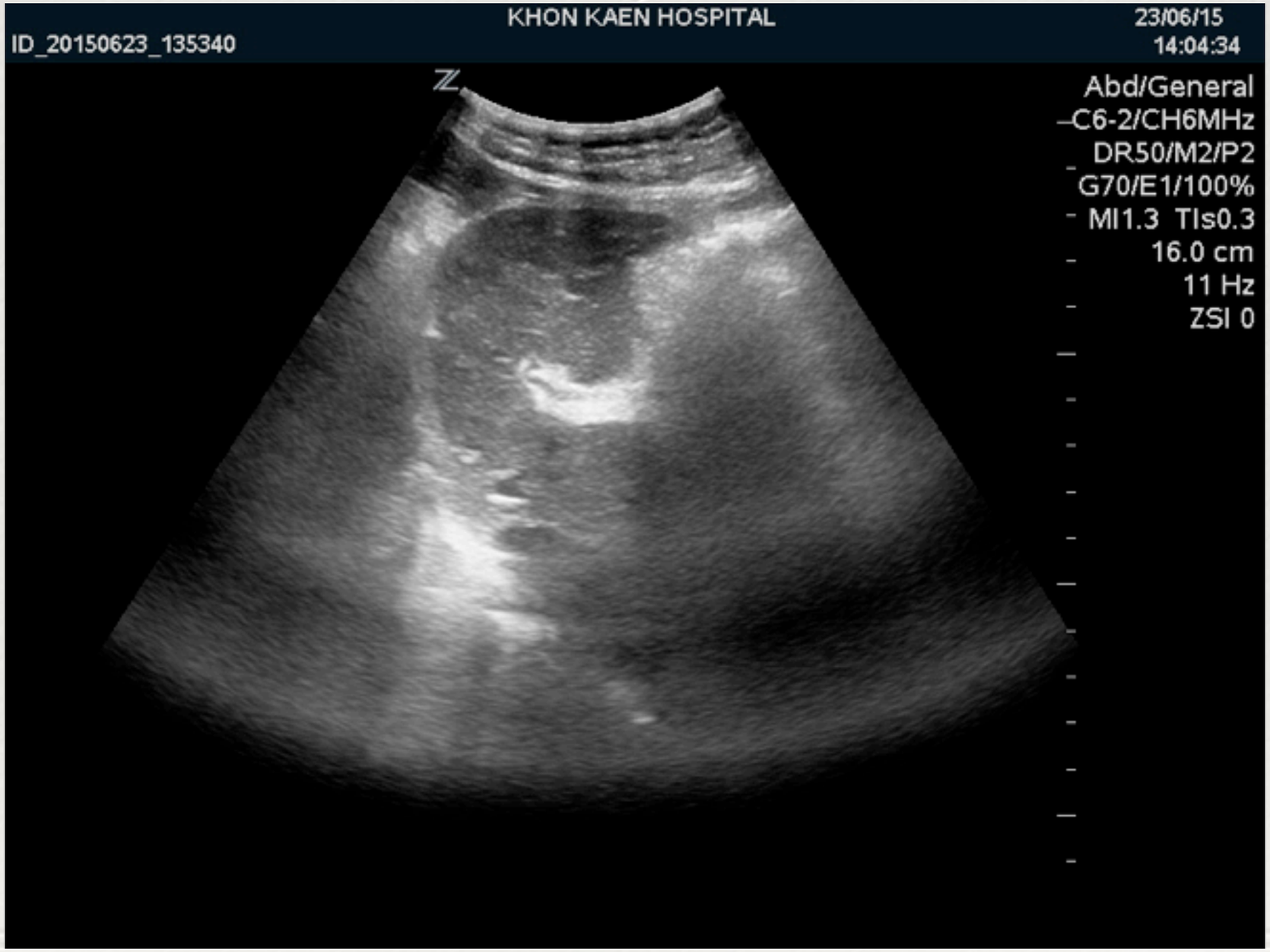
IVC distensibility index : $(D_{max}-D_{min}/D_{min})*100$

