

Table S1 Imaging examinations

Imaging examinations	Group A (n=291)	Group B (n=369)	Total (n=660)
PET/CT	291 (100.0)	0	291 (44.1)
Abdominal contrast-enhanced MRI	271 (93.1)	344 (93.2)	615 (93.2)
Abdominal contrast-enhanced CT	77 (26.5)	56 (15.2)	133 (20.2)
Chest CT	63 (21.6)	105 (28.5)	168 (25.5)
Chest radiography	228 (78.4)	264 (71.5)	492 (74.5)

PET/CT, positron emission tomography/computed tomography; MRI, magnetic resonance imaging; CT, computed tomography.

Table S2 Sequences and parameters of abdominal contrast-enhanced MRI[†]

MR machines	Parameters	TR (ms)	TE (ms)	BW (Hz/pixel)	FOV (mm × mm)	Acquisition matrix	Slice thickness (mm)	Flip angle (°)
UIHMR 770, United Imaging, China; 3.0 Tesla	T2WI-FS	2,000	106.2	365	380×380	256×256	6.0	100
	DWI (b=0, 500 mm ² /s)	5,000	66.3	2,370	380×300	128 ×128	6.0	90
	T1WI IP/OP	4.2	1.2/2.5	900	400×300	288×224	3.0	10
	T1WI-FS tra	3.3	1.5	650	400×270	320 ×288	3.0	10
	T1WI-FS cor	3.3	1.5	600	340×340	270×270	3.0	10
Magnetom Verio, Siemens Healthcare, Germany; 3.0 Tesla	T2WI-FS	2,500	83	260	380×330	320×165	5.5	122
	DWI (b=0, 500 mm ² /s)	3,400	70	2,442	380×285	128×80	6.0	90
	T1WI IP/OP	207	2.3/3.7	930	380×285	256×141	5.5	70
	T1WI-FS tra	4.2	1.4	390	380×285	352×200	3.0	9
	T1WI-FS cor	4.1	1.5	9	380×380	384×269	3.0	9
Magnetom Avanto, Siemens Healthcare, Germany; 1.5 Tesla	T2WI-FS	3,100	84	260	360×304	256×173	7.0	150
	DWI (b=0, 500 mm ² /s)	2,800	66	1,502	360×315	112×128	7.0	90
	T1WI IP/OP	118	2.0/5.0	376/416	360×270	256×134	7.0	70
	T1WI-FS tra	5.1	2.4	299	380×264	288×130	4.0	10
	T1WI-FS cor	5.2	2.4	300	380×308	128×112	5.0	10
Magnetom Aera, Siemens Healthcare, Germany; 1.5 Tesla	T2WI-FS	4,918	106	195	380×380	384×273	5.5	160
	DWI (b=0, 500 mm ² /s)	5,100	55	1735	380×297	192×120	5.5	90
	T1WI IP/OP	6.9	2.4/4.8	435/480	380×297	320×188	4.0	10
	T1WI-FS tra	3.5	1.4	405	380×281	352×195	3.0	10
	T1WI-FS cor	4.4	2.0	410	380×350	320×320	3.0	10
UIHMR 560, United Imaging, China; 1.5 Tesla	T2WI-FS	2,693	85.6	260	380×360	288×201	6.0	150
	DWI (b=0, 500 mm ² /s)	280.7	75.7	1,720	380×300	128×115	6.0	90
	T1WI IP/OP	115.8	2.2/4.4	360	380×290	288×230	6.0	70
	T1WI-FS tra	4.5	2.2	400	400×280	256×192	3.5	10
	T1WI-FS cor	4.5	2.2	360	450×350	256×125	3.0	10

[†], the sequences include axial respiratory-triggered T2WI-FS, breath-hold gradient echo T1WI IP/OP, breath-hold DWI with b values of 0 and 500 mm²/s, T1-weighted 3D-volumetric interpolated breath-hold examination imaging with transverse and coronal fat suppressed (T1WI-FS tra, T1WI-FS cor), dynamic contrast-enhanced imaging (pre-contrast, arterial, portal venous and delayed phases). MRI, magnetic resonance imaging; TR, repetition time; TE, echo time; BW, bandwidth; FOV, field of view; T2WI-FS, T2-weighted imaging fat suppressed fast spin echo sequence; T1WI IP/OP, T1-weighted in-phase and opposed-phase imaging; DWI, diffusion-weighted imaging.

