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HEPATIC CANCER (A SINGAL AND A MUFTI, SECTION EDITORS)

LI-RADS v2018: a Primer and Update for Clinicians

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Abstract

Purpose of Review

To familiarize readers with recent updates and additions to the Liver Imaging and Reporting Data System (LI-RADS) v2018 for hepatocellular carcinoma surveillance, diagnosis, and treatment response assessment.

Recent Findings

US surveillance, diagnosis, and treatment response assessment algorithms are now incorporated into LI-RADS v2018. Updates to the diagnostic algorithm for CT and MRI include clarification of the LI-RADS appropriate population, revision of LR-5 criteria to match with those advocated by the American Association for Study of Liver Disease, new specific criteria for the LR-M category, and modification of the tumor in vein (TIV) category.

Summary

LI-RADS v2018 facilitates clear communication between radiologists and the rest of the health care team by standardizing imaging terminology, interpretation, and reporting. LI-RADS also enhances imaging quality by providing minimal technical requirements for hepatocellular carcinoma imaging. Recent updates address US surveillance, clarify terminology, and incorporate treatment response. With these updates, LI-RADS addresses the entire spectrum of hepatocellular carcinoma imaging from screening to treatment response, thereby further promoting its integration into practice.

Keywords LI-RADS · Hepatocellular carcinoma · HCC · Diagnostic liver imaging · Liver MRI · Liver CT · Screening/surveillance imaging

Introduction

The purpose of this article is to acquaint readers with the Liver Imaging and Reporting Data System (LI-RADS) v2017 and v2018 updates that incorporate nomenclature for ultrasound and cross-sectional imaging, provide recommendations for follow-up of imaging results [1, 2], and achieve uniformity with the American Association for Study of Liver Disease (AASLD) guideline recommendations. The American College of Radiology-sponsored LI-RADS writing group used multi-step iteration to create the most recent document, which integrates evidence-based data and input from other specialties and organizations including the AASLD [3] and Organ Procurement and Transplant Network (OPTN) [4]. To encourage broad applicability and acceptance, the algorithm was kept as simple as possible. The multi-disciplinary and adaptive process of LI-RADS development has expanded its relevance and in 2018, LI-RADS has been incorporated into the newest practice guidance of the AASLD [5, 6], making working knowledge of LI-RADS essential for all specialists and other providers who care for patients with liver disease.

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Table 1 US categories and definitions

US category	Criteria	Management
US-1 (negative)	No observation or only definitely benign observations (i.e., cyst)	Return to routine surveillance 6 months
US-2 (sub-threshold)	Observation(s) < 10 mm in diameter, not definitely benign	Short-term 3–6 months US surveillance
US-3 (positive)	Observation(s) ≥ 10 mm, not definitely benign or new thrombus in vein	Consider diagnostic imaging with multiphase contrast-enhanced MRI, CT, or CEUS
US visibility Score	Criteria	Management
A = no or minimal limitations	Limitations if any are unlikely to meaningfully affect sensitivity	Refer to US category
B = moderate limitations	Limitations may obscure small masses	Refer to US category If patient is very high risk, consider alternative imaging*
C = significant limitations	Limitations significantly lower sensitivity for focal liver lesions	Consider alternative imaging*

*Alternative imaging may include abbreviated MRI, standard diagnostic MRI, CT, or CEUS

HCC Surveillance

Screening, typically the one-time application of a test, is intended to detect prevalent disease; whereas, surveillance, i.e., repeated application of the test over time, detects incident disease within a defined population. The development of an effective surveillance program should be considered in the context of multiple factors such as sensitivity of the imaging test, access to appropriate imaging technology, availability of efficacious treatments, and cost-effectiveness. The latter relies heavily on defining a sufficiently "at risk" population. LI-RADS defers to AASLD, NCCN, and other professional society guidelines (EASL, JSH, etc.) for the definition of the appropriate surveillance population. According to the AASLD, this includes patients with cirrhosis of any etiology and subsets of patients with non-cirrhotic chronic hepatitis B infection [7]. With regard to recommended surveillance imaging, unenhanced ultrasound (US) is the most commonly used modality due to relatively low cost and widespread availability. In contradistinction to a surveillance test, diagnostic tests emphasize *specificity over sensitivity*. The most commonly used diagnostic methods are multiphase contrast-enhanced MRI and CT. Contrast-enhanced ultrasound (CEUS) is emerging as a diagnostic method for problem solving and was incorporated into LI-RADS v2017, but will not be discussed in detail in this review.

