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AllergoOncology: Harnessing the allergy cascade and mitochondria fission for solid tumors

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Abstract

AllergoOncology introduces allergy-assisted cancer immunotherapy (AACI), a new strategy that uses the body's acute allergic response (a rapid immune reaction to allergens) to target cancer cells and alter the tumor microenvironment (the area surrounding and supporting the tumor). AACI involves administering allergen-specific IgE monoclonal antibodies (lab-made immune protein involved in allergies) along with their matching allergens (substances that activates allergic responses), which triggers maximal mast cell degranulation (release of inflammatory substances from immune cells) within the solid tumor. This response activates extensive mitochondrial fission (the splitting of mitochondria, the cell's energy producers), disrupting the cancer cell's metabolism and making tumor cells easier for the immune system to detect and attack. This review explores AACI as a promising advance in mitochondrial-focused cancer immunotherapy.

Keywords: AllergoOncology; IgE Antibodies; Immunology; Mitochondria Fission; Solid Tumors

1. Introduction

Malignant solid tumors (abnormal cell growths forming masses in tissues) remain one of the greatest challenges in oncology, largely due to their capacity for immune evasion (the ability to avoid immune detection), metabolic adaptability (adjustment of cellular energy use), and resistance to conventional therapies. Recent advances have highlighted mitochondrial dynamics—especially the regulation of mitochondrial fission (splitting) and fusion (joining)—as key determinants of cancer cell survival, progression, and therapeutic resistance. AllergoOncology, an emerging interdisciplinary field, integrates principles from allergy and cancer research to propose a novel paradigm: allergy-assisted cancer immunotherapy (AACI). As explored throughout this review, AACI harnesses the acute allergic response—using allergen-specific IgE monoclonal antibodies (lab-made immune proteins targeting specific allergens) and controlled allergen exposure (deliberate introduction of substances causing allergies)—to provoke targeted mast cell degranulation (release of immune cell cytotoxic mediators) and promote DRP1-mediated (involving the dynamin-related protein 1 enzyme) mitochondrial fission within tumor cells. This dual strategy disrupts tumor metabolism, promotes apoptosis (programmed cell death), and boosts immune recognition, effectively converting immunologically "cold" (unresponsive) tumors into "hot," immune-responsive lesions. The review presents current mechanistic insights and applications across cancer types.

2. Discussion

After outlining AACI's conceptual framework, the following section provides a stepwise discussion of how allergy-assisted passive cancer immunotherapy is operationalized in practice, illustrating with specific examples.

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2.1. Antibody Transfer: Passive Immunotherapy

- Intralesional Antibody Therapy: The MOv18 IgE (lab-made, allergen-specific monoclonal antibody) is administered to the patient by intratumoral injection[1].
- Mechanism: This lab-made antibody infiltrates the tumor microenvironment (the tissue and fluids in and surrounding the tumor) and binds to FcεRI-primed mast cells (a high-affinity receptor expressed on mast cells) [2].

2.2. Allergen Exposure: Degranulation

- Intralesional Allergen Therapy: Once the lab-made antibodies bind to FcεRI-primed mast cells, the patient is similarly exposed to the Folate Receptor-alpha allergen (FRα) by intratumoral injection.
- Targeted Degranulation: The allergen triggers IgE-primed mast cells to degranulate and release inflammatory mediators directly within the tumor microenvironment (TME) [3].

