

# 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*

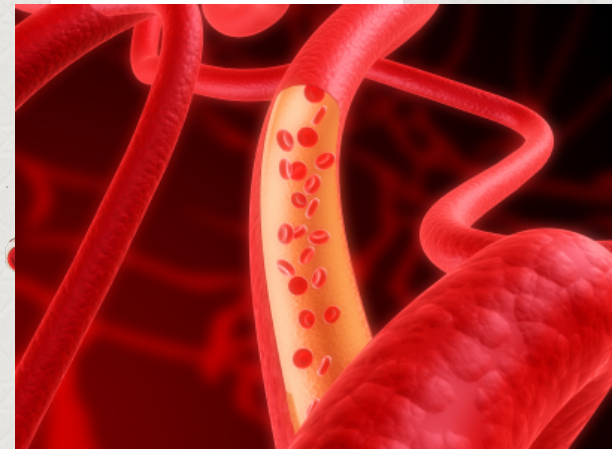


# Ultrasound

## 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



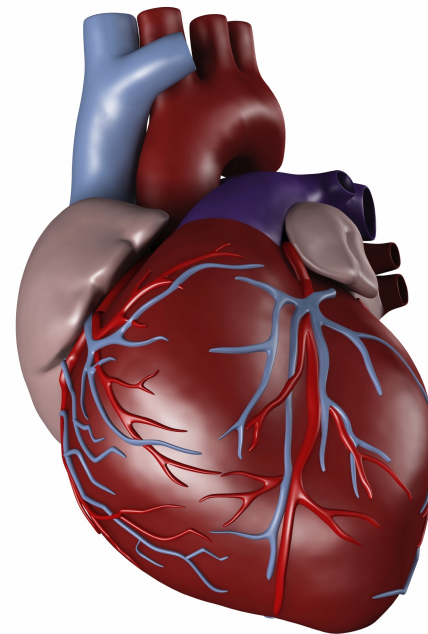


***“The Pump”***



# Rush Exam

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





# Rush Exam

## ★ *Position A*

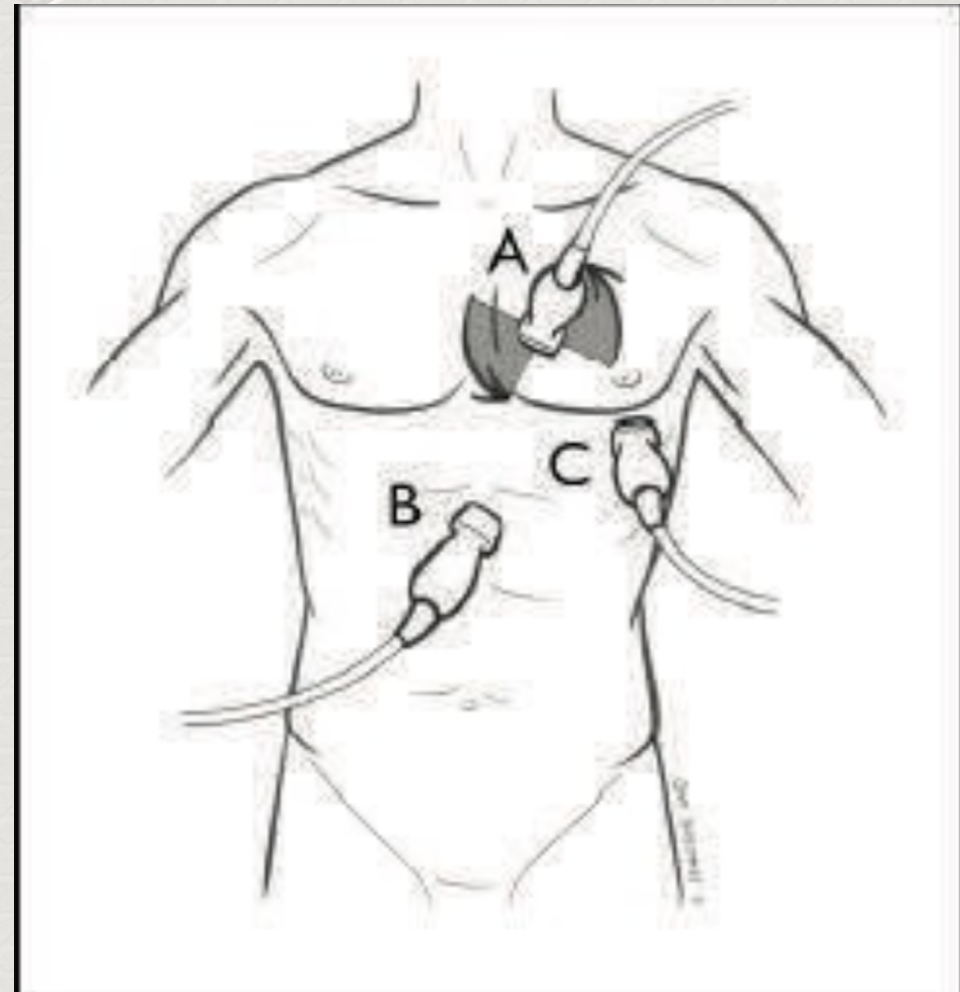
- *Parasternal long axis*
- *Parasternal short axis*

## ★ *Position B*

- *Subxiphoid*

## ★ *Position C*

- *Apical 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*

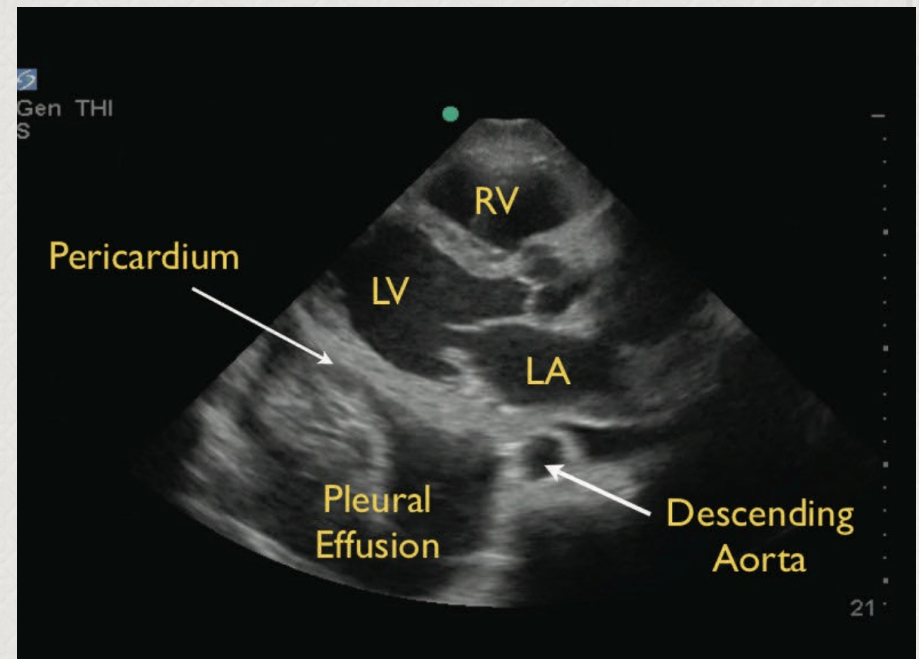
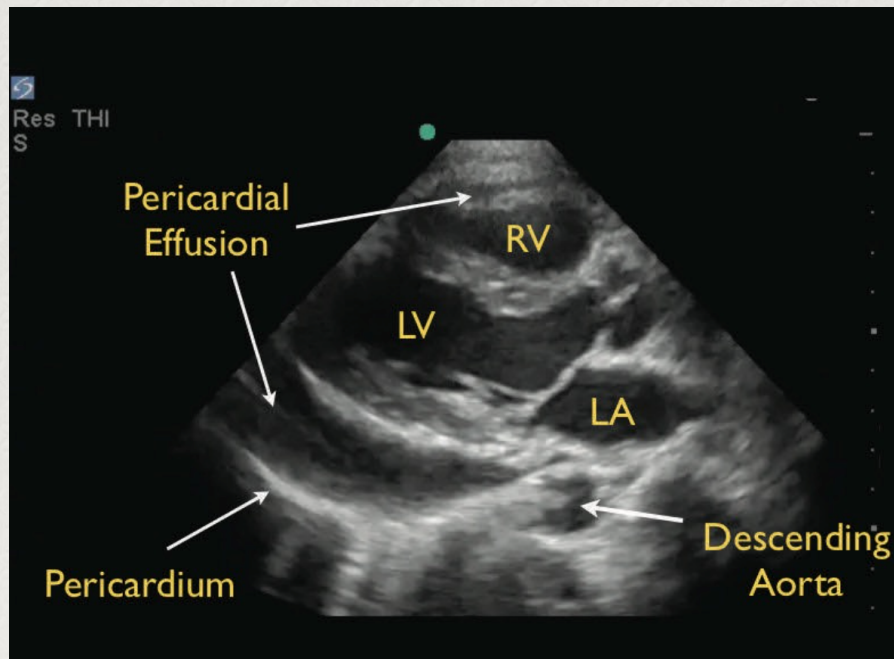
*intrapericardial  $p$  > RV diastolic  $p$*



