Assessment of Perioperative Ultrasound Workflow Understanding: A Consensus

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Objectives: **Understanding of the workflow of perioperative ultrasound (US) examination is an integral component of proficiency. Workflow consists of the practical steps prior to executing an US examination (eg, equipment operation). Whereas other proficiency components (ie, cognitive knowledge and manual dexterity) can be tested, workflow understanding is difficult to define and assess due to its contextual and institution-specific nature. The objective was to define the workflow components of specific perioperative US applications using an iterative process to reach a consensus opinion.**

Design: **Expert consensus, survey study.**

Setting: **Tertiary university hospital.**

Participants: **This study sought expert consensus among a focus group of 9 members of an anesthesia department with experience in perioperative US. Afterward, 257 anesthesia faculty members from 133 academic centers across the United States were surveyed.**

Interventions: **A preliminary list of tasks was designed to establish the expectations of workflow understanding by an anesthesiology resident prior to clinical exposure to perioperative US. This list was modified by a focus group through an iterative process. Afterwards, a survey was sent to faculty members nationwide, and Likert scale ratings for each task were obtained and reviewed during a second round.**

Measurements and Main Results: **Consensus among members of the focus group was reached after 2 iterations. 72 participants responded to the nationwide survey (28%), and consensus was reached after the second round (Cronbach's $\alpha = 0.99$, ICC $= 0.99$) on a final list of 46 workflow-related tasks.**

Conclusions: **Specific components of perioperative US workflow were identified. Evaluation of workflow understanding may be combined with cognitive knowledge and manual dexterity testing for assessing proficiency in perioperative US.**

KEY WORDS: perioperative ultrasound, anesthesia education, workflow, proficiency

INTRODUCTION

Perioperative ultrasound (US) refers to the use of US for patient management in the perioperative arena.[1,2] This includes transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE), abdominal and chest wall US, and procedural guidance for vascular access and regional anesthesia. Due to its expanding clinical use, it has been suggested that proficiency-based perioperative US training should be a component of accredited anesthesiology residency programs.[1,3–5] Such an endeavor would necessitate uniform US training curricula across training programs. Recognizing proficiency in perioperative US as a milestone of accredited anesthesia residency could be the first step to achieve this goal.

Proficiency in performance of a clinical procedure is a composite of cognitive knowledge, manual dexterity, and workflow understanding (Fig 1). Workflow understanding is defined as an individual's comfort level with the various practical steps that an operator needs to take in order to successfully perform the desired procedure (eg, patient identification, preparation, selection of appropriate equipment). Cognitive knowledge of basic US with workflow understanding may establish a trainee's readiness to acquire manual dexterity through repetitive clinical exposure.

Because components of workflow understanding are contextual and institution-specific it is difficult to test and has not been established for perioperative US. Prior to developing a metric to assess perioperative US workflow, it would be important to establish the components of specific US examinations. Additionally, while the different US modalities are based on the same imaging principles, they also have specific workflow components. For example, knowledge of the workflow for US-guided vascular access does not imply that the trainee can perform a TEE examination. Whereas metrics of cognitive knowledge and manual dexterity are established, none exists for evaluation of workflow understanding.[6–8] Therefore, there is value in developing a broad definition of perioperative US workflow tasks to facilitate proficiency-based evaluation of trainees across various residency programs. By employing an iterative process designed to reach a consensus opinion of national experts, the authors' goal was to define the workflow components of specific perioperative US applications.

METHODS

This study was conducted as part of an Institutional Review Board-approved protocol for perioperative US education with waiver of informed consent. Consent was implied if the participant decided to become a referee or complete the survey

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after a thorough explanation of the objectives and methodology of the study.

Preliminary List of Tasks

Three investigators (R.M., F.M., M.M.) compiled a preliminary list of general and modality-specific tasks for evaluating perioperative US workflow understanding based on a review of the literature and their personal knowledge and experience.[9–12] This task list contained 3 general categories: pre-procedural tasks, procedural tasks, and post-procedural tasks. Additionally, modality-specific items were organized into 5 categories: vascular access, regional anesthesia, TEE, TTE, and abdominal/chest wall US. The task list was evaluated first by an expert focus group and subsequently by practicing anesthesiologists and residency program directors in academic medical centers across the United States (Fig 2). This task list was specifically designed to establish the expectations of basic understanding of perioperative US workflow by an anesthesiology resident prior to clinical exposure to perioperative US.

