

University of Florida BASICS MODULE: Supporting Literature

Introduction:

Critical care ultrasonography is a new discipline with real time adaptation to the critically ill patient. These patients main adversary is time to diagnosis or treatment of condition causing morbidity and/or mortality. Speed of decision making is very important in this population and the ability to perform serial bedside limited ultrasound examinations to answer specific emergent conditions can be life-saving and help confirm correct treatment. The use of ultrasound in critical care settings has been shown to be safe, accurate, repeatable, and provides data that may not be found with other routine methods of physical examination [1]. Quality of care is also improved by the use of ultrasound in many emergency and intensive care unit applications. The use of real time ultrasound guidance during central line insertion to prevent complications is one of the Agency for Healthcare Research and Quality's highly rated patient safety practices designed to decrease medical errors [2]. This has also been shown in many other procedures performed in the critically ill patient such as arterial line access, thoracentesis, pericardiocentesis, paracentesis, and even peripheral line access [3]. The health care provider must be able to acquire and interpret the images, make the bedside clinical decision, and use it in real time to implement and monitor changes in management. When a brief echocardiographic examination is added to the physical exam, diagnostic accuracy can be increased [4, 5]. In the following sections, point of care ultrasound applications are discussed individually, then we will show how you can put the individual applications together to evaluate shock and hypoxia in the resuscitation of a critically ill patient.

- [1]. Lichtenstein D, Axler O. Intensive use of general ultrasound in the intensive care unit. Prospective study of 150 consecutive patients. *Intensive Care Med* 1993; 19:353–5
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- [3]. Nicolaou S, Talsky A, Khashoggi K, Venu V. Ultrasound-guided interventional radiology in critical care. *Crit Care Med* 2007;35:Suppl:S186-S197.
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Training:

Health care providers who take care of critically ill patients manage conditions that relate to all anatomical regions. Management consists of evaluations of multisystem disease states and performing various high risk procedures. Ultrasound training standards are required for

developing clinical care providers and physicians with skills to perform ultrasound enhanced point of care applications that involve many regions of the body [1-3]. The American College of Chest Physicians have suggested that ultrasound competency for critical care include modules in the following areas: pleural, vascular, thoracic, and cardiac. The purpose of their document was to describe the components of competence so that health care providers can have specific goals of training while they develop their skills. Competence is distinguished from certification, which is defined as the process by which competence is recognized by an external agency [4]. As ultrasound grows in each specialty, we will begin to see more competence based training during residency or fellowship training [5]. In fact, many medical schools are now incorporating ultrasound in the pre-clinical years in order to help students grasp anatomy through visualization of ultrasound, and as a result this training should become easier for the individual throughout their graduate training years in all different specialties that are incorporating ultrasound into their curriculum [6].

Simulation of point of care ultrasound applications is very straightforward. Many applications can be practiced on ‘phantom’ models or even more sophisticated computer based models used frequently in echocardiogram applications. There has been a shift in medical procedural training from experience based (where training experience is defined by number of procedures performed) to competency based (which involves development of models specifically designed to assess procedural skill. It is well known that individuals acquire skills at different rates and therefore require different durations of training to become competent [7, 8]. The societal views of physician or health care provider practice to provide objective evidence of acquired skill has changed to assure accountability to the general public to improve quality of care, and therefore many of the applications we will discuss have many studies to assess competence [9]. One must understand that these applications are meant to answer specific bedside questions, and many of these ‘limited’ or ‘focused’ exams are meant to be adjuncts to other clinical indicators for management (for example urine output, central venous pressure, etc.). More complex measurements or evaluations should be reserved for formal ultrasound examinations performed by trained ultrasound specialists and interpreted by radiologists or cardiologists. For this reason, in each application we describe below, we will clarify the limited or focused question to be answered by the critical care health care provider at the bedside who will subsequently make immediate and patient care changing decisions.

[1]. Cholley BP, Vieillard-Baron A, Mebazaa A: Echocardiography in the ICU: time for wide-spread use! *Intensive Care Med* 2005; 32: 9 –10

[2]. Mayse ML: Real-time ultrasonography— Should this be available to every critical care physician? *Crit Care Med* 2005; 33: 1231–1238

[3]. Duvall WL, Croft LB, Goldman ME: Can hand-carried ultrasound devices be extended for use by the noncardiology medical community? *Echocardiography* 2003; 20: 471– 476

[4]. Mayo PH, Beaulieu Y, Doelken P, Feller-Kopman D, Harrod C, Kaplan A, Oropello J, Vieillard-Baron A, Axler O, Lichtenstein D, Maury E, Slama M, Vignon P. American College of Chest Physicians/La Societe de Reanimation de Langue Francaise Statement on Competence in Critical Care Ultrasonography. *Chest* 2009; 135; 1050-1060.

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- [8]. Wahidi MM, Silvestri GA, Coakley RD, et al. A prospective multicenter study of competency metrics and educational interventions in the learning of bronchoscopy among new pulmonary fellows. *Chest*. 2010;137(5):1040-1049.
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Uses of Ultrasound:

Ultrasound research and description of use in the shock patient for resuscitation, hemodynamic evaluation, and procedural skills has grown exponentially in recent years. Many algorithms have been developed for use in specific situations, such as the trauma patient with the well known FAST (focused assessment with sonography in trauma) exam, as well as management of hypoxia, respiratory failure, and hypotension. In the future we may have developed algorithms for other common critical care conditions such as fever of unknown origin, oligoanuria, and nutrition status. In a recent paper the “ICU-sound” protocol found transthoracic ultrasound examination can be used to diagnose abnormalities and modify admitting diagnoses in 26% of patients, led to changes in medical therapy in 18% of patients, and initiated invasive procedures in 22% of patients [1]. Point of care or “bedside” ultrasound involves the use of ultrasound at the patient’s bedside to answer very specific clinical questions that can be used immediately to make diagnostic and therapeutic decisions by the patient’s health care provider. This reduces the time to life-saving interventions which has been shown in previous studies to decrease morbidity and mortality [2]. First we will discuss individual applications used in the critically ill patient, and then we will discuss algorithms one can use by combining these individual applications in order to best assess a patient in shock, respiratory failure, and procedural ultrasound use.

- [1]. Manno E, Navarra M, Faccio L, Motevallian M, Bertolaccini L, Mfochive A, Pesce M, Evangelista A. Deep Impact of Ultrasound in the Intensive Care Unit: The ICU sound protocol. *Anesthesiology* V 117 No 4; 2012: 117:801-809
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