Editorial

Echocardiography is a feasible tool for assessing volume responsiveness

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Shock remains a common and lethal syndrome. Despite several scientific advances, administration of intravenous crystalloid remains a key therapy. Inappropriate administration of fluid, however, results in increased mortality and morbidity. Over the past decade, it has become apparent that the conventional methods of assessing fluid responsiveness with static measures, like central venous pressure, are inaccurate. Several small studies have demonstrated the utility of echocardiographic measures that exploit heart-lung interactions to predict fluid responsiveness in selected patients. Vignon and colleagues recently compared multiple echocardiographic indices to predict fluid responsiveness in ventilated patients (1). Their study is commendable for its large size, and its inclusion of several different categories of acute circulatory failure, including sepsis, hypovolemia, and cardiogenic shock. Also commendable is their reporting of feasibility. The inferior vena cava, pulse pressure variation, and aortic velocity could not be measured in 22% of patients due to image acquisition or absence of sinus rhythm, while superior vena cava could be measured in nearly all patients. It also appeared that superior vena cava collapsibility was the most predictive of the echocardiographic measures.

Feasibility is a challenging aspect when studying novel therapies or diagnostic techniques. Typically, initial studies are small in size, and ignore feasibility. Several patients are excluded in order to increase the internal validity. The initial studies that demonstrated diagnostic accuracy of aortic velocity variation, or vena cava diameter variation were small, usually less than 50 patients, and were studied only under specific physiologic states, such as sepsis, or passive mechanical ventilation (2-4). Typically, enthusiasm for these novel techniques is based on the initial studies, and feasibility is rarely assessed until after widespread adoption. It is only much later that larger studies will negate or demonstrate reduced effect size of initial study. A key reason for the decreased effect size in subsequent larger studies is decreased external validity and decreased generalizability (5). Vignon and colleagues have presciently assessed the feasibility of these measurements for patients in a mixed intensive care unit before these assessments have been fully adopted by the average intensivist. The high diagnostic accuracy and high feasibility of these techniques suggest that it is reasonable to apply them in the critical care setting. Despite the reported high feasibility, these measurements still are limited only to patients receiving mechanical ventilation who are either receiving neuromuscular blockade or are sedated so heavily as to not generate any spontaneous breathing effort. While the study intensive care unit had a large proportion of patients passively ventilated, these patients may be less common in several contemporary medical intensive care units (ICUs). In one mixed ICU that where such sedation is rare, those ultrasound measurements were feasible in around 1% of patients receiving fluid challenges (6).

Another aspect of Vignon's study worth considering is the

use of a passive leg raise as a surrogate for successful volume expansion. As excess fluid administration can be harmful, it was deemed unethical to actually administer fluid in every patient. While the passive leg raise is not a perfect surrogate for successful volume expansion, it is fairly accurate in many physiologic states including circulatory shock from several etiologies, in spontaneous and passive breathing, and with regular or irregular heart rhythm (7). Despite its accuracy and its age, the passive leg raise is not widely utilized in all intensive care units. The lack of nursing enthusiasm for passive leg raise may be improved with a pivoting bed, which decreases nursing burden for assessing passive leg raise. In the absence of a pivoting bed, a bedside clinician may have to hold the legs up for 1–2 minutes to perform the assessment. Even with enthusiastic participants, there are certain states where the passive leg raise may be inaccurate or infeasible, such as pregnancy, intraabdominal hypertension, unstable hip fracture, or intracranial hypertension. Although these patients were not explicitly tested in Vignon's study, ultrasonographic assessments might be a useful method of determining fluid responsiveness in patients where a passive leg raise is infeasible, or where there are insufficient personnel or equipment to perform passive leg raise.

The key obstacle to utilizing echocardiographic assessment of hemodynamics has always been an assumption that acquisition of skills is too difficult for average intensivist. This assumption is incorrect. Over a decade ago the American Medical Association (AMA) published a resolution that ultrasound imaging is "*within the scope of practice of appropriately trained physician*" (8). These skills described by Vignon and colleagues are specifically taught at courses hosted by multiple professional societies and universities, and are increasingly taught in fellowship training. Venues also exist for self-training. One can achieve proficiency in basic critical care echocardiography in less than 24 hours (9-12). Even those clinicians with minimal training can obtain appropriate information in under 2 minutes (10). The fourth edition of the surviving sepsis campaign guidelines mention echocardiography as a useful tool for detailed assessment of the causes of hemodynamic issues (13). The 2014 European Society of Intensive Care Medicine consensus statement on circulatory shock proposes echocardiography as a first-line modality for evaluation of shock (14).

While ultrasound training for intensivists and emergency medicine physicians continues to increase in popularity, we have not yet reached the point where the skill is as ubiquitous as interpretation of chest radiographs or electrocardiograms. While the field of critical care echocardiography is evolving, the barriers to training are sufficiently low and the evidence of value is sufficiently high to advocate that all intensivists should have at least basic critical care echocardiography training.

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Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

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