LI-RADS v2018 includes a US core document dedicated to standardizing technique, interpretation, reporting, and management for surveillance imaging in patients at high-risk for hepatocellular carcinoma (HCC) [8]. As detailed in Table 1, there are three US detection categories for communicating surveillance results: (US-1) negative: no or only benign observations, (US-2) sub-threshold: observations < 10 mm in diameter and not definitely benign, and (US-3) positive: observations ≥ 10 mm in diameter and not definitely benign or new venous thrombus. Follow-up and management of patients in each category are included in the new US core document. For US-1, repeat ultrasound-based surveillance imaging in 6 months is recommended. For US-2, repeat ultrasound-based surveillance imaging in 3–6 months is recommended. For US-3, diagnostic contrast-enhanced imaging with CT or MRI is recommended. In addition, an ultrasound visualization score (A = no or minimal, B = moderate, and C = severe limitations) is provided to communicate the expected adequacy and sensitivity of the surveillance test. Relevant factors include reduced beam penetration, limited acoustic window, or parenchymal heterogeneity. Although the LI-RADS visualization score has not yet been tested per se, Simmons et al. examined a similar concept and found that the rate of inadequate ultrasound visualization was as high as 20% and more common in obese patients, those with Child Pugh B or C cirrhosis and those with alcohol or NASH-related cirrhosis [9]. The authors suggested consideration of alternative surveillance modalities in patients with limited ultrasound exams, but the effectiveness of CT/MRI in these patients is unknown. Studies have shown limitations in use of ultrasound for detecting early HCC, and in a recent meta-analysis, ultrasound detection for early HCC was as low as 47% (95% CI = 33–61) [10, 11]. It is unclear to what extent inadequate visualization contributed to this low sensitivity for early HCC detection, and there is currently insufficient evidence to support routine use of MRI or CT in this situation. Early data suggests that abbreviated MRI protocols using hepatobiliary agents may provide a high negative predictive value for HCC surveillance [12, 13] and may be cost-effective in selected high-risk patients [14]. However, additional data are needed to better understand how MRI and CT could be operationalized in a surveillance program and specifically in the subsets of patients with limited US screening/surveillance exams.

Diagnostic Imaging

Diagnostic imaging methods for HCC include multiphase contrast-enhanced MRI or CT and CEUS. To achieve desired high (> 95%) positive predictive value (PPV), there must be a sufficiently high pre-test probability which mandates that imaging criteria be applied only in at-risk patients. While similar to surveillance populations, there are specific additions and exclusions for the optimal diagnostic population. Patients less than 18 years of age, those with cirrhosis due to congenital hepatic fibrosis, congestive heart failure, Budd-Chiari, or other vascular processes such as chronic portal vein occlusion, hereditary hemorrhagic telangiectasia, and diffuse nodular regenerative hyperplasia are excluded from LI-RADS categorization for diagnostic tests. The rationale behind these additional exclusions is that vascular causes of chronic liver disease and congenital hepatic fibrosis are associated with the formation of benign arterialized nodules that mimic HCC and reduce PPV. Similarly, diagnostic accuracy of imaging for HCC has not been sufficiently proven in pediatric populations, where the pre-test probability is lower than that observed in adults.

Since its first major update in 2013, the LI-RADS diagnostic algorithm has prescribed both an ordinal probabilistic approach to HCC diagnosis (ranging from LR-1 = definitely benign to LR-5 = definitely HCC) and additional categories to communicate other relevant considerations. In the latest release, v2018, these additional categories include lesions with substantial possibility of being malignancies other than HCC (LR-M), lesions with tumor in vein (LT-TIV), and lesions where meaningful assignment of a category is not possible due to degradation or omission of necessary images (LR-NC) (Fig. 1) [2]. An early branch point in the algorithm not requiring LR-5 criteria to be met, LR-TIV is defined by the unequivocal presence of enhancing soft tissue within a vein, with or without the presence of an accompanying mass. The assignment of LR-TIV indicates complete certainty that a malignant neoplasm has invaded a vein and is important for management and prognosis. Emerging evidence indicates that tumor in vein can be associated with non-HCC malignancies in a significant number of cases [15•]. In a retrospective study conducted over a 3-year period at a large liver transplant center by Fraum et al., consecutive pathologically proven masses (HCC = 136, combined hepatocellular-cholangiocarcinoma = 20, intrahepatic cholangiocarcinoma = 11, and other malignancies = 11) in an at-risk population were evaluated using LI-RADS v2014 criteria. Of note, TIV was more frequently noted in non-HCCs (12–24%) than HCCs (5–10%); however, this was not significant for both reviewers ($p = 0.16$, 0.04) [15•]. LI-RADS provides guidance to radiologists for interpretation and reporting the most likely etiology of tumor in vein. For example, when tumor in vein is associated with an LR-5 parenchymal mass, it should be reported as LR-TIV due to definite HCC. When tumor in vein is associated with a parenchymal mass with malignant but nonspecific features, it may be reported as LR-TIV possibly due to malignancy other than HCC.

