



## 10 Good Reasons for Cardiac US in the ICU



Since most patients admitted to the ICU for cardiorespiratory compromise who die do so because of haemodynamic failure or fluid overload, haemodynamic monitoring is key to their management. This study, published in the journal *Anaesthesiology Intensive Therapy*, focused on critical care echocardiography (CCE) and its ability to monitor haemodynamics.

"Experts in haemodynamics have published a 'consensus of 16' regarding an update on haemodynamic monitoring. They reported the 10 key properties of an 'ideal' haemodynamic monitoring system, which perfectly match the 10 good reasons we describe here for performing CCE in critically ill patients," say Cyril Charron and co-authors.

The authors hope these 10 reasons for using CCE will convince intensivists to seek training in, and to use, echocardiography at the bedside to optimise patient management.

### 1. Measures Relevant Variables

CCE plays a central role in functional haemodynamic monitoring, which is a way to monitor haemodynamics more qualitatively and less invasively. A good example is the need for fluids. In the past, the main goal was to evaluate cardiac preload using pulmonary artery occlusion pressure or central venous pressure (CVP), neither of which is very relevant for fluid adaptation because of their well-known limitations.

With the functional haemodynamic monitoring approach, the goal now is to evaluate preload responsiveness, which CCE has been reported to predict well, using, as an example, vena cava respiratory variations with good sensitivity and specificity. CCE is also able to evaluate right heart function accurately, to detect acute cor pulmonale in different situations, and to recognise left ventricular (LV) dysfunction.

### 2 and 3. Provides Accurate and Reproducible Measurements; Is Operator-Independent

Whereas the first assertion is true, the second is debatable. As emphasised above, many echocardiographic parameters in critically ill patients have been reported to be accurate for evaluation of cardiac function and preload responsiveness. Reproducibility has also been studied for the usual echocardiographic parameters. Intra- and inter-observer variabilities of between 3-10 percent have been reported.

Logically, better image quality and acquisition result in better reproducibility. Thus, in the authors' view, transoesophageal echocardiography (TEE) in mechanically ventilated patients is probably more accurate and reproducible, and less operator-dependent, than transthoracic echocardiography (TTE).

### 4. Provides Interpretable Data

Since echocardiography directly visualises the cardiac chambers and ventricular contraction, parameters are by definition interpretable, provided image acquisition is adequate. In a clinical study of 128 transthoracic procedures, Vignon et al. reported quality that was good in 55 percent of cases, suboptimal in 23 percent, and poor in 22 percent. In the event of TTE failure, TEE was very efficient.

### **5. Is Easy to Use**

CCE can be defined as basic or advanced. Basic CCE, also called goal-directed echocardiography, is a procedure based on TTE which allows a focused and rapid exam to diagnose obvious haemodynamic profiles, such as profound hypovolemia and severe LV systolic dysfunction. Provided that appropriate skills acquisition is included in the training curriculum of all intensivists, one can say that basic CCE is (or will be) very easy to use. To acquire the necessary skills, a 10-hour course is recommended, divided into lectures and illustrative cases, plus at least 30 fully supervised TTE exams in unstable patients.

Advanced CCE is quite different in that it allows a full haemodynamic evaluation. It requires formal certification following a 40-hour course, 100 supervised TTE and 35 supervised TEE exams. Given these requirements, it is hard to maintain that advanced CCE is currently easy to use, but there are an increasing number of certification courses (local or international) open to intensivists.

### **6. Is Readily Available**

Even though no recent survey has been done, one can nonetheless say that most ICUs now have one ecocardiography machine available 24/7. Similarly, TEE probe cleaning is better performed in the unit by the team itself.

### **7. Has a Rapid Response Time**

In a recent multicentre study of the ability of 41 trainees to evaluate haemodynamics adequately in mechanically ventilated patients using TEE, Charron et al. reported that after six months and  $31 \pm 9$  supervised TEE examinations per trainee, they were able to perform a full haemodynamic evaluation adequately in about 13 minutes.

### **8. Causes No Harm**

Whereas TTE is completely noninvasive, TEE can be considered as minimally invasive. When contraindications are strictly respected, side effects are few. In a large study of 2,508 TEE examinations, Hüttemann et al. reported a 2.6 percent incidence of complications. Most of these complications could actually be considered minor and most occurred in spontaneously breathing patients.

### **9. Is Cost-Effective**

Some studies indirectly suggest that, by limiting fluid overload, CCE may reduce the length of stay in the ICU and mortality compared to management using CVP. Also, the cost of echocardiography machines has significantly decreased over time and new 'pocket' machines are now available at a very low price (< \$10,000).

### **10. Should Provide Information That Can be Used to Guide Therapy**

Many studies reported a therapeutic impact in 20–68 percent of cases when TEE was performed in addition to the rest of the haemodynamic evaluation. In these studies, TTE also had a significant therapeutic impact when adequate images were obtained.

Image Credit: GE Healthcare

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