Table S3 Impact of PET/CT on treatment allocation

Patient	Findings on CIE	Findings on PET/CT	Impact on treatment allocation	Follow-up (up until May 2020)
1	Multiple tumors in the liver and enlarged hilar lymph nodes	Right 7 th , 9 th posterior costal and right acetabular metastasis	Avoiding unnecessary surgery	Osseous metastases progressed and the patient died in 10.5 months
2	Multiple tumors in the left lobe of liver and enlarged hilar and para-aortic lymph nodes	Increased FDG uptake in para-aortic and pelvic lymph nodes and suspicious pulmonary metastasis	Avoiding unnecessary surgery	The pulmonary nodule remained stable but lymph node metastases progressed and the patient died in 6.3 months
3	Multiple tumors in the liver and enlarged hilar lymph nodes	5 th thoracic vertebra metastasis	Avoiding unnecessary surgery	Osseous metastases progressed and the patient died in 10.5 months
4	Multiple tumors in the right lobe of liver and enlarged hilar and lymph nodes	Increased FDG uptake in para-aortic lymph nodes and suspicious pulmonary metastasis	Avoiding unnecessary surgery	Metastatic lesions progressed and the patient died in 21.6 months
5	Multiple tumors in the liver and small pulmonary nodules in chest radiography	Pulmonary metastases	Avoiding unnecessary surgery	pulmonary nodules progressed and the patient died in 17.2 months
6	A tumor in the left external lobe of liver and enlarged hilar lymph nodes	Multiple osseous metastases	Avoiding unnecessary surgery	Osseous metastases progressed and the patient died in 17.8 months
7	A tumor in the left external lobe of liver and suspicious right 5 th rib metastasis	Multiple osseous metastases	Avoiding unnecessary surgery	Osseous metastases progressed and the patient died in 9.9 months
8	A tumor in the right posterior lobe of liver and enlarged hilar and para-aortic lymph nodes	Increased FDG uptake in para-aortic and left clavicular lymph nodes	Avoiding unnecessary surgery	The left clavicular lymph node metastasis was confirmed by biopsy and the patient died in 6 months
9	Multiple tumors in the liver and enlarged para-aortic lymph nodes	Increased FDG uptake in para-aortic, pelvic, and left clavicular lymph node; pelvic implantation metastasis; right ischial metastasis	Avoiding unnecessary surgery	Metastatic lesions progressed and the patient died in 4.6 months
10	Multiple tumors in the left lobe of liver	Multiple osseous metastases	Avoiding unnecessary surgery	Osseous metastases progressed and the patient died in 9.1 months
11	Multiple tumors in the right lobe of liver	Right retroperitoneal implantation metastasis	Avoiding unnecessary surgery	Metastatic lesions progressed and the patient died in 14.9 months
12	A tumor in the left external lobe of liver	suspicious pulmonary metastasis	Avoiding unnecessary surgery	The pulmonary nodule progressed and the patient died in 6.8 months
13	Multiple tumors in the liver and enlarged hilar lymph nodes	Increased FDG uptake in para-aortic lymph nodes; peritoneal and pelvic implantation metastases; multiple osseous metastases	Avoiding unnecessary surgery	Metastatic lesions progressed and the patient died in 5.6 months
14	A tumor in the right lobe of liver and enlarged hilar lymph nodes	Increased FDG uptake in pelvic lymph nodes and peritoneal metastases	Expanding the scope of lymphadenectomy	The surgically resected peritoneal nodules and pelvic lymph nodes were confirmed metastasis pathologically and the patient relapsed in 5.1 months and died in 18.7 months
15	A tumor in the right lobe of liver	Increased FDG uptake in hilar and left cardia lymph nodes	Expanding the scope of lymphadenectomy	The surgically resected lymph nodes were confirmed metastasis pathologically and the patient relapsed in 25.3 months and was still alive in 35.6 months
16	A tumor in the left external lobe of liver and enlarged hilar lymph nodes	Increased FDG uptake in para-aortic lymph nodes	Expanding the scope of lymphadenectomy	The resected para-aortic lymph node was confirmed metastasis pathologically, but pericardial invasion was found during the operation, and the patient died in 3.4 months
17	A tumor in the right lobe of liver	Left ilium metastasis	Treating osseous metastasis using γ knife	Multiple osseous metastases were found by PET/CT in 23.6 months and the patient was still alive in 27.6 months

