EMERGING TECHNOLOGY REVIEW

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Perioperative Anesthesiology UltraSonographic Evaluation (PAUSE): A Guided Approach to Perioperative Bedside Ultrasound

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BEDSIDE, OR POINT OF CARE, ultrasonography is emerging as a tool for real-time diagnostic assessment in addition to standard physical examination in the emergency department, intensive care unit, and now in the perioperative period as ultrasound didactics are being incorporated into residency training programs. Even though anesthesiologists have embraced the use of bedside ultrasound as a procedural tool, diagnostic use of this technology is underutilized, with the exception of transesophageal echocardiography.[1,2] Diagnostic use of surface ultrasound techniques, such as transthoracic echocardiography (TTE) and lung ultrasonography, have been proposed in the cardiology, emergency medicine, and critical care medicine literature.[3–12] These approaches (eg, Focused Assessment with Sonography for Trauma [FAST], FATE, and FoCUS) have proven useful as a guide for clinicians providing care to patients with unstable conditions and those who are acutely ill.[3] However, these approaches recommend imaging that is not necessarily relevant to the perioperative patient (FAST) or exclude scanning of the lungs/pleura for pulmonary pathologic conditions (FATE/FoCUS), which may be important, especially during or after the administration of anesthesia. Few studies describing the diagnostic use of TTE or lung ultrasound by the general anesthesiologist exist, and to date, there are no systematic approaches for applying these techniques to the care of perioperative patients.[13–15] Despite the well-accepted diagnostic value of point-of-care ultrasound, adoption by anesthesia providers and incorporation into residency training curriculum have lagged.[2,16]

The use of point-of-care/bedside TTE/ultrasonography by non-cardiologists has been well-validated in emergency medicine and intensive care unit settings and in the preoperative evaluation of cardiac murmurs.[9,17–29] Multiple studies have demonstrated that with just 1 day of ultrasound didactics, novice providers are able to identify clinically significant pathologic conditions.[30,31] The Hemodynamic Echocardiography Assessment in Real Time (HART) course evaluated the ability of anesthesiologists and critical care/emergency medicine physicians to identify major abnormalities using limited TTE views.[32] When judged by expert cardiologists, the providers' determination of TTE findings was in agreement 90% to 99% of the time, with most disagreement related to false-positive interpretations.[32]

Canty et al demonstrated a 54% change in anesthetic management when bedside ultrasound was used in the preoperative evaluation of patients with symptoms of cardiac disease or those believed to be at risk for cardiac disease.[33] Using perioperative TTE, Cowie identified a change in management for 82% of cases.[14] In the Cowie cohort, use of TTE led to escalation or de-escalation of invasive monitoring strategies, procedure location changes or cancellations, fluid boluses or restrictions, or alteration in anesthetic management, and 20% of patients were referred for formal cardiology evaluation.[14] Using bedside TTE in 99 patients with known or suspected cardiac disease, Canty et al found a significant number of patients with aortic stenosis, cardiac failure, tamponade, or significant intravascular volume depletion, leading to a change in management in 36% of patients.[13] Applying focused cardiac ultrasound, Gerlach et al identified a previously unrecognized cardiac tamponade preoperatively while attempting to assess the patient's overall cardiac function.[34]

This article reviews some clinical scenarios in which point-of-care ultrasonography might prove efficacious in the perioperative setting. The goal is to provide a structured approach to using bedside ultrasound as a physical examination adjunct and diagnostic tool that can be learned and performed by the general anesthesiologist.[35,36] The Perioperative Anesthesiology UltraSonographic Evaluation (PAUSE) approach is a tool for the anesthesiologist to pause at various times during perioperative management and use bedside ultrasonography to assess the patient, extending the information provided by physical examination or vital sign monitoring. This approach to the use of ultrasound is described along with recommendations for how providers, new to the use of ultrasound for diagnostic imaging, can learn and properly apply these skills.

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PREOPERATIVE EVALUATION USING ULTRASONOGRAPHY

The success of modern medicine at managing chronic disease and increasing longevity has created a challenging patient population for the anesthesiologist. Not only are acuity and disease burden increasing, but there may be little time before a scheduled procedure to safely risk stratify patients and balance safe anesthetic care with the need to delay or cancel a procedure to obtain additional information. Medical history alone may be unreliable, unattainable, or clouded by comorbidities such as limited exercise tolerance due to joint disease or obesity. Consider the following scenario:

You are on call and evaluating an 85-year-old female for repair of a hip fracture after an unwitnessed fall at home. She is confused and mildly hypotensive with parched mucous membranes, and a murmur is heard over the right parasternal boarder. Medical records are not immediately available. How can bedside ultrasound be of assistance in the preoperative clinical decision-making process?

