

Additional Table 1. Summary of clinical trials on immunotherapy in glioma (mono-therapy)

Category	Therapeutic approach	Conditions	Phase	Enrollment	Median OS	Median PFS	Study Number	Status	PMID
Tumor Vaccine									
Single neoantigen vaccine	MT-201-GBM	Newly Diagnosed GBM	Phase 1	27	N/A	N/A	NCT04741984	Not yet recruiting	N/A
	CDX-110	Newly Diagnosed EGFRvIII-positive Glioblastoma	Phase 3	745	14.8~20.1 months	8.0 months	NCT01480479	Completed	28844499
	PEP-3 vaccine	Malignant Neoplasms of Brain	Phase 2	40	N/A	8.1-17.6 months	NCT00643097	Completed	N/A
	Histone H3.3-K27M Neoantigen Vaccine Therapy	Diffuse Intrinsic Pontine Glioma	Phase 1	30	N/A	N/A	NCT04749641	Recruiting	N/A
	H3K27M peptide vaccine	Newly Diagnosed H3-mutated Glioma	Phase 1	15	N/A	N/A	NCT04808245	Not yet recruiting	N/A
	PEPIDH1M vaccine	IDH1 Positive Recurrent Grade II Glioma	Phase 1	24	N/A	N/A	NCT02193347	Active, not recruiting	N/A
	IDH1 Peptide Vaccine	IDH1R132H-mutated Grade III-IV Gliomas	Phase 1	39	3-year death-free rates of 0.84	3-year progression-free rates of 0.64; 2-year progression-free rate of 0.82 in patients with immune responses	NCT02454634	Completed	33762734
	DC205-NY-ESO-1 vaccine	NY-ESO-1 Expressing GBM and other Solid Tumors	Phase 1	18	N/A	N/A	NCT01522820	Completed	N/A

	PEP-CMV Vaccine	Recurrent Malignant Glioma, and other malignant brain tumors	Phase 2	120	N/A	N/A	NCT05096481	Not yet recruiting	N/A
	PEP-CMV	HGG, and other malignant brain tumors	Phase 1	30	N/A	N/A	NCT03299309	Recruiting	N/A
	SurVaxM	GBM, and other malignant brain tumors	Phase 1	35	N/A	N/A	NCT04978727	Not yet recruiting	N/A
	SurVaxM	Recurrent GBM	Phase 1	9	86.6 weeks	17.6 weeks	NCT01250470	Completed	27576783
	VXM01	Glioblastoma	Phase 1	14	N/A	N/A	NCT02718443	Completed	N/A
	WT1 vaccine	Recurrent GBM	Phase 1	14	24.7 weeks OS rate: 36%	1-year N/A	NCT02718443	Completed	N/A
	WT1 vaccine	GBM	Phase 1	14	24.7 weeks OS rate: 36%	1-year N/A	UMIN000003506	unknown	30430205
	WT1 vaccine	GBM	Phase 1/2	59	252 days	83 days	Umin000002001	unknown	27170523
Mixed antigen vaccine	IMA950	Glioblastoma	Phase 1	6	N/A	N/A	NCT01403285	Terminated	N/A
	IMA950/poly-ICLC vaccine	CNS Tumor, Adult	Phase 1/2	19	19 months for GBM	N/A	NCT01920191	Completed	30753611
	ADU-623	Recurrent WHO Grade III/IV Astrocytomas	Phase 1	11	N/A	N/A	NCT01967758	Completed	N/A
	HLA-A2 restricted glioma antigen peptides vaccine	HLA-A2–positive children with newly diagnosed BSG and HGG	Phase 1	26	13.3 months (from diagnosis)	24/26 pts without progressive diseases in first two vaccine courses	NCT01130077	Active, not recruiting	24888813
	Glioma Lysate Vaccines	WHO Grade II Glioma	Phase 1	28	N/A	N/A	NCT02549833	Active, not recruiting	N/A
	GP96 Heat Shock Protein-Peptide Complex Vaccine	Recurrent or Progressive Glioma	Phase 1/2	96	42.6 weeks; 1-year OS rate: 29.3	19.1weeks; 1-year PFS rate: 29.3	NCT00293423	Completed	N/A
	HSPPC-96 Vaccine	High Grade Glioma	Phase 1	10	N/A	N/A	NCT02722512	Terminated	N/A
	Multi Peptide Vaccination With XS15	Glioblastoma Multiforme	Phase 1	15	N/A	N/A	NCT04842513	Recruiting	N/A

