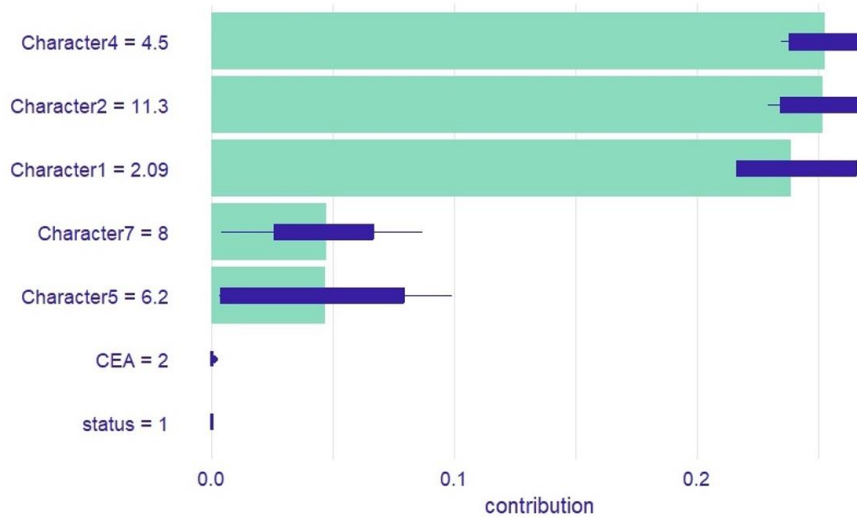**Supplementary Figure 1 Parameter acquisition process based on magnetic resonance imaging radiomics.** MLM: Metachronous liver metastasis; RFM: Random forest model; GLRM: Generalized linear regression model; LASSO: Least absolute shrinkage and selection operator.

Supplementary Figure 2 Evaluation of the importance of random forest prediction parameters based on SHapley additive ex-planations. CEA: Carcinoembryonic antigen.

Supplementary table 1 Comparison of clinical baseline and radiomics parameters for predicting metachronous liver metastasis based on random partitioning training and validation samples, *n* (%)

Variables	Training cohort			*P* value	Testing cohort			*P* value
	Overall (*n* = 210)	MLM (*n* = 31)	Non-MLM (*n* = 179)		Overall (*n* = 91)	MLM (*n* = 18)	Non-MLM (*n* = 73)	
Age [median (IQR)]	45.50 (30.00, 57.00)	47.00 (32.00, 59.50)	45.00 (29.00, 57.00)	0.437	48.00 (32.00, 59.00)	54.50 (48.50, 62.00)	44.00 (31.00, 58.00)	0.061
Gender								
Male	88 (41.9)	12 (38.7)	76 (42.5)	0.847	48 (52.7)	10 (55.6)	38 (52.1)	0.998
Female	122 (58.1)	19 (61.3)	103 (57.5)		43 (47.3)	8 (44.4)	35 (47.9)	
BMI, kg/m² [median (IQR)]	23.75 (20.90, 26.30)	24.20 (21.00, 26.85)	23.70 (20.85, 26.25)	0.646	23.00 (20.55, 25.50)	22.35 (20.40, 23.98)	23.20 (20.80, 25.60)	0.449
Smoking								
Yes	99 (47.1)	16 (51.6)	83 (46.4)	0.73	41 (45.1)	10 (55.6)	31 (42.5)	0.462
No	111 (52.9)	15 (48.4)	96 (53.6)		50 (54.9)	8 (44.4)	42 (57.5)	

Drinking								
Yes	98 (46.7)	13 (41.9)	85 (47.5)	0.706	44 (48.4)	9 (50.0)	35 (47.9)	1
No	112 (53.3)	18 (58.1)	94 (52.5)		47 (51.6)	9 (50.0)	38 (52.1)	
MTD, cm								
≤ 4	98 (46.7)	15 (48.4)	83 (46.4)	0.99	49 (53.8)	10 (55.6)	39 (53.4)	1
> 4	112 (53.3)	16 (51.6)	96 (53.6)		42 (46.2)	8 (44.4)	34 (46.6)	
Pathological grade								
I-II	97 (46.2)	10 (32.3)	87 (48.6)	0.136	45 (49.5)	7 (38.9)	38 (52.1)	0.461
III	113 (53.8)	21 (67.7)	92 (51.4)		46 (50.5)	11 (61.1)	35 (47.9)	
Pathological type								
Infiltrating	22 (10.5)	2 (6.5)	20 (11.2)	0.544	16 (17.6)	2 (11.1)	14 (19.2)	0.746
Ulcerative	78 (37.1)	12 (38.7)	66 (36.9)		33 (36.3)	6 (33.3)	27 (37.0)	
Cauliflower	47 (22.4)	5 (16.1)	42 (23.5)		27 (29.7)	7 (38.9)	20 (27.4)	
Uplift	63 (30.0)	12 (38.7)	51 (28.5)		15 (16.5)	3 (16.7)	12 (16.4)	

