Reviewer's report

Title: The caval index: an adequate non-invasive ultrasound parameter to predict fluid responsiveness in the emergency department?

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Reviewer: Daniel Johnson

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Review by Daniel W. Johnson MD
Department of Anesthesiology
University of Nebraska Medical Center

The authors should be congratulated for conducting a study of caval index in the spontaneously breathing patient in the emergency department. Critical care ultrasonographers (like myself) are often asked by trainees, “How do you use IVC ultrasound in the spontaneously breathing patient?” The answer is currently unsatisfying because we lack studies to show us exactly how to use it. Many of us have come to the same conclusion as this study: If the IVC is large and has minimal respiratory variability in diameter, then giving fluid is unlikely to help the patient.

Feissel et al and Barbier et al published such beautiful studies that are helpful in the management of mechanically ventilated patients with distributive shock. While this study lacks the sophistication of the Barbier and Feissel studies (echo-derived cardiac output was used as the marker of fluid responsiveness, as opposed to SBP here), it is an important first attempt to answer a burning clinical question.

Discretionary Revisions (which are recommendations for improvement but which the author can choose to ignore)

Page 6, final paragraph, the first sentence is problematic. Perhaps state “In the absence of invasive hemodynamic measurements an increase in systolic blood pressure is a reasonable parameter in the determination of fluid responsiveness.” You cite the Barbier paper (citation 13), which does not state that systolic blood pressure is the most reliable parameter to predict fluid responsiveness. In fact, Barbier et al used trans-thoracic echocardiography (certainly non-invasive) to measure the cardiac output prior to and after the fluid challenge in their study. This makes me question the accuracy of your citations. It is very common to have incorrectly numbered citations during the editing process. Please double check your numbering.

Increase in blood pressure after a fluid bolus is of great interest to emergency medicine physicians. I would recommend editing your paper to reflect the study that you performed: caval index as a predictor for increase in blood pressure
following a small fluid bolus. Your results suggest that a small caval index predict that a 500 mL fluid bolus is unlikely to result in an increase in blood pressure. This result will be of great interest to many clinicians.

Respiratory effort and negative intra-thoracic pressure have a large impact on respiratory variation in caval diameter, which may account for the poor positive predictive value found. Many ED patients are in respiratory distress for a variety of reasons, leading to large inspiratory efforts and large negative intra-thoracic pressure. Factors totally unrelated to fluid responsiveness, such as anxiety or pain, can cause a patient to breathe more vigorously, which impacts the caval index.

The baseline characteristics of patients indicate that the patients in this study were not very ill. In many ICUs and Emergency Departments, patients with the vital signs of your included patients would receive neither a fluid bolus nor an IVC evaluation with ultrasound. The careful reader might conclude that your data does not guide him/her in decision-making because they weren’t very ill at baseline. Including patients with only ONE sign of shock might have limited the applicability of the study and impaired your ability to detect a positive predictive value for caval index. Prior authors have used SBP < 90 or the requirement of vasopressors to maintain SBP > 90 as inclusion criteria for studies of caval index. In future studies, use of “harsher” criteria for shock would be more useful to the clinicians who read your study.

Studies of caval index in mechanically ventilated patients are able to conclude with more concrete recommendations about fluid responsiveness because the patient-to-patient and breath-to-breath variability of intra-thoracic pressure in these patients is markedly less than that in spontaneously breathing patients.

Probably the next step in this investigation of caval index would be to repeat this study but with stricter requirements to be classified as “shock,” and with a much larger number of patients. I would recommend 1000 mL of crystalloid instead of 500 mL as the bolus, as you mentioned your concern that some potential responders were missed because the bolus was small. I would omit the PLR completely from the next study. The third phase of the study: After determination of the caval index below which fluid bolus does not increase BP, conduct a prospective trial in which that caval index (for example 36.5%) is tested as a valid predictor of increase in BP.

Minor Essential Revisions (such as missing labels on figures, or the wrong use of a term, which the author can be trusted to correct)

Intro
Line 1, “unstable” instead of “instable”
Line 5, “hemodynamically unstable” instead of “hemodynamic instable”
Line 6, delete “So a”
Para 3, line 1, “Several studies have investigated...”
Line 6, delete “Furthermore”
Page 5, line 2, “has not yet been performed.”

Major Compulsory Revisions (which the author must respond to before a decision on publication can be reached) –

Was the BP measured by non-invasive cuff or by arterial line. I assume cuff but this needs to be stated.

Page 7, IVC Sonography, line 6 “ultrasound machine” not “ultrasoundmachine,” then line 8 should be “all measurements” not “all measurement”

Why did you do the PLR maneuver in addition to the fluid challenge? Were all post-fluid measurements taken with the patient in the PLR position? This is unclear in the Protocol section. The data would have been more easily understood and utilized by the reader without adding this (another independent variable) to the protocol. I am confused about the timing of PLR with regard to your measurements, which makes all of the results and conclusions difficult for me to apply to my patient population. Please clarify this in your paper.

Were other factors that impact blood pressure controlled, such as administration of anxiolytics or analgesics? This needs to be stated.

Limitations: need to add right heart failure, severe pulmonary hypertension, severe tricuspid regurgitation as other conditions that impact the usefulness of caval index, as any right atrial pressure overload will tend to result in distention of the IVC.

**Level of interest:** An article of importance in its field

**Quality of written English:** Acceptable

**Statistical review:** No, the manuscript does not need to be seen by a statistician.

**Declaration of competing interests:**

I have no competing interests.

Have you in the past five years received reimbursements, fees, funding, or salary from an organisation that may in any way gain or lose financially from the publication of this paper, either now or in the future? No.

Do you hold any stocks or shares in an organisation that may in any way gain or lose financially from the publication of this paper, either now or in the future? No.

Do you hold or are you currently applying for any patents relating to the content
of the manuscript? No.

Have you received reimbursements, fees, funding, or salary from an organization that holds or has applied for patents relating to the content of the manuscript? No.

Do you have any other financial competing interests? No.

Do you have any non-financial competing interests in relation to this paper? No.