**Supplementary materials**

**Figure Legends**

**Figure S1.** The blood expression levels of triglycerides (TG), total cholesterol (TC), high-density lipoprotein (HDL), low-density lipoprotein (LDL) in benign liver disease (BL), chronic hepatitis (CH), liver cirrhosis (LC), and heparocellular carcinoma (HCC) groups. A, triglycerides (TG). B, total cholesterol (TC). C, high-density lipoprotein (HDL). D, low-density lipoprotein (LDL). * indicates $P < 0.05$, ** indicates $P < 0.01$

**Figure S2.** Overall survival curves in training cohort. A, ApoB. B, ApoE. C, triglycerides (TG). D, total cholesterol (TC). E, high-density lipoprotein (HDL). F, low-density lipoprotein (LDL).

**Figure S3.** Disease free survival curves in training cohort. A, ApoB. B, ApoE. C, triglycerides (TG). D, total cholesterol (TC). E, high-density lipoprotein (HDL). F, low-density lipoprotein (LDL).

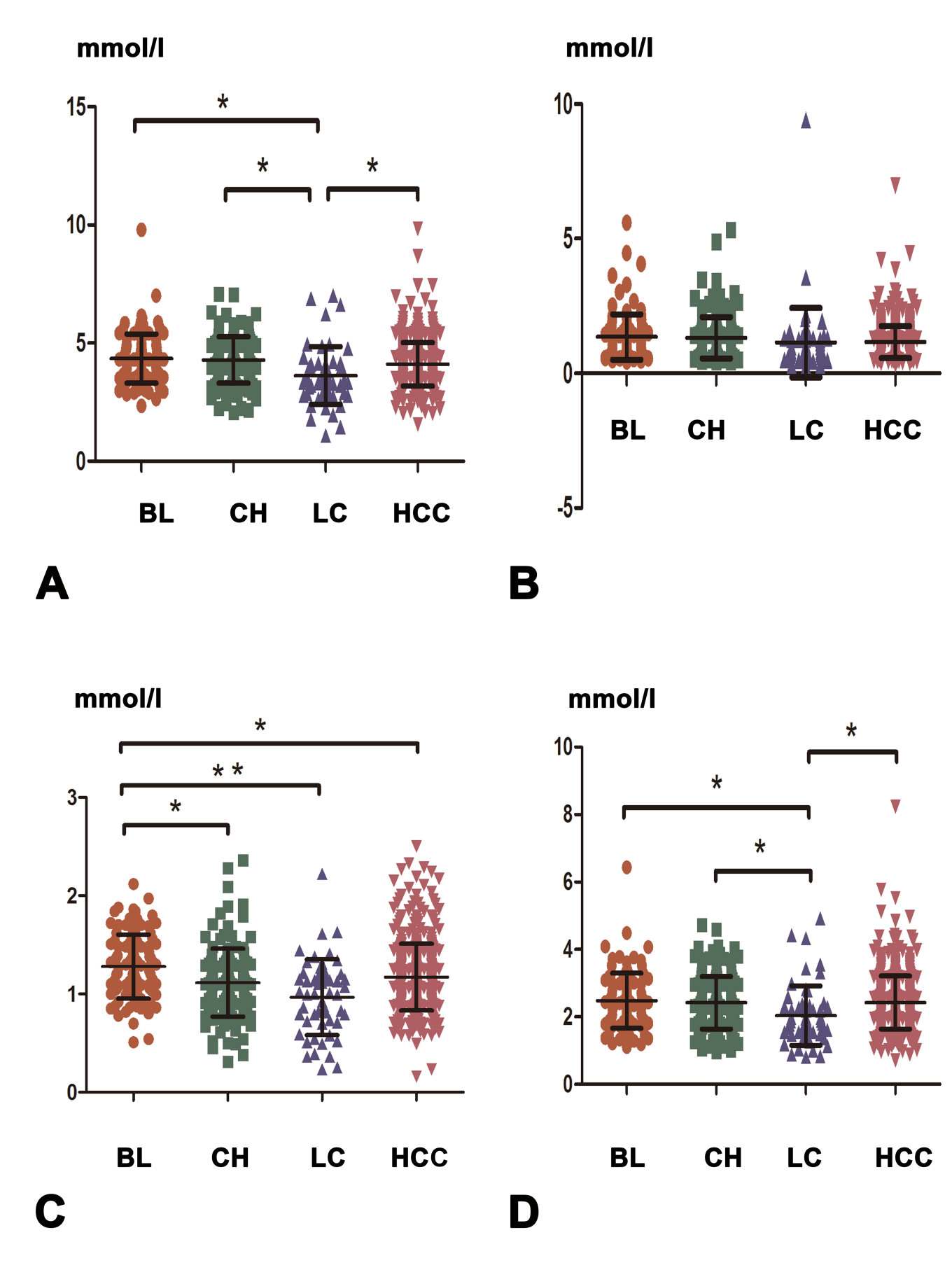
**Figure S4.** Overall survival curves in validation cohort. A, ApoB. B, ApoE. C, triglycerides (TG). D, total cholesterol (TC). E, high-density lipoprotein (HDL). F, low-density lipoprotein (LDL).

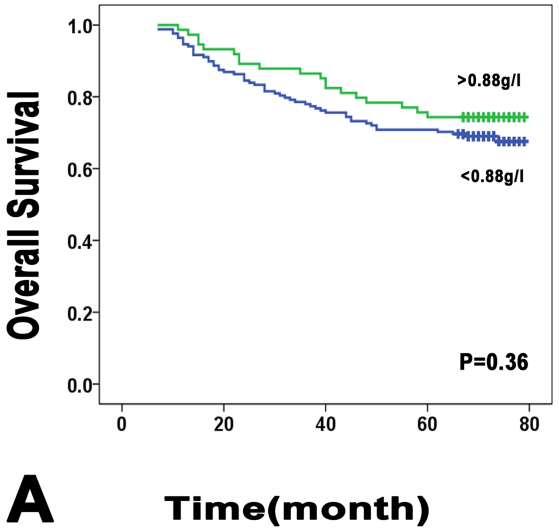
**Figure S5.** Disease free survival curves in validation cohort. A, ApoB. B, ApoE. C, triglycerides (TG). D, total cholesterol (TC). E, high-density lipoprotein (HDL). F, low-density lipoprotein (LDL).

**Figure S6.** Prognostic significance of ApoA1 in patients with AFP concentration of ≤400 ng/mL in the trainging and validation cohorts. (A, B) HCC patients with a low ApoA1 have a poor OS (A) and short DFS (B) in training cohort. (C, D) HCC patients with a low ApoA1 have a poor OS (C) and short DFS (D) in validation cohort.