fluid responsiveness has distensibility index > 18%

IVC variability index: $(D_{max}-D_{min}/D_{mean})*100$

fluid responsiveness has variability index > 12%

The tank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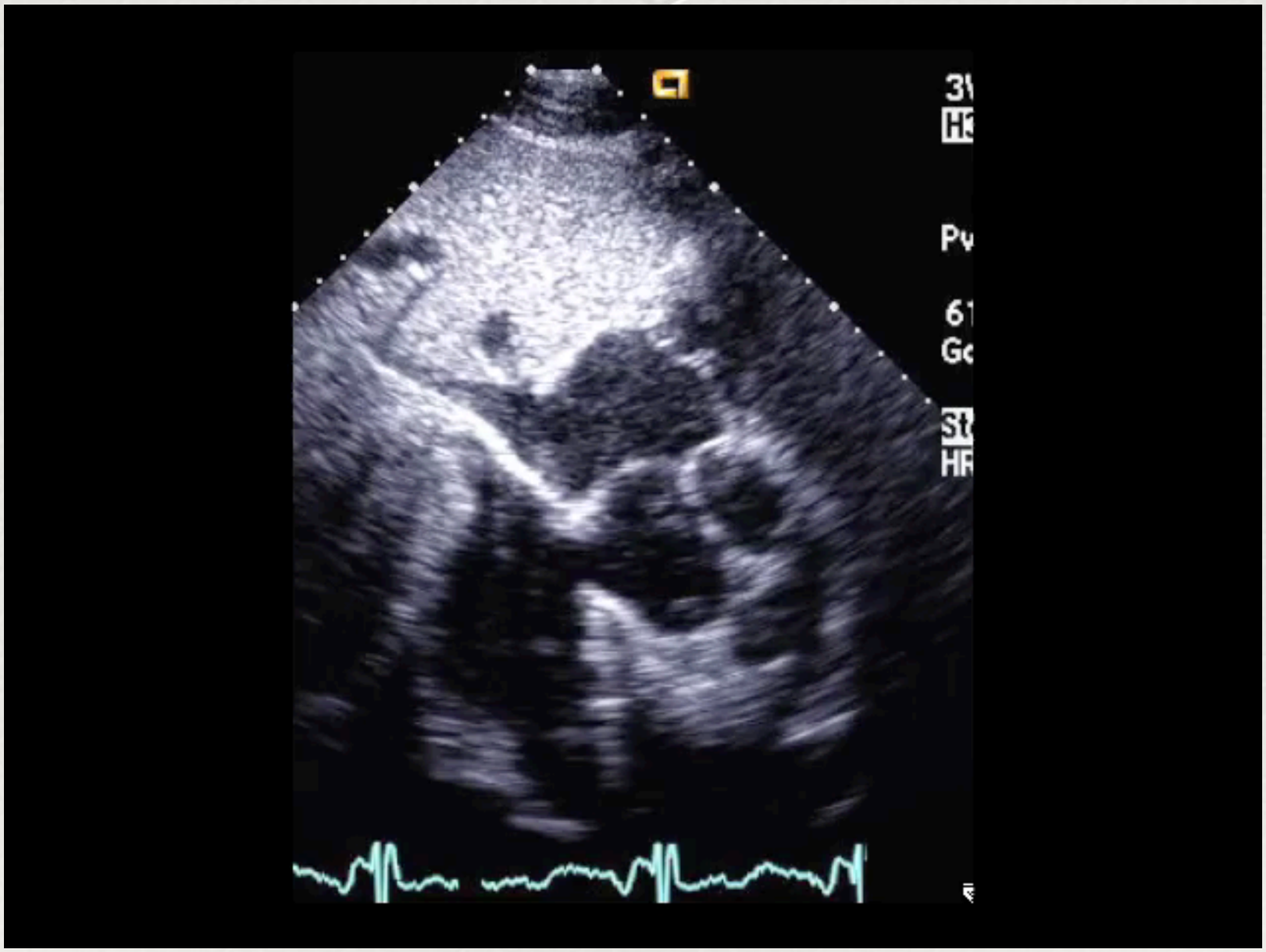
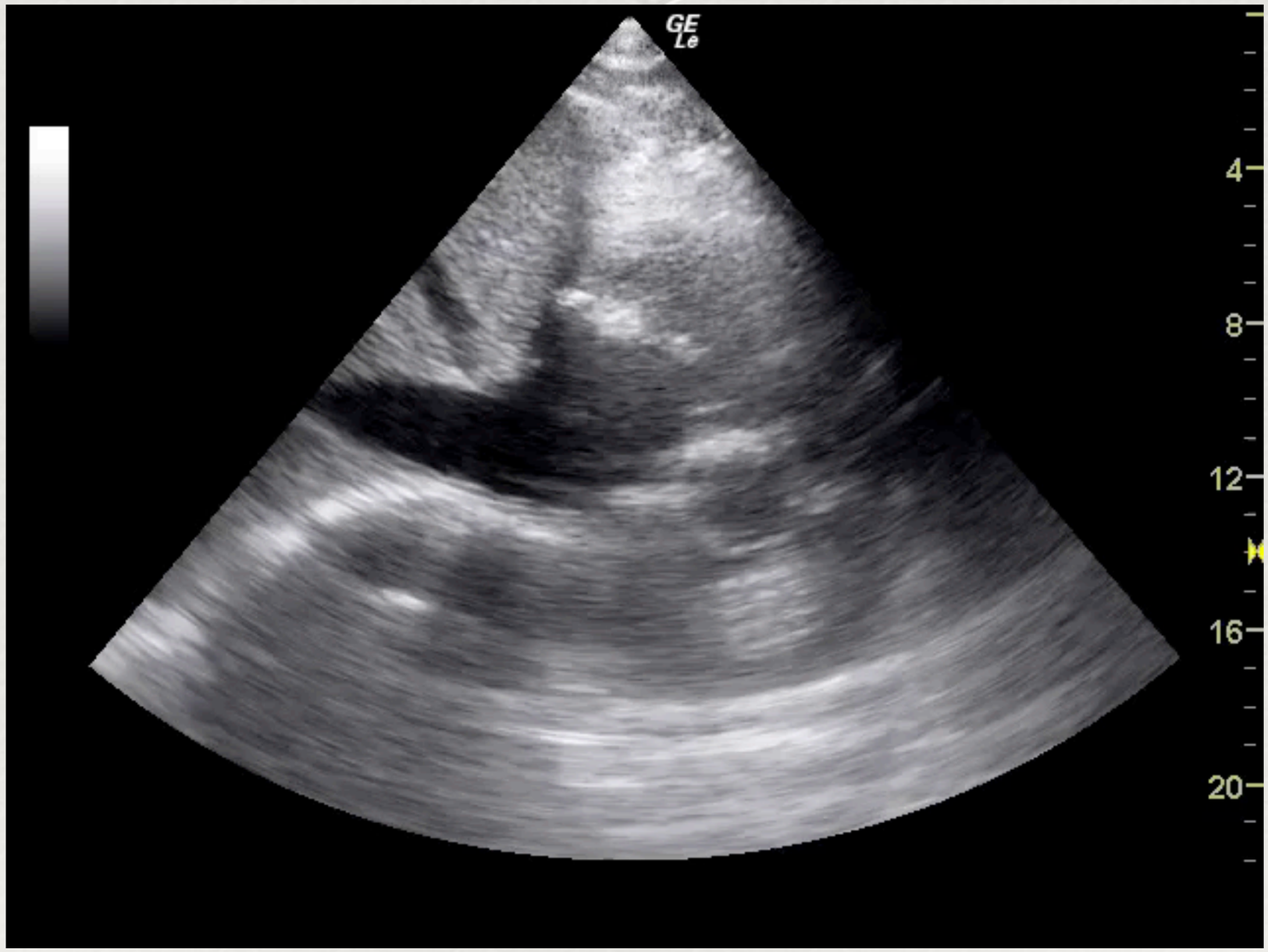
23/06/15
14:04:34
Abd/General
C6-2/CH6MHz
DR50/M2/P2
G70/E1/100%
MI1.3 TIs0.3
16.0 cm
11 Hz
ZSI 0