	SL-701	recurrent glioblastoma multiform (GBM)	Phase 1/2	74	N/A	N/A	NCT02078648	Completed	N/A
	RNA-lipid Particle (RNA-LP) Vaccines	Newly Diagnosed Pediatric High-Grade Gliomas (pHGG) and Adult Glioblastoma (GBM)	Phase 1	28	N/A	N/A	NCT04573140	Recruiting	N/A
	ERC1671	Glioblastoma	Phase 2	84	12.1 months	7.3 months	NCT01903330	Active, not recruiting	30157683
	PPV	Recurrent GBM	Phase 3	88	8.4 months	N/A months	unknown	unknown	30500939
	Tumor Lysate Vaccine	High Risk or Recurrent Grade II Gliomas	Early Phase 1	19	N/A	N/A	NCT01678352	Completed	N/A
Oncolytic virus-based vaccine	PVSRIPO	Malignant Glioma, and other malignant solid tumors	Phase 1	12	N/A	N/A	NCT03043391	Active, not recruiting	N/A
	PVSRIPO	Malignant Glioma	Phase 2	122	N/A	N/A	NCT02986178	Active, not recruiting	N/A
	PVSRIPO	Recurrent Glioblastoma	Phase 1	61	2-year OS rate: 21% 3-year OS rate: 21%	N/A	NCT01491893	Active, not recruiting	29943666
	rQNestin34.5v.2	Recurrent Malignant Glioma	Phase 1	56	N/A	N/A	NCT03152318	Recruiting	N/A
	HSV G207	Recurrent HGG	Phase 2	30	N/A	N/A	NCT04482933	Not yet recruiting	N/A
	oHSV M032	Recurrent Glioblastoma Multiforme Progressive Glioblastoma Multiforme Anaplastic Astrocytoma or Gliosarcoma	Phase 1	36	N/A	N/A	NCT02062827	Recruiting	N/A
	C134	Recurrent Malignant Glioma	Phase 1	24	N/A	N/A	NCT03657576	Recruiting	N/A
	HSV G207	Malignant Glioma, and other malignant brain tumors	Phase 1	12	N/A	N/A	NCT02457845	Active, not recruiting	N/A
	G207	Recurrent Malignant Glioma	Phase 1/2	65	N/A	N/A	NCT00028158	Completed	N/A

	HSV G207	GBM, and other malignant brain tumors	Phase 1	15	N/A	N/A	NCT03911388	Recruiting	N/A
	HSV-1716	Pediatric Brain Tumor	Phase 1	2	N/A	N/A	NCT02031965	Terminated	N/A
	DNX-2401	Glioblastoma	Phase 1	37	N/A	N/A	NCT02197169	Completed	N/A
	DNX2401	GBM	Phase 1	31	N/A	N/A	NCT01956734	Completed	N/A
	DNX-2401	Recurrent HGG	Phase 1	36	N/A	N/A	NCT03896568	Recruiting	34824133
	DNX-2440	GBM	Phase 1	24	N/A	N/A	NCT03714334	Recruiting	N/A
	NSC-CRAAd-S-pk7	Recurrent HGG	Phase 1	30	N/A	N/A	NCT05139056	Not yet recruiting	N/A
	NSC-CRAAd-S-pk7	Newly Diagnosed HGG	Phase 1	13	18.4 months	9.1 months	NCT03072134	Active, not recruiting	34214495
DC Vaccine	GAA-DC vaccine	Brain and Central Nervous System Tumors	Phase 1	8	14.5 months	9.6 months	NCT00612001	Completed	23377664
	Brain Tumor Initiating Cell (BTIC) Vaccine	Diffuse Intrinsic Pontine Glioma	Phase 1	8	N/A	N/A	NCT01400672	Terminated	N/A
	DC Vaccine	Recurrent or Progressive Malignant Gliomas	Phase 1	8	N/A	N/A	NCT01171469	Completed	N/A
	ICT-121 Dendritic Cell Vaccine	Recurrent Glioblastoma	Phase 1	20	N/A	N/A	NCT02049489	Completed	N/A
	CMV-ATCT-DC	Glioblastoma	Phase 1	23	N/A	N/A	NCT00693095	Completed	29093005
	CMV-DCs	Recurrent Malignant Glioma, and other malignant brain tumors	Phase 1	11	N/A	N/A	NCT03615404	Completed	N/A
	DC Vaccine	HLA-A2 Positive Recurrent Malignant Gliomas	Phase 1/2	22	13.23–32.88 months	WHO3 AG: 5–15 months WHO4 GBM: 4 months	NCT00766753	Completed	N/A

