LI-RADS Classification and Outcomes of Hepatocellular Carcinoma Treated With Transcatheter Arterial Chemoembolization Plus Radiofrequency Ablation

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Abstract. Aim: The aim of this study was to clarify the usefulness of the Liver Imaging Reporting and Data System (LI-RADS) for predicting a patient’s prognosis after transcatheter arterial chemoembolization (TACE) combined with radiofrequency ablation (TACE-RFA) for hepatocellular carcinoma (HCC) of Barcelona-Clinic Liver Cancer (BCLC) stage 0 or A. Patients and Methods: We retrospectively analyzed cases of patients with HCC who underwent TACE-RFA (Jan 2005 to Dec 2015). Nodules were categorized based on their LI-RADS v2018 core. The LI-RADS category was assigned to each nodule using dynamic contrast-enhanced computed tomography. LR-3, LR-4 and LR-5 nodules were extracted. The overall (OS) and recurrence-free (RFS) survival was assessed among patients with BCLC 0 and BCLC A disease. Results: Of the 64 nodules extracted, 22 were LR-3 or -4 (mean±standard deviation=14.8±6.7 mm) and 42 were LR-5 (17.1±6.9 mm). Regarding OS, there was no significant difference between those with LR-3 or -4 and those with LR-5 (p=0.278). In particular, patients with BCLC A with LR-5 nodules had significantly poorer RFS than those with LR-3 or -4 (p=0.016) nodules. Conclusion: For patients with BCLC A, LR-3 or -4 nodules are associated with a better prognosis than LR-5 nodules.

Hepatocellular carcinoma (HCC) is the third leading cause of cancer-related death worldwide, accounting for 85-90% of primary liver tumors (1-3). HCC treatment depends on disease progression, and prognosis can vary significantly (4, 5). Therefore, early detection of HCC is very important. Currently, HCC can be diagnosed non-invasively by the presence of typical imaging features in high-risk patients.

The American Association of Radiologists has developed a standardized diagnostic algorithm termed the Liver Reporting and Data System (LI-RADS) to classify HCC using images such as dynamic multidetector computed tomography (CT), dynamic magnetic resonance imaging (MRI), and ultrasonography (US), together with other findings (6). LI-RADS can be used to make a detailed diagnosis by understanding the patient’s tumor condition, which may be useful for predicting prognosis and selecting treatment methods (7).

Prognosis remains poor for patients with advanced HCC. Patients diagnosed early, however, are eligible for curative treatment such as surgical resection, liver transplantation, and radiofrequency ablation (RFA) (8). In addition, treatment with transcatheter arterial chemoembolization (TACE) may be performed for HCC. TACE is currently recommended in patients with Barcelona-Clinic Liver Cancer (BCLC) stage B or for those who cannot undergo surgical resection. There are also many reports that TACE combined with RFA (TACE-RFA) can achieve even better treatment results than TACE treatment alone (9-11). While there are many reports on the
treatment results of TACE-RFA, as far as we are aware, no studies have considered the relation between the prognosis of patients who underwent TACE-RFA and the LI-RADS of the target tumor, and such details remain to be clarified.

The purpose of this study was to assess the relation between LI-RADS grading and the treatment effect of TACE-RFA, and to clarify the prognosis of TACE-RFA treatment in patients with early-stage HCC of BCLC 0 and A.

Patients and Methods

Study design and patients. This was a retrospective study approved by the Review Board at our Institution (approval number: 2005). The requirement for informed consent was waived. We retrospectively analyzed cases of patients with HCC who underwent TACE-RFA between January 2005 and December 2015. A total of 562 patients were diagnosed with liver tumor by diagnostic imaging modalities such as CT, MRI and US during this period, and subsequently underwent TACE. Of these, 276 had no history of treatment—including TACE, RFA, or resection—and thus were receiving their first treatment for HCC. In this subgroup, 73 patients had TACE for all their tumors and RFA on the same tumors within a week. In addition, 69 of these patients had three-phase dynamic CT images taken before TACE, and 66 of these patients had BCLC 0 and A; the latter group comprised the subjects of this study. The extracted patients were divided by BCLC stage according to the Bolondi classification (12, 13). For all nodules, images obtained by postoperative CT confirmed the deposition of lipiodol. All the included patients met the LI-RADS population criteria. Nodules were classified according to the LI-RADS category using CT imaging. Among patients with BCLC 0 and A stage cancer, those with nodules classified as LR-3 (intermediate probability of being HCC), LR-4 (probably HCC) or LR-5 (definitely HCC) were extracted. In this assessment, patients with nodules classified as LR-M were

Figure 1. Survey population flow chart of patients with hepatocellular carcinoma (HCC). CT: Computed tomography; BCLC: Barcelona-Clinic Liver Cancer Stage; RFA: radiofrequency ablation; TACE: transcatheter arterial chemoembolization.
excluded because they may not be HCC-specific. Our final subject pool included 64 patients with LR-3, -4 and -5 tumors (Figure 1).