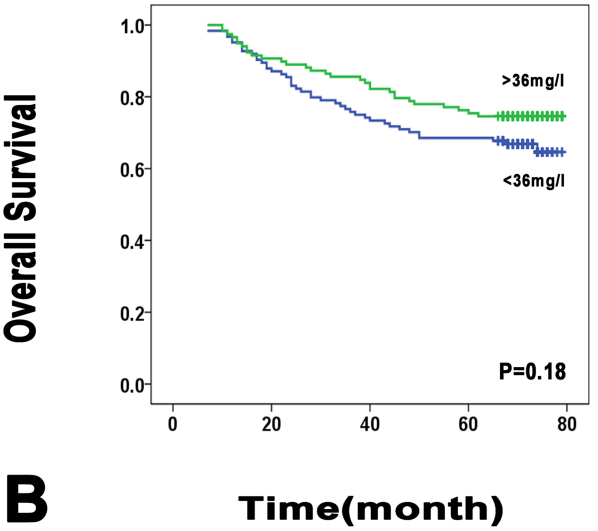
**Figure S7.** Early recurrence curves according to ApoA1 ≤1.23g/l or ApoA1 >1.23g/l in subgroups. (A) subgroup with an AFP concentration of ≤400 μg/L in training cohort. (B) subgroup with an AFP concentration of ≤400 μg/L in validation cohort. (C) subgroup with tumor size ranging from 2cm to 5cm in training cohort. (D) subgroup with an AFP concentration of ≤400 μg/L in validation cohort. (E) subgroup of TNM stage I in training cohort. (F) subgroup of TNM stage I in validation cohort. (G) subgroup with solitary tumor in training cohort. (H) subgroup with solitary tumor in validation cohort.

**Figure S8.** Early recurrence curves according to ApoA1 ≤1.23g/l or ApoA1 >1.23g/l in subgroups. (A) vascular invasion negative subgroup in training cohort. (B) vascular invasion negative subgroup in validation cohort.

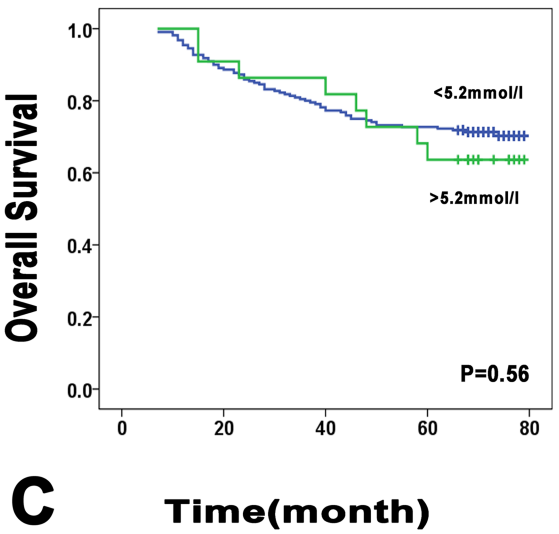

mmol/l
15
10
5
0
*
*
*
BL
CH
LC
HCC
A
mmol/l
10
5
0
-5
BL
CH
LC
HCC
B
mmol/l
3
2
1
0
*
**
*
BL
CH
LC
HCC
C
mmol/l
10
8
6
4
2
0
*
*
*
BL
CH
LC
HCC
D


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
>0.88g/l
<0.88g/l
P=0.36
0
20
40
60
80
Time(month)

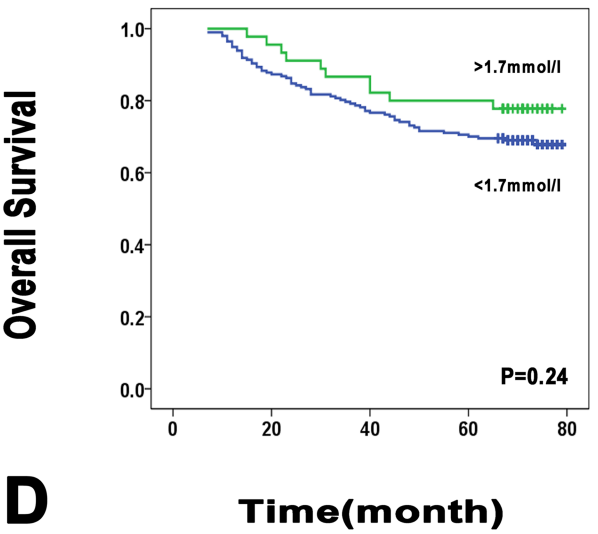
A


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
>36mg/l
<36mg/l
P=0.18
0
20
40
60
80
Time(month)

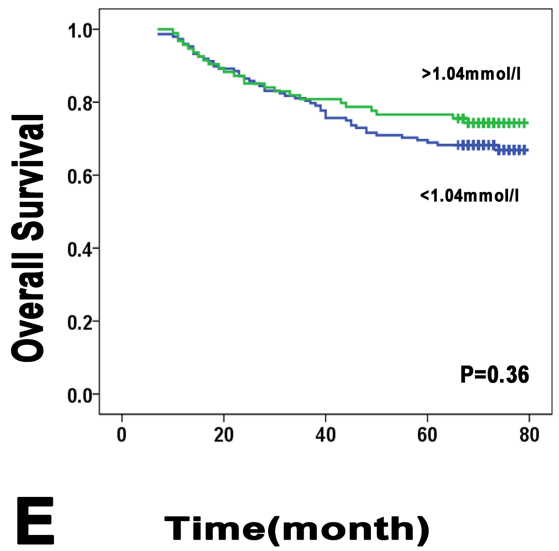
B


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
<5.2mmol/l
>5.2mmol/l
P=0.56
0
20
40
60
80
Time(month)

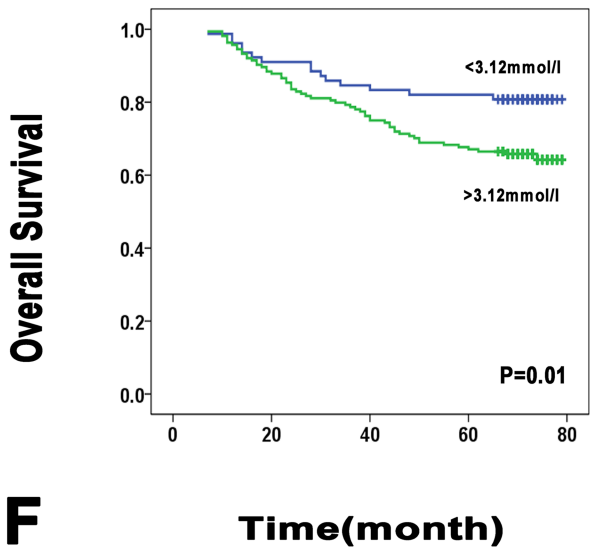
C


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
>1.7mmol/l
<1.7mmol/l
P=0.24
0
20
40
60
80
Time(month)

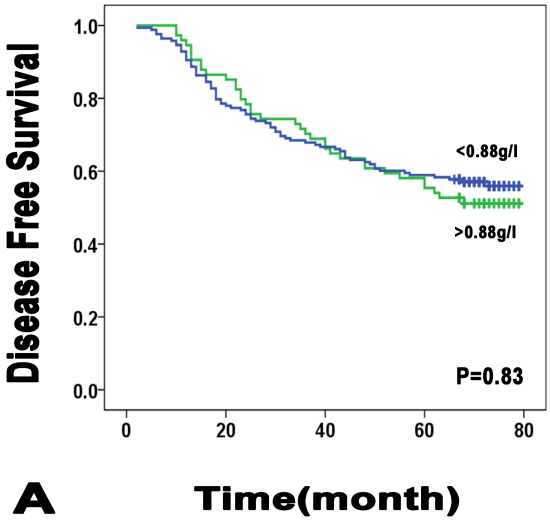
D


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
>1.04mmol/l
<1.04mmol/l
P=0.36
0
20
40
60
80
Time(month)

