**Supplementary Table 1.** Landmark gastroesophageal vaccines in recent and ongoing trials (extended). Articles accessed on 22 January 2026. (OS = overall survival, PFS = progression-free survival, AE = adverse event, IFN-γ = interferon gamma, CTL = cytotoxic T-lymphocyte, DFS = disease-free survival, RFS = relapse-free survival, TTP = time to progression, HER2 = human epidermal growth factor receptor 2, PD-L1 = programmed death-ligand 1, PD-1 = programmed death protein-1).

| Compound | Mechanism of Action | Combination Therapy | Participants (n) | Phase | Primary Outcome | Other Key Findings | Study Design | Sponsor | Status | NCT Identifier | PMID Number | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Esophageal Cancer | | | | | | | | | | | | |
| CHP-NY-ESO-1 | NY-ESO-1 cancer-testis antigen loaded with novel antigen delivery system cholesteryl pullulan (CHP) | N/A | 25 | 1 | 200 μg induced stronger IgG response (p = 0.015) compared to 100 μg | 200 μg with similar PFS (p = 0.748) compared to 100 μg; no grade 3-4 AEs observed | Randomized comparison | ImmunoFrontier | Completed | NCT01003808 | 24093426 | [13] |
| Multiple-peptide vaccine | Peptides included TTK, URLC10, KOC1, VEGFR1, VEGFR2 | Radiotherapy, cisplatin, 5-fluorouracil | 11 | 1 | Grade 3 toxicities (neutropenia, anemia, thrombocytopenia) observed | All patients developed CTL responses (quantified as IFN-γ); six cases of complete response and five cases of progressive disease observed after the 8th vaccination | Non-comparative observation | Teikyo University | Completed | NCT00632333 | 24708624 | [14] |
| S-588410 | Peptide vaccine comprised of 5 HLA-A*24:02 restricted peptides from five cancer-testis antigens (URLC10, CDCA1, KOC1, | N/A | 276 | 3 | Similar median RFS (84.3 vs 84.1 months, p = 0.8156) in vaccine versus placebo arms | Similar OS (p = 0.6533) in vaccine versus placebo arms despite adequate CTL induction; grade 3 injection site reactions reported in 12.9% of patients | Randomized comparison | Takeda Pharmaceutical | Completed | N/A | 38990441 | [15] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DEPDC1, MPHOSPH1) | | | | | | | | | | | |
| G17DT | Induction of antigastrin antibody creation | Cisplatin, fluorouracil | 103 | 2 | Over response rate of 30% | Median OS and TTP were longer in immune-responders than in immune-nonresponders ($p < or = 0.0001$ and $p = 0.0005$, respectively) | Exploratory subgroup analysis | N/A | Completed | N/A | 16568451 | [18] |
| Neo-DCVac | Personalized tumor peptide-pulsed dendritic cells | Neoadjuvant immunotherapy (unspecified) | 12 | 1 | 38.5% with AE without noted grade 3-4 AE | Increased CD3, CD4, and CD8 T-cell populations in all patients; 1-year DFS and OS 88.3% and 100% (respectively); 2-year DFS and OS 66.7% and 91.7% (respectively) | Non-comparative observation | Sichuan University | Completed | NCT05023928 | N/A | [24] |
| URLC10-177 VEGFR1-A12-9 | Peptide vaccine containing oncoantigen expressed in esophageal squamous cell carcinoma (eSCC) | N/A | 12 | 1 | No patient experienced a grade 3-4 AE | Median OS time of 3.9 months; 4 cases with stable disease and 8 cases with progressive disease following vaccine administration | Non-comparative observation | University of Tokyo | Completed | NCT00753844 | 24398900 | [25] |
| iNeo-Vac-P01 | Personalized cancer vaccine | G-CSF | 24 | 1 | 1-, 2-, 3-year RFS rates of 91.3%, 83%, 73.8% (respectively) | 1-, 2-, 3-year OS rates of 100%, 94.7%, and 81.2%, respectively, T-cell responses in 100% of patients; 4 patients showed 100% response rates | Non-comparative observation | Hangzhou Neoantigen Therapeutics | Completed | NCT05307835 | N/A | [26] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Personalized mRNA tumor vaccine | Encodes neoantigen for unresectable or metastatic advanced esophageal cancer | N/A | 24 | 1 | AEs | 2nd Endpoints: PFS, OS, disease control rate, TTP | Non-comparative observation | Stemirna Therapeutics | In progress | NCT03908671 | N/A | [27] |
| Gastric Cancer | | | | | | | | | | | | |