The differentiation of HCC from other non-HCC malignancies (i.e., ICC, combined HCC-CC) by imaging can be challenging and is important in directing appropriate management. The LR-M category is intended to capture all malignant neoplasms in the liver that do not meet criteria for definite HCC. This group of neoplasms includes HCCs with atypical imaging features as well as non-HCC malignancies. In prior versions, LI-RADS gave loose guidance to radiologists for assigning LR-M. To maximize sensitivity for malignancy while maintaining specificity for HCC, LI-RADS v2018 has introduced explicit LR-M criteria [16]. The primary features of LR-M are targetoid dynamic enhancement, targetoid appearance on hepatobiliary phase imaging, and diffusion weighted imaging, features characteristic of non-HCC malignancy. Non-targetoid masses with infiltrative appearance, marked diffusion restriction, necrosis or severe ischemia, and other ancillary features suggesting a non-HCC malignancy also prompt LR-M categorization.

The algorithmic approach to LI-RADS categorization begins with the detection of an "observation," a term that LI-RADS uses for any area of the liver distinctive from background. An observation may be a true lesion (an imaging abnormality with a corresponding pathology abnormality, e.g., a mass) or a pseudolesion (an imaging abnormality that resembles a mass when no corresponding lesion is present pathologically). If an observation is detected on a technically sufficient CT or MR in an at-risk patient, the radiologist marches stepwise through a decision tree by determining successively if there is tumor in vein (TIV), if the observation is definitely or probably benign (LR-1/2), or if it meets criteria for LR-M, and reports accordingly. If the observation does not fit those categories, then categorization (LR-3/4/5) depends on major imaging features defined as observation size, non-rim arterial phase hyperenhancement (APHE), nonperipheral washout appearance, enhancing capsule appearance, and threshold growth [17–20]. As noted above, the spatial types of APHE and washout appearance are important; observations with rim APHE and/or peripheral washout appearance should be categorized LR-M, not LR-3/4/5. LI-RADS also makes use of the term "appearance" or adds quotation marks for features such as "washout" and "capsule" whose manifestation on imaging may not reflect the implied pathophysiology. If needed, the final category can be adjusted using tie-breaking rules and ancillary imaging features. Ancillary features—some of which favor benignity, malignancy, or HCC specifically—are used to refine the estimated probability of malignancy. To preserve specificity of LR-5 for definite HCC and to maintain uniformity with AASLD and OPTN, ancillary features are not allowed to upgrade the category to LR-5 for observations not meeting criteria for definite HCC based on major features.

CT/MRI LI-RADS® v2018 CORE

Untreated observation without pathologic proof in patient at high risk for HCC

- If cannot be categorized due to image degradation or omission → LR-NC
- If definite tumor in vein (TIV) → LR-TIV
- If definitely benign → LR-1
- If probably benign → LR-2
- If probably or definitely malignant but not HCC specific (e.g., if targetoid) → LR-M

Otherwise, use CT/MRI diagnostic table below

- If intermediate probability of malignancy → LR-3
- If probably HCC → LR-4
- If definitely HCC → LR-5

CT/MRI Diagnostic Table

Arterial phase hyperenhancement (APHE)		No APHE		Nonrim APHE		
Observation size (mm)		< 20	≥ 20	< 10	10-19	≥ 20
Count additional major features: •Enhancing "capsule" •Nonperipheral "washout" •Threshold growth	None	LR-3	LR-3	LR-3	LR-3	LR-4
	One	LR-3	LR-4	LR-4	LR-4 / LR-5	LR-5
	≥ Two	LR-4	LR-4	LR-4	LR-5	LR-5

LR-4 / LR-5: Observations in this cell are categorized based on one additional major feature:
•LR-4 – if enhancing "capsule"
•LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

Fig. 1 LI-RADS diagnostic algorithm. Reprinted with permission from the American College of Radiology (https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems/LI-RADS/CT-MRI-LI-RADS-v2018).

