Supplementary Material 1.

Computed tomography (CT) image acquisition

CT images were obtained using various multi-detector row CT scanners: 320-channel scanners (Aquilion ONE; Canon Medical Systems, Otawara, Japan; n=18), a 256-channel scanner (iCT 256; Philips Healthcare, Best, Netherlands; n=32), 128-channel scanners (Ingenuity; Philips Healthcare; n=12), 96-channel scanners (Somatom Force; Siemens Healthineers, Forchheim, Germany; n=32), 64-channel scanners (IQon, Brilliance 64; Philips Healthcare, n=61; Somatom Definition and Sensation 64; Siemens Healthineers; n=51; Discovery CT750 HD, Optima CT660, Revolution; GE Healthcare, Chicago, Il, USA; n=20), and 16-channel scanners (Emotion 16; Siemens Healthineers; n=4; Lightspeed 16; GE Healthcare; n=7).

The routine four-phase liver CT protocol of our institution was obtained using the following parameters: section thickness of 2.5-3.0 mm, reconstruction interval of 2.0-3.0 mm, rotation time of 0.50-0.75 seconds, peak voltage of 100-120 kVp, and tube current of 150-250 mAs. After the acquisition of precontrast axial images, an intravenous nonionic contrast medium (iobitridol [Xenetix 350; Guerbet, Villepinte, France] or iohexol [Bonorex 350; Central Medical Service, Nottingham, UK]) was injected at a dose of 1.6 mL/kg at a rate of 3-5 mL/s followed by a 20-40 mL saline flush using an automatic power injector. Using the bolus tracking technique, arterial phase and portal venous phase (PVP) axial images were obtained with a scan delay of 17-19 seconds and 55-70 seconds, respectively, starting from the threshold enhancement of 100-150 HU in the distal thoracic aorta. Subsequently, delayed phase axial images were obtained 180 seconds after starting the injection of the contrast medium.

Hepatobiliary contrast agent-enhanced magnetic resonance imaging (MRI) acquisition

Liver MRI exams were performed on 3.0-T or 1.5-T scanners as follows: 3.0-T scanners (Skyra, Magnetom Verio, Magnetom Trio, Biograph mMR; Siemens Healthineers; n=112; Ingenia, Ingenia CX; Philips Healthcare; n=103; Discovery 750W; GE Healthcare; n=18) and 1.5-T scanners (Magnetom Avanto; Siemens Healthineers; n=1; Signa HDxt 1.5T; GE Healthcare; n=2; Ingenia; Philips Healthcare; n=1).

The routine liver MRI protocol of our institution includes the following sequences: a respiratory-triggered T2-weighted fast spin-echo sequence, a half-Fourier acquisition single-shot turbo spin-echo sequence, diffusion-weighted imaging, breath-hold T1-weighted gradient-echo in and out-of-phase sequences, and breath-hold T1-weighted fat-suppressed 3D gradient-echo sequences for precontrast and post-contrast imaging including the arterial phase, PVP, transitional phase, and hepatobiliary phase. MRI scan parameters are described in Supplementary Table 1. For dynamic phase imaging, after obtaining precontrast images, a standard dose (0.025 mmol/kg) of gadoxetic acid (Primovist; Bayer, Leverkusen, Germany) was injected intravenously at a rate of 1.0 mL/s using a power injector, followed by a 20-mL saline flush. Using a real-time MRI fluoroscopic monitoring system, arterial phase axial images were acquired 7-8 seconds after contrast material arrival at the distal thoracic aorta. Of note, we obtained dual portal venous phases during 53-67 and 73-87 seconds after contrast media injection, respectively. Subsequently, transitional phase and hepatobiliary phase axial images were obtained approximately 3 and 20 minutes, respectively, after starting the injection of contrast medium.

Diagnostic performance of 2022 Korean Liver Cancer Association-National Cancer Center (KLCA-NCC) guideline for hepatocellular carcinoma (HCC) diagnosis

With CT, there was one probable HCC case, according to the KLCA-NCC guidelines. According to Liver Imaging Reporting and Data System (LI-RADS), this lesion was 31 mm in diameter and had nonrim arterial phase hyperenhancement (APHE) and enhancing capsule (EC) but not nonperipheral washout, which would be LI-RADS category 5 (LR-5). This observation was confirmed to be HCC on pathological examination. The distribution of observations concerning the pathological diagnosis and KLCA-NCC guidelines or LI-RADS on CT and hepatobiliary agent-enhanced MRI (HBA-MRI) is shown in Supplementary Tables 6 and 7. Among the 10 non-HCC tumors misclassified as definite HCC by the KLCA-NCC guidelines and LI-RADS, combined HCC-cholangiocarcinomas (cHCC-CCAs) accounted for 70.0% (7/10) and showed high hepatocellular differentiation (60-95%).

With HBA-MRI, 12 probable HCCs were identified according to the KLCA-NCC guidelines. All 12 observations were LR-4 according to the LI-RADS. EC was present in only one of the 12 observations. All 12 lesions were confirmed as HCCs. Among the 12 non-HCC tumors misclassified as definite HCC by both KLCA-NCC guidelines and LI-RADS, cHCC-CCAs accounted for 75.0% (9/12), and most (88.9% [8/9]) presented a high degree of hepatocellular differentiation (60-95%).