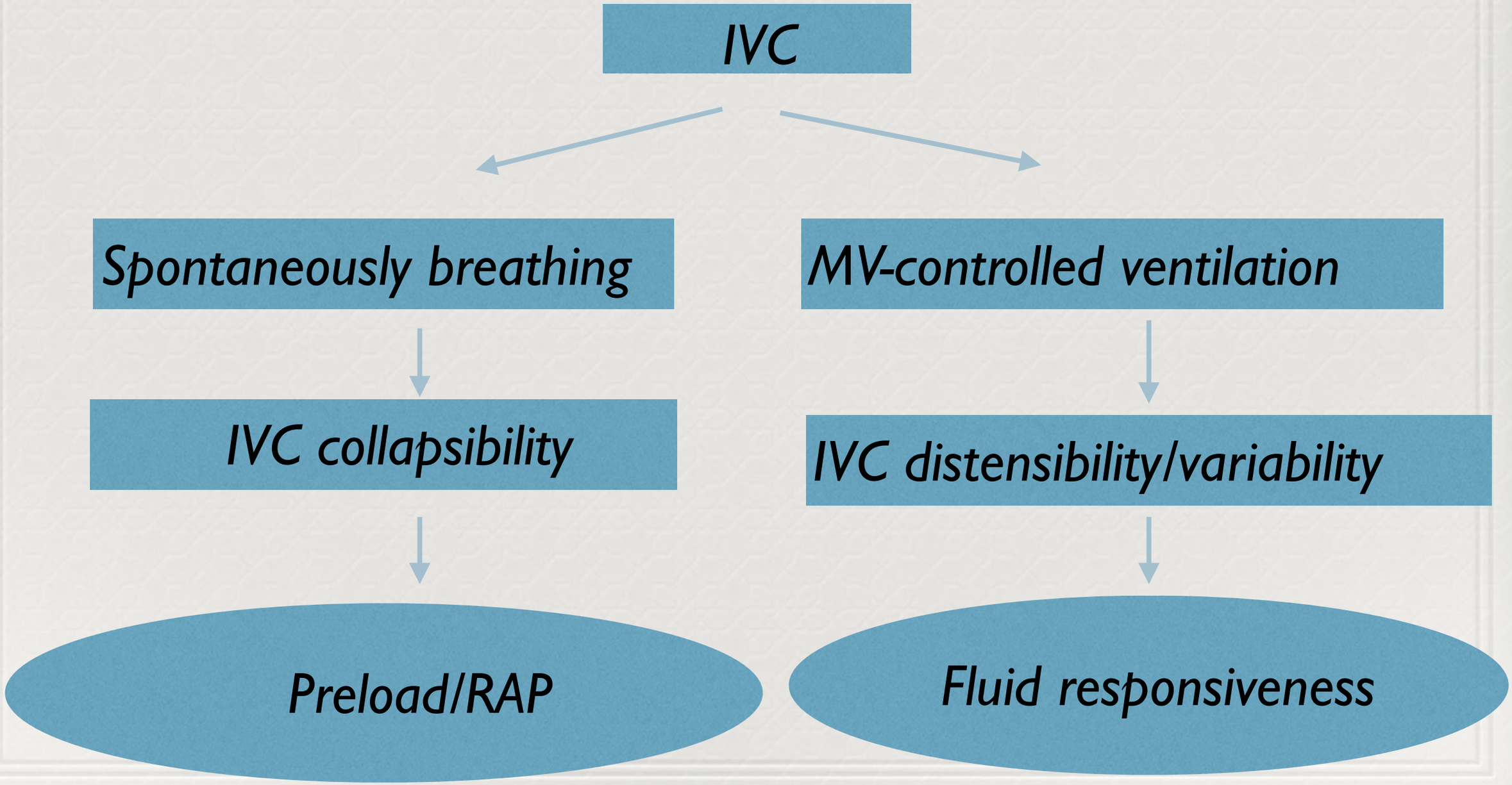
The tank



The tank

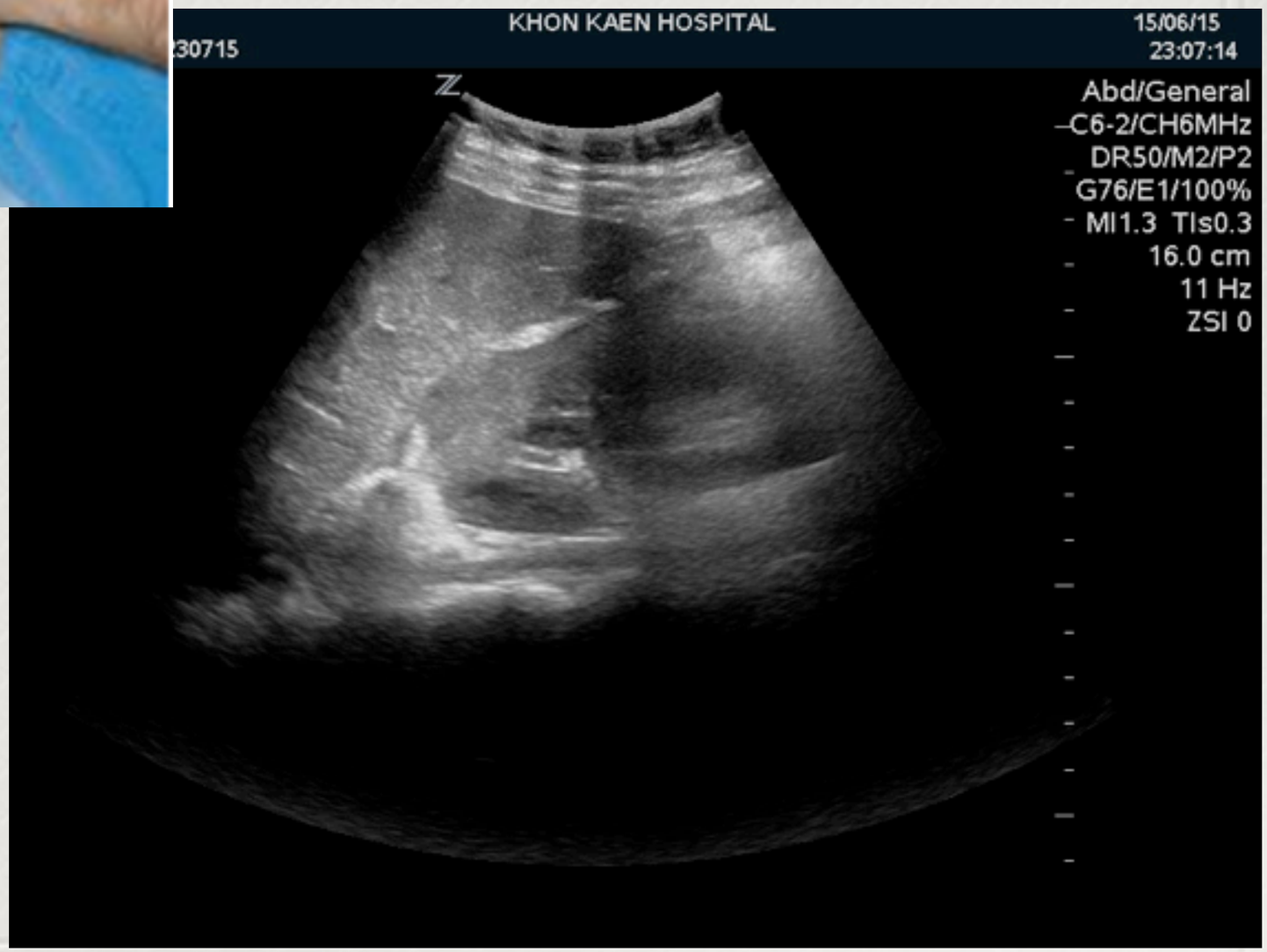


Fluid status assessment



The tank

- ***Leakage of the tank / Tank overload/Tank compromise***
- *FAST*
- *Lungs ultrasound*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30715
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23:07:14
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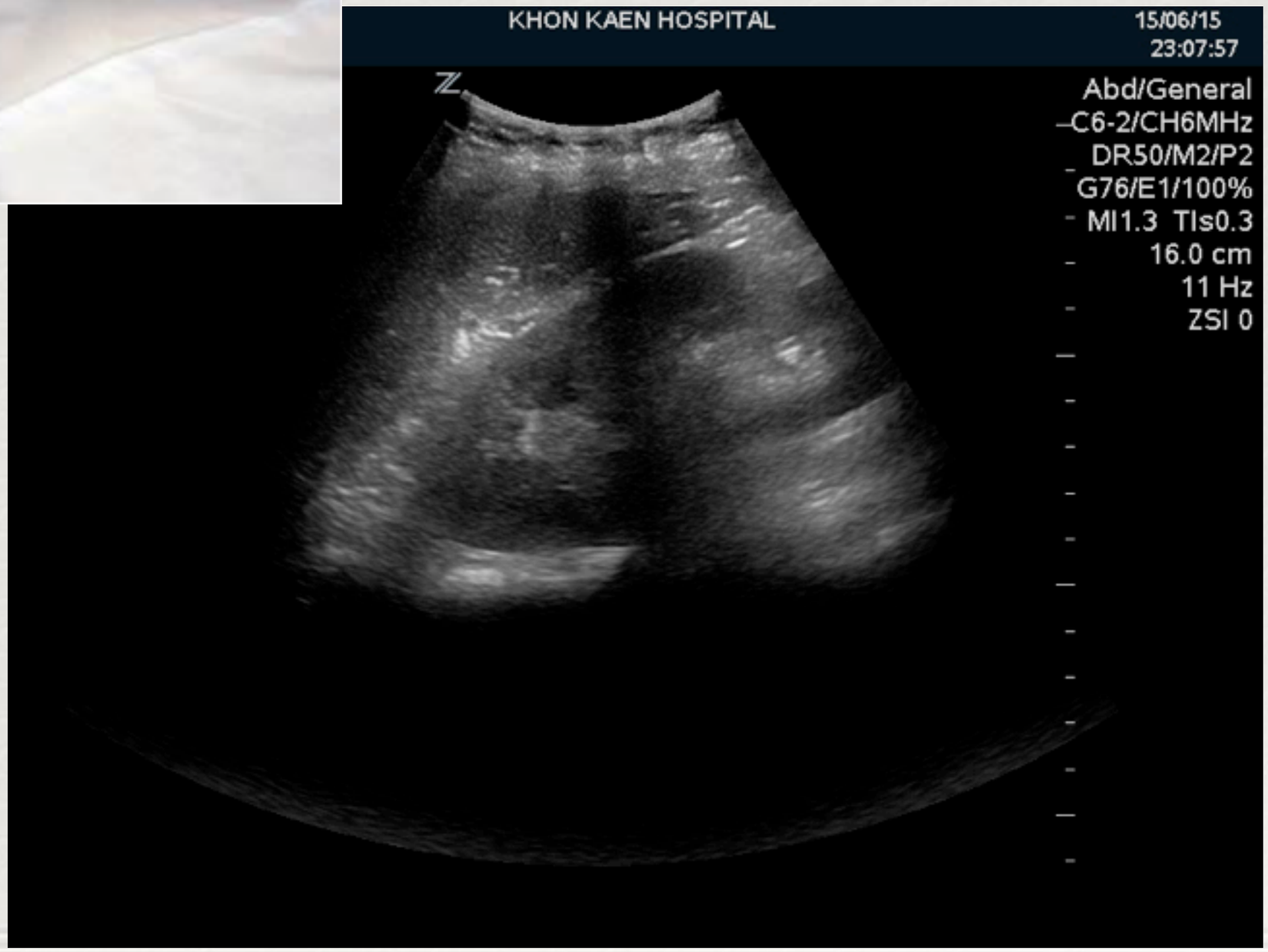
DR50/M2/P2
G76/E1/100%
MI1.3 TIs0.3
16.0 cm
11 Hz
ZSI 0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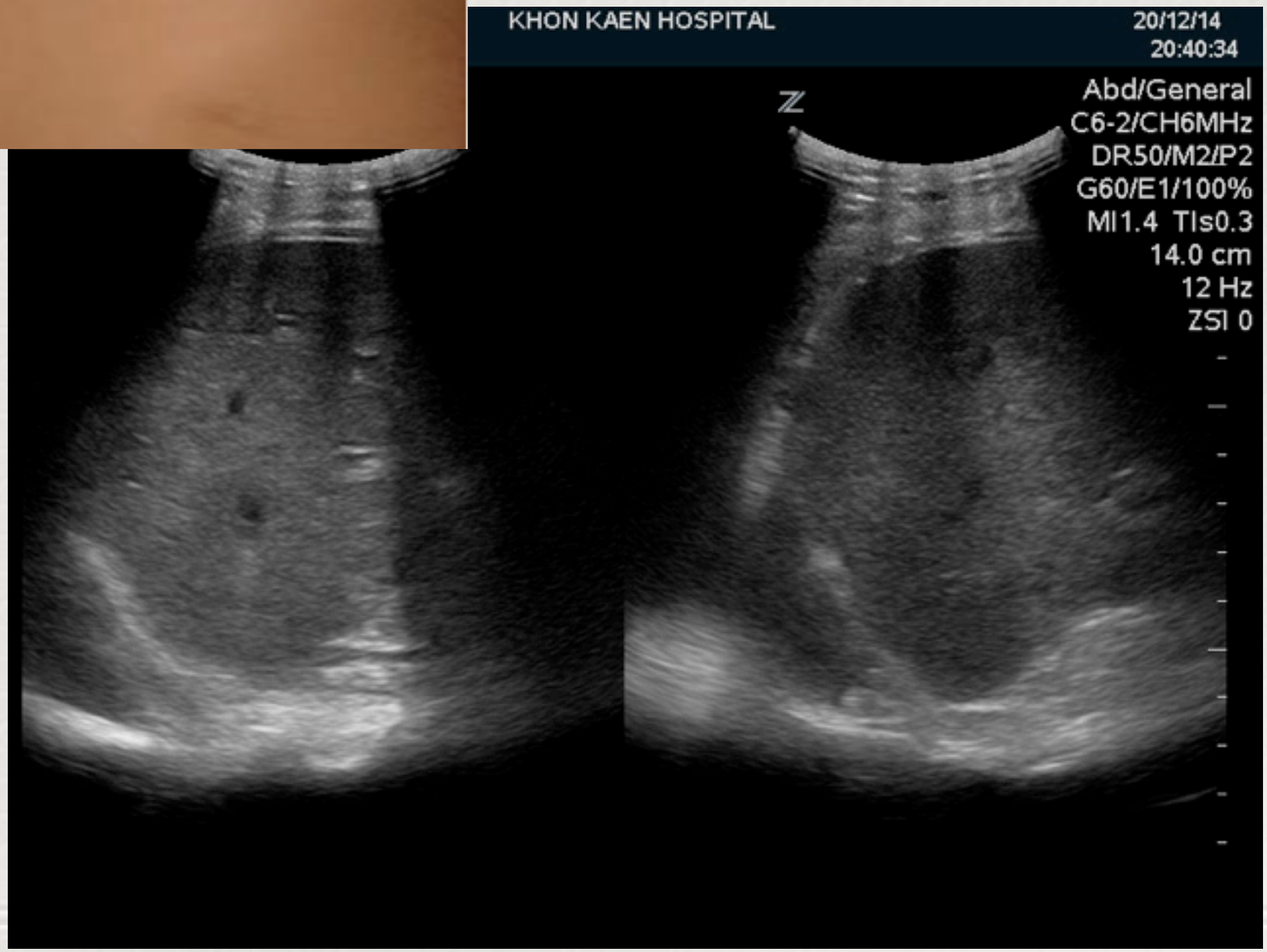
G76/E1/100%
MI1.3 TIs0.3
16.0 cm
11 Hz
ZSI 0


