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MORNING REPORT

Provider-performed Point-of-care Ultrasound: An Emerging Technology or "Disruptive Innovation"?

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A 76-year-old gentleman with recurrent left tonsillar squamous cell carcinoma is seen in pre-op clinic the day before his scheduled neck dissection surgery. He originally underwent left neck dissection and radiation in 2001, followed by right neck dissection and radiation in 2002. His then developed mandibular osteoradionecrosis, requiring a fibular free flap in 2012.

We have an elderly gentleman undergoing pre-operative risk assessment before a non-cardiac surgery. Utilizing the updated 2014 American College of Cardiology (ACC)/American Heart Association (AHA) pre-operative guidelines,[1] we aim to calculate the combined patient-procedure risk of major cardiac events (MACE). At this point, we need to know more about his comorbid conditions.

His medical history is significant for coronary artery disease, with coronary artery bypass grafting in 1982 and 1989. He has ischemic cardiomyopathy and chronic systolic heart failure (CHF), ejection fraction (EF) 20% in 2013. He has atrial fibrillation and a pacemaker/defibrillator. He has chart history of chronic obstructive pulmonary disease (COPD) without supporting documentation.

We now learn that he has multiple cardiopulmonary comorbidities that place him at a higher risk of peri-operative cardiopulmonary complications. We can calculate his estimated risk of peri-operative cardiac complications with a validated risk calculator to determine if he requires additional testing for coronary risk stratification. Additionally, we must consider the burden of CHF-related post-operative morbidity and mortality, which is higher than that related to coronary artery disease.[2] We also need to complete our history and physical to determine if these comorbid conditions are optimized and stable.

He reports adherence to his cardiac medication package of carvedilol, digoxin, apixaban, amiodarone, and atorvastatin; however, he discontinued his furosemide eight months prior for unclear reasons. He walks short distances at a slow pace, limited by fatigue rather than overt dyspnea. He denies lower extremity edema. He sleeps on two pillows to manage his oral secretions but denies overt orthopnea or paroxysmal nocturnal dyspnea (PND). He denies recent defibrillator shocks. His vital signs are: blood pressure 118/77 mmHg, heart rate 79 beats per minute, and 16 respirations per minute with oxygen saturation 97% on room air. He is a gaunt age-appropriate gentleman in no distress. Heart sounds are distant but regular and without murmurs. He has right basilar crackles and diffuse wheezes. He has bilateral neck scars and radiation-related skin tightening; his jugular venous pressure (JVP) cannot reliably be assessed. He has trace to 1+ lower extremity edema. EKG shows a V-paced rhythm at 80 beats per minute.

We are now concerned that this gentleman may be volume overloaded and not optimized. His exam raises concerns for active pulmonary or cardiac disease. Classic heart failure symptoms (e.g. orthopnea or PND, exertional dyspnea) have approximately 30% sensitivity for predicting heart failure. Wheezing can be associated with pulmonary edema or obstructive lung disease. The accuracy of JVP assessments is limited, and his exam is further complicated by his post-surgical and post-radiation anatomy. Even in the setting of known systolic heart failure, clarifying his degree of compensation is important as decompensated heart failure is associated with higher risk of post-operative cardiac complications.[3] Additionally, in known heart failure, the 2014 ACC/AHA guidelines provide a Class IIa recommendation for repeat evaluation of left ventricular (LV) function with change in clinical status and Class IIb recommendation for updated ECHO after a year interval.[1]

We are unable to obtain a same-day transthoracic ECHO given the late hour. His surgeon and anesthesiologist are notified that we may have to delay or cancel his surgery. A bedside ultrasound machine is available in clinic, so we decide to perform a focused cardiac ultrasound. Parasternal windows reveal a dilated left ventricle with grossly reduced systolic function. Subcostal views reveal a dilated inferior vena cava (IVC) without respiratory variation. B-lines are seen in his lungs, suggestive of pulmonary edema.

POCUS (point of care ultrasound) refers to the use of bedside ultra-

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sound by clinicians for immediate, focused, goal-directed imaging to answer a specific diagnostic question. Emergency medicine, critical care, obstetrics, and anesthesiology have assimilated this technology into standard practice, and hospitalist and internal medicine groups are rapidly catching up. A growing body of literature demonstrates that this provider-performed procedure is feasible, improves resource utilization, expedites patients' care, and is a skill that can be reasonably mastered by trainees. Focused cardiac ultrasound (FOCUS/FCU) has been validated for specific findings, such as decreased LV systolic function and IVC collapsibility as a marker of volume status. FOCUS has been shown to be superior to physical exam for LV ejection fraction of less than 40%, improving detection by 40% and with sensitivity, specificity, and accuracy of 69%, 91%, and 89%, respectively.[4] *Cardiopulmonary ultrasound has been shown to improve differentiation of acute decompensated heart failure from pulmonary pathology in cases of dyspnea in the emergency room.*[5,6]

The next day surgery is canceled, and our patient is referred to cardiology. Formal ECHO reveals severely decreased LV systolic function (EF 20% to 25%) and moderately reduced right ventricular (RV) systolic function. Furosemide is resumed. Further workup includes a nuclear medicine perfusion scan, which demonstrates a previously documented large fixed inferior wall defect. Once euvolemic, the patient is deemed stable, though at elevated risk, for his necessary malignancy-related surgery, which is completed 1.5 months after his original surgery date. He does well in the immediate peri-operative period and is discharged home on post-op day 1. He requires up-titration of furosemide about a week after surgery.

While ultrasound has been used for decades in patient care, advances in portability and affordability have allowed a growing number of physicians to augment real-time diagnostic reasoning and guide therapy with this technology. Some describe it as "the stethoscope of the future." Ideally, POCUS will enhance rather than replace the physician's history and physical exam. Additionally, POCUS calls the physician to the bedside, which enhances opportunities for patient education, engagement, and satisfaction. It is easy to forget that the stethoscope was once considered a "disruptive innovation":

That it will ever come into general use, notwithstanding its value, is extremely doubtful because its beneficial application requires much time and gives a good bit of trouble; both to the patient and practitioner. Its hue and character are foreign and opposed to all our habits and associations.

—The Times of London, 1834

Teaching Points

1. Assessment of cardiac and pulmonary pathology by history and physical exam alone can be limited.
2. Point of care ultrasound (POCUS) is an emerging technology that, like social media, can become another tool in our patient care arsenal. "Disruptive innovations," when addressed in an evidence-based fashion, can positively influence the evolution of patient care.
3. Twitter and the online social media community are fantastic resources for self-directed POCUS learning! We recommend exploring #FOAMus, #POCUS, #IMPOCUS, @Periop_Echo, @UTS_Australia, and @SonoRoundtable for starters.

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