VBI-1901	Glioblastoma Multiforme	Phase 1/2	38	arm1(VBI-1901+GM-CSF) 6-month and 12-month OS : 80% and 60% arm2(VBI-1901 + GSK's AS01B): 6-month OS : 89%;12-month OS not yet reached	N/A	NCT03382977	Active, not recruiting	N/A
DC Vaccine	HGG, and other malignant brain tumors	Phase 1/2	1	N/A	N/A	NCT02332889	Terminated	
CMV-specific DC vaccines	Newly Diagnosed Glioblastoma Multiforme	Phase 1	42	41.1; 5-year survival rate: 33~36%	25.3 months	NCT00639639	Active, not recruiting	28411277; 32719000
pp65 DC vaccine	Newly Diagnosed GBM	Phase 2	120	N/A	N/A	NCT02465268	Recruiting	N/A
CMV RNA-Pulsed Dendritic Cells Vaccines	Newly Diagnosed GBM	Phase 1	10	N/A	N/A	NCT04963413	Not yet recruiting	N/A
CMV pp65-LAMP mRNA-pulsed autologous DCs	Newly-Diagnosed WHO Grade IV Unmethylated Glioma	Phase 2	48	N/A	N/A	NCT03927222	Suspended	N/A
Proteome-based Personalized DC vaccine	Glioblastoma	Phase 2/3	60	N/A	N/A	NCT01759810	Unknown status	N/A
DC Vaccine	GBM	Phase 2	100	13.7 months	7.7 months	NCT01567202	Recruiting	30159779
ICT-107	Glioblastoma Multiforme	Phase 2	124	16.7~18.3 months	9~11.2 months	NCT01280552	Completed	N/A
DC Vaccine	Glioblastoma	Phase 1	22	N/A	N/A	NCT00576641	Completed	24893855
TTRNA-DC vaccines + TTRNA-xALT	Brain Stem Glioma, and other malignant brain tumors	Phase 1	21	N/A	N/A	NCT03396575	Recruiting	N/A

TTRNA-DC vaccines+ TTRNA-xALT	Malignant Glioma, and other malignant brain tumors	Phase 1	24	N/A	N/A	NCT04837547	Recruiting	N/A
TTRNA-DC vaccines+ TTRNA-xALT	HGG	Phase 1	10	N/A	N/A	NCT03334305	Recruiting	N/A
WT1-targeted DC vaccine	HGG, and other malignant brain tumors	Phase 1/2	10	N/A	N/A	NCT04911621	Recruiting	N/A
WT1 mRNA-loaded DC Vaccine	GBM	Phase 1/2	20	N/A	N/A	NCT02649582	Recruiting	N/A
Dendritic Cell-Based Tumor Vaccine	WHO Grade IV Gliomas	Phase 2	50	N/A	N/A	NCT02772094	Unknown status	N/A
Autologous Dendritic Cells	Diffuse Intrinsic Pontine Glioma	Phase 1	10	N/A	N/A	NCT02840123	Unknown status	N/A
BTSC mRNA-loaded DCs	Recurrent Central Nervous System Neoplasm	Phase 1	50	N/A	N/A	NCT00890032	Completed	N/A
DC Vaccine	Glioblastoma	Phase 1/2	20	759days (from surgery)	694days (from surgery)	NCT00846456	Completed	23817721
DC-GSC	Recurrent Glioblastoma	Phase 1	20	N/A	N/A	NCT02820584	Completed	N/A
DC Vaccine	Newly Diagnosed GBM	Phase 2	11	N/A	N/A	NCT00323115	Completed	N/A
ATL-DC Vaccine	Brain and Central Nervous System Tumors	Phase 1	28	34.4 months	18.1 months	NCT00068510	Completed	23377664
DC Vaccine	Brain and Central Nervous System Tumors	Phase 1	7	N/A	N/A	NCT00107185	Completed	N/A
Dendritic Cell Vaccine +/- Toll-like Receptor Agonists	Malignant Glioma	Phase 2	60	N/A	N/A	NCT01204684	Active, not recruiting	N/A
DC/tumor cell fusion vaccine	Newly Diagnosed GBM	Phase 1/2	10	N/A	N/A	NCT04388033	Recruiting	N/A
Dendritic Cell Vaccine	Newly Diagnosed or Recurrent Glioblastoma	Phase 1	39	N/A	N/A	NCT02010606	Completed	N/A