When a patient was being treated for multiple tumors, we considered the largest one. Patient age ranged from 35-91 years (mean=71.9 years). The male:female ratio was 37 (58%): 27 (42%). Other characteristics of patients are listed in Table I.

We then assessed the overall (OS) and recurrence-free (RFS) survival between the LR-3 or -4 and LR-5 cases, and between patients with BCLC 0 and BCLC A disease.

CT protocol. CT scans were performed at our hospital and related hospitals using a 64-section multidetector CT (MDCT) scanner (Aquilion CX TSX-101A/NA; Canon Medical Systems, Tochigi, Japan) or a 320-section MDCT scanner (Aquilion ONE TXS-301A/2A; Canon Medical Systems). The scanning parameters used for MDCT were as follows: 120 kVp, 200-400 mAs, rotation time 0.5 s, pitch of 0.98 (64 detectors) and 0.6 (320 detectors), and section thickness of 1 mm with a 1 mm reconstruction interval. CT images were acquired via image archives and communication systems.

For three-phase CT imaging, a total of 100 ml of contrast medium (Iopamiron 370; Bayer Schering Pharma, Leverkusen, Germany) was injected using a power injector at a rate of 3 ml/s. Each scan delay was determined using automatic bolus tracking. Images of three phases (arterial phase, portal vein phase, and equilibrium phase) were acquired.

Transcatheter arterial chemoembolization. TACE was performed by at least one of two Board-certificated interventional radiologists (R.T and M.M with 12 and 10 years). In interventional radiology, we used digital subtraction angiography, CT during hepatic arteriogram, and CT during arterial portography to assess the number and size of tumors and identify tumor-feeding vessels. Once the trophic arteries of the target tumor nodules were identified by this method, TACE was performed using anticancer drugs, poppy seed oil (Lipiodol; Guerbet Japan, Tokyo), and gelatin particles. As an anticancer drug, 10-60 mg epirubicin (Farmorubicin, Kyowa Hakko Kogyo, Tokyo) or 60-120 mg miriplatin (Miripla, Sumitomo Dainippon Pharma Co., Osaka, Japan) was used with iodine. The amounts of the drugs were determined by a consensus between radiologists and gastroenterologists. Anticancer drugs were mixed with 2-10 ml poppy oil and injected via a microcatheter. Gelatin particles (Gelpart; Nippon Kayaku, Tokyo) were then injected until the feeding arteries were completely embolized.

Radiofrequency ablation. All patients were treated with monopolar RFA by at least one of two Board-certificated gastroenterologists (K.H. and M.E. with 13 and 6 years of experience). RFA was performed under US guidance within 3 days to 1 week of TACE treatment. In interventional radiology, we used a 17-gauge internally cooled electrode with a 2 or 3 cm exposed tip (Cool-tip; Radionics, Burlington, MA, USA). When using a 2 cm needle, the output was started at 40 W and increased by 10 W every min for incineration. For a 3-cm needle, the output was started at 60 W and increased by 10 W every min for incineration. In both cases, incineration continued until the output rolled off.

LI-RADS category. The nodules were categorized for analysis according to the LI-RADS v2018 core (7). The LI-RADS category was assigned to each nodule using dynamic contrast-enhanced CT. When two or more nodules were evaluated, we selected the largest. Major imaging features used in the classification included non-rim arterial-phase hyperenhancement, observation size, non-peripheral washout, and enhancing capsule. Patients were also categorized with hepatic observation threshold growth added to the extent possible. In addition, ancillary features were used to fine-tune the categorization (upgrade the category when there were findings supporting malignancy; downgrade it when there were findings supporting benignity). When we were uncertain about the categorization, we used tie-breaking rules that would bring us one step closer to LR-3. Images were reviewed in consensus of Board-certificated radiologists (R.T. and Y.A. with 14 and 19 years of experience, respectively) according to these rules.

