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EDITORIAL

Benefits and risks in the broader incorporation of ultrasound in medical education

Riesgos y beneficios de una mayor incorporación de la ecografía en la educación médica

Ultrasound has been used to image the human body for over half a century and is now one of the most widely used imaging technologies in medicine. It is portable, free of radiation risk, and relatively inexpensive when compared with magnetic resonance and computed tomography. Ultrasound images can be acquired in real time, and offer a cross-sectional view of anatomical structures.

What is ultrasound's role in medical education?

Ultrasound is a terrific modality for teaching. Seeing in real time is powerful, and translates the theoretical to the real. It allows immediate visualization of anatomic structures to consolidate theoretical learning about structures as varied as the thyroid, gallbladder, placenta, and aorta. Ultrasound can also illuminate key physiologic principles, and can help students understand concepts such as preload or intrathoracic pressure variation.

In addition to using ultrasound for learning, there has been an increasing incorporation of ultrasonography technique into the skillset of non-radiologists. Many types of specialists can use ultrasound in their daily practice, clarifying a clinical finding (such as a thyroid nodule), making diagnoses such as left ventricular hypertrophy, or tracking therapeutic progress (such as amount of ascites). Ultrasonography has also been shown to improve the safety of several procedures (such as thoracentesis and central line insertion). The improved accuracy that can result from the effective use of ultrasound can increase patient safety and comfort and result in fewer errors.

Why has incorporation of ultrasound expanded recently?

There are no known adverse effects of ultrasound. Technological advances have resulted in ultrasound devices becoming progressively smaller and cheaper, making it feasible for individual providers to have access to a device.

As medical curricula have embraced the educational psychology of active learning, the ability to incorporate teaching techniques that allow learners to participate in the learning experience can enhance retention by improving relevance and clinical applicability of the material.

How is ultrasound being introduced into curricula?

With the increasing availability of ultrasound devices and the growing evidence of ultrasound as an effective teaching and point-of-care clinical tool, schools in the United States, Australia, and Europe have developed curricular and teaching approaches to maximize the impact of this technology for learners and patients alike. Several medical schools have embraced ultrasound education as a longitudinal theme in their curricula. What often begins as a program in emergency radiology is often elaborated into other disciplines as the devices become more ubiquitous and the students and teachers become familiar with them. Organizations such as the Society of Ultrasound in Medical Education (susme.org) and the American Institute for Ultrasound in Medicine (aium.org) have supported these efforts and are working to improve the awareness of the education community about the effectiveness of the approach for teaching and learning.

What do these studies add to our understanding about ultrasound in education?

The study by Dr. Sanchez and his colleagues published in this issue of Rev Clin Esp[1] helps clarify that small groups of medical students can be effectively taught to use ultrasound to accurately identify abdominal aortic aneurysms, splenomegaly, ascites, and urinary retention

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with approximately 15 hours of supervised training. The study demonstrates that non-specialists can readily learn the techniques and identify important findings accurately with limited training.

The manuscript by Drs. Beltrán and Garcia de Casasola,[2] also in this issue, provides clear examples of ultrasound's utility in clinical practice when used by internists to detect problems varying from carotid atheroma, aortic stenosis, hydronephrosis, to acute cholecystitis. Several of these findings are difficult to detect clinically, but are readily detected with ultrasound. The study demonstrates the potential clinical applicability of wider use of ultrasound in practice environments.

What are the risks of wider adoption of ultrasonography for non-radiologists?

It is premature to declare the value of ultrasound in medical education to be a settled matter. In our experience, ultrasound is not trivial to teach, and takes many hours of individual instruction to generate the skill necessary to be effective. Several instructors have found that the maximum group size for hands-on education cannot exceed 4, a finding that has implications for the faculty time needed to support effective instruction.

There's also a necessary trade-off between the time spent in other priorities. There is a risk that increased availability of ultrasound will erode the skill development in physical examination; physical examination skills are cheap, readily and quickly performed, and require very limited if any equipment. It would be an unfortunate loss if bedside echocardiography becomes necessary to diagnose mitral regurgitation, or a cool hard piece of technology replaces the warm and human touch of a physician.

While ultrasound's role in improving instruction in the fundamental understanding of anatomy, physiology, and medicine, not every medical student will ultimately benefit from learning how to perform an ultrasound examination.

Inadequately trained ultrasound users have a high false-positive rate for abnormalities that need additional investigation, which could paradoxically increase costs by resulting in unnecessary and potentially invasive investigation or even inappropriate treatment. Similarly, a false-negative finding may result in a decision to inappropriately forego a skilled evaluation by an expert radiologist and lead to a potentially missed diagnoses. Teachers will need to be cautious about interpreting student self-confidence or satisfaction as indicating competence; over-confidence with ultrasound is common.

Device limitations

Higher frequency ultrasound wave are absorbed more superficially and have a smaller penetration depth but higher resolution. For this reason, it is best to use high-frequency transducers (up to 10–15 MHz range) to image superficial structures and low-frequency transducers (typically 2–5 MHz) for imaging deeper structures. More portable ultrasound machines tend to have a narrower range of frequencies and can be used only for selected uses. For example, a portable device may be unable to visualize a thyroid nodule, but be very suitable for evaluating ascites. Device selection is therefore important.

Next steps

Ultrasound's role in medical education is clear. It can be effectively used to enhance students learning of anatomy and physiology, and help consolidate problem-based learning. Ultrasound's increasing availability can also ultimately enhance safety, comfort and cost-effective medical care when incorporated into diagnostic use. However, further research will need to define the most effective ways to incorporate ultrasound into curricula and clinical care in ways that maximize efficiency, effectiveness and educational impact.

References

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