Modern sonology and the bedside practitioner: evolution of ultrasound from curious novelty to essential clinical tool

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Sonography-based clinical assessment continues to gain traction as an essential clinical tool throughout the world [1, 2]. In that context, it is critical to recognize the truly global effort to introduce, popularize, and further advance the use of sonography in everyday clinical practice across the planet [1, 3, 4]. Sonology, or the science of performing bedside ultrasound exam and the associated clinical interpretation, is now an established scientific discipline that empowers the bedside practitioner to not only acquire relevant anatomic images, but to analyze their meaning, and to determine the clinical course of action accordingly [5, 6]. More importantly, due to sonographic equipment miniaturization, sonologists are no longer restricted to the office or hospital settings, but can assist patients in a variety of prehospital, geographically remote and austere environments [7–9].

As portable (i.e., mobile platform-based and truly handheld) ultrasound units become common place [10], non-radiology practitioners stand to gain true opportunity to glimpse into the inner workings of the body and turn that ability to practical, often life-saving, interventions [11, 12]. The true impact of sonology is easily appreciated by performing a simple internet search using the very phrase “bedside sonography”, with 2,061 results on PubMed and 17,900 results on Google™ Scholar (search performed on June 26, 2014).

When one uses versatility as the benchmark, the power of sonography becomes truly obvious as the number of its potential applications and disciplines involved is examined. For example, sonologists and proceduralists can claim substantial contributions in the areas of central [13] and peripheral [14] venous access, disaster triage [15], musculo-skeletal diagnosis and treatment [16, 17], vascular diagnosis [18], intravascular volume status assessment [19], cardiovascular assessment [20, 21], tracheal airway placement verification [2], ophthalmologic and neurologic applications [22–25], diagnosis of cholecystitis [26, 27], appendicitis [28], and abdominal solid organ abnormalities [29–32], obstetric and gynecologic applications [33, 34], and percutaneous drainage of fluid collections [35, 36], among many other clinical uses [37–41].

Principal aim of the next two special issues of EJTES is to highlight the progress of sonology as a discipline, focusing on the procedural and emergency applications. One of the key concepts central to the new sonology-based practice is the “I-AIM” paradigm [42]. Here, the independently functioning practitioner operates based on the premises of “indication, acquisition, interpretation, and medical decision-making”. More specifically, each sonographic exam should carry a specific indication, along with a pre-test probability. There has to be an orderly image acquisition procedure, followed by an established interpretation of the acquired data. Finally, the findings are translated into the paradigm of medical decision-making, where a consideration is given to perform specific clinical interventions, and/or altering the clinical course of action, based on said results [7, 43].

The merging of miniaturization, portability and a diverse need for diagnostic certainty at the bedside has led to a boom in ultrasound in medical education [44–46]. As more practitioners integrate ultrasound into their clinical

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practice, the question becomes whether it is used simply as an aid to the physical exam or, in a more advanced context, as a diagnostic procedure with saved images and a generated report [47]. This is the next part of this transformational journey as ultrasound is taught at the earliest stages in medical school and residency, focusing on the scientific foundations behind the practical way sonology is utilized and applied in a variety of clinical scenarios.

The needs of the patient can be answered with knowledge of acoustics and artifacts as well as the awareness of how ultrasound can detect fluid collections or air in various spaces in the human body [48–54]. The physiologic, anatomic, and pathologic findings detected with ultrasound can help the clinician at the bedside put the clinical context to what he or she is “seeing” on the ultrasound monitor. All the required skills can be taught, students and residents can learn, yet ultrasound has still not achieved its full potential within the landscape of modern medicine. How do we go further? How do we truly integrate ultrasound into the way we diagnose, prognosticate, and treat our patients?

Well, the very next step is for health care decision makers to implement a more ultrasound-centric practical change in the care for patients. Many authors decry the dangers of ionizing radiation associated with much over-used computed tomography [55–58] as well as the escalating costs of health care [59]. Consequently, the authors’ hope is that ultrasound can be operationalized into modern medicine on a more systematic and algorithmic basis to remedy these systemic problems, among many others. Ultrasound use in screening and coordinating care at both modern medical centers and in austere environments opens up new avenues for creative clinicians to broach the chasm from bench to bedside. How can ultrasound better help the patient?

Smart technology is all about using existing capabilities and innovating upon those in incremental fashion. The use of ultrasonic waves to produce images of the human body has revolutionized the critical care of the ill or injured patients, as well as the field of bedside procedures. As our collective knowledge advances, the technological improvements will lead to better devices and superior image quality [60–62]. It is up to the sonologist to create static and/or moving images that tell a medical story. The ultrasound can help the practitioner find fluid in a number of potential spaces like interstitium, or along tissue planes around the retina, or perhaps in Morison’s pouch or the Paracolic gutters. Finding and draining fluid collections with ultrasound can help the provider make decisions, facilitating “yes/no” answers to dichotomous questions. As the practitioner uses the tools to inform a decision, a focused ultrasound application helps answer specific questions. The impact of sonography is profound, its possibilities vast, and the number of clinical stories to be told is truly limitless!

The future of ultrasound is very bright but we must not forget the late adopters and the skeptics. The ultrasound technology is, of course, operator dependent and can be difficult to use, misleading at times, and prone to misinterpretations by the novice user. Consequently, early and comprehensive sonology education is a must, with emphasis on focused ultrasound applications and pertinent skill-based practice early in a career. As time passes and reach of ultrasonography expands, practitioners will likely find an expanding array of bedside sonography uses as they strive to help patients and provide safer, reliable, and efficient care. Sonology is the practice of using ultrasound at the bedside to assist the practitioner in their medical decision-making. The next two focus issues of the European Journal of Trauma and Emergency Surgery will provide a comprehensive insight into the modern face of this exciting and growing field.

Conflict of interest Stanislaw P. Stawicki MD FACS and David P. Bahner MD RDMS declare that they have no conflict of interest related to this work.

Compliance with ethical requirements This work is in compliance with ethical requirements.

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