Potent Tumor-Directed T cell Activation and Tumor Inhibition Induced by a 4-1BB x 5T4 ADAPTIR™ Bispecific Antibody

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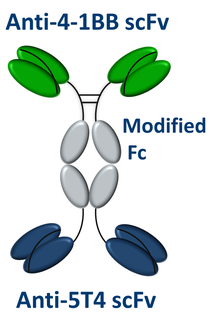
Introduction

- 4-1BB (CD137) is an activation-induced costimulatory immune receptor expressed on tumor-infiltrating T cells and NK cells
- Stimulation of 4-1BB leads to enhanced proliferation, increased survival, intensified cytolytic activity, and induced IFN-γ production of T and NK cells
- 4-1BB-targeting immunotherapies have shown promising anti-tumor effects clinically but one monospecific 4-1BB agonist has induced dose-limiting hepatic toxicities
- 5T4 is a tumor-associated antigen expressed in patients in a variety of malignancies, including NSCLC, head and neck, mesothelioma, renal, pancreas, bladder, breast, colorectal, gastric, ovarian and cervical cancers

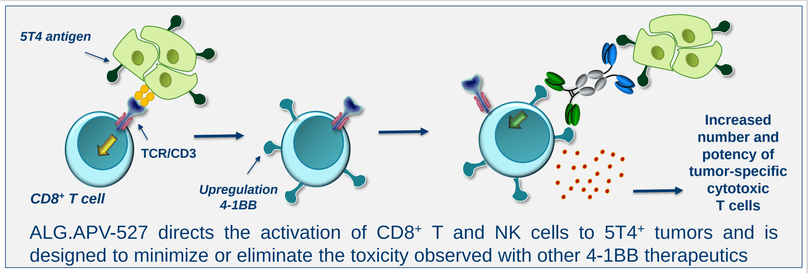
About ALG.APV-527

- ALG.APV-527 is a bispecific therapeutic in the ADAPTIR™ format containing two sets of binding domains, scFv, targeting 5T4 and 4-1BB which are linked to a silent Ig Fc domain, providing an antibody-like *in vivo* half-life
- The scFv originate from the Alligator Gold® human scFv library (Alligator Bioscience)
- Each scFv has then been optimized and developed for use in the bispecific ADAPTIR™ format (Aptevo Therapeutics)

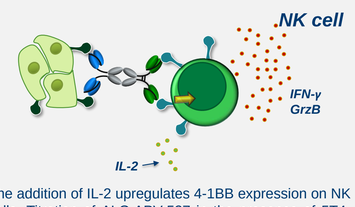


- ALG.APV-527 features target-driven T cell activation, optimized stability, good manufacturing properties with potential for improved risk-benefit in humans than other monospecific 4-1BB antibodies
- ALG.APV-527 is cross-reactive to 4-1BB and 5T4 of cynomolgus monkey. It binds to human and cynomolgus 5T4 and 4-1BB expressing cells and enhances activation of CD3-stimulated human and cynomolgus T cells
- Demonstrated an extended antibody-like serum half-life of 9 days

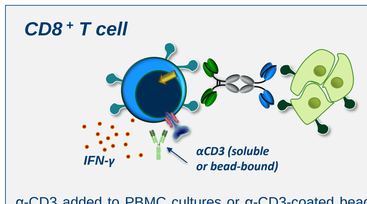
ALG.APV-527 Mode of Action



ALG.APV-527 directs the activation of CD8⁺ T and NK cells to 5T4⁺ tumors and is designed to minimize or eliminate the toxicity observed with other 4-1BB therapeutics

