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Imaging of Lumps and Bumps in Pediatric Patients: An Algorithm for Appropriate Imaging and Pictorial Review

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Superficial lumps and bumps are a common presenting complaint in the pediatric patient population. Although encountered frequently, the path to a definitive diagnosis is not always a straightforward one. Imaging offers a valuable tool to aid in this diagnostic challenge. Radiologists must be familiar with pediatric lumps and bumps, their imaging characteristics, and the best way to further evaluate challenging clinical presentations. This will not only allow the radiologist to serve as a valuable asset to the treating physician in choosing the most appropriate imaging modality but also help in accurate diagnosis, all while ensuring the "image gently" principle. An algorithm for imaging in the pediatric patient with lumps and bumps has been presented in this article and a few example entities along with their imaging findings have also been reviewed.
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Introduction

Lumps and bumps in pediatric patients can be a source of apprehension for parents who typically fear the worst for their child. The differential diagnosis for these types of lesions can be wide ranging, including both osseous and soft tissue pathology. Although most of these presenting complaints are not serious or life threatening, there is the ever-present fear of the "cannot miss" diagnoses and the anxious parent that often propel the physician to make an attempt at a definitive diagnosis. Imaging is often sought to help clear up the clinical picture. Considering the commonality of this presenting complaint, it is prudent for the radiologist to not only be familiar with the imaging presentation of certain entities to ensure the most accurate diagnosis but also be knowledgeable on how to most appropriately image the patient to serve as an effective advisor to the treating physician.

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Imaging Modalities

In an effort to keep in line with the "image gently" campaign developed by The Alliance for Radiation Safety in Pediatric Imaging to be a relevant member of the integrated health care team, it is imperative for radiologists to be able to recommend appropriate imaging for further characterization of pediatric lumps and bumps. Ultrasound, plain film radiography, computed tomography (CT), and magnetic resonance imaging (MRI) are the currently available imaging modalities that should be used to effectively aid in diagnosing most lesions faced in the clinical setting. CT and MR angiography can also be of value but are typically used as a secondary study to further define a known entity (ie, completely evaluating the extent of a vascular malformation).

Ultrasound is widely available, noninvasive, and performed without ionizing radiation and the need for sedation. Ultrasound is highly user dependent and is best performed where the radiologist is available to personally scan as needed. Plain film radiography is also universally available and can be performed quickly, at a relatively low cost. The drawback of plain film radiography is the radiation exposure, albeit it is lower than CT. CT is also widely available, but is more expensive than plain film radiography and requires higher radiation doses. MRI is not only the most expensive modality, it is also not available in all locales. However, it does offer excellent

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soft tissue characterization without any radiation exposure. Other considerations for the use of MRI include the potential need for sedation and its untoward effects on a pediatric patient. MRI can also be a very lengthy examination, depending on the body part being imaged.

Algorithm

The first step in working up a lump or bump is physical examination to determine whether the palpable mass is bony or soft tissue in origin. Some lesions are indeterminate. If the lesion feels bony, the first step in the imaging workup would be radiography to determine if the lesion is calcified or bony in origin and to assess if there is involvement of the underlying bone. Radiographs can, in some cases, be diagnostic and in others can offer significant information toward the diagnosis. Radiographs can help determine if a bony lesion has an aggressive or nonaggressive appearance. However, associated soft tissue components can be underappreciated with this modality. Depending on the initial radiographic appearance and taking radiation exposure risk into consideration, the next diagnostic choice may be either MRI or CT. CT offers excellent evaluation of bone cortex and high-resolution capability. MRI offers greater characterization of bone marrow involvement and associated soft tissue components.

For palpable lesions thought to be soft tissue, the initial imaging choice would be ultrasound. On imaging in gray scale, the solid vs cystic nature of a lesion can be determined, as can be the spatial location and size of the lesion. The vascularity of the lesion can be evaluated with both color and spectral Doppler at the time of ultrasound. The next choice for soft tissue lesions would be MRI, which offers excellent tissue characterization. In addition, MR can evaluate deeper lesions that may not be able to be fully evaluated with ultrasound. Basic MR sequences to obtain when evaluating a lump or bump include imaging in at least 2 planes and T1, fat-saturated T2, and postcontrast images. Additional sequences can be added as needed. Postcontrast imaging characteristics offer clues to the diagnosis, demonstrate necrosis, and can help guide biopsy.

If it is difficult to assess whether the lesion is soft tissue or osseous in origin, then plain film radiographs offer the most efficient and cost-effective imaging modality to determine it. The diagnosis may not always be made on the basis of plain radiographs, but the findings often add sufficient information to guide decisions regarding additional imaging. A summary of these recommendations can be found in Figure 1.

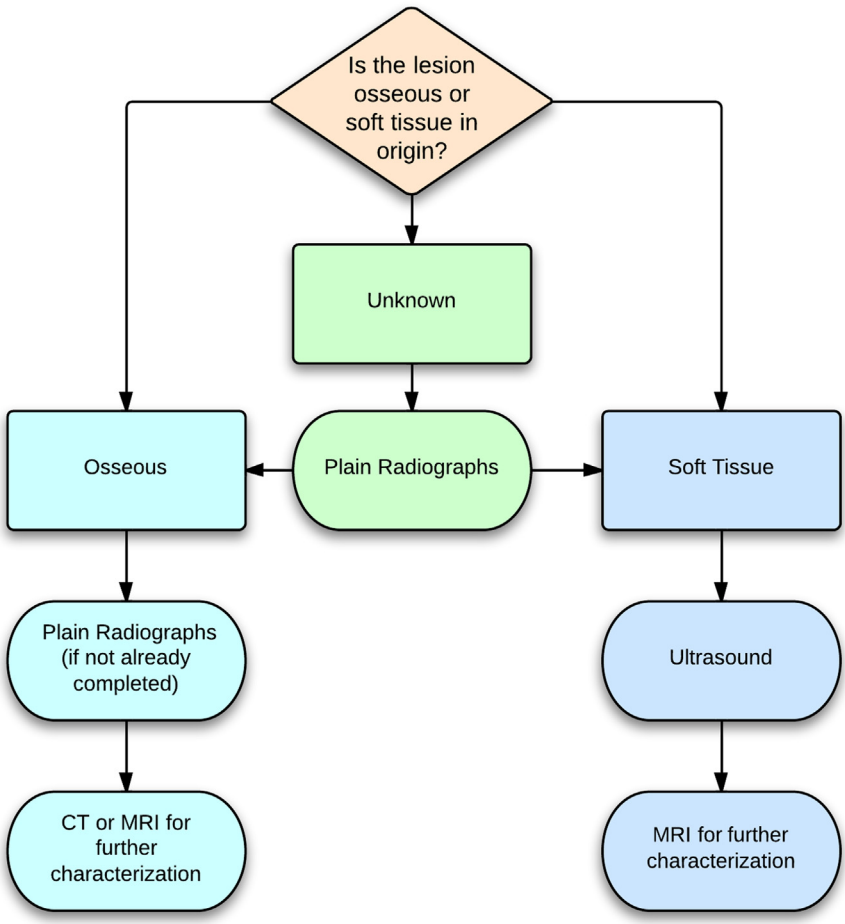

Figure 1 Imaging algorithm. A systematic approach to image evaluation of the pediatric patient with a palpable abnormality is presented. (Color version of figure is available online.)

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