EDITORIAL VIEW

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POCUS or no POCUS

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ABSTRACT

The use of point-of-care ultrasound (POCUS) in the perioperative setting by the anesthesiologists has now become a new demand. It has been proven to improve the patient outcome and to guide clinical management in critical situations. The anesthesiologists are still struggling to obtain POCUS skills and become POCUS competent. In Canada, many institutions have started to integrate POCUS into their anesthesiology training programs to build up a new generation of POCUS trained anesthesiologists. However, it's important to remember that POCUS is very different from the formal ultrasound examination done by the radiologists. This editorial defines the benefits of POCUS to anesthesia practice and offers strategies to help integrate POCUS into the routine anesthesia training programs.

Key words: POCUS; Anesthesia; Anesthesia practice; Perioperative ultrasound

List of abbreviations: POCUS: Point-of-care Ultrasound, US: ultrasound, CEUS: Canadian Emergency Ultrasound Society, CPoCUS: Canadian Point of Care Ultrasound Society, CAR: Canadian Association of Radiologists, TTE: Transthoracic echocardiography, RV: Right ventricle, IVC: Inferior Vena Cava, OR: Operating room, LUS: Lung ultrasonography, CT: Computed topography, FAST: Focused assessment with sonography for trauma, LL: Lower limb, DVT: Deep venous thrombosis.

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Point-of-care ultrasound (POCUS) is the bedside use of ultrasound to get a diagnosis and assess real-time responses to treatment. In the last decade, POCUS has gained much popularity in anesthesia practice. The interest in POCUS has rather been explosive, as proved by the huge increase in recent articles related to it. Ultrasound (US) is now considered the stethoscope of the new century. Although the word stethoscope comes from the Greek words *stethos* (which means 'thorax') and *skopion* (which means 'to look in'), it does not allow us to 'see' into the chest in real terms. US, however, does truly allow us to do just that.[1]

The real value of POCUS of the chest and abdomen in critical situations is now more widely accepted. According to the latest AHA guideline on Advanced Life Support, US is recommended to be used in cardiac arrest.[1]

The Canadian Emergency Ultrasound Society (CEUS) developed the Emergency Department Echo Course in 2001, which became the standard POCUS certification course for emergency physicians in Canada. CEUS rebranded itself as the Canadian Point of Care Ultrasound Society (CPoCUS) (https://www.cpocus.ca) in 2016.[2]

Although US role for vascular access and guided regional anesthesia is now well-established, most of the anesthesiologists are still not familiar with its use for chest and abdomen examination in the perioperative setting. They continue to obtain POCUS skills, while it's now a well-established diagnostic tool for emergency and critical care practice. In 2016, the Canadian Anesthesiologists Society (CAS) formed a task force to address and develop perioperative POCUS in anesthesia

practice. The first perioperative POCUS course in Canada was held in Vancouver in June 2016.[2]

The Canadian Association of Radiologists (CAR) has expressed numerous concerns about the spread of POCUS across Canada in many specialties; anesthesia, internal medicine, intensive care, and emergency. Their main concern is that physicians in other specialties with inadequate US training will risk inducing harm, either by missing critical findings or misinterpreting some findings. This will lead to misdiagnosis and thus inappropriate patient management.[3]

In 2020, an article was submitted at the CAR's journal in response to the CAR's position statement on POCUS. It stated that POCUS has now become a powerful clinical tool for physicians around the world, including Canada. It also stated that POCUS is different from radiology-performed US and radiologists are not expected to control its use.[4]

Studies suggest that after 20 scans (or even less), a non-radiologist can become sufficiently proficient.[5] However, it is crucial that anesthesiologists recognize their limits by understanding when to seek assistance from more experienced colleagues.[6]

How to start?

