

machine learning

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(MRI)	
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Table 1

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microarray

B

sample

5 (PN, P, P-M, PT, PT-M)

Table 2. sample

GROUP	Standard of classification
PN	metastasis free HCC group - have a single primary HCC lesion without detectable metastasis at the time of surgery
P	intra-hepatic spread - tumor spreading to other parts of the liver
P-M	much smaller and satellite-like tumors that are nearby the main tumors(P) with a usual distance within or about 1cm apart, and they were usually from the same segment of primary lesions
PT	tumor thrombi in the portal vein - tumor thrombus in the branch of portal vein (tumor invading into the portal vein)
PT-M	portal vein thrombi were well separated from their main tumors(PT)

Table 3. sample

Case#	Age	Main tumor size	Tumor type	Intrahepatic spread: size (cm) and location	Portal vein involvement	Clastic	Control	Days of Follow-up	Histology and Grade	Sera AFP (ng/ml)
011	61	3.5	nodular dysplasia (segment IV/VI), with intrac. resection (VI)	2 segment VI	No	No	alive	256	HCC, II	8
012	43	3	segmentary of right posterior lobe segment VI & VII with intracapsular	No	right posterior lobe	Yes	dead	177	HCC, II	477.9
013	50	4	nodular dysplasia (segment IV/VI), with intracapsular	No	right lobe of lobe	No	alive	247	HCC, I	298.7
014	64	4.5	multiple limited nodules (segment VI, VII)	0, segment V	No	Yes	alive	241	HCC, II	5
017	44	7.4	segmentary of right posterior lobe segment VI & VII	1, multiple nodules, near the main lobe	No	Yes	alive	211	HCC, I	555.9
018	52	7	enhanced right hepatic lobectomy segment V-VI (anterior part of IV)	1.2, multiple nodules around the main lobe	No	Yes	alive	274	HCC, II	8
019	57	4	intrahepatic nodules (partial of segment V, VI) with intracapsular	No	right branch and common bile duct	Yes	no response		HCC, II	4524
020	45	1.5	right hepatic lobectomy (segment V-VI)	1.2, multiple nodules around the main lobe	No	Yes	dead	17	HCC, II	8722
021	45	4.2	right hepatic lobectomy (segment V-VI)	No	right branch	Yes	alive	270	HCC, II	3
023	36	1.3	nodular dysplasia (segment IV/VI), with intracapsular	No	right lobe of lobe	Yes	dead	11	HCC, II	9
024	54	3	intrahepatic nodules (segment VI, partial of V & VII)	1, near the main tumor	No	Yes	dead	170	HCC, II	4001
025	55	3	left hepatic lobectomy with intracapsular	No	left branch and main lobe	Yes	dead	155	HCC, II	4500
026	48	3.0	intrahepatic nodules (segment VI, partial of V & VII) with intracapsular	No	infero-ventral lobe	Yes	alive	207	HCC, II	56
027	47	17.5	enhanced right hepatic lobectomy segment V-VI (anterior part of IV)	1.2, multiple nodules around the main lobe	No	Yes	alive	207	HCC, II	18
028	74	17	left hepatic lobectomy	No	left branch	No	no response		HCC, II	5554
029	65	5	intrahepatic nodules (partial of segment V, VI)	1.2, multiple nodules around the main lobe	No	Yes	dead	25	HCC, II	3
030	39	5	left hepatic lobectomy	1.2, multiple nodules around the main lobe	No	Yes	dead	100	HCC, V	2400
032	44	4	intrahepatic nodules (partial of segment V, VI)	1.2, multiple nodules, around the main lobe	No	Yes	alive	205	HCC, II	7
033	54	1.5	intrahepatic nodules (partial of segment V, VI) with intracapsular	No	right branch	Yes	alive	119	HCC, II	469
034	38	1.3	right hepatic lobectomy with intracapsular	No	right branch	Yes	alive	205	HCC, II	3052
035	45	5	intrahepatic nodules (partial of segment V, VI)	1.2, 2 nodules, around the main lobe	No	Yes	alive	243	HCC, II	49
037	38	3.5	multiple limited nodules (partial of segment V, VI and various segments)	1.5, segment II	No	No	no response		HCC, II	743
038	42	5	intrahepatic nodules with intracapsular	No	right branch and common bile duct	Yes	alive	227	HCC, II	3409
039	51	7	intrahepatic nodules	1.2, around the main lobe	No	Yes	alive	228	HCC, II	22
040	48	3.5	intrahepatic nodules with common bile duct lumen	3, lymph node (1) around the main lobe	No	No	no response		HCC, II	100
041	39	3.0	multiple limited nodules (segment V, VI and VII)	3.4, segment V, 1.2, segment VII	No	Yes	alive	213	HCC, II	2479
047	50	3.0	right hepatic lobectomy with intracapsular	No	right branch	Yes	no response		HCC, II	546
048	52	3.0	intrahepatic nodules	No	No	Yes	alive	335	HCC, II	21
042	45	2	intrahepatic nodules	No	No	Yes	alive	232	HCC, II	4
044	45	3.5	intrahepatic nodules	No	No	Yes	alive	239	HCC, V	179
045	45	3.5	intrahepatic nodules	No	No	Yes	alive	231	HCC, II	389
049	43	1.0	intrahepatic nodules	No	No	Yes	alive	228	HCC, II	5
047	45	7	right hepatic lobectomy	No	No	No	alive	228	HCC, I	5505
049	65	2.2	intrahepatic nodules	No	No	Yes	alive	219	HCC, I, II	13
051	72	2.5	intrahepatic nodules	No	No	No	alive	245	HCC, II	383
050	60	1.5	intrahepatic nodules	No	No	Yes	alive	228	HCC, II	2715
053	61	1.3	intrahepatic nodules (segment V, VI)	No	No	No	alive	228	HCC, II	19
055	45	3	right hepatic lobectomy	No	No	Yes	no response		HCC, II	458
056	43	2.5	intrahepatic nodules	No	No	Yes	alive	227	HCC, II	12
057	57	1.2	left hepatic lobectomy	No	No	Yes	alive	279	HCC, II	2