Statistical analysis. We evaluated OS and RFS for all patients. BCLC 0 and A were extracted according to the Bolondi classification, and OS and RFS were compared by LI-RADS category. OS was defined as the time from the day of TACE treatment to the day of death. RFS was defined as the time from the date of TACE treatment to the date of tumor recurrence or death. Patients who remained alive at the date of the last follow up were censored in the statistical analysis. For assessment of recurrence, three-phase CT and dynamic MRI were used. Recurrence was defined when tumors that showed non-rim arterial-phase enhancement and non-peripheral washout appeared locally or elsewhere in the liver. The observation period was 1-116 months.

Regarding OS and RFS, the whole cohort was divided into two groups and were compared for each item. Fisher's exact test was used for comparison between the two groups. The boundaries were 70 years of age, alfa-fetoprotein (AFP) 10 ng/ml, and protein induced by vitamin K absence or antagonist-II (PIVKA-II) 40 mAU/ml. Comparisons were made between the two groups A and B for Child–Pugh score, hepatitis B virus and hepatitis C virus for

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>Mean±SD 71±9±8</td>
</tr>
<tr>
<td>Sex, n (%)</td>
<td>Male 37 (58%) Female 27 (42%)</td>
</tr>
<tr>
<td>AFP, ng/ml</td>
<td>Mean (range) 44.7 (1.6-982.7)</td>
</tr>
<tr>
<td>PIVKA-II, mAU/ml</td>
<td>Mean (range) 579.4 (10-20,836)</td>
</tr>
<tr>
<td>Child–Pugh class, n (%)</td>
<td>A 50 (78%) B 14 (22%)</td>
</tr>
<tr>
<td>Chronic liver disease, n (%)</td>
<td>HBV 10 (16%) HCV 37 (58%) Alcoholic 10 (16%) Unknown 7 (10%)</td>
</tr>
<tr>
<td>BCLC, n (%)</td>
<td>0 31 (48%) A 33 (52%)</td>
</tr>
<tr>
<td>LI-RADS, n (%)</td>
<td>3 3 (5%) 4 19 (30%) 5 42 (65%)</td>
</tr>
<tr>
<td>Anticancer drug, n (%)</td>
<td>Epirubicin 56 (88%) Miriplatin 8 (12%)</td>
</tr>
<tr>
<td>Tumor size, mm</td>
<td>Mean±SD 16±7±0</td>
</tr>
</tbody>
</table>

AFP: Alpha-fetoprotein; BCLC: Barcelona Clinic Liver Cancer stage; HBV: hepatitis B virus; HCV: hepatitis C virus; LI-RADS: Liver Imaging Reporting and Data System; PIVKA-II: protein induced by vitamin K absence or antagonist-II.
chronic liver disease, and A and 0 for BCLC. Regarding LI-RADS, we again compared two groups, LR-3 or 4 and LR-5 using Cox regression analysis. Survival was assessed by the Kaplan–Meier method and log-rank test. Variables with \( p < 0.2 \) at univariate analysis were subjected to multivariate analysis to identify the most reliable prognostic marker. The evaluation was carried out using R (version 4.0.3; The R Foundation, Vienna, Austria).

**Results**

As shown in Table II and Table III, there was a significant difference only in the comparison of LI-RADS regarding RFS in the BCLC A group. For other parameters, no significant difference was found in univariate and multivariate analysis. **Overall survival.** At the end of the study, 24 out of the 64 patients had died. In a comparison of the 64 cases, there was no significant difference in OS between patients with LR-3 or 4 and those with LR-5 in univariate analysis \( (p=0.278) \) (Table II). Figure 2A shows the results of the Kaplan–Meier estimates. Furthermore, for BCLC 0 and A, patients with LR-3 or 4 and LR-5 were extracted and compared (Figure 2B and C). There were no significant differences between LR-3 or 4 and LR-5 regarding the OS of the BCLC 0 or BCLC A cases \( (p=0.952\) and \( p=0.194\), respectively).

