01. REMINDER : VENTRICULAR INDEPENDANCE

A brief reminder of this physiological phenomenon is necessary for a full understanding of the echocardiographic anomalies observed in ACP.

Normally, the right and left ventricles contract at the same time, during systole. When right ventricular ejection is hindered, as in ACP, right ventricular contraction is prolonged, whereas contraction of the left ventricle (LV) has already started its diastolic phase. The persistent pressure of the RV then reverses the transseptal pressure gradient, the pressure acting on the right ventricular face exceeding that on the left ventricular face. This pushes the septum to the left, as seen in ACP at the start of diastole.

This septal flattening persists throughout diastole, since the right ventricular filling pressure is greater, because of diastolic overload (fig. 1). But at the beginning of systole, the transseptal pressure gradient is again reversed, and the septum is pushed towards the right ventricular chamber (Figure1). This results in the “paradoxical” movement of the interventricular septum.

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Another important physiological feature to take into account is the rigidity of the pericardium surrounding the two ventricles. Any right ventricular dilatation occurs at the expense of the left ventricle, which is compressed (Figure 2).

A final physiological parameter to recall is that right ventricular size varies with the quality of its filling: hypovolemia can markedly reduce the dimensions of the right ventricular chamber, and this disorder must be corrected before the echocardiographic examination if the results are to be interpreted correctly. Insufficient venous return affecting right ventricular size can be detected by ultrasound examination of the vena cavae (2, 3, 4). In particular, in a ventilated patient, partial or complete collapse of the superior vena cava on mechanical insufflation indicates hypovolemia.

Film 1 : Transesophageal echocardiography (TEE) longitudinal view of the superior vena cava (SVC) in a patient mechanically ventilated because of sepsis caused by lung disease. Two-dimensional imaging (on the right) coupled to M-mode (on the left) reveals collapse of the SVC on each insufflation. This image is suggestive of hypovolemia and indicates the need for volume expansion.

Film 2 : In the same patient as in film 1, volume expansion has corrected the circulatory insufficiency and eliminated SVC collapse on insufflation.

Media

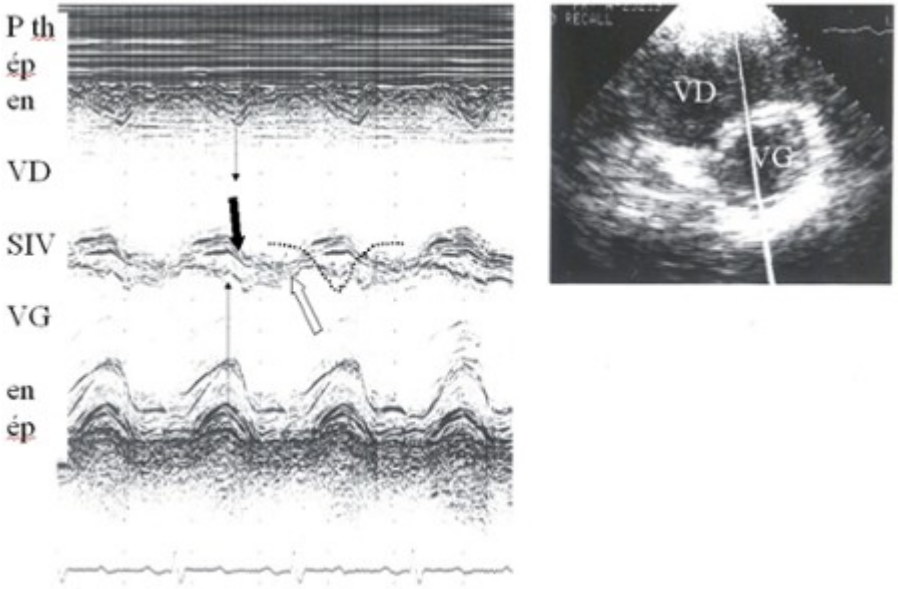

Figure 1

Figure 1

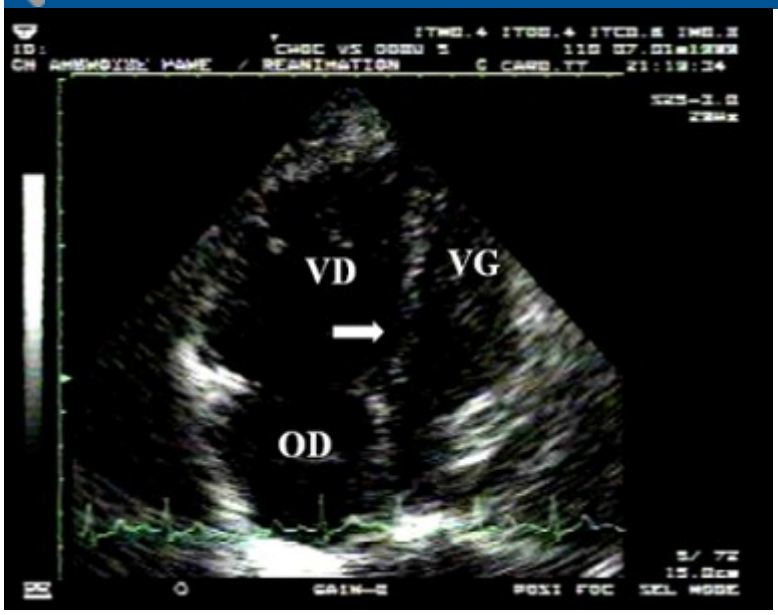

Figure 2

Figure 2

Figure 1 : : Paradoxical septal motion of acute cor pulmonale. Guided by the two-dimensional image, a short-axis parasternal approach is used for M-mode recording of the different structures crossed by the ultrasound: ThW: anterior thoracic wall, ep: epicardium, en: endocardium, RV: right ventricular chamber, IVS: interventricular septum, LV: left ventricular chamber. The thin vertical arrows indicate the end of ventricular contraction and the delayed end of right ventricular contraction on the left, inducing protodiastolic septal displacement, indicated by the thick black arrow. The septum remains displaced throughout diastole, and is again pushed towards the right ventricular chamber on the next left ventricular contraction (thick white arrow). Theoretical normal septal movement is shown in dotted lines to highlight the paradoxical motion.

Figure 2 : Major right ventricular dilatation during massive pulmonary embolism. The right atrium (RA) and the right ventricle (RV) are very dilated on this apical four-chamber view. The left ventricle (LV) appears compressed by septal displacement (arrow).