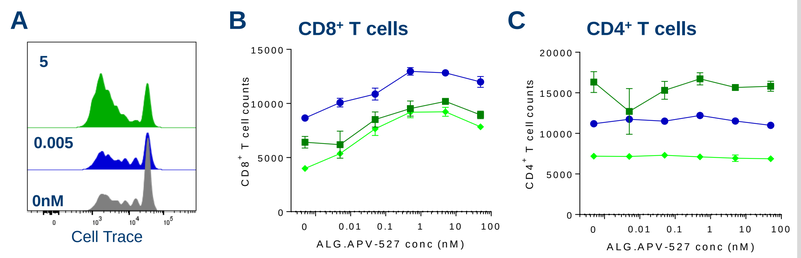


The addition of IL-2 upregulates 4-1BB expression on NK cells. Titration of ALG.APV-527 in the presence of 5T4-expressing tumor cells enhances secretion of cytolytic molecules such as IFN-γ and granzyme B and promotes proliferation.

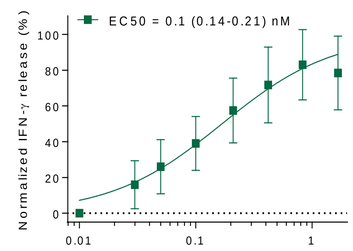


α-CD3 added to PBMC cultures or α-CD3-coated beads cultured with enriched CD8⁺ T cells stimulate through the TCR to induce the upregulation of 4-1BB. The addition of ALG.APV-527 in culture with 5T4⁺ tumors augment the cells' proliferation and secretion of IFN-γ.

ALG.APV-527 augments CD8⁺ T cell proliferation and IFN-γ production in the presence of 5T4+ cells

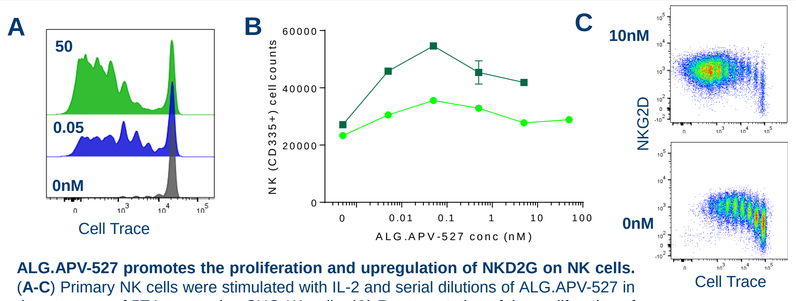


ALG.APV-527 augments CD8⁺T cell proliferation. Primary PBMC were stimulated with α-CD3 Ab in solution and serial dilutions of ALG.APV-527 in the presence of 5T4-expressing CHO-K1 cells. (**A**) Representation of the proliferation of CD8⁺ T cells. The number of CD8⁺ T cells (**B**) and CD4⁺ T cells (**C**) were calculated at 96 hours via flow cytometry. Three healthy donors are represented here.

