Supplementary Table 1: Differential protein candidates in small-for-size graft group identified by Mass Spectrometry

	Accession No.	Protein Score	Protein Score C.I. %	Protein MW(KDa)
Down-regulation				
Glutathione Peroxidase 3 (GPx3)	GI:6723180	243	100	25.65
complement component 1 gamma	GI:114554613	162	100	25.95
complement component 4	GI:158537756	195	100	193.6
Up-regulation				
Nucleoside diphosphate kinase A	GI:19924089	209	100	17.29
Serum amyloid P-component precursor (SAP)	GI:148747488	290	100	26.27
Nitrilase homolog 1	GI:51702765	76	99.95	32.69
delta-aminolevulinic acid dehydratase	GI:6978483	170	100	36.46
Complement component factor h-like 1	GI:112984278	101	100	31.57

The protein score is calculated for each possible candidate from the MASS Spectrum. It indicated the possibility that the identified protein candidates are precise.

Protein score C.I. % is the statistical analysis of the confidence level of the Protein Score. The closer it is to 100%, the higher the possibility that the protein candidate is precisely identified.

Protein MW indicates Molecular Weight.

The expression of GPx3 in small-for-size liver graft group was down-regulated more than 2-folds compared with whole graft group.

Supplementary Table 2: Cox proportional hazard regression model for overall survival analysis

	Univariable analysis	
	HR(95%CI)	*P*
Plasma GPx3 (Day 1)		
Low *vs* High level	7.237 (2.416-21.676)	0.000*
Plasma GPx3 (Day 7)		
Low *vs* High level	3.240 (1.152-9.115)	0.026*
UCSF criteria		
Beyond *vs* Within	2.585 (1.151-5.802)	0.021*
Milan criteria		
Beyond *vs* Within	1.549 (0.695-3.455)	0.285
Venous infiltration		
Presence *vs* Absence	1.498 (0.957-2.345)	0.077
Number of tumor nodules		
≥3 *vs* <3	2.660 (1.163-6.086)	0.020*
Tumor size		
≥5 cm *vs* <5 cm	1.580 (0.623-4.010)	0.336
AFP		
≥20ng/mL *vs* <20ng/mL	1.724 (0.737-4.034)	0.209