| HER-Vaxx (IMU-131) | B-cell peptide vaccine in HER2-overexpressing gastric adenocarcinoma (induction of HER2-specific antibodies medicating Ab-dependent cell cytotoxicity) | Standard-of-care chemotherapy | 11 | 1 | Patients who received 50 µg experienced higher HER2-specific IgG antibody response compared to patients who received 10 µg and 30 µg dosages | Patients who received 50 µg experienced higher PFS compared to patients who received 10 µg and 30 µg dosages | Randomized comparison | Imugene Limited | Completed | NCT02795988 | 33879458 | [19] |
| HER-Vaxx (IMU-131) | B-cell peptide vaccine in HER2-overexpressing gastric adenocarcinoma (induction of HER2-specific antibodies medicating Ab-dependent cell cytotoxicity) | Standard-of-care chemotherapy | 36 | 2 | Elevation in HER-2 specific IgG and IgG1 antibodies were significantly correlated with tumor reduction ($p = 0.001$ and $p = 0.016$, respectively) | 40% OS benefit with HER-Vaxx with chemotherapy (13.9 months vs. 8.31 months) when compared against chemotherapy alone | Randomized comparison | Imugene Limited | Completed | NCT02795988 | 39028916 | [20] |
| OSTGC-A24 | HLA-A*24:02-binding peptide vaccine cocktail targeting FOXM1, DEPDC1, KIF20A, | Cyclophosphamide | 24 | 1/1b | Positive CTL responses following vaccination were observed in 33% (in 3-week cohort), 88% (in 2-week cohort), and 78% (in 1-week cohort) of patients | Median PFS of 1.7 months and median OS of 5.7 months | Non-randomized observation | National University Hospital, Singapore | Completed | NCT01227772 | 29587677 | [22] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | URLC10 and VEGFR1 | | | | | | | | | | | |
| MASCT-I | Autologous non-engineered immune cell therapy composed of multiple-antigen peptides (15 TAAs) loaded mature DCs | Camrelizumab | 15 | 1 | Only AE below grade 2 was reported (e.g., fever, fatigue) | Median PFS of 10.23 months (in patients with microsatellite instability) and 2.35 months (in patients expressing PD-L1); longest treatment duration of 18.9 months | Non-randomized observation | HRYZ Biotech | Completed | NCT03393416 | N/A | [23] |
| LY6K-177 | Lymphocyte antigen 6 complex locus K (LY6K) expresses a tumor-associated antigen (cancer/testis antigen found in NSCLC and eSCC) | N/A | 6 | 1 | LY6K was expressed in 85% of gastric cancer tissues examined | Stable disease in 3 patients, tumor shrinkage in 1 patient following administration; no systemic adverse effects observed | Non-randomized observation | Kinki University | Completed | NCT00845611 | 23613128 | [28] |
| p53MVA | Genetically engineered version of MVA virus to immunize patients with wild type p53 antigen | N/A | 12 | 1 | Frequency of PD-1 positive CD8+ T-cells showed an inverse correlation with the peak CD8+ p53 response ($p = 0.02$) | No AEs above grade 2 reported following immunization | Non-randomized observation | City of Hope | Completed | NCT01191684 | 24987057 | [29] |
| AD5.F35-GUCY2C PADRE | Encodes extracellular domain of guanylyl cyclase C, normally restricted to intestinal cells but overexpressed in | N/A | 81 | 2a | Safety/tolerability | 2nd Endpoints: T-cell/Ab responses, DFS, OS | Randomized comparison | Thomas Jefferson University | Recruiting | NCT04111172 | N/A | [30] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GI adenocarcinomas | | | | | | | | | | | |
| AST-301 | DNA vaccine that encodes the intracellular domain of HER2 | rhuGM-CSF | 24 | 2 | AEs, IFN-γ assay | 2nd Endpoints: DFS, change in memory T-cell populations | Randomized comparison | Aston Sci. Inc. | Recruiting | NCT05771584 | N/A | [31] |

**Supplemental Table 2.** Landmark CRC vaccines in recent and ongoing trials (extended). Articles accessed on 22 January 2026. (DC = dendritic cell, CEA = carcinoembryonic antigen, GM-CSF = granulocyte macrophage colony-stimulating factor, AE = adverse event, PD-1 = programmed death protein-1, PFS = progression-free survival, OS = overall survival, TP53 = tumor protein p53, PD-L1 = programmed death-ligand 1, TIL = tumor-infiltrating lymphocyte).

