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Commentary

CLINICAL ROLE OF CRITICAL CARE ECHOCARDIOGRAPHY IN SEPTIC PATIENTS: CURRENT KNOWLEDGE AND FUTURE DIRECTIONS

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ABSTRACT

Critical care echocardiography (CCE) use is rapidly growing and echocardiography is recommended as first-line approach to patients presenting with shock. In most cases the prompt use of CCE offers the opportunity to quickly identify the shock aetiology, with the advantage of being a non-invasive point-of-care tool. Septic shock is among the most common diagnoses of hypotension both in the emergency department and in the intensive care unit. CCE may have a substantial role in sepsis. Initially it may exclude other causes of hypotension and support the appropriateness of fluid-resuscitation. After the initial resuscitation, CCE may help in directing fluid management, guiding the "optimization" and "stabilization" phases, identifying among others conditions of fluid-responsiveness. In a later stage, CCE can be likewise helpful for the "de-escalation" phase of fluid management, supporting a goal-directed fluid removal. We summarize the current knowledge on the use of CCE in sepsis from the gap in knowledge with opened questions for future research to the use of CCE from clinical perspectives in guiding fluid and pharmacological therapy.

1. Introduction

Over recent years, there has been a great increase in the overall use of critical care echocardiography (CCE) in the field of intensive care medicine[1], and echocardiography assessment is recommended as a first-line approach to patients presenting with shock over the more invasive hemodynamic monitoring [2]. Indeed, in most cases CCE has the ability to rapidly and non-invasively identify the shock aetiology, distinguishing the hypokinetic from the hypovolemic and/or hyperdynamic left ventricle (LV), or the ability to identify or exclude a condition of the dilated right ventricle (RV),supporting or opposing a diagnosis of pulmonary embolism. Therefore, even when the CCE exam has not found the aetiology of shock, it remains a very useful and non-invasive point-of-care tool for excluding at least some of the most common causes [2].

Sepsis is one of the most common admission diagnosis in the intensive care unit (ICU) and CCE may have a substantial role in guiding the fluid-resuscitation of septic patients with the aim of avoiding the development of shock or eventually reversing it.

Moreover, after resuscitation, CCE may help in guiding the subsequent phases of fluid management, known as "optimization" and "stabilization", identifying conditions of fluid-responsiveness and tailoring the fluid maintenance.

Finally, a large emphasis is currently given to the de-escalation (also known as "evacuation") phase of fluid management, which refers to late goal-directed fluid removal associated with conservative fluid management in patients that are deemed no longer at risk of shock. During de-escalation it is important to achieve a negative fluid balance, and in such cases CCE may represent a valuable tool as at this stage of patient recovery the advanced hemodynamic invasive monitoring may not be in place anymore.

In the present short commentary we briefly discuss some of the current knowledge and the challenges for future developments in CCE with particular interest in the field of sepsis.

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2. Critical Care Echocardiography and sepsis: what we know

Over The majority of studies conducted with the use of CCE have been conducted in the field of sepsis and septic shock, as highlighted recently by a systematic appraisal of the literature by a panel of international experts[3]. In this regard, pooled evidence suggests that LV diastolic dysfunction has a prominent role over systolic dysfunction [4,5].

However, clinicians should keep in mind the challenges in the diagnosis of septic cardiomyopathy [6] and the limitations in the assessment of LV diastolic function in the ICU setting, especially in mechanically ventilated patients with significant variability in the vasomotor tone [7].The lack of association between LV systolic dysfunction and prognosis of septic patients is not entirely surprising since most parameters used for the assessment of LV systolic function are highly dependent on loading conditions, both preload and afterload. Preload conditions are highly variable in septic patients according to the degree of fluid resuscitation and to the grade of endothelial insult and vascular leakage. Similarly, afterload conditions are the balance between extreme levels of vasoplegia in patients with septic shock, partially counterbalanced by the use of vasoactive drugs. In this regard, the use of speckle-tracking echocardiography (STE)seems promising, in particular with the evaluation of global longitudinal strain (GLS), which has been associated with mortality in septic patients [8]. Nonetheless, it should be kept in mind that performing STE requires a high-degree of training and that only a limited number of ICUs worldwide has facilities to perform STE, which remains more a domain of cardiologists. Whilst the role of CCE in the diagnosis of sepsis is well-established, its role in the prognosis is less clear and only small single centre studies have suggested that even a limited CCE may improve the prognosis of patients with sepsis [9].

3. Critical Care Echocardiography: what we need to study

In the context of sepsis, there are several aspects deserving more investigation with CCE. One of the biggest issues when looking at any form of LV dysfunction and prognosis in septic patients is the lack of longitudinal data, with particular emphasis on the absence of data on premorbid heart function. Indeed, a decreased LV systolic function may be the result of the septic insult with circulating cytokines and their depressing effect on myocardial performance and/or a condition of chronic dysfunction pre-existing in the development of sepsis.

Another significant aspect deserves more research. To date, meta-analyses have pointed out the associations between single aspects of myocardial performance (i.e. LV diastolic function) and mortality, but these data are not corrected for confounders, thus a causative effect (correlation) has not been established yet. Moreover, the interaction between LV systolic and diastolic dysfunction has been evaluated by only a few studies, whilst meta-analyses have addressed these aspects singularly. It is advisable that future studies improve the reporting of their data eventually allowing pooling of these with those from other studies in order to increase both the sample size investigated and the external validity of the overall findings.

