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| Table S1. Clinical significance of the TIL subsets in breast cancer |
| Immune cell | Typical marker | Clinicopathological significance | Relationship with prognosis | Reference |
| CD8+ T cell | CD8+ | Higher tumor grade, Older age, Lower ER / PgR expression | Better BCSS in ER- and ER+/HER2+ BC | [12, 13] |
| CD4+ T cell | CD4+ |  | Better DFS / OS in TNBC | [14, 15] |
| Worse DFS in HR\*+ BC |
| Regulatory T cell | FOXP3+ | Higher in tumor tissue than in normal breast, Higher tumor grade, Lymph node involvement, ER–negative | Worse BCSS in ER+ BC | [16-19] |
| Better BCSS in ER- BC |
| Follicular helper T cell | CXCR5++ |  | Better DFS in ER+ / HER2- and HER2+ BC | [20] |
| ICOS+ |
| PD-1 |
| B cell | CD20+ | Higher tumor grade, ER / PgR-negative, Basal-like subtypes | Better BCSS in the ER- BC | [15, 21] |
| Worse DFS in HR+ BC |
| Macrophage | CD68+ | Higher tumor grade, Lymph node metastasis, Vascular invasion, ER / PgR negativity, HER2 expression, Basal phenotype | Worse DFS, BSCC, OS | [22, 23] |
| Myeloid-derived suppressor cells | HLA-DR-/low | Advanced clinical T | Worse DFS in ER+ BC | [24] [25]† |
| CD33+ | Higher tumor grade, HR negativity, HER2 positivity |
| Dendritic cell | HLA-DR+ | Higher tumor grade (TNBC) | Better OS in n+ TNBC | [26] [27]† |
| CD11b+ | Invasive > Non-invasive |
| Natural killer cell | CD56+ | Higher tumor grade, Advanced clinical Stage, Lymph node metastasis, | Worse DFS | [28] |
| CD3- |
| Natural killer T cell | CD3+ | Not well known |  |  |
| CD56+ |
| \*：ER and / or PgR |
| †：Non-specific marker was used in assessment of indicated immune cell. |

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| Table S2. Clinical-pathological characteristics of the whole cohort |
| Overall (N=45) | 　 | Overall (N=45) |
| Menopausal status |  | Histological Grade |
|    Unknown | 1 |  |    Unknown | 5 |
|    Post | 29 (65.9%) |  |    Grade 3  | 11 (27.5%) |
|    Pre | 15 (34.1%) |  |    Grade 1 or 2 | 29 (72.5%) |
| Neo-adjuvant thrrapy |  | ER status |  |
|  absent | 37 (82%) |  |  Positive | 17 (37.8%) |
|  present | 8 (18%) |  |  Negative | 28 (62.2%) |
| Histological Type |  | PgR status |  |
|    IDC | 39 (86.7%) |  |  Positive | 7 (15.6%) |
|    ILC | 1 (2.2%) |  |  Negative | 38 (84.4%) |
|    Special | 5 (11.1%) |  | HER2 status |  |
| Invasive tumor size |  |    Unknown | 1 |
|    Unknown | 1 |  |  Positive | 8 (18.2%) |
|    ≥20mm | 36 (81.8%) |  |  Negative | 36 (81.8%) |
|    < 20mm | 8 (18.2%) |  | Ki67 |  |
| Lymph node metastasis |  |    ≥ 20% | 33 (73.3%) |