*Statistical significance HR: Hazard Ratio CI: Confidence Interval

Supplementary Figure 1

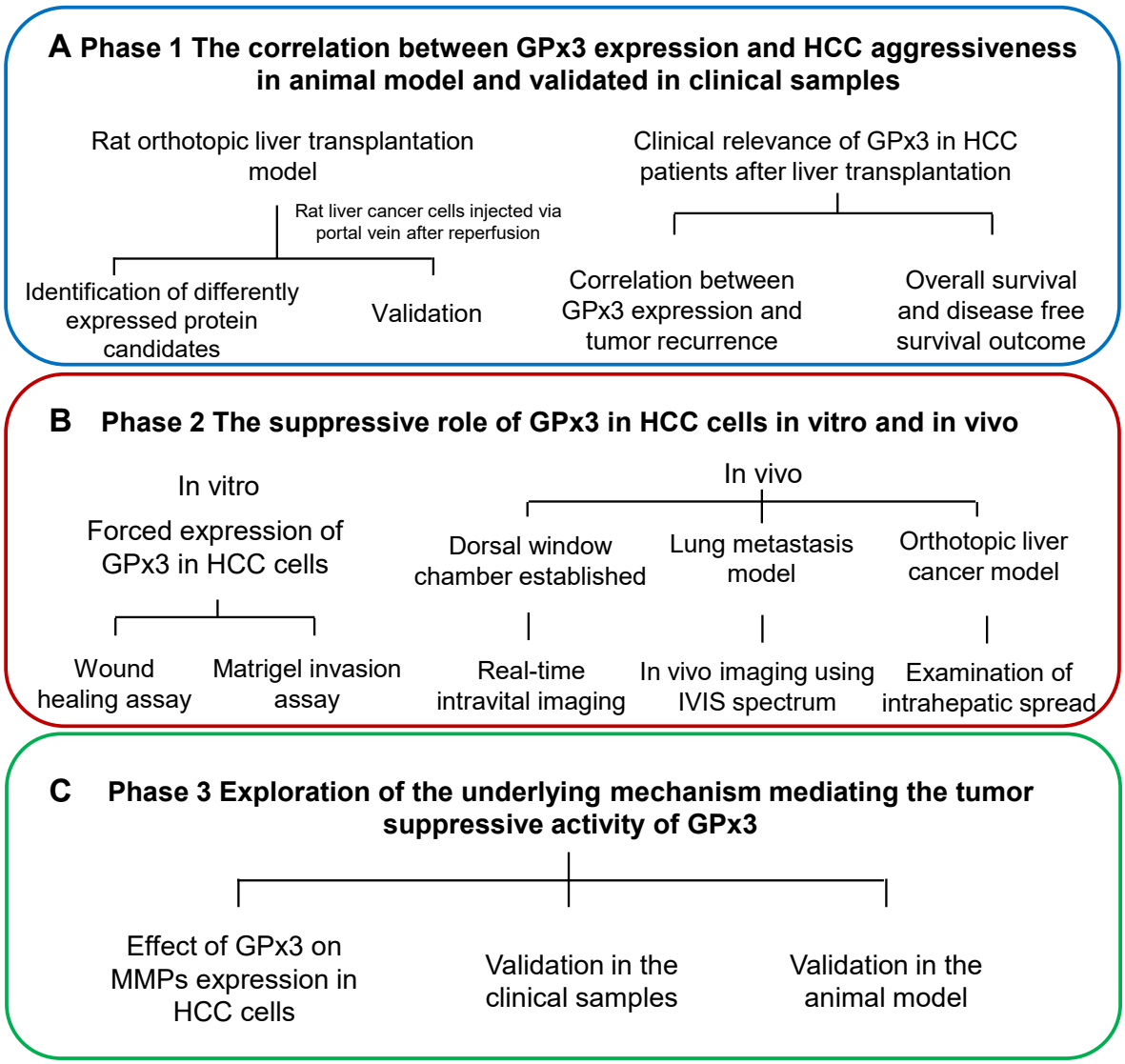

Fig. S1. The diagram showed the study design.

