ImaCor hTEE™

SEPSIS

Hemodynamic management of septic patients with the ImaCor hTEE system – a miniseries of two cases

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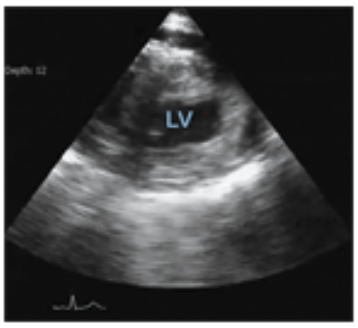
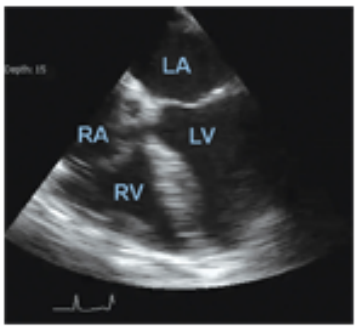
Despite twenty years of progress since Rivers et al.1 introduced goal-directed therapy for sepsis, and the use of MAP and CVP targets in the 2008 Surviving Sepsis Campaign2, assessment of cardiac function and filling in septic patients remains a significant challenge. In addition, both LV dysfunction3,4 and RV dysfunction5 are common in septic shock (see also a recent review6 and references therein). Transesophageal echocardiography (TEE) has been shown to detect both preload deficits7 and cardiac dysfunction8; more generally, Vieillard-Baron et al.9 described a standard focused TEE exam for assessing cardiac function and filling: "a long-axis view permits examination of the four cardiac cavities … we measure left ventricular (LV) and right ventricular (RV) end-diastolic and end-systolic size and calculate the LV ejection fraction. . . . A short-axis view of both ventricles by a transgastric . . . approach also permits measurement of LV size, calculation of LV fractional area contraction, and examination of septal shape and kinetics. (Thirdly), a long-axis view of the superior vena cava, anastomosing with the right atrium, allows us to examine variation in its diameter during the respiratory cycle."

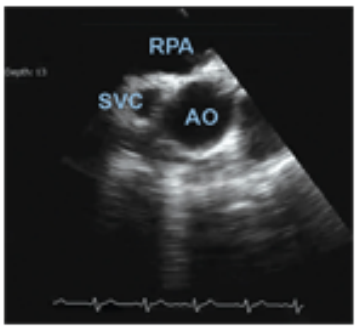
Here are static pictures of the above TEE views using the ImaCor hTEE system – with one change; the superior vena cava is shown in a long-axis view.



Trans-Gastric Short Axis
LV Filling & Function



Four Chamber
Biventricular Function



Superior Vena Cava
Fluid Responsiveness

This three-case mini-series illustrates the use of the ImaCor hTEE system to guide hemodynamic management of sepsis patients.

Case 1. hTEE detects underfilling, rules out LV dysfunction. Donald Reiff, MD, and S. Chris Bellot, MD. University of Alabama at Birmingham, Birmingham, AL.
An immuno-suppressed patient with AIDS, 65% BSA burned and presumed sepsis, had been resuscitated with a modified Brooke formula. hTEE was ordered three days post admission, and notably following resuscitation.

hTEE revealed an underfilled LV, hypovolemia not detected by PAC (diastolic pressure 17 mmHg). Administration of a fluid bolus (2 L over 45 min) and followup hTEE revealed more normal filling and a significant improvement in resuscitation measured by SvO2. hTEE was further used **to rule out LV dysfunction and guide fluid administration. In summary, hTEE imaging provided critical information on fluid status and guided medical management, in a high-risk burn patient.**

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Case 2. hTEE detects RV dysfunction, helps guide pressor weaning in a septic patient.
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The patient, a 48-year old male with a history of tobacco abuse and COPD presented with new onset chest pain. Cardiac catheterization revealed multi-vessel coronary artery disease, and the patient an uneventful three-vessel off-pump CABG on hospital day 2. He had a normal ejection fraction on intraoperative TEE. Postoperatively, he received DT prophylaxis per CIWA protocol, but otherwise his CVICU course was uneventful and he was transferred to the floor in stable condition on POD 1. On POD 2, he required transfer back to the CVICU with apparent sepsis manifested by hypoxia with an oxygen saturation 76%, hypotension (SBP 90s mmHg), and oliguria. He continued to deteriorate despite early cultures and initiation of broad-spectrum antibiotics. The patient required endotracheal intubation and Bi-level mechanical ventilation for support as he progressed to acute respiratory distress syndrome. Invasive hemodynamic monitoring with an arterial line and central venous line was initiated as the patient required a substantial fluid resuscitation (5 L) and multiple vasopressors. Initially the patient was on norepinephrine, but as the dose was escalated > 10 mcg/min, vasopressin 0.04 Units/min was added as per our practice protocol. His initial ScvO2 was 47%, and his base deficit went as high as 4.1 and lactate as high as 2.5. To guide resuscitation and monitor cardiac function, an ImaCor hTEE probe was placed at the bedside while a Dobhoff feeding tube was still in. hTEE demonstrated new RV dysfunction with reduced TAPSE and poor wall thickening toward the apex, felt to be secondary to sepsis. Low dose epinephrine at 2 mcg/min was chosen in the setting of hypotension for inotropic and RV support. The patient was found to have become relatively adrenally insufficient after serial assessments of random serum cortisol levels, so stress dose steroids hydrocortisone 100 mg q8h were also added. Over the next 24 hours the patient's hemodynamics improved dramatically and he was weaned off all pressors except low dose epinephrine, which was also stopped a few days later. The patient's ventilator was weaned over the next several days as the patient underwent diuresis and clinical improvement ensued.

Discussion
In summary, these cases demonstrate the potential of hTEE to guide hemodynamic management in septic patients.

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