KHON KAEN HOSPITAL
15/06/15
23:08:31
Abd/General
C6-2/CH6MHz
DR50/M2/P2
G72/E1/100%
MI1.3 TIs0.3
16.0 cm
11 Hz
ZSI 0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20:40:34
Abd/General
C6-2/CH6MHz
DR50/M2/P2
G60/E1/100%
MI1.4 TIs0.3
14.0 cm
12 Hz
ZSI 0


KHON KAEN HOSPITAL
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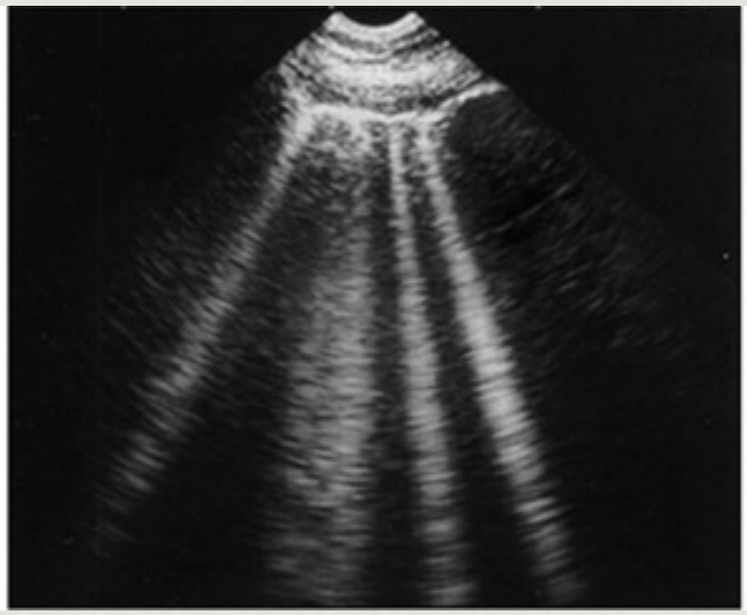
19/05/15
17:51:25
Abd/General
_C6-2/CH6MHz
DR50/M2/P2
G56/E1/100%
MI1.4 TIs0.3
14.0 cm
12 Hz
ZSI 0
LIVER
RT EFFUSION

The tank


04-JAN-01
08:55:02
EG: 20 GP:-13 GD:2.9
DYN:1 CTR:1/3 LIS:1
POST-T:1
F12/04
ID:
HITACHI EUB 405
SWEEP ◄◄ SWEEP ◄ STEERING DATA NEXT EXIT