Table 2 Treatment response assessment categories, criteria and management

LR-TR category	Criteria	Management
LR-TR nonevaluable	Treatment response cannot be evaluated due to image degradation or omission	Consider same or alternative diagnostic imaging in ≤ 3 months
LR-TR non-viable	No lesional enhancement or treatment-specific expected enhancement pattern (e.g., smooth rim enhancement following TACE)	Consider same or alternative diagnostic imaging in ≤ 3 months
LR-TR equivocal	Enhancement atypical for treatment-specific expected enhancement pattern and not meeting criteria for probably or definitely viable	Consider same or alternative diagnostic imaging in ≤ 3 months
LR-TR viable	Nodular, mass-like, or thick irregular tissue in or along the treated lesion with any of the following: -APHE -Washout appearance -Enhancement similar to pretreatment	MDD for consensus management. Often includes retreatment

Measuring viable tumor: longest dimension through enhancing area of treated lesion, not traversing nonenhancing area(s). If multiple regions of viable tumor are separate by nonenhancing tissue, measure the region with longest dimension

Treatment Response

LI-RADS v2018 introduces a treatment response (TR) assessment algorithm that provides guidance for evaluating and reporting residual viable tumor following locoregional therapies [21]. Of note, the treatment response assessment algorithm applies to locoregional therapy and observations that may develop at the margins of resection. It does not apply to systemic therapy nor to new observations developing separate from locoregionally treated or resected sites. The former should be reported using best judgment and the latter using the LI-RADS diagnostic algorithm.

The response assessment algorithm prescribes three response categories regardless of locoregional treatment technique: viable (LT-TR viable), equivocal (LR-TR equivocal), and non-viable tumor (LR-TR non-viable). Viable is defined as nodular, mass-like, or thick irregular tissue with one of the following features: arterial phase hyperenhancement, washout appearance, or enhancement similar to pretreatment. The LR-TR equivocal category addresses cases where it is unclear whether imaging features represent residual viable tumor or post-treatment changes. Non-viable categorization requires resolution of lesional enhancement or findings expected after successful treatment (e.g., a thin rim of enhancement around a cavity). Similar to the diagnostic algorithm and LR-NC, the TR algorithm acknowledges that image degradation or omission can preclude meaningful assessment of treatment response in some cases, for which a designation of LR-TR nonevaluable is appropriate.

In addition to standardizing the assessment of post-treatment viability, the TR algorithm also standardizes how the viable tumor should be measured—namely by measuring the diameter of the single largest, continuous area of viable tumor. Size measurements should be provided for LR-TR viable and LR-TR equivocal treated lesions. Additionally, radiologists should report the pretreatment diagnostic LI-RADS category as well as the pretreatment size. This combination succinctly communicates the information required to guide further management. Table 2 shows the LR-TR categories and an explanation of viable tumor measurement.

This initial version of the treatment response assessment algorithm introduces a standardized lexicon and approach to assessing response to locoregional therapy. For simplicity and to encourage adoption for clinical care and research, a single algorithm was proposed for assessing response to all therapies. Since various therapies differ in their mechanisms of action and expected postprocedural imaging findings, future versions of the response assessment algorithm may require refinement to address the unique pathophysiological effects of each type of administered treatment.

One challenge for radiologists is that patients may have a combination of treated and non-treated observations. Clear and effective communication requires that the radiologist accurately track which observations have been treated and which have not, and to report accordingly. This enables reliable monitoring of tumor burden, which is essential for staging, determining transplant eligibility, and facilitating individualized management.

