

Supplementary Table 1. Clinicopathological characteristics of breast cancer patients

Cases	Age at diagnosis (yr)	Grade	TNM	Focality	Molecular subtype	ER	PR	HER2	Ki-67 (%)	Neoadjuvant chemotherapy
1	37	3	T2N2M0	UF	TN	-	+	0	80	Yes
2	50	3	T2N0M0	MF	Lum B HER2-	+	+	1+	38	No
3	53	2	T1N0M0	MF	TN	-	-	0	87	No
4	64	2	T2N1M0	UF	Lum B HER2-	+	+	1+	30	No
5	64	2	T2N0M0	UF	Lum B HER2+	+	+	3+	21	Yes
6	56	1	T4N3M0	UF	Lum B HER2-	+	-	1+	42	No
7	44	2	T2N1M0	UF	Lum B HER2-	+	+	0	20	No
8	58	3	T4N1M0	UF	TN	-	-	2+ (FISH-)	52	Yes
9	48	3	T2N2M0	UF	TN	-	-	0	36	Yes
10	58	2	T2N1M0	UF	Lum B HER2-	+	+	1+	43	No
11	71	3	T2N1M0	UF	Lum B HER2-	+	0	0	85	No
12	76	1	T2N <sub>x</sub> M0	UF	Lum A HER2-	+	+	1+	7	No
13	45	2	T2N0M0	UF	Lum A HER2-	+	+	1+	14	No
14	60	2	T3N1M0	UF	Lum B HER2-	+	+	0	32	ND
15	62	1	T2N1M0	UF	Lum B HER2-	+	+	0	44	Yes
16	36	2	T2N <sub>x</sub> M0	MF	Lum B HER2-	+	+	0	35	Yes
17	45	2	T2N0M0	UF	TN	-	-	0	77	Yes
18	68	3	T2N <sub>x</sub> M <sub>x</sub>	UF	Lum B HER2-	+	0	-	33	Yes
19	60	1	T2N0M0	UF	Lum B HER2-	+	+	2+ (FISH-)	38	No
20	55	2	T4N1M0	UF	HER2+	-	-	3+	18	Yes

UF, unifocal; MF, multifocal; Lum, luminal; TN, triple-negative; yr, years; ER, estrogen receptors; PR, progesterone receptors; TNM, tumor-node-metastasis classification; "+", presence; "-", absence; FISH, fluorescence in situ hybridization

Supplementary Table 2. Expression of stemness/EMT and proliferation genes in CTCs of breast cancer patients

