Table S1. Immune cell subsets associated metagene

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Immune cell subsets** | **CTL** | **aDC** | **Treg** | **MDSC** |
| **Gene symbol** | **CD8A** | **ARHGAP22** | **CCL19** | **ADORA3** |
| **CD8B** | **BIRC3** | **CD34** | **ARG1** |
| **GZMA** | **CCL1** | **CD72** | **BIN2** |
| **GZMB** | **CCL13** | **CTLA4** | **C1orf162** |
| **PRF1** | **CCL17** | **FOXP3** | **CAPS** |
|  | **CCL18** | **GADD45B** | **CD14** |
|  | **CCL19** | **GEM** | **CD163L1** |
|  | **CCL20** | **IL1RL1** | **CD274** |
|  | **CCL22** | **IL9R** | **CD40** |
|  | **CCL5** | **MADCAM1** | **CD44** |
|  | **CCL8** | **MYH10** | **CR2** |
|  | **CCR7** | **NCF2** | **CTR9** |
|  | **CD1B** | **RCSD1** | **EBP** |
|  | **CD1E** | **RYR1** | **FCER2** |
|  | **CD80** | **SELE** | **FCGRT** |
|  | **CD86** | **SELP** | **FERMT3** |
|  | **CHST7** | **SFRP1** | **FLOT1** |
|  | **CLIC2** | **SIT1** | **FLT1** |
|  | **CXCL10** | **TGFB1** | **GIMAP7** |
|  | **CXCL11** | **TIGIT** | **GLI4** |
|  | **CYP27A1** | **TLR10** | **GNA15** |
|  | **DHX58** | **TLR2** | **GPR34** |
|  | **EBI3** | **TLR7** | **GPSM3** |
|  | **ETV3** | **TLR8** | **IKZF1** |
|  | **FPR3** | **TRAF1** | **IL13** |
|  | **HESX1** | **WIPF1** | **IL18BP** |
|  | **HTR2B** |  | **IL4R** |
|  | **IFI44L** |  | **INPP5D** |
|  | **IL12B** |  | **ITGA3** |
|  | **IL2RA** |  | **KDR** |
|  | **KYNU** |  | **KRIT1** |
|  | **LAMP3** |  | **LGALS3** |
|  | **MAP3K13** |  | **MGAT4A** |
|  | **MMP12** |  | **NAIP** |
|  | **MSC** |  | **NEK3** |
|  | **NR4A3** |  | **NOG** |
|  | **PDCD1LG2** |  | **PARVG** |
|  | **PLA1A** |  | **PDRG1** |
|  | **PLA2G7** |  | **PECAM1** |
|  | **PTGIR** |  | **PIK3R5** |
|  | **RASSF4** |  | **PSAP** |
|  | **RSAD2** |  | **PTGES2** |
|  | **SIGLEC1** |  | **PTPRE** |
|  | **SLC15A3** |  | **RNASE1** |
|  | **SLC2A6** |  | **S100A8** |
|  | **SLCO5A1** |  | **S100A9** |
|  | **ST3GAL6** |  | **SELPLG** |
|  | **TNFAIP6** |  | **SLA** |
|  | **TNFRSF11A** |  | **SLC36A1** |
|  | **TNFRSF4** |  | **SLC44A1** |
|  | **TREM2** |  | **ST8SIA4** |
|  | FAM70A |  | **STAT3** |
|  | IDO |  | **STAT6** |
|  |  |  | **TBXAS1** |
|  |  |  | **TFRC** |
|  |  |  | **TGFB2** |
|  |  |  | **TPP1** |
|  |  |  | **VTCN1** |
|  |  |  | AG2 |
|  |  |  | CD117 |
|  |  |  | CD11B |
|  |  |  | CD11C |
|  |  |  | CD124 |
|  |  |  | CD15 |
|  |  |  | CD1D1 |
|  |  |  | CD21 |
|  |  |  | CD23 |
|  |  |  | CD31 |
|  |  |  | CD35 |
|  |  |  | CD43 |
|  |  |  | CD66B |
|  |  |  | COX2 |
|  |  |  | FAM48A |
|  |  |  | FAM70B |
|  |  |  | HLA-DR |
|  |  |  | IDO |
|  |  |  | IL12 |
|  |  |  | IL1R |
|  |  |  | NFSF13 |
|  |  |  | PPP1R2P4 |
|  |  |  | RP11 |
|  |  |  | TFGFB1 |
|  |  |  | TFGFB2 |
|  |  |  | TFGFB3 |
|  |  |  | TFGFB5 |
| **Gene counts** | 5 | 53 | 26 | 85 |

1 CTL-metagene from *Jiang, et al., Nat Med 2018, 24, 1550-1558*

2 aDC-, Treg-, and MDSC-metagene from *Newman, et al., Nat Methods 2015, 12, 453-457*