Finally, in the author's opinion, the study of RV function deserves more attention with a clear distinction of septic patients with or without features of acute respiratory distress syndrome, as the increase in airway pressure and the strain on the RV is significantly different in these two categories of septic patients.

4. Critical Care Echocardiography: what we should do from clinical perspectives

From a clinical perspective, the role of CCE is very well-established and continuously growing.

There is also a rise in interest towards the use of trans-oesophageal echocardiography outside the cardiac anaesthesia and cardiac ICU. Indeed, not all patients have acceptable acoustic windows with trans-thoracic echocardiography allowing good imaging and differential diagnosis, but trans-thoracic echocardiography cannot be easily performed in some patients such as those in prone positioning or in patients with extensive burn injury to the chest [10].

In parallel to the rising clinical interest in the use of CCE, scientific societies are trying to meet this significant demand for training and accreditation pathways in CCE with several accreditation pathways worldwide, from only basic CCE to more advanced ones. Usually a basic accreditation requires only course attendance and a relatively short case logbook, whilst comprehensive accreditations often require large logbooks, together with written and practical exams.

It is a widely accepted opinion that most ICU physicians should be able to perform basic CCE in the very near future, possibly with an expert in each ICU for performing advanced CCE [11,12]. Teaching trans-thoracic echocardiography is not a difficult task as there is a growing number of supervisors and mentors available, however, gaining exposure to and experience in trans-oesophageal echocardiography still seems a domain of cardiac anaesthesia and not many general ICUs are equipped with a dedicated trans-oesophageal echocardiography probe.

5. Critical Care Echocardiography to guide pharmacological interventions

CCE is a form of non-continuous monitoring and can be used as a sequential evaluation tool. In this regard, it may be useful in evaluating the effects of pharmacological interventions aimed at optimizing the cardiovascular performance in septic patients. Indeed, drugs as beta-blockers[13] and dexmedetomidine[14] have been proposed as possible modulators of cardiovascular function in septic patients.Starting these drugs with a baseline CCE evaluation and a subsequent one performed after a period of infusion may represent a valid tool to understand the potential benefits of these therapies.

References

1. Vieillard-Baron A, Millington SJ, Sanfilippo F, et al: A decade of progress in critical care echocardiography: a narrative review. Intensive Care Med 2019; 45: 770-788
2. Cecconi M, De Backer D, Antonelli M, et al: Consensus on circulatory shock and hemodynamic monitoring. Task force of the European Society of Intensive Care Medicine. Intensive Care Med 2014; 40: 1795-815
3. Huang S, Sanfilippo F, Herpain A, et al: Systematic review and literature appraisal on methodology of conducting and reporting critical-care echocardiography studies: a report from the European Society of Intensive Care Medicine PRICES expert panel. Ann Intensive Care 2020; 10: 49

4. Sanfilippo F, Corredor C, et al: Tissue Doppler assessment of diastolic function and relationship with mortality in critically ill septic patients: a systematic review and meta-analysis. BJA: British Journal of Anaesthesia 2017; 119: 583-594
5. Sanfilippo F, Corredor C, Fletcher N, Landesberg G, Benedetto U, Foex P, Cecconi M: Diastolic dysfunction and mortality in septic patients: a systematic review and meta-analysis. Intensive Care Med 2015
6. Sanfilippo F, Orde S, Oliveri F, Scolletta S, Astuto M: The Challenging Diagnosis of Septic Cardiomyopathy. Chest 2019; 156: 635-636
7. Sanfilippo F, Scolletta S, Morelli A, Vieillard-Baron A: Practical approach to diastolic dysfunction in light of the new guidelines and clinical applications in the operating room and in the intensive care. Ann Intensive Care 2018; 8: 100
8. Sanfilippo F, Corredor C, Fletcher N, Tritapepe L, Lorini FL, Arcadipane A, Vieillard-Baron A, Cecconi M: Left ventricular systolic function evaluated by strain echocardiography and relationship with mortality in patients with severe sepsis or septic shock: a systematic review and meta-analysis. Crit Care 2018; 22: 183
9. Sanfilippo F, Maybauer MO, Sankar V: Limited echocardiography in the management of critically ill patients in shock. J Crit Care 2015; 30: 430
10. Maybauer MO, Asmussen S, Platts DG, Fraser JF, Sanfilippo F, Maybauer DM: Transesophageal echocardiography in the management of burn patients. Burns 2014; 40: 630-5
11. International expert statement on training standards for critical care ultrasonography. Intensive Care Med 2011; 37: 1077-83
12. International consensus statement on training standards for advanced critical care echocardiography. Intensive Care Med 2014; 40: 654-66
13. Sanfilippo F, Santonocito C, Morelli A, Foex P: Beta-blocker use in severe sepsis and septic shock: a systematic review. Curr Med Res Opin 2015; 31: 1817-25
14. Morelli A, Sanfilippo F, Arnemann P, et al: The Effect of Propofol and Dexmedetomidine Sedation on Norepinephrine Requirements in Septic Shock Patients: A Crossover Trial. Crit Care Med 2018