**Recurrence-free survival.** The next comparison of 64 cases revealed that the RFS rate of patients with LR-5 disease was significantly lower than that of those with LR-3 or 4 \( (p=0.03) \) (Table III). Multivariable analysis with the Cox proportional

**Table II. Univariate analyses and multivariate analyses of factors affecting overall survival.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Subgroup comparison</th>
<th>Cases, n</th>
<th>HR</th>
<th>95% CI</th>
<th>p-Value</th>
<th>HR</th>
<th>95% CI</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>&gt;70 vs. ≤70 years</td>
<td>40 vs. 24</td>
<td>1.81</td>
<td>0.76-4.31</td>
<td>0.184</td>
<td>1.40</td>
<td>0.44-4.46</td>
<td>0.572</td>
</tr>
<tr>
<td>Sex</td>
<td>Male vs. female</td>
<td>37 vs. 27</td>
<td>1.75</td>
<td>0.77-3.98</td>
<td>0.181</td>
<td>0.80</td>
<td>0.27-2.33</td>
<td>0.677</td>
</tr>
<tr>
<td>AFP*</td>
<td>&gt;10 vs. ≤10 ng/ml</td>
<td>25 vs. 34</td>
<td>2.11</td>
<td>0.89-5.003</td>
<td>0.091</td>
<td>2.17</td>
<td>0.62-7.56</td>
<td>0.226</td>
</tr>
<tr>
<td>PIVKA***</td>
<td>&gt;40 vs. ≤40 mAU/ml</td>
<td>18 vs. 39</td>
<td>1.89</td>
<td>0.74-4.82</td>
<td>0.183</td>
<td>2.57</td>
<td>0.93-7.09</td>
<td>0.068</td>
</tr>
<tr>
<td>Child-Pugh score</td>
<td>A vs. B</td>
<td>50 vs. 14</td>
<td>0.50</td>
<td>0.21-1.20</td>
<td>0.121</td>
<td>0.76</td>
<td>0.21-2.74</td>
<td>0.674</td>
</tr>
<tr>
<td>Chronic liver disease</td>
<td>VH vs. other</td>
<td>47 vs. 17</td>
<td>2.56</td>
<td>0.75-8.71</td>
<td>0.131</td>
<td>1.61</td>
<td>0.38-6.73</td>
<td>0.515</td>
</tr>
<tr>
<td>BCLC</td>
<td>0 vs. A</td>
<td>31 vs. 33</td>
<td>2.02</td>
<td>0.82-4.97</td>
<td>0.128</td>
<td>1.50</td>
<td>0.48-4.71</td>
<td>0.486</td>
</tr>
<tr>
<td>Anticancer drug</td>
<td>Epirubicin vs. miriplatin</td>
<td>56 vs. 8</td>
<td>1.07</td>
<td>0.36-3.18</td>
<td>0.907</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LI-RADS</td>
<td>LR-3 or 4 vs. LR-5</td>
<td>22 vs. 42</td>
<td>1.66</td>
<td>0.66-4.16</td>
<td>0.278</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of lesions</td>
<td>Single vs. multiple</td>
<td>54 vs. 10</td>
<td>1.13</td>
<td>0.34-3.40</td>
<td>0.824</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Table III. Univariate analyses and multivariate analyses of factors affecting recurrence-free survival.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Subgroup comparison</th>
<th>Cases, n</th>
<th>HR</th>
<th>95% CI</th>
<th>p-Value</th>
<th>HR</th>
<th>95% CI</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>&gt;70 vs. ≤70 years</td>
<td>40 vs. 24</td>
<td>1.00</td>
<td>0.55-1.82</td>
<td>0.993</td>
<td>1.44</td>
<td>0.77-2.70</td>
<td>0.250</td>
</tr>
<tr>
<td>Sex</td>
<td>Male vs. female</td>
<td>37 vs. 27</td>
<td>1.58</td>
<td>0.87-2.87</td>
<td>0.134</td>
<td>1.44</td>
<td>0.77-2.70</td>
<td>0.250</td>
</tr>
<tr>
<td>AFP*</td>
<td>&gt;10 vs. ≤10 ng/ml</td>
<td>25 vs. 34</td>
<td>1.44</td>
<td>0.76-2.72</td>
<td>0.259</td>
<td>1.23</td>
<td>0.62-2.44</td>
<td>0.559</td>
</tr>
<tr>
<td>PIVKA***</td>
<td>&gt;40 vs. ≤40 mAU/ml</td>
<td>18 vs. 39</td>
<td>1.23</td>
<td>0.62-2.44</td>
<td>0.559</td>
<td>1.43</td>
<td>0.79-2.59</td>
<td>0.241</td>
</tr>
<tr>
<td>Child-Pugh score</td>
<td>A vs. B</td>
<td>50 vs. 14</td>
<td>0.97</td>
<td>0.47-1.97</td>
<td>0.923</td>
<td>0.57</td>
<td>0.22-1.46</td>
<td>0.241</td>
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<tr>
<td>Chronic liver disease</td>
<td>VH vs. other</td>
<td>47 vs. 17</td>
<td>1.71</td>
<td>0.84-3.48</td>
<td>0.136</td>
<td>1.45</td>
<td>0.69-3.04</td>
<td>0.321</td>
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<tr>
<td>BCLC</td>
<td>0 vs. A</td>
<td>31 vs. 33</td>
<td>1.43</td>
<td>0.79-2.59</td>
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<td>Anticancer drug</td>
<td>Epirubicin vs. miriplatin</td>
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<td>0.22-1.46</td>
<td>0.241</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LI-RADS</td>
<td>LR-3 or 4 vs. LR-5</td>
<td>22 vs. 42</td>
<td>2.05</td>
<td>1.07-3.93</td>
<td><strong>0.030</strong></td>
<td>2.00</td>
<td>1.04-3.85</td>
<td><strong>0.039</strong></td>
</tr>
<tr>
<td>Number of lesions</td>
<td>Single vs. multiple</td>
<td>54 vs. 10</td>
<td>0.83</td>
<td>0.39-1.80</td>
<td>0.643</td>
<td></td>
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<td></td>
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</tbody>
</table>