3 Gene symbols used in RNASeq to evaluate enrichment levels of immune cell subsets were annotated in boldface.

Table S2. Statistics of the used genes in different platforms to evaluate immune cells enriched levels.

|  |  |  |
| --- | --- | --- |
|  | **RNASeq** | **Agilent microarray** |
| **CTL** | 5 | 3 |
| **aDC** | 51 | 50 |
| **Treg** | 26 | 24 |
| **MDSC** | 58 | 55 |

1 Several genes in evaluated immune subsets by RNASeq are not existed in agilent microarray. For example, CTL (CD8A and GZMA), aDC (FPR3), Treg (IL9R and TIGIT), and MDSC (FERMT3, INPP5D, and PECAM1). Therefore, these genes are removed when we evaluate immune cells enriched level by using agilent microarray data.

Table S3. Characteristics of all GBM RNASeq samples from TCGA.

|  |  |
| --- | --- |
|  | **RNASeq data**  (n = 154) |
| **Gender** | |
| Male | 99 |
| Female | 54 |
| N/A | 1 |
| **Age** | |
| Median  (Q1 - Q3) | 60.0  (52.0 - 70.0) |
| **Survival days** | |
| Median survival  (Q1 - Q3) | 342.5  (153.0 – 515.5) |
| **IDH1/2** \* | |
| Wild-type | 139 |
| Mutant | 10 |
| N/A | 5 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Feature name | Wavelet transform | Feature class | Model | Importance (ratio) | P |
| 784. SIFT\_d45\_Median | LLL | First order | CTL | 0.48 | 0.0052 |
| 767. SIFT\_d44\_Mean absolute deviation | LLH | First order | CTL | 0.13 | 0.0077 |
| 766. SIFT\_d44\_Mean | HHH | First order | CTL | 0.09 |  |
| 767. SIFT\_d44\_Mean absolute deviation | HHH | First order | CTL | 0.07 |  |
| 773. SIFT\_d44\_Standard deviation | HHH | First order | CTL | 0.06 |  |
| 771. SIFT\_d44\_Root mean square | HHH | First order | CTL | 0.05 |  |
| 771. SIFT\_d44\_Root mean square | LLH | First order | CTL | 0.04 |  |
| 775. SIFT\_d44\_Variance | HHH | First order | CTL | 0.04 |  |
| 773. SIFT\_d44\_Standard deviation | LLH | First order | CTL | 0.04 |  |
| 55\_LRHGLE a | HLH | GLRLM | aDC | 0.39 | 0.0492 |
| 52\_SRLGLE a | HLL | GLRLM | aDC | 0.29 |  |
| 52\_SRLGLE a | HHH | GLRLM | aDC | 0.12 |  |
| 52\_SRLGLE a | LHL | GLRLM | aDC | 0.12 | 0.0425 |
| 52\_SRLGLE a | HHL | GLRLM | aDC | 0.08 | 0.0023 |
| 45\_SRE a | HHH | GLRLM | Treg | 0.41 | 0.0056 |
| 52\_SRLGLE a | LHL | GLRLM | Treg | 0.31 |  |
| 52\_SRLGLE a | HLH | GLRLM | Treg | 0.20 |  |
| 52\_SRLGLE a | HHL | GLRLM | Treg | 0.04 | 0.0016 |
| 52\_SRLGLE a | HHH | GLRLM | Treg | 0.04 |  |
| 793. SIFT\_d45\_Third quartile | LLL | First order | MDSC | 0.22 | 0.0008 |
| 45\_SRE a | HHH | GLRLM | MDSC | 0.12 | 0.0007 |
| 821. SIFT\_d47\_Standard deviation | HLH | First order | MDSC | 0.09 |  |
| 819. SIFT\_d47\_Root mean square | HLH | First order | MDSC | 0.09 | 0.0001 |
| 52\_SRLGLE a | HHH | GLRLM | MDSC | 0.09 |  |
| 823. SIFT\_d47\_Variance | HLH | First order | MDSC | 0.07 |  |
| 999. SIFT\_d58\_Variance | HLL | First order | MDSC | 0.05 |  |
| 218. SIFT\_d10\_Energy | HHH | First order | MDSC | 0.04 |  |
| 11\_Skewness | LLL | First order | MDSC | 0.04 |  |
| 997. SIFT\_d58\_Standard deviation | HLL | First order | MDSC | 0.03 |  |
| 995. SIFT\_d58\_Root mean square | HLL | First order | MDSC | 0.03 |  |
| 52\_SRLGLE a | HLH | GLRLM | MDSC | 0.03 |  |
| 11\_Skewness |  | First order | MDSC | 0.03 |  |
| 923. SIFT\_d54\_Entropy | HHL | First order | MDSC | 0.02 |  |
| 999. SIFT\_d58\_Variance | LHH | First order | MDSC | 0.02 |  |
| 714. SIFT\_d41\_Energy | LHH | First order | MDSC | 0.01 |  |
| 995. SIFT\_d58\_Root mean square | LHH | First order | MDSC | 0.01 |  |
| 997. SIFT\_d58\_Standard deviation | LHH | First order | MDSC | 0.01 |  |