2.3. Allergy-Assisted Cancer Immunotherapy (AACI) and Mitochondrial Fission

- Intratumoral injection of MOv18 IgE (lab-made allergen-specific monoclonal antibody) and the FRα allergen aims to provoke a localized acute allergic reaction, triggering changes in tumor-associated mitochondrial dynamics via an orchestrated inflammatory and metabolic cascade [4,5,6].
- The FcεRI-IgE-allergen interaction on mast cells triggers maximal degranulation (release of immune cell granules), releasing mediators (substances facilitating immune responses) that increase the expression of mechanoenzymes (enzymes involved in mechanical cell processes) and tumor-associated mitochondrial fission (splitting of mitochondria, cellular energy producers) (e.g., Substance P, IL-1, IL-13, IL-33, and TNF-α, which are signaling proteins) directly into the stroma (supporting tissue around the tumor) [7,8,9].
- This acute inflammation and metabolic stress in the TME rapidly activate DRP1 (Dynamin-related protein 1), the main driver of mitochondrial fission. Hyper-activated DRP1 fragments the cancer cell's mitochondrial networks into punctate, dysfunctional pieces [10,11].
- Excessive mitochondrial fission disrupts solid tumor metabolism by inhibiting OXPHOS, altering the TCA cycle, and elevating ROS, ultimately leading to cytochrome c release and apoptosis via caspase cascades [12,13].

2.4. Clinical Significance

Harnessing the acute allergic response to promote mitochondrial hyper-fission could starve solid tumors by causing the fragmented mitochondria to lose ATP production and leak ROS, triggering Mitochondrial Outer Membrane Permeabilization, cytochrome c release, and programmed cell death [14,15].

3. Overview of AACI and Mitochondrial Fission Applications Across Cancer Types

The following sections outline how the principles of AACI, and mitochondrial fission are relevant to various solid tumor types, highlighting specific opportunities for intervention.

3.1. Bladder Cancer

Allergy Cascade **-** Asthma is associated with a decreased risk of urothelial bladder cancer, especially among aggressive tumors. A study concluded that having a history of asthma is associated with a significantly decreased risk of developing aggressive or muscle-invasive urothelial bladder cancer [16].

Mitochondrial Dynamics **-** Artificially inducing excessive mitochondrial fission to elucidate the regulatory mechanisms of DRP1 under different conditions is of great significance, as it will help clarify the coordinated interaction among various cellular events and provide new perspectives [17].

3.2. Breast Cancer

Allergy Cascade - A history of allergies may be associated with a modest reduction in breast cancer risk. A study found that asthma may be associated with reduced breast cancer risk among premenopausal women [18].

Mitochondrial Dynamics - OPA1-driven mitochondrial fusion has been identified as a critical metabolic axis that supports the survival and regenerative potential of residual cancer cells following DNA-damaging treatments and chemotherapy [19].

3.3. Colon Cancer

Allergy Cascade - The allergy cascade may be associated with a decreased risk of colon cancer, as heightened immune responses associated with atopy may reduce the risk. A cohort study found that a history of allergic conditions was inversely associated with both the risk of developing colorectal cancer (CRC) and mortality from it [20].

Mitochondrial Dynamics - DRP1 expression was decreased by up to 75% in malignant colon cancers, and levels dropped even further with more advanced cancer grades [21].

3.4. Glioblastoma

Allergy Cascade - A history of allergies is associated with a decreased risk of developing glioblastoma, an aggressive and common brain tumor. Researchers found that a history of respiratory allergies, asthma, and eczema was associated with approximately a 30% lower risk of developing gliomas [22].

Mitochondrial Dynamics - Forcing mitochondrial fission causes metabolic dysfunction and energy collapse, ultimately leading to tumor cell death (apoptosis) [23].

3.5. Liver Cancer

Allergy Cascade - Patients with allergic or atopic conditions generally have a significantly lower risk of developing primary liver cancer. A cohort study found that adults with allergic diseases, such as asthma and atopic dermatitis, have a significantly reduced risk of developing liver cancer [24].

Mitochondrial Dynamics - High levels of the fusion protein OPA1 are found in liver tumors, promoting mitochondrial metabolic reprogramming that allows cancer cells to fuel rapid growth and resist apoptosis [25].

3.6. Melanoma Cancer

Allergy Cascade - Allergies reduce the risk of skin cancer and extracutaneous malignancies. Patients with a history of atopy (e.g., allergic asthma, rhinitis, or atopic dermatitis) have a significantly reduced risk of developing cutaneous melanoma [26].