**Table II.** Univariate analyses and multivariate analyses of factors affecting overall survival.

**Table III.** Univariate analyses and multivariate analyses of factors affecting recurrence-free survival.

AFP: Alpha-fetoprotein; BCLC: Barcelona Clinic Liver Cancer stage; CI: confidence interval; HR: hazard ratio; LI-RADS: Liver Imaging Reporting and Data System; PIVKA-II: protein induced by vitamin K absence or antagonist-II; VH: viral hepatitis. *Data were available in 59 cases. **Data were available in 57 cases. Statistically significant \( p \)-values are shown in bold.
hazards regression model revealed that the LI-RADS class was an independent prognostic factor ($p=0.039$). The Kaplan–Meier estimate is shown in Figure 3A. As with the OS comparison, for BCLC 0 and A, cases with LR-3 or -4 and -5 were extracted and compared. The results of the Kaplan–Meier curve for each result are shown in Figure 3B and C. For the BCLC 0 cases, there were no significant differences in RFS between LR-3 or -4 and LR-5 ($p=0.533$). For the BCLC A cases, however, the log-rank test results showed significant differences between LR-3 or -4 and LR-5 ($p=0.016$): The 1-, 3-, and 5-year survival rates of patients with LR-3 or -4 were 89%, 56% and 33%, while those for patients with LR-5 were significantly lower at 58%, 8% and 4%, respectively.

**BCLC and LI-RADS classification.** Of the 64 patients, BCLC classification resulted in 31 patients in the BCLC 0 group and 33 in the BCLC A group. Patients were then classified by LI-RADS classification. In patients with BCLC 0, one tumor was LR-3, 12 were LR-4, and 18 were LR-5. For patients with BCLC A, two tumors were LR-3, seven were LR-4, and 24
were LR-5. Table IV shows the baselines characteristics of BCLC 0 and A class patients with LR-3 or 4, and LR-5, which were the targets of this comparison. Example clinical images are presented in Figure 4 and Figure 5. Figure 4 is an image of a patient of the BCLC 0 group with a tumor corresponding to LR-4; Figure 5 is an image of a patient of the BCLC A group with a tumor corresponding to LR-5.

Baseline characteristics of patients with LR-3 or -4 and LR-5 are shown in Table IV. Comparison of groups showed significantly higher PIVKA-II values for LR-5 tumors, indicating that these are more aggressive tumors than LR-3 and 4. There were no significant differences in age, sex, AFP, Child–Pugh class, chronic liver disease, BCLC stage, anticancer drug, or tumor size.

Discussion

In this study, we compared prognosis between patients with nodules classified as LR-3 or -4 and those with LR-5 tumors. There was a significant difference in RFS in the comparison of all 64 cases. In particular, for cases with BCLC A, we found that those with LR-5 disease had a worse RFS than...
LR-3 or -4. In contrast, there was no significant difference in OS between patients with LR-3 or -4 and LR-5 tumors.