| Compound | Mechanism of Action | Combination Therapy | Participants (n) | Phase | Primary Outcome | Other Key Findings | Study Design | Sponsor | Status | NCT Identifier | PMID Number | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CEA-loaded DC | DCs pulsed with CEA-derived HLA-A2 peptide<br><br>DCs electroporated with CEA mRNA | N/A | 16 | 1/2 | All patients had T cell responses against control antigen | CEA peptide-specific T cells found in 8 out of 11 patients in peptide group, 0 out of 5 in mRNA group | Exploratory subgroup analysis | Radboud University Medical Center | Completed | NCT00228189 | 21187495 | [7] |
| GVAX | Whole-cell, GM-CSF immunotherapy inducing T-cell immunity | Cyclophosphamide, pembrolizumab | 17 | 2 | Failed to induce radiographic responses, but some biochemical response with CEA decline in 41% of patients | Generally well-tolerated with Grade 3 AEs (hemolytic anemia, corneal transplant rejection) in two patients | Non-randomized observation | Sidney Kimmel (Johns Hopkins) | Completed | NCT02981524 | 31876399 | [8] |
| p53MVA | Genetically engineered version of | N/A | 12 | 1 | CD4+ and CD8+ T cells showing enhanced recognition | The frequency of PD-1 + CD8+ T cells inversely correlated with peak | Non-randomized observation | City of Hope | Completed | NCT01191684 | 24987057 | [29] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | modified vaccinia Ankara (MVA) virus to immunize patients with wild type p53 antigen | | | | of p53 peptide, after first vaccination particularly in CD8+ T cells (p = 0.03) | CD8+ p53 response (p = 0.02) | | | | | | |
| CEA-loaded DC | DCs pulsed with CEA | Low dose interleukin-2 | 12 | 1 | Well-tolerated, no severe AEs; two patients had stable disease (17%), 10 patients with disease progression (83%) | Significant increase in proliferation against CEA by T cells in two patients (22%) | Non-randomized observation | National Institute of Cancer Research, Taiwan | Completed | NCT00154713 | 27558635 | [32] |
| MUC1 | Peptide vaccine containing Mucin-1 | N/A | 103 | 2 | Recurrent adenomas were observed in 66% in placebo group versus 56.3% in MUC1 group (p = 0.25) | Participants with immune responses in weeks 12 and 55 had a 38% absolute risk reduction in adenoma recurrence compared to placebo (p = 0.08) | Randomized comparison | University of Pittsburgh | Completed | NCT02134925 | 36892581 | [33] |
| MVA-5T4 | Highly attenuated, non-replicating modified vaccinia Ankara virus delivering tumor-associated antigen trophoblast glycoprotein (5T4) | Cyclophosphamide | 55 | 1/2 | Patients with greater than 2-fold increase in anti-5T4 responses had prolonged PFS (5.6 vs. 2.4 months, p < 0.001) and OS (20.0 vs. 10.3 months, p = 0.008) | Cyclophosphamide did not enhance the effectiveness of the vaccine | Randomized comparison | Cardiff University | Completed | ISRCTN54669986* | 28880972 | [34] |
| Alpha-type-1 DC vaccine | Autologous DCs loaded with killed autologous tumor cells, keyhole limpet hemocyanine (KLH), and PADRE peptides | N/A | 9 | 1 | 89% of lymphatic cannulations and implantations were successful and well tolerated; average port patency was 7.5 +/- 3.2 weeks | One patient with aggressive carcinomatosis was alive at 90 months without evidence of disease | Exploratory subgroup analysis | Pawel Kalinski | Completed | NCT00558051 | 27096100 | [35] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CV-301 | Poxviral vaccine targeting CEA and MUC1 | Quadruple Therapy: N-803, M9241, Bintrafusp alfa<br><br>Triple Therapy: N-803, Bintrafusp alfa | 32 | 1/2 | One complete response (5%) in quadruplet therapy arm, 0% in triplet therapy | Grade 3 AEs in 8 patients (26.7%) most commonly anemia and GI hemorrhage | Non-randomized observation | National Cancer Institute | Completed | NCT04491955 | 41520164 | [36] |
| GVAX | Whole-cell, GM-CSF immunotherapy inducing T-cell immunity | Guadecitabine | 18 | 1 | No significant change in CD45RO+ T-cells was found, demonstrating no significant immunologic activity | Grade 3-4 AEs were observed to consist of neutropenia, leukopenia, and/or fatigue | Exploratory subgroup analysis | Sidney Kimmel (Johns Hopkins) | Completed | NCT01966289 | 33531075 | [37] |