DCVax-L	Newly Diagnosed GBM	Phase 3	331	23.1 months (from surgery); 2 and 3-year survival rates of 46.2 and 25.4%	N/A	NCT00045968	Unknown status	29843811
DC Vaccine	Newly Diagnosed GBM	Phase 1/2	76	N/A	N/A	NCT04801147	Recruiting	N/A
DC Vaccine	Recurrent GBM	Phase 1	26	N/A	N/A	NCT04002804	Terminated	N/A
Th-1 Dendritic Cell Vaccine	Glioblastoma	Phase 1	24	N/A	N/A	NCT04552886	Recruiting	N/A
DC Vaccine	Glioblastoma	Phase 2	136	N/A	N/A	NCT03395587	Recruiting	N/A
TVI-Brain-1	Glioma High Grade Astrocytoma GBM	Phase 1/2	14	N/A	N/A	NCT01081223	Completed	N/A
DC Vaccine	Brain and Central Nervous System Tumors	Phase 2	40	N/A	N/A	NCT00003185	Completed	N/A
DC Vaccine	Glioblastoma	Phase 1	1	N/A	N/A	NCT01702792	Terminated	N/A
DC Vaccine	Malignant Glioma	Phase 1	28	16.9 months	3.6 months	N/A	N/A	32169363
DC Vaccine	Glioblastoma	Phase 1	10	19 months	N/A	NCT02709616	Unknown	32078016
DC Vaccine	GBM	Phase 2b	101	19 months	N/A	EudraCT 2009-018228-14	Unknown	30952748
Audencel	GBM	Phase 2	87	N/A	N/A	NCT01213407	Completed	30518425
ADCTA	GBM	NA	27	20.07~60.97 months	4.43~11.2 months	CMUH106-REC1-098	Unknown	29910795
DC Vaccine	Newly Diagnosed GBM	Phase 2	26	23.4 months	12.7 months	NCT01006044	Completed	28499389
FC-vaccination	GBM	Phase/ 2	32	17~30 months	11~17 months	16-184-4412	Unknown	27688162
CSC-targeted DC Vaccine	Glioblastoma	Phase 2/3	60	N/A	N/A	NCT03548571	Recruiting	N/A
Dendritic Cell Vaccine	Pediatric Brain Tumors	Phase 1	1	N/A	N/A	NCT01902771	Terminated	N/A
Dendritic Cell Vaccine	Malignant Glioma	Phase 1	20	N/A	N/A	NCT01808820	Active, not recruiting	N/A
Dendritic Cell Vaccine	Malignant Glioma	Phase 1	71	N/A	N/A	NCT01792505	Completed	N/A

	Autologous Dendritic Cell / Tumor Antigen (ADCTA-SSI-G1)	Glioblastoma Multiforme	Phase 3	118	N/A	N/A	NCT04277221	Recruiting	N/A
	DC activated CIK combined with DC	Malignant Glioma	Phase 1/2	30	N/A	N/A	NCT01235845	Unknown status	N/A
	DC Vaccine	Malignant Glioma	Phase 1	35			NCT00576446	Completed	N/A
	APVAC vaccine	Glioblastoma	Phase 1	16	29 months	14.2 months	NCT02149225	Completed	30568303
Immune checkpoint inhibitors									
PD-1	Pembrolizumab	Malignant Glioma, and other malignant solid tumors	Phase 1	110	N/A	N/A	NCT02359565	Recruiting	N/A
	Pembrolizumab	Glioblastoma Multiforme	Phase 1/2	30	N/A	N/A	NCT04977375	Not yet recruiting	N/A
	Camrelizumab	Recurrent Glioblastoma	Phase 2	94	N/A	N/A	NCT04952571	Recruiting	N/A
	Pembrolizumab	GBM, and other malignant brain tumors	Phase 1	21	N/A	N/A	NCT03426891	Active, not recruiting	N/A
	Nivolumab	Glioblastoma	Phase 1	4	N/A	N/A	NCT02648633	Terminated	N/A
	MK-3475	Brain Cancer	Phase 1	25	N/A	N/A	NCT02852655	Completed	N/A
	Pembrolizumab	GBM	Phase 2	50	N/A	N/A	NCT03197506	Recruiting	N/A
	Pembrolizumab	Recurrent Glioblastoma	Phase 2	20	N/A	N/A	NCT02337686	Active, not recruiting	N/A
	Pembrolizumab	Newly Diagnosed Glioblastoma	Phase 2	56	N/A	N/A	NCT03899857	Recruiting	N/A
	Pembrolizumab	Recurrent HGG	Phase 2	32	9.3 months	6.54 months	NCT02313272	Active, not recruiting	33173935
	Avelumab	Recurrent GBM	Phase 2	54	18.0–26.6 weeks	6-m-PFS rate: 18.5%–22.2%	NCT03291314	Completed	33067319
	Pembrolizumab	Newly Diagnosed Glioblastoma	Early Phase 1	35	7.5–13.7 months	2.4–3.3 months	N/A	Unknown	30742122
	MDV9300	Diffuse Intrinsic Pontine Glioma	Phase 1/2	50	15.6 months	9.3 months	NCT01952769	Active, not recruiting	29143272
	Nivolumab	GBM	Phase 3	369	9.8 months	1.5 months	NCT02017717	Active, not recruiting	32437507
PD-L1	Durvalumab	Glioblastoma	Phase 1/2	112	N/A	N/A	NCT02866747	Recruiting	N/A

