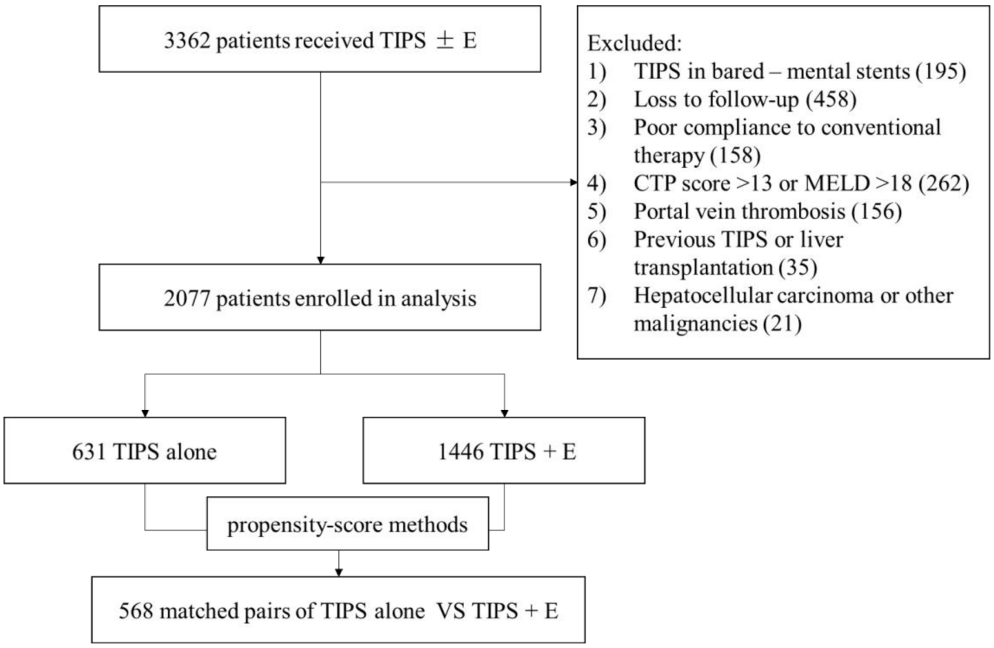
List of Supplementary Materials

Supplementary Figure 1 Flow chart of patient selection



CTP, Child-Turcotte-Pugh; MELD, model for end-stage liver disease; TIPS, transjugular intrahepatic portosystemic shunt; TIPS + E, transjugular intrahepatic portosystemic shunt plus extrahepatic collateral embolization

Supplementary Table 1. Demographic and Baseline characteristics of patients with TIPS±E before and after PSM

Characteristics	Overall (n = 2077)	Before PSM			After PSM		
		TIPS (n = 631)	TIPS + E (n = 1446)	P	TIPS (n = 568)	TIPS+E (n = 568)	P
Age(years)	52.0 (44.0, 60.0)	53.0 (45.0, 61.0)	51.0 (44.0, 60.0)	0.04	52.0 (45.0, 60.0)	52.5 (45.0, 61.0)	0.88
Gender(M/F)	1335/742	383/248	952/494	0.03	354/214	360/208	0.71
Etiology of cirrhosis							
Virus	1400 (67.4%)	440 (69.7%)	960 (66.4%)	0.30	403 (71.0%)	371 (65.3%)	0.07
Alcoholic	124 (6.0%)	33 (5.3%)	91 (6.3%)		28 (4.9%)	42 (7.4%)	
Others	553 (26.6%)	158 (25.0%)	395 (27.3%)		137 (24.1%)	155 (27.3%)	
PLT (10^9/L)	60.0 (41.5, 88.0)	60.0 (40.0, 99.0)	59.0 (42.0, 85.3)	0.11	60.0 (40.0, 95.8)	64.0 (44.0, 93.0)	0.24
Hb (g/L)	81.0 (70.0, 95.0)	81.0 (70.0, 96.0)	81.0 (70.0, 95.0)	0.38	82.0 (71.0, 96.0)	82.0 (70.0, 95.0)	0.40
Alb (g/L)	33.8 (30.3, 37.4)	34.0 (31.0, 37.4)	33.6 (30.0, 37.4)	0.22	34.2 (30.9, 37.5)	33.6 (30.2, 37.5)	0.39
TBIL (μmol/L)	20.9 (14.4, 30.0)	20.0 (13.8, 30.4)	21.4 (14.7, 30.4)	0.12	20.5 (14.1, 29.1)	20.8 (14.4, 29.9)	0.41
Cr (μmol/L)	73.0 (59.0, 88.0)	73.0 (59.0, 89.0)	73.0 (59.0, 88.0)	0.53	75.5 (61.0, 90.0)	74.0 (60.0, 90.0)	0.40