| RNA-pulsed DC | CEA mRNA-pulsed patient's DCs are reinfused into the patient's body | N/A | 24 | 2 | 69% of patients had a median relapse at 122 days | One complete response, two minor responses, three with stable disease and 18 with progressive disease | Non-randomized observation | Duke Cancer Institute | Completed | NCT00003433 | 23624851 | [38] |
| ADC | Autologous dendritic cells loaded with tumor lysate | Best supportive care (BSC) | 52 | 2 | Median PFS 2.7 months with vaccine versus 2.3 months in control (p = 0.628); median OS 6.2 months in vaccine versus 4.7 months in control (p = 0.41) | Among patients with robust immune response, OS increased 7.3 months versus 3.8 months in controls (p = 0.026); study terminated early given futility | Randomized comparison | Fundacion Clinic per a la Recerca Biomedica | Completed | NCT01413295 | 27428073 | [39] |
| ADC | Autologous dendritic cells | Avelumab | 19 | 1/2 | Study terminated early as primary endpoint was not met (only 11% patients were disease-free at 6 months) | Median PFS of 3.1 months and overall survival of 12.2 months; in vitro immune stimulation observed but did not translate into clinical benefit | Non-randomized observation | Grupo Espanol Multidisciplinario del Cancer Digestivo | Completed | NCT03152565 | 36083313 | [40] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GRT-C903 GRT-C904 | Chimpanzee adenovirus (ChAd68) primed with self-amplifying mRNA boost | Ipilimumab, nivolumab | 39 | 1/2 | Median PFS of 1.9 months, OS of 7.9 months; two patients experienced grade 3/4 AE that were dose-limiting toxicities | T-cell responses skewed towards TP53 neoantigens (included in the vaccine) rather than KRAS, despite KRAS being the most common tumor mutation | Non-randomized observation | Gristone Bio, Inc. | Completed | NCT03953235 | 38538867 | [41] |
| MUC1 | Peptide vaccine (tumor-associated antigen) in setting of advanced colonic adenoma | N/A | 39 | 1/2 | Highly immunogenic in 43.6% of patients, inducing strong anti-MUC1 IgG responses and long-term immune memory | No grade 3-4 AE observed in patient with MUC1-specific immune response | Non-randomized observation | Robert Schoen | Completed | NCT00773097 | 23248097 | [42] |
| AlloStim | Th1 memory cells derived from healthy donor blood using CD3/CD28 microbeads in the setting of third-line metastatic CRC | Cryotherapy | 13 | 2 | OS greater in AlloStim alone (368 days) compared to AlloStim + cryotherapy (97 days) | Grade 3 AEs included pancreatitis, fatigue and pneumonia | Non-randomized observation | Mirror Biologics, Inc. | Completed | NCT02380443 | N/A | [43] |
| PolyPEPI1018 | Multi-peptide vaccine containing 12 immunogenic epitopes derived from 7 shared tumor antigens | Atezolizumab | 18 | 1b/2a | Patients with increased PFS > 12 weeks had increased PD-L1 expression ($p = 0.007$) and increased CD8+ TIL density ($p = 0.016$) | Disease control rate of 61%; 81.3% showed robust vaccine CD4/CD8 T-cell response | Non-randomized observation | Treos Bio Limited | Completed | NCT05243862 | N/A | [44] |
| PolyPEPI1018 | Multi-peptide vaccine containing 12 immunogenic epitopes derived from 7 shared tumor antigens | N/A | 11 | 2b | 80% of patients had CD8+ T-cell response and patients with multiple doses had PFS 12.5 months and single dose had | Well tolerated vaccine with no serious AEs reported | Non-randomized observation | Tres Bio Zrt | Completed | NCT03391232 | 35472243 | [45] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PFS 4.6 months (p = 0.017) | | | | | | | |
| SPL mKRASvax | Peptide vaccine targeting KRAS | Balstilimab, botensilimab | 54 | 1 | Progression-free survival, objective response rate | Secondary Endpoint: Disease control rate | Non-randomized observation | Sidney Kimmel (Johns Hopkins) | Recruiting | NCT06411691 | N/A | [46] |
| NA DC vaccine | Neoantigen dendritic cell vaccine | Nivolumab | 60 | 2 | 24-mo relapse free survival, induced immune response against vaccinated NAs | Secondary Endpoints: AEs, OS | Non-randomized observation | Bristol-Myers Squibb | Recruiting | NCT04912765 | N/A | [47] |

* This trial is registered in the UK's clinical study registry (ISRCTN).