Understanding the machine and its use is very important. There are three different types of probes that can be used; 1) the linear high frequency probe, which is optimal for scanning superficial structures with high resolution, 2) the curvilinear abdominal probe, with lower frequency, which is good for scanning deep abdominal structures due to its high penetration, but with less resolution, and 3) the phased array probe (cardiac probe) which is similar to the curvilinear probe as regards the depth and the frequency but with smaller footprint which is ideal for scanning in between the ribs.

One should be familiar with how to optimize the image by adjusting the depth and gain. It is very important to adjust the depth according to the structure of interest. The overall gain and time-gain compensation is also very important; one does not want the image to be too bright with too much noise nor too dim that important structures are missed.

How can POCUS really affect our anesthesia practice?

Transthoracic echocardiography (TTE)

Through TTE, the anesthetist will be able to answer many questions and identify the causes of hemodynamic instability whether it is obstructive, cardiogenic, or hypovolemic, and thus change the treatment accordingly. Ventricular function, filling and pericardial effusion can be easily assessed. Additionally, TTE can also help in diagnosis of pulmonary embolism by showing signs of right ventricle (RV) failure and dilatation. A thrombus can be even seen in the RV or the main pulmonary artery. Severe valvular lesions can also be diagnosed perioperatively in emergency cases when there is no time for formal echocardiography by a cardiologist. Fluid status can be easily assessed by measuring the inferior vena cava (IVC) size and collapsibility.[1,7,8]

Many studies have shown the importance of POCUS cardiac scan and its implication in the anesthesia practice. These studies documented better outcomes and lower mortality rates[7] and early identification of the cause of shock in trauma[9], and non-trauma patients.[8]

TTE is readily available and portable in the operating room (OR) and can be performed without stopping surgery or resuscitation efforts.

Lung ultrasound

The lung ultrasonography (LUS) is considered to be superior to chest X-ray and similar to chest computed topography (CT) for detection of normal aerated lung, and diagnosis of number of lung pathologies such as; pneumothorax, alveolar consolidation, alveolar interstitial disease, and pleural effusion.[10]

LUS reduces the utilization of chest radiography and chest CT in intensive care unit (ICU). It is more efficient in diagnosis of pneumothorax in ICU without exposing the patients to the risks of

radiation. Ford et al. showed that POCUS for lung examination is more sensitive and specific than either chest radiography and/or clinical examination, even when performed by POCUS novices after only 50 mentored lung scans.[11]

Diaphragmatic ultrasound

The diaphragm is considered to be the most important respiratory muscle, and its dysfunction can lead to respiratory complications, and prolong the duration of mechanical ventilation. Sonographic evaluation of the diaphragm has recently started to gain popularity in the ICU and anesthesia.

Abnormal diaphragmatic motion or diaphragmatic paralysis can occur postoperatively with conditions such as phrenic nerve injury, neuromuscular diseases, after abdominal or cardiac surgery. It can also be seen in some cases after interscalene nerve block. Since diaphragmatic motion plays a prominent role in spontaneous respiration, observation of the diaphragm kinetics seems essential.

Diaphragmatic sonography is bedside, readily available and less complicated than the traditional tests to assess diaphragmatic function. US can be easily used for diagnosing diaphragmatic paralysis, and postoperative diaphragmatic dysfunction without the need to transfer the patient to the radiology suits or expose the patient to radiation.[12]

Focused assessment with sonography for trauma (FAST)

Emergency physicians, surgeons, intensivists have been using FAST for a long time in their practice. Abdominal CT is more specific than FAST for diagnosis of intra-abdominal injury. However, FAST can be readily available and can be performed on bedside or in OR to diagnose life threatening intra-abdominal bleeding without the need to transfer the patient. It also can be done as an alternative to CT scan when CT scan is relatively contraindicated e.g. in pregnant patients

In order to do FAST, one is not required to be fully competent in abdominal ultrasonography. FAST is taught mainly to identify the presence of fluid collection in the abdomen rather than to diagnose pathological lesions.