|    Unknown | 1 |  |   < 20% | 12 (26.7%) |
|    Negative | 23 (52.3%) |  | TIL |  |
|    Positive | 21 (47.7%) |  |    Unknown | 1 |
| Lymphatic invasion |  |    Low | 23 (52.3%) |
|    Unknown | 1 |  |    Intermediate | 15 (34.1%) |
|    Negative | 19 (43.2%) |  |    High | 6 (13.6%) |
|    Positive | 25 (56.8%) |  | PD-L1 |  |
| Vascular invasion |  |    Unknown | 1 |
|    Unknown | 1 |  |    Positive | 25 (56.8%) |
|    Negative | 38 (86.4%) |  |    Negative | 19 (43.2%) |
|    Positive | 6 (13.6%) | 　 | 　 | 　 |

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| Table S3. Clinical-pathological characteristics of cohort with blood sample |
| Overall (N=18) | 　 | Overall (N=18) |
| Menopausal status |  | Histological Grade |
|    Unknown | 0 |  |    Unknown | 3 |
|    Post | 11 (61.1%) |  |    Grade 3  | 9 (60.0%) |
|    Pre | 7 (38.9%) |  |    Grade 1 or 2 | 6 (40.0%) |
| Neo-adjuvant thrrapy |  | ER status |  |
|  absent | 15 (83.3%) |  |  Positive | 0 (0%) |
|  present | 3 (16.7%) |  |  Negative | 18 (100.0%) |
| Histological Type |  | PgR status |  |
|    IDC | 14 (77.8%) |  |  Positive | 0 (0%) |
|    ILC | 0 (0%) |  |  Negative | 18 (100.0%) |
|    Special | 4 (22.2%) |  | HER2 status |  |
| Invasive tumor size |  |    Unknown | 1 |
|    Unknown | 0 |  |    Positive | 3 (17.6%) |
|    ≥20mm | 15 (83.3%) |  |    Negative | 14 (82.4%) |
|    < 20mm | 3 (16.7%) |  | Ki67 |  |
| Lymph node metastasis |  |    ≥ 20% | 14 (77.8%) |
|    Unknown | 0 |  |   < 20% | 4 (22.2%) |
|    Negative | 11 (61.1%) |  | TIL |  |
|    Positive | 7 (38.9%) |  |    Unknown | 0 |
| Lymphatic invasion |  |    Low | 7 (38.9%) |
|    Unknown | 0 |  |    Intermediate | 9 (50.0%) |
|    Negative | 9 (50.0%) |  |    High | 2 (11.1%) |
|    Positive | 9 (50.0%) |  | PD-L1 |  |
| Vascular invasion |  |    Unknown | 0 |
|    Unknown | 0 |  |    Positive | 11 (61.1%) |
|    Negative | 15 (83.3%) |  |  Negative | 7 (38.9%) |
|    Positive | 3 (16.7%) | 　 | 　 | 　 |

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| Table S4. Antibodies used for flow cytometry |
| Antigen | Conjugate | Company | Cat.# | Clone |
| CD3 | BUV496 | BD | 564809 | UCHT1 |
| CD4 | BV650 | BL | 317436 | OKT4 |
| CD8 | APC-Cy7 | BL | 344714 | SK1 |
| CD11c | AF700 | BD | 561352 | B-ly6 |
| CD14 | PerCP-Cy5.5 | BD | 550787 | M5E2 |
| CD16 | BUV395 | BD | 563785 | 3G8 |
| CD19 | PE-Cy5.5 | eBio | 35-0198-42 | SJ25C1 |
| CD45 | BV421 | BD | 563879 | HI30 |
| CD56 | BV711 | BD | 563169 | NCAM16.2 |
| HLA-DR | ECD | BC | PN IM3636 | Immu-357 |
| PD-L1 | PE-Cy7 | BD | 558017 | MIH1 |