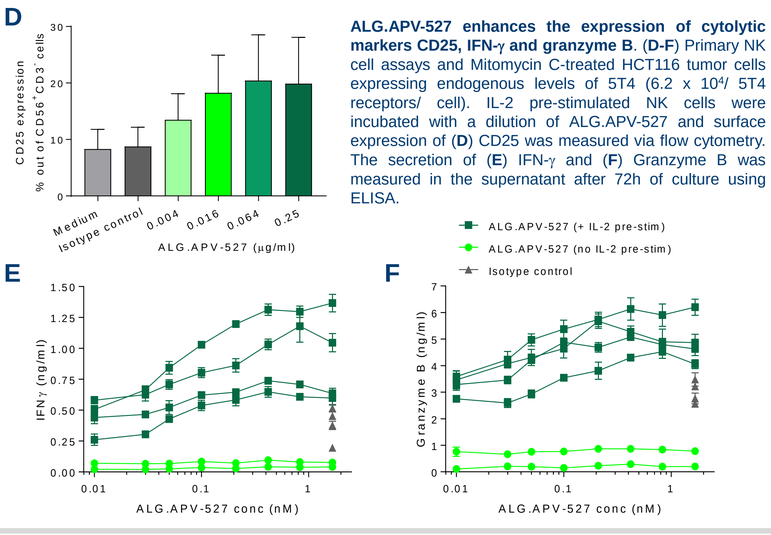


ALG.APV-527 enhances CD8+ T cells' ability to secrete IFN-γ. (**D**) Primary CD8⁺ T cells and anti-CD3 abs coated on beads at a 1:1 T cell/ beads ratio were incubated with ALG.APV-527 in the presence of Mitomycin C treated HCT116 tumor cells expressing endogenous levels of 5T4 (6.2 x 10^4/ 5T4 receptors/ cell). IFN-γ production was measured in the supernatant after 72h using ELISA. Normalized IFN-γ levels (mean of 12 donors) and nonlinear curve fit log (agonist) vs. normalized response variable slope) is plotted here using GraphPad Prism.

ALG.APV-527 enhances NK cell effector function in presence of 5T4⁺ cells

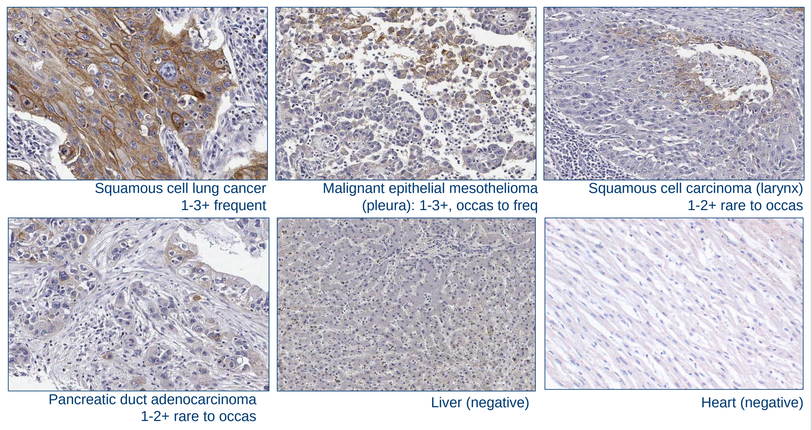


ALG.APV-527 promotes the proliferation and upregulation of NKD2G on NK cells. (**A-C**) Primary NK cells were stimulated with IL-2 and serial dilutions of ALG.APV-527 in the presence of 5T4-expressing CHO-K1 cells. (**A**) Representation of the proliferation of NK cells. (**B**) The number of CD335⁺ NK cells were assessed in 2 healthy samples on day 6 by flow cytometry. (**C**) Representative expression of NKG2D on treated NK cells.



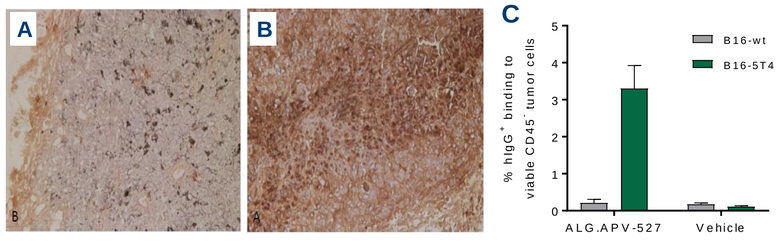
ALG.APV-527 enhances the expression of cytolytic markers CD25, IFN-γ and granzyme B. (**D-F**) Primary NK cell assays and Mitomycin C-treated HCT116 tumor cells expressing endogenous levels of 5T4 (6.2 x 10^4/ 5T4 receptors/ cell). IL-2 pre-stimulated NK cells were incubated with a dilution of ALG.APV-527 and surface expression of (**D**) CD25 was measured via flow cytometry. The secretion of (**E**) IFN-γ and (**F**) Granzyme B was measured in the supernatant after 72h of culture using ELISA.

