

Table S1 Univariate analysis to explore potential factors associated with microvascular invasion (M0 vs. M1+M2) in HCC patients

Variables	MVI: M0 (n=346)	MVI: M1+M2 (n=275)	Coefficient (r)	P value (two-tailed)
Gender: Male/Female	296 (85.5%)/50 (14.5%)	239 (86.9%)/36 (13.1%)	-0.020	0.63
ABO blood types: A/B/O/AB	111 (33.8%)/73 (22.3%)/ 113 (34.5%)/31 (9.5%)	65 (24.3%)/79 (29.6%)/ 97 (36.3%)/26 (9.7%)	0.060	0.14
HBsAg: Positive/Negative	281 (82.6%)/59 (17.4%)	229 (83.9%)/44 (16.1%)	-0.016	0.69
HCVAb: Positive/Negative	30 (8.8%)/310 (91.2%)	20 (7.3%)/253 (92.7%)	0.027	0.50
Age, y (mean \pm SD)	56.8 \pm 11.4	55.3 \pm 11.5	-0.072	0.07
White blood cell, $\times 10^9$ /L median (IQR)	4.97 (2.23)	5.17 (1.62)	0.079	0.06
Red blood cell, $\times 10^{12}$ /L median (IQR)	4.29 (0.73)	4.42 (0.71)	0.081	0.04*
Hemoglobin, g/L median (IQR)	134 (22)	138 (19)	0.065	0.11
Platelet, $\times 10^9$ /L median (IQR)	149 (82)	153 (88)	0.057	0.16
Total bilirubin, μ mol/L median (IQR)	14.1 (9.4)	14.3 (6)	0.011	0.78
Direct Bilirubin, μ mol/L median (IQR)	5.3 (3.7)	5.2 (2.6)	0.003	0.94
ALT, U/L median (IQR)	29 (21)	33 (28)	0.055	0.17
AST, U/L median (IQR)	30 (19)	41 (25)	0.175	<0.001*
ALP, U/L median (IQR)	84 (38)	93 (45)	0.108	0.007*
γ -GTP, U/L median (IQR)	42 (54)	68 (88)	0.184	<0.001*
Total protein, g/L median (IQR)	64.9 (7.7)	65.1 (7.5)	0.021	0.60
Albumin, g/L median (IQR)	39.2 (6.2)	38.7 (7.1)	-0.021	0.61
FBG, mmol/L median (IQR)	5 (1.2)	4.9 (0.9)	-0.070	0.09
Total cholesterol, mmol/L median (IQR)	3.91 (1.06)	4.25 (1.33)	0.093	0.03*
HDL cholesterol, mmol/L median (IQR)	1.07 (0.37)	1.03 (0.45)	-0.006	0.89
LDL cholesterol, mmol/L median (IQR)	2.33 (0.88)	2.54 (0.98)	0.117	0.006*
AFP, μ g/L median (IQR)	10.5 (96.5)	206.2 (1986.3)	0.325	<0.001*
CEA, μ g/L median (IQR)	2.46 (1.69)	2.49 (1.65)	-0.032	0.61
CA 19-9, U/ml median (IQR)	7.3 (9.6)	7.9 (12.5)	0.033	0.61
LDH, U/L median (IQR)	196 (58)	214 (79)	0.189	<0.001*
LDH: \leq ULN/ $>$ ULN	283 (81.8%)/63 (18.2%)	178 (64.7%)/97 (35.3%)	0.194	<0.001*

*, $P < 0.05$ was considered statistically significant. HCC, hepatocellular carcinoma; MVI, microvascular invasion; HBsAg, hepatitis B surface antigen; HCVAb, hepatitis C antibody; SD, standard deviation; IQR, interquartile range; ALT, alanine aminotransferase; AST, aspartate aminotransferase; ALP, alkaline phosphatase; γ -GTP, γ -glutamyltransferase; FBG, fasting blood glucose; HDL, high-density lipoprotein; LDL, low-density lipoprotein; AFP, α -fetoprotein; CEA, carcinoembryonic antigen; CA 19-9, carbohydrate antigen 19-9; LDH, lactate dehydrogenase; ULN, upper limit of normal.