Management

LI-RADS v2018 provides imaging modality and interval recommendations for LR-US, diagnostic, and TR categories. However, patient care is driven by individual factors and transplant eligibility; hence, multidisciplinary discussion is often appropriate and recommended for categories with higher malignant potential. Overall management is determined on the patient level rather than imaging but it is typically driven by the imaging observation with the highest risk of malignancy

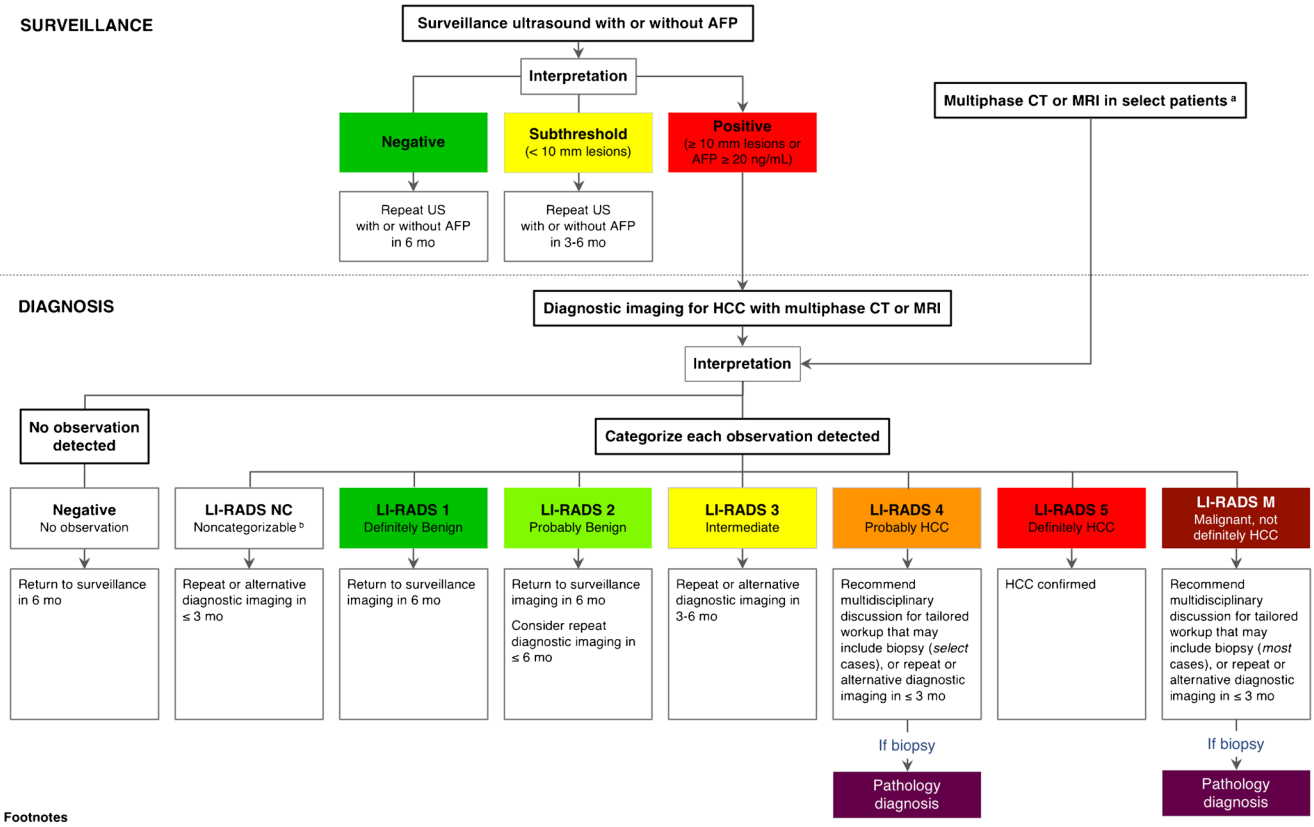

Fig. 2 LI-RADS management algorithm. **a**. Multiphase CT or MRI in select patient. Some high-risk patients may undergo multiphase CT or MRI for HCC surveillance (depending on patients body habitus, visibility of liver at ultra sound, being on the transplant waiting list other factors). **b** Noncategorizable. These are due to technical problems such as image omission or severe degradation. Reprinted with permission from the American College of Radiology (https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems/LI-RADS/CT-MRI-LI-RADS-v2018).

(e.g., if a patient has multiple LR-3 and an LR-5, the management would be driven by the LR-5). Figure 2 [2] provides a general management approach consistent with that advocated by the newest AASLD guidance.