Supplementary Figure 2

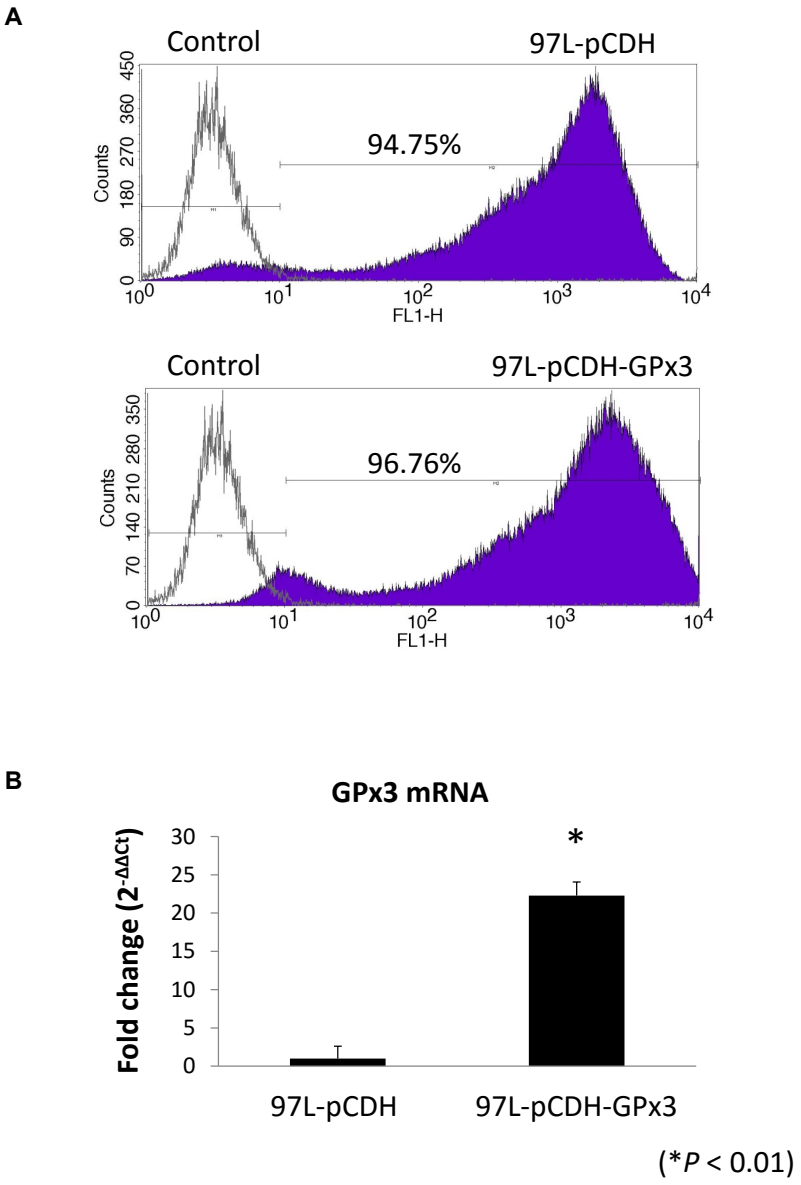

Fig. S2. Over-expression of GPx3 was established in HCC cells. (A) The transduction efficiency was more than 90% confirmed by flow cytometry. (B) The expression of GPx3 was 20 times higher after transduction and selection.

