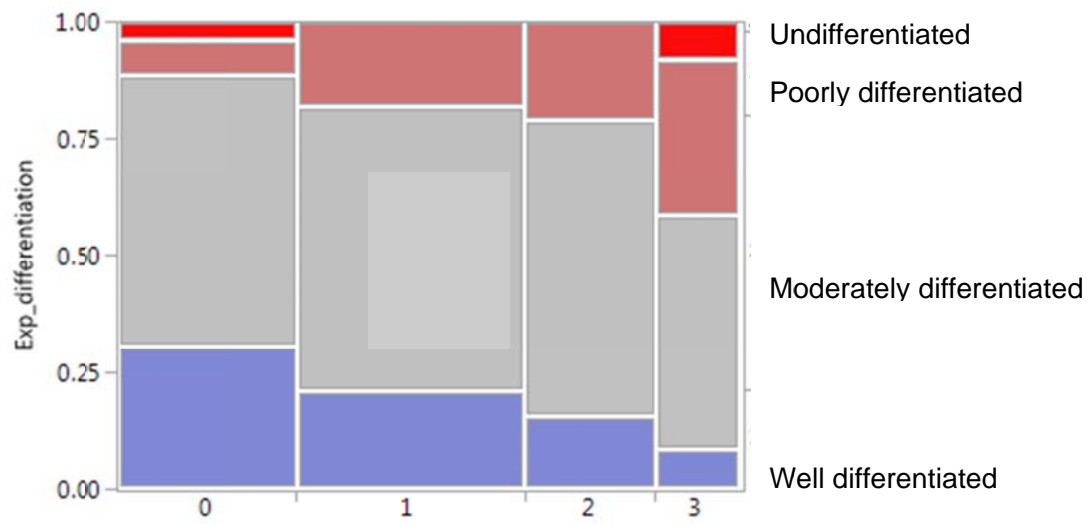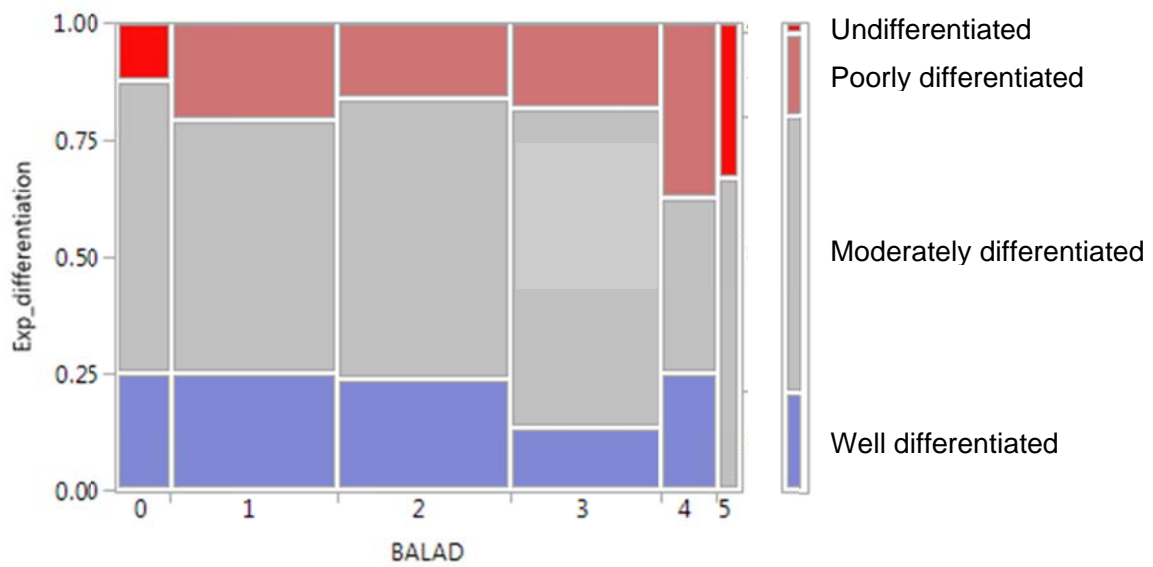A

B

Supplementary Figure 1 Mosaic plot of tumor differentiation by number of elevated biomarkers (AFP, AFP-L3, DCP) (A) and BALAD score (B).