Table S2 Ordinal logistic regression analysis to identify independent factors associated with microvascular invasion (M0 vs. M1+M2) in HCC patients

Variables	Coefficient (B)	95% CI		Standard Error	Wald χ^2	P value
		Lower limit	Upper limit			
ABO blood types=A	-0.016	-1.081	1.050	0.544	0.001	0.977
ABO blood types=B	0.943	-0.149	2.034	0.557	2.866	0.090
ABO blood types=O	0.717	-0.329	1.763	0.534	1.804	0.179
Age, y	-0.015	-0.040	0.011	0.013	1.314	0.252
White blood cell, $\times 10^9/L$	0.011	-0.169	0.192	0.092	0.015	0.901
Red blood cell, $\times 10^{12}/L$	0.000	-0.502	0.503	0.256	0.000	0.999
Hemoglobin, g/L	0.015	-0.009	0.039	0.012	1.468	0.226
Platelet, $\times 10^9/L$	-0.001	-0.006	0.003	0.002	0.271	0.603
Total bilirubin, $\mu\text{mol}/L$	-0.009	-0.086	0.069	0.039	0.047	0.828
Direct Bilirubin, $\mu\text{mol}/L$	-0.015	-0.131	0.101	0.059	0.061	0.805
ALT, U/L	-0.008	-0.022	0.005	0.007	1.509	0.219
AST, U/L	0.008	-0.010	0.025	0.009	0.772	0.380
ALP, U/L	0.001	-0.003	0.005	0.002	0.414	0.520
γ -GTP, U/L	0.001	-0.002	0.004	0.002	0.298	0.585
Albumin, g/L	-0.048	-0.128	0.032	0.041	1.393	0.238
FBG, mmol/L	-0.131	-0.254	-0.008	0.063	4.357	0.037
Total cholesterol, mmol/L	-0.067	-0.470	0.336	0.206	0.106	0.745
LDL cholesterol, mmol/L	0.486	-0.102	1.073	0.300	2.621	0.105
AFP, $\mu\text{g}/L$	4.98×10^{-5}	-9.93×10^{-6}	0.001	3.05×10^{-5}	2.671	0.102
LDH, U/L	0.005	2.90×10^{-5}	0.010	0.003	3.887	0.049*

*, $P < 0.05$ was considered statistically significant. HCC, hepatocellular carcinoma; CI, confidence interval; ALT, alanine aminotransferase; AST, aspartate aminotransferase; ALP, alkaline phosphatase; γ -GTP, γ -glutamyltransferase; FBG, fasting blood glucose; LDL, low-density lipoprotein; AFP, α -fetoprotein; LDH, lactate dehydrogenase.

Table S3 Ordinal logistic regression analysis to identify independent factors associated with severity of microvascular invasion in HCC patients with negative serum HCVAb

Variables	Coefficient (B)	95% CI		Standard Error	Wald χ^2	P value
		Lower limit	Upper limit			
ABO blood types=A	0.231	-0.890	1.351	0.572	0.163	0.687
ABO blood types=B	0.918	-0.217	2.053	0.579	2.511	0.113
ABO blood types=O	0.908	-0.207	2.024	0.569	2.546	0.111
Age, y	-0.011	-0.035	0.013	0.012	0.790	0.374
White blood cell, $\times 10^9/L$	0.069	-0.096	0.235	0.085	0.674	0.412
Red blood cell, $\times 10^{12}/L$	-0.298	-0.773	0.177	0.242	1.513	0.219
Hemoglobin, g/L	0.024	-9.68×10^{-6}	0.048	0.012	3.838	0.051
Platelet, $\times 10^9/L$	-0.002	-0.007	0.002	0.002	1.211	0.271
Total bilirubin, $\mu\text{mol}/L$	-0.016	-0.088	0.055	0.036	0.196	0.658
Direct Bilirubin, $\mu\text{mol}/L$	-0.006	-0.112	0.100	0.054	0.012	0.912
ALT, U/L	-0.008	-0.020	0.005	0.006	1.500	0.221
AST, U/L	0.009	-0.006	0.025	0.008	1.394	0.238
ALP, U/L	0.000	-0.002	0.003	0.001	0.039	0.843
γ -GTP, U/L	0.002	-0.001	0.004	0.001	1.015	0.314
Albumin, g/L	-0.071	-0.151	0.008	0.041	3.096	0.078
FBG, mmol/L	-0.106	-0.222	0.010	0.059	3.226	0.072
Total cholesterol, mmol/L	-0.167	-0.545	0.211	0.193	0.754	0.385
LDL cholesterol, mmol/L	0.432	-0.129	0.993	0.286	2.273	0.132
AFP, $\mu\text{g}/L$	8.7×10^{-6}	-1.67×10^{-5}	3.40×10^{-5}	1.29×10^{-5}	0.450	0.502
LDH, U/L	0.004	0.001	0.008	0.002	5.328	0.021*