*Early diastolic RV collapse*



# Pericardial effusion

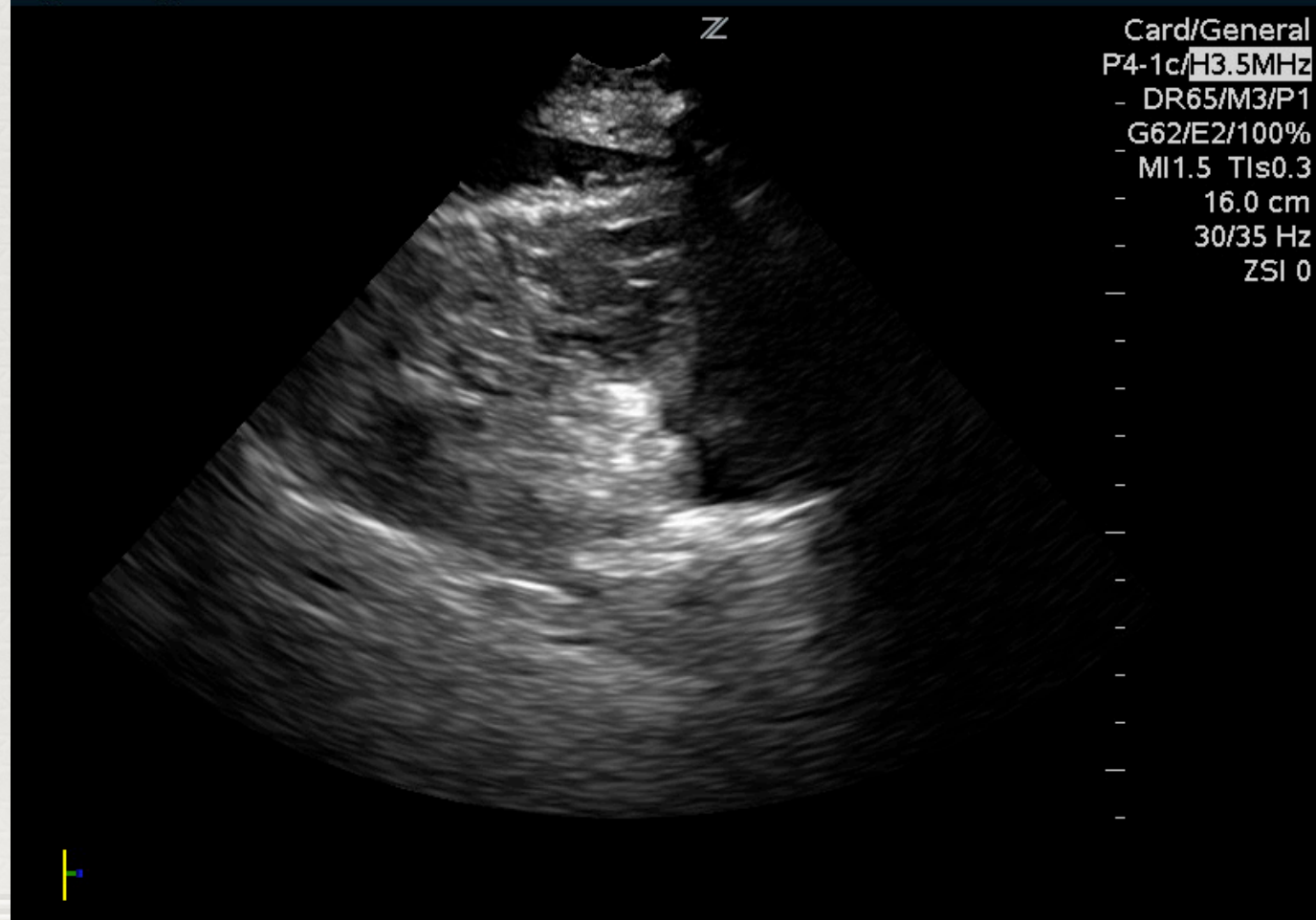


# Pericardial effusion

HEMOPERICARDIUM,  
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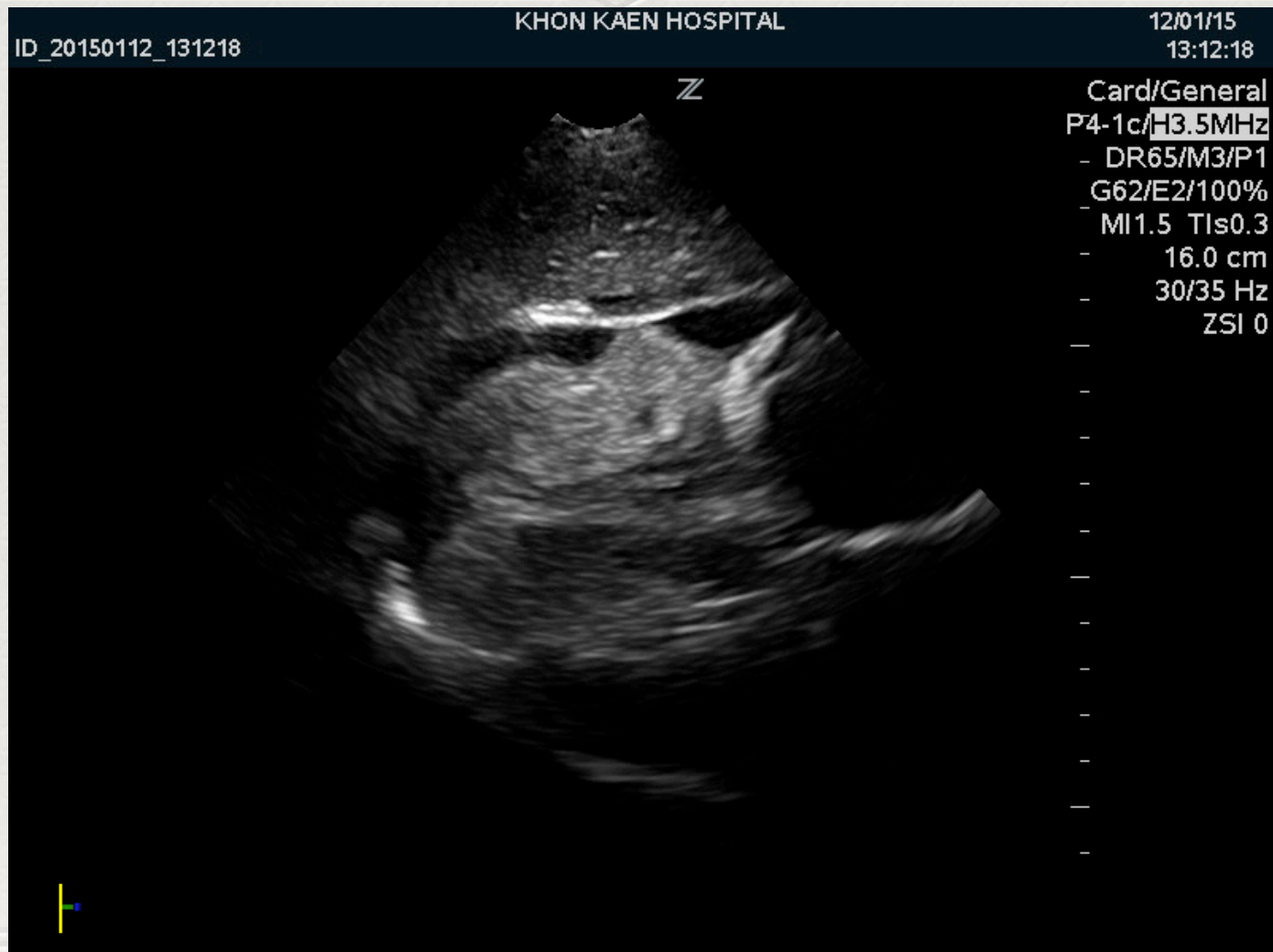
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# Pericardial effusion