Lower Limb (LL) venous duplex

LL deep venous thrombosis (DVT) is a life-threatening condition that affects adults of all ages and has an annual incidence of 0.1%. Accurate and fast diagnosis of the DVT is crucial because one-third of untreated DVTs may clinically progress to significant pulmonary embolism. As DVT is difficult to diagnose clinically, imaging is required for its diagnosis. Although the gold standard for the diagnosis of DVT is contrast venography, POCUS is increasingly used in for evaluation of lower extremity DVT.

Given the common delay in obtaining the ultrasonography study through the consultative pathway, the anesthetist can perform the examination and has an immediate diagnosis that is relevant to the management of the patient if pulmonary embolism is suspected. LL POCUS is easy to be performed using either 2-point POCUS or 3-point POCUS test, both are excellent methods for the diagnosis of DVT with high sensitivity and specificity.[13]

Airway US

Difficult airways have always been an anesthesiologist's worst nightmare. Airway management is a critical skill for the anesthesiologists. Inadequate airway management is currently the largest contributing factor to poor patient outcomes causing brain hypoxia and death.[14] Cricothyroidotomy is always the last approach that can really save the patient's life when all other non-surgical approaches fail.

Unfortunately, the success rate of anesthesiologists attempting to perform life-saving cricothyrotomy is low. Difficult identification of the cricothyroid membrane by external visualization or palpation is the main reason for the low success rates. It has been recommended that the cricothyroid membrane should be identified before induction of anesthesia, when suspecting difficult intubation. US can facilitate the identification of the

cricothyroid membrane. This in turn improves the success rate of cricothyrotomy.[14] In 2016, Kristensen et al. showed that all anesthesiologists, after having one-hour training course on airway US, in the form of e-learning, a lecture and hands-on training sessions, were successful in identifying the cricothyroid membrane of obese females with body mass index 39.0 - 43.9 kg/m^2.[15]

Moreover, airway US has improved competence in confirming the endotracheal intubation (specially in cases of cardiac arrest with absent end tidal CO_2.[14]

Gastric US

The use of gastric US to confirm empty stomach before induction of anesthesia is very helpful. It is especially useful in patient with potentially full stomach, e.g. emergency cases, patient with known delayed gastric emptying or patients suffering from dementia where fasting hours are uncertain. With the use of POCUS gastric scan, the operator can easily confirm whether the stomach is empty or full of clear fluids, thick fluids, or solid food particles.

POCUS experience from Department of Anesthesiology, University of Ottawa

As a POCUS group at the Ottawa University, we started an elective POCUS rotation for anesthesia residents in 2019 to give them an introduction to different aspects of perioperative POCUS. This POCUS rotation will be mandatory starting July 2021.

Furthermore, a POCUS anesthesia fellowship program will be started this year (2020). Through it, an anesthesia fellow will spend one-year learning POCUS skills and getting involved in POCUS research projects. During the POCUS fellowship, the trainee will perform a predetermined minimum number of POCUS scans necessary to get the appropriate level of competency. The trainee will be appropriately mentored by POCUS expert staff.

At the same time, we started a training program (Train the trainer program) for the staff anesthesiologists to prepare them to teach and supervise the residents and fellows in the near future. This program consists of a 16-hour course with extensive hands on sessions, in addition to mentorship program over 6-9 months, followed by end of program evaluation. On completion of this program the staff will be competent enough to join the POCUS group and he/she will be able to supervise a new cohort of trainees.

CONCLUSION

POCUS examination can help to answer critical perioperative questions in a very short time when physical examination findings are not enough to establish a definite diagnosis.

The use of POCUS in the perioperative setting can really improve the patient outcome. This reinforces the need to have POCUS trained and competent anesthesiologists.

In Canada, many institutions have integrated POCUS into their anesthesia training programs. Ottawa University is one of the leaders in the area of POCUS.

We should never forget that we are physicians and anesthesiologists, not radiologists. With the failure to obtain and acquire an image that is needed for getting a diagnosis and help our management, one must drop the probe and start acting as a clinician.

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