

**Supplementary Material S1.** Treatment strategies for initial hepatocellular carcinoma

Briefly, the procedures before resection or radiofrequency ablation (RFA) included liver-protocol dynamic computed tomography (CT) and/or magnetic resonance imaging (MRI), chest CT, and bone scans, in addition to measurement of serum parameters related to the etiology of liver disease and alpha-fetoprotein (AFP). In the European Association for the Study of the Liver and American Association for the Study of Liver Diseases guidelines, resection and RFA were recommended as curative treatment options for hepatocellular carcinoma (HCC) patients with Barcelona Clinic Liver Cancer stages 0/A.<sup>1,2</sup> Regarding treatment strategies for initial HCC, resection and RFA were equally considered as possible treatment options because most of patients (87.0%) had single HCC and median size was 2.3 cm (interquartile range, 1.7 to 3.0 cm) in this study. Resection was performed when patients preferred the resection, and had indocyanine green (ICG) tests R15 value <15% with lesions difficult to reach with RFA electrodes or close to vital structures like vessels and adjacent organs, or when RFA electrode placement is impaired. RFA for initial HCC was performed when patients preferred the RFA treatment and had lesions without any contraindications.

For all candidates for resection, ICG tests were performed to evaluate portal hypertension. Patients who had ICG R15 value <15% were treated with resection. Anatomic partial hepatectomy was performed by three surgeons experienced in hepatobiliary surgery in a standardized manner: ligating the feeding vessels and securing margins of at least 2 cm under low central venous pressure at less than 5 mm Hg. However, if liver function was poor, non-anatomic partial hepatectomy was also performed. RFA was performed by two specialized radiologists using a RF generator of 200 W (Radionics, Burlington, MA, USA), with a 17-gauge single cooled-tip needle electrode for HCC <2 cm, or a triple-cluster needle electrode for HCC ≥2 cm. Under the guidance of sonography, the electrode was placed at

the deep margin and RF energy delivery was maintained for 13 to 18 minutes depending on the tumor size. The ablation was performed repeatedly until the entire lesion was enveloped by assumed necrotic areas: echogenic bubble clouds. The completeness of the ablation was assessed using dynamic CT immediately after the procedure, and a repeat RFA was performed for any incomplete ablation.

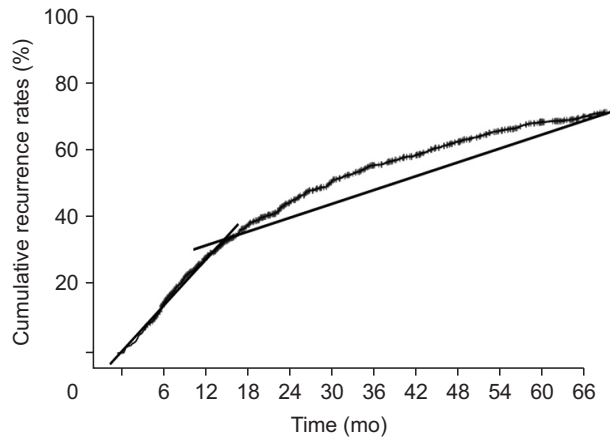
For all patients, postoperative routine follow-up included a dynamic liver CT, laboratory tests, and serum AFP analysis according to each follow-up surveillance interval.

**Supplementary Materials S2.** Definition of hepatocellular carcinoma

In initial diagnosis of hepatocellular carcinoma (HCC), it was based on radiologic findings in dynamic computed tomography (CT) and/or magnetic resonance imaging (MRI) as recommended: intense arterial uptake followed by “washout” of contrast in the venous-delayed phases.<sup>1,2</sup> For patients who had equivocal findings of CT scanning, liver-specific contrast in MRI was used to diagnose HCC. If there were no characteristic findings of HCC in MRI scanning, we performed a liver biopsy for HCC diagnosis on non-characterized nodules in image studies. In diagnosis of HCC recurrence during follow-up periods, the same approaches were used to identify HCC recurrence. In this study, image review was conducted by two expert radiologists (D.H.L. and J.M.L.) with >10 years of experience.

## REFERENCES

1. European Association for the Study of the Liver; European Organisation for Research and Treatment of Cancer. EASL-EORTC clinical practice guidelines: management of hepatocellular carcinoma. *J Hepatol* 2012;56:908-943.
2. Bruix J, Sherman M; American Association for the Study of Liver Diseases. Management of hepatocellular carcinoma: an update. *Hepatology* 2011;53:1020-1022.



**Supplementary Fig. 1.** The recurrence pattern was changed after 1 year: early and late recurrence. Curve graph means cumulative recurrence rates and line graph means approximation line.