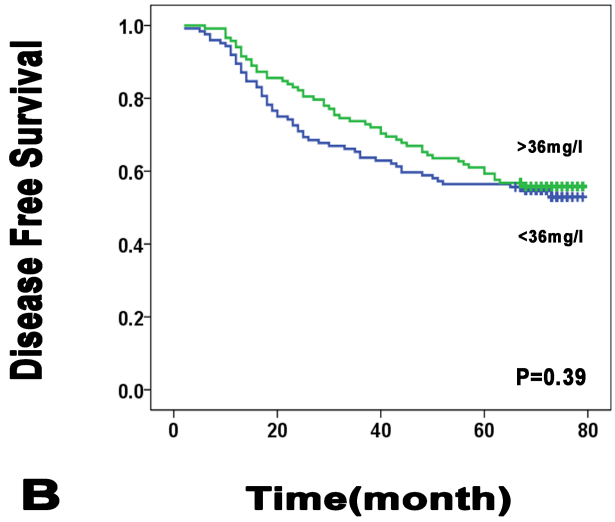
E


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
<3.12mmol/l
>3.12mmol/l
P=0.01
0
20
40
60
80
Time(month)

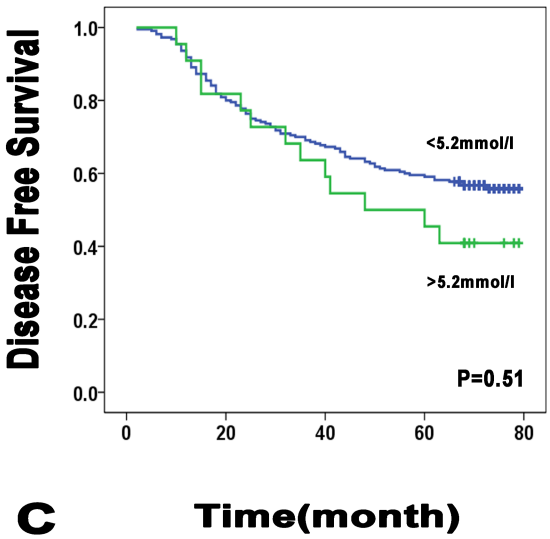
F


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
<0.88g/l
>0.88g/l
P=0.83
0
20
40
60
80
Time(month)

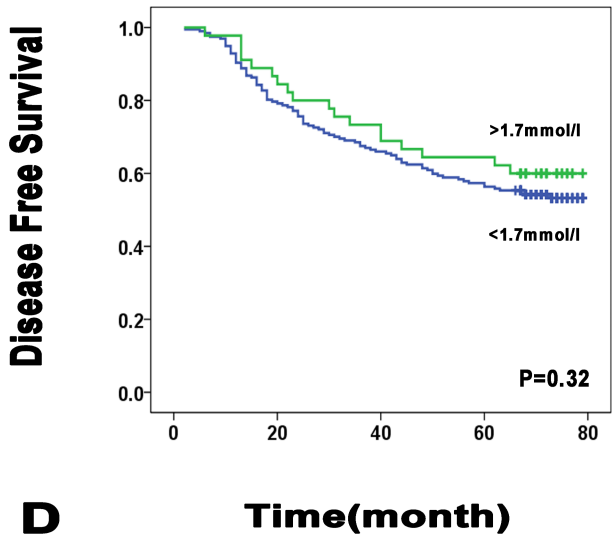
A


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
>36mg/l
<36mg/l
P=0.39
0
20
40
60
80
Time(month)

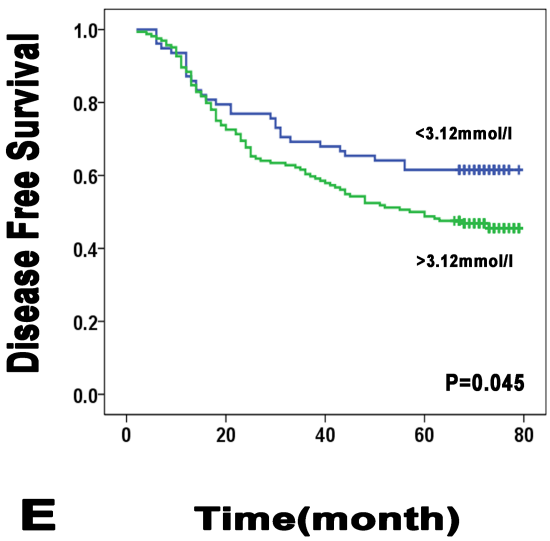
B


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
<5.2mmol/l
>5.2mmol/l
P=0.51
0
20
40
60
80
Time(month)

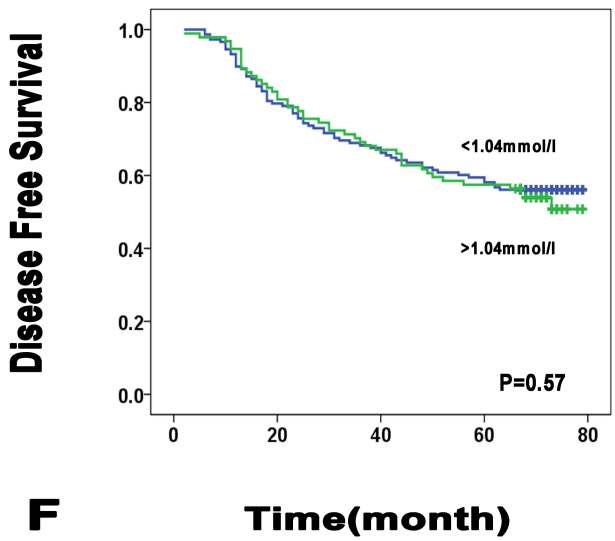
C


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
>1.7mmol/l
<1.7mmol/l
P=0.32
0
20
40
60
80
Time(month)

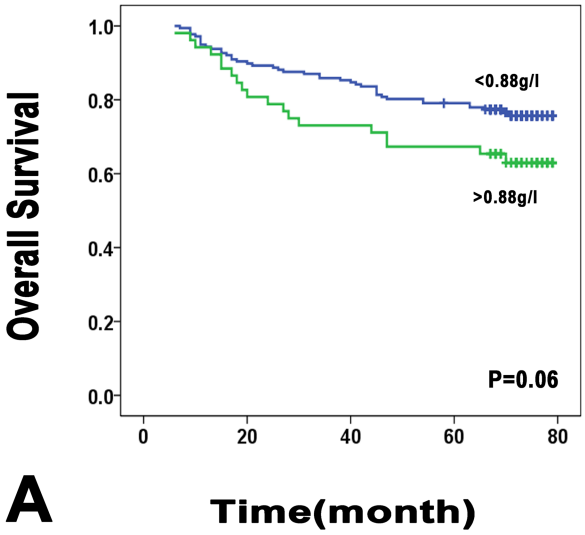
D


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
<3.12mmol/l
>3.12mmol/l
P=0.045
0
20
40
60
80
Time(month)

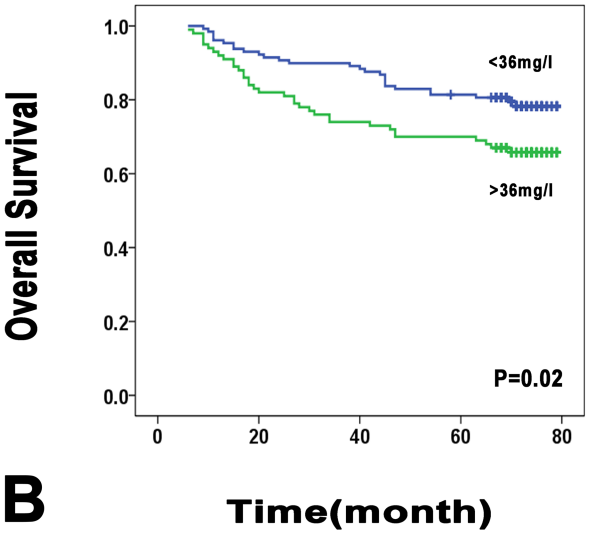
E


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
<1.04mmol/l
>1.04mmol/l
P=0.57
0
20
40
60
80
Time(month)