	Atezolizumab	GBM	Phase 1/2	80	N/A	N/A	NCT03174197	Active, not recruiting	N/A
	Avelumab	GBM	Phase 2	30	N/A	N/A	NCT03047473	Active, not recruiting	N/A
	Avelumab	Glioblastoma	Phase 2	6	N/A	N/A	NCT02968940	Completed	N/A
	Avelumab	GBM	Phase 1	30	N/A	N/A	NCT03341806	Recruiting	N/A
	Durvalumab	Glioblastoma	Phase 2	159	19.3–64.8 weeks	7.9–19.9 weeks	NCT02336165	Completed	N/A
IDO	Indoximod	Malignant Glioma, and other malignant solid tumors	Phase 2	140	N/A	N/A	NCT04049669	Recruiting	N/A
	Indoximod	Progressive Primary Brain Tumors	Phase 1	81	N/A	N/A	NCT02502708	Completed	N/A
	PF-06840003	Malignant Glioma, and other malignant brain tumors	Phase 1	17	N/A	Mean duration of stable disease (SD) was 32.1 (12.1-72.3) weeks	NCT02764151	Terminated	32436060
CXCR4	Plerixafor	Newly Diagnosed Glioblastoma	Phase 2	20	N/A	N/A	NCT03746080	Recruiting	N/A
CD38	Daratumumab	Glioblastoma	Phase 1/2	16	N/A	N/A	NCT04922723	Not yet recruiting	N/A
CAR therapy									
CAR-T	EGFR CAR T	Malignant Gliomas Overexpressing EGFR	Phase 1	10	N/A	N/A	NCT02331693	Unknown status	N/A
	EGFR BATs	Glioblastoma	Phase 1	18	N/A	N/A	NCT03344250	Active, not recruiting	N/A
	EGFR806-specific CAR T	EGFR-positive Recurrent or Refractory Pediatric CNS Tumors	Phase 1	36	N/A	N/A	NCT03638167	Recruiting	N/A
	EGFRvIII-directed CAR T	Recurrent glioblastoma	Phase 1	11	N/A	251days	NCT02209376	Terminated	28724573
	EGFRvIII-directed CAR T	Malignant Glioma Expressing EGFRvIII	Phase 1/2	18	N/A	N/A	NCT01454596	Completed	N/A
	EGFRvIII-CAR T	Glioblastoma	Phase 1	10	N/A	N/A	NCT05063682	Active, not recruiting	N/A
	EGFR-vIII CAR-T	Recurrent Glioblastoma	Phase 1	2	N/A	N/A	NCT03283631	Terminated	N/A
	EGFRvIII CAR T	Newly-Diagnosed Glioblastoma	Phase 1	3	N/A	N/A	NCT02664363	Terminated	N/A