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| Table S5. Definition of immune cell lineage in this study  |
| Leanage | Marker |
| Leucocyte | CD45+ |  |  |  |  |  |  |
| Total T cell | CD45+ | CD3+ |  |  |  |  |  |
| CD4+ T cell | CD45+ | CD3+ | CD4+ |  |  |  |  |
| CD8+ T cell | CD45+ | CD3+ | CD8+ |  |  |  |  |
| B cell | CD45+ | CD3- | CD19+ |  |  |  |  |
| Monocyte / Macrophage | CD45+ | CD3- | CD19- | CD14+ |  |  |  |
| Non-classical Monocyte | CD45+ | CD3- | CD19- | CD14+ | CD16+ |  |  |
| MDSC\* | CD45+ | CD3- | CD19- | CD14+ | HLA-DR low |  |  |
| Dendritic cell | CD45+ | CD3- | CD19- | CD14- | CD56- | HLA-DR+ |  |
| Myeloid dendritic cell | CD45+ | CD3- | CD19- | CD14- | CD56- | HLA-DR+ | CD11c+ |
| Natural killer cell | CD45+ | CD3- | CD19- | CD14- | CD56 dim | CD16+ |  |
| Minor NK\*\* | CD45+ | CD3- | CD19- | CD14- | CD56 high | CD16- |  |
| Natural killer T cell | CD45+ | CD3+ | CD56+ |  |  |  |  |
| \*MDSC: myeloid-derived supressor cells |
| \*\*Natural killer cell |

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| Table S6. Clinical-pathological characteristics by hTIL score |
| 　 | hTIL score 0 (N=23) | hTIL score1,2 (N=21) | *p-*value | 　 | 　 | hTIL score 0 (N=23) | hTIL score1,2 (N=21) | *p-*value |
| Menopausal status |  | 0.512 |  | Vascular invasion |  | 0.089 |
|    Unknown | 0 | 1 |  |  |    Unknown | 1 | 0 |  |
|    Post | 16 (69.6%) | 12 (60.0%) |  |  |    Negative | 17 (77.3%) | 20 (95.2%) |  |
|    Pre | 7 (30.4%) | 8 (40.0%) |  |  |    Positive | 5 (22.7%) | 1 (4.8%) |  |
| Neo-adjuvant thrrapy |  | 0.155 |  | Histological Grade |  | 0.011\* |
|  absent | 17 (73.9%) | 19 (90.5%) |  |  |    Unknown | 2 | 3 |  |
|  present | 6 (26.1%) | 2 (9.5%) |  |  |    Grade 3  | 2 (9.5%) | 9 (50.0%) |  |
| Histological Type |  | 0.544 |  |    Grade 1, 2 | 19 (90.5%) | 9 (50.0%) |  |
|    IDC | 20 (87.0%) | 18 (85.7%) |  |  | ER status |  |  | 0.002\* |
|    ILC | 1 (4.3%) | 0 (0.0%) |  |  |  Positive | 14 (60.9%) | 3 (14.3%) |  |
|    Special | 2 (8.7%) | 3 (14.3%) |  |  |  Negative | 9 (39.1%) | 18 (85.7%) |  |
| Invasive tumor size |  | 0.631 |  | PgR status |  |  | 0.269 |
|    Unknown | 1 | 0 |  |  |  Positive | 5 (21.7%) | 2 (9.5%) |  |
|    ≥20mm | 19 (86.4%) | 17 (81.0%) |  |  |  Negative | 18 (78.3%) | 19 (90.5%) |  |
|    < 20mm | 3 (13.6%) | 4 (19.0%) |  |  | HER2 status |  |  | 0.062 |
| Lymph node metastasis |  | 0.443 |  |    Unknown | 0 | 1 |  |
|    Unknown | 1 | 0 |  |  |    Positive | 6 (26.1%) | 1 (5.0%) |  |
|    Negative | 10 (45.5%) | 12 (57.1%) |  |  |    Negative | 17 (73.9%) | 19 (95.0%) |  |
|    Positive | 12 (54.5%) | 9 (42.9%) |  |  | Ki67 |  |  | 0.036\* |
