

## MEDICAL EDUCATION: PART I

# TEACHING ULTRASONOGRAPHY TO FIRST-YEAR MEDICAL STUDENTS

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Over the last few decades, ultrasonography (US) has been increasingly utilized across numerous medical specialties due to the relatively lower cost and safety of this imaging modality. Additionally, the development of hand-held, portable US equipment (point-of-care-ultrasonography [POCUS]) has made bedside diagnosis more accessible. The expanding use of POCUS across medical specialties has prompted the inclusion of early hands-on US training.

To accommodate the need for early US education, multiple medical schools have included POCUS training into the undergraduate (UME) and graduate medical (GME) curricula to varying degrees. Some institutions have fully integrated US into all four years of medical school<sup>1,2</sup>, whereas others have incorporated training into portions of the undergraduate<sup>3</sup> or graduate<sup>4,5</sup> coursework.

At the University of Colorado School of Medicine (CUSOM), formal US training has been included in the UME as part of the first-year dissection-based gross anatomy course since 2014. US is integrated throughout the course as hands-on scanning sessions where students scan each other while utilizing the gross anatomy they are currently learning. These US sessions allow them to build a familiarity with the US machine and transducers, review anatomy pertinent to the gross anatomy course, view structures and anatomical relationships that are often disrupted during dissection, and understand the clinical relevance of gross anatomy and US to diagnose and treat (i.e., bedside procedures) patients. For example, while scanning the right upper quadrant of the abdomen, students will identify specific liver and kidney structures as well as the hepatorenal recess or Morison's pouch which is often difficult to conceptualize in 2D images and after cadaveric dissection. Once these structures are located, students can discuss how ultrasound is used to detect the presence of fluid within this space. US sessions are an excellent opportunity to integrate clinical skills training with the basic sciences.

Within the CUSOM gross anatomy course, there are five, 50-minute scanning sessions that align with the regional anatomy lectures and dissections. Before US sessions, students complete pre-session content explaining the US and anatomy relevant to the scanning session. Over the years, this pre-session content has been in various formats including video, iBook, and interactive online learning modules. During the sessions, small groups of 3-4 students use a laptop-based US machine and written instructions to obtain the same US images and identify the same anatomical structures addressed in the pre-session content. Students in each group alternate between manipulating the transducer and volunteering as the scan model. Additionally, a pair of student groups will have a clinical facilitator (e.g. clinical faculty, resident, or 3<sup>rd</sup>/4<sup>th</sup> year medical students) and a graduate student teaching-assistant familiar with anatomy and trained in US. Together, the clinical facilitator and graduate teaching-assistant, guide student groups through the US sessions providing additional anatomy review and clinical examples. This combined facilitator effort has been perceived effective in this setting.<sup>6</sup>

By requiring students to complete the pre-session content prior to class, as a flipped classroom format, students are able to have a hands-on experience. Additionally, the pre-session content and the session instructions are both aligned to include directions for manipulating the probe and acquire specific images. Once the views are obtained, both resources direct students to identify anatomical structures and relationships, guide them to recall additional anatomical concepts not visible on US, and discuss clinical questions. For example, directions are given to obtain a view of the anterior midline of the neck and subsequently the thyroid gland and nearby musculature will be identified in the on-screen US image. Next the muscle innervations will be reviewed although not visible in the on-screen image and finally students will discuss how

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a thyroid nodule would appear on US. The consistency between these resources reinforces US and anatomical concepts while allowing students opportunities to test and identify gaps in their knowledge.

The integration of US sessions into a gross anatomy course is an excellent way to introduce a clinical skill while demonstrating the clinical relevance of anatomy. The flipped classroom format allows for an active approach to learning and incorporates forced recall activities to help students learn both subjects. Students are expected to demonstrate professionalism and can practice other skills such as physical examination while working in small groups. Furthermore, the inclusion of live US scanning sessions is an engaging format for learning anatomy and ultrasonography. Many students are genuinely excited to correlate the gross anatomical structures from cadaveric dissection with the living anatomy of themselves and their classmates.

Integrating the teaching of US to gross anatomy and correlating it to

physical exam provide students with a subset of interrelated knowledge and skills that will be imperative for their future clinical practice. The US content taught during these sessions provides students with early literacy in US as well as the stepping-stone for the continued growth and development of these skills, which will likely be fundamental for practice.

**References**

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