**Supplemental Table 3.** Landmark HCC vaccines in recent and ongoing trials (extended). Articles accessed on 22 January 2026. (ORR = objective response rate, IHC = immunohistochemistry, CTL = cytotoxic T-lymphocyte, HLA = human leukocyte antigen, TAA = tumor-associated antigen, DC = dendritic cell, PFS = progression-free survival, AE = adverse event, OS = overall survival).

| Compound | Mechanism of Action | Combination Therapy | Participants (n) | Phase | Outcomes | Other Key Findings | Study Design | Sponsor | Status | NCT Identifier | PMID Number | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GNOS-PV02 | DNA plasmid personalized therapeutic cancer vaccine | Pembrolizumab | 36 | 1/2 | ORR of 30.6%, with 8.3% achieving complete response | Neoantigen-specific T-cell response in 86.4%; no dose-limited toxicities or grade 3 adverse events noted | Non-randomized observation | Geneos Therapeutics | Completed | NCT04251117 | 38584166 | [48] |
| GPC3 | Glypican-3 peptide vaccine | N/A | 68 | 2 | Long-term survival at 8 years of 67.1% vs. 38.9% in vaccine arm versus control arm (p = 0.038) | Patients positive for GPC3 IHC staining are more likely to have induced CTLs, with 60% survival beyond 5 years | Exploratory subgroup analysis | Onco Therapy Science, Inc | Completed | UMIN000002614* | 32449239 | [49] |
| Hepa-Vac101 | Combination of IMA970A (5 HLA-A*24 and 7 HLA-A*02 as well as 4 HLA-DR | Cyclophosphamide | 82 | 1/2 | Immune responses against vaccinated HLA class I TAA and vaccinated HLA class II TAA were | Grade 3-4 AEs in 2 patients: non-serious amylase increase, lipase increase, influenza-like illness | Non-randomized observation | National Cancer Institute, Naples | Completed | NCT03203005 | 35421231 | [50] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | restricted peptides) as well as CV8102 (RNA-based immunostimulator) | | | | respectively induced in 37% and 53% of patients | | | | | | | |
| DC vaccine | Monocyte-derived autologous DCs pulsed with a cell lysate made from HepG2 cells (a hepatoblastoma cell line known to express several putative HCC tumor antigens) | Transarterial chemoembolization (TACE), cyclophosphamide | 48 | 2 | Median PFS was 18.6 months in the vaccine infusion arm compared to 10.4 months in the control arm (p = 0.016) | The addition of DC infusions did not significantly increase the incidence of severity of AEs | Randomized comparison | NIHR Birmingham Liver Biomedical Research Centre. | Completed | 09/160/24** | 40499144 | [51] |
| HSP70 GPC3 | Peptide vaccine containing heat shock protein 70 and glypican-3 | hLAG-3Ig + poly-ICLC | 20 | 1 | Per IHC analysis, 60% of patients demonstrated infiltration of CD8+ T-cells in tumors with target antigen expression | Grade 1 AEs in 95% of patients | Randomized comparison | CYTLIMIC | Completed | jRCTs061180058*** | 36929310 | [52] |
| NA DC | Neoantigen dendritic cell vaccine | Nivolumab | 60 | 2 | 24-mo relapse free survival, induced immune response | 2nd Endpoints: AEs, OS | Non-randomized observation | National Cancer Centre, Singapore | Recruiting | NCT04912765 | N/A | [47] |
| CSC DC | Cancer stem cell-loaded dendritic cell vaccine | N/A | 40 | 1/2 | # of participants with AEs | 2nd Endpoints: Vaccine immune responses | Randomized comparison | Fuda Cancer Hospital, Guangzhou | Active | NCT02089919 | N/A | [53] |
| CRCL + BAG | Chaperone-rich cell lysate (calreticulin, HSP70, HSP90, gp96 neoantigens) derived from patient's own tumor biopsy + bioengineered | N/A | 15 | 2 | Response measured by mRECIST score and experimental biomarker changes | 2nd Endpoints: Immune monitoring via longitudinal CT scans/biopsies | Non-randomized observation | Mirror Biologies, Inc. | Active | NCT02409524 | N/A | [54] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | allograft (derived from healthy donor Th1 memory cells) | | | | | | | | | | | |

* This trial is registered in the Japanese University Hospital Medical Information Network (UMIN). ** This trial is registered in the British clinical study registry (NIHR). *** This trial is in Japan's Registry for Clinical Trials (jRCT).

