

Additional Table 2. Summary of clinical trials on immunotherapy in glioma (combined-therapy)

Category	Therapeutic approach	Conditions	Phase	Enrollment	Median OS	Median PFS	Study Number	Status	PMID
Immunotherapy + standard therapy									
	Nivolumab+Radiation	Brain Cancer	Phase 3	560	13.4 months	6.01 months	NCT02617589	Active, not recruiting	32691060
	Nivolumab+TMZ+Radiation	Brain Neoplasms	Phase 3	716	N/A	N/A	NCT02667587	Active, not recruiting	35511454
Immunotherapy A + Immunotherapy B									
ICIs+tumor vaccine	Basiliximab+RNA-loaded DC vaccine	Malignant Neoplasms Brain	Phase 1	34	N/A	N/A	NCT00626483	Completed	N/A
	Nivolumab+H3.3K27M Peptide Vaccine	H3 K27M-Mutant diffuse midline glioma	Phase 1/2	49	1-year OS rate: 39%–44%	3.5–4.9 months	NCT02960230	Recruiting	32817593
	hP1A8+GBM6-AD vaccine	Glioblastoma	Phase 1	24	N/A	N/A	NCT04642937	Active, not recruiting	N/A
	Nivolumab+DC Vaccines	Recurrent Brain Tumors	Phase 1	6	N/A	N/A	NCT02529072	Completed	N/A
	Pembrolizumab+SurVaxM vaccine	Recurrent Glioblastoma	Phase 2	40	N/A	N/A	NCT04013672	Active, not recruiting	N/A
	Varlilumab+IMA950/poly-iclc	Recurrent Glioblastoma	Phase 1	14	N/A	N/A	NCT02924038	Active, not recruiting	N/A
	Nivolumab/Ipilimumab+Autologous Dendritic Cells	Childhood Glioblastoma	Phase 1/2	25	N/A	N/A	NCT03879512	Recruiting	N/A
	daclizumab+EGFRVIII-targeted peptide vaccination	Recurrent Glioblastoma	Phase 1	16	N/A	N/A	NCT00626015	Completed	22383993
	Pembrolizumab+ATL-DC	Recurrent Glioblastoma	Phase 1	40	N/A	N/A	NCT04201873	Recruiting	N/A
	Camrelizumab+GSC-DCV	Recurrent Glioblastoma	Phase 2	40	N/A	N/A	NCT04888611	Recruiting	N/A
	Pembrolizumab+HSPPC-96	Glioblastoma	Phase 2	90	N/A	N/A	NCT03018288	Active, not recruiting	N/A

	rHSC-DIPGVax+ Balstilimab+Zalifrelimab	H3 K27M-Mutant diffuse midline glioma, and other malignant brain tumor	Phase 1	36	N/A	N/A	NCT04943848	Not yet recruiting	N/A
	Nivolumab+AdV-tk/Valacyclovir	Glioma, Malignant	Phase 1	36	N/A	N/A	NCT03576612	Active, not recruiting	N/A
	Pembrolizumab+DNX-2401 oncolytic adenovirus	GBM, and other malignant brain tumors	Phase 2	49	N/A	N/A	NCT02798406	Completed	N/A
	Atezolizumab+PVSRIO	Malignant Glioma	Phase 1/2	0	N/A	N/A	NCT03973879	Withdrawn	N/A
	pembrolizumab+PVSRIO	Glioblastoma Recurrent Glioblastoma Supratentorial Glioblastoma Brain Tumor	Phase 2	30			NCT04479241	Active, not recruiting	
	Atezolizumab+D2C7-IT	Malignant Glioma	Phase 1	18	N/A	N/A	NCT04160494	Recruiting	N/A
	Cemiplimab+INO-540+INO-901	Glioblastoma	Phase 1/2	52	N/A	N/A	NCT03491683	Active, not recruiting	N/A
	Nivolumab+AdV-tk/Valacyclovir	Glioma, Malignant	Phase 1	36	N/A	N/A	NCT03576612	Active, not recruiting	N/A
	Pembrolizumab+DNX-2401 oncolytic adenovirus	GBM, and other malignant brain tumors	Phase 2	49	N/A	N/A	NCT02798406	Completed	N/A
	Atezolizumab+PVSRIO	Malignant Glioma	Phase 1/2	0	N/A	N/A	NCT03973879	Withdrawn	N/A
	pembrolizumab+PVSRIO	Glioblastoma Recurrent Glioblastoma Supratentorial Glioblastoma Brain Tumor	Phase 2	30			NCT04479241	Active, not recruiting	
	Atezolizumab+D2C7-IT	Malignant Glioma	Phase 1	18	N/A	N/A	NCT04160494	Recruiting	N/A
ICIs+CAR-T	Nivolumab and Ipilimumab+IL13Ra2-CAR T Cells	Recurrent Glioblastoma	Phase 1	60	N/A	N/A	NCT04003649	Recruiting	N/A
Dual-target	Ipilimumab+Nivolumab	Recurrent HGG	Phase 2	37	N/A	N/A	NCT04145115	Recruiting	N/A
ICIs	Ipilimumab+Nivolumab	MGMT-Unmethylated Glioblastoma	Phase 2/3	485	N/A	N/A	NCT04396860	Recruiting	N/A

