CHEST

Critical Care Transesophageal Echocardiography for the Resuscitation of Shock

An Important Diagnostic Skill for the Modern Intensivist

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Shock is the next-door neighbor of death: a harrowing final pathway that, for centuries, has incited clinicians to push the boundaries of resuscitative science. Although many cases of shock pose little diagnostic dilemma, cases of undifferentiated or mixed shock continue to challenge the modern intensivist.

Fortunately, the phenotyping of shock can often be done with basic history and physical examination: extremity temperature, pulse characteristics, pulse pressure, and the pretest probability for a specific disease process based on clinical history. When these are integrated with laboratory and imaging data, their diagnostic utility is further augmented. As patient multimorbidity increases, however, the interplay between acute and chronic disease distorts the archetypal Venn-diagram of shock subtypes. Additionally, for the moribund patient, the causes of shock converge clinically and are difficult to diagnose based on examination alone. These challenges have led many intensivists to adopt critical care echocardiography (CCE) as a first-line diagnostic tool for shock.[1]

CCE is effective for phenotyping shock and for guiding ongoing resuscitation. Its safety, portability, and repeatability have made it a cornerstone of resuscitative diagnostics.[1] In addition to the hemodynamic data provided, which can be obtained by other more invasive monitoring tools (eg, pulmonary artery catheter), CCE provides an anatomic explanation for deranged physiologic condition. In some critically ill patients, however, limited acoustic windows, patient positioning, and other competing clinical interests limit the diagnostic power of transthoracic echocardiography (TTE). As well, some commonly used TTE markers of fluid responsiveness (eg, inferior vena cava collapsibility) have poor diagnostic performance.[2] These barriers have led clinicians to search for alternative hemodynamic assessment modalities.

Although CCE traditionally is viewed as a transthoracic technique, critical care transesophageal echocardiography (ccTEE) has emerged as an alternative diagnostic tool for patients with shock.[3] Similar to transthoracic CCE, ccTEE is a modality of scalable complexity: from core resuscitative views to advanced hemodynamic profiling that include the assessment of fluid responsiveness.[3] When implemented, ccTEE often results in a change in diagnostic and management strategies, even when performed by providers with limited training.[4] The diagnostic yield of ccTEE is often additive to TTE, with ccTEE resulting in additional changes in management beyond TTE in up to 40% of patients.[4] Furthermore, intensivist-performed ccTEE has similar diagnostic accuracy for a variety of pathologic conditions when compared with cardiology performed TEE.[5] These potential advantages of ccTEE, coupled with its relative ease of image acquisition, make it an ideal diagnostic tool for undifferentiated or refractory shock.

For the patient who is hemodynamically deranged, a resuscitative transesophageal echocardiography (TEE) protocol with focused views is effective for phenotyping

ABBREVIATIONS: CCE = critical care echocardiography; ccTEE = critical care transesophageal echocardiography; TEE = transesophageal echocardiography; TTE = transthoracic echocardiography

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shock, even for providers with limited and primarily simulation-based training.[3,4] These resuscitative ccTEE views can identify severe left or right ventricular dysfunction, pericardial disease, catastrophic valvular pathologic conditions, and unexpected causes of shock that include dynamic left ventricular outflow track obstruction or extrinsic cardiac compression.[3,4] Additionally, resuscitative ccTEE views can help guide invasive procedures that include extracorporeal membrane oxygenation cannulation.[4]

For the patient whose shock type has already been diagnosed, ccTEE can also be used to guide the titration of IV fluids, vasopressors, and inotropes, although these are more advanced applications.[4] For patients with hemodynamic instability, for example, up to one-half of patients are not fluid responsive; that is, they will not increase their cardiac output after a fluid bolus.[2] Giving IV fluids to patients who are not fluid responsive has no potential benefit and exposes them to the risks of iatrogenic volume overload.[2] Transthoracic CCE has well-validated techniques to assess fluid responsiveness, with left ventricular outflow track velocity time integral measurements before and after a passive leg raise having high predictive accuracy for fluid responsiveness; however, the required views can be difficult to obtain for some critically ill patients.[2] One advantage to ccTEE is its close proximity to the heart, which yields excellent views irrespective of body habitus or hyperinflation of the lungs. This allows ccTEE-derived left ventricular outflow track velocity time integral measurements to be repeated serially with minimal time required to reobtain views.

The high diagnostic yield of ccTEE is complemented by its relative safety.[4] Although complications are reported in the literature, the majority are minor oropharyngeal bleeding.[4] Cases of more severe bleeding are reported, although rare, and no severe complications like esophageal injury or death are reported in the ccTEE literature.[4] Additionally, for the critically ill patient who is intubated, sedation- and airway-related risks are minimal. Importantly, a high level of utility and safety can be achieved by providers with only limited training, which makes it feasible for intensivists from diverse clinical backgrounds.[4]

In recent years, individualized care has become a focus for critical care medicine. For patients with shock, individualized therapy requires not only accurate characterization of the deranged physiologic condition but also an understanding of its anatomic cause. ccTEE is an ideal diagnostic tool to accomplish this in the ICU, given the ease of image acquisition, its safety, and the ability to provide repeat assessments. Although further research into the impact of ccTEE on patient outcomes is needed to optimize its implementation, ccTEE is ready to become a key diagnostic skill for the modern intensivist to help diagnose and manage undifferentiated shock.

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