

## **POINT OF CARE ULTRASOUND**

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### **How is point of care ultrasound defined?**

Ultrasound is used widely in the perioperative arena by the anesthesiologists, for echocardiography, vascular access, regional anesthesia; Point of care ultrasonography refers to the use of ultrasound for management of surgical patients during the perioperative period. Current applications of perioperative ultrasound which are specific to anesthesiologists include, transthoracic and transesophageal echo (TTE and TEE), ultrasound for procedural guidance, and emergency point-of-care abdominal, chest wall and airway US.

### **What is the model for ultrasound education during anesthesia training?**

Currently there is no structured training program available for introduction to the broad applications of perioperative ultrasound during anesthesia residency training. Proficiency in the use of ultrasound is implied with clinical exposure, which is neither graduated from simple to complex nor appropriate to trainee skill level. Clinical exposure and training varies with setting (university vs. community hospital, faculty comfort and patient load). Whereas some ultrasound training is conferred during regional and critical care fellowship training, only accredited cardiac anesthesia fellowship has a pathway for achieving advanced TEE certification through the National Board of Echocardiography (NBE). The NBE also offers a basic level TEE certification for anesthesiologists not formally trained in cardiac anesthesia.

### **Why it is important to develop a point of care ultrasound program?**

Multiple other specialties have initiated the process of defining the scope of ultrasound training and practice within their domains. In the perioperative arena, specific to anesthesiologists ultrasound is practiced as individual techniques and not as a broad skill set essential for a modern day anesthesiologist. There is no procedure non-specific ultrasound education curriculum to prepare trainees for these specialized applications of ultrasound. We need to introduce a curriculum based on “Fundamentals of Ultrasound” to encompass the basic principles and workflow of a perioperative ultrasound examination could address this requirement.

### **Are there similar programs for other specialties?**

We are currently faced with the challenge of clinical adoption of a technology i.e. ultrasound, prior to development of guidelines of its use. Other specialties have faced similar challenges and have introduced broad-based educational programs for fully trained and physicians in training. Fundamentals of laparoscopic and endoscopic surgery (FLS and FES) are such multi-modality educational programs to teach and test cognitive knowledge and objectively test basic manual dexterity skills of trainees prior to actual clinical exposure. These are mandatory for all surgical trainees in accredited surgical residency programs and trained surgeons as part of their continuing education for recertification. However, these are specialty non-specific and open to other surgical disciplines as well.

### **What is the role of a web-based multi-modality training program?**

Restraints on trainee duty hours necessitate innovations for qualitative and quantitative enhancements in clinical educational. The advantages of a web-based didactics over conventional methods are that they can be interactive, offered remotely, and can be flexibly integrated with focused hands-on sessions. This concept of a flipped classroom can be utilized to offer better training without impacting resident duty hours. A web-based model also offers the opportunity to have a uniform content across multiple locations and standardized testing.

### **Why it is important to describe a learning curve for point of care ultrasound?**

Ultrasound training requires repetitive performance for mastery and may benefit from objective performance assessment tools to individualize this process. Latest generation 'mixed' ultrasound simulators with haptic components have shown value as task trainers and performance evaluation tools. Hence, all components of the 'orientation phase' of ultrasound training (cognitive knowledge, instrument operation and psychomotor skills) can be acquired and objectively tested. Clinical performance is evaluated with detailed performance evaluation by faculty during specialty rotations. This makes every clinical encounter maximally educational. Establishing training requirements to achieve proficiency can develop into a standardized national curriculum with performance evaluation tools similar to FLS and FES programs.

### **Using simulation technology for ultrasound training**

Simulation technology has been employed to reduce the initial learning curve in procedures requiring fine motor skills and eye-hand coordination. Even a brief warm-up time with a simulator prior to an actual surgery has been shown to reduce errors during actual laparoscopic procedures. Due to similarities in the requirement of manual dexterity and fine motor skills, it is possible that a degree of training facilitation could possibly be achieved for ultrasound training utilizing a simulator. An understanding of normal views, anatomy, and acquaintance with the technical and manual skills of the examination can improve the comfort level and quality of image acquisition during an actual ultrasound guided examination. The inclusion of this method of training in the anesthesia residency curriculum has the potential to improve resident education and training and eventually, patient safety.

Currently, expertise in ultrasound is defined principally by the amount of time spent performing this technique, denoted by the number of studies

performed. The trainee can objectively explore both the development of manual dexterity and the acquisition of knowledge critical to successful implementation of this clinical skill set. Standard tests exist for dexterity, but the interaction between manual and cognitive skills for complex procedures is less understood.