MRF								
Yes	115 (54.8)	14 (45.2)	101 (56.4)	0.333	47 (51.6)	9 (50.0)	38 (52.1)	1
No	95 (45.2)	17 (54.8)	78 (43.6)		44 (48.4)	9 (50.0)	35 (47.9)	
EMVI								
Yes	104 (49.5)	15 (48.4)	89 (49.7)	1	50 (54.9)	11 (61.1)	39 (53.4)	0.747
No	106 (50.5)	16 (51.6)	90 (50.3)		41 (45.1)	7 (38.9)	34 (46.6)	
Node								
Yes	86 (41.0)	15 (48.4)	71 (39.7)	0.475	47 (51.6)	11 (61.1)	36 (49.3)	0.526
No	124 (59.0)	16 (51.6)	108 (60.3)		44 (48.4)	7 (38.9)	37 (50.7)	
Spicule								
Yes	116 (55.2)	19 (61.3)	97 (54.2)	0.59	48 (52.7)	9 (50.0)	39 (53.4)	1
No	94 (44.8)	12 (38.7)	82 (45.8)		43 (47.3)	9 (50.0)	34 (46.6)	
AFP, ng/mL [median (IQR)]	2.76 (2.23, 3.38)	2.69 (2.16, 3.37)	2.76 (2.25, 3.38)	0.715	3.06 (2.29, 3.42)	2.69 (2.18, 3.30)	3.06 (2.34, 3.50)	0.19

CA199, U/mL [median (IQR)]	9.52 (6.60, 12.66)	10.33 (7.03, 12.72)	9.08 (6.46, 12.66)	0.365	9.88 (6.74, 12.43)	8.41 (6.24, 10.82)	10.65 (7.05, 13.06)	0.101
CEA, ng/mL [median (IQR)]								
pT stage	112 (53.3)	8 (25.8)	104 (58.1)	0.002	55 (60.4)	6 (33.3)	49 (67.1)	0.018
T2	98 (46.7)	23 (74.2)	75 (41.9)		36 (39.6)	12 (66.7)	24 (32.9)	
T3								
N stage	107 (51.0)	18 (58.1)	89 (49.7)	0.507	51 (56.0)	12 (66.7)	39 (53.4)	0.454
N0	103 (49.0)	13 (41.9)	90 (50.3)		40 (44.0)	6 (33.3)	34 (46.6)	
N1								
N2	65 (31.0)	12 (38.7)	53 (29.6)	0.596	29 (31.9)	4 (22.2)	25 (34.2)	0.617
Character 1 [median (IQR)]	67 (31.9)	9 (29.0)	58 (32.4)		35 (38.5)	8 (44.4)	27 (37.0)	

Character 2 [median (IQR)]	78 (37.1)	10 (32.3)	68 (38.0)		27 (29.7)	6 (33.3)	21 (28.8)	
Character 3 [median (IQR)]	0.46 (0.30, 0.63)	1.60 (1.42, 1.95)	0.40 (0.28, 0.55)	< 0.001	0.46 (0.32, 0.64)	1.82 (1.65, 1.99)	0.41 (0.29, 0.550	< 0.001
Character 4 [median (IQR)]	8.70 (7.80, 9.57)	13.00 (11.85, 14.75)	8.30 (7.60, 9.20)	< 0.001	8.70 (7.60, 9.55)	13.55 (11.55, 14.73)	8.20 (7.50, 8.80)	< 0.001
Character 5 [median (IQR)]	171.15 (143.72, 198.80)	163.70 (148.10, 185.65)	176.00 (143.00, 199.60)	0.631	166.80 (134.70, 194.20)	173.75 (141.18, 203.22)	164.10 (134.20, 190.50)	0.449
Character 6 [median (IQR)]	1.80 (1.30, 2.40)	4.10 (3.75, 5.05)	1.60 (1.15, 2.25)	< 0.001	1.60 (1.10, 2.35)	4.50 (3.45, 5.30)	1.50 (1.10, 1.90)	< 0.001
Character 7 [median (IQR)]	3.60 (2.92, 4.20)	7.60 (5.40, 8.95)	3.40 (2.70, 4.00)	< 0.001	3.50 (2.75, 4.25)	5.30 (4.40, 6.95)	3.30 (2.70, 4.00)	< 0.001

Age [median (IQR)]	31.50 (21.68, 42.18)	29.70 (22.75, 36.85)	31.80 (20.85, 42.45)	0.382	33.30 (25.15, 44.70)	31.50 (26.18, 42.20)	33.40 (25.00, 45.40)	0.53
Gender	4.10 (2.80, 5.10)	7.20 (6.15, 8.15)	3.80 (2.60, 4.70)	< 0.001	4.50 (3.10, 5.40)	7.10 (6.05, 8.07)	3.70 (2.70, 5.00)	< 0.001

MLM: Metachronous liver metastasis; IQR: Interquartile range; BMI: Body mass index; MTD: Maximum tumor diameter; MRF: Mesenteric fascia; EMVI: Extramural venous invasion; AFP: Alpha fetoprotein; CA199: Carbohydrate antigen 199; CEA: Carcinoembryonic antigen; Character 1: T2_wavelet.LHL_firstorder_RobustMeanAbsoluteDeviation; Character 2: T1_log.sigma10.mm.3D_firstorder_Kurtosis; Character 3: T1_lbp.3D.m1_firstorder_Skewness; Character 4: ADC_wavelet.LHL_gldm_LargeDepenceHighGrayLevelEmphasis; Character 5: ADC_wavelet.HLL_glrlm_LongRunHighGrayLeveEmphasis; Character 6: T1_log.sigma30.mm.3D_glrlm_GrayLevelNonUniformity; Character 7: T1_wavelet.HHL_glszm_GrayLevelNonUniformity.