Mitochondrial Dynamics - In wild-type and metabolically active melanoma cells, cellular respiration is often sustained by favoring mitochondrial fusion [27].

3.7. Ovarian Cancer

Allergy Cascade - Allergies may be associated with a decreased risk of ovarian cancer. Ovarian cancer risk was decreased in persons with any allergic history, and increasing numbers of allergies were associated with decreasing risk of this form of cancer [28].

Mitochondrial Dynamics - Imbalanced MFN1-mediated mitochondrial fusion is strongly linked to the regulation of cancer stem cells in the tumor [29].

3.8. Pancreatic Cancer

Allergy Cascade - Allergies are associated with a reduced risk of pancreatic cancer. Hay fever was associated with a significant reduction in pancreatic cancer risk [30].

Mitochondrial Dynamics - While moderate ROS levels aid pancreatic tumor growth, an abrupt spike caused by fission-inducing drugs overwhelms the cell's antioxidant defenses, ultimately triggering apoptosis [31].

3.9. Throat Cancer

Allergy Cascade - Allergies may reduce the risk of throat cancer. Patients with a history of allergies showed a reduced odds ratio for developing laryngeal neoplasms [32].

Mitochondrial Dynamics – Inducing mitochondrial fission in tumor cells can promote the release of mitochondrial DNA (mtDNA) into the cytosol. When recognized by DNA sensors like cGAS, this release triggers stress signals (e.g., the cGAS-STING pathway and type I interferons) that can drive tumor apoptosis and engage antitumor immune responses [33].

4. Conclusion

Allergy-assisted cancer immunotherapy (AACI) offers a novel direction in oncology by leveraging the body's allergic response to disrupt tumor metabolism and enhance immune recognition. AACI combines targeted allergen-specific IgE monoclonal antibody delivery with controlled allergen exposure to drive excessive mitochondrial fission, leading to metabolic collapse and apoptosis in cancer cells. This approach may be adaptable across various solid tumor types, particularly those resistant to standard therapies. While AACI shows promise, further research is needed to optimize delivery, ensure safety, and validate clinical effectiveness. If successful, AACI could provide a valuable new tool for treating treatment-resistant malignancies and advancing precision oncology.

Compliance with ethical standards

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Artificial intelligence technology was used in the preparation of this review article. Gemini AI (version 2.5 Pro, Google LLC, Mountain View, CA) was used during the research period of June 2026. Grammarly was used for grammar, spelling, and punctuation throughout the preparation of the review article.

The tool (Grammarly, version 14.1271.0, Grammarly Inc., San Francisco, CA) was used to review and edit the entire review article for grammatical accuracy, clarity, and readability. Grammarly's AI-powered writing assistant provided suggestions on sentence structure, word choice, and tone consistency, which the author reviewed and selectively incorporated. The tool was not used to generate original scientific content, data analysis, or research conclusions. The author takes full responsibility for the integrity of all content generated and presented in this review article.

Disclosure of conflict of interest

The author claims no conflict of interest.

References

[1] Josephs, DH, Bax, HJ, Karagiannis, SN. IgE Antibodies as Therapeutic Agents in Cancer. Clinical & Experimental Allergy, 2020; 50(7), 757–769.

[2] Kumari S, Ghosh S, Doerner A. IgE-based therapeutics are an emerging modality in cancer treatment. Discover Oncology. 2025 Nov 25;16(1):2161.

[3] Dochniak MJ. Allergy-assisted passive immunotherapy: Harnessing IgE-mediated responses for cancer treatment GSC Biological and Pharmaceutical Sciences, 2025; 30(03), 385-387.

[4] Galli, SJ, Tsai M, Piliponsky AM. The development of allergic inflammation. Nature, 2008; 454(7203), 445–454.

