ADHERENCE TO CRITERIA FOR LIVER IMAGING REPORTING AND DATA SYSTEM CATEGORY 5 IN CLINICAL PRACTICE

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Liver Imaging Reporting And Data Systems LI-RADS

• Created to standardize an algorithm and lexicon for interpretation and reporting of CT and MRI in patients at risk for hepatocellular carcinoma (HCC)
• Employs consistent terminology to reduce interpretation variability and error
• Enhance communication with referring clinicians
• Diagnostic algorithm based on a set of defined major and ancillary imaging features, which are combined to assign a category which reflects probability that an observation is HCC, non-HCC malignancy or a benign lesion

• Major Features:
  • Arterial Phase Hyperenhancement (APHE)
  • “Washout” (WO)
  • “Capsule”
  • Diameter
  • Threshold Growth (TG)
Observation in high-risk patient

Treated observation

Untreated observation

Definitely benign

LR-1

Probably benign

LR-2

Neither definite nor probable benign

Probable malignancy, not specific for HCC

LR-M

Tumor in vein

LR-5V

**Arterial phase hypo- or iso-enhancement**

<table>
<thead>
<tr>
<th>Diameter (mm):</th>
<th>&lt; 20</th>
<th>≥ 20</th>
<th>&lt; 10</th>
<th>10-19</th>
<th>≥ 20</th>
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</thead>
<tbody>
<tr>
<td>&quot;Washout&quot;</td>
<td>None:</td>
<td>LR-3</td>
<td>LR-3</td>
<td>LR-3</td>
<td>LR-3</td>
</tr>
<tr>
<td>&quot;Capsule&quot;</td>
<td>One:</td>
<td>LR-3</td>
<td>LR-4</td>
<td>LR-4</td>
<td>LR-4</td>
</tr>
<tr>
<td>Threshold growth</td>
<td>≥ Two:</td>
<td>LR-4</td>
<td>LR-4</td>
<td>LR-5</td>
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**Arterial phase hyper-enhancement**

<table>
<thead>
<tr>
<th>Diameter (mm):</th>
<th>&lt; 20</th>
<th>≥ 20</th>
<th>&lt; 10</th>
<th>10-19</th>
<th>≥ 20</th>
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<td>LR-4</td>
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<td>LR-5</td>
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Apply ancillary features and then tie-breaking rules to adjust category
LI-RADS 5 (LR-5)

- Observation with imaging features diagnostic of HCC
- Nearly 100% specificity that observation is HCC, no biopsy is needed
- In order to be compliant with United Network for Organ Sharing (UNOS) and maintain the desired high specificity, criteria for LR-5 must be met upfront and no ancillary features can be used to upgrade an observation to LR-5
- LR-5 lesions proceed to treatment (including liver) without biopsy confirmation
- Criteria
  - 10-19mm mass
    - HAPE
    - $\geq 2$ of the following: WO, “capsule”, TG
  - $\geq 20$mm mass
    - HAPE
    - $\geq 1$ of the following: WO, “capsule”, TG
GOAL

- Assess adherence to LR5 criteria in clinical practice
MATERIALS & METHODS

- Reviewed all clinical MR and CT reports with standardized LI-RADS template 4/15-2/17

Observation #1:
Location: Segment III
Size: 2.0 x 1.9 cm (image #47, series 501)
HAP Hyperenhancement: Yes (image #142, series 206)
Threshold Growth: Yes, measured 12 mm 6 months ago
PV/Delayed Phase Washout: Yes (image #340, series 206)
Capule Appearance: Absent
Ancillary Features:
* Favoring benignity: N/A
* Favoring malignancy: Slight restricted diffusion (image 360, series 1105)
Overall Assessment: LI-RADS 5 (Definite HCC)
MATERIALS AND METHODS

- Presence of all described major features, AF and reported LR category (LR-Report) were recorded.
- LR category (LR-Asgin) was assigned based on described major features and AF using LI-RADS v 2014 algorithm.
- Agreement between LR-Report and LR-Asgin was assessed by weighted k statistics:
  - Moderated agreement 0.41-0.6
  - Substantial agreement 0.61-0.8
  - Almost perfect agreement 0.81-0.99
### RESULTS: PATIENTS AND OBSERVATIONS

#### Patients

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<table>
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<tbody>
<tr>
<td>Total number</td>
<td>265</td>
</tr>
<tr>
<td>Male</td>
<td>172 (65%)</td>
</tr>
<tr>
<td>Mean Age</td>
<td>63 years (SD 10)</td>
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</table>

#### Observations

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<table>
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<tr>
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<tbody>
<tr>
<td>Number of observations</td>
<td>487</td>
</tr>
<tr>
<td>Median Diameter</td>
<td>14 mm (IQR 10-20mm)</td>
</tr>
<tr>
<td>APHE</td>
<td>344 (71%)</td>
</tr>
<tr>
<td>WO</td>
<td>306 (63%)</td>
</tr>
<tr>
<td>“Capsule”</td>
<td>86 (18%)</td>
</tr>
<tr>
<td>TG</td>
<td>71 (15%)</td>
</tr>
<tr>
<td>≥1 AF favoring malignancy</td>
<td>333 (68%)</td>
</tr>
<tr>
<td>≥1 AF favoring benignity</td>
<td>31 (6%)</td>
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</tbody>
</table>
RESULTS

- Agreement between LR-Assign and LR-Report was substantial (κ = 0.807, 95% CI 0.80-0.83)
- Of 143 LR-5 LR-Report observations, 12 (8%) were categorized as LR-4 LR-Assign
  - 3 (25%) had no APHE
  - 8 (78%) had diameter of 10-19mm, APHE and one additional major feature other than TG
  - 1 (11%) had diameter of 10-19mm, APHE and TG other than what is required for LR-5g (≥50% growth in ≤ 6 months)

<table>
<thead>
<tr>
<th></th>
<th>LR-Report</th>
<th>LR-Assign</th>
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<tbody>
<tr>
<td>LR-3</td>
<td>200/487 (41%)</td>
<td>213/487 (44%)</td>
</tr>
<tr>
<td>LR-4</td>
<td>144/487 (29%)</td>
<td>129/487 (27%)</td>
</tr>
<tr>
<td>LR-5</td>
<td>143/487 (29%)</td>
<td>145/487 (30%)</td>
</tr>
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DISCUSSION

• Our results demonstrated that overall agreement between the reported LI-RADS category and the LI-RADS category assigned based on the reported major and ancillary features was substantial.

• Of 143 observations reported to be LR-5, 8% did not meet the criteria for LR-5.
  • These 8% of observations met criteria for LR-4 based on the reported features.

• While 8% is a relatively small number, erroneous assignment of LR-5 category potentially can have profound effect on management:
  • Specificity of LR-4 category for HCC is less than 100%, and therefore patients with LR-4 may require either close follow-up or biopsy prior to treatment.
  • Particularly, unlike patients with LR-5 observations, patients with LR-4 observations are not eligible to receive HCC exception points for liver transplantation without biopsy confirmation.

• While overall performance of radiologists is good, further educational and outreach efforts are required to improve adherence to LR-5 criteria in clinical practice.
LIMITATIONS

• Retrospective, single center
• Information was extracted from the clinical reports; the studies were not reviewed to determine whether the interpretations were accurate
• Did not assess the impact on patient management or outcomes
CONCLUSION

• While agreement between reported and assigned LI-RADS categories was substantial, 8% of reported LR-5 observations did not meet criteria for LR-5 based on the described imaging features.