Autologous CAR-T/TCR-T	Malignant Glioma, and other malignant solid tumors	Phase 1/2	50	N/A	N/A	NCT03941626	Recruiting	N/A
Autologous CAR-T/TCR-T Cell Immunotherapy for Malignancies	Malignant Glioma, and other malignant solid tumors	Phase 1/2	73	N/A	N/A	NCT03638206	Recruiting	N/A
BRiTE	Malignant Glioma[Glioblastoma	Phase 1	18	N/A	N/A	NCT04903795	Not yet recruiting	N/A
IL13RA2-specific CAR-T	Recurrent glioblastoma	Case report	1	N/A	228days	NCT02208362	Recruiting	28029927
IL13Ra2-Redirected CAR T	Recurrent glioblastoma	Phase 1	3	10.3	N/A	NCT00730613	Completed	26059190
HER2-CAR CMV-T	Progressive HER2-positive glioblastoma	Phase 1	17	11.1 months (from first T-cell infusion); 24.5m(from diagnosis)	N/A	NCT01109095	Completed	28426845
HER2-specific CAR T	HER2-positive Recurrent/Refractory Pediatric CNS Tumors	Phase 1	48	N/A	N/A	NCT03500991	Recruiting	34253928
B7-H3-Specific CAR T Cell	Malignant Glioma, and other malignant solid tumors	Phase 1	70	N/A	N/A	NCT04185038	Recruiting	N/A
MUC1-directed CAR-T	MUC1-positive Malignant Glioma of Brain Colorectal Carcinoma Gastric Carcinoma	Phase 1/2	20	N/A	N/A	NCT02617134	Unknown status	N/A
MUC1-specific CAR-pNK Cell	Malignant Glioma, and other malignant solid tumors	Phase 1/2	10	N/A	N/A	NCT02839954	Unknown status	N/A
C7R-GD2.CAR T	GD2-expressing Brain Tumors	Phase 1	34	N/A	N/A	NCT04099797	Recruiting	N/A
NKG2D-based CAR T	relapsed/refractory NKG2DL+ Glioblastoma, other NKG2DL+ solid tumor	Phase 1	3	N/A	N/A	NCT05131763	Recruiting	N/A
CD147-CART	CD147 Positive Recurrent Glioblastoma	Early Phase 1	31	N/A	N/A	NCT04045847	Recruiting	N/A
Anti-PD-L1 CSR T cells	GBM	Phase 1	20	N/A	N/A	NCT02937844	Unknown status	N/A

	Chlorotoxin-CD28-CD3z-CD19 t-expressing CAR T-cells	MMP2+ Recurrent or Progressive Glioblastoma	Phase 1	36	N/A	N/A	NCT04214392	Recruiting	N/A
CAR-NK	NK-92/5.28.z CAR-NK	Glioblastoma	Phase 1	42	N/A	N/A	NCT03383978	Recruiting	28879551

EGFR=epidermal growth factor receptor; EGFRvIII=Epidermal growth factor receptor variant III; GBM=glioblastoma multiforme; HGG=high-grade glioma; N/A: Not applicable; OS=overall survival; PFS=progression-free survival; IDH1=Isocitrate Dehydrogenase (NADP(+)) 1; NY-ESO-1=New York esophageal squamous cell carcinoma 1; PEP-CMV=peptide -cytomegalovirus; WT1=Wilms' tumor 1; poly-ICLC=Polyinosinic-Polycytidylic; HLA=human leukocyte antigen; GP96=Glycoprotein96; HSPPC=heat shock protein peptide-complex; HSV=herpes simplex virus; oHSV=oncolytic HSV; GAA=glioma-associated antigens; DC= dendritic cell; PVSRIPO= recombinant nonpathogenic polio-rhinovirus chimera; TTRNA=total tumor RNA; xALT=ex vivo expanded autologous lymphocyte transfer; BTSC=brain tumor stem cell; GSC=glioblastoma stem cell; Th1= Type 1 T helper; ADCTA= autologous dendritic cell/tumor antigen; CSC=cancer stem cell; APVAC=actively personalized vaccines; PD-1= programmed death 1; PD-L1= programmed death-ligand 1; IDO= indoleamine 2,3-dioxygenase; CXCR4= C-X-C Motif chemokine receptor 4; CAR-T=chimeric antigen receptor-T cells; TCR=T-cell receptor; IL13RA2=Interleukin-13 receptor alpha 2; HER2=human epidermal growth factor receptor 2; B7-H3= B7 Homolog 3; MUC1= Mucin 1; GD2= disialoganglioside 2; NKG2D= natural killer group 2, member D; CSR= chimeric switch receptor; MMP2=matrix metalloproteinase 2; NK=natural killer.