

Ultrasound as an Alternative to Computed Tomography for Pediatric Imaging

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Computed tomography (CT) is a wonderful technology that allows rapid and accurate diagnosis of many serious and life-threatening conditions. However, one of the disadvantages of CT is that it exposes patients to ionizing radiation. Although the literature is divided on the absolute and relative risks of exposure to medical radiation, the American College of Radiology has recommended that radiologists always keep radiation doses "as low as reasonably achievable" (ALARA).

Radiation awareness is especially important when performing imaging studies on children, as their immature tissues are more susceptible to the effects of ionizing radiation. In addition, their longer potential survival after exposure provides more time during which they could manifest the latent effects of DNA damage—some of which take up to 30 years to develop. Furthermore, radiation effects are thought to be cumulative, which is of particular importance in children diagnosed with "image intensive" chronic diseases, such as Crohn disease. Fortunately, articles in the popular press, academic papers, and educational campaigns such as Image Gently are providing patients, parents, radiologists, and referring clinicians with more information regarding the risks of radiation, and all of these stakeholders are becoming more judicious when weighing the risks and benefits of CT scans.

In fact, while the total number of CT scans performed

in the United States has been increasing exponentially, use of CT scans in pediatric hospitals has been leveling off. At these institutions, children are increasingly being imaged by ultrasound and/or magnetic resonance imaging, 2 modalities that do not use ionizing radiation [1]. Ultrasound is particularly well suited for use in children, as the main limitation of ultrasound is the amount of body tissue that the sound waves can penetrate, and this is much less of a constraint in a pediatric population. Thus anatomic detail is usually much greater on pediatric ultrasounds than on adult ultrasounds. Another major advantage of ultrasound is that it is a real-time examination, so it can compensate for patient movement. When performed by a skilled operator, ultrasound can provide information about a child who may not be able to sit or lie still for a CT scan or for standard radiographs.

Because of these advantages and the fact that ultrasound involves no radiation, it is often the first-choice imaging modality for many indications in pediatric patients. For example, ultrasound plays a prominent role in the evaluation of possible appendicitis in children. Multiple studies have shown that ultrasound performed by an experienced operator is only slightly less sensitive and nearly as specific as CT for the evaluation of appendicitis. Many children's hospitals now perform ultrasound as the initial test for the evaluation of right lower quadrant pain,

followed by CT in cases with equivocal results [2]. Using a protocol of ultrasound alone (in cases when there is low pretest probability) or ultrasound followed by CT (in cases with intermediate or high pretest probability) has also been shown to be the most cost-effective approach [3], a consideration that is of increasing importance in today's medical environment.

Despite the advantages of ultrasound in some settings, there are times when a CT scan is necessary and appropriate. In the scenario described above, of a patient with right lower quadrant pain, CT should be performed when ultrasound results are equivocal and clinical suspicion of appendicitis remains elevated. CT is also the first-line imaging modality in trauma cases and in cancer staging, and CT can be a very valuable tool for preoperative evaluation of complex cases. Finally, at certain times and in certain locations, CT may be the only imaging modality available. The main point is not that CT should be avoided at all costs, but that an appropriate risk/benefit analysis should always be performed whenever any type of imaging is being considered.

Given the pros and cons of various imaging modalities, referring clinicians and parents should talk with radiologists to determine the best course of action in each case. There are many times when an ultrasound can be performed instead of a CT scan, and most radiologists, particularly those who specialize in pediatric radiology, can help guide these clinical decisions. A brief discussion of the patient, his or her signs and symptoms, and the clinical question to be answered can ensure that the right test is performed and that an accurate, useful result can be obtained and reported. Also, when the best test for the pa-

tient involves the use of ionizing radiation, the radiologist can help to put the risks of radiation into relative terms for clinicians and patients. For example, a frontal and lateral chest radiograph exposes the patient to about the same amount of radiation as a round-trip flight across the United States. Simply understanding radiation and its risks is often very helpful and relieves anxiety. Through these discussions and collaborations, both radiologists and clinicians can ensure that they are providing the best patient care. **NCMJ**

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