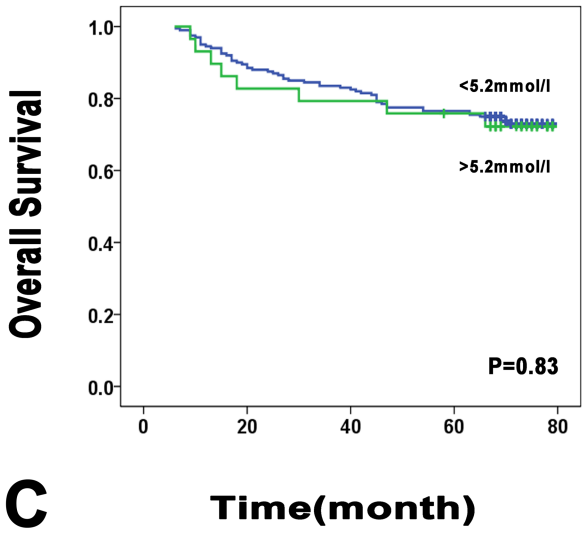
F


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
<0.88g/l
>0.88g/l
P=0.06
0
20
40
60
80
Time(month)

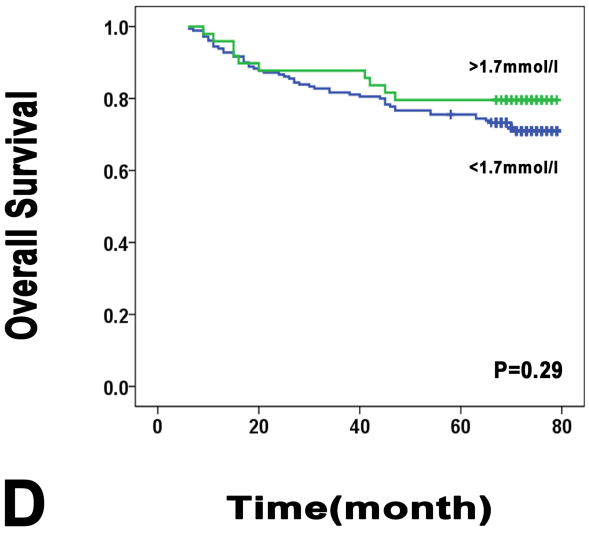
A


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
<36mg/l
>36mg/l
P=0.02
0
20
40
60
80
Time(month)

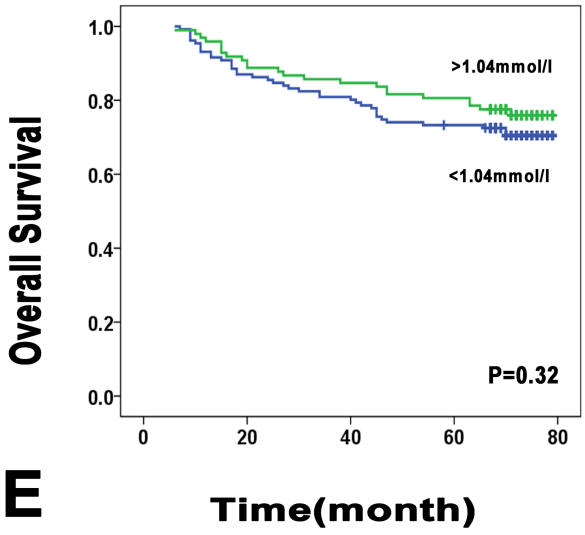
B


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
<5.2mmol/l
>5.2mmol/l
P=0.83
0
20
40
60
80
Time(month)

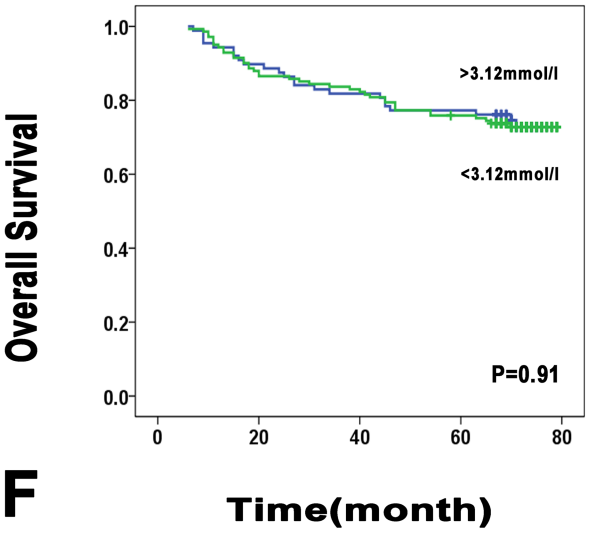
C


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
>1.7mmol/l
<1.7mmol/l
P=0.29
0
20
40
60
80
Time(month)

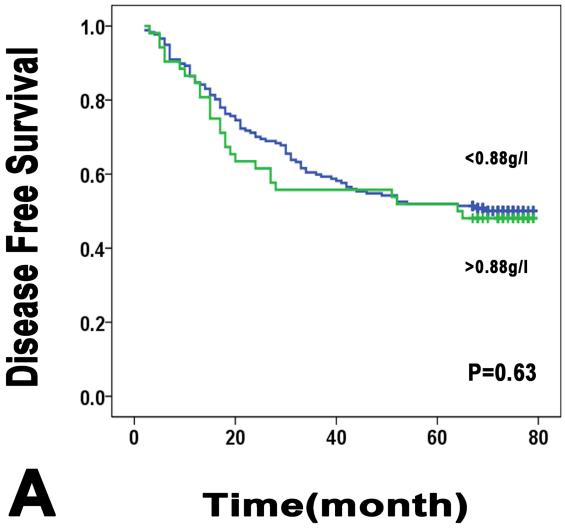
D


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
>1.04mmol/l
<1.04mmol/l
P=0.32
0
20
40
60
80
Time(month)

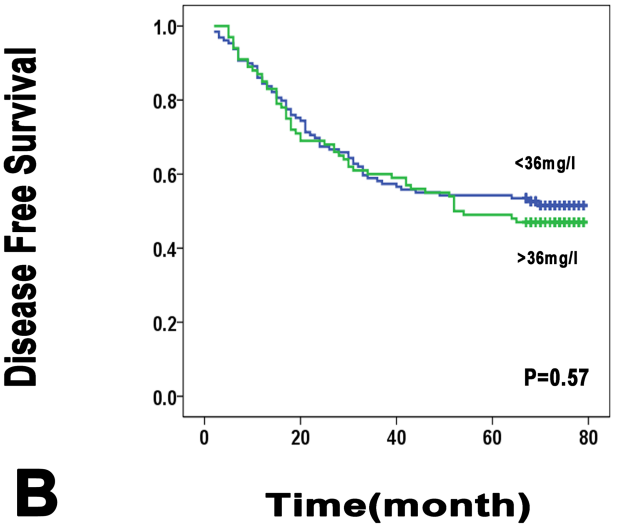
E


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
>3.12mmol/l
<3.12mmol/l
P=0.91
0
20
40
60
80
Time(month)