	<i>CD133/ PROM1</i>	<i>ALDH1A1</i>	<i>CD44/ CD24</i>	<i>SNAI1</i>	<i>SNAI2</i>	<i>KLF4</i>	<i>OCT4/ POU5F1</i>	<i>MYC</i>	<i>CDH1</i>	<i>CDH2</i>	<i>VIM</i>	<i>ZEB1</i>	<i>ZEB2</i>	<i>MKI67</i>
1. CTCs expressing isolated integrin subunits, n=143	1/143 (0.7%)	0/143 (0.0%)	13/143 (9.1%)	0/143 (0.0%)	0/143 (0.0%)	1/143 (0.7%)	0/143 (0.0%)	0/143 (0.0%)	16/143 (11.2%)	0/143 (0.0%)	56/143 (39.2%)	3/143 (2.1%)	39/143 (27.3%)	0/143 (0.0%)
2. CTCs expressing isolated integrin $\alpha$ -subunits, n=81	1/81 (1.2%)	2/81 (2.5%)	16/81 (19.8%)	1/81 (1.2%)	0/81 (0.0%)	2/81 (2.5%)	0/81 (0.0%)	0/81 (0.0%)	7/81 (8.6%)	0/81 (0.0%)	38/81 (46.9%)	2/81 (2.5%)	30/81 (37.0%) <b>p=0.008</b>	1/81 (1.2%)
3. CTCs expressing different heterodimers containing $\beta$ 1-subunit without other $\beta$ -subunits, n=8	0/8 (0.0%)	1/8 (12.5%) <b>p=0.043*</b>	1/8 (12.5%)	0/8 (0.0%)	0/8 (0.0%)	1/8 (12.5%)	1/8 (12.5%) <b>p=0.043</b>	0/8 (0.0%)	1/8 (12.5%)	0/8 (0.0%)	3/8 (37.5%)	0/8 (0.0%)	3/8 (37.5%)	1/8 (12.5%)
4. CTCs expressing different heterodimers containing $\beta$ 2-subunit without other $\beta$ -subunits, n=2	0/2 (0.0%)	0/2 (0.0%)	1/2 (50.0%)	0/2 (0.0%)	0/2 (0.0%)	0/2 (0.0%)	0/2 (0.0%)	0/2 (0.0%)	1/2 (50.0%)	0/2 (0.0%)	2/2 (100.0%)	0/2 (0.0%)	2/2 (100.0%) <b>p=0.042</b>	0/2 (0.0%)
5. CTCs expressing different heterodimers containing $\beta$ 3-subunit without other $\beta$ -subunits, n=11	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	1/11 (9.1%)	0/11 (0.0%)	1/11 (9.1%)	0/11 (0.0%)
6. CTCs expressing different $\beta$ -subunits with at least one potential heterodimer, n=38	0/38 (0.0%)	0/38 (0.0%)	4/38 (10.5%)	0/38 (0.0%)	0/38 (0.0%)	0/38 (0.0%)	0/38 (0.0%)	0/38 (0.0%)	1/38 (2.6%)	0/38 (0.0%)	9/38 (23.7%)	0/38 (0.0%)	14/38 (36.8%) <b>p=0.034</b>	0/38 (0.0%)
7. CTCs expressing $\beta$ 4-subunit along with other subunits or heterodimer, n=3	0/3 (0.0%)	1/3 (33.3%) <b>p=0.017</b>	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	1/3 (33.3%) <b>p=0.038</b>	1/3 (33.3%)	0/3 (0.0%)	1/3 (33.3%)	1/3 (33.3%)	2/3 (66.6%)	0/3 (0.0%)
8. CTCs expressing genes of full-fledged integrin $\alpha$ 6 $\beta$ 4, n=5	1/5 (20%) <b>p=0.027</b>	1/5 (20%) <b>p=0.027</b>	1/5 (20%)	0/5 (0%)	0/5 (0.0%)	3/5 (60%) <b>p=0.033</b>	0/5 (0.0%)	2/5 (40%) <b>p=0.002</b>	0/5 (0.0%)	1/5 (20%) <b>p=0.027</b>	5/5 (100%) <b>p=0.01</b>	4/5 (80%) <b>p&lt;0.001</b>	2/5 (40%)	1/5 (10.0%) <b>p=0.06</b>
9. CTCs without integrins subunits gene expression, n=154	0/154 (0.0%)	0/154 (0.0%)	20/154 (13.0%)	1/154 (0.65%)	0/154 (0.0%)	2/154 (1.3%)	0/154 (0.0%)	1/154 (0.65%)	20/154 (13.0%)	0/154 (0.0%)	61/154 (39.6%)	6/154 (3.9%)	31/154 (20.1%)	1/154 (0.65%)

\*Note: The table shows significant differences compared to the CTCs without integrins gene expression (group 9).

Supplementary Table 3. Gene expression of laminin subunits in CTCs of breast cancer patients