There may be instances where overall disease burden is not adequately captured by LR categorization. This most commonly occurs when there are multiple LR-4 observations, which in aggregate are highly suspicious for multicentric HCC, but individually, do not meet strict criteria for LR-5 due to small size or other factors. It is important to understand that despite the somewhat binary approach used in transplant eligibility (i.e., a lesion does or does not meet criteria), LI-RADS categories reflect a spectrum of malignant potential. The LI-RADS report should reflect both the presence of definite HCC (LR-5) and when present, indicate multicentric disease (multiple LR-4) to provide clarity in communicating stage and potential transplant eligibility. The following section reviews the evidence regarding the odds of HCC for each category.

What Is the Evidence?

LI-RADS v2018 was created based on evidence when available and informed by multidisciplinary expert consensus when evidence was controversial or absent [22••]. With regard to validation of the LI-RADS algorithm in its entirety, there are three components of primary interest: (1) inter-reader agreement as an indicator of reliability, (2) accuracy-primarily measured by radiology-pathology agreement, and (3) natural history of suspicious but not definitely malignant lesions (e.g., LR-3, LR-4).

Current literature supports the overall reliability of major features, in particular for APHE and observation size with slightly lower agreement for capsule and washout appearance [23–29]. Reliability for the overall algorithm in regard to assignment of diagnostic category, intraclass correlation coefficients range from 0.44 to 0.82, with highest agreement for the binary delineation of LR-5 versus other categories [25, 29]. There is a paucity of data on the reliability of ancillary features

and their impact on the final diagnostic categories. Likewise, the treatment response (TR) algorithm and US surveillance algorithms are new and yet to be widely tested in the literature. However, the proposed measure of viable tumor is nearly identical to modified RECIST criteria [30, 31], which has been extensively studied and is commonly used in clinical trials.

With regard to accuracy or prediction of LR categories for diagnosis of HCC, current evidence is limited by less than optimal study design with a preponderance of retrospective/descriptive and observational studies subject to multiple forms of bias and imperfect reference standards. While perfect pathological correlation is desired, this is often not possible due to a lack of clinical indication for tissue sampling in cases of definitive HCC (LR-5) or for observations with only intermediate (LR-3) or low (LR-2) probability of being HCC, cost of conducting a prospective trial, and use of locoregional therapies as a bridge to transplantation that render the final explant pathology suboptimal or non-diagnostic. Likewise, even for prospective studies, the true sensitivity and specificity of an imaging test may be impacted by verification bias, loss to follow-up, and image-based selection bias. A recent prospective study evaluating LI-RADS criteria for diagnosis of small (< 3 cm) HCC in a total of 422 patients with 595 nodules detected mainly by surveillance US and then imaged with both CT and MRI found that the frequency of HCC was 0% for observations categorized as LR-1/2, 33–41% for those categorized LR-3, 53–55% for those categorized LR-4, and 91–95% for those categorized LR-5 [32•]. Other authors performing observational studies in retrospective pathologically proven cohorts have demonstrated high (> 95%) specificity/PPV for LR-5/5 V for the diagnosis of HCC [33, 34]. In a study by Darnell et al. [35] using LI-RADS v2013, there were higher rates of HCC in each of the above categories, up to 25% of LR-2, 69% of LR-3, and 96% of LR-4 observations. This study differs from the others cited in that it only included observations detected at antecedent ultrasound. Antecedent ultrasound visibility was not included in the v2013 LI-RADS algorithm but, based largely on the results reported by Darnell, was incorporated into subsequent versions of as a means to achieve higher LI-RADS diagnostic categorization. As a result, many observations categorized LR-3 and LR-4 in the Darnell study now would be categorized LR-4 and LR-5, respectively. This evidence-based modification of LI-RADS not only highlights the system's dynamic and adaptive nature but also indicates the need for caution when analyzing and comparing data generated using prior LI-RADS versions.

The impact of ancillary features on the final diagnostic accuracy is less well-known. Some have found that ancillary features for upgrading an LR-3 to LR-4 category resulted in a modest increase in sensitivity for HCC at the expense of a modest decrease in specificity [32•]. In a study by Cerny et al., a retrospective series of 275 observations in at-risk patients, demonstrated a range of sensitivities (3–62%) and specificities (79–99%) for ancillary features for HCC [36]. In particular, the features specific for HCC, blood products, intralesional fat, and mosaic architecture, showed highest specificities for HCC. The authors concluded that use of ancillary features may improve sensitivity while preserving specificity when used in combination with major features.