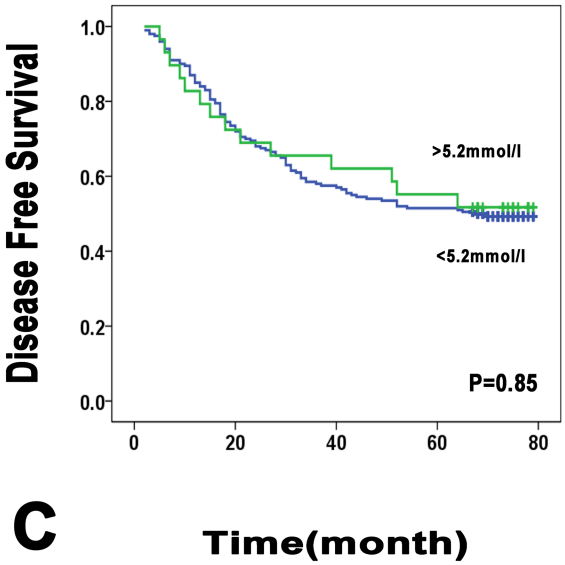
F


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
<0.88g/l
>0.88g/l
P=0.63
0
20
40
60
80
Time(month)

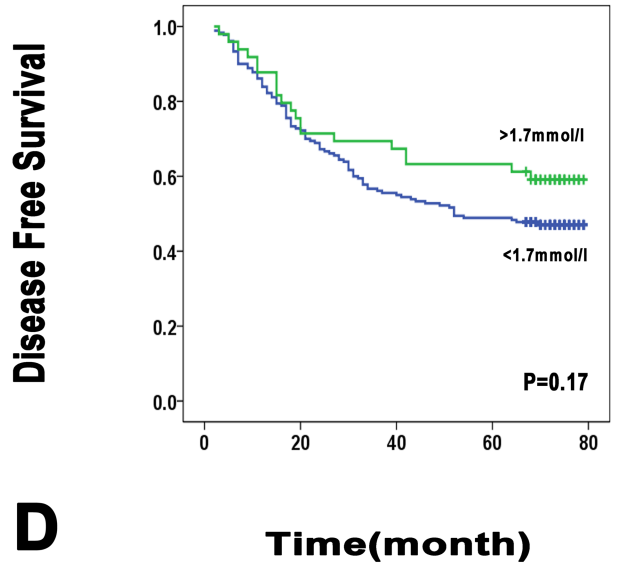
A


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
<36mg/l
>36mg/l
P=0.57
0
20
40
60
80
Time(month)

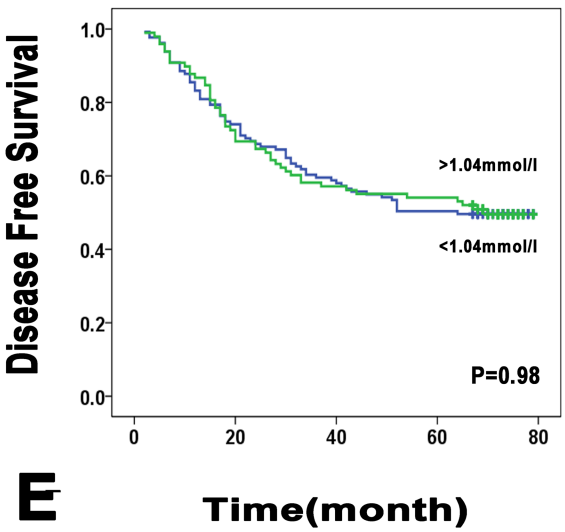
B


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
>5.2mmol/l
<5.2mmol/l
P=0.85
0
20
40
60
80
Time(month)

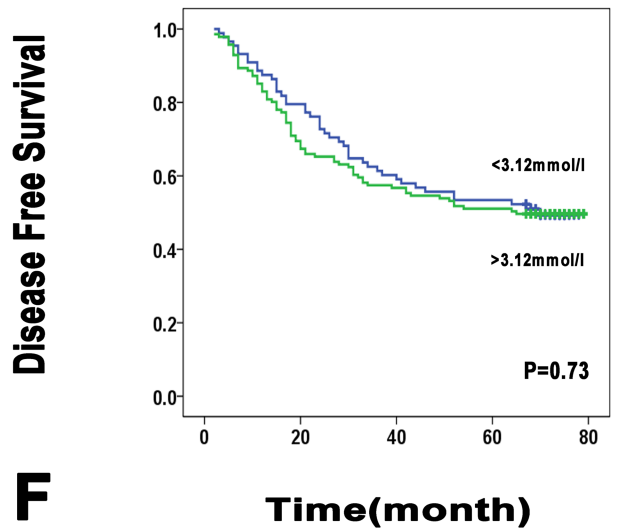
C


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
>1.7mmol/l
<1.7mmol/l
P=0.17
0
20
40
60
80
Time(month)

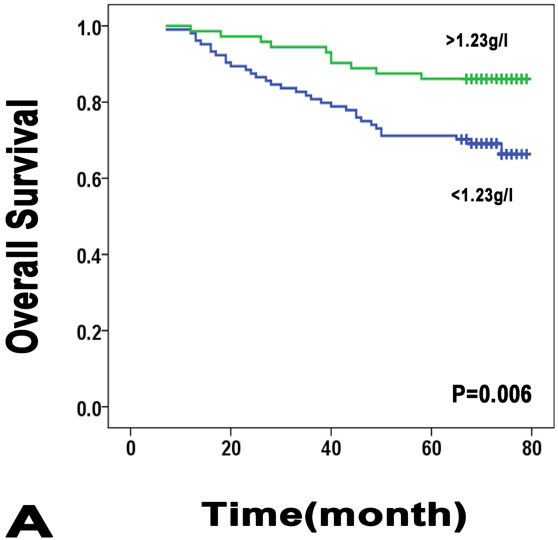
D


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
>1.04mmol/l
<1.04mmol/l
P=0.98
0
20
40
60
80
Time(month)

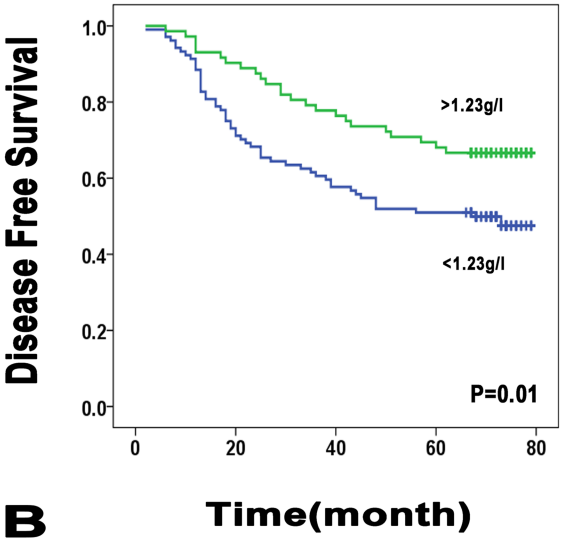
E


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
<3.12mmol/l
>3.12mmol/l
P=0.73
0
20
40
60
80
Time(month)