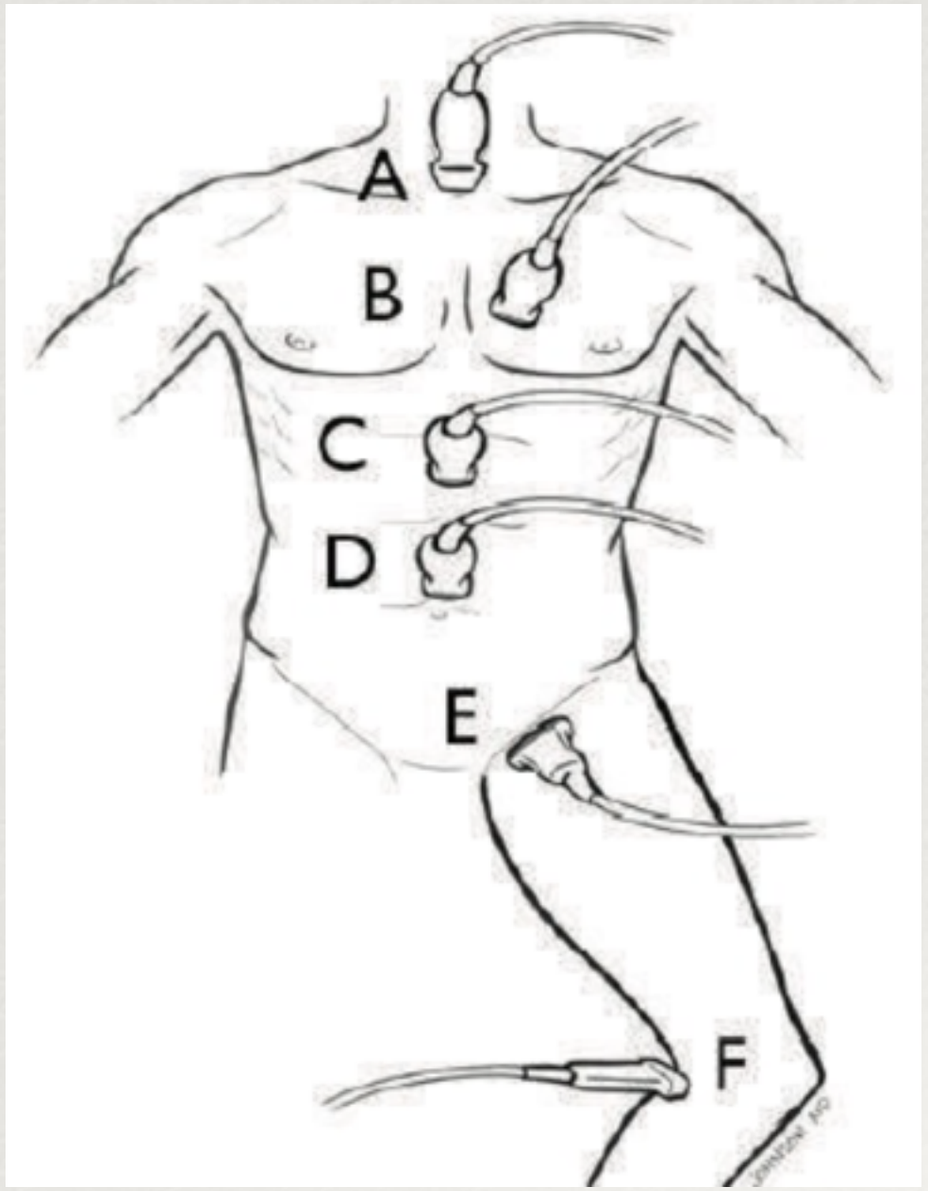

EG: 23 NG:- 6 FG:1.7
DYN:4 ENH:2/2 SCC:2
POST-P:2
F12/24
ID:
HITACHI OSIRIS
SNEXT EXIT

The tank

“The Pipes”

The pipes

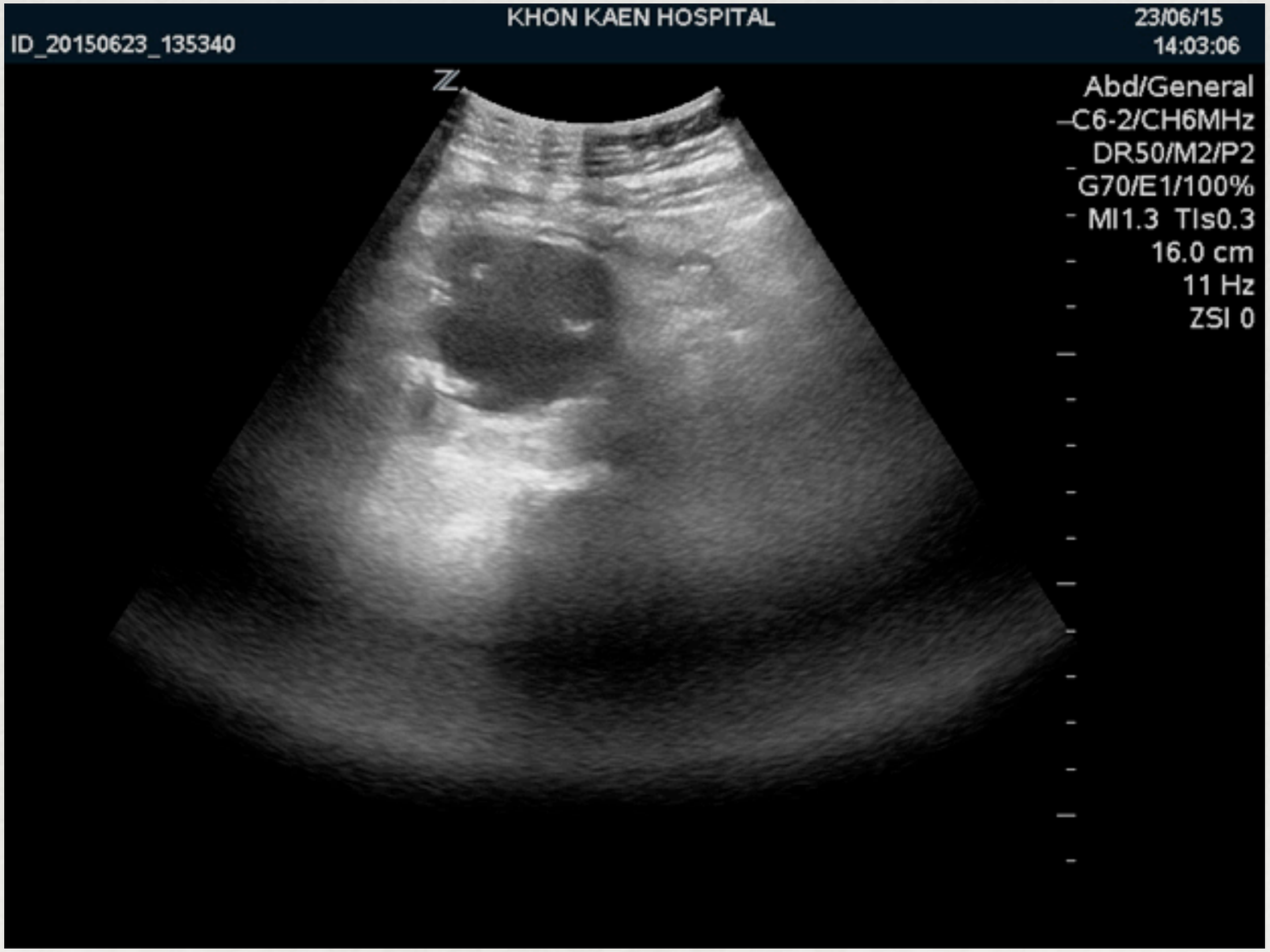
- *Position A*
  Suprasternal
- *Position B*
  Parasternal
- *Position C*
  Epigastrium
- *Position D*
  Supraumbilicus
- *Position E*
  Femoral DVT
- *Position F*
  Popliteal DVT



