Surgical Innovation

Ultrasonographic-Guided Resuscitation of the Surgical Patient

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What Is the Innovation?

Point-of-care ultrasonography (POCUS) has proven to be an effective tool to supplement physical examinations and help clinicians guide therapy.[1,2] Surgeons are familiar with the use of POCUS in the trauma setting beginning with the introduction of the Focused Assessment With Sonography for Trauma (FAST) examination. However, training of surgeons in POCUS in other areas, such as the lung, pleura, and heart, is limited.[1,3]

The utility of thoracic POCUS is of importance for the evaluation of a patient with deteriorating health. Limited transthoracic echocardiography (LTTE) can be used to help diagnose hypovolemia, left ventricular failure, and pulmonary embolism. Lung and pleural ultrasonography are effective in identifying causes of hypoxia.[2,4]

Despite all the evidence regarding POCUS, when a patient in the surgical ward (hereinafter referred to as a surgical patient) deteriorates, surgeons and surgeons in training use other lower-yield methods as the first line of diagnosis, especially when patients are not in the critical care setting. The innovation presented herein is the use of POCUS for the evaluation of hypoxia and/or hypotension as a first-line technique, regardless of the physical location of the patient in question. This technique should combine ultrasonographic examinations of the abdomen, lung, pleura, and heart in a single study. Because the ultrasound machine is portable, the use of this tool can be expanded to any location.

What Are the Key Advantages Over Existing Approaches?

At present, in the event of a hypotensive and/or hypoxic episode during the perioperative period, surgeons rely on blood gas measurements, chest radiographs, and the physical examination to make a diagnosis. Although these methods are important for the information that they provide, ample evidence demonstrates that the use of ultrasonography to be of higher yield. Ultrasonography has better sensitivity and specificity compared with portable chest radiography in diagnosing lung abnormalities that lead to acute respiratory failure.[3,5] Limited transthoracic echocardiography can be used to diagnose causes of hypotension and guide therapy.[2]

POCUS is a bedside examination that can be performed in a fast and efficient manner. The operator can obtain useful anatomical and physiological information. The ultrasound machine is portable and can be used to assess patients in the emergency department, intensive care unit, surgical wards, perioperative area, and operating room. This tool can also be used in underserved areas where sophisticated technology is not available. Furthermore, POCUS omits the need for transportation of a hemodynamically unstable patient to obtain imaging studies and thereby avoids unsafe conditions.

How Will This Affect Clinical Care?

The use of POCUS can expedite the diagnosis of life-threatening conditions and avoid unnecessary time wasted in patient transportation and other unsafe situations.[2,3] An entire examination of the abdominal and thoracic cavity can be achieved with a low-frequency phased-array probe and a 2-dimensional ultrasound machine. Although training in this technique can be achieved with instruction, proficiency is only acquired when these examinations are performed routinely with a quality improvement program to address image acquisition and interpretation of results. Using POCUS to evaluate the surgical patient can yield a faster clinical decision and is more cost-effective. Furthermore, if performed routinely, POCUS can be incorporated in the surgical training curriculum.

Is There Evidence Supporting the Benefits of the Innovation?

In the past decades, an increasing number of reports have been published about the utility of POCUS, especially in the surgical patient. In 1993, Rozycki et al[6] published the first study defining what would later become the FAST examination. In 2000, Kimura and Demaria[7] proposed focused transthoracic echocardiographic examination or LTTE. Furthermore, ample evidence suggests that lung ultrasonography is superior in diagnosing causes of respiratory failure compared with portable radiography.[3,5]

More than 19 studies have been published that describe the use of cardiac ultrasonography for resuscitation performed by noncardiologists.[2] Although the examination has different names,

Table. List of Applications of POCUS in General Surgery

Examination	Summary	Useful Publication
Focused assessment with sonography for trauma	Identifying intra-abdominal, intrapleural, and pericardiac fluid; in trauma, free fluid represents blood; helps with the triage of patients with hypotension and blunt trauma	Rozycki et al,[6] 1993
Venous and arterial ultrasonography and guidance in central line placement	Fewer complications using ultrasonography for central line procedure guidance	Mehta et al,[8] 2013
Lung and pleural ultrasonography	Diagnosis of pneumothorax, pleural effusion, and consolidation and guiding therapy in patients with hypoxia	Via et al,[9] 2012
Cardiac ultrasonography	Literature review of the use of cardiac ultrasonongraphy to diagnose causes of hypotension to guide therapy	Ferrada,[2] 2016
Other POCUS uses in general surgery	Literature review of the use of POCUS in general surgery includes ultrasonography of the gallbladder, aorta, trauma, hernia or dehiscence, thyroid, parathyroid, breast, and appendicitis	Beggs and Thomas,[10] 2013

Abbreviation: POCUS, point-of-care ultrasonography.

the views obtained and the anatomical and physiological information obtained are all similar. In addition to the previously described uses of POCUS (FAST, LTTE, lung, and pleura), POCUS has a role in central line placement and other applications in general surgery, such as the diagnosis of dehiscence, hernias, and appendicitis (Table).[8-10]

What Are the Barriers to Implementing This Innovation More Broadly?

The barriers of implementing this technique are simple; because POCUS is operator dependent, the surgeon must become proficient at obtaining and interpreting images and have access to an ultrasound machine for daily use. Images must be stored and analyzed by clinicians to enhance future quality improvement.

Many courses are available for instruction in POCUS; however, a course alone will not enhance proficiency. As with any technique, the operator needs repetition and expert supervision to obtain manual dexterity. Inclusion of POCUS in the surgical education curriculum of residency programs can help trainees become familiar with the technique at an early stage.

In What Time Frame Will This Innovation Likely Be Applied Routinely?

After a critical mass of expertise is created and the knowledge is spread throughout different institutions, the use of ultrasonography to resuscitate surgical patients will become the standard of care. Students, residents, fellows, and attending surgeons must be trained in ultrasonography. Failure to do so would result in missed opportunities in the use of this tool clinically and in the creation of guidelines for this practice. Surgeons are responsible for obtaining expertise in a technique that is already being used by other disciplines to make clinical decisions for patients.

ARTICLE INFORMATION

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