* All but 511 were 433-positive cases; all but 551 are male patients.
 ** The histology of these cases was determined by two independent. All malignancies and metastases are T, well differentiated; II, moderately differentiated; III, poorly differentiated. The maximum diameter of the largest nodule (cm) is indicated. III, 1.0-1.5 cm; IV, 1.6-2.0 cm; V, 2.1-3.0 cm; VI, 3.1-4.0 cm; VII, 4.1-5.0 cm; VIII, 5.1-6.0 cm; IX, 6.1-7.0 cm; X, 7.1-8.0 cm; XI, 8.1-9.0 cm; XII, 9.1-10.0 cm; XIII, 10.1-11.0 cm; XIV, 11.1-12.0 cm; XV, 12.1-13.0 cm; XVI, 13.1-14.0 cm; XVII, 14.1-15.0 cm; XVIII, 15.1-16.0 cm; XIX, 16.1-17.0 cm; XX, 17.1-18.0 cm; XXI, 18.1-19.0 cm; XXII, 19.1-20.0 cm; XXIII, 20.1-21.0 cm; XXIV, 21.1-22.0 cm; XXV, 22.1-23.0 cm; XXVI, 23.1-24.0 cm; XXVII, 24.1-25.0 cm; XXVIII, 25.1-26.0 cm; XXIX, 26.1-27.0 cm; XXX, 27.1-28.0 cm; XXXI, 28.1-29.0 cm; XXXII, 29.1-30.0 cm; XXXIII, 30.1-31.0 cm; XXXIV, 31.1-32.0 cm; XXXV, 32.1-33.0 cm; XXXVI, 33.1-34.0 cm; XXXVII, 34.1-35.0 cm; XXXVIII, 35.1-36.0 cm; XXXIX, 36.1-37.0 cm; XL, 37.1-38.0 cm; XLI, 38.1-39.0 cm; XLII, 39.1-40.0 cm; XLIII, 40.1-41.0 cm; XLIV, 41.1-42.0 cm; XLV, 42.1-43.0 cm; XLVI, 43.1-44.0 cm; XLVII, 44.1-45.0 cm; XLVIII, 45.1-46.0 cm; XLIX, 46.1-47.0 cm; L, 47.1-48.0 cm; LI, 48.1-49.0 cm; LII, 49.1-50.0 cm; LIII, 50.1-51.0 cm; LIV, 51.1-52.0 cm; LV, 52.1-53.0 cm; LVI, 53.1-54.0 cm; LVII, 54.1-55.0 cm; LVIII, 55.1-56.0 cm; LVIX, 56.1-57.0 cm; LX, 57.1-58.0 cm; LXI, 58.1-59.0 cm; LXII, 59.1-60.0 cm; LXIII, 60.1-61.0 cm; LXIV, 61.1-62.0 cm; LXV, 62.1-63.0 cm; LXVI, 63.1-64.0 cm; LXVII, 64.1-65.0 cm; LXVIII, 65.1-66.0 cm; LXIX, 66.1-67.0 cm; LXX, 67.1-68.0 cm; LXXI, 68.1-69.0 cm; LXXII, 69.1-70.0 cm; LXXIII, 70.1-71.0 cm; LXXIV, 71.1-72.0 cm; LXXV, 72.1-73.0 cm; LXXVI, 73.1-74.0 cm; LXXVII, 74.1-75.0 cm; LXXVIII, 75.1-76.0 cm; LXXIX, 76.1-77.0 cm; LXXX, 77.1-78.0 cm; LXXXI, 78.1-79.0 cm; LXXXII, 79.1-80.0 cm; LXXXIII, 80.1-81.0 cm; LXXXIV, 81.1-82.0 cm; LXXXV, 82.1-83.0 cm; LXXXVI, 83.1-84.0 cm; LXXXVII, 84.1-85.0 cm; LXXXVIII, 85.1-86.0 cm; LXXXIX, 86.1-87.0 cm; LXXXX, 87.1-88.0 