PET/CT, positron emission tomography/computed tomography; CIE, conventional imaging examination; FDG, fluorodeoxyglucose.

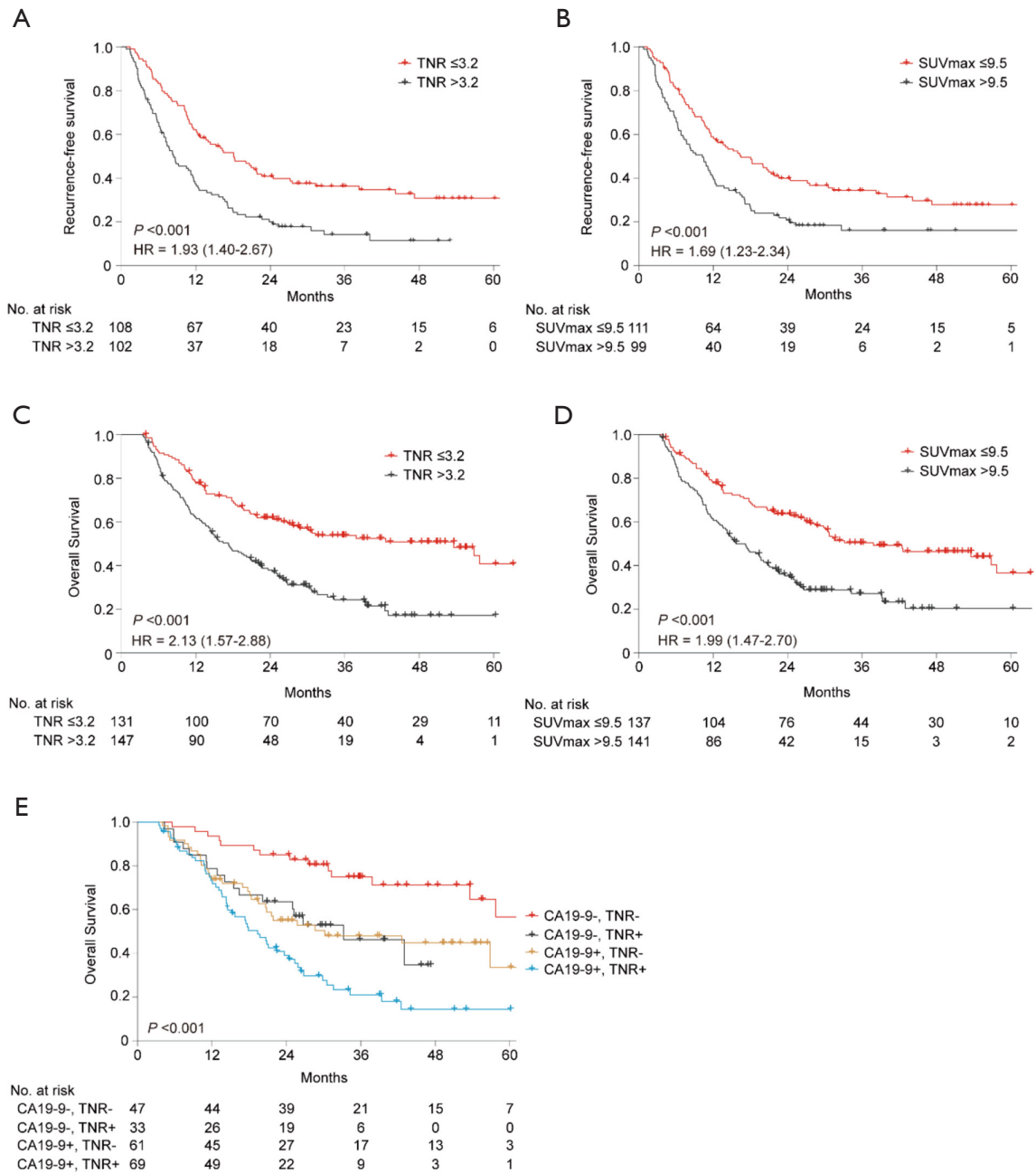


Figure S1 Prognostic stratification by TNR, tumor SUVmax, and CA19-9. (A,B) Kaplan-Meier curves based on TNR (A) and tumor SUVmax (B) for RFS in patients receiving surgery (n=210). (C,D) Kaplan-Meier curves based on TNR (C) and tumor SUVmax (D) for OS in group A (n=278). (E) Kaplan-Meier curves based on TNR and CA19-9 status for OS in patients receiving surgery of group A (n=210). CA19-9-: CA19-9 < 37 U/mL; CA19-9+: CA19-9 ≥ 37 U/mL; TNR-: TNR ≤ 3.2 ; TNR+: TNR > 3.2 . HR, hazard ratio; OS, overall survival; RFS, recurrence-free survival; TNR, tumor-to-non-tumor ratio; SUVmax, maximum standardized uptake value; CA19-9, carbohydrate antigen 19-9.

Table S4 Univariate and multivariate analyses of prognostic factors of OS in patients receiving surgery (n=210)

Variables	Univariate P value	I [†]			II [‡]		
		Multivariate			Multivariate		
		HR	95% CI	P value	HR	95% CI	P value
Age, years (≥63 vs. <63)	0.974	–	–	NA	–	–	NA
Gender (male vs. female)	0.556	–	–	NA	–	–	NA
HBV infection (positive vs. negative)	0.114	–	–	NA	–	–	NA