### **Curriculum based approach:**

The point of care ultrasound should be incorporated as a specific curriculum. We have successfully incorporated it as a part of the curriculum for the last four years. There is a comprehensive course in the beginning of the training period. During the first three months as a categorical resident in anesthesia the residents learn the basics of perioperative ultrasound and complete the orientation phase. It is a multimodal curriculum utilizing various steps and resources. At the end of the training, readiness for performance of clinical ultrasound examination will be established with demonstration of successfully completing the orientation phase of the training that consists of:

1. Cognitive knowledge of ultrasound
2. Understanding of the workflow of an ultrasound examination
3. Possession the necessary psychomotor skills

### **Cognitive Knowledge**

Cognitive knowledge is imparted through a web-based education model. The website has faculty narrated presentations on point of care ultrasound modalities (basic to advanced), with pre and post-review questions to assess the knowledge gain.

Testing of cognitive knowledge is performed with serial multiple choice question examinations.

### **Workflow of an Ultrasound Examination**

It is defined as a trainee's ability to integrate their cognitive knowledge with the available information to select, prepare and operate the ultrasound

equipment most appropriate for the indicated examination. This is taught through faculty moderated hands-on sessions that will have a detailed description of available equipment, operation, image acquisition, storage and retrieval. There is a detailed description of various ultrasound machine functions e.g. Doppler, linear measures and image optimization and troubleshooting (Table).

Resident's understanding of workflow is assessed with hands-on sessions of standardized tasks relating to various aspects of basic perioperative ultrasound.

*What is being performed?* TEE Examination/TTE/Abdominal & Chest/Vascular Access

*Why it is being performed?* Indications (Emergency/Elective)/Contraindications

*Which equipment to use?* Ultrasound system capable of desired examination

*How to operate the equipment:* Power on/appropriate probe selection/probe calibration/patient information.

*Procedure Non-Specific Workflow*

1. Appropriate ultrasound machine selection
2. Equipment operation
3. Ultrasound examination preparation (Appropriate patient information)
4. Procedure specific ultrasound probe selection
5. Probe insertion and calibration
6. Final equipment check and readiness

### **Psychomotor Skills for an Ultrasound Examination**

Possession of psychomotor skills is establishment by the resident's ability to satisfactorily complete pre-defined tasks for each application of ultrasound. Visual metrics Assessment of manual dexterity skills is assessed with completion of pre-defined tasks with various applications of basic ultrasound skills.

*How to perform the indicated examination?* TEE probe insertion/patient positioning for TTE and surface ultrasound examination

*What information to acquire?* Indication specific views for TTE and TEE/Identification of neurovascular bundle for regional anesthesia and vascular access

*What to do with the information?* Clinical decision-making

### **Point of care training for Anesthesia Faculty:**

Proficiency in US is currently considered a desirable skill; it should be an expectation for all anesthesiologists. Universal adoption and recognition of US as a necessary skill set requires concerted efforts at multiple levels. Individual practitioners have to recognize this training gap and be motivated to enhance their technical skills. Anesthesia departments should facilitate provision of meaningful training opportunities and create mechanisms to ensure continued clinical use of US technology by faculty. Such efforts may include but not limited to credentialing and quality assurance and improvement initiatives for professional development and patient safety. Finally, professional societies should strive to get proficiency in US recognized as a core competency for anesthesiologist with simultaneous provision of opportunities for innovative educational research. Establishing a broad proficiency in perioperative US will possibly obviate the need for establishing a specific certification for proficiency in clinical use of US. The use of US has contributed to improvement in quality and value, specifically in regards to procedural safety, timeliness of care, diagnostic accuracy, and cost reduction.

### **Summary:**

Other than for transesophageal echo (TEE) and ultrasound for vascular access there are no guidelines to define the scope, training and clinical applications of perioperative ultrasound in general. Despite having the same basic physical principles and workflow as a task, perioperative ultrasound is practiced as isolated individual techniques. Ideally there should be a unified basic curriculum encompassing physics of ultrasound, equipment operation and workflow of image acquisition and optimization. Trainees should be oriented to the fundamentals of ultrasound that are common to all the perioperative applications prior to its use. In the current era of technological advancements US fulfills the concept of “staged

imaging” where the use of US first can answer important clinical questions accurately without the expense, time or side effects of advanced imaging or invasive procedures. Whereas an advanced clinical use of US will require specialized training, a basic level understanding can and should be imparted to all the anesthesiologist. An analogy can be made to the expectation of basic level understanding of EKG strips and chest radiographs by all clinicians and advanced level interpretations requiring expert input and advice. In fact, handheld US systems are being introduced in medical school curricula as the modern stethoscopes. The design of our program can be criticized for not including improvement in patient outcome as a metric. Anesthesiologists have been at the forefront of innovations in patient safety. The 10-fold reduction in anesthesia related mortality over the decades could be attributed to adoption of clinical practices and technologies over time that incrementally enhanced patient safety. This was also based on inferential implied logic and common sense rather than rigid controlled trials of outcome benefit. We believe incorporation of US in our daily practice qualifies as a similar patient safety initiative. It would be unjust to subject this obvious safety practice to this litmus test. This recognition will most likely improve outcome and prevent a large number of anesthesiologists from being disenfranchised.