[5] Di Gioacchino M, Della Valle L, Allegra A, Pioggia G, Gangemi S. AllergoOncology: role of immune cells and immune proteins. Clinical and Translational Allergy. 2022;e12133.

[6] Dochniak MJ. Personalized medicine: Harnessing the allergy cascade to disrupt solid tumors GSC Biological and Pharmaceutical Sciences, 2025; 32(03), 039–043.

[7] Abbas M, Goldin J. Type I Hypersensitivity Reaction. [Updated 2025 Aug 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2026 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560561/

[8] Dochniak, MJ. Allergy-assisted passive immunotherapy: Harnessing IgE-mediated responses for cancer treatment. GSC Biological and Pharmaceutical Sciences, 2025;30(03), 385-387.

[9] McCraw AJ, Chauhan J, Bax HJ, Stavraka C, Osborn G, Grandits M, López-Abente J, Josephs DH, Spicer J, Wagner GK, Karagiannis SN, Chenoweth A, Crescioli S. Insights from IgE Immune Surveillance in Allergy and Cancer for Anti-Tumor IgE Treatments. Cancers (Basel). 2021 Sep 4;13(17):4460.

[10] Galli SJ, Borregaard N, Wynn, TA. Phenotypic and functional plasticity of cells of innate immunity: macrophages, mast cells, and neutrophils. Nature Immunology, 2011;12(11), 1035–1044.

[11] Fan K, Ding X, Zang Z, Zhang Y, Tang X, Pei X, Chen Q, Yin H, Zheng X, Chen Y, Li S, Yang H. Drp1-Mediated Mitochondrial Metabolic Dysfunction Inhibits the Tumor Growth of Pituitary Adenomas. Oxidative Medicine Cell Longevity. 2022 Mar 23;2022:5652586.

[12] Youle RJ, Strasser A. The BCL-2 protein family: opposing activities that mediate cell death. Nature Reviews Molecular Cell Biology, 2008;9(1), 47–59.

[13] Galli SJ, Grimbaldeston M, Tsai M. Immunomodulatory mast cells: negative, as well as positive, regulators of immunity. Nature Reviews Immunology, 2008;8(6), 478–486.

[14] Ježek J, Cooper KF, Strich R. The Impact of Mitochondrial Fission-Stimulated ROS Production on Pro-Apoptotic Chemotherapy. Biology (Basel). 2021 Jan 6;10(1):33.

[15] Dalseno D, Gajic N, Flanagan L, Tait SWG. Cell death and cancer: Metabolic interconnections. Cell Reports: Cell Pres. 2025 Jun 24;44(6):115804.

[16] Rava M, Czachorowski M J, Silverman D, Márquez M, Kishore S, Tardón A, Serra C, García-Closas M, Carrato ., Rothman N, Real F ., Kogevinas M, Malats N. Asthma status is associated with decreased risk of aggressive urothelial bladder cancer. International journal of cancer, 2018; 142(3), 470–476.

[17] Wang N, Wang X, Lan B, Gao Y, Cai Y. DRP1, fission and apoptosis. Cell Death Discovery. 2025 Apr 7;11(1):150.

[18] Lowcock EC, Cotterchio M, Ahmad N. Association between allergies, asthma, and breast cancer risk among women in Ontario, Canada. Cancer Causes Control. 2013;24(5):1053-1056.

[19] Curcio A, Ganino L, Valentino I, Gentile M, Alcaro S, Rocca R, Artese A, Amodio N. OPA1 as a Cancer Target: Molecular Mechanisms, Structural Insights, and Strategies for Drug Development. Antioxidants (Basel). 2026 Jan 22;15(1):144.

[20] Ma W, Yang J, Li P, Lu X, Cai J. Association between allergic conditions and colorectal cancer risk/mortality: a meta-analysis of prospective studies. Science Reports. 2017;7(1):5589.

[21] Kim YY, Yun SH, Yun