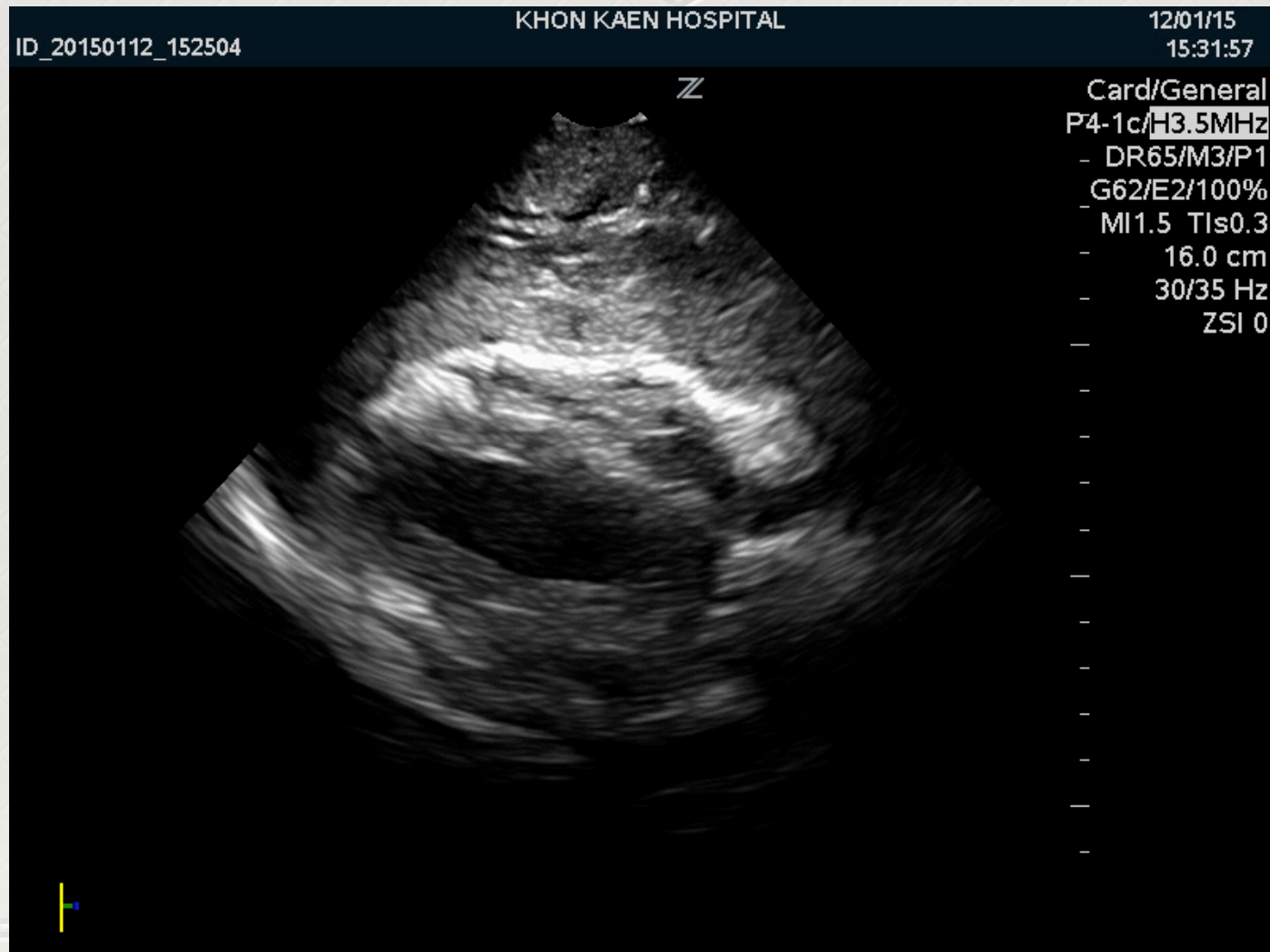


# Pericardial effusion





# 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

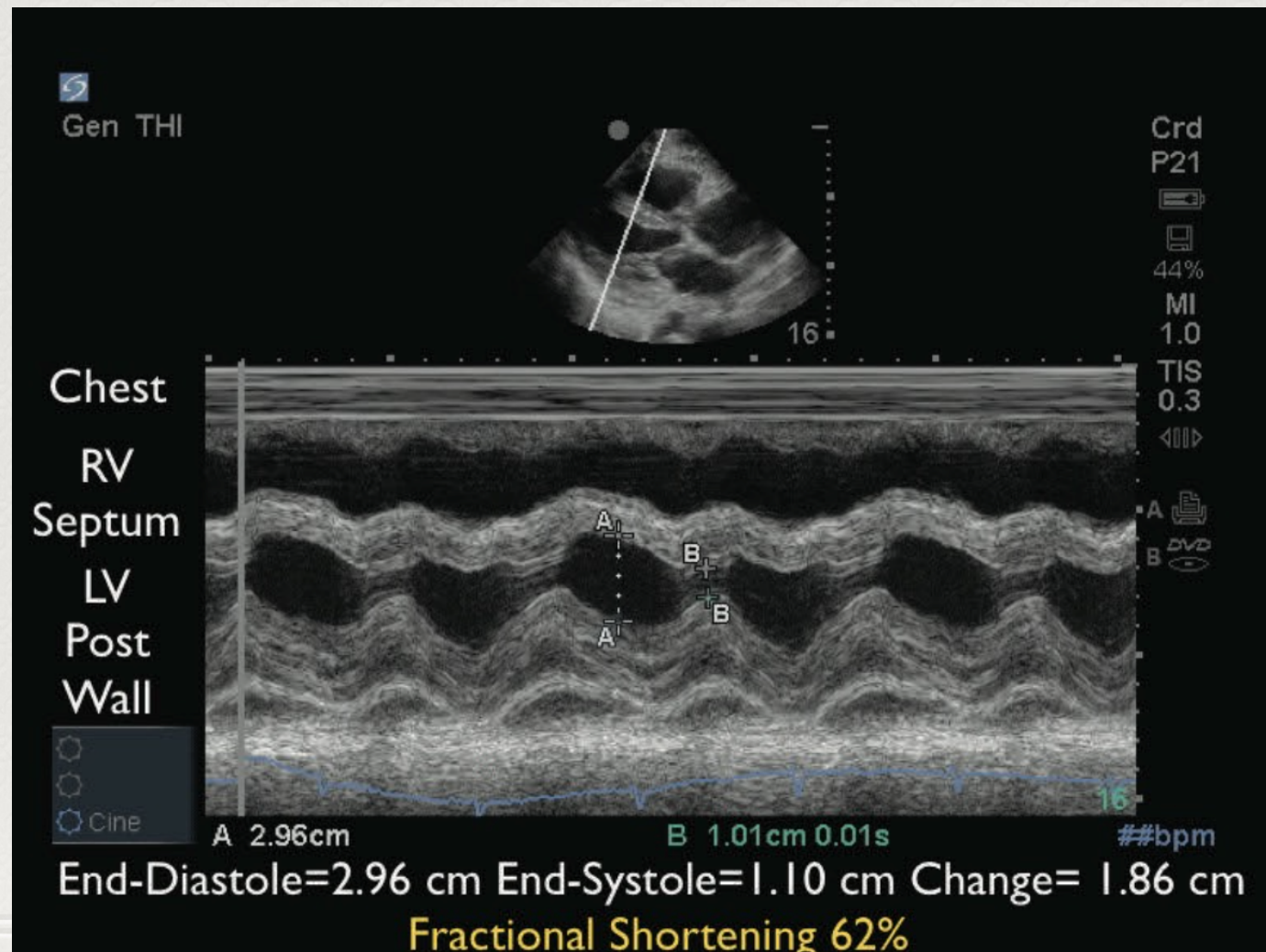
***Fractional shortening :***

$$(EDD-ESD)/EDD*100$$

*Not directly calculate the ejection fraction*

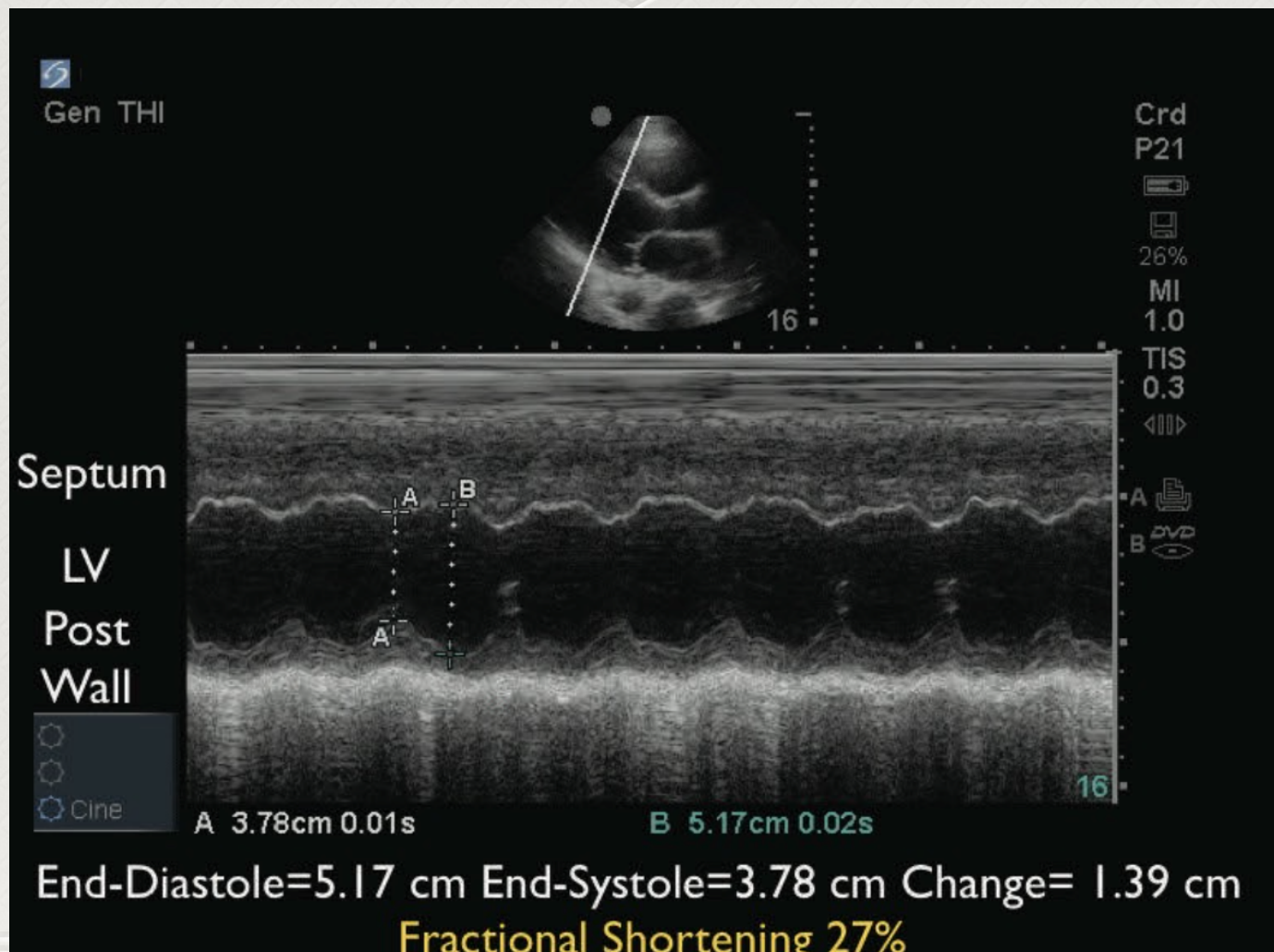


# LV contractility



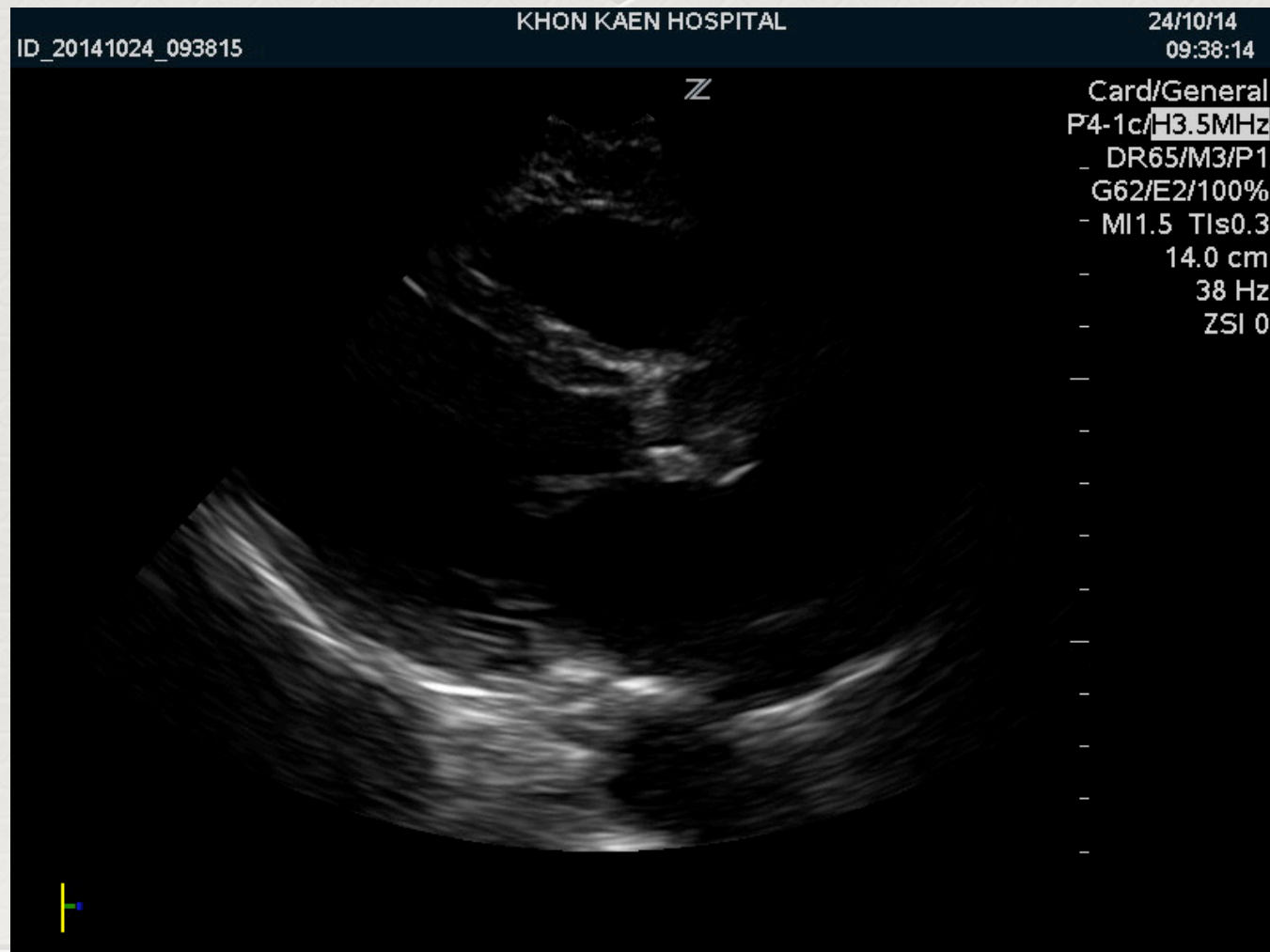


# LV contractility





# LV contractility

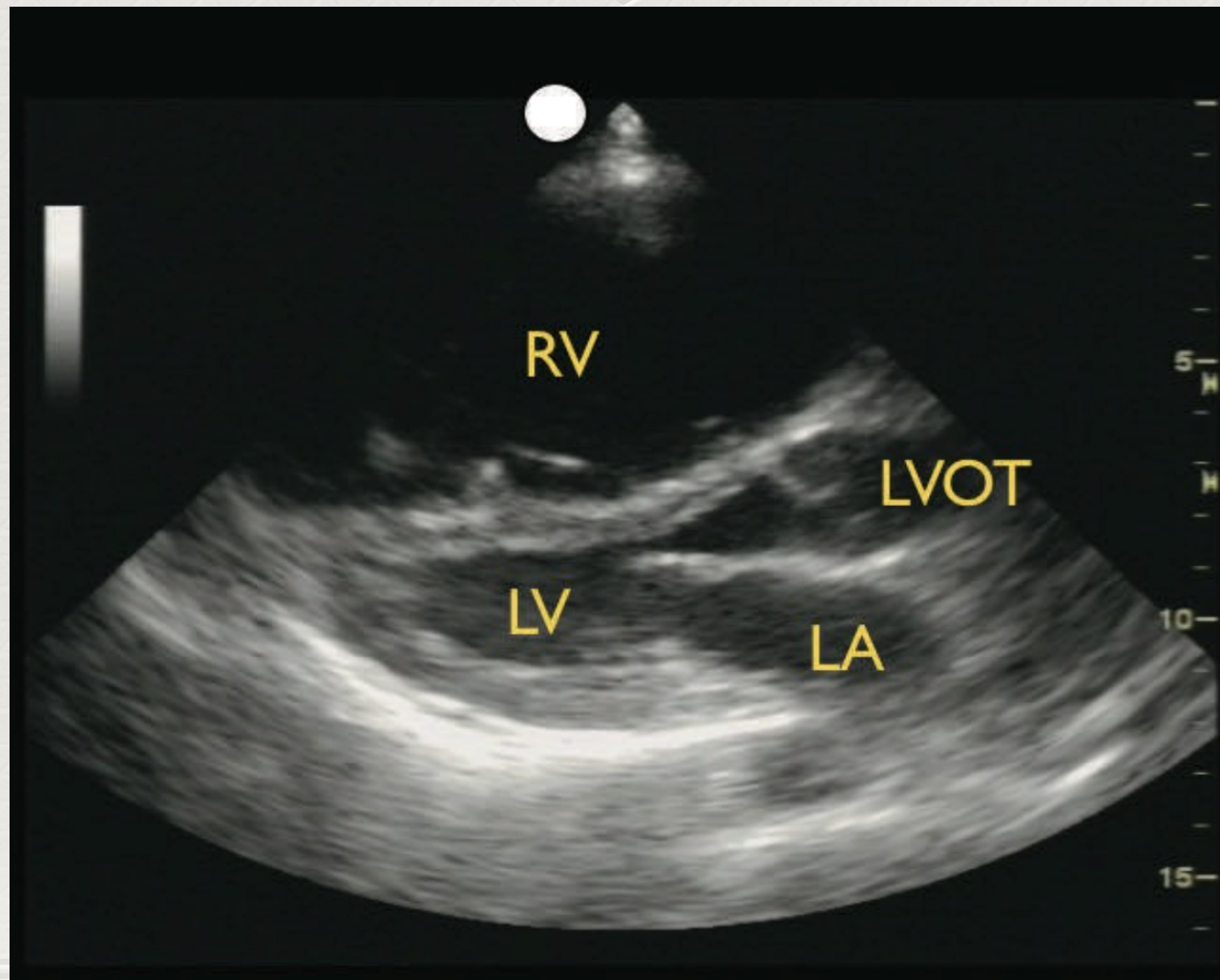


# Right Ventricular size

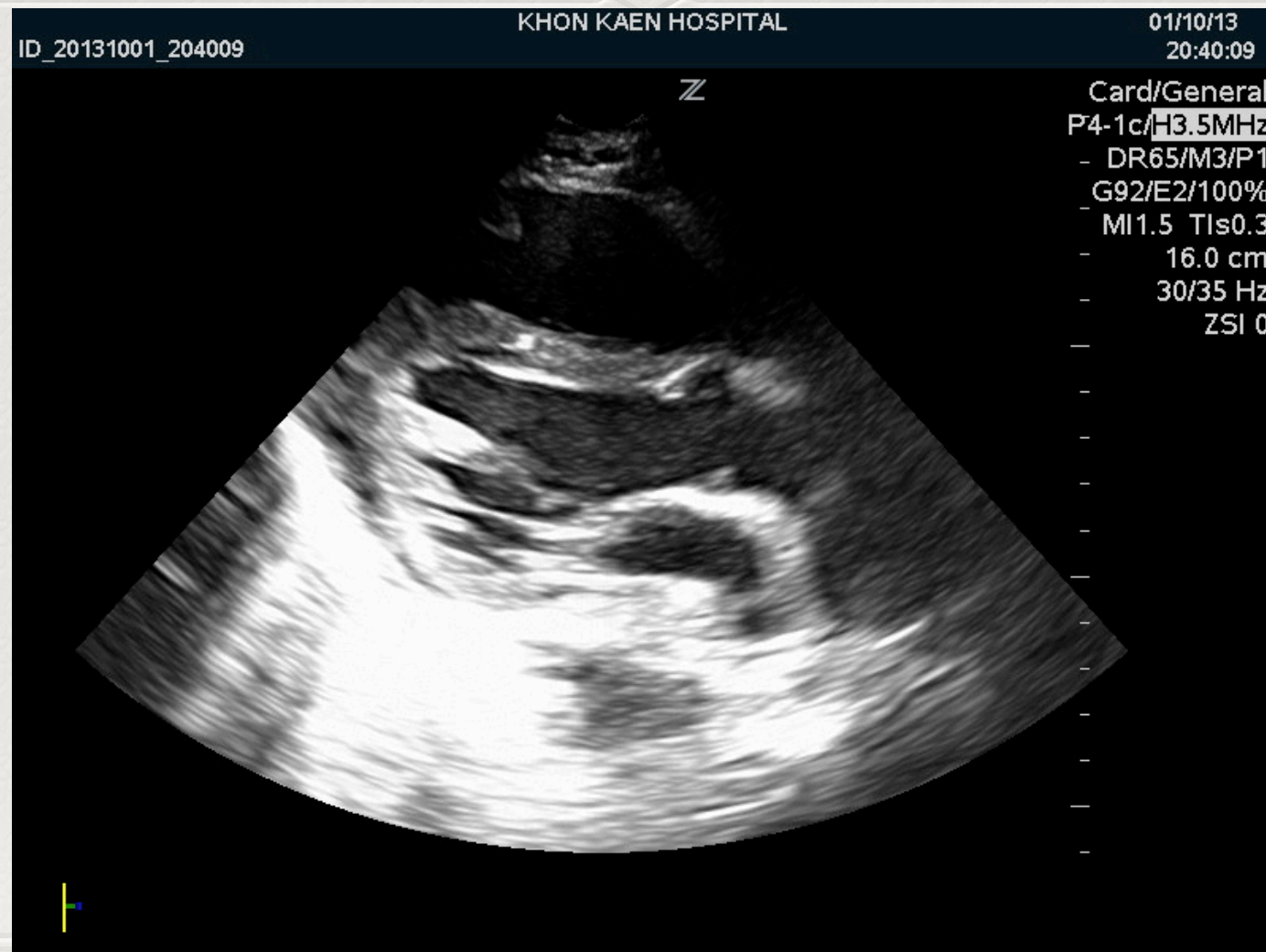
- ✿ *Left- to-Right ventricle is 1 : 0.6*
- ✿ *Dilation of the right ventricle*
- ✿ *Inter-ventricular septum toward the left ventricle*
- ✿ *Evaluation of the leg veins for a deep vein thrombosis*