Due to the challenges of assessing accuracy by pathology correlation, other authors have examined the natural history of observations initially categorized LR-2, LR-3, or LR-4. These studies have found that the cumulative incidence of progression to HCC or other malignancy ranges from 0% for observations initially categorized LR-2 [37]; 6–9% for those initially categorized LR-3 [37, 38]; and 31–79% for those initially categorized LR-4 [34, 39].

With recent changes to LR-M and TIV categories, no literature yet addresses the accuracy of the new v2017 or v2018 criteria; however, there are studies on these categories using earlier versions of LI-RADS. Retrospective studies using LI-RADS v2014 have shown that a substantial proportion (13–77%) of biopsied or histologically sampled LR-M categorized observations are HCC [33, 40, 41]. Of interest, An et al., in a study of 225 patients (218 HCC, three cholangiocarcinomas, and four biphenotypic tumors), demonstrated worse prognosis following curative hepatic resection for patients with malignancies categorized as LR-M [40], including HCCs. Hence, HCCs with atypical features meeting LR-M criteria may portend a worse prognosis than the more classic LR-5 HCC. In the previously mentioned study by Fraum et al., the authors found that differentiating rim APHE from non-rim APHE and excluding TIV as a means to satisfy LR-5 criteria (i.e., LR-5V) resulted in improvements in specificity for diagnosis of HCC, helping to justify the new v2017 algorithmic changes [15•].

Controversies, Future Directions, Challenges

Additional evidence is needed and welcomed to help shape the next versions of LI-RADS. Particular areas of need include well-designed studies aimed at evaluating TIV criteria and impact on management, the contribution of threshold growth as a criterion, the role of hepatobiliary phase imaging features as major criteria for HCC, validation and operationalization of treatment response criteria including expansion to CEUS, and optimizing modalities for surveillance imaging. Immediate goals for development are focused on creation of a comprehensive manual to supplement the already available online LI-RADS core and essentials documents (https://www.acr.org/Clinical-Resources/Reporting-and-Data-Systems/LI-RADS). Updates to the existing materials and algorithmic changes are expected in approximately 3–5-year intervals with emphasis on the following key missions: (1) alignment of liver imaging

diagnostic criteria across indications, practice environments, and organizations; (2) standardization of lexicon for clinical and research reporting; and (3) continual evolution to meet the needs of patients and care providers engaged in liver imaging-potentially expanding scope beyond the chronic liver disease setting.

With regard to current controversies, the existence of multiple different liver imaging diagnostic algorithms supported by various organizations poses a challenge to progress in the field. The imaging diagnosis of HCC is firmly established with over a decade of published experience with various diagnostic algorithms—AASLD, European Association for the Study of Liver Diseases, LI-RADS, OPTN, Japan Society of Hepatology, Asia-Pacific Association for the Study of Liver Diseases, to name a few. While all imaging algorithms ultimately strive for accuracy, the exact balance of specificity versus sensitivity may be calibrated by contextual elements. That is, whether the algorithm is intended for use in the transplantation setting where a high PPV is an absolute requirement or rather for populations where resection is the primary treatment modality and maximal sensitivity is desired. Thus, the management informed by various LI-RADS categories will need to reflect such regional practice pattern differences. As an intermediate goal, LI-RADS proposes a unified lexicon for reporting and in a more long-term mindset is actively engaging international colleagues in an effort to promote cohesion and develop materials aimed at the needs of the global community.

Conclusion

LI-RADS v2018 introduces new diagnostic categories and algorithms for treatment response and surveillance, providing a comprehensive guide and platform for integration of care for patients with or at risk for HCC. The current algorithms are based on the best available evidence and multidisciplinary expertise. Future growth and refinement of LI-RADS is expected as additional evidence emerges along with greater cross-societal and international collaborations.

Compliance with Ethical Standards

Conflict of Interest Kathryn J. Fowler and Elizabeth Hecht each declare no potential conflicts of interest. Ania Z. Kielar reports grants from General Electric, for liver MRI research. Amit G. Singal serves on the speakers bureau and as a consultant for Bayer. Claude B. Sirlin reports research grants from Bayer, GE, Philips, and Siemens; lab service agreements with Gilead, ICON, Intercept, Shire, Synageva, and VirtualScopics; consulting agreements with AMRA, Boehringer, Guerbet; and speaker's bureau for Resoundant.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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- • Of importance
- •• Of major importance

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