High 5T4 expression in TMA of different tumor indications but low expression in normal tissue



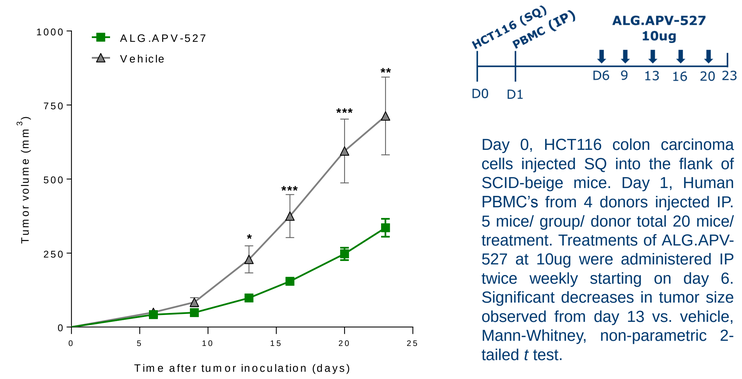
5T4 expression in human normal and tumor tissue. Formalin-fixed paraffin-embedded tissue micro-arrays (TMAs) were acquired from US Biomax Inc, and stained for 5T4 detection (clone MAB4975, R&D Systems). 5T4 expression was detected in tumors from NSCLC, Head and Neck, mesothelioma, pancreatic, bladder, renal and ovarian cancer with variable frequency and intensity, as exemplified above. Occasional membranous staining of 5T4 was detected in specific cell populations in normal tissue, specifically on the smooth myocytes of the esophagus, osteocytes in bone marrow and epithelial cells in the adenohypophysis. There was no 5T4 staining on cells from any major organ system such as cardiovascular, respiratory or hepatic systems.

ALG.APV-527 localizes to 5T4⁺ tumors



5T4-dependent localization of ALG.APV-527 in a B16 twin tumor model
Day 0: each mouse received one 5T4 negative and one 5T4 positive B16 tumor injected subcutaneously (SQ, $1x10^5$ cells in 100 µL) at each side of the hind flank/back. Intraperitoneal (IP) treatment of ALG.APV-527 (100 µg) was given on days 6 and 13 and mice were sacrificed on day 14 (24 h after the final treatment). Tumors were collected and the levels of hIgG positive cells were assessed either by IHC or flow cytometry using an antibody detecting human IgG. IHC of ALG.APV-527 binding to either
A 5T4-negative tumors or **B** 5T4-positive tumors. **C** Flow cytometry of ALG.APV-527 binding to dissociated 5T4-positive and -negative tumor cells (percentage of hIgG+ cells out of live CD45- cells)

ALG.APV-527 inhibits tumor growth of a human HCT116 colon carcinoma



Day 0, HCT116 colon carcinoma cells injected SQ into the flank of SCID-beige mice. Day 1, Human PBMC's from 4 donors injected IP. 5 mice/ group/ donor total 20 mice/ treatment. Treatments of ALG.APV-527 at 10ug were administered IP twice weekly starting on day 6. Significant decreases in tumor size observed from day 13 vs. vehicle, Mann-Whitney, non-parametric 2-tailed *t* test.

Summary and Conclusions

> ***ALG.APV-527***:

- Augments CD8⁺ T cell proliferation and IFN- γ production but only in the presence of 5T4⁺ expressing cells
- Enhances the cytotoxic profile of NK cells via an increase in $CD25^{high}$ & NKD2G expression and the production of IFN-γ and Granzyme B
- Effectively localizes to 5T4⁺ tumor *in vivo*
- Inhibits colon carcinoma HCT116 tumor growth in a xenograft murine model

> **5T4 is expressed in a wide range of tumor indications, but not in any vital organs such as the heart or the liver**

> **The α-4-1BB x α-5T4 ADAPTIR molecule, ALG.APV-527, has the potential to be a unique α-cancer therapeutic agent with an improved safety profile for the treatment of numerous 5T4-expressing solid tumors with high unmet medical need**