# Right Ventricular size



# Right Ventricular size





***“The Tank”***

# The Tank

- ✦ **Position A**

- IVC

- ✦ **Position B**

- FAST / RUQ / Pleural

- ✦ **Position C**

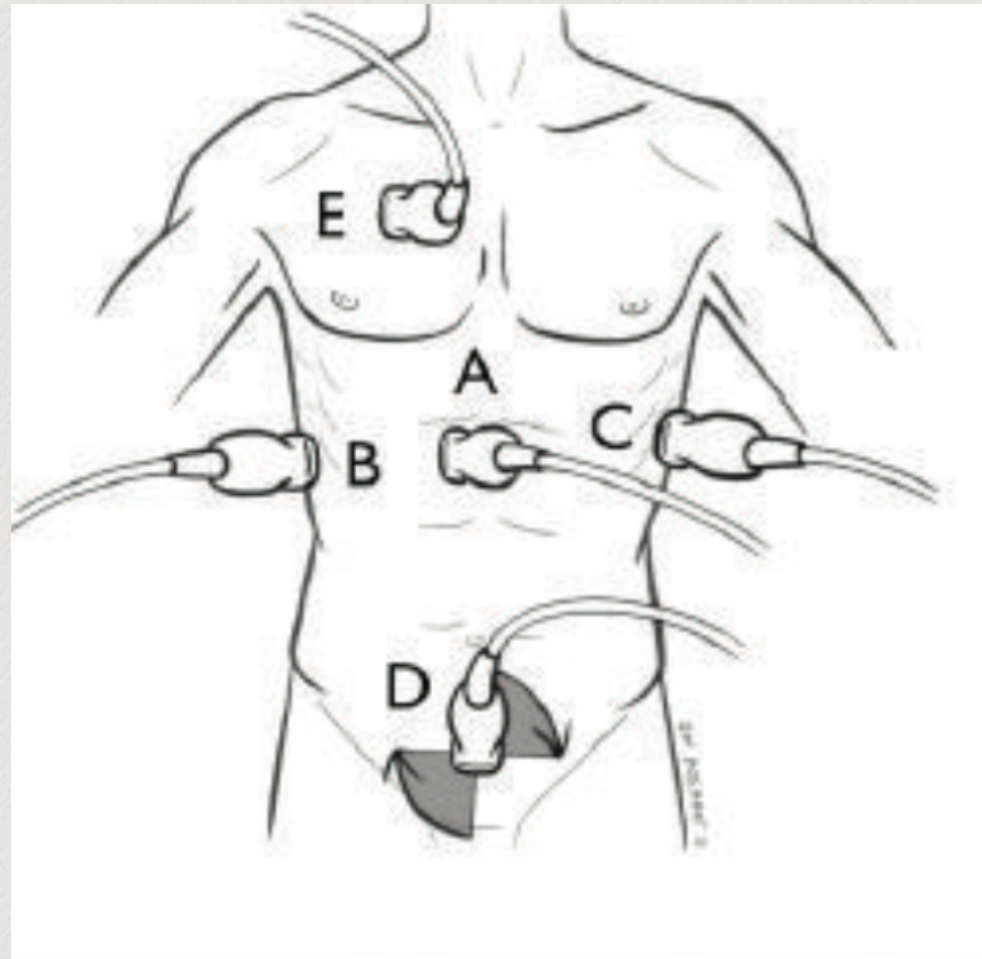
- FAST / LUQ / Pleural

- ✦ **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*

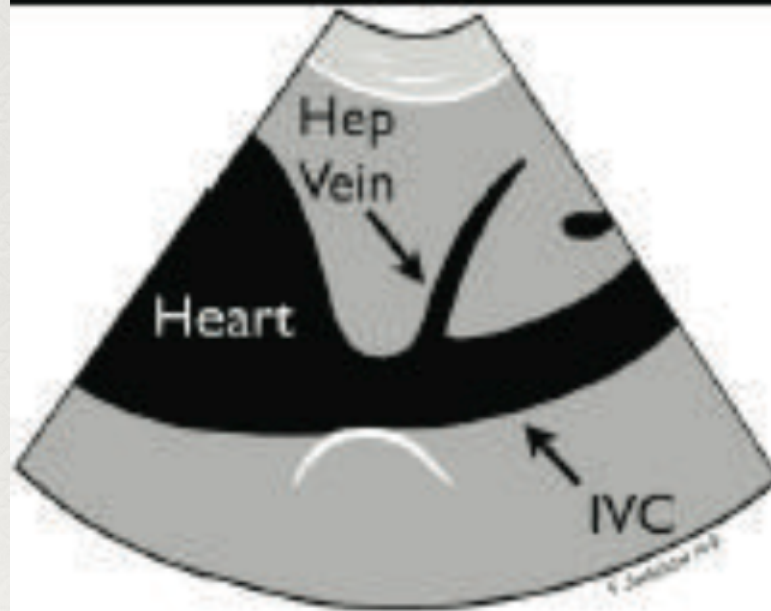
# The tank

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

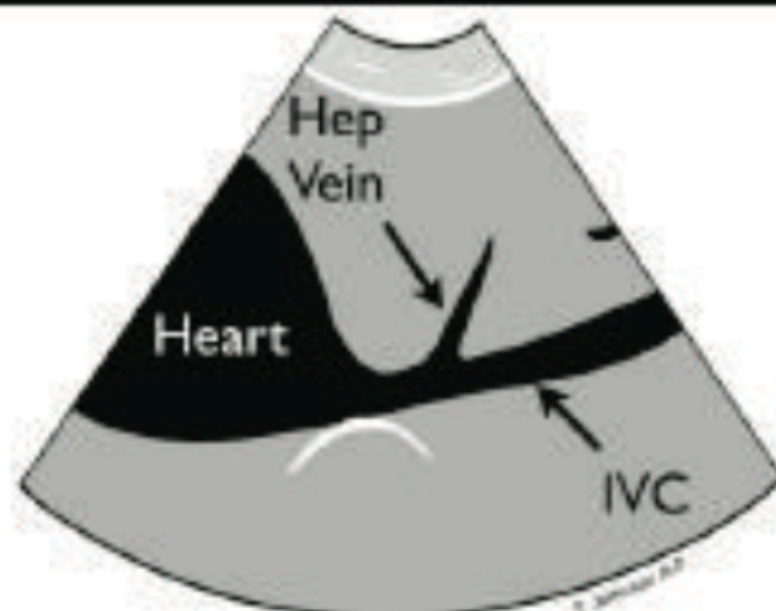


# The tank

Before Inspiration



After Inspiration



# IVC collapsibility index

**Collapsibility index :  $(D_{\max} - D_{\min}) / D_{\max} \times 100$**



# RAP and IVC collapse index

<i>IVC diameter (cm)</i>	<i>IVC collapse (%)</i>	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

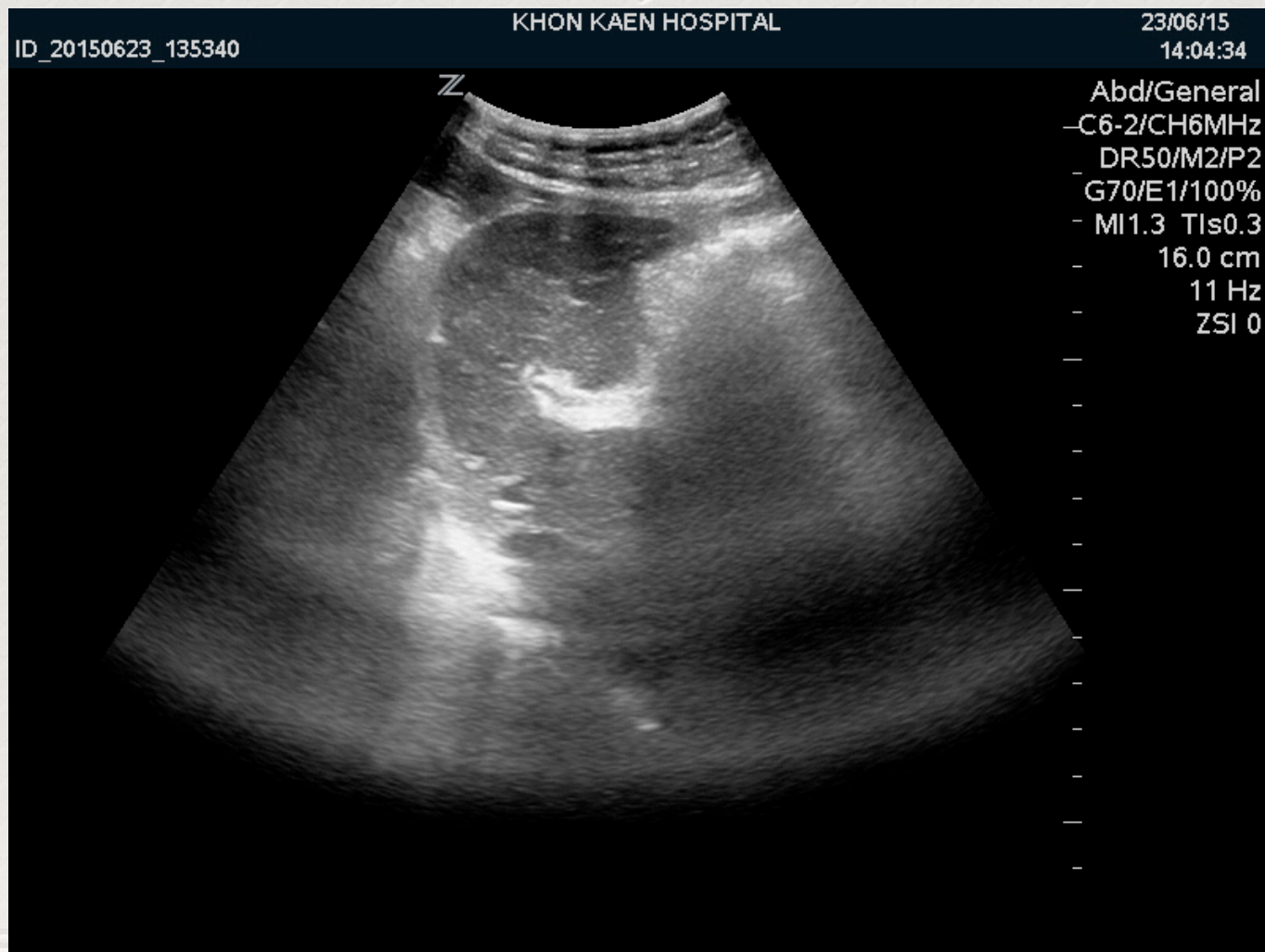
IVC distensibility index :  $(D_{\max} - D_{\min} / D_{\min}) * 100$