Few would argue that this patient requires careful assessment of volume status, underlying ventricular function, and the potential for a significant cardiac valve abnormality before she enters the operating room. Fig 1 suggests a basic approach for using ultrasonography to expeditiously evaluate items of cardiovascular interest in the preoperative setting. There often is a great deal of information available using the parasternal short- and long-axis views. Although complementary views

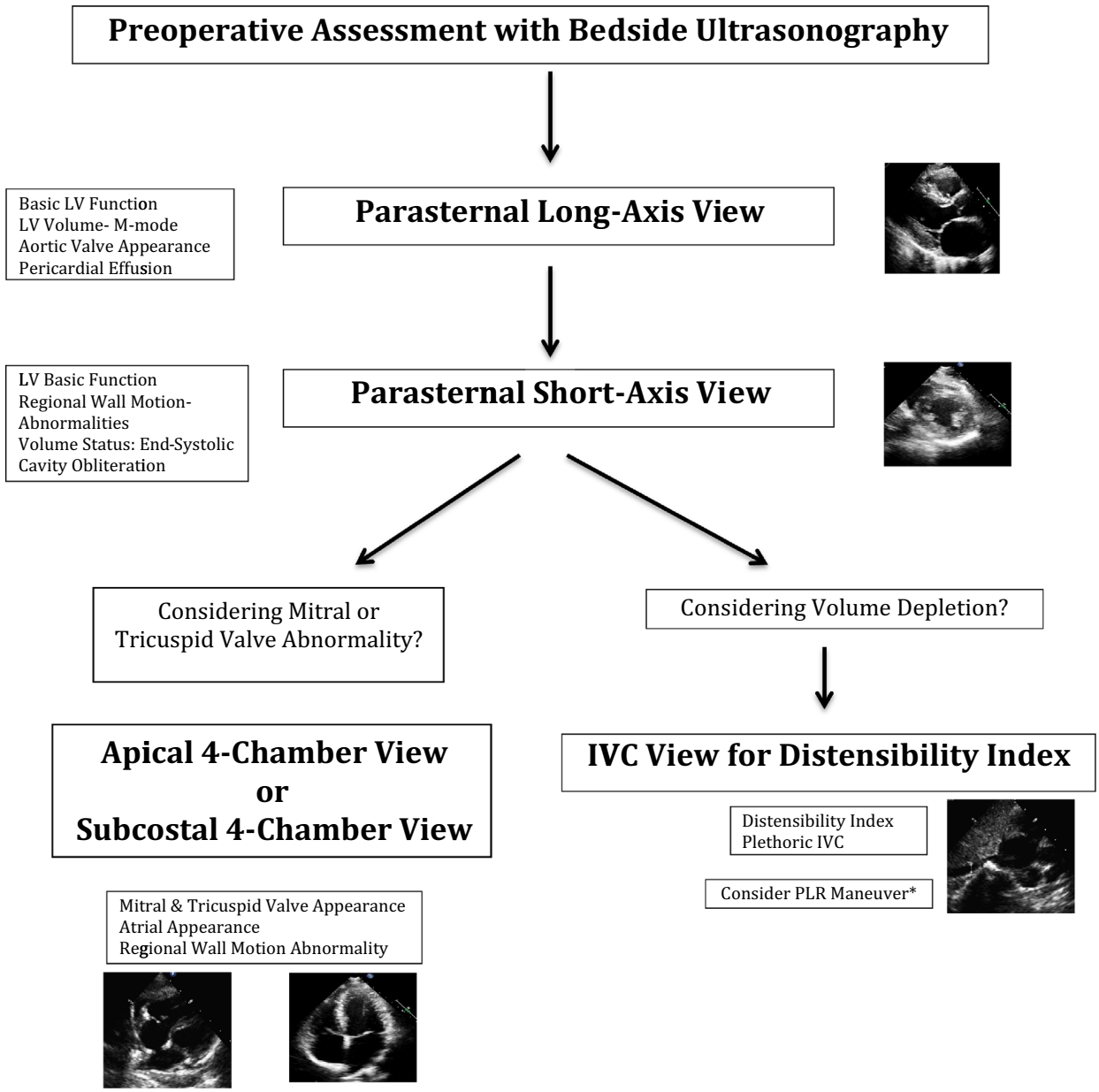

Fig 1. Perioperative Anesthesia UltraSonographic Evaluation (PAUSE) approach for preoperative bedside ultrasound patient evaluation. LV, left ventricle; IVC, inferior vena cava; M-mode, motion mode; PLR, passive leg raise.