	<i>LAMA4</i>	<i>LAMA5</i>	<i>LAMB1</i>	<i>LAMB2</i>	<i>LAMB3</i>	<i>LAMC1</i>
1. CTCs expressing isolated integrin subunits, n=143	0/143 (0.0%)	1/143 (0.0%)	1/143 (0.0%)	0/143 (0.0%)	1/143 (0.0%)	0/143 (0.0%)
2. CTCs expressing isolated integrin $\alpha$ -subunits, n=81	0/81 (0.0%)	1/81 (1.2%)	2/81 (2.4%)	0/81 (0.0%)	0/81 (0.0%)	2/81 (2.4%)
3. CTCs expressing different heterodimers containing $\beta$ 1-subunit without other $\beta$ -subunits, n=8	0/8 (0.0%)	1/8 (0.0%)	1/8 (0.0%)	0/8 (0.0%)	0/8 (0.0%)	1/8 (12.5%)
4. CTCs expressing different heterodimers containing $\beta$ 2-subunit without other $\beta$ -subunits, n=2	0/2 (0.0%)	0/2 (0.0%)	0/2 (0.0%)	0/2 (0.0%)	0/2 (0.0%)	0/2 (0.0%)
5. CTCs expressing different heterodimers containing $\beta$ 3-subunit without other $\beta$ -subunits, n=11	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)
6. CTCs expressing different $\beta$ -subunits with at least one potential heterodimer, n=38	0/38 (0.0%)	0/38 (0.0%)	1/38 (0.0%)	0/38 (0.0%)	0/38 (0.0%)	0/38 (0.0%)
7. CTCs expressing $\beta$ 4-subunit along with other subunits or heterodimer, n=3	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)
8. CTCs expressing genes of full-fledged integrin $\alpha$ 6 $\beta$ 4, n=5	5/5 (100.0%) <b>p&lt;0.001*</b>	1/5 (20.0%) <b>p=0.028</b>	5/5 (100.0%) <b>p&lt;0.001</b>	3/5 (60.0%) <b>p&lt;0.001</b>	1/5 (20.0%) <b>p=0.028</b>	4/5 (80.0%) <b>p&lt;0.001</b>
9. CTCs without integrins subunits gene expression, n=154	0/154 (0.0%)	0/154 (0.0%)	0/154 (0.0%)	0/154 (0.0%)	0/154 (0.0%)	1/154 (0.6%)

\*Note: The table shows significant differences compared to the CTCs without integrins gene expression (group 9).

Supplementary Table 4. Gene expression of chemokines/their receptors and inflammatory factors in CTCs of breast cancer patients

	<i>TGFB1</i>	<i>VEGFA</i>	<i>CCL2</i>	<i>CXCR7/ ACKR3</i>	<i>IL1B</i>	<i>CXCL8/ IL8</i>	<i>IL18</i>	<i>IL6</i>	<i>CASP1</i>	<i>NLRP3</i>	<i>ASC/ PYCARD</i>
1. CTCs expressing isolated integrin subunits, n=143	72/143 (50.3%) <b>p&lt;0.001*</b>	1/143 (0.7%)	0/143 (0.0%)	0/143 (0.0%)	5/143 (3.5%)	3/143 (2.1%)	7/143 (4.9%) <b>p=0.005</b>	0/143 (0.0%)	2/143 (1.4%)	1/143 (0.7%)	21/143 (14.7%)
2. CTCs expressing isolated integrin $\alpha$ -subunits, n=81	28/81 (34.6%) <b>p=0.015</b>	0/81 (0.0%)	0/81 (0.0%)	0/81 (0.0%)	3/81 (3.7%)	2/81 (2.5%)	5/81 (6.2%)	0/81 (0.0%)	1/81 (1.2%)	2/81 (2.4%)	11/81 (13.6%)
3. CTCs expressing different heterodimers containing $\beta$ 1-subunit without other $\beta$ -subunits, n=8	3/8 (37.5%)	0/8 (0.0%)	0/8 (0.0%)	0/8 (0.0%)	0/8 (0.0%)	0/8 (0.0%)	0/8 (0.0%)	0/8 (0.0%)	0/8 (0.0%)	0/8 (0.0%)	1/8 (12.5%)
4. CTCs expressing different heterodimers containing $\beta$ 2-subunit without other $\beta$ -subunits, n=2	0/2 (0.0%)	1/2 (0.0%)	0/2 (0.0%)	0/2 (0.0%)	1/2 (50.0%) <b>p=0.022</b>	1/2 (50.0%) <b>p=0.022</b>	0/2 (0.0%)	1/2 (50.0%) <b>p=0.022</b>	0/2 (0.0%)	1/2 (50.0%) <b>p=0.022</b>	0/2 (0.0%)
5. CTCs expressing different heterodimers containing $\beta$ 3-subunit without other $\beta$ -subunits, n=11	8/11 (72.7%) <b>p=0.006</b>	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)
6. CTCs expressing different $\beta$ -subunits with at least one potential heterodimer, n=38	35/38 (92.1%) <b>p&lt;0.001</b>	1/38 (2.6%)	0/38 (0.0%)	0/38 (0.0%)	1/38 (2.6%)	2/38 (5.2%) <b>p&lt;0.001</b>	1/38 (2.6%)	0/38 (0.0%)	0/38 (0.0%)	0/38 (0.0%)	2/38 (5.2%)
7. CTCs expressing $\beta$ 4-subunit along with other subunits or heterodimer, n=3	1/3 (33.3%)	1/3 (33.3%) <b>p=0.038</b>	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	1/3 (33.3%)
8. CTCs expressing genes of full-fledged integrin $\alpha$ 6 $\beta$ 4, n=5	5/5 (100.0%) <b>p=0.003</b>	3/5 (60.0%) <b>p&lt;0.001</b>	2/5 (40.0%) <b>p&lt;0.001</b>	5/5 (100.0%) <b>p&lt;0.001</b>	0/5 (0.0%)	1/5 (20.0%) <b>p=0.054</b>	0/5 (0.0%)	1/5 (20.0%) <b>p=0.028</b>	1/5 (20.0%) <b>p= 0.028</b>	0/5 (0.0%)	1/5 (20.0%)
9. CTCs without integrins subunits gene expression, n=154	46/154 (29.9%)	1/154 (0.6%)	0/154 (0.0%)	0/154 (0.0%)	1/154 (0.6%)	1/154 (0.6%)	0/154 (0.0%)	0/154 (0.0%)	0/154 (0.0%)	0/154 (0.0%)	16/154 (9.0%)