fluid responsiveness has distensibility index > 18%

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

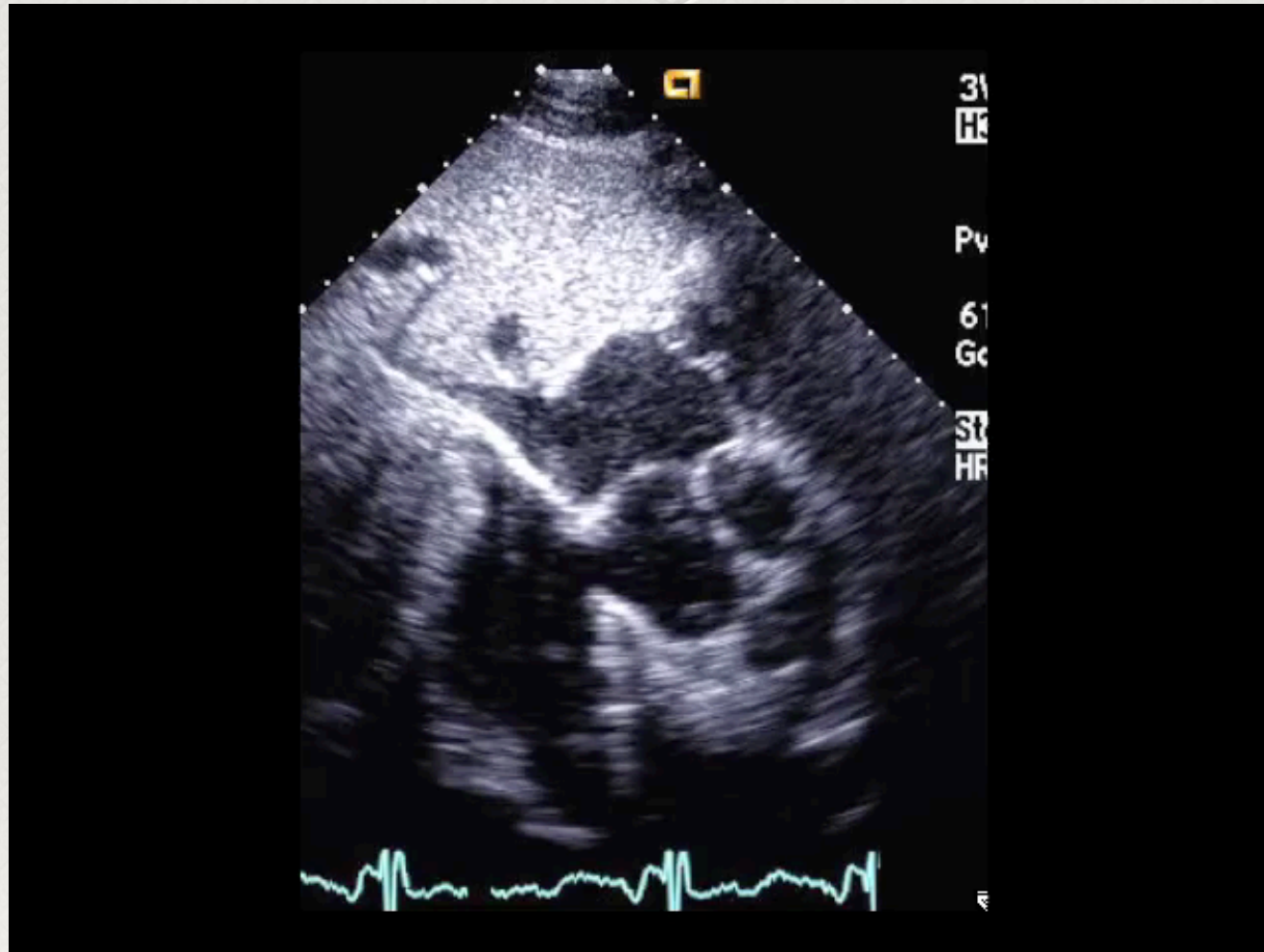
fluid responsiveness has variability index > 12%

# The tank

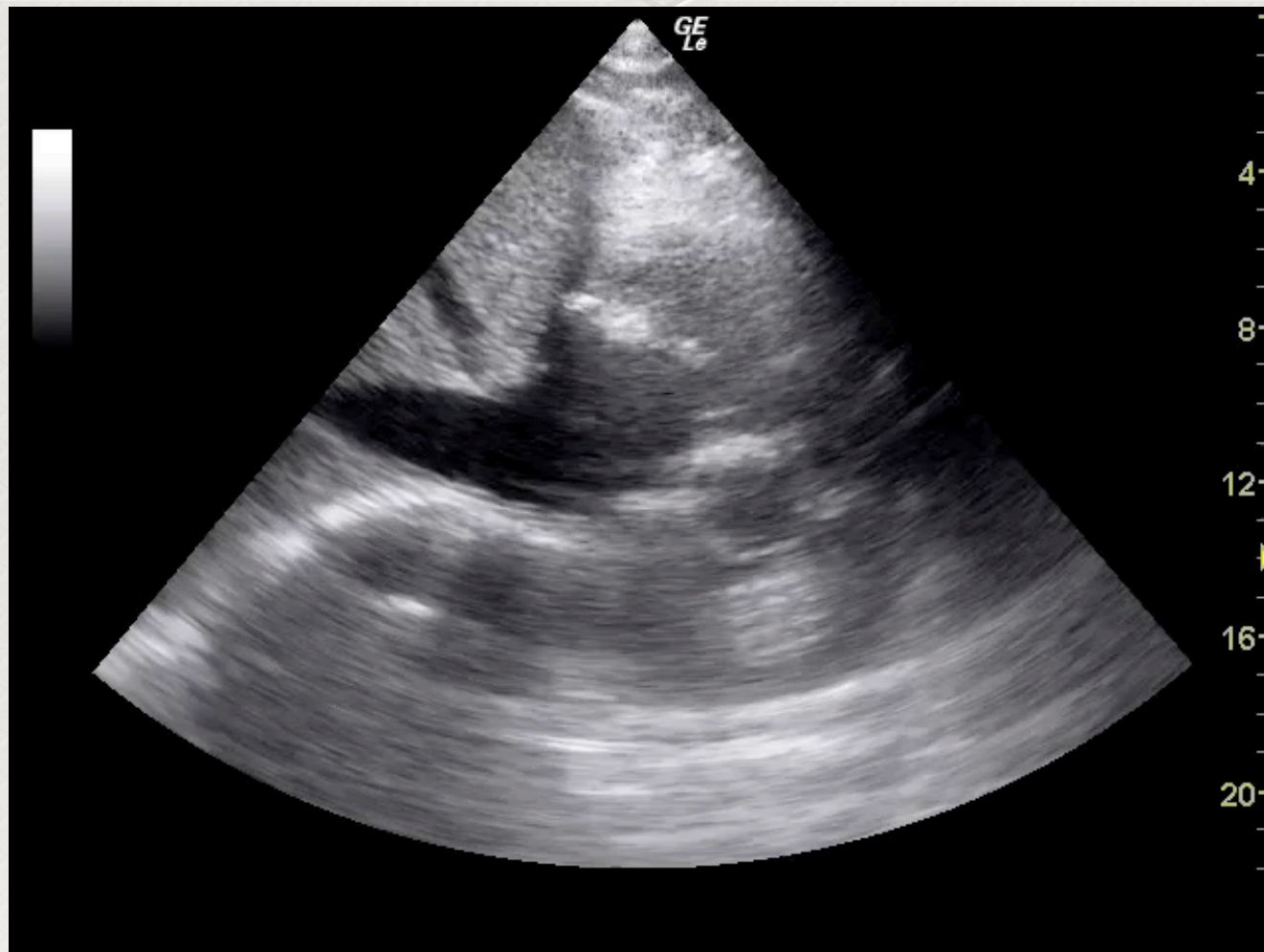




# The tank

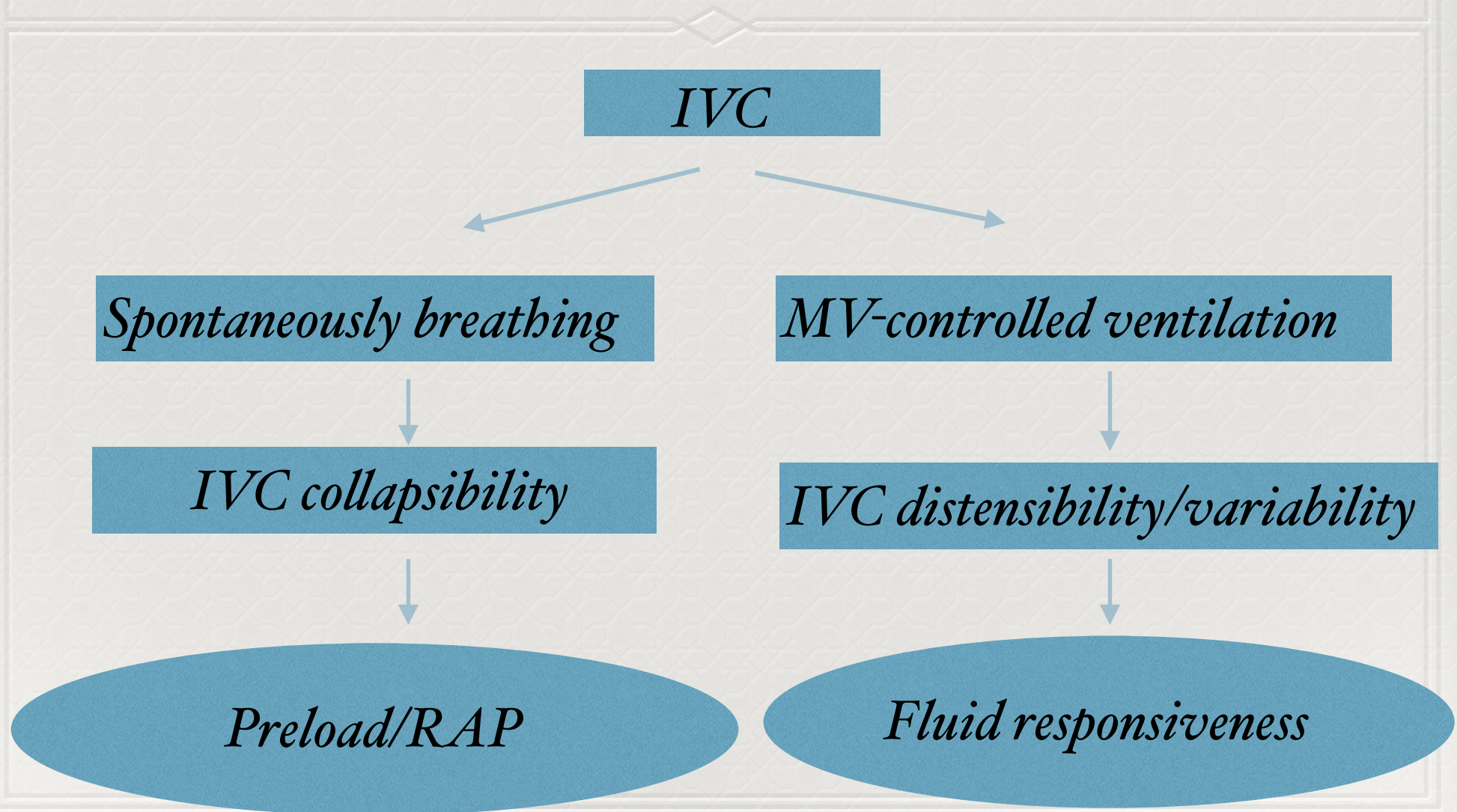


# The tank





# Fluid status assessment

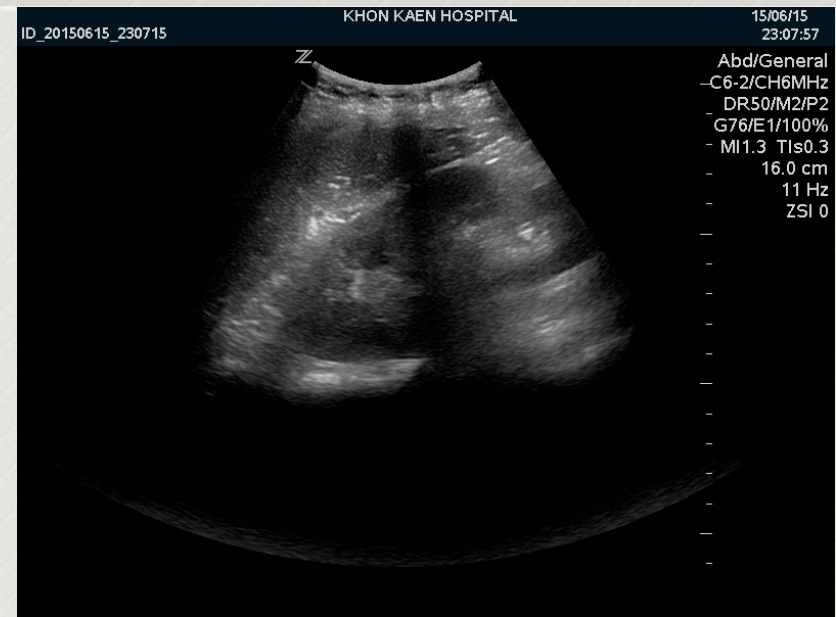
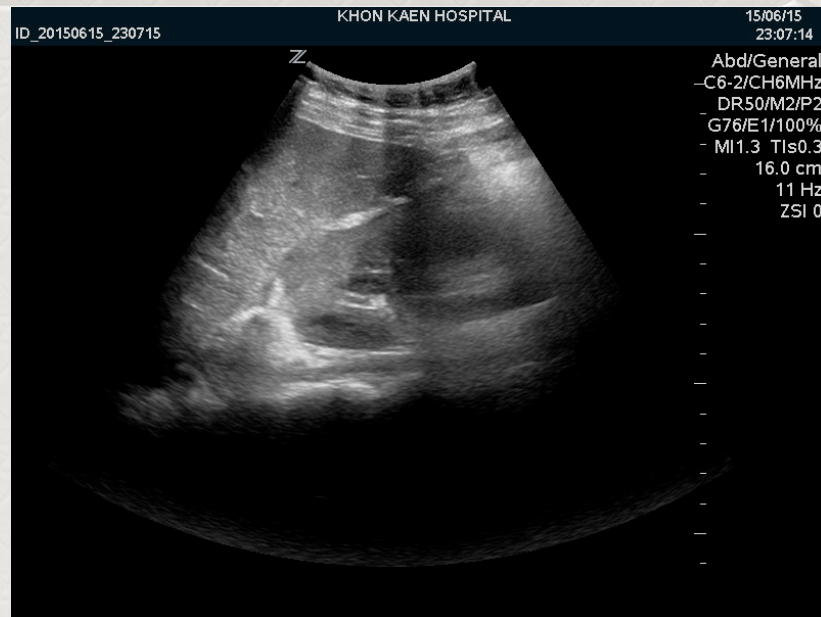