INR	1.30 (1.18, 1.45)	1.31 (1.19, 1.47)	1.31 (1.19, 1.47)	0.14	1.31 (1.18, 1.47)	1.29 (1.18, 1.44)	0.23
CTP Score	7.0 (6.0, 8.0)	7.0 (6.0, 8.0)	7.0 (6.0, 8.0)	0.44	7.0 (6.0, 8.0)	7.0 (6.0, 8.0)	0.39
CTP Grade							
A	810 (39.0%)	253 (40.1%)	557 (38.5%)	0.68	235 (41.4%)	214 (37.7%)	0.38
B	1061 (51.1%)	320 (50.7%)	741 (51.2%)		277 (48.8%)	300 (52.8%)	
C	206 (9.9%)	58 (9.2%)	148 (10.2%)		56 (9.9%)	54 (9.5%)	
MELD score	11.0 (9.0, 13.0)	11.0 (9.0, 13.0)	11.0 (9.0, 13.0)	0.35	11.0 (9.0, 13.0)	11.0 (9.0, 13.0)	0.61
Ascites							
+	1399 (67.4%)	427 (67.7%)	972 (67.2%)	0.84	381 (67.1%)	385 (67.8%)	0.80
-	678 (32.6%)	204 (32.3%)	474 (32.8%)		187 (32.9%)	183 (32.2%)	
HE							
+	21 (1.0%)	7 (1.1%)	14 (1.0%)	0.77	5 (0.9%)	5 (0.9%)	1.00
-	2056 (99.0%)	624 (98.9%)	1432 (99.0%)		563 (99.1%)	563 (99.1%)	
Varices classification							
(Sarin’s classification)				0.00			0.08
EV	681 (32.8%)	202 (32.0%)	461 (21.9%)		188 (33.1%)	154 (27.1%)	

GOV 1	705 (33.9%)	244 (38.7%)	479 (33.1%)		228 (40.1%)	268 (47.2%)	
GOV 2	244 (11.7%)	86 (13.6%)	158 (10.9%)		68 (12.0%)	65 (11.4%)	
IGV 1	447 (21.5%)	99 (15.7%)	348 (24.1%)		84 (14.8%)	81 (14.3%)	
Timing of TIPS							
Acute variceal bleeding	310 (14.9%)	84 (13.3%)	226 (15.6%)	0.17	80 (14.1%)	88 (15.5%)	0.50
Secondary prevention	1767 (85.1%)	547 (86.7%)	1220 (84.4%)		488 (85.9%)	480 (84.5%)	
PPG, mmHg	24.0 (20.0, 27.3)	23.5 (19.3, 27.2)	24.0 (20.6, 27.9)	0.04	23.5 (19.9, 27.3)	24.0 (20.0, 27.9)	0.41
pPPG, mmHg	8.8 (6.0, 11.0)	8.1 (5.9, 10.4)	8.8 (6.5, 11.0)	0.002	8.0 (5.9, 10.3)	8.1 (6.0, 11.0)	0.24
PPG%	64.0 (53.3, 73.1)	65.2 (54.5, 74.1)	63.6 (52.6, 72.4)	0.02	66.5 (55.6, 74.9)	65.6 (54.8, 73.5)	0.34
Stent diameters							
6mm	91 (4.4%)	73 (11.6%)	18 (1.2%)	0.00	16 (2.8%)	18 (3.2%)	0.93
8mm	1886 (90.8%)	537 (85.1%)	1349 (93.3%)		531 (93.5%)	528 (93.0%)	
10mm	100 (4.8%)	21 (25.9%)	79 (5.5%)		21 (3.7%)	22 (3.9%)	
Hemodynamic success							
+	1843 (88.7%)	568 (90.0%)	1275 (88.2%)	0.22	517 (91.0%)	514 (90.5%)	0.76
-	234 (11.3%)	63 (10.0%)	171 (11.8%)		51 (9.0%)	54 (9.5%)	

Follow-up time	32.5 (19.3, 56.6)	29.9 (16.2, 59.5)	33.7 (20.5, 54.9)	0.049	32.6 (18.7, 63.6)	33.8 (20.4, 56.0)	0.87

Data were presented by median (lower quartile, upper quartile). PSM, propensity score matching; PLT, platelet; Alb, albumin; TBIL, total bilirubin; INR, international normalized ratio; Hb, hemoglobin; Cr, Creatinine; CTP, Child-Turcotte-Pugh; HE, hepatic encephalopathy; PPG, portal pressure gradient; pPPG, post-TIPS portal pressure gradient; MELD, model for end-stage liver disease; TIPS, transjugular intrahepatic portosystemic shunt; TIPS + E, transjugular intrahepatic portosystemic shunt plus extrahepatic collateral embolization.