Supplementary Table 1 Univariate models for early recurrence outcome (within 36 months after transplant)

Variable	Hazard ratio for recurrence		Hazard ratio for early recurrence	
	HR (95%CI)	*P* value	HR (95%CI)	*P* value
MELD score (per point)	1.03 (0.98-1.09)	0.26	1.02 (0.96-1.08)	0.43
Maximal tumor size at time of transplant (per cm)	1.27 (1.04-1.56)	0.02	1.26 (1.009-1.57)	0.039
Tumor number at time of transplant	1.001 (0.73-1.37)	1.00	1.08 (0.76-1.43)	0.64
Neutrophil lymphocyte ratio > 4	2.24 (1.17-4.26)	0.02	2.65 (1.30-5.63)	0.008
Hypothyroidism	1.26 (0.55-2.85)	0.59	1.40 (0.52-3.19)	0.48
BALAD components				
Albumin (per g/dL)	0.75 (0.41-1.38)	0.36	0.73 (0.37-1.41)	0.36
Bilirubin (per mg/dL)	1.03 (0.98-1.09)	0.21	1.02 (0.95-1.08)	0.47
AFP: > 400 ng/mL	2.42 (1.18-5.00)	0.02	3.10 (1.34-6.55)	0.005
AFP-L3 >15%	1.86 (0.98-3.52)	0.056	1.92 (0.95-3.94)	0.07
DCP > 1.2 ng/mL	2.83 (1.42-5.61)	0.003	3.73 (1.74-8.93)	0.0006
BALAD Score				
0	Reference		Reference	
1	0.70 (0.20-2.47)	0.58	1.41 (0.28-7.01)	0.66
2	1.18 (0.37-3.75)	0.78	1.75 (0.36-8.44)	0.46
3	1.99 (0.62-6.36)	0.24	3.78 (0.82-17.53)	0.055
4	2.97 (0.84-10.58)	0.09	5.22 (1.01-27.01)	0.04
5	5.02 (0.92-27.54)	0.06	15.63 (2.10-116.17)	0.02
BALAD Score (per increase of 1)	1.48 (1.15-1.91)	0.002	1.66 (1.24-2.22)	0.0006
BALAD-2 Score				
1	Reference		Reference	
2	0.41 (0.12-1.32)	0.13	0.57 (0.14-1.88)	0.35

3	1.53 (0.66-3.54)	0.32	1.63 (0.64-4.42)	0.31
4	2.17 (0.90-5.25)	0.09	2.41 (0.89-6.75)	0.08
BALAD-2 Score (per increase of 1)	1.45 (1.06-1.98)	0.02	1.46 (1.04-2.07)	0.03
Within Milan criteria at diagnosis	1.69 (0.84-3.41)	0.14	2.16 (0.97-4.48)	0.058
Within UCSF criteria at diagnosis	1.85 (0.85-4.05)	0.12	2.36 (0.94-5.23)	0.07
Within Milan criteria at transplant	1.24 (0.59-2.62)	0.57	1.65 (0.72-3.47)	0.22
Within UCSF criteria at transplant	0.33 (0.05-2.43)	0.28	0.88 (0.14-2.91)	0.86
z-GALAD	1.12 (1.03-1.21)	0.006	1.14 (1.05-1.23)	0.003
GALAD score	3.01 (1.14-7.91)	0.03	3.74 (1.41-10.61)	0.008
AFP model cutoff > 2 (explant)	2.82 (1.47, 5.41)	0.002	3.51 (1.78-6.73)	0.0005
AFP model (per increase of 1, explant)	1.42 (1.20, 1.68)	< 0.001	1.48 (1.24-1.75)	< 0.001

Supplementary Table 2 Baseline characteristics of non-recurrent hepatocellular carcinoma patients who had serum samples available for biomarker assays prior to liver transplantation versus those who did not have serum samples *n* (%)

Variables	Serum available (*n* = 75)	Serum not available (*n* = 179)
Age, years (mean ± SD)	57.4 ± 8.5	57.0 ± 8.5
Male	56 (74.7)	130 (72.6)
Race		
White	56 (74.7)	149 (83.2)
Non-white	19 (25.3)	25 (14.0)
Unknown	0	5 (2.8)
Etiology		
HCV	46 (61.3)	98 (54.7)
HBV	8 (10.7)	15 (8.4)
Nonalcoholic fatty liver disease or cryptogenic	8 (10.7)	24 (13.4)
Alcohol	10 (13.3)	23 (12.8)
Others	3 (4.0)	18 (10.2)
MELD score, median (range)	11.5 (0.8-22)	11.0 (0.6-34.4)
Total bilirubin, mg/dL, median (range)	1.7 (0.2-14)	1.7 (0.2-9.7)
Albumin, g/dL, median (range)	3.2 (2.3-5.6)	3.3 (1.5-4.6)
INR, median (range)	1.2 (0.9-1.9)	1.2 (0.9-2.3)
PT, seconds, median (range)	15.1 (9.1-21.6)	14.6 (9.0-25.8)
Creatinine, mg/dL, median (range)	0.9 (0.5-1.6)	0.9 (0.4-12)
Maximum tumor size, cm (mean ± SD)	2.5 ± 1.5	2.7 ± 1.6
Tumor number		

1	48 (64.0)	95 (53.4)
2	18 (24.0)	28 (15.7)
3	4 (5.3)	42 (23.6)
≥ 4	5 (6.7)	13 (7.3)
Missing	0	1
Portal vein invasion	0 (0)	1 (0.6)
Milan criteria		
Within Milan criteria	59 (76.6)	128 (71.5)
Outside Milan criteria	18 (23.4)	51 (28.5)