When determining the LI-RADS classification, if conditions such as non-rim arterial-phase enhancement and non-peripheral washout are the same, tumor size is considered (7). Larger tumors may have more vascular invasion, and a higher probability of recurrence (14-16). In addition, with a large tumor, some portions of the tumor that are not visible in the image may not be treatable, which may affect treatment results (17, 18). It is possible that the drug did not reach the interior of the tumor with TACE, or that some portions of the tumor that are not visible from a safety margin were assumed, RFA did not sufficiently incinerate the tumor. In addition, when the tumor has an enhancing capsule, the larger the size, the easier it is to infiltrate out beyond the enhancing capsule, and thus the greater is the likelihood of metastasis (19, 20).

As indicated in Table IV, there were no significant differences in age, sex, or AFP values between patients with LR-3 or -4 and those with LR-5 tumors. However, there was a significant difference in PIVKA-II values. There is an association between PIVKA-II values and tumor vascular invasion (21). LR-5 tumors have high PIVKA-II values, and there might be microvascular invasion that is not visible on the pretreatment image. As a result, we considered that the risk of recurrence was high in our patients with LR-5 tumors with high PIVKA-II values.

Regarding non-peripheral washout, previous reports revealed that non-peripheral washout of hypervascular HCC occurred earlier as the histological grade advanced, the histological architecture became closer to pure trabecular HCC, and hypervascular HCCs with thicker tumor plates showed worse histological grade and earlier washout pattern (22, 23). Thus, clear non-peripheral washout may indicate an aggressive tumor, such as a moderately to poorly differentiated HCC with thicker tumor plates.

Moreover, there was no significant difference in OS. One of the possible reasons for this is that HCC can exhibit multicentric development (24, 25). Even if a tumor is treated completely, new HCC, not intrahepatic metastasis, can develop elsewhere in the liver, which significantly influences survival. Unfortunately, in many cases it is difficult to tell the difference between intrahepatic metastasis from the original tumor and a newly developed tumor. Other possible factors that affect prognosis include worsening liver function and cirrhosis, and these effects may be greater than the tumor aggressiveness itself (26).
In this study, there was no significant difference between patients with LR-3 or -4 and those with LR-5 in the BCLC 0 group regarding OS and RFS. In the very early stage of HCC, if a tumor is well treated, the subsequent prognosis may depend on the likelihood of developing another HCC in the liver, or on the deterioration of underlying liver function (27). There may have been cases in which recurrence unrelated to the primarily treated tumor occurred.

This study had several limitations: (i) It was a retrospective study and selection bias which could have affected the results might therefore exist. (ii) Data were collected from a single center, and samples from multiple regions are required for further validation. Collecting more cases would have allowed us to investigate in more detail. (iii) Two anticancer drugs were used during TACE. There was no significant difference observed in OS and RFS due to differences in anticancer drugs used but the accuracy of the study might have been improved if comparisons could have been made under the same drug conditions (28). (iv) Patients with BCLC 0 or A might be good surgical candidates; however, our hospital traditionally favored less invasive therapy such as TACE-RFA. Thus, patients who were eligible for surgery may also have been included (29). (v) This study was the result of CT imaging only, therefore, it may be necessary to consider using other imaging modalities.

The LI-RADS classification is a tool for classifying images according to their major characteristics. Detailed tumor characteristics such as degree of differentiation are not included and may be classified using other algorithms. Examining the LI-RADS classification by adding more detailed features of the tumor can provide a more detailed prognosis. It has also been reported that the combination of diffusion-weighted MRI analysis and LI-RADS can improve confidence (30). In the future, combining LI-RADS with various factors may make it easier to predict prognosis.

In conclusion, tumors categorized as LR-5 confer a worse RFS than those classified as LR-3 or -4, especially in
patients with BCLC A disease. LI-RADS, originally created for use at the radiologist’s discretion in diagnosis, can predict patient prognosis. The course of patients with tumors classified as LR-5 by LI-RADS require more attention than those with tumors of other classifications.

Conflicts of Interest

The Authors declare that they have no conflicts of interest.

Authors’ Contributions

All persons who meet authorship criteria are listed as authors, and all authors certify that they participated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the article.

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