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Editorial

Delivering Clinically Relevant Living Anatomy by Surfing the Waves of Ultrasound

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Editorial

An elderly man on arrival to the Emergency Department (ED) complains of chest pain and left arm and left leg paralysis. His vital signs are: arterial pressure of 80/40, heart rate of 110, respiration of 22, and oxygen saturation of 98%. This is an emergent situation and the clock is ticking. How quickly can the ED physician decide on a correct diagnosis and coordinate appropriate medical intervention? By ignoring the temptress of high tech imaging (e.g., CT scan and MRI), the physician rapidly deploys ultrasound (US) at the bedside to render the correct diagnosis within an astonishing three minutes of the patient's arrival to the ED. While the reader may have initially made a diagnosis of stroke, US, however, vividly revealed an aortic dissection as the cause of the patient's symptoms. This was the dramatic message conveyed by Dr. Barry Knapp in his presentation, Improving Patient Outcomes with Ultrasound: A Clinician's Perspective, at the second conference on Ultrasound in Anatomy and Physiology Education held on the campus of Eastern Virginia Medical School in March of 2014 [1].

As exemplified by the clinical case above, there is clearly diagnostic value and utility of using US at the bedside to improve patient care and safety. Consequently, clinicians are currently extolling the virtues of vertically integrating the advances in ultrasound technology throughout the four years of undergraduate medical education [2,3]. Logically, the port of entry for its as simulation begins early in the curriculum with gross anatomy where US serves as a useful complementary tool in immersing medical students in the clinical application of this foundational explanatory science and introducing them to image interpretation [4,5]. Expectedly, early adopters of ultrasound in the medical curriculum are now rapidly transforming the manner in which anatomists advance the skills and knowledge of the next generation of physicians.

As pioneers in the vertical integration of ultrasound throughout the continuum of undergraduate medical education, Hoppmann and colleagues shared in their seminal review article the implementation process, lessons learned, and future directions for ultrasound integration in medical education from their experiences at the University of South Carolina, School of Medicine [3]. By designing and deploying a graduated series of US lessons, they were able to integrate US into the M1 courses of anatomy and physiology. In the M2 year, US modules were offered in conjunction with the yearlong introduction to Clinical Medicine course. Learning opportunities were also provided to students in the form of open US labs and embedded in the pathology course [6] as well as scheduled problem-based learning sessions. During the M3 year, medical students were provided ultrasound experiences in each of the required clerkships and objective structured clinical examinations that followed each clinical rotation. The fourth year provided varied experiences: an emergency medicine US elective, US activities were added to the radiology elective, an US independent study elective, and a two-day US Capstone course. Moreover, Web-based US learning modules were offered over the four-year continuum. The early successes of Hoffmann and colleagues blazed the trail for others to follow, such as Eastern Virginia Medical School, The Ohio State University, and University of California Irving [2,7,8].

In addition to the schools above, anatomists at other medical schools in the United States and internationally (George Washington University, University of North Texas Health Science Center, and Durham University in the UK) have similarly embraced US as a critical teaching tool in advancing a student's learning of clinically relevant living anatomy. Specifically, anatomists are deploying US to demonstrate the anatomical relationships of: 1) neck structures (e.g., trachea, thyroid gland, common carotid artery, and internal jugular vein); 2) musculoskeletal anatomy of the glenohumeral joint, rotator muscles, and tendon of the long head of the biceps brachi muscle lying in the bed of the bicipital groove; 3) long flexor tendons and median nerve of the carpal tunnel; hepatorenal fossa (pouch of Morison, a potential space), hepatobiliary structures (e.g., gallbladder, portal triad), and popliteal artery and vein.

While several anatomists have successfully launched US in their courses, other anatomists may understandably be cautious and hesitant to use US in the teaching of anatomy due to their unfamiliarity with the technology. However, with recent technologic advances in US technology accompanied by a growth mindset and a desire to learn, anatomy faculty can quickly learn to teach anatomy with minimal training [4]. Consistent with the finding of Jurjus [4] that anatomists can teach anatomy using US with minimal training, participants at the second conference on Ultrasound in Anatomy and Physiology Education [8] and the anatomy ultrasound workshop at the annual meeting of the American Association of Anatomists [9] eagerly engaged in hands on activities that engrossed them in using US devices on standardized patients or session participants. Again, with minimal training, conference attendees vividly demonstrated the living anatomic relationship of the common carotid artery and internal jugular vein on US in the short axis. Observing the internal jugular vein significantly distend by having a subject perform the Valsalva maneuver further reinforces living anatomy as well as physiology. Moreover, viewing the living anatomy of a normal

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mitral valve, in real time, rhythmically opening and smacking the interventricular septum followed by its closing, in the US parasternal long axis was amazingly stunning. Coupling this experience with an US video of a dysfunctional mitral valve further serves to enhance the learning of anatomy in a clinical context [1].

In conclusion, as a grounds well of anatomists develop into change agents, in just a few years learning activities that readily translate cadaveric anatomy into the clinical realm of US imaging will be a *sine qua non* of a quality medical education. Clearly, anatomists can qualify to use US as a teaching tool with minimal training and are uniquely positioned to introduce medical students to the importance of US in understanding anatomic relationships through image interpretation and fostering student awareness of clinically relevant anatomy. This is a clarion call to capitalize on this exemplary educational opportunity.

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