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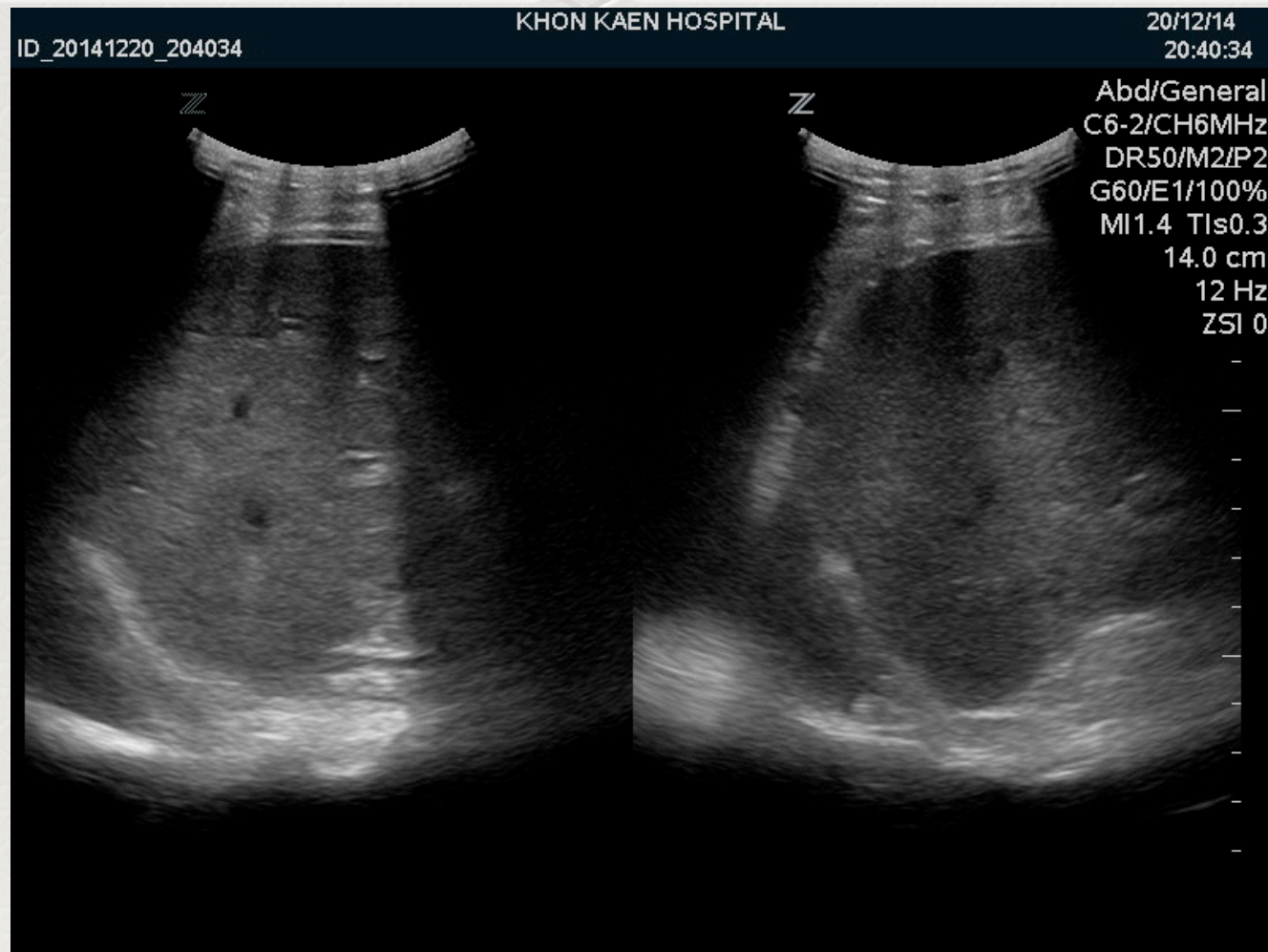
- ✿ ***Leakage of the tank / Tank overload/Tank compromise***
- ✿ *FAST*
- ✿ *Lungs ultrasound*



# The tank

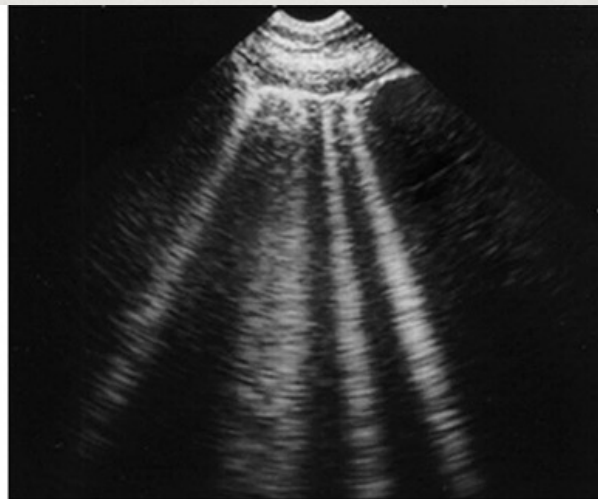


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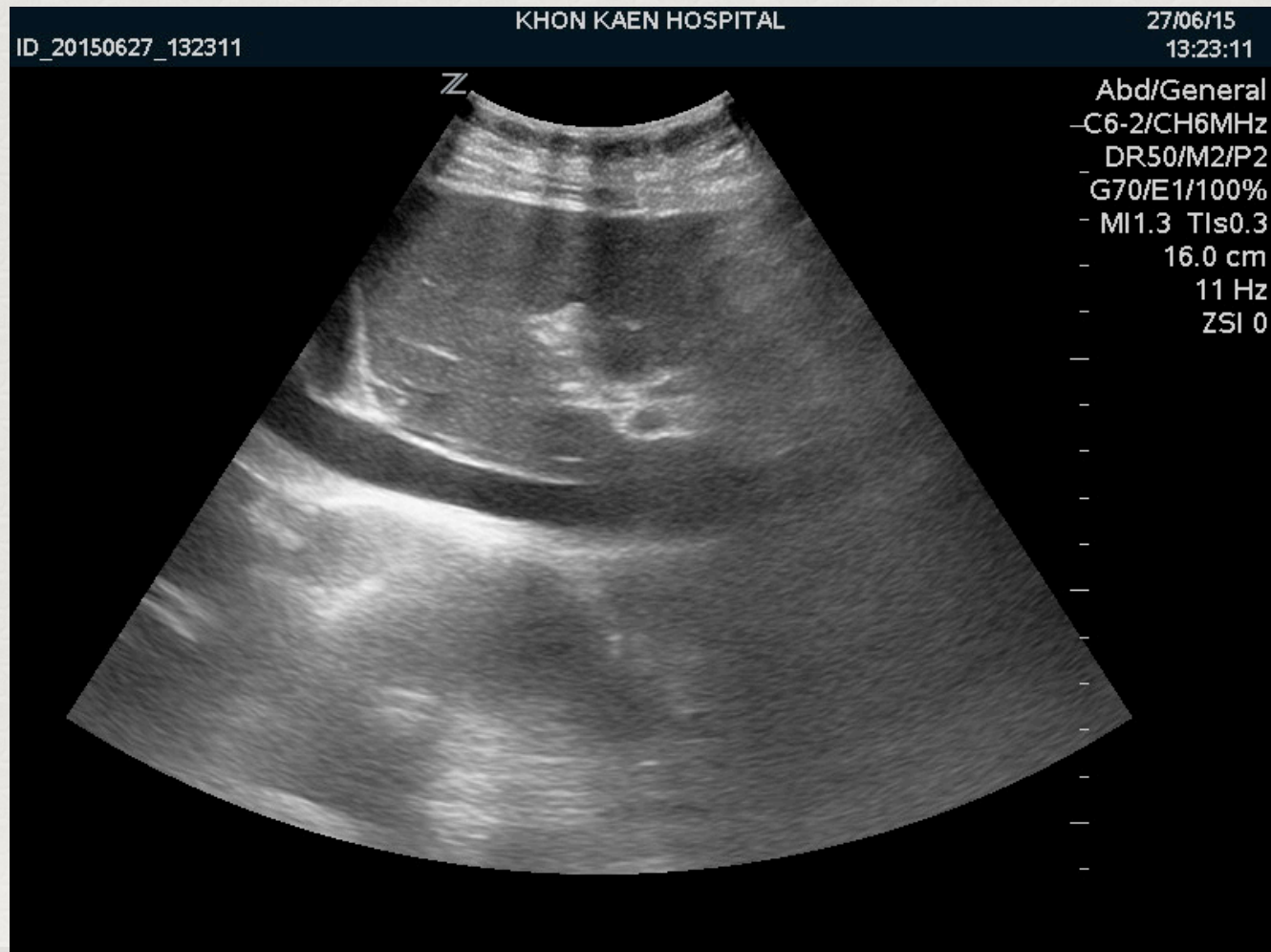




# The tank



# The tank



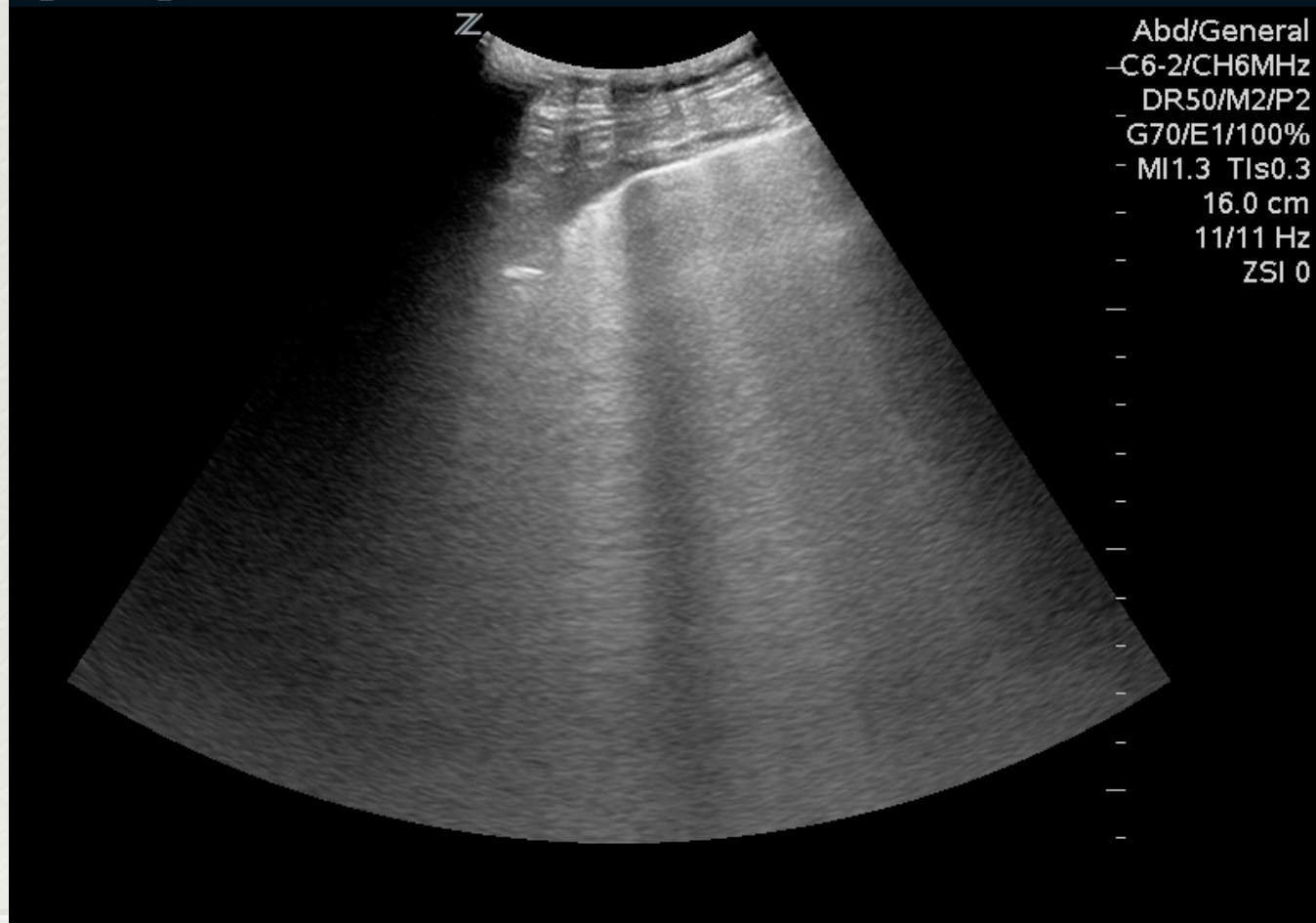


# The tank

B LINE AND IVC ,  
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# The tank