Supplementary Figure 3

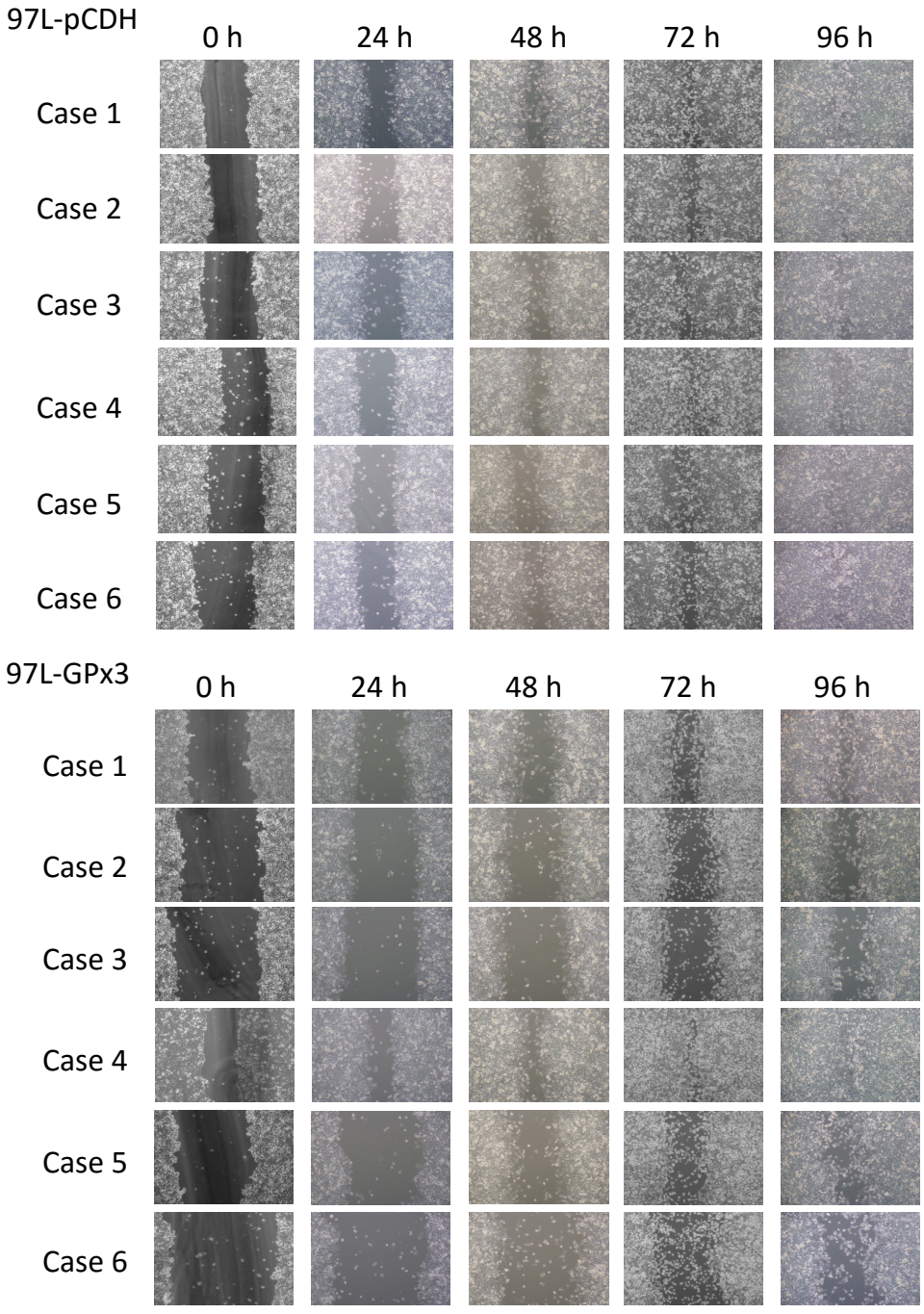

Fig. S3. Over-expression of GPx3 significantly suppressed the migration of GPx3 in wound healing assay. The experiment was repeated for six times.