Supplementary Table 2 propensity-score methods for TIPS VS TIPS + E

Variables in logistics regression	B	P	Exp(B)
Centers	0.015	0.676	1.015
Gender	0.288	0.019	1.334
age	0.002	0.717	1.002
Etiology	0.205	0.046	1.228
CTP	-0.239	0.014	0.788
MELD	-0.041	0.145	0.960
Varices classification	0.200	0.000	1.222
TIPS indication	0.114	0.447	1.120
PPG	0.008	0.704	1.008
pPPG	0.007	0.905	1.007
PPG %	0.008	0.807	1.005
stents diameters	1.559	0.000	4.755
follow up time	0.000	0.642	1.000
Match types	exact match	0.000	
	fuzzy matching	568.000	
PSSS	0.200		
matching attempt count	129990.000		
incremental rejection percentage	99.561		

Supplementary Table 3 propensity-score methods for embolization of GV and GV+SPSS

Variables in logistics regression	B	P	Exp(B)
Centers	1.248	0.035	0.287
Gender	0.027	0.941	1.027
age	-0.009	0.564	0.991
Etiology	-0.720	0.023	0.487
CTP	0.807	0.005	2.240
MELD	-0.312	0.022	0.732
Varices classification	2.696	0.000	14.816
TIPS indication	-0.162	0.676	0.851
PPG	0.017	0.818	1.017
pPPG	-0.152	0.468	0.859
PPG%	0.082	0.598	1.003
Stents diameters	-0.143	0.480	0.867
followup	0.000	0.203	1.000
Match types	exact match	0.000	
	fuzzy matching	65.000	
PSSS	0.020		
matching attempt count	18543.000		
incremental rejection percentage	99.694		

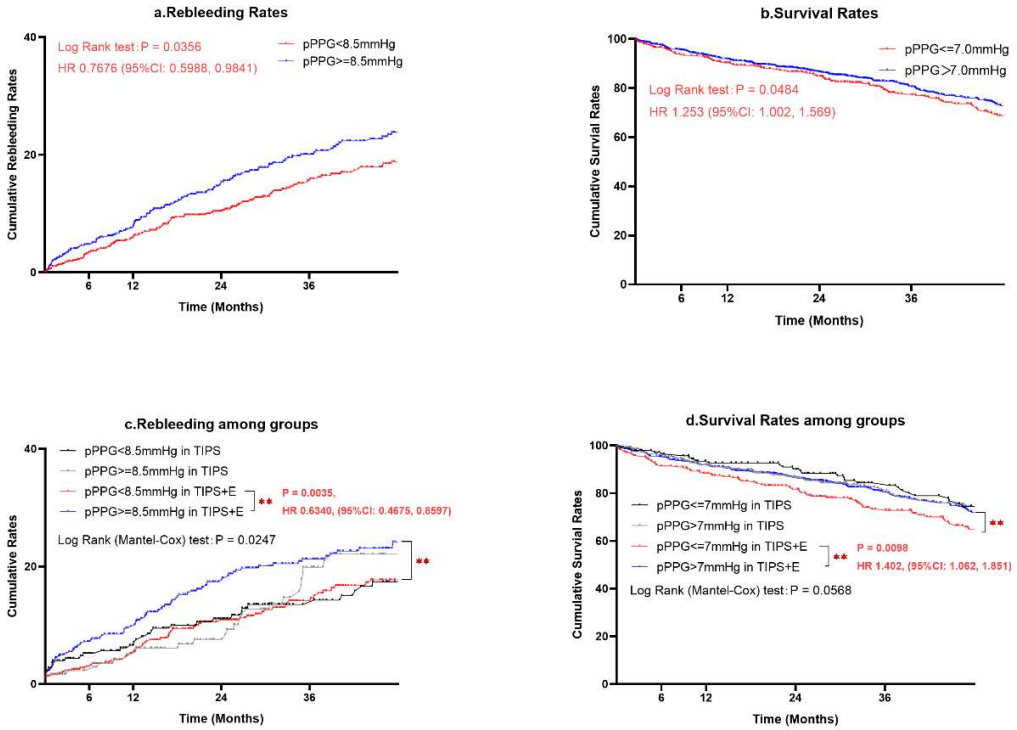
Supplementary Table 4 The prognostic models and predictive values by machine learning algorithm and traditional regression (Ranking by AUROC)

Outcomes	Model	Accuracy	AUC	Sensitivity	Specificity
Rebleeding	Random Forests	0.851 (0.803, 0.899)	0.863 (0.839 ,0.887)	0.851 (0.887 ,0.827)	0.852 (0.827 ,0.875)
	Support Vector Machine	0.712 (0.771 ,0.853)	0.802 (0.778 ,0.826)	0.833 (0.826 ,0.809)	0.847 (0.809 ,0.857)
	Artificial neural network	0.723 (0.782 ,0.864)	0.835 (0.811 ,0.859)	0.798 (0.859 ,0.774)	0.836 (0.774 ,0.822)
	Logistic Regression	0.801 (0.750, 0.860)	0.790 (0.764, 0.817)	0.787 (0.758, 0.814)	0.778 (0.747, 0.807)
	Cox Regression	0.594 (0.582 ,0.605)	0.767 (0.748 ,0.785)	0.819 (0.800 ,0.838)	0.628 (0.616 ,0.639)
HE	Random Forests	0.801 (0.760 ,0.842)	0.713 (0.689 ,0.737)	0.362 (0.737 ,0.338)	0.957 (0.338 ,0.386)
	Support Vector Machine	0.752 (0.711 ,0.793)	0.693 (0.669 ,0.717)	0.287 (0.717 ,0.263)	0.866 (0.263 ,0.311)
	Artificial neural network	0.733 (0.692 ,0.774)	0.673 (0.649 ,0.697)	0.212 (0.697 ,0.188)	0.775 (0.188 ,0.236)
	Logistic Regression	0.661 (0.615, 0.707)	0.674 (0.650, 0.698)	0.877 (0.853, 0.897)	0.682 (0.648, 0.715)
	Cox Regression	0.684 (0.637 ,0.730)	0.606 (0.561 ,0.650)	0.877 (0.853, 0.898)	0.682 (0.648, 0.716)
Survival	Random Forests	0.83 (0.789 ,0.871)	0.776 (0.752 ,0.800)	0.202 (0.17 ,0.234)	0.363 (0.909 ,0.957)
	Support Vector Machine	0.716 (0.675 ,0.757)	0.765 (0.741 ,0.789)	0.883 (0.789 ,0.859)	0.697 (0.682 ,0.712)

	Artificial neural network	0.711 (0.67 ,0.752)	0.762 (0.738 ,0.786)	0.778 (0.786 ,0.754)	0.768 (0.754 ,0.802)
	Logistic Regression	0.694 (0.646, 0.742)	0.756 (0.733, 0.779)	0.735 (0.704, 0.764)	0.806 (0.775, 0.833)
	Cox Regression	0.659 (0.637 ,0.681)	0.653 (0.609 ,0.696)	0.748 (0.689 ,0.807)	0.684 (0.668 ,0.700)
Further decompensation	Random Forests	0.803 (0.762 ,0.844)	0.896 (0.872 ,0.920)	0.903 (0.92 ,0.879)	0.608 (0.879 ,0.927)
	Support Vector Machine	0.793 (0.752 ,0.834)	0.756 (0.732 ,0.780)	0.663 (0.78 ,0.639)	0.685 (0.639 ,0.687)
	Artificial neural network	0.762 (0.721 ,0.803)	0.776 (0.752 ,0.800)	0.754 (0.8 ,0.73)	0.765 (0.730 ,0.778)
	Logistic Regression	0.696 (0.652, 0.740)	0.725 (0.703, 0.747)	0.693 (0.661, 0.723)	0.825 (0.795, 0.851)
	Cox Regression	0.638 (0.617 ,0.658)	0.712 (0.681 ,0.742)	0.694 (0.664 ,0.724)	0.596 (0.582 ,0.609)

RF, random forests; SVM, support vector machine; ANN, artificial neural network; LR, logistic regression; HE, hepatic encephalopathy; AUROC, the area under the receiver operating characteristic curves;

Supplementary Figure 2 different pPPG groups of clinical outcomes



a. Rebleeding rates grouped by pPPG 8.5mmHg; b. Survival rates grouped by pPPG 7.0mmHg; c. Rebleeding rates grouped by pPPG 8.5mmHg and TIPS±E; d. Survival rates grouped by pPPG 7.0mmHg and TIPS±E;