**Supplementary Table 4.** Landmark BTC and PDAC vaccines in recent and ongoing trials (extended). Articles accessed on 22 January 2026. (GM-CSF = granulocyte macrophage colony-stimulating factor, RFS = relapse-free survival, PFS = progression-free survival, OS = overall survival, AE = adverse event, TCR = T-cell receptor, DFS = disease-free survival, TSA = tumor-specific antigen, TAA = tumor-associated antigen, ORR = objective response rate, IFN-γ = interferon gamma).

| Compound | Mechanism of Action | Combination Therapy | Participants (n) | Phase | Primary Outcome | Other Key Findings | Study Design | Sponsor | Status | NCT Identifier | PMID Number | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Biliary Tract Cancer** | | | | | | | | | | | | |
| WT1 | Wilms tumor 1 peptide vaccine | Gemcitabine | 25 | 1 | WT1-specific T cells detected in 59% of patients | 2-month disease control rate of 50% with median survival time of 288 days | Non-randomized observation | Jikei University School of Medicine | Completed | UMIN000004081* | 21150717 | [57] |
| OCV-C01 | HLA-A*24:02-restricted three-peptide cancer vaccine targeting VEGFR1, VEGFR2 (targets both tumor angiogenesis) as well as KIF20A (oncoantigen) | N/A | 6 | 2 | 67% of patients exhibited vaccine-specific T-cell responses to one or more of three antigens | T-cell response was significantly correlated with overall survival (p = 0.0177) | Exploratory subgroup analysis | Cancer Precision Medicine, Inc. | Completed | UMIN000012778* | 33788741 | [58] |
| HLA-A*2402 restricted | Four-peptide vaccine containing lymphocyte | N/A | 9 | 1 | Peptide-specific T-cell responses observed in 77% | Median PFS and OS of 156 and 380 days, | Non-randomized observation | Nakayama Cancer | Completed | UMIN000003207* | 23479678 | [59] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| epitope peptides | antigen 6 complex locus K-177, TTK protein kinase-567, insulin-like growth factor-II mRNA-binding protein 3-508, DEP domain containing 1 | | | | of patients with clinical responses observed in 66% of patients | respectively; no grade 3 or 4 adverse events following four-peptide vaccination | | Research Institute | | | | |
| Personalized peptide vaccine (PPV) | Maximum of four HLA class I-matched peptides are selected from candidate antigen peptides | Cyclophosphamide (CPA) | 49 | 2 | PPV/CPA arm with significantly higher median PFS (6.1 vs. 2.9 months, p = 0.008) and OS (12.1 vs. 5.9 months, p = 0.004) compared to PPV alone arm | Increase in IL-6 observed only in PPV/CPA arm | Randomized comparison | Taiho Pharmaceutical Co., Ltd. | Completed | UMIN000006249* | 28188670 | [60] |
| Elpamotide | HLA-A*24:02-restricted epitope peptide that induces CTLs to specifically recognize VEGFR-2/KDR169 | Gemcitabine (Gem) | 55 | 2 | Median survival of 10.1 months, with 1-year survival rate of 44.4% | Injection site reactions were observed in 64.8%, in whom median survival was 14.8 months compared to 5.7 months in those with no injection site reaction (p = 0.002) | Exploratory subgroup analysis | OncoTherapy Science | Completed | UMIN000002500* | 25502982 | [61] |
| Multiple-peptide vaccine | Targeted antigens included CDCA1, KIF20A, cadherin 3 (derived from cancer-testis antigens) within patients with HLA type A*2402 | N/A | 9 | 1 | Peptide-specific T-cell response observed in 55% of patients | Median PFS and OS of 3.4 and 9.7 months, respectively; no grade 3-4 AEs | Non-randomized observation | University of Tokyo | Completed | UMIN000003229* | 24606884 | [62] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OBI-833 | Carbohydrate-conjugate vaccine designed to induce complement-dependent cytotoxicity (mediated by IgM and IgG) against tumor cells expressing the Globo H antigen | OBI-821 | 30 | 2 | PFS | Secondary Endpoints: OS, tumor response, safety profile | Non-randomized observation | Chang Gung Memorial Hospital | Not yet recruiting | NCT06490198 | N/A | [63] |
| mBTC vax | Peptide vaccine with poly-ICLC (dsRNA complex) that activates toll-like receptor 3 to enhance dendritic and NK cell activity | Durvalumab, tremelimumab | 25 | 1 | AEs from drug-related toxicities, change in CD8 and CD4 populations | Secondary Endpoint: PFS and OS | Non-randomized observation | AstraZeneca | Recruiting | NCT06564623 | N/A | [64] |