cm; LXXXXI, 88.1-89.0 cm; LXXXXII, 89.1-90.0 cm; LXXXXIII, 90.1-91.0 cm; LXXXXIV, 91.1-92.0 cm; LXXXXV, 92.1-93.0 cm; LXXXXVI, 93.1-94.0 cm; LXXXXVII, 94.1-95.0 cm; LXXXXVIII, 95.1-96.0 cm; LXXXXIX, 96.1-97.0 cm; LXXXXX, 97.1-98.0 cm; LXXXXXI, 98.1-99.0 cm; LXXXXXII, 99.1-100.0 cm; LXXXXXIII, 100.1-101.0 cm; LXXXXXIV, 101.1-102.0 cm; LXXXXXV, 102.1-103.0 cm; LXXXXXVI, 103.1-104.0 cm; LXXXXXVII, 104.1-105.0 cm; LXXXXXVIII, 105.1-106.0 cm; LXXXXXIX, 106.1-107.0 cm; LXXXXXX, 107.1-108.0 cm; LXXXXXXI, 108.1-109.0 cm; LXXXXXXII, 109.1-110.0 cm; LXXXXXXIII, 110.1-111.0 cm; LXXXXXXIV, 111.1-112.0 cm; LXXXXXXV, 112.1-113.0 cm; LXXXXXXVI, 113.1-114.0 cm; LXXXXXXVII, 114.1-115.0 cm; LXXXXXXVIII, 115.1-116.0 cm; LXXXXXXIX, 116.1-117.0 cm; LXXXXXXX, 117.1-118.0 cm; LXXXXXXXI, 118.1-119.0 cm; LXXXXXXXII, 119.1-120.0 cm; LXXXXXXXIII, 120.1-121.0 cm; LXXXXXXXIV, 121.1-122.0 cm; LXXXXXXXV, 122.1-123.0 cm; LXXXXXXXVI, 123.1-124.0 cm; LXXXXXXXVII, 124.1-125.0 cm; LXXXXXXXVIII, 125.1-126.0 cm; LXXXXXXXIX, 126.1-127.0 cm; LXXXXXXX, 127.1-128.0 cm; LXXXXXXXI, 128.1-129.0 cm; LXXXXXXXII, 129.1-130.0 cm; LXXXXXXXIII, 130.1-131.0 cm; LXXXXXXXIV, 131.1-132.0 cm; LXXXXXXXV, 132.1-133.0 cm; LXXXXXXXVI, 133.1-134.0 cm; LXXXXXXXVII, 134.1-135.0 cm; LXXXXXXXVIII, 135.1-136.0 cm; LXXXXXXXIX, 136.1-137.0 cm; LXXXXXXX, 137.1-138.0 cm; LXXXXXXXI, 138.1-139.0 cm; LXXXXXXXII, 139.1-140.0 cm; LXXXXXXXIII, 140.1-141.0 cm; LXXXXXXXIV, 141.1-142.0 cm; LXXXXXXXV, 142.1-143.0 cm; LXXXXXXXVI, 143.1-144.0 cm; LXXXXXXXVII, 144.1-145.0 cm; LXXXXXXXVIII, 145.1-146.0 cm; LXXXXXXXIX, 146.1-147.0 cm; LXXXXXXX, 147.1-148.0 cm; LXXXXXXXI, 148.1-149.0 cm; LXXXXXXXII, 149.1-150.0 cm; LXXXXXXXIII, 150.1-151.0 cm; LXXXXXXXIV, 151.1-152.0 cm; LXXXXXXXV, 152.1-153.0 cm; LXXXXXXXVI, 153.1-154.0 cm; LXXXXXXXVII, 154.1-155.0 cm; LXXXXXXXVIII, 155.1-156.0 cm; LXXXXXXXIX, 156.1-157.0 cm; LXXXXXXX, 157.1-158.0 cm; LXXXXXXXI, 158.1-159.0 cm; LXXXXXXXII, 159.1-160.0 cm; LXXXXXXXIII, 160.1-161.0 cm; LXXXXXXXIV, 161.1-162.0 cm; LXXXXXXXV, 162.1-163.0 cm; LXXXXXXXVI, 163.1-164.0 cm; LXXXXXXXVII, 