*, $P < 0.05$ was considered statistically significant. HCC, hepatocellular carcinoma; HCVAb, hepatitis C antibody; CI, confidence interval; ALT, alanine aminotransferase; AST, aspartate aminotransferase; ALP, alkaline phosphatase; γ -GTP, γ -glutamyltransferase; FBG, fasting blood glucose; LDL, low-density lipoprotein; AFP, α -fetoprotein; LDH, lactate dehydrogenase.

Table S4 Ordinal logistic regression analysis to identify independent factors associated with severity of microvascular invasion in HCC patients with positive serum HBsAg

Variables	Coefficient (B)	95% CI		Standard Error	Wald χ^2	P value
		Lower limit	Upper limit			
ABO blood types=A	0.279	-0.986	1.544	0.645	0.187	0.665
ABO blood types=B	1.019	-0.253	2.292	0.649	2.465	0.116
ABO blood types=O	0.973	-0.291	2.237	0.645	2.278	0.131
Age, y	-0.015	-0.043	0.013	0.014	1.066	0.302
White blood cell, $\times 10^9/L$	0.075	-0.113	0.262	0.096	0.611	0.435
Red blood cell, $\times 10^{12}/L$	-0.288	-0.867	0.291	0.295	0.951	0.329
Hemoglobin, g/L	0.019	-0.009	0.047	0.014	1.814	0.178
Platelet, $\times 10^9/L$	-0.003	-0.008	0.002	0.003	1.279	0.258
Total bilirubin, $\mu\text{mol}/L$	0.066	-0.031	0.162	0.049	1.782	0.182
Direct Bilirubin, $\mu\text{mol}/L$	-0.206	-0.398	-0.014	0.098	4.400	0.036*
ALT, U/L	-0.005	-0.018	0.008	0.007	0.517	0.472
AST, U/L	0.011	-0.005	0.028	0.008	1.974	0.160
ALP, U/L	0.000	-0.002	0.003	0.001	0.072	0.789
γ -GTP, U/L	0.002	-0.002	0.005	0.002	0.926	0.336
Albumin, g/L	-0.056	-0.152	0.040	0.049	1.293	0.255
FBG, mmol/L	-0.109	-0.255	0.037	0.074	2.148	0.143
Total cholesterol, mmol/L	-0.321	-0.831	0.189	0.260	1.524	0.217
LDL cholesterol, mmol/L	0.737	0.012	1.462	0.370	3.965	0.046*
AFP, $\mu\text{g}/L$	6.83×10^{-6}	-1.96×10^{-5}	3.32×10^{-5}	1.35×10^{-5}	0.256	0.613
LDH, U/L	0.004	0.001	0.008	0.002	4.062	0.044*

HCC, hepatocellular carcinoma; HBsAg, hepatitis B surface antigen; CI, confidence interval; ALT, alanine aminotransferase; AST, aspartate aminotransferase; ALP, alkaline phosphatase; γ -GTP, γ -glutamyltransferase; FBG, fasting blood glucose; LDL, low-density lipoprotein; AFP, α -fetoprotein; LDH, lactate dehydrogenase. * $P < 0.05$ was considered statistically significant.

Table S5 Ordinal logistic regression analysis to identify independent factors associated with severity of microvascular invasion in HCC patients with positive HBsAg and negative HCVAb