| Lymphatic invasion |  | 0.897 |  |    ≥ 20% | 14 (60.9%) | 19 (90.5%) |  |
|    Unknown | 1 | 0 |  |  |   < 20% | 9 (39.1%) | 2 (9.5%) |  |
|    Negative | 9 (40.9%) | 9 (42.9%) |  |  | PD-L1 |  |  | < .001\* |
|    Positive | 13 (59.1%) | 12 (57.1%) |  |  |    Unknown | 0 | 0 |  |
|  |  |  |  |  |    Positive | 7 (30.4%) | 18 (85.7%) |  |
| 　 | 　 | 　 | 　 | 　 |    Negative | 16 (69.6%) | 3 (14.3%) | 　 |
| \*Statistically significant *p*-value |  |  |  |  |  |  |

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| Table S7. Clinical-pathological characteristics by hPD-L1 status |
| 　 | hPD-L1 positive (N=25) | hPD-L1 negative (N=19) | *p-*value | 　 | 　 | hPD-L1 positive (N=25) | hPD-L1 negative (N=19) | *p-*value |
| Menopausal status |  | 0.126  |  | Vascular invasion |  | 0.232  |
|    Unknown | 1 | 0 |  |  |    Unknown | 1 | 0 |  |
|    Post | 18 (75.0%) | 10 (52.6%) |  |  |    Negative | 22 (91.7%) | 15 (78.9%) |  |
|    Pre | 6 (25.0%) | 9 (47.4%) |  |  |    Positive | 2 (8.3%) | 4 (21.1%) |  |
| Neo-adjuvant thrrapy |  | 0.223  |  | Histological Grade |  | 0.086  |
|  absent | 22 (88.0%) | 14 (73.7%) |  |  |    Unknown | 2 | 3 |  |
|  present | 3 (12.0%) | 5 (26.3%) |  |  |    Grade 3  | 9 (39.1%) | 2 (12.5%) |  |
| Histological Type |  | 0.508  |  |    Grade 1, 2 | 14 (60.9%) | 14 (87.5%) |  |
|    IDC | 22 (88.0%) | 16 (84.2%) |  |  | ER status |  |  | 0.005\* |
|    ILC | 0 (0.0%) | 1 (5.3%) |  |  |  Positive | 5 (20.0%) | 12 (63.2%) |  |
|    Special | 3 (12.0%) | 2 (10.5%) |  |  |  Negative | 20 (80.0%) | 7 (36.8%) |  |
| Invasive tumor size |  | 0.451  |  | PgR status |  |  | 0.100  |
|    Unknown | 1 | 0 |  |  |  Positive | 2 (8.0%) | 5 (26.3%) |  |
|    ≥20mm | 21 (87.5%) | 15 (78.9%) |  |  |  Negative | 23 (92.0%) | 14 (73.7%) |  |
|    < 20mm | 3 (12.5%) | 4 (21.1%) |  |  | HER2 status |  |  | 0.451  |
| Lymph node metastasis |  | 0.290  |  |    Unknown | 1 | 0 |  |
|    Unknown | 1 | 0 |  |  |    Positive | 3 (12.5%) | 4 (21.1%) |  |
|    Negative | 14 (58.3%) | 8 (42.1%) |  |  |    Negative | 21 (87.5%) | 15 (78.9%) |  |
|    Positive | 10 (41.7%) | 11 (57.9%) |  |  | Ki67 |  |  | 0.164  |
| Lymphatic invasion |  | 0.224  |  |    ≥ 20% | 21 (84.0%) | 12 (63.2%) |  |
|    Unknown | 1 | 0 |  |  |   < 20% | 4 (16.0%) | 7 (36.8%) |  |
|    Negative | 12 (50.0%) | 6 (31.6%) |  |  | TIL Low 0 vs Int/High 1 |  | <.001\* |
|    Positive | 12 (50.0%) | 13 (68.4%) |  |  |    Unknown | 0 | 0 |  |
|  |  |  |  |  |    Score 0 | 7 (28.0%) | 16 (84.2%) |  |
| 　 | 　 | 　 | 　 | 　 |  Score 1, 2 | 18 (72.0%) | 3 (15.8%) | 　 |
| \*Statistically significant *p*-value |  |  |  |  |  |  |