\*Note: The table shows significant differences compared to the CTCs without integrins gene expression (group 9).

Supplementary Table 5. Gene expression of invasion markers in CTCs of breast cancer patients

	<i>RAC1</i>	<i>RHOC</i>	<i>ROCK1</i>	<i>MMP1</i>	<i>MMP2</i>
1. CTCs expressing isolated integrin subunits, n=143	53/143 (37.0%)	15/143 (10.5%)	20/143 (14.0%)	0/143 (0.0%)	0/143 (0.0%)
2. CTCs expressing isolated integrin $\alpha$ -subunits, n=81	25/81 (30.9%)	7/81 (8.6%)	17/81 (21.0%) <b>p=0.020</b>	0/81 (0.0%)	0/81 (0.0%)
3. CTCs expressing different heterodimers containing $\beta$ 1-subunit without other $\beta$ -subunits, n=8	2/8 (25.0%)	1/8 (12.5%)	1/8 (12.5%)	0/8 (0.0%)	0/8 (0.0%)
4. CTCs expressing different heterodimers containing $\beta$ 2-subunit without other $\beta$ -subunits, n=2	1/2 (50.0%)	0/2 (0.0%)	1/2 (50.0%)	0/2 (0.0%)	0/2 (0.0%)
5. CTCs expressing different heterodimers containing $\beta$ 3-subunit without other $\beta$ -subunits, n=11	6/11 (54.5%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)
6. CTCs expressing different $\beta$ -subunits with at least one potential heterodimer, n=38	27/38 (71.1%) <b>p&lt;0.001*</b>	12/38 (31.6%) <b>p=0,001</b>	10/38 (26.3%) <b>p=0.013</b>	0/38 (0.0%)	0/38 (0.0%)
7. CTCs expressing $\beta$ 4-subunit along with other subunits or heterodimer, n=3	1/3 (33.3%)	0/3 (0.0%)	2/3 (66.7%) <b>p=0.027</b>	0/3 (0.0%)	0/3 (0.0%)
8. CTCs expressing genes of full-fledged integrin $\alpha$ 6 $\beta$ 4, n=5	5/5 (100.0%) <b>p=0.002</b>	5/5 (100.0%) <b>p&lt;0.001</b>	4/5 (80.0%) <b>p=0.001</b>	1/5 (20.0%) <b>p=0.028</b>	5/5 (100.0%) <b>p&lt;0.001</b>
9. CTCs without integrins subunits gene expression, n=154	45/154 (29.2%)	15/154 (9.7%)	15/154 (9.7%)	0/154 (0.0%)	0/154 (0.0%)

\*Note: The table shows significant differences compared to the CTCs without integrins gene expression (group 9).

