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Cautious optimism- Can preoperative ultrasound predict post-induction hypotension?

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Hypotension (MAP < 55 mm of Hg) during general anesthesia lasting for even short periods of time can lead to major adverse events (MAE) in the postoperative period.¹ Hypotension following induction of general anesthesia can be made less likely by a) using proper dosing and rate of administration of specific drugs tailored to the patient's preoperative status and b) prophylactic administration of fluids and vasoactive medications to patients identified as high risk for developing hemodynamic instability during induction. In this context, the study published in the current issue of Anesthesiology, "Inferior Vena Cava Ultrasonography prior to General Anesthesia can Predict Hypotension after Induction." is of clinical relevance.² The authors conclude that preoperative scanning of Inferior Vena Cava (IVC) with point of care ultrasound and assessment of IVC collapsibility index (IVC-CI) can reliably predict hypotension (defined as MAP < 60mm of Hg or a 30% mean blood pressure, MBP, decrease from baseline) following induction in 75% of patients with American Society of Anesthesiologists (ASA) physical status I-III undergoing surgery. Hypotension was predicted when IVC-CI was greater than 43%. Assessment of IVC size alone was less clinically useful, due to the reason that too many patients were in the unpredictable or gray zone (59%).

Currently, we use static parameters such as central venous pressure, pulmonary artery pressure as well as dynamic markers of fluid responsiveness such as delta stroke volume, delta cardiac index, pulse pressure variation and plethysmographic variations in the perioperative period to assess and optimize fluid status. Measurement of these parameters necessitates an invasive procedure (arterial line, central line or pulmonary arterial

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catheterizations); however it may not be required for the performed surgical procedure. Even if the use of a hemodynamic monitor is indicated, results from these parameters may not be available prior to anesthesia induction. Dynamic fluid responsiveness monitors have been well studied in mechanically ventilated patients and are not useful in spontaneously breathing patients during the pre-induction period. Point-of-care ultrasound IVC scanning is a valuable technique to predict the risk of post-induction hypotension in the absence of a reliable preoperative monitor that predicts cardiovascular behavior during induction of anesthesia. Point-of-care ultrasound IVC scanning can be learned quickly and is reproducible to predict post induction hypotension, which is valuable given the indeterminate risk seen only in 10% of patients. The authors need to be complimented for generating this hypothesis. This finding, if duplicated in larger populations with differing risk and patient characteristics (e.g., body habitus), will have significant potential to reduce major adverse events following induction of general anesthesia.

It is important to note that there are several weaknesses that make it unclear as to how sensitive and specific the IVC-CI will be in a general population. First, this is a small study with differing patient characteristics. As shown by an increasing indeterminate IVC-CI in cardiac patients, the behavior of this parameter in patients with other risk factors (diastolic dysfunction, patients taking Angiotensin converting enzyme inhibitors) is unknown. Second, the definition of hypotension was also arbitrarily dichotomized with a MAP <60 mm of Hg instead of using percent change from baseline MAP as the sole definition. This could have led to a positive study finding while it could have been a well described statistical effect of regression to the mean. Third, the predictive utility comes from custom fitting the parameters to the current data set. This prediction power is decreased often with validation cohorts. Fourth, the measurement of non-invasive blood pressure was less frequent (once every 2 minutes) than necessary in half the study population. This certainly could have lead to missed detection of hypotension making the interpretation of this study finding difficult. Fifth, etomidate was the induction drug in this study. This may not be a common practice and it is unknown how this finding will change if any other drug such as propofol is used for induction. Finally, this method suggests an approach to prevent hypotension following induction. However, the bigger goal is to prevent hypotension in the entire intraoperative period. There is a need to use complimentary techniques such as dynamic fluid responsiveness to achieve the ultimate goal of reducing MAE.

Preoperative fluid optimization can perhaps be attempted with an IVC-CI target of 38% in the holding area in an attempt to reduce the incidence of post induction hypotension. However, it has the potential to prolong either the turn over time or the anesthesia ready time. There is no doubt that this paper will encourage discussion about cost benefit analysis. The cost of personnel training and equipment costs should be taken into consideration as well.

With the ever-expanding use of ultrasound in the perioperative period, this manuscript will enable future studies to refine current findings. For now, this technique is promising and has the potential to be useful for the safe and smooth conduct of anesthesia induction.

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