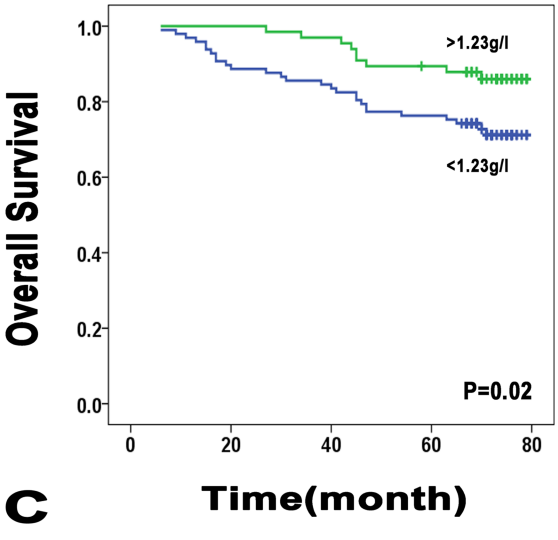
F


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.006
0
20
40
60
80
Time(month)

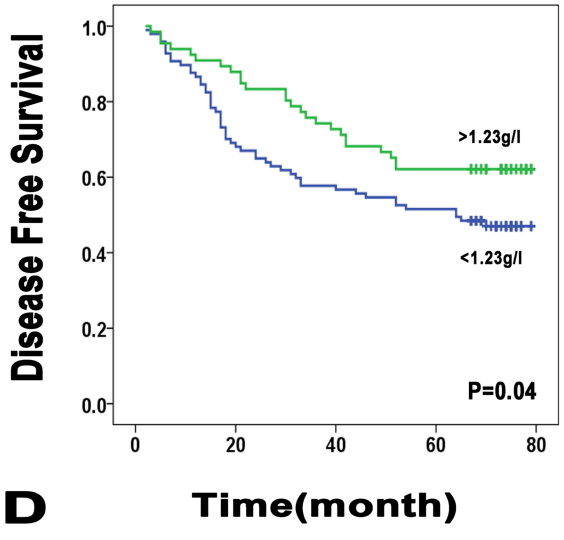
A


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.01
0
20
40
60
80
Time(month)

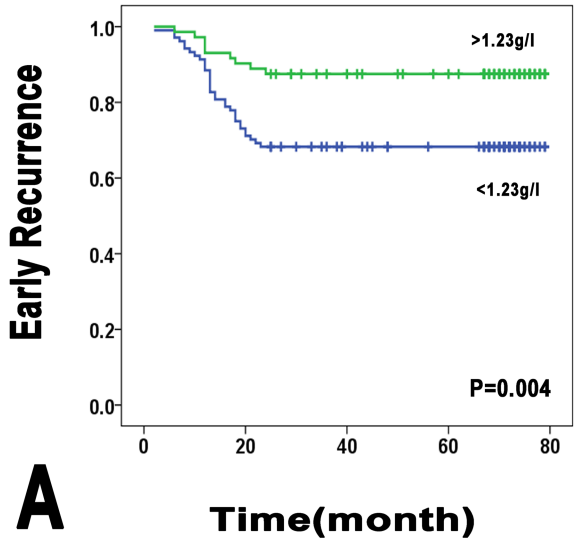
B


Overall Survival
1.0
0.8
0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.02
0
20
40
60
80
Time(month)

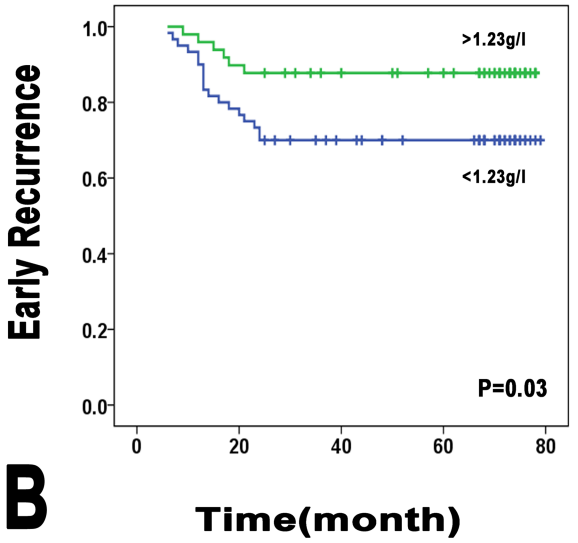
C


Disease Free Survival
1.0
0.8
0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.04
0
20
40
60
80
Time(month)

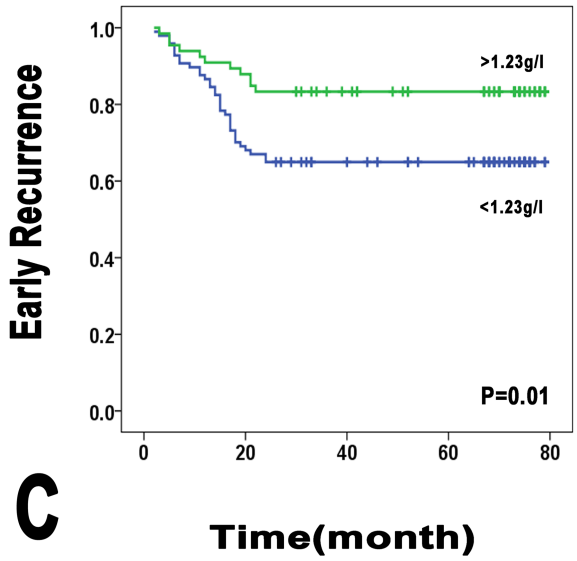
D


Early Recurrence
1.0
0.8
0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.004
0
20
40
60
80
Time(month)

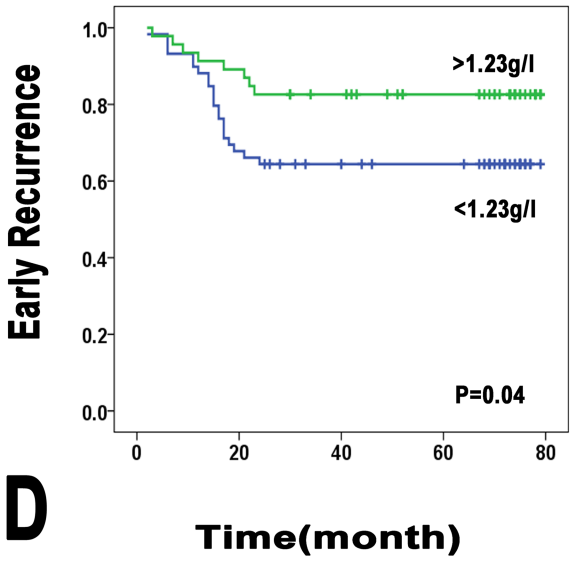
A


Early Recurrence
1.0
0.8
0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.03
0
20
40
60
80
Time(month)

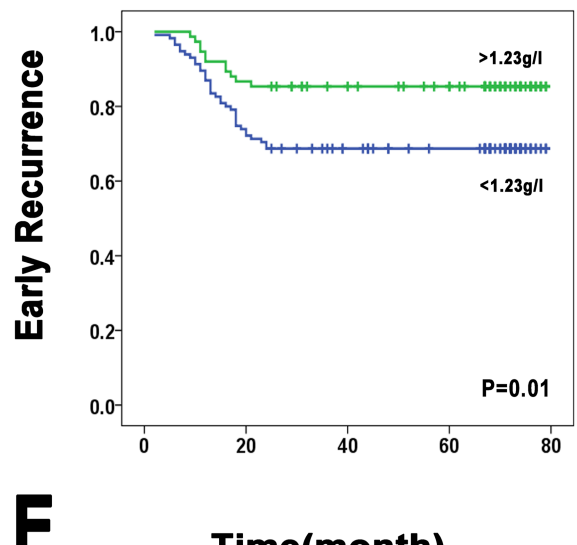
B


Early Recurrence
1.0
0.8
0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.01
0
20
40
60
80
Time(month)