Clinical symptoms (yes vs. no)	0.008	–	–	NS	–	–	NS
CEA, ng/mL (≥5 vs. <5)	0.001	–	–	NS	–	–	NS
CA19-9, U/mL (≥37 vs. <37)	<0.001	2.27	1.49–3.45	<0.001	2.40	1.58–3.64	<0.001
Liver cirrhosis (yes vs. no)	0.509	–	–	NA	–	–	NA
Tumor size, cm (≥5 vs. <5)	0.052	–	–	NA	–	–	NS
Tumor number (multiple vs. single)	<0.001	1.97	1.35–2.88	<0.001	2.04	1.39–2.98	<0.001
Tumor necrosis (yes vs. no)	0.055	–	–	NA	–	–	NS
Vascular invasion (yes vs. no)	0.002	–	–	NS	–	–	NS
Surrounding tissue invasion (yes vs. no)	<0.001	1.72	1.12–2.65	0.013	1.71	1.11–2.61	0.014
Regional LN metastasis (yes vs. no)	<0.001	2.10	1.38–3.20	<0.001	2.11	1.39–3.22	<0.001
Distant metastasis (yes vs. no)	<0.001	1.77	1.02–3.08	0.044	2.08	1.22–3.58	0.008
TNR (high vs. low)	<0.001	1.60	1.07–2.38	0.023	–	–	–
Tumor SUVmax (high vs. low)	0.002	–	–	–	–	–	NS

[†], includes clinicopathologic variables and TNR; [‡], includes clinicopathologic variables and tumor SUVmax. OS, overall survival; HR, hazard ratio; CI, confidential interval; CEA, carcinoembryonic antigen; CA19-9, carbohydrate antigen 19-9; LN, lymph node; TNR, tumor-to-non-tumor ratio; SUVmax, maximum standardized uptake value; NA, not applicable; NS, not significant.