Variables	Coefficient (B)	95% CI		Standard Error	Wald χ^2	P value
		Lower limit	Upper limit			
ABO blood types=A	0.214	-1.056	1.485	0.648	0.109	0.741
ABO blood types=B	0.934	-0.344	2.213	0.652	2.051	0.152
ABO blood types=O	0.914	-0.353	2.181	0.646	2.000	0.157
Age, y	-0.013	-0.041	0.016	0.014	0.769	0.381
White blood cell, $\times 10^9/L$	0.084	-0.106	0.274	0.097	0.745	0.388
Red blood cell, $\times 10^{12}/L$	-0.271	-0.848	0.306	0.294	0.847	0.357
Hemoglobin, g/L	0.020	-0.008	0.048	0.014	1.914	0.167
Platelet, $\times 10^9/L$	-0.003	-0.008	0.002	0.003	1.176	0.278
Total bilirubin, $\mu\text{mol}/L$	0.067	-0.029	0.164	0.049	1.881	0.170
Direct Bilirubin, $\mu\text{mol}/L$	-0.204	-0.394	-0.014	0.097	4.442	0.035*
ALT, U/L	-0.004	-0.017	0.010	0.007	0.299	0.585
AST, U/L	0.010	-0.006	0.027	0.008	1.529	0.216
ALP, U/L	0.000	-0.002	0.003	0.001	0.073	0.787
γ -GTP, U/L	0.001	-0.002	0.005	0.002	0.856	0.355
Albumin, g/L	-0.059	-0.156	0.038	0.050	1.406	0.236
FBG, mmol/L	-0.110	-0.254	0.035	0.074	2.202	0.138
Total cholesterol, mmol/L	-0.311	-0.818	0.196	0.259	1.449	0.229
LDL cholesterol, mmol/L	0.710	-0.012	1.432	0.368	3.717	0.054
AFP, $\mu\text{g}/L$	6.12×10^{-6}	-2.02×10^{-5}	3.25×10^{-5}	1.34×10^{-5}	0.207	0.649
LDH, U/L	0.004	6.16×10^{-5}	0.008	0.002	3.964	0.046*

*, $P < 0.05$ was considered statistically significant. HCC, hepatocellular carcinoma; HBsAg, hepatitis B surface antigen; HCVAb, hepatitis C antibody; CI, confidence interval; ALT, alanine aminotransferase; AST, aspartate aminotransferase; ALP, alkaline phosphatase; γ -GTP, γ -glutamyltransferase; FBG, fasting blood glucose; LDL, low-density lipoprotein; AFP, α -fetoprotein; LDH, lactate dehydrogenase.

Table S6 Selecting 17 variables (serum AFP level was removed) into ordinal logistic regression analysis to identify independent factors associated with severity of microvascular invasion in HCC patients

Variables	Coefficient (B)	95% CI		Standard Error	Wald χ^2	P value
		Lower limit	Upper limit			
ABO blood types=A	-0.535	-1.199	0.129	0.339	2.490	0.115
ABO blood types=B	0.147	-0.517	0.812	0.339	0.188	0.664
ABO blood types=O	-0.057	-0.703	0.588	0.329	0.030	0.862
Age, y	-0.012	-0.028	0.004	0.008	2.104	0.147
White blood cell, $\times 10^9/L$	0.041	-0.069	0.151	0.056	0.533	0.465
Red blood cell, $\times 10^{12}/L$	-0.119	-0.500	0.263	0.194	0.372	0.542
Hemoglobin, g/L	0.007	-0.009	0.024	0.009	0.759	0.384
Platelet, $\times 10^9/L$	0.000	-0.003	0.002	0.001	0.076	0.783
Total bilirubin, $\mu\text{mol}/L$	-0.002	-0.046	0.042	0.022	0.009	0.924
Direct Bilirubin, $\mu\text{mol}/L$	-0.006	-0.079	0.067	0.037	0.024	0.877
ALT, U/L	-0.011	-0.020	-0.001	0.005	5.112	0.024*
AST, U/L	0.005	-0.005	0.016	0.006	0.993	0.319
ALP, U/L	0.001	-0.001	0.003	0.001	0.685	0.408
γ -GTP, U/L	0.002	0.000	0.004	0.001	4.903	0.027*
Albumin, g/L	-0.011	-0.058	0.037	0.024	0.193	0.660
FBG, mmol/L	-0.081	-0.162	0.001	0.041	3.787	0.052
Total cholesterol, mmol/L	-0.113	-0.435	0.209	0.164	0.473	0.492
LDL cholesterol, mmol/L	0.388	-0.041	0.818	0.219	3.137	0.077
LDH, U/L	0.003	0.001	0.005	0.001	8.354	0.004*

*, $P < 0.05$ was considered statistically significant. AFP, α -fetoprotein; HCC, hepatocellular carcinoma; CI, confidence interval; ALT, alanine aminotransferase; AST, aspartate aminotransferase; ALP, alkaline phosphatase; γ -GTP, γ -glutamyltransferase; FBG, fasting blood glucose; LDL, low-density lipoprotein; LDH, lactate dehydrogenase.