164.1-165.0 cm; LXXXXXXXVIII, 165.1-166.0 cm; LXXXXXXXIX, 166.1-167.0 cm; LXXXXXXX, 167.1-168.0 cm; LXXXXXXXI, 168.1-169.0 cm; LXXXXXXXII, 169.1-170.0 cm; LXXXXXXXIII, 170.1-171.0 cm; LXXXXXXXIV, 171.1-172.0 cm; 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LXXXXXXXI, 388.1-389.0 cm; LXXXXXXXII, 389.1-390.0 cm; LXXXXXXXIII, 390.1-391.0 cm; LXXXXXXXIV, 391.1-392.0 cm; LXXXXXXXV, 392.1-393.0 cm; LXXXXXXXVI, 393.1-394.0 cm; LXXXXXXXVII, 394.1-395.0 cm; LXXXXXXXVIII, 395.1-396.0 cm; LXXXXXXXIX, 396.1-397.0 cm; LXXXXXXX, 397.1-398.0 cm; LXXXXXXXI, 398.1-399.0 cm; LXXXXXXXII, 399.1-400.0 cm; LXXXXXXXIII, 400.1-401.0 cm; LXXXXXXXIV, 401.1-402.0 cm; LXXXXXXXV, 402.1-403.0 cm; LXXXXXXXVI, 403.1-404.0 cm; LXXXXXXXVII, 404.1-405.0 cm; LXXXXXXXVIII, 405.1-406.0 cm; LXXXXXXXIX, 406.1-407.0 cm; LXXXXXXX, 407.1-408.0 cm; LXXXXXXXI, 408.1-409.0 cm; LXXXXXXXII, 409.1-410.0 cm; LXXXXXXXIII, 410.1-411.0 cm; LXXXXXXXIV, 411.1-412.0 cm; LXXXXXXXV, 412.1-413.0 cm; LXXXXXXXVI, 413.1-414.0 cm; LXXXXXXXVII, 414.1-415.0 cm; LXXXXXXXVIII, 415.1-416.0 cm; LXXXXXXXIX, 416.1-417.0 cm; LXXXXXXX, 417.1-418.0 cm; LXXXXXXXI, 418.1-419.0 cm; LXXXXXXXII, 419.1-420.0 cm; LXXXXXXXIII, 420.1-421.0 cm; LXXXXXXXIV, 421.1-422.0 cm; LXXXXXXXV, 422.1-423.0 cm; LXXXXXXXVI, 423.1-424.0 cm; LXXXXXXXVII, 424.1-425.0 cm; LXXXXXXXVIII, 425.1-426.0 cm; LXXXXXXXIX, 426.1-427.0 cm; LXXXXXXX, 427.1-428.0 cm; LXXXXXXXI, 428.1-429.0 cm; LXXXXXXXII, 429.1-430.0 cm; LXXXXXXXIII, 430.1-431.0 cm; LXXXXXXXIV, 431.1-432.0 cm; LXXXXXXXV, 432.1-433.0 cm; LXXXXXXXVI, 433.1-434.0 cm; LXXXXXXXVII, 434.1-435.0 cm; LXXXXXXXVIII, 435.1-436.0 cm; LXXXXXXXIX, 436.1-437.0 cm; LXXXXXXX, 437.1-438.0 cm; LXXXXXXXI, 438.1-439.0 cm; LXXXXXXXII, 439.1-440.0 cm; LXXXXXXXIII, 440.1-441.0 cm; LXXXXXXXIV, 441.1-442.0 cm; LXXXXXXXV, 442.1-443.0 cm; LXXXXXXXVI, 443.1-444.0 cm; LXXXXXXXVII, 444.1-445.0 cm; LXXXXXXXVIII, 445.1-446.0 cm; LXXXXXXXIX, 446.1-447.0 cm; LXXXXXXX, 447.1-448.0 cm; LXXXXXXXI, 448.1-449.0 cm; LXXXXXXXII, 449.1-450.0 cm; LXXXXXXXIII, 450.1-451.0 cm; LXXXXXXXIV, 451.1-452.0 cm;