| Pancreatic Adenocarcinoma | | | | | | | | | | | | |
| p53MVA | Genetically engineered version of MVA virus to immunize patients with wild type p53 antigen | N/A | 12 | 1 | PD-1 expression limited sustained T-cell expansion ($p = 0.02$) | Safe, well-tolerated and immunogenic with robust CD8 T-cell responses against p53 | Non-randomized observation | City of Hope | Completed | NCT01191684 | 24987057 | [29] |
| GVAX | Vaccine introduces irradiated pancreatic tumor cells that have been genetically | Cyclophosphamide (Cy), pembrolizumab, stereotactic body radiation | 58 | 2 | 44% of patients underwent resection, with 42% of resected cases showing major pathologic responses | Combination therapy was feasible and immunologically active in locally advanced | Non-randomized observation | Sidney Kimmel (Johns Hopkins) | Completed | NCT02648282 | 38324679 | [68] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | modified to produce GM-CSF | | | | | pancreatic cancer | | | | | | |
| ELI-002 ELI-002 2P | A peptide-based cancer vaccine that consists of amphiphile KRAS peptides combined with CpG adjuvant | N/A | 25 | 1 | Median RFS 16.3 months, which correlated with T cell responses above 12.75-fold above baseline (p = 0.0167) | 84% of patients demonstrated mKRAS-specific T-cell responses; no dose-limiting toxicities were observed | Non-randomized observation | Elicio Therapeutics | Completed | NCT04853017 | 38195752 | [69] |
| ELI-002 ELI-002 2P | A peptide-based cancer vaccine that consists of amphiphile KRAS peptides combined with CpG adjuvant | N/A | 25 | 1 | At median 19.7 months, patients with mKRAS-specific T cell responses above 9.17-fold above baseline had median radiographic RFS not reached versus 3.02 months (p = 0.0002) | 71% of patients induced both CD4 and CD8 cells, and antigen spreading present in 67% of patients | Non-randomized observation | Elicio Therapeutics | Completed | NCT04853017 | 40790272 | [70] |
| Autogene cevumeran | An mRNA neoantigen vaccine generated in real time from surgically resected PDAC tumors | Atezolizumab, mFOLFIRINOX | 29 | 1 | At 18-month follow-up, T-cell responders had a longer median recurrence free survival (not reached), compared to non-responders (p = 0.003) | Vaccine-induced clonal expansion was detected in 100% of responders and in 12.5% of non-responders | Non-randomized observation | Memorial Sloan Kettering Cancer Center | Completed | NCT04161755 | 37165196 | [72] |
| Autogene cevumeran | An mRNA neoantigen vaccine generated in real time from | Atezolizumab, mFOLFIRINOX | 29 | 1 | At 3.2 year follow up, responders demonstrated longer median | In responders, the vaccine induced CD8 T-cell clones with | Non-randomized observation | Memorial Sloan Kettering Cancer Center | Completed | NCT04161755 | 39972124 | [73] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | surgically resected PDAC tumors | | | | recurrence-free survival (not reached) compared with non-responders at 13.4 months (p = 0.007) | average lifespan 7.7 years | | | | | | |
| SVN-2B | A peptide vaccine developed from survivin splice variant 2B (SVN-2B) | Interferon-β | 83 | 2 | No significant improvement in PFS (66 days vs. 70 days) compared to control arm (p = 0.2617) | Subgroup analysis demonstrated that longer SVN-2B with IFN-β treatment may lead to improved survival | Exploratory subgroup analysis | Sapporo Medical University | Completed | UMIN000012146* | 31218770 | [75] |
| Mesopher | Autologous DC vaccine | Mitazalimab | 16 | 1 | One transient dose-limiting toxicity found; no objective radiographic response observed | 50% of patients showed stable disease after three administrations | Non-randomized observation | Erasmus MC Cancer Institute | Completed | NCT05650918 | 41315287 | [77] |