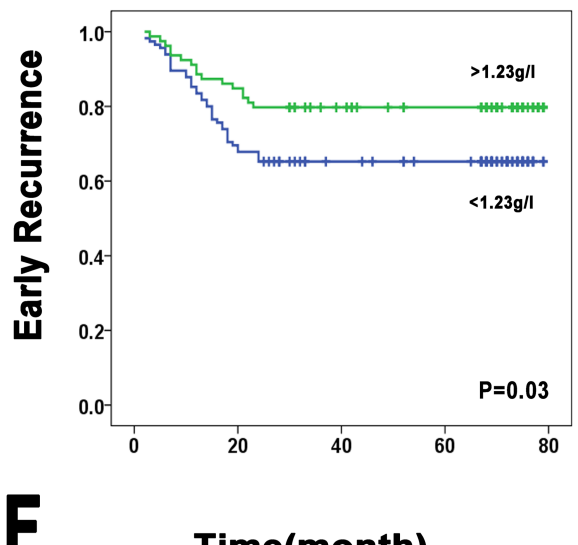
C


Early Recurrence
1.0
0.8
0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.04
0
20
40
60
80
Time(month)

D


Early Recurrence
1.0
0.8
0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.01
0
20
40
60
80
Time(month)

E


Early Recurrence
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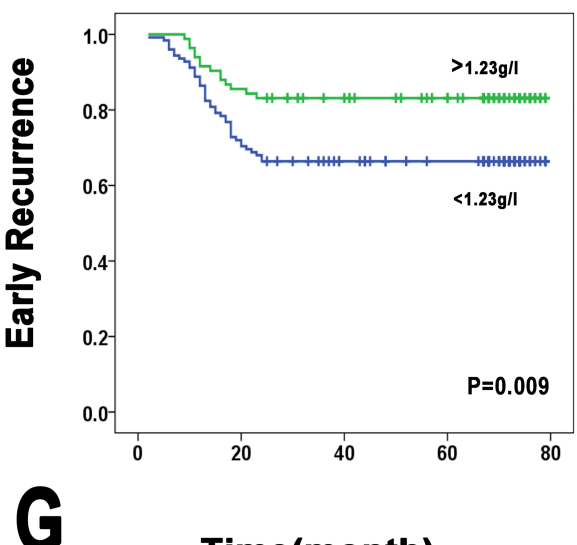
0.8
0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.03
0
20
40
60
80
Time(month)

F


Early Recurrence
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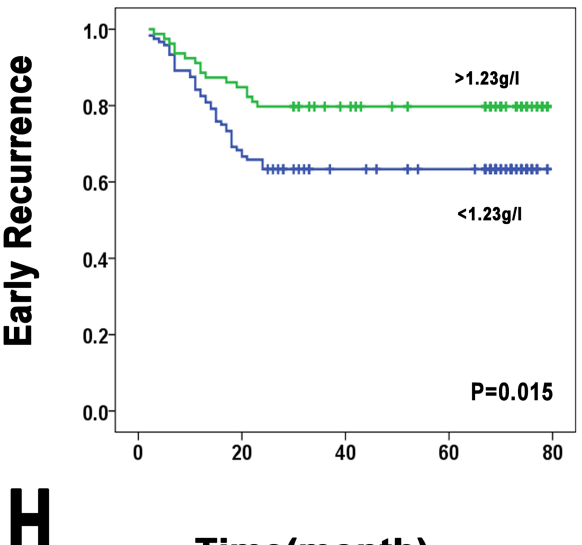
0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.009
0
20
40
60
80
Time(month)

G


Early Recurrence
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0.6
0.4
0.2
0.0
>1.23g/l
<1.23g/l
P=0.015
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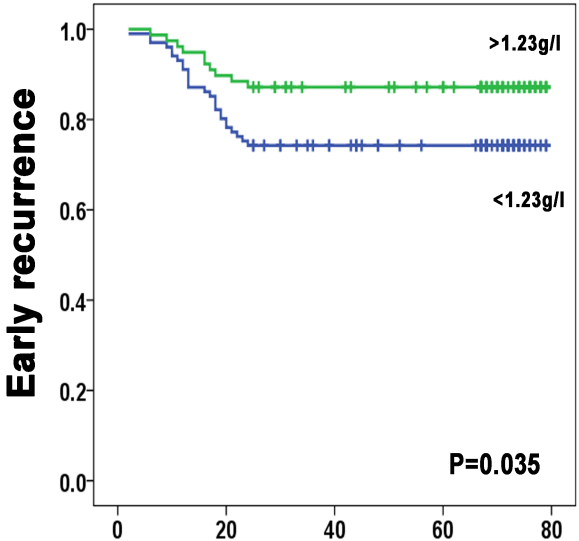
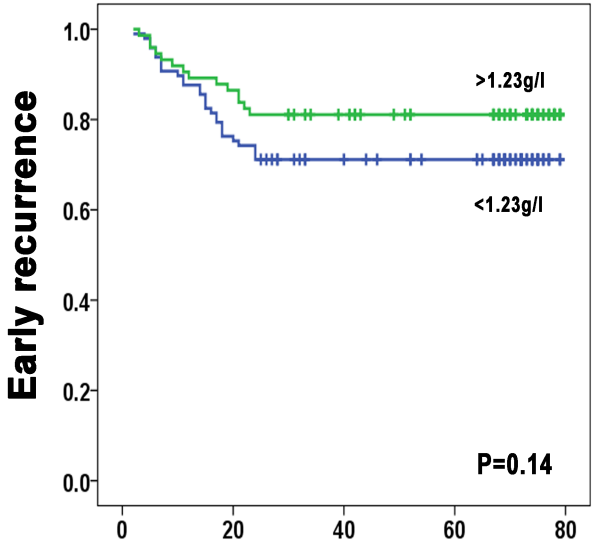
20
40
60
80
Time(month)

H




A

Time(month)




B

Time(month)

| Table S1 | Patient characteristics in the training and validation cohorts | | |
|---|---|---|---|
| Variable | n=242 | n=229 | P |
| Age(yr),median(range) | 54(16-85) | 55(26-78) | 0.87 |
| Gender(Male/Female) | 209/33 | 189/40 | 0.26 |
| liver cirrhosis | 183/59 | 161/68 | 0.21 |
| Hepatitis history | 175/67 | 157/72 | 0.42 |
| BMI | 23.6(15.6-32.4) | 23.4(16.4-34.9) | 0.37 |
| GLU | 5.2(3.8-13.9) | 5.4(2.9-18) | 0.28 |
| APLB | 0.21(0.09-0.36) | 0.22(0.1-0.44) | 0.34 |
| ALT | 37.3(7-131) | 37.5(5-145) | 0.9 |
| TB | 12.6(1.7-36) | 13.3(3.2-51.6) | 0.22 |
| AFP | 49.9(1.1-60500) | 50.1(1.3-60500) | 0.88 |
| ALB | 40.8(28-49) | 41.1(31-52) | 0.29 |
| GGT | 75.1(10.2-587) | 71.8(11-629) | 0.64 |
| TNM | 190/27/25 | 194/19/16 | 0.22 |
| Maximal tumour diameter (cm) | 5.2(0.8-19) | 4.6(0.8-18) | 0.06 |
| Tumour number (solitary/multiple) | 208/34 | 199/30 | 0.79 |
| Tumour capsule(complete/none) | 154/88 | 149/80 | 0.77 |
| Vascular invasion (absent/present) | 229/13 | 222/7 | 0.26 |
| Edmondson grade (I-II/III-IV) | 171/71 | 164/65 | 0.84 |
| CHOL | 4.11(2.03-9.83) | 4.09(1.56-8.67) | 0.82 |
| TG | 1.2(0.4-6.97) | 1.13(0.34-3.07) | 0.18 |
| HDL | 1.17（0.16-2.29） | 1.18（0.58-2.5） | 0.73 |
| LDL | 2.42(0.96-8.24) | 2.43(0.71-5.77) | 0.97 |
| ApoA1 | 1.19(0.16-2.37) | 1.19(0.69-2.22) | 0.89 |
| ApoB | 0.82(0.36-6.8) | 0.81(0.28-6.87) | 0.96 |
| ApoE | 38.6(16-90) | 38(1-94) | 0.54 |