Table S5 Univariate and multivariate analyses of prognostic factors of RFS in patients receiving surgery (n=210)

Variables	Univariate P value	I [†]			II [‡]		
		Multivariate			Multivariate		
		HR	95% CI	P value	HR	95% CI	P value
Age, years (≥63 vs. <63)	0.582	–	–	NA	–	–	NA
Gender (male vs. female)	0.952	–	–	NA	–	–	NA
HBV infection (positive vs. negative)	0.942	–	–	NA	–	–	NA
Clinical symptoms (yes vs. no)	<0.001	1.46	1.04–2.04	0.028	1.52	1.08–2.12	0.015
CEA, ng/mL (≥5 vs. <5)	0.001	–	–	NS	–	–	NS
CA19-9, U/mL (≥37 vs. <37)	0.029	–	–	NS	–	–	NS
Liver cirrhosis (yes vs. no)	0.390	–	–	NA	–	–	NA
Tumor size, cm (≥5 vs. <5)	0.006	–	–	NS	–	–	NS
Tumor number (multiple vs. single)	<0.001	1.88	1.35–2.61	<0.001	1.94	1.39–2.71	<0.001
Tumor necrosis (yes vs. no)	<0.001	2.27	1.14–2.27	0.006	1.70	1.21–2.39	0.002
Vascular invasion (yes vs. no)	0.042	–	–	NS	–	–	NS
Surrounding tissue invasion (yes vs. no)	0.008	–	–	NS	–	–	NS
Regional LN metastasis (yes vs. no)	<0.001	2.01	1.41–2.86	<0.001	1.99	1.39–2.85	<0.001
Distant metastasis (yes vs. no)	0.001	–	–	NS	–	–	NS
TNR (high vs. low)	<0.001	1.63	1.18–2.25	0.003	–	–	–
Tumor SUVmax (high vs. low)	0.001	–	–	–	–	–	NS

[†], includes clinicopathologic variables and TNR; [‡], includes clinicopathologic variables and tumor SUVmax. RFS, recurrence-free survival; HR, hazard ratio; CI, confidential interval; CEA, carcinoembryonic antigen; CA19-9, carbohydrate antigen 19-9; LN, lymph node; TNR, tumor-to-non-tumor ratio; SUVmax, maximum standardized uptake value; NA, not applicable; NS, not significant.

Table S6 Multivariate analyses of prognostic factors of OS before PSM (n=639)

Variables	HR	95% CI	P value [†]
Age, years (≥ 63 vs. < 63)	1.13	0.91–1.40	0.258
Gender (male vs. female)	0.96	0.77–1.20	0.734
HBV infection (positive vs. negative)	0.70	0.54–0.91	0.008
Clinical symptoms (yes vs. no)	1.33	1.06–1.66	0.014
CEA, ng/mL (≥ 5 vs. < 5)	1.44	1.13–1.83	0.003
CA19-9, U/mL (≥ 37 vs. < 37)	1.32	1.06–1.66	0.020
Liver cirrhosis (yes vs. no)	1.19	0.88–1.62	0.263
Tumor size, cm (≥ 5 vs. < 5)	1.11	0.86–1.44	0.425
Tumor number (multiple vs. single)	1.87	1.47–2.37	< 0.001
Tumor necrosis (yes vs. no)	1.17	0.91–1.50	0.213
Vascular invasion (yes vs. no)	1.31	1.04–1.65	0.023
Surrounding tissue invasion (yes vs. no)	1.35	1.04–1.74	0.023
Regional LN metastasis (yes vs. no)	2.04	1.56–2.67	< 0.001
Distant metastasis (yes vs. no)	2.26	1.70–3.02	< 0.001
Performing PET/CT (yes vs. no)	0.78	0.62–0.97	0.028

[†], significance is determined by multivariate Cox proportional hazards regression. CA19-9, carbohydrate antigen 19-9; CEA, carcinoembryonic antigen; OS, overall survival; PSM, propensity score matching; HR, hazard ratio; CI, confidential interval; LN, lymph node; PET/CT, positron emission tomography/computed tomography.