	Ipilimumab+Nivolumab	Newly Diagnosed HGG	Phase 1	90	N/A	N/A	NCT03425292	Recruiting	N/A
	Ipilimumab+Nivolumab	Malignant Glioma	Phase 1	33	N/A	N/A	NCT02829931	Active, not recruiting	N/A
	Ipilimumab+Nivolumab	Recurrent HGG	Phase 1	45	N/A	N/A	NCT04323046	Recruiting	32627129
	Tremelimumab+Durvalumab	Recurrent Malignant Glioma	Phase 2	36	N/A	N/A	NCT02794883	Unknown status	N/A
	spartalizumab+MBG453	Glioblastoma Multiforme	Phase 1	15	N/A	N/A	NCT03961971	Recruiting	N/A
	AB154+AB122	Glioblastoma	Early Phase 1	46	N/A	N/A	NCT04656535	Recruiting	N/A
	Cemiplimab+ASP8374	Recurrent Glioma	Phase 1	65	N/A	N/A	NCT04826393	Not yet recruiting	N/A
other immune targets combination	D2C7-IT+2141-V11	Recurrent Glioblastoma	Phase 1	30	N/A	N/A	NCT04547777	Recruiting	N/A
	Ibrutinib+Indoximod	Pediatric Brain Cancer	Phase 1	37	N/A	N/A	NCT05106296	Not yet recruiting	N/A
	INCMGA00012+INCAGN01876	Glioblastoma	Phase 2	32	N/A	N/A	NCT04225039	Recruiting	N/A
	Nivolumab + MK-4166/INCB024360 /Ipilimumab	Glioblastoma Glioblastoma Multiforme	Phase 1	3	N/A	N/A	NCT03707457	Terminated	N/A
	Nivolumab+BMS-986205	Glioblastoma	Phase 1	30	N/A	N/A	NCT04047706	Recruiting	N/A
	Nivolumab+NKTR-214	GBM, and other malignant tumors	Phase 1/2	228	N/A	N/A	NCT04730349	Not yet recruiting	N/A
	Atezolizumab+Tocilizumab	Recurrent Glioblastoma	Phase 2	12	N/A	N/A	NCT04729959	Recruiting	N/A
	Retifanlimab+ Epcadostat	Glioma Glioblastoma	Phase 2	55	N/A	N/A	NCT03532295	Recruiting	

Ad-hCMV-TK+Ad-hCMV-Flt3L	Malignant Glioma Glioblastoma Multiforme	Phase 1	19	N/A	N/A	NCT01811992	Completed	N/A
immunotherapy+angiogenesis								
Carilizumab+Apatinib	Recurrent High-Grade Glioma	Phase 2	60	N/A	N/A	NCT04588987	Recruiting	N/A
ADCTA+Bevacizumab	Glioblastoma Multiforme	Phase 3	118	N/A	N/A	NCT04277221	Recruiting	N/A
ALECSAT+Bevacizumab	Glioblastoma Multiforme	Phase 2	25	N/A	N/A	NCT02060955	Terminated	N/A
Atezolizumab+Cabozantinib	Recurrent Glioblastoma	Phase 1/2	6	N/A	N/A	NCT05039281	Not yet recruiting	N/A
Camrelizumab+Bevacizumab	Recurrent Glioblastoma	Phase 2	94	N/A	N/A	NCT04952571	Recruiting	N/A
CDX-110+GM-CSF+Bevacizumab	Relapsed EGFRvIII-Expressing Glioblastoma	Phase 2	127	12 month OS rate: 44%	6-month PFS rate: 28%	NCT01498328	Completed	32034072
DC vaccine+Bevacizumab	Diffuse Intrinsic Pontine Glioma or Glioblastoma	Phase 1	10	N/A	N/A	NCT03914768	Enrolling by invitation	N/A
DSP-7888+Bevacizumab	Glioblastoma	Phase 3	236	N/A	N/A	NCT03149003	Active, not recruiting	N/A
Durvalumab+Bevacizumab	Glioblastoma	Phase 2	159	N/A	N/A	NCT02336165	Completed	N/A
Epacadostat+Retifanlimab+Bevacizumab	Glioma Glioblastoma	Phase 2	55	N/A	N/A	NCT03532295	Recruiting	N/A
GX-I7+Bevacizumab	Recurrent Glioblastoma	Phase 2	20	N/A	N/A	NCT05191784	Recruiting	N/A
HSPPC-96+Bevacizumab	Recurrent Glioblastoma Recurrent Adult Brain Tumor Gliosarcoma	Phase 2	90	N/A	N/A	NCT01814813	Active, not recruiting	N/A
Indoximod+ Bevacizumab	Glioblastoma Multiforme Glioma Gliosarcoma Malignant Brain Tumor	Phase 1/2	160	N/A	N/A	NCT02052648	Completed	N/A
Nivolumab+Bevacizumab	Recurrent Adult Brain Tumor	Phase 2	40	N/A	N/A	NCT03890952	Recruiting	N/A
Nivolumab+Bevacizumab	Glioblastoma	Phase 2	94	N/A	N/A	NCT03743662	Recruiting	N/A
Nivolumab+Bevacizumab	Glioblastoma	Phase 2	90	N/A	N/A	NCT03452579	Active, not recruiting	N/A

