A. IVC DIAMETER & COLLAPSIBILITY

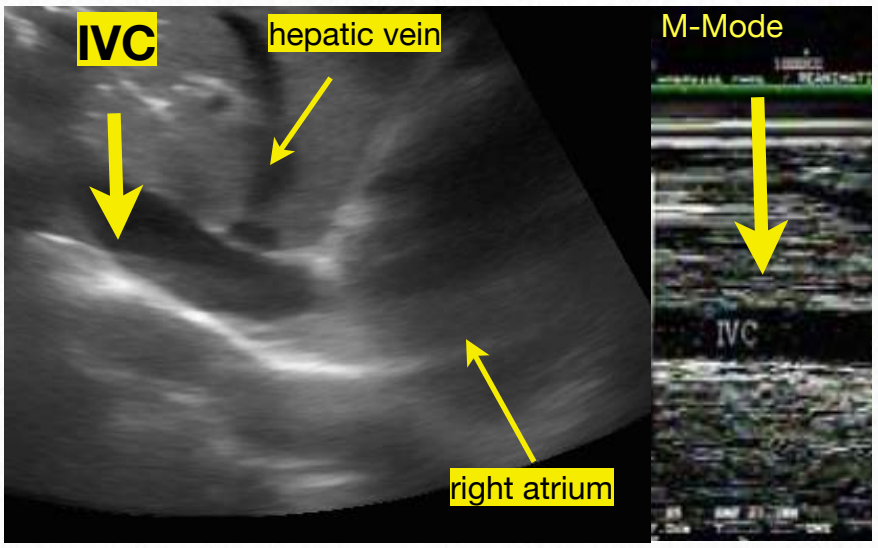
IVC Diameter:
The diameter of the IVC has been shown to accurately predict the pressure in the main vessels emptying to the heart and correlates well with CVP. Using the measure or caliber feature one can assess the diameter of the IVC in either a standard 2–D image or an M-mode image. It is important to realize that even though this modality can help predict central venous pressure, it does not indicate volume responsiveness. Please see the below table for the relationship between IVC diameter and its collapsibility to the patients CVP.

IVC Collapsibility:
Measuring the change in the IVC diameter during different phases of respiration differentiates normal subjects from patients with elevated right atrial pressure. In other words, it is normal for one's IVC to change secondary to changes in pleural pressure from respiration. If this does not occur, it suggests that the pressure in the venous system (CVP) is abnormally high. In spontaneous breathing, where one generates negative pleural pressure, the cyclic variations in pleural pressure are transmitted to the right atrium and produce cyclic variations in venous return. Specifically, with a *negative inspiratory breath,* RA filling is improved and the IVC diameter will *decrease* (since it gets unloaded). A reduction of >50% equals a CVP of less than 5 mmHg. Please see the following table for the relationship between IVC diameter, its collapsibility, and the patient's CVP. Note that when measuring the IVC diameter one uses the *maximum diameter size* achieved during expiration in a spontaneously breathing patient and during inspiration in a mechanically ventilated patient.

In a patient requiring *ventilatory support*, the inspiratory phase induces an increase in pleural pressure which is transmitted to the right atrium, thus reducing venous return into atrium and increasing the volume in the venous system. The result is an inversion of the cyclic changes in IVC diameter, leading to *increases* in the *inspiratory phase* and *decreases* in the *expiratory phase*. The same 50% rule and diameter changes apply.

Please note that in a patient presenting with signs of circulatory insufficiency, a 50% change in IVC diameter to respiration may indicate hypovolemia.

IVC Size (cm)	Changes with respiration or "sniff"	Estimated mean CVP (mmHg)
Small (< 0.5)	Collapse	0-5
Normal (1.5-2.5)	↓ by ≥ 50%	5-10
Normal (1.5-2.5)	↓ by ≤ 50%	10-15
Dilated (> 2.5)	↓ < 50%	> 15



Probes

Curved Linear

Phased Array

Probe position: To obtain this image, one should place the curved linear or phased array transthoracic probe in the subxiphoid space with the probe indicator in the 12 o'clock position. Ideal measurement of the IVC diameter should be just distal to where it merges with the hepatic vein, which is usually *2 cm to 3 cm from the IVC entry into the right atrium* (see picture below). Sometimes the IVC is completely collapsed and may be difficult to visualize (virtual IVC). Such a situation in a mechanically ventilated or spontaneously breathing patient always indicates severe hypovolemia in the absence of raised intra-abdominal pressure. 2-D imaging using the caliber/measure feature or M-Mode can be used to measure IVC diameter/ collapsibility.