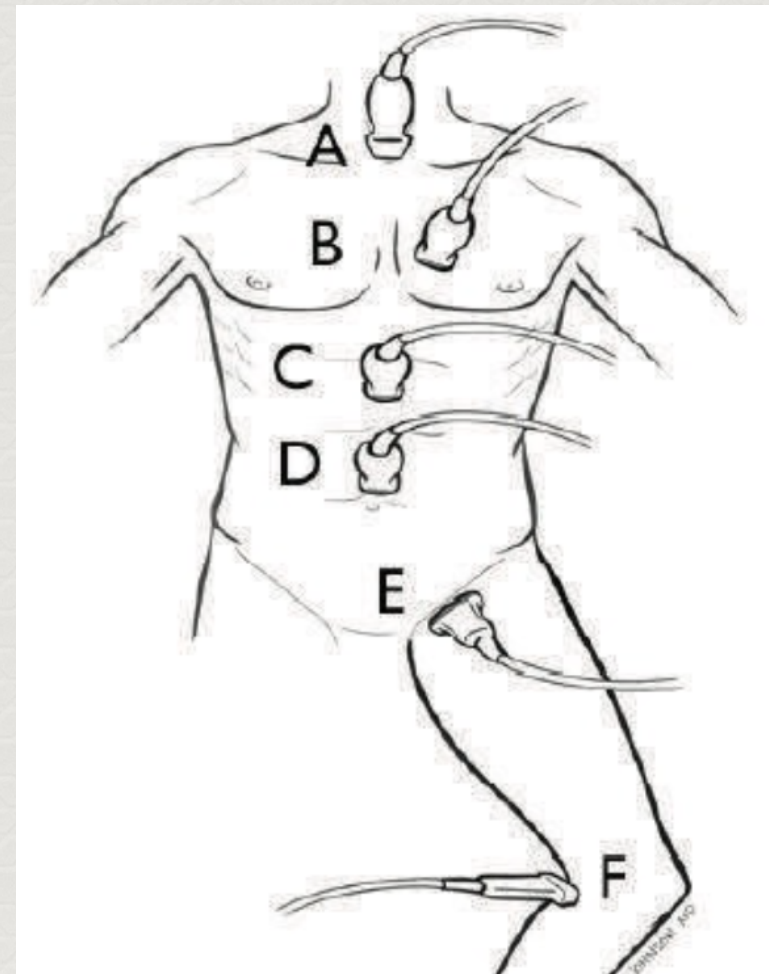




# ***“The Pipes”***

# The pipes

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

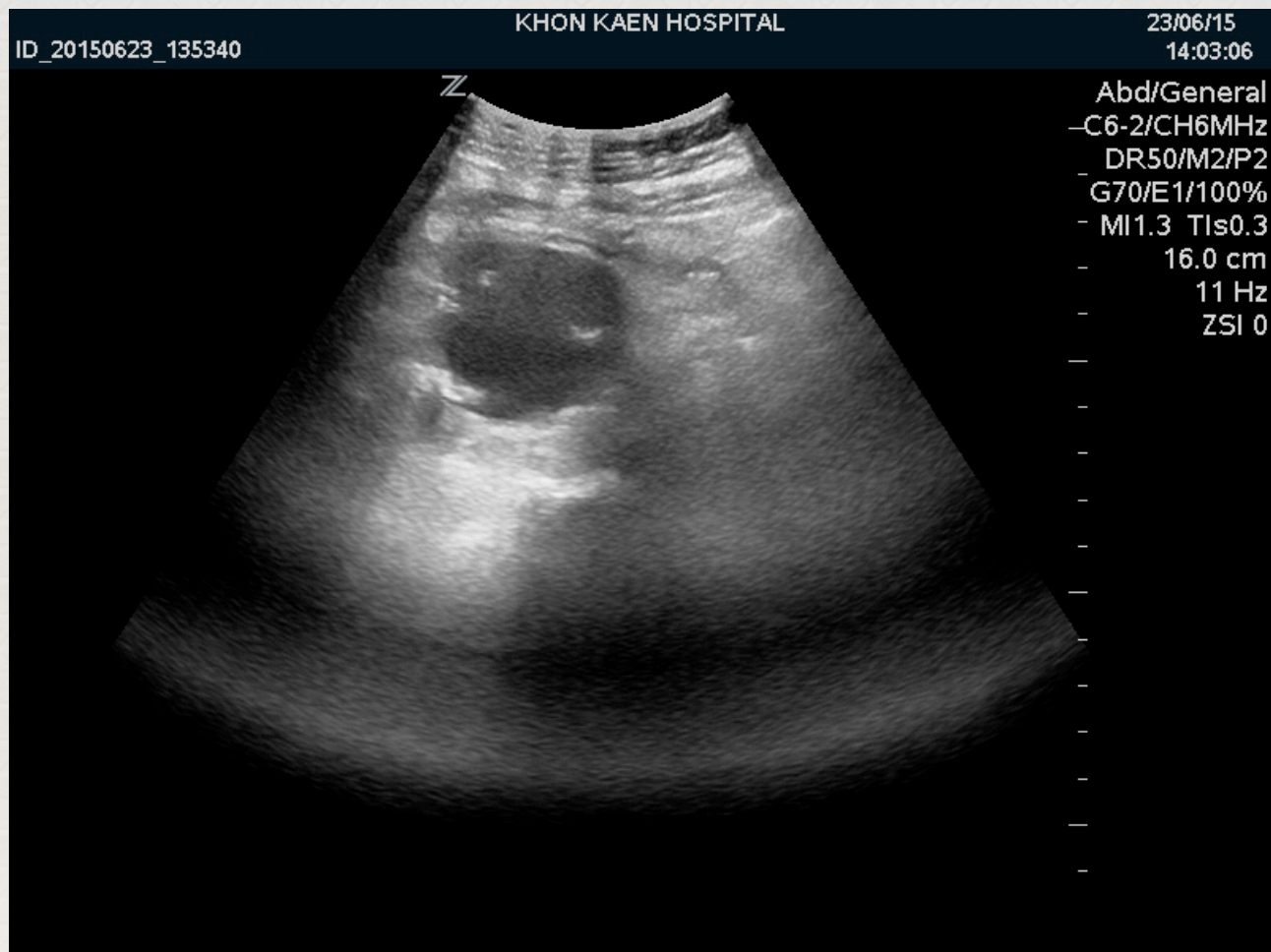




# The pipes

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

# The pipes



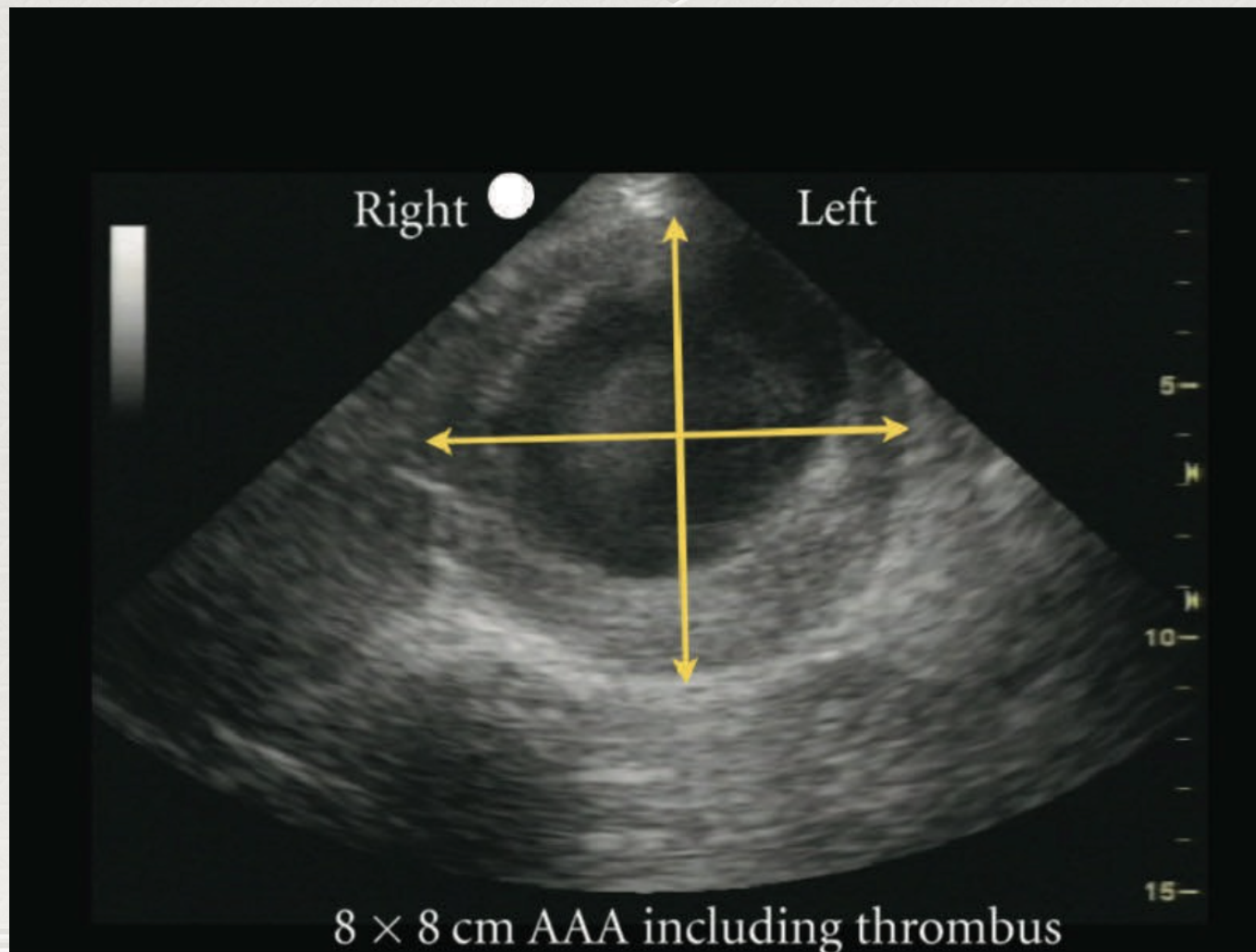


# The pipes

**AAA**

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

# The pipes

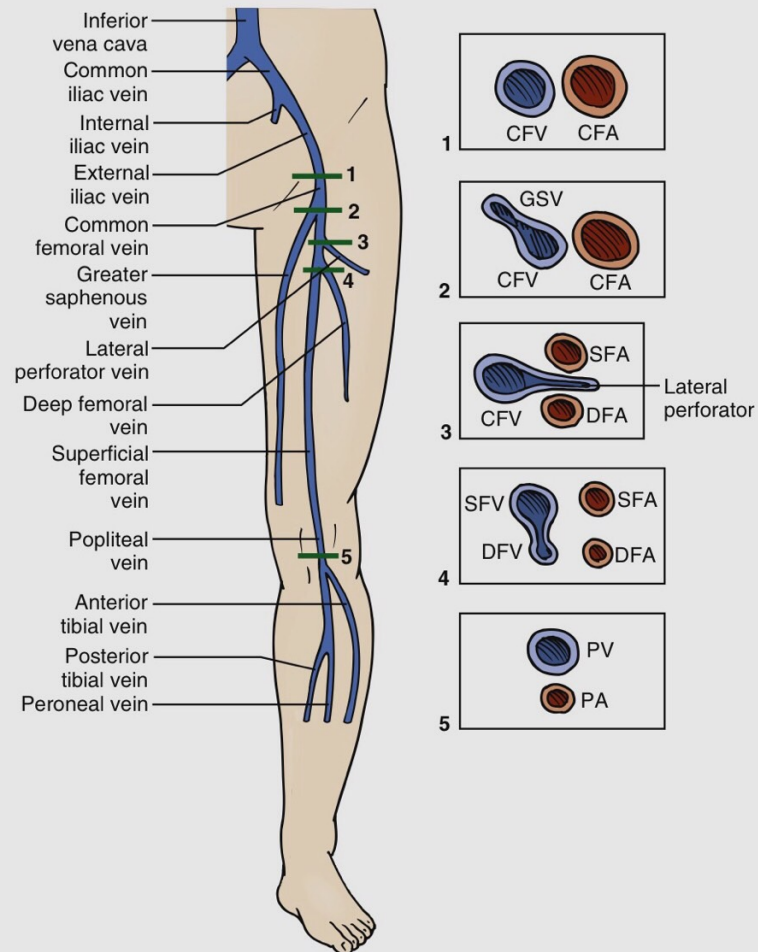




# The pipes

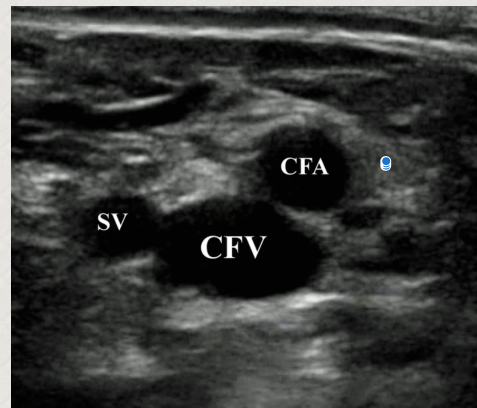
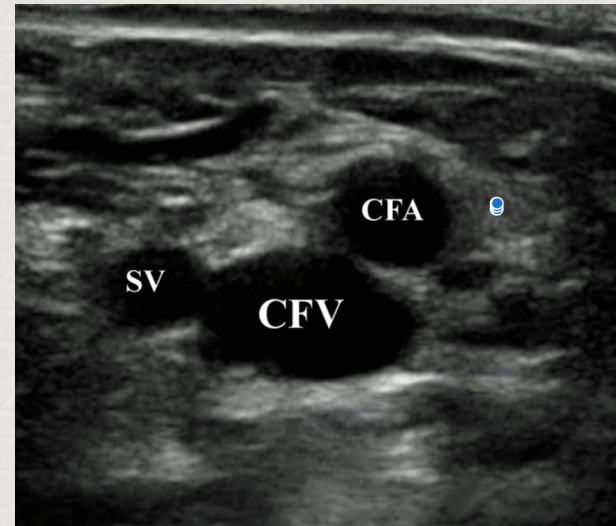
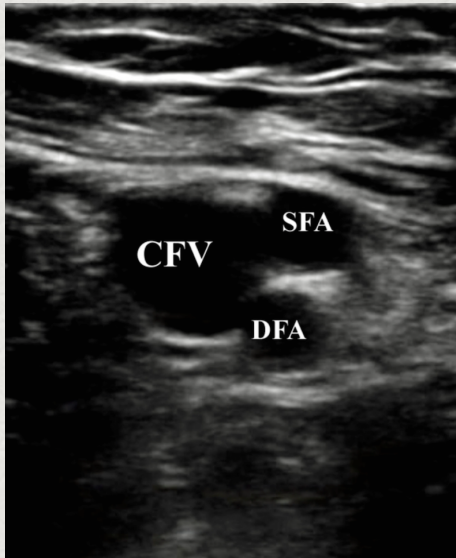
- ✿ ***Obstruction of the pipe***
  - ✿ *Thromboembolic event*
  - ✿ *Incomplete compression of the anterior and posterior walls of the vein*

# The pipes



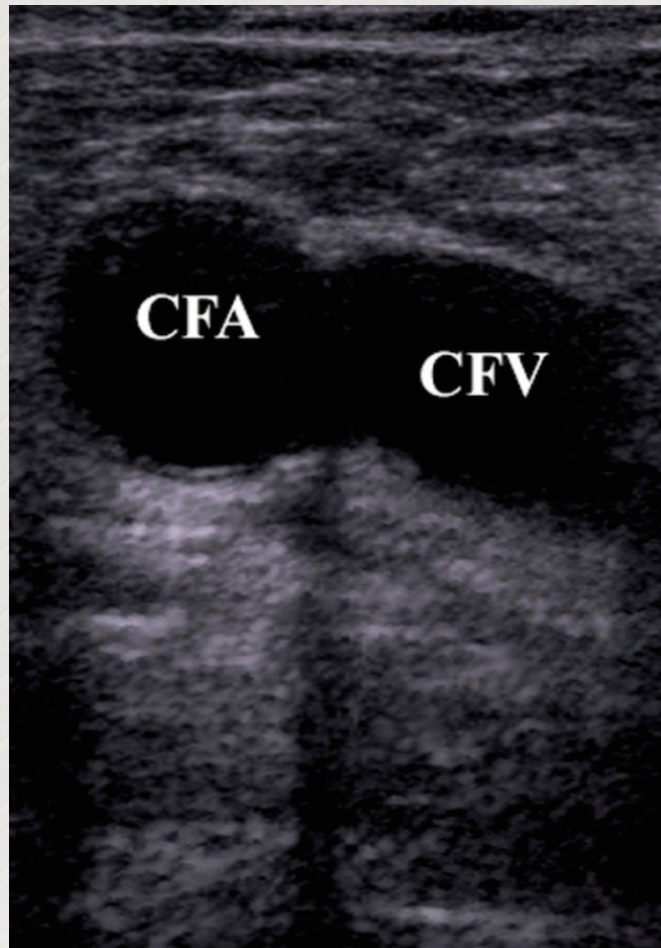


# The pipes

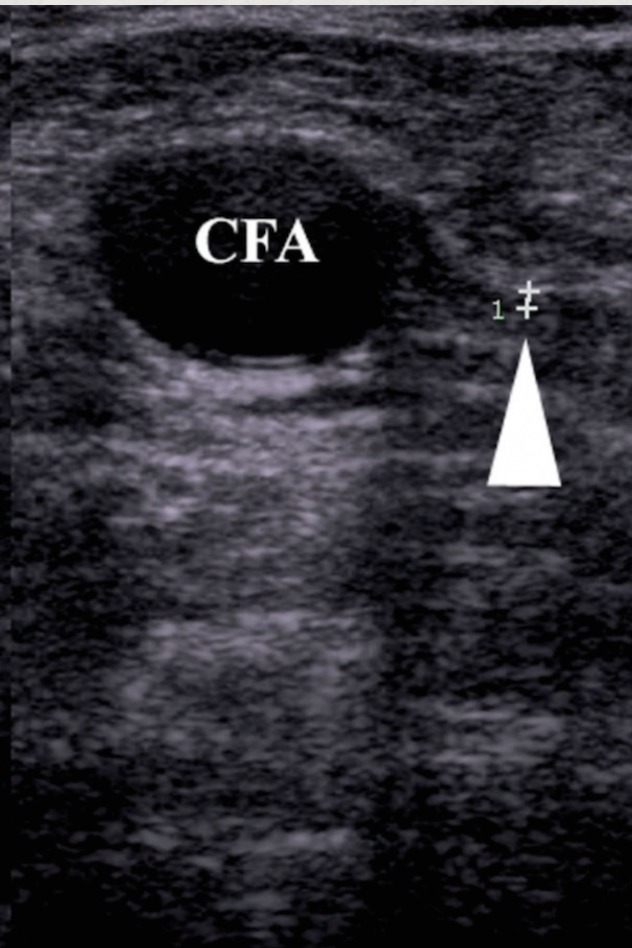




# The pipes



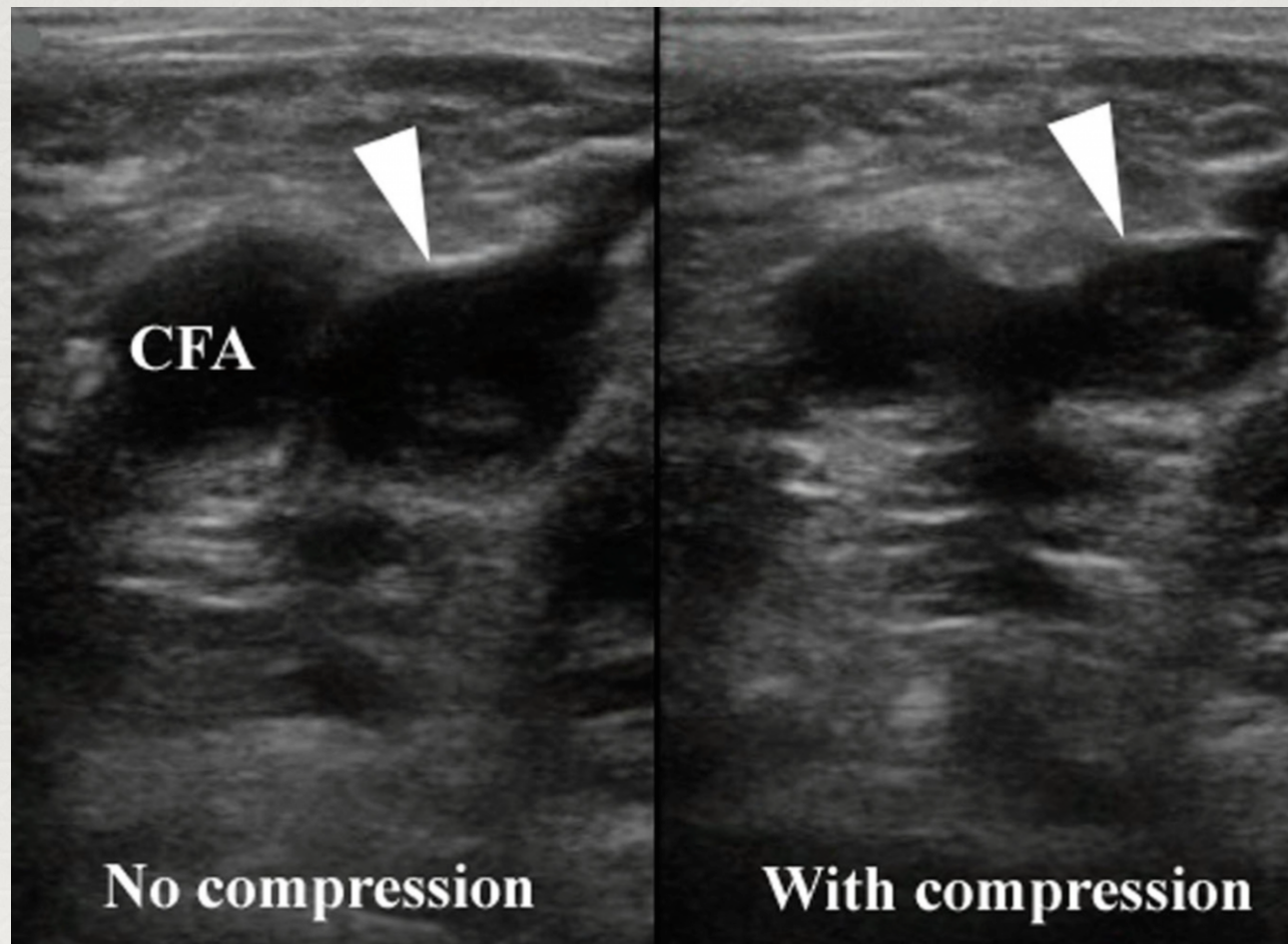
RIGHT CFV NO COMP



RIGHT CFV COMP



# The pipes



# The pipes





# Put it all together

	<i>Step 1</i>	<i>Step 2</i>	<i>Step 3</i>