The pipes

- ***Ruptered of the pipe***
  - *Arterial system*
  - *Aortic root < 3.8cm*
  - *Parasternal long axis and Suprasternal view*

The pipes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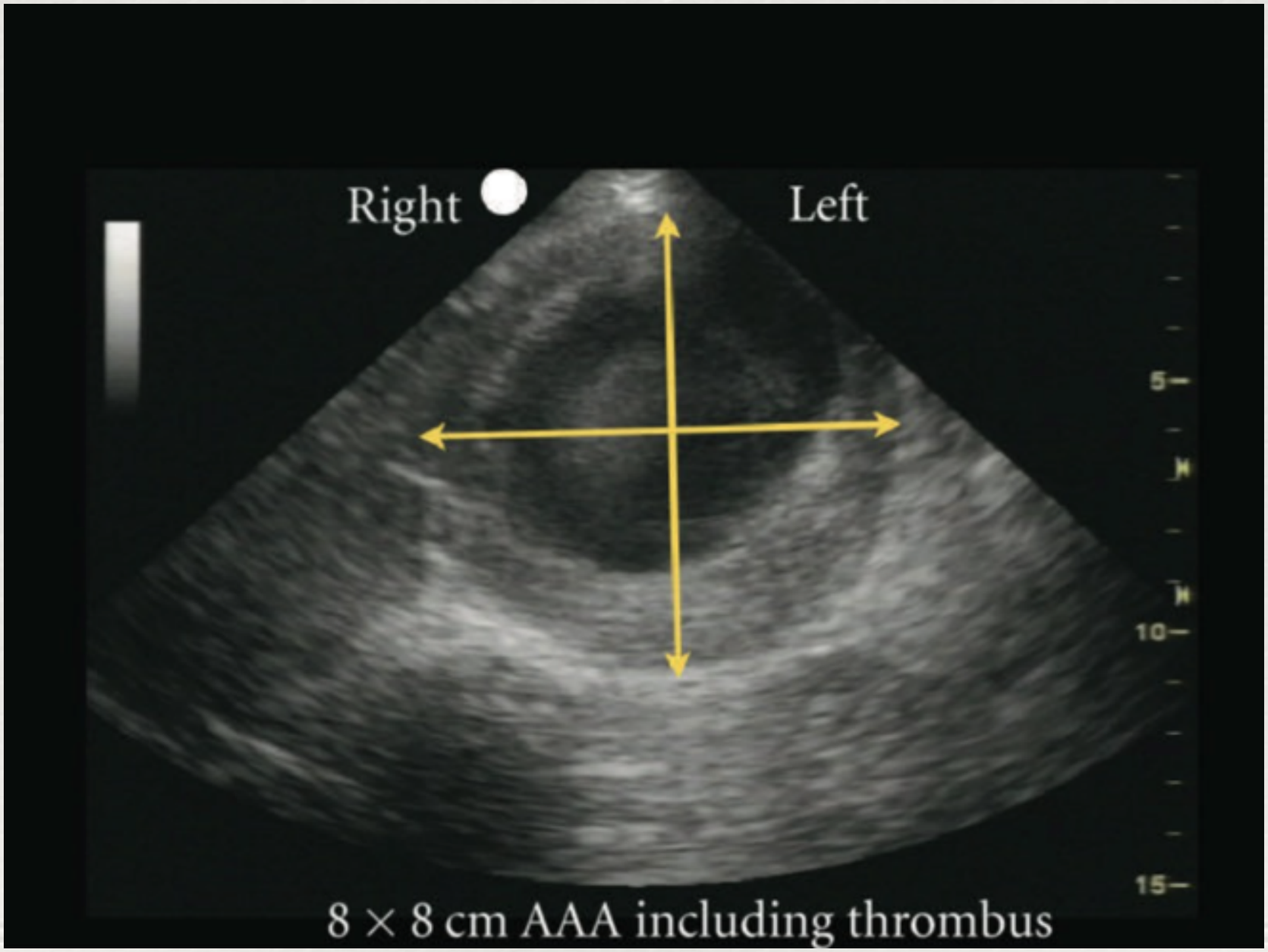
ID_20150623_135340
23/06/15
14:03:06
Abd/General
C6-2/CH6MHz
DR50/M2/P2
G70/E1/100%
MI1.3 TIs0.3
16.0 cm
11 Hz
ZSI 0