Supplementary Figure 4

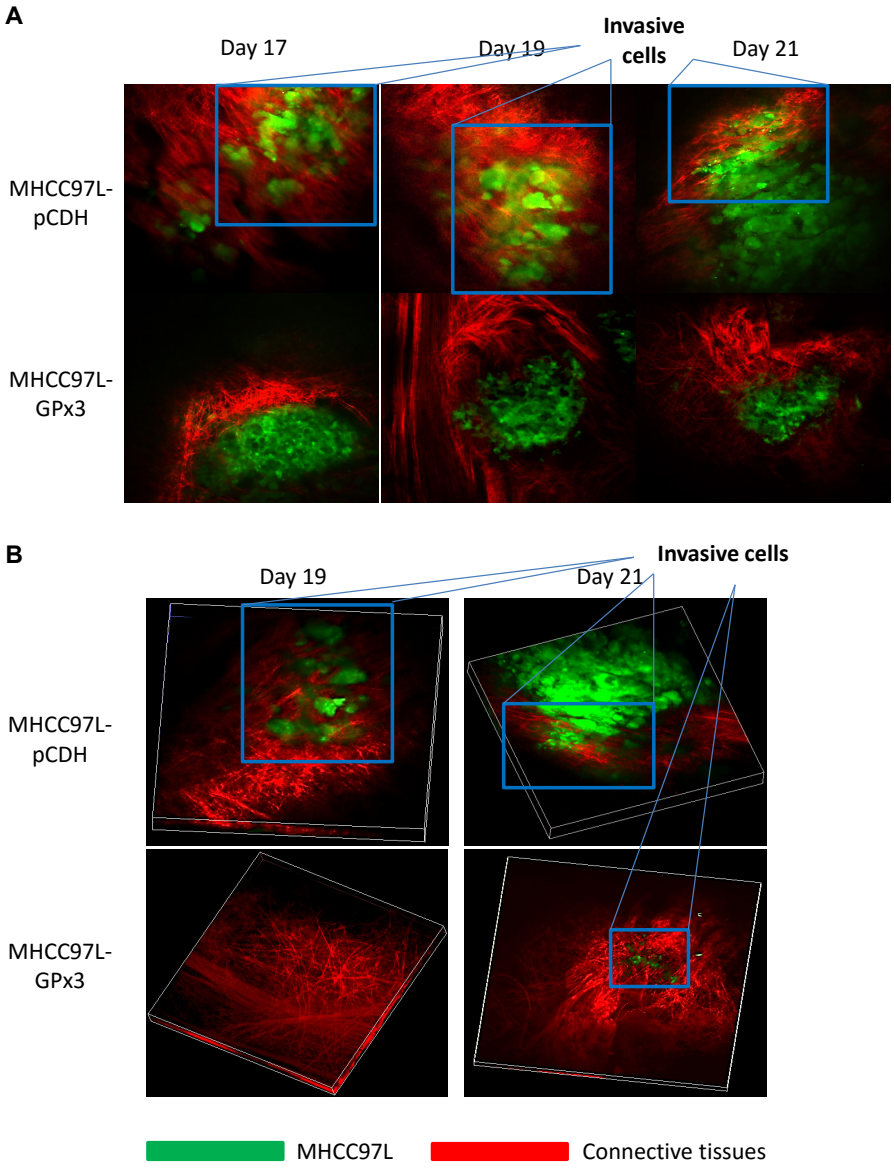

Fig. S4. Real-time intravital imaging showed that over-expression of GPx3 suppressed HCC invasiveness at different time points after innoculation. (A) More HCC cells invaded into surrounding connective tissues in the control group. In the contrast, the HCC cells with over-expression of GPx3 remained relatively intact. (B) Three-dimension reconstructed images showed that over-expression of GPx3 significantly suppressed HCC invasiveness in Z-axis at later time points in a live animal.

Supplementary Figure 5

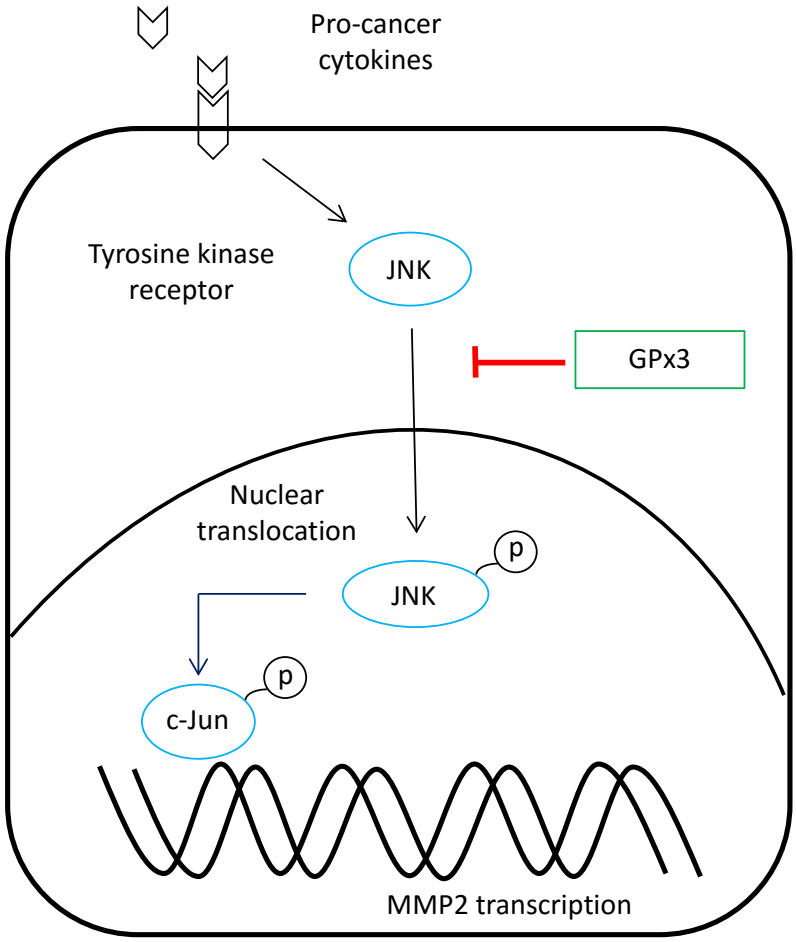

Fig. S5. Diagram showing the mechanism of suppressive effect of GPx3 mediated through JNK-cJun-MMP2 signaling pathway.