Definition of Consensus

During the focus group meetings, consensus to add, remove, or modify items was reached when an absolute majority of referees agreed. For the survey of practicing anesthesiologists, the authors established that consensus was reached when an item had $\geq$70% of positive responses (Likert rating $\geq$4 out of 5) and a quartile deviation $\leq$1. The authors removed items when 20% or more of the respondents suggested removal or no consensus was reached.

Focus Group Round 1

The preliminary list of items was presented to a focus group of 9 referees. These referees were selected members of the authors' anesthesia department with experience in perioperative US and anesthesiology education. They were asked to modify, remove, or add items on the list of perioperative US workflow tasks. They were also encouraged to comment on the reasons why an item should be added, modified, or removed.

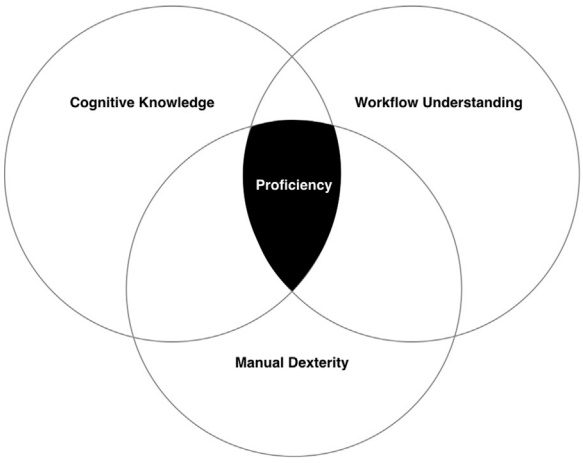

Fig 1. Components of proficiency.

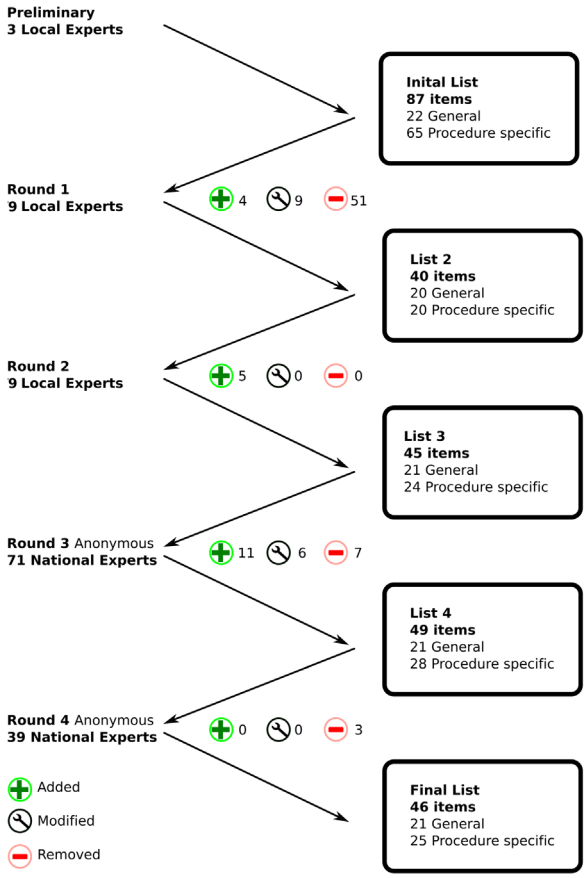

Fig 2. Summary of the methodology for creating the perioperative ultrasound workflow task list.

Focus Group Round 2

The addition, removal, and modifications to the task list as per the referees' suggestions resulted in a modified list of items. This modified list was presented to the same focus group 1 month after their initial meeting, and questions and opinions regarding addition, removal, or rephrasing of items were discussed among the referees. The participants were encouraged to suggest modification, removal, or addition of items, and to state their comments during this process.

Nationwide Survey of Anesthesiologists Round 1

The task list was modified according to the suggestions provided during the second meeting of the focus group. The authors then invited 257 anesthesia faculty members from 133 academic hospitals throughout the United States to participate in the study. The authors sent them an electronic mail message containing a brief description of their study, with the following link to an anonymous, online survey (Survey Monkey, Palo Alto, CA):

https://www.surveymonkey.com/r/Preview/?sm=9NltxXlne1TrZj7gKmU29DooOb2F0darVxBg3sFWo0o_3D.

The survey asked participants to rate each individual item on the perioperative US workflow task list according to its relevance by using a 5-point Likert scale (1 = Not at all important, 2 = Somewhat important, 3 = Important, 4= Very