The pipes

AAA

Short axis plane
outer wall to outer wall
diameter exceed 3 cm

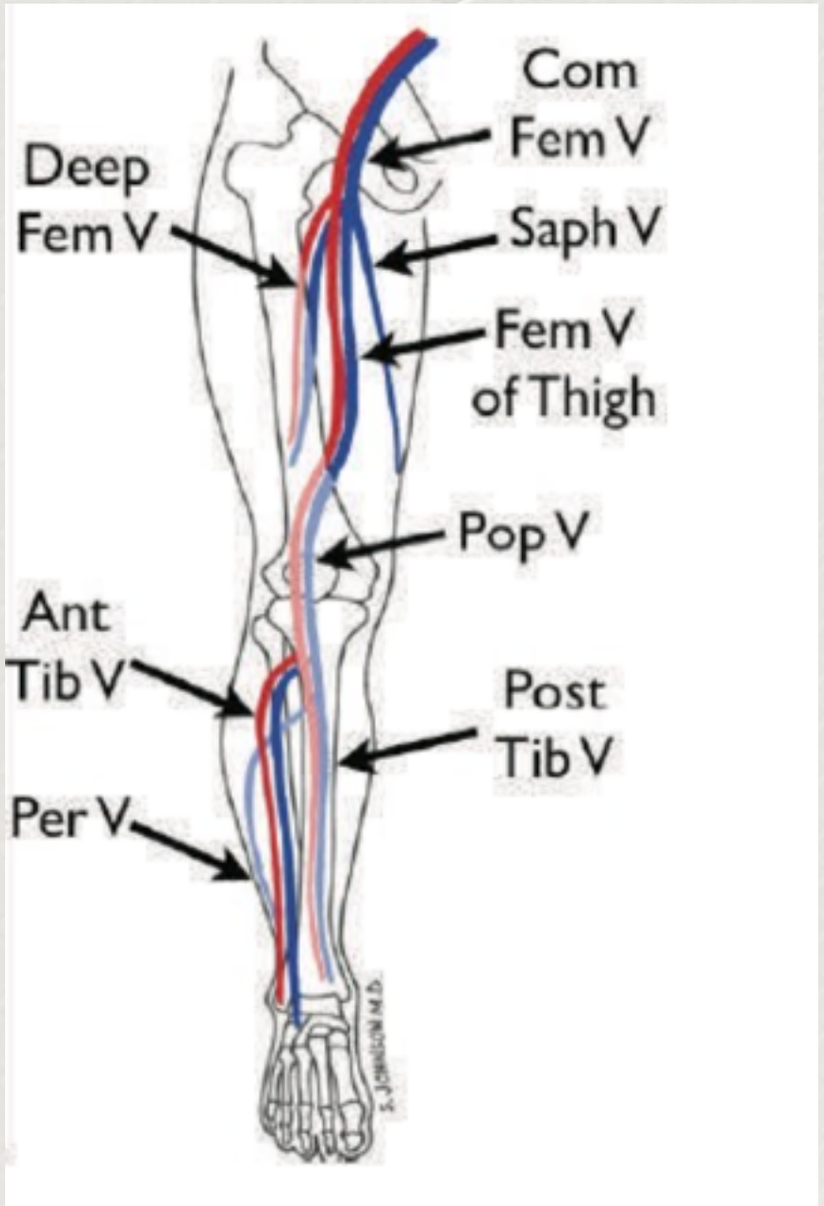
The pipes



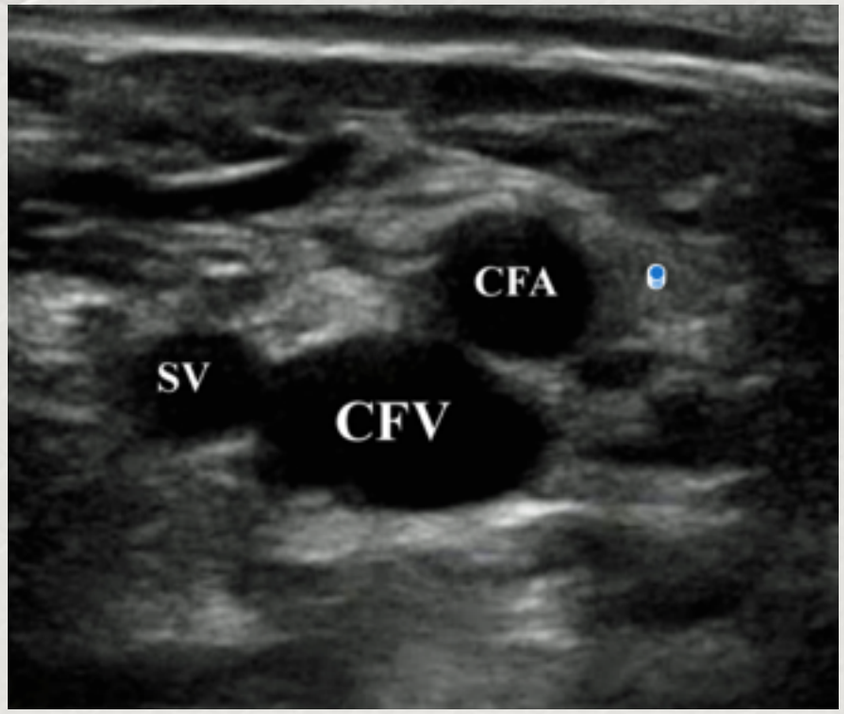
The pipes

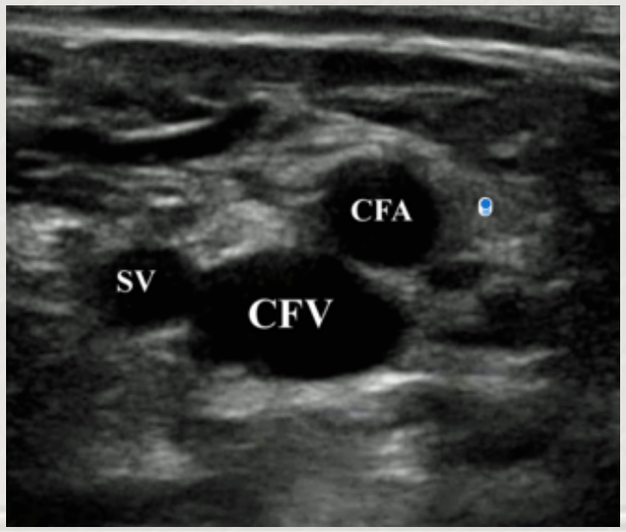
- *Obstruction of the pipe*
  - *Thromboembolic event*
  - *Incomplete compression of the anterior and posterior walls of the vein*

