**Supplementary materials**

**Details of the prospective patient cohort**

***Patient selection and inclusion***

The study included a prospective cohort to further validate the results from the retrospective cohort. Patients with hepatocellular carcinoma (HCC) treated with transarterial chemoembolization (TACE) between January 2021 and December 2022 at the leading participating hospital were prospectively screened and included. Inclusion and exclusion criteria of the prospective cohort were similar to those of the retrospective cohort expect for the condition that patients were treated with TACE-based therapy rather than TACE monotherapy. During the past 3 years, several phase III randomized controlled trials of anti-PD-(L)1 agents and anti-VEGF and/or tyrosine kinase inhibitors (TKI) have demonstrated positive efficacy and safety for the treatment of HCC and and have been recommended in the first-line setting. Considering the synergistic activity of TACE and anti-PD-(L)1 agents and anti-VEGF and/or TKI, TACE-based therapy, TACE combined with anti-PD-(L)1 agent and anti-VEGF and/or TKI, has been widely applied in clinical practice for the treatment of HCC during the past three years. Therefore, the prospective cohort included patients treated with TACE combined with anti-PD-(L)1 agent and anti-VEGF and/or TKI rather than treated with TACE monotherapy.

***Results***

A total of 44 patients were included in the prospective cohort. In brief, the mean age was 58 years, the majority (37/44, 84.1%) were men, and 30 (68.2%) had hepatitis B virus -related HCC. The median overall survival has yet to be achieved, and the progression-free survival was 15.5 months, and the objective response rate was 65.9% (29/44).

The prognostic performance outcomes in the prospective cohort showed that the CNLC staging system performed better than the BCLC staging system. For model discrimination, the CNLC had a higher C-index (0.544 vs. 0.511) and a lower AIC (34.48 vs*.* 34.70) than the BCLC. For model monotonicity of the gradient, the BCLC had higher linear trends of chi-square tests than the CNLC [0.161 vs. 0.023; *p* < 0.001]. For model homogeneity, the CNLC had higher likelihood ratios of chi-square tests than the BCLC (2.534 vs. 0.168; *p* < 0.001]. For model calibration, R2 the CNLC was slightly better than the BCLC (0.857 vs. 0.846).