Supplementary Table 6. Gene expression of epithelial markers in CTCs of breast cancer patients

	<i>EPCAM</i>	<i>KRT10</i>	<i>KRT5</i>	<i>KRT8</i>	<i>KRT7</i>	<i>KRT18</i>	<i>KRT19</i>	<i>MUC1</i>	<i>CDH1</i>	<i>ERBB2</i>
1. CTCs expressing isolated integrin subunits, n=143	1/143 (0.7%)	15/143 (10.5%)	42/143 (29.4%)	55/143 (38.5%)	0/143 (0.0%)	30/143 (21.0)	1/143 (0.7%)	2/143 (1.4%)	16/143 (11.2%)	0/166 (0.0%)
2. CTCs expressing isolated integrin $\alpha$ -subunits, n=81	5/81 (6.2%)	17/81 (21.0%)	37/81 (45.7%)	19/81 (23.4%)	1/81 (1.2%)	14/81 (17.3%)	0/81 (0.0%)	3/81 (3.7%)	7/81 (8.6%)	0/81 (0.0%)
3. CTCs expressing different heterodimers containing $\beta$ 1-subunit without other $\beta$ -subunits, n=8	1/8 (12.5%)	1/8 (12.5%)	3/8 (37.5%)	2/8 (25.0%)	0/8 (0.0%)	2/8 (25.0%)	0/8 (0.0%)	1/8 (12.5%)	1/8 (12.5%)	1/8 (12.5%) <b>p=0.049</b>
4. CTCs expressing different heterodimers containing $\beta$ 2-subunit without other $\beta$ -subunits, n=2	0/2 (0.0%)	0/2 (0.0%)	0/2 (0.0%)	0/2 (0.0%)	1/2 (50.0%)	0/2 (0.0%)	0/2 (0.0%)	0/2 (0.0%)	1/2 (50.0%)	0/2 (0.0%)
5. CTCs expressing different heterodimers containing $\beta$ 3-subunit without other $\beta$ -subunits, n=11	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	7/11 (63.6%) <b>p=0.005</b>	0/11 (0.0%)	4/11 (36.4%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)	0/11 (0.0%)
6. CTCs expressing different $\beta$ -subunits with at least one potential heterodimer, n=38	0/38 (0.0%)	2/38 (5.3%)	5/38 (5.3%) <b>p=0.001</b>	18/38 (47.4%) <b>p=0.004</b>	0/38 (0.0%)	15/38 (39.5%) <b>p=0.017</b>	0/38 (0.0%)	0/38 (0.0%)	1/38 (2.6%)	0/38 (0.0%)
7. CTCs expressing $\beta$ 4-subunit along with other subunits or heterodimer, n=3	1/3 (33.3%)	1/3 (33.3%)	1/3 (33.3%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	0/3 (0.0%)	1/3 (33.3%)	0/3 (0.0%)
8. CTCs expressing genes of full-fledged integrin $\alpha$ 6 $\beta$ 4, n=5	0/5 (0.6%)	3/5 (60.0%) <b>p=0.013*</b>	0/5 (0.0%)	3/5 (60.0%)	0/5 (0.0%)	5/5 (100.0%) <b>p&lt;0.001</b>	2/5 (40.0%) <b>p=0.011</b>	0/5 (0.0%)	0/5 (0.0%)	0/5 (0.0%)
9. CTCs without integrins subunits gene expression, n=154	4/154 (2.6%)	16/154 (10.4%)	70/154 (45.5%)	34/154 (22.1%)	1/154 (0.6%)	30/154 (19.5%)	4/154 (2.6%)	2/154 (1.2%)	20/154 (13.0%)	0/154 (0.0%)

\*Note: The table shows significant differences compared to the CTCs without integrins gene expression (group 9).