<i>Pump</i>	<b><i>Pericardial eff</i></b> <i>effusion ?</i> <i>sign of tamponade</i>	<b><i>LV contractility</i></b> <i>hyper</i> <i>normal</i> <i>decrease</i>	<b><i>RV strain</i></b> <i>increase size of RV</i> <i>Septal displacement</i>
<i>Tank</i>	<b><i>Tank volume</i></b>	<b>Tank leakiness</b>	<b>Tank compromised tension</b> <b>pneumothorax</b>
<i>Pipes</i>	<b>AAA</b>	<b>Thoracic a aneurysm/ dissection</b>	<b>DVT</b>



# Rush protocol

	<i>Hypovolemic</i>	<i>Cardiogenic</i>	<i>Obstructive</i>	<i>Distributive</i>
<i>Pump</i>	<i>Hypercontractile heart</i> <i>Small heart size</i>	<b>Hypocontractile heart</b> <b>Dilated heart size</b>	Pericardial effusion, RV strain Hypercontractile heart	Hypercontractile heart (early sepsis) Hypocontractile heart (late sepsis)
<i>Tank</i>	<b>Flat IVC Flat IJV</b> <b>Peritoneal fluid</b> <b>Pleural fluid</b>	<i>Distended IVC</i> <i>Distended IJV</i> <i>Lung rockets</i> <i>Pleural effusions, ascites</i>	<b>Distended IVC</b> <b>Distended IJV</b> <b>Absent lung sliding (PTX)</b>	<b>Normal/small IVC</b> <b>Normal/small IJV</b> <b>Pleural fluid (empyema)</b> <b>Peritoneal fluid (peritonitis)</b>
<i>Pipes</i>	<b>AAA Aortic dissection</b>	<b>Normal</b>	<b>DVT</b>	<b>Normal</b>



***“Thank you”***