The pipes

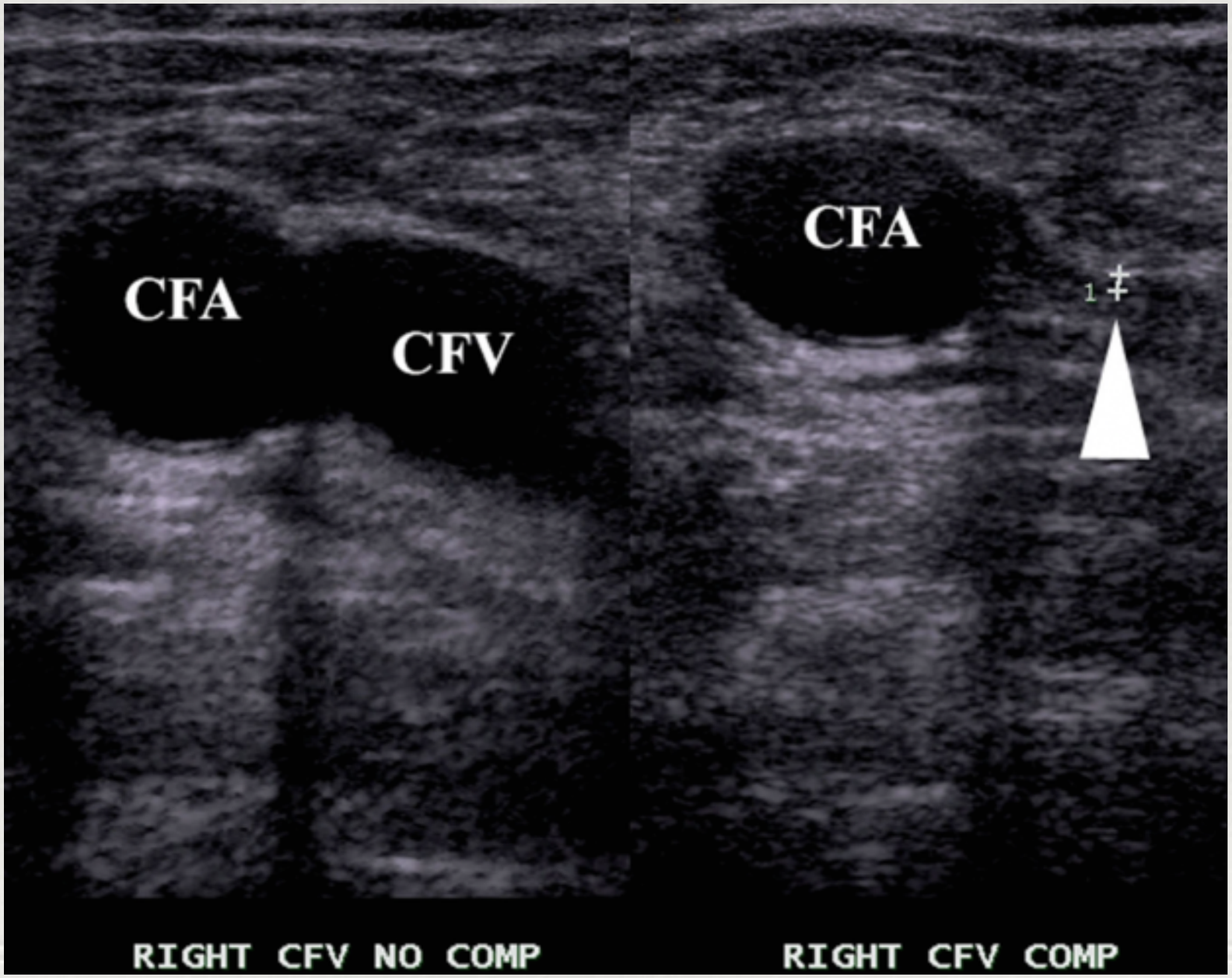

Com
Fem V
Deep
Fem V
Saph V
Fem V
of Thigh
Pop V
Ant
Tib V
Post
Tib V
Per V

The pipes

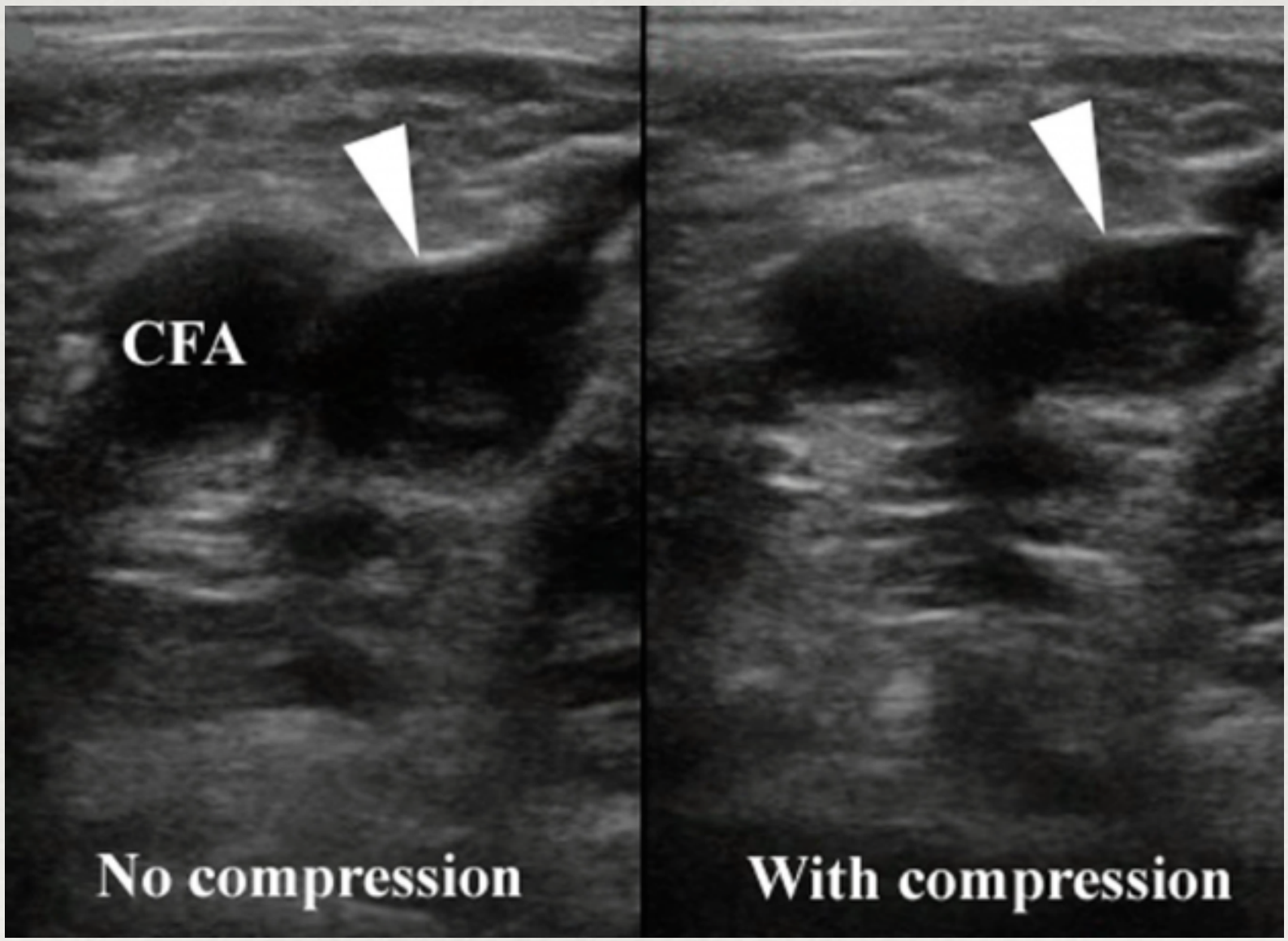




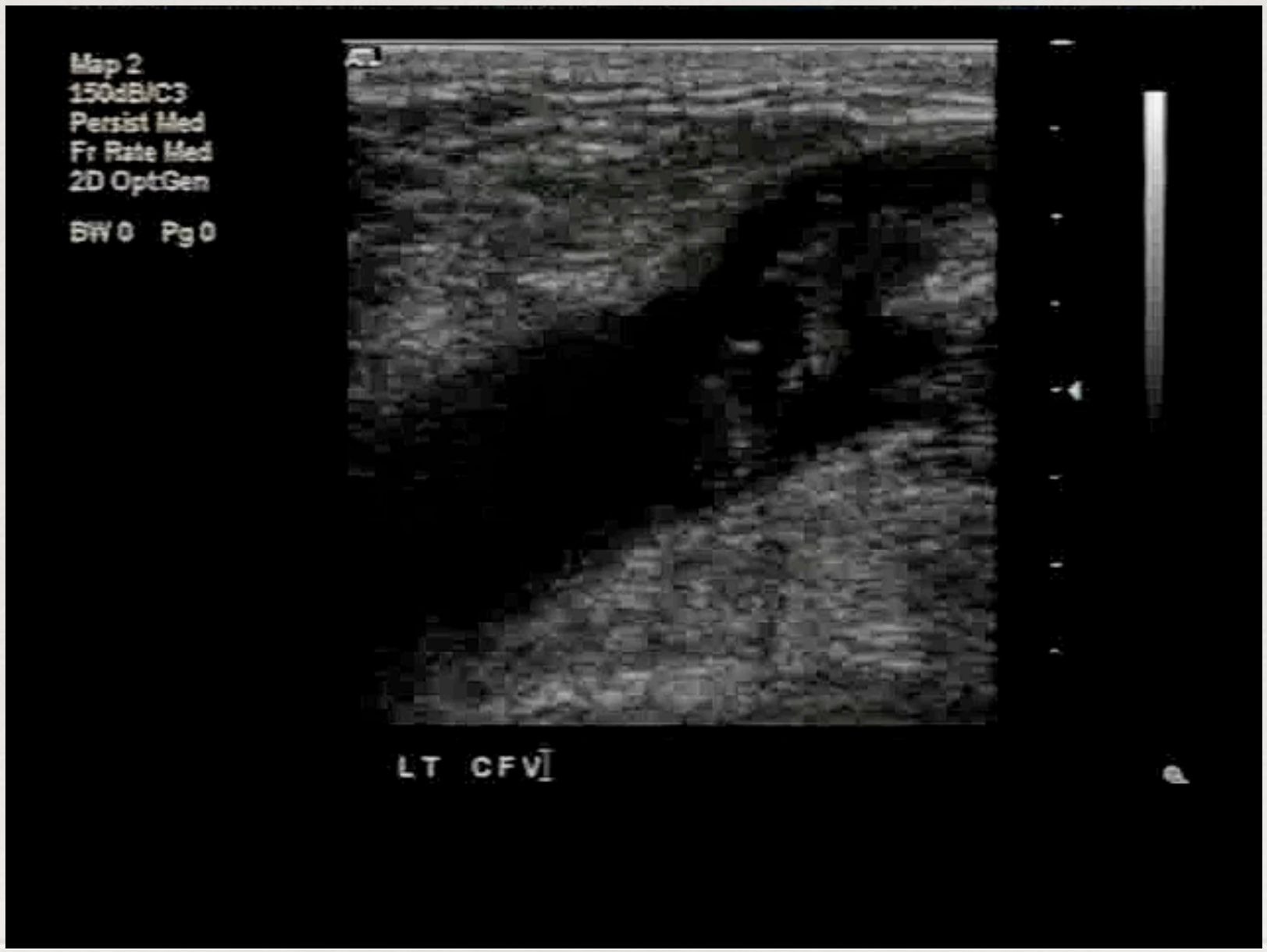
The pipes



The pipes



The pipes


Map 2
150dB/C3
Persist Med
Fr Rate Med
2D OptiGen
BW 0 Pg 0
LT CFVI

“Thank you”