COMMENTARY

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American College of Radiology LI-RADS in pediatric patients: the good, the bad, and the future

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"Children are not little adults" is a phrase often used in pediatric medicine. One area where this sentiment is particularly true is in the evaluation and management of pediatric focal liver lesions. In this issue of *Pediatric Radiology*, Ludwig et al. [1] reported on their experience with applying the American College of Radiology (ACR) Liver Imaging Reporting and Data System (LI-RADS) v2017 in pediatric patients. The authors retrospectively evaluated the application of the LI-RADS v2017 criteria to a cohort of pediatric patients with known liver lesions [1]. In light of this paper and ongoing efforts to standardize the imaging evaluation of pediatric hepatocellular carcinoma (HCC) and hepatoblastoma, I would like to share my thoughts on the potential benefits and drawbacks of using the current version of LI-RADS in the pediatric population and where our efforts as pediatric liver imagers might lead us.

ACR LI-RADS is a "comprehensive system for standardizing the terminology, technique, interpretation, reporting, and data collection of liver imaging" that is "designed to improve communication, patient care, education, and research" in adults at high risk for HCC [2]. LI-RADS uses final assessment categories (i.e. LR-1, LR-2, etc.) that help stratify liver lesions based on the likelihood of HCC. Regardless of patient age, there is little doubt that standardization of practice can improve our ability as physicians to provide optimal care. Standardizing how CT and MRI examinations are performed and reported for patients at risk for or carrying a diagnosis of focal liver lesions yields opportunity to effectively collaborate broadly across institutions for patient care and research efforts. More effective communication is facilitated among radiologists, and between radiologists and referring providers, when

we are able to speak the same language via a standardized terminology.

While there are benefits to standardizing our practice, there are clear differences between adult and pediatric liver tumors that should be considered before implementing LI-RADS for pediatric patients. First, hepatoblastoma is the most common primary pediatric liver malignancy. Most patients are diagnosed within the first 5 years of life [3]. Most cases of hepatoblastoma are sporadic, though several associations have been reported [4–6]. Second, up to 70% of pediatric HCC — the second most common primary pediatric liver tumor — develops in children without underlying liver disease during the latter part of the first or early second decade [7, 8]. In sharp distinction, HCC is the most common primary hepatic malignancy in adults and is diagnosed at a much higher frequency than all malignant pediatric liver tumors combined [7, 9]. Most cases of adult HCC are linked to pre-existing liver disease associated with risk factors such as cirrhosis, chronic hepatitis B, and nonalcoholic fatty liver disease [9]. Third, pediatric HCC typically presents with a larger tumor size, more advanced disease, and higher rate of regional and distant metastatic disease, suggesting the pathogenesis is distinct from that observed in adult HCC [10, 11]. Effectively, most pediatric patients are diagnosed with larger and more aggressive tumors than adults who are being screened for HCC secondary to a high-risk condition and in whom there is a need to differentiate among small lesions and identify lesions that might be malignant. In most children, the tumor is obviously malignant and there is no need to distinguish between lesions.

In its current form, the CT/MRI core LI-RADS v2018 document indicates it is intended for the surveillance and diagnosis/staging of patients at high risk for HCC [2]. The LI-RADS algorithm does not apply in patients <18 years old, those with cirrhosis from congenital hepatic fibrosis, those with cirrhosis from a vascular disorder (such as cardiac congestion), or those without cirrhosis/chronic hepatitis B infection/current or prior HCC [2]. Considering that most cases of pediatric HCC develop without associated liver disease, effectively using LI-RADS

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in its current form in a surveillance manner would not be feasible. Some pediatric patients have additional exclusion criteria from the list described (in addition to the inherent age exclusion), such as those developing HCC in the setting of Fontan hepatopathy. It is unclear how effective the LI-RADS algorithm would be in these types of children with multiple types of liver lesions.

Using the current version of LI-RADS for the pediatric population ignores the lack of specific categorization and direction for children with a mass suspicious for or known to be hepatoblastoma. While all primary liver neoplasms in children are uncommon, utilization of an LI-RADS system that does not specifically take into account the most common primary pediatric hepatic malignancy is less than ideal. At best, in the current version of LI-RADS the LR-M category (used in LI-RADS to categorize a mass that has features highly suggestive of malignancy but not specific for HCC) might be used for masses suspicious for hepatoblastoma, as was shown by Ludwig and colleagues [1].

To maintain perspective, we should keep in mind the goals when imaging a pediatric patient with a primary liver lesion: (1) help determine whether the mass is benign or malignant and (2) facilitate guidance regarding further lesion characterization and management. Ludwig et al. [1] ultimately concluded that "LI-RADS in its current state may be useful in the pediatric population with respect to selecting lesions for biopsy." It is important to note that Ludwig et al. only evaluated the LI-RADS application on a single lesion per patient. It is unclear how the algorithm performs when evaluating a child with multiple liver lesions or children with potentially premalignant lesions — such as certain adenoma subtypes. Ultimately, an algorithm that brings to attention those pediatric patients with focal liver lesions in need of additional diagnostic evaluation/biopsy would be very valuable.

To summate, the current version of ACR LI-RADS applicable to adults provides four essential elements: (1) a standard lexicon, (2) an algorithm to identify features supporting a diagnosis of HCC, (3) a standard way to report risk (via the LR assessment categories) and (4) a framework to conduct research. At best, when the current version of LI-RADS is applied to pediatric patients we might benefit from a standard lexicon and a framework to conduct research, both of which would be useful moving forward.

Recognizing the need for pediatric-specific guidance, the ACR LI-RADS committee convened the Pediatric LI-RADS Working Group in 2017. Two of the authors of Ludwig et al. [1], Kathryn Fowler and Geetika Khanna, are contributing. The group's initial endeavor has been to formulate a set of consensus imaging recommendations for hepatoblastoma and pediatric HCC. The forthcoming document provides consensus guidelines based on the most up-to-date literature. The guidelines focus on appropriate imaging modalities (ultrasound, contrast-enhanced ultrasound, CT, MRI), imaging techniques and protocols, and standardized reporting. The goal of this document is two-fold: (1) provide guidance for optimizing the imaging modality used to evaluate pediatric patients with focal liver lesions and (2) provide guidance on specific clinical and imaging scenarios involving children with a known or suspected liver tumor. I anticipate this document will be beneficial to radiologists who participate in the care of pediatric patients with a liver lesion. The Pediatric LI-RADS Working Group hopes that incorporation of the guidelines will help improve imaging quality, decrease image interpretation errors, enhance communication with referring providers, and advance patient care.

Although work has been done toward the goal of improving the care that radiologists provide for children with known or suspected liver tumors, much work remains. Ludwig et al. [1] have shown that we might be able to extract useful information for our pediatric patients from the application of a system designed for adults. The adult version of LI-RADS might serve as a foundation for a system tailored to pediatric patients. We, as the pediatric imaging community, should continue to work toward optimizing the care of pediatric patients with focal liver lesions — especially hepatoblastoma and HCC.

Compliance with ethical standards

Conflicts of interest   None

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