Supplementary Figure 6

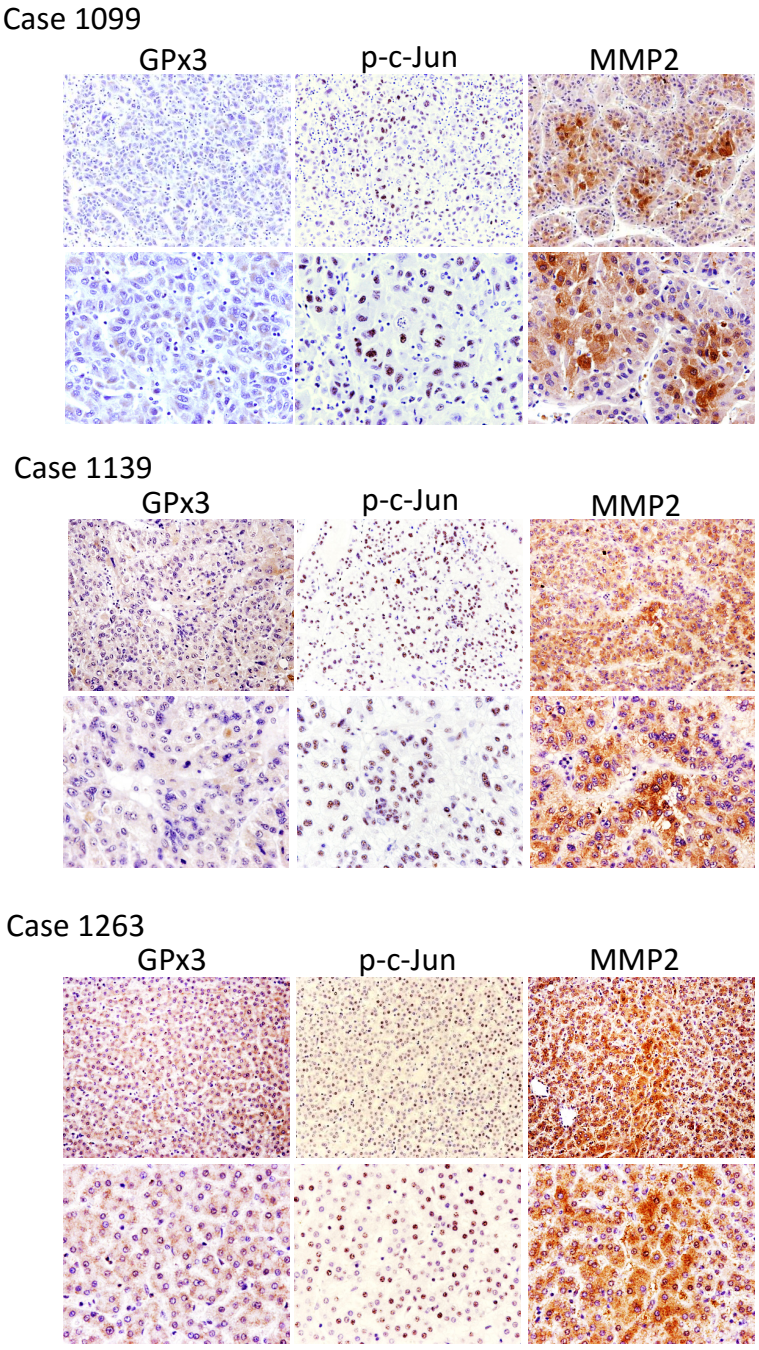

Fig. S6. The representative images showing the negative correlation between MMP2 and GPx3 expression within tumor tissues collected from HCC patients during liver transplantation. The activation of c-Jun and expression of MMP2 was consistently higher while the GPx3 expression was relatively lower.