Table S4. Radiomic features for models with T1C MR imaging.

a LRHGLE: Long Run High Gray-Level Emphasis; SRLGLE: Short Run Low Gray-Level Emphasis; SRE: Short Run Emphasis

Table S5. Radiomic features for models with ADC MR imaging.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Feature name | Wavelet transform | Feature class | Model | Importance (ratio) | P |
| 53\_SRHGLE a | HHL | GLRLM | CTL | 0.32 | 0.0067 |
| 45\_SRE a | HLH | GLRLM | CTL | 0.30 |  |
| 231. SIFT\_d10\_Variance |  | First order | CTL | 0.20 | 0.0322 |
| 1034. SIFT\_d61\_Energy |  | First order | CTL | 0.14 | 0.0196 |
| 229. SIFT\_d10\_Standard deviation |  | First order | CTL | 0.02 |  |
| 227. SIFT\_d10\_Root mean square |  | First order | CTL | 0.02 |  |
| 1063. SIFT\_d62\_Variance | LLL | First order | aDC | 0.20 | 0.0018 |
| 229. SIFT\_d10\_Standard deviation |  | First order | aDC | 0.09 |  |
| 1061. SIFT\_d62\_Standard deviation | LLL | First order | aDC | 0.09 |  |
| 227. SIFT\_d10\_Root mean square |  | First order | aDC | 0.08 |  |
| 231. SIFT\_d10\_Variance |  | First order | aDC | 0.07 | 0.0006 |
| 813. SIFT\_d47\_Maximum | HHL | First order | aDC | 0.07 | 0.0318 |
| 818. SIFT\_d47\_Range | HHL | First order | aDC | 0.07 |  |
| 205. SIFT\_d9\_Maximum | LLL | First order | aDC | 0.05 |  |
| 210. SIFT\_d9\_Range | LLL | First order | aDC | 0.05 |  |
| 266. SIFT\_d13\_Energy |  | First order | aDC | 0.05 | 0.0232 |
| 786. SIFT\_d45\_Range | HHL | First order | aDC | 0.04 |  |
| 781. SIFT\_d45\_Maximum | HHL | First order | aDC | 0.04 |  |
| 138. SIFT\_d5\_Energy | LLL | First order | aDC | 0.03 |  |
| 146. SIFT\_d5\_Range | LLL | First order | aDC | 0.02 |  |
| 141. SIFT\_d5\_Maximum | LLL | First order | aDC | 0.02 |  |
| 989. SIFT\_d58\_Maximum | LLL | First order | aDC | 0.01 |  |
| 994. SIFT\_d58\_Range | LLL | First order | aDC | 0.01 |  |
| 818. SIFT\_d47\_Range | LLH | First order | aDC | 0.01 |  |
| 813. SIFT\_d47\_Maximum | LLH | First order | aDC | 0.01 |  |
| 53\_SRHGLE a | HHL | GLRLM | aDC | 0.01 |  |
| 35\_IMC1 a | HHL | GLCM | Treg | 0.68 |  |
| 1062. SIFT\_d62\_Uniformity | HHL | First order | Treg | 0.32 |  |
| 231. SIFT\_d10\_Variance | HHH | First order | MDSC | 0.38 |  |
| 221. SIFT\_d10\_Maximum | HHH | First order | MDSC | 0.10 |  |
| 226. SIFT\_d10\_Range | HHH | First order | MDSC | 0.10 |  |
| 229. SIFT\_d10\_Standard deviation | HHH | First order | MDSC | 0.10 |  |
| 227. SIFT\_d10\_Root mean square | HHH | First order | MDSC | 0.09 |  |
| 218. SIFT\_d10\_Energy | HHL | First order | MDSC | 0.07 |  |
| 226. SIFT\_d10\_Range | HHL | First order | MDSC | 0.04 | 0.0000 |
| 221. SIFT\_d10\_Maximum | HHL | First order | MDSC | 0.04 |  |
| 223. SIFT\_d10\_Mean absolute deviation | HHH | First order | MDSC | 0.03 | 0.0000 |
| 218. SIFT\_d10\_Energy | HHH | First order | MDSC | 0.02 | 0.0000 |
| 222. SIFT\_d10\_Mean | HHH | First order | MDSC | 0.02 | 0.0090 |

**a** SRHGLE: Short Run High Gray-Level Emphasis; SRE: Short Run Emphasis; IMC1: Informational measure of correlation 1