Abbreviations: BMI: body mass index; GLU: glucose; APLB: prealbumin; ALT: alanine aminotransferase; TB: total bilirubin; AFP: alpha-fetoprotein; ALB: prealbumin; GGT: glutamyl transpeptidase; HbA1C: hemoglobin A1C; CRP: C reactive protein; TC: total cholesterol; TG: triglycerides; HDL: high-density lipoprotein; LDL:low-density lipoprotein;

Table S2 Multivariate comparison of the prognostic power of TNM Stage in training cohort

| | OS | | DFS | |
|---|---|---|---|---|
| | HR(95%CI) | P value | HR(95%CI) | P value |
| ApoA1 | 0.517(0.309-0.866) | 0.01 | 0.537(0.363-0.793) | 0.002 |
| GGT | 1.715(1.068-2.756) | 0.03 | 1.478(1.015-2.153) | 0.04 |
| AFP | 1.97(1.208-3.213) | 0.007 | 1.499(1.017-2.209) | 0.04 |
| LDL | 1.969(1.086-3.569) | 0.03 | 1.498(0.978-2.297) | 0.06 |
| Edmondson grade | | | 1.669(1.129-2.467) | 0.01 |
| TNM stage | 1.508(1.105-2.059) | 0.01 | 1.457(1.135-1.871) | 0.001 |

Abbreviations: AFP: alpha-fetoprotein; GGT: glutamyl transpeptidase; LDL:low-density lipoprotein; OS: overall survival; DFS: disease free survival; HR: Hazard Ratio; CI: confidence interval.

Table S3 Univariate and multivariate analyses of prognostic factors in HCC in validation cohort

| Variables | OS | | | DFS | | |
|---|---|---|---|---|---|---|
| | Univariate | Multivariate | | Univariate | Multivariate | |
| | P | HR (95% CI) | P | P | HR (95% CI) | P |
| Gender | 0.03 | | | 0.005 | | |
| Age(years) | 0.51 | | | 0.16 | | |
| liver cirrhosis | 0.48 | | | 0.14 | | |
| Hepatitis history | 0.19 | | | 0.63 | | |
| BMI | 0.12 | | | 0.29 | | |
| GLU | 0.1 | | | 0.12 | | |
| APLB | 0.045 | 0.477(0.241-0.944) | 0.03 | 0.006 | 0.576(0.354-0.838) | 0.03 |
| ALT | 0.22 | | | 0.1 | | |
| TB | 0.83 | | | 0.11 | | |
| AFP | 0.003 | | | 0.03 | | |
| ALB | 0.89 | | | 0.61 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| GGT | <0.001 | 1.914(1.133-3.232) | 0.02 | 0.007 | 1.535(1.057-2.23) | 0.02 |
| CHOL | 0.83 | | | 0.85 | | |
| TG | 0.29 | | | 0.17 | | |
| HDL | 0.32 | | | 0.98 | | |
| LDL | 0.91 | | | 0.73 | | |
| Tumor size | <0.001 | 3.072(1.825-5.172) | <0.001 | 0.001 | 1.525(1.021-2.277) | 0.04 |
| Tumor number | 0.02 | | | 0.048 | | |
| Tumor capsule | 0.67 | | | 0.37 | | |
| Vascular invasion | <0.001 | | | <0.001 | 1.735(1.148-2.622) | 0.009 |
| Edmondson grade | 0.03 | | | 0.14 | | |
| TNM stage | 0.001 | | | 0.03 | | |
| ApoA1 | 0.01 | 0.418(0.234-0.747) | 0.003 | 0.007 | 0.609(0.409-0.908) | 0.02 |
| ApoB | 0.06 | | | 0.63 | | |
| ApoE | 0.02 | 1.897(1.123-3.204) | 0.02 | 0.57 | | |

Univariate analysis: Kaplan-Meier method; multivariate analysis: Cox proportional hazards regression model;

Abbreviations: BMI: body mass index; GLU: glucose; APLB: prealbumin; ALT: alanine aminotransferase; TB: total bilirubin; AFP: alpha-fetoprotein; ALB: prealbumin; GGT: glutamyl transpeptidase; HbA1C: hemoglobin A1C; CRP: C reactive protein; TC: total cholesterol; TG: triglycerides; HDL: high-density lipoprotein; LDL:low-density lipoprotein; OS: overall survival; DFS: disease free survival; HR: Hazard Ratio; CI: confidence interval.

Table S4 Multivariate comparison of the prognostic power of TNM Stage in validation cohort

| | OS | | DFS | |
|---|---|---|---|---|
| | HR(95%CI) | P value | HR(95%CI) | P value |
| APLB | 0.494(0.248-0.983) | 0.04 | 0.526(0.324-0.853) | 0.009 |
| AFP | 1.755(1.037-2.97) | 0.04 | | |
| GGT | 2.135(1.268-3.596) | 0.004 | 1.613(1.114-2.337) | 0.01 |
| ApoA1 | 0.421(0.234-0.755) | 0.004 | 0.585(0.394-0.868) | 0.008 |
| ApoE | 1.939(1.136-3.31) | 0.02 | | |
| TNM stage | 1.443(1.012-2.031) | 0.04 | 1.319(0.989-1.759) | 0.06 |

Abbreviations: APLB: prealbumin; AFP: alpha-fetoprotein; GGT: glutamyl transpeptidase; OS: overall survival; DFS: disease free survival; HR: Hazard Ratio; CI: confidence interval.

Table S5 Multivariate comparison of the prognostic power of TNM Stage for early recurrence

| | early recurrence (training cohort) | | early recurrence (validation cohort) | |
|---|---|---|---|---|
| | HR(95%CI) | P value | HR(95%CI) | P value |
| Gender | | | 2.479(0.975-6.302) | 0.057 |
| AFP | 1.684(1.039-2.73) | 0.03 | 1.559(0.969-2.509) | 0.07 |
| GGT | 1.681(1.045-2.703) | 0.03 | 2.215(1.392-3.526) | 0.001 |
| Edmondson grade | 1.924(1.192-3.107) | 0.007 | | |
| TNM stage | 1.643(1.227-2.2) | 0.001 | | |
| ApoA1 | 0.35590.206-0.611) | <0.001 | 0.537(0.31-0.93) | 0.03 |

Abbreviations: AFP: alpha-fetoprotein; GGT: glutamyl transpeptidase; HR: Hazard Ratio; CI: confidence interval.