Supplementary Figure 7

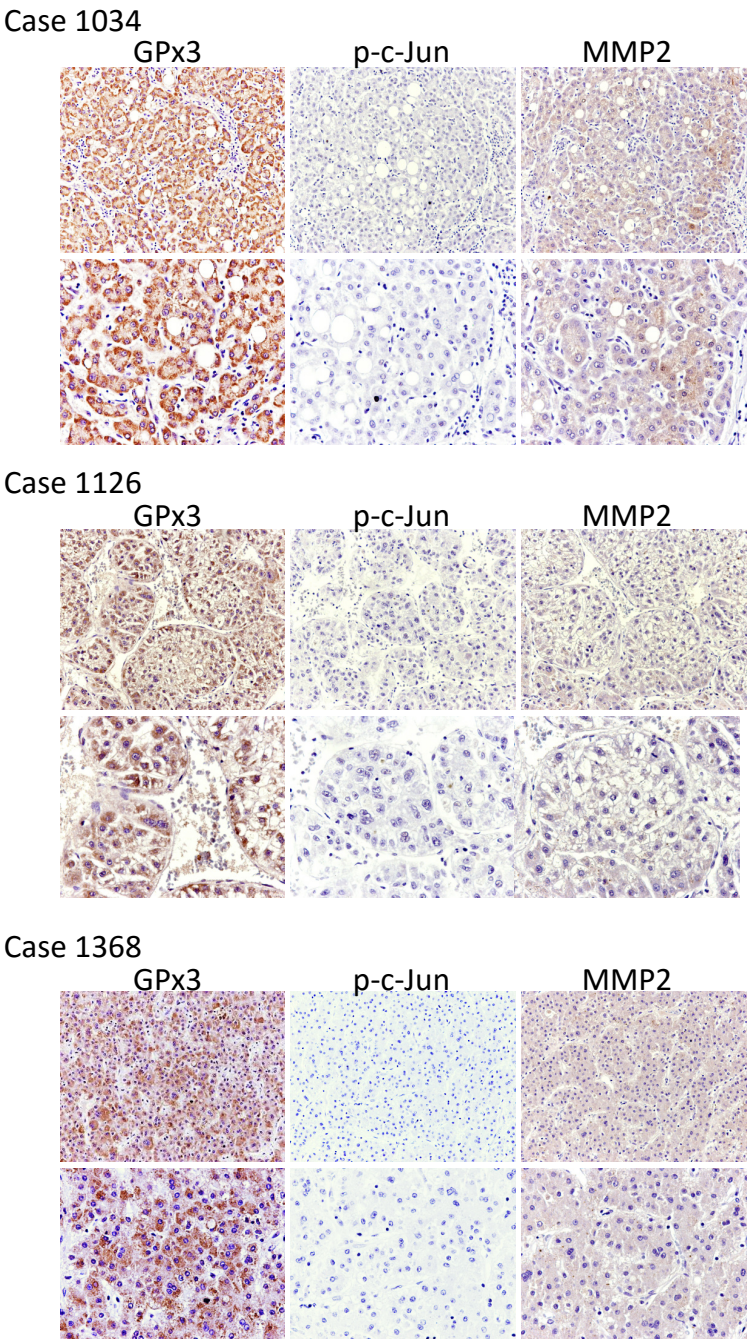

Fig. S7. The representative images showing the negative correlation between MMP2 and GPx3 expression within tumor tissues collected from HCC patients during liver transplantation. The activation of c-Jun and expression of MMP2 was consistently lower while the GPx3 expression was significantly higher.

Movie. S1. Reconstructed 3D image showing HCC invasiveness occurred as early as 2 week after tumor cells innoculation in Control group. Red: connective tissue surrounding tumor. Green: tumor tissue.

Movie. S2. Reconstructed 3D image showing HCC invasiveness was significantly inhibited at day 14 after tumor cells innoculation in GPx3 over-expression group. Red: connective tissue surrounding tumor. Green: tumor tissue.

Movie. S3. Reconstructed 3D image showing HCC invasiveness at day 19 after tumor cells innoculation in Control group. Red: connective tissue surrounding tumor. Green: tumor tissue.

Movie. S4. Reconstructed 3D image showing HCC invasiveness was significantly inhibited at day 19 after tumor cells innoculation in GPx3 over-expression group. Red: connective tissue surrounding tumor. Green: tumor tissue.