Nivolumab+Ipilimumab+Bevacizumab	Newly Diagnosed High Grade Glioma	Phase 1	90	N/A	N/A	NCT03425292	Recruiting	N/A
Nivolumab+Ipilimumab+Bevacizumab	Malignant Glioma	Phase 1	33	N/A	N/A	NCT02829931	Active, not recruiting	N/A
Pembrolizumab+Bevacizumab	Glioblastoma	Phase 2	61	N/A	N/A	NCT03661723	Active, not recruiting	N/A
Pembrolizumab+Bevacizumab	Glioblastoma	Phase 2	80	Pembrolizumab+Bevacizumab cohort: 8.8 months	N/A	NCT02337491	Completed	N/A
Pembrolizumab+Bevacizumab	Malignant Glioma	Phase 1	32	Bevacizumab-naïve cohort: 13.45 months Bevacizumab-resistant cohort: 9.3 months	Bevacizumab-naïve cohort: 7.92 months Bevacizumab-resistant cohort: 6.54 months	NCT02313272	Completed	33173935
Plerixafor+Bevacizumab	High Grade Glioma	Phase 1	26	N/A	N/A	NCT01339039	Terminated	N/A
SL-701+poly-ICLC+Bevacizumab	Adult Brain Glioblastoma Glioblastoma Multiforme	Phase 1/2	74	N/A	N/A	NCT02078648	Completed	N/A
TH-302+bevacizumab	High Grade Glioma	Phase 2	28	N/A	N/A	NCT01403610	Completed	N/A
TRC105+Bevacizumab	Adult Gliosarcoma	Phase 1/2	116	N/A	N/A	NCT01648348	Completed	N/A
VB111+Bevacizumab	Glioblastoma Recurrent Glioblastoma	Phase 2	45	N/A	N/A	NCT04406272	Recruiting	N/A
VB-111+Bevacizumab	Glioblastoma	Phase 3	252	VB-111+bevacizumab group: 6.8 months; Bevacizumab monotherapy group: 7.9 months	N/A	NCT02511405	Completed	31844890
VB-111+Bevacizumab	Glioblastoma Multiforme	Phase 1/2	75	N/A	N/A	NCT01260506	Completed	N/A
immunotherapy+TTFields								
MTA-based vaccine+TTFields	Glioblastoma	Phase 1	13	N/A	N/A	NCT03223103	Active, not recruiting	N/A
Poly-ICLC+Peptides++TTFields	Glioblastoma	Phase 1	13	N/A	N/A	NCT03223103	Active, not recruiting	N/A

recruiting

Nivolumab+Ipilimumab+TTFields

Recurrent Glioblastoma

Phase 2

5

N/A

N/A

NCT03430791

Terminated

N/A

CAR=chimeric antigen receptor; DC=dendritic cell; ICIs=immune checkpoint inhibitors; N/A=not applicable; OS=overall survival; PFS=progression-free survival; PVSRIPO=oncolytic polio/rhinovirus recombinant; poly-ICLC=Polyinosinic-Polycytidylic; TMZ=temozolomide; TTFields=tumor-treating fields; hP1A8= human P1A8; HSPPC=heat shock protein peptide-complex; ALT=autologous lymphocyte transfer; PVSRIPO= recombinant nonpathogenic polio-rhinovirus chimera; GBM=glioblastoma; D2C7-IT=D2C7 immunotoxin; GSC-DCV= dendritic cells pulsed with glioblastoma stem-like cell antigens; AdV-tk=adenoviruses armed with thymidine kinase; IL13Ra2=Interleukin-13 receptor alpha 2; MGMT=methylguanine methyltransferase; hCMV=human cytomegalovirus; Flt3L= Fms -like tyrosine kinase 3 ligand; ADCTA=autologous dendritic cell/tumor antigen vaccine; ALECSAT =autologous lymphoid effector cells specific against tumor; GM-CSF= granulocyte-macrophage colony-stimulating factor; MTA-based vaccine =mutation-derived tumor antigen based vaccine.