| Algenpantucel-L (NLG0205) | Introduction of irradiated allogenic pancreatic cancer cells transfected to express murine α-1,3-galactosyltransferase, with subsequent rapid activation of antibody-dependent cell-mediated cytotoxicity | FOLFIRINOX or Gemcitabine/Nab-Paclitaxel | 303 | 3 | Median OS was 14.9 months in standard group versus 14.3 months in experimental (p = 0.98); median PFS 13.4 months in standard and 12.4 months in experimental (p = 0.59) | Grade 3 or 4 AEs 75% in standard and 81% in experimental (p > 0.05) | Randomized comparison | NewLink Genetics | Completed | NCT01836432 | 33630475 | [79] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GVAX | Vaccine introduces irradiated pancreatic tumor cells that have been genetically modified to produce GM-CSF | Ipilimumab | 25 | 1 | Combination therapy led to improved survival in 27% of patients along with increased diversification of TCR repertoires | Patients with more than 100 clones expanded after treatment survived nearly 3 times longer than patients with fewer clones expanded ($p < 0.01$) | Randomized comparison | Sidney Kimmel (Johns Hopkins) | Completed | NCT00836407 | 29997287 | [80] |
| GVAX | Vaccine introduces irradiated pancreatic tumor cells that have been genetically modified to produce GM-CSF | Ipilimumab | 82 | 2 | Median OS 9.38 months in experimental versus 14.7 months in control ($p = 0.019$) | Combination therapy promoted T-cell differentiation and increased M1 macrophages in tumor; study discontinued due to futility after analysis | Randomized comparison | Sidney Kimmel (Johns Hopkins) | Completed | NCT01896869 | 32591464 | [81] |
| GVAX | Vaccine introduces irradiated pancreatic tumor cells that have been genetically modified to produce GM-CSF | Cyclophosphamide (Cy) | 87 | 2 | GVAX alone had longer DFS than GVAX/Cy combo | Tertiary lymphoid aggregates developed in 85% patients after vaccination | Randomized comparison | Sidney Kimmel (Johns Hopkins) | Completed | NCT00727441 | 33277370 | [82] |
| GVAX | Vaccine introduces irradiated pancreatic tumor cells that have been genetically modified to produce GM-CSF | Nivolumab, stereotactic body radiation (SBRT) | 31 | 2 | Median OS of 20.4 months, major pathologic response rate of 35% | There was no difference in mean CD8 T cell density in study patients versus historical control | Non-randomized observation | Sidney Kimmel (Johns Hopkins) | Completed | NCT03161379 | 40407726 | [83] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GVAX, CRS-207 | GVAX = irradiated pancreatic tumor cells that have been genetically modified to produce GM-CSF<br><br>CRS-207 = live, attenuated *Listeria monocytogenes* expressing mesothelin | Cyclophosphamide (Cy), nivolumab | 57 | 2 | Response rates were not different in treatment arms | Grade 3+ AEs were seen in 39 (68%) patients, with 33 of those attributed to CRS-207 | Randomized comparison | Sidney Kimmel (Johns Hopkins) | Completed | NCT03190265 | 41524570 | [84] |
| Personalized peptide vaccine | Induces TSA/TAA-specific effector T-cell immune responses | Imiquimod, pembrolizumab, sotigalimab | 150 | 1 | AEs | OS, PFS, RFS, response rate, changes in neoantigen-specific T-cell response | Non-randomized observation | MD Anderson Cancer Center | Enrolling by invitation | NCT02600949 | N/A | [85] |
| KRAS peptide vaccine + poly-ICLC adjuvant | A peptide-based cancer vaccine against mutant KRAS | N/A | 25 | 1 | AEs, changes in IFN-gamma producing mutant-KRAS-specific CD8+ and CD4+ T-cells at 5/13/17 weeks | Changes in T-cell quality | Non-randomized observation | Sidney Kimmel (Johns Hopkins) | Recruiting | NCT05013216 | N/A | [86] |
| KRAS peptide vaccine + poly-ICLC adjuvant | A peptide-based cancer vaccine against mutant KRAS | Nivolumab, ipilimumab | 30 | 1 | AEs, changes in IFN-γ producing mutant-KRAS-specific CD8+ and CD4+ T-cells | OS, DFS, PFS, ORR | Non-randomized observation | Sidney Kimmel (Johns Hopkins) | Active | NCT04117087 | N/A | [78] |
| ELI-002 2P | A peptide-based cancer vaccine that consists of amphiphile KRAS | N/A | 158 | 1/2 | Phase 1: AEs<br>Phase 2: DFS | Phase 1: Reduction in ctDNA, CA 19-9, CEA | Randomized comparison | Elicio Therapeutics | Active | NCT05726864 | N/A | [71] |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | peptides combined with CpG adjuvant | | | | Phase 2: OS | | | | | | | |
| Autogene cevumeran | An mRNA neoantigen vaccine generated in real time from surgically resected PDAC tumors | Atezolizumab + mFOLFIRINOX | 260 | 2 | DFS | OS, AEs | Randomized comparison | Genentech, Inc. | Recruiting | NCT05968326 | N/A | [74] |

* These trials are registered in the Japanese University Hospital Medical Information Network (UMIN).