**Supplementary materials and methods**

**Preparation of PBMCs**

PBMCs were separated as described below: heparinized venous blood was diluted in PBS and loaded on FicollHistopaque (Sigma, St. Louis, Mo, USA) in 50-mL tubes. After centrifugation at 2000 rpm for 20 min at room temperature, PBMCs were harvested from the interphase, and resuspended in complete culture medium consisting of RPMI 1640 medium (GibcoBRL, Grand Island, NY, USA), 10 % heat-inactivated fetal calf serum (FCS) (GibcoBRL), 100 U/mL of penicillin, and 100 µg/mL of streptomycin (GibcoBRL). PBMCs were resuspended in RPMI 1640 medium containing 80% FCS and 10% dimethyl sulfoxide, and cryopreserved until use.

**Statistical analysis**

The Fisher’s exact test, Mann-Whitney U test, and Wilcoxon signed-rank test were used to analyze the differences in clinical background and ICP among CCA, HV and HCV SVR12 patients group. Overall survival was calculated from the day of cholangiocarcinoma diagnosis until the date of death or the last day of the follow-up period. Recurrence-free survival was calculated from the day of surgery until the date of recurrence or the last day of the follow-up period. Cumulative survival and recurrence were calculated using the Kaplan-Meier method, and differences were evaluated using the log-rank test. A *p*-value of <0.05 was considered to be significant and all tests were two-sided. All statistical analyses were carried out using the SPSS statistical software program package (SPSS version 26.0 for Windows).