가 sample 가 sample
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Table 4. Performance of classifier

Classifier category	Clinical groups	Total number of cases	Number of cases misclassified	Classifier P-value	Number of genes in the classifiers
FN vs. PT	PT	10	0	<0.0005	153
	FN	10	0		
FN vs. P	FN	10	1	<0.0005	157
	P	10	0		
FN vs. P and PT	FN	10	2	<0.001	256
	P and PT	20	0		
P vs. PT	P	10	3	0.216	20
	PT	10	4		
PT vs. PT-M	Paired samples	10	3	0.296	1
P and PT vs. P-M and PTM	Paired samples	20	5	0.132	7
P vs. PT-M	P	10	4	0.248	14
	PT-M	10	3		
PT vs. P-M	PT	10	2	0.163	9
	P-M	10	4		
Tumor diameter	>5 cm	16	7	0.234	7
	≤5 cm	14	4		
Ages	>45 years	17	5	0.334	4
	≤45 years	13	7		
Tumor metastasis	Presence	9	2	0.037	13
	Absence	21	4		
Cirrhosis	Presence	14	7	0.798	1
	Absence	6	6		

*CCP was used to classify various clinical groups with a total of 9,180 genes at a significance level of P=0.001. Classifier was based on 2,000 random permutations. Expected number of false-positive genes in classifier is 10.

224 , sample 가 microarray sample 3
 가 sample sample

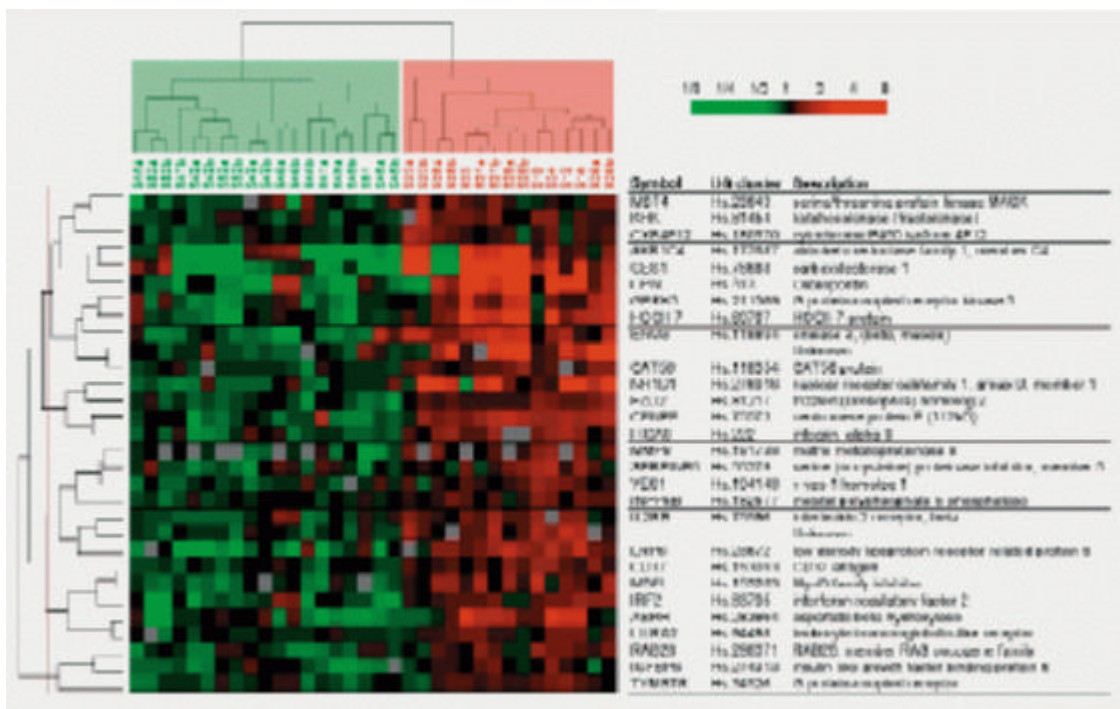


Figure 1. PN 30 PT PT-M Hierarchical Clustering

osteopontin(SPP1) *in vitro/in vivo* assay

osteopontin 가 가

3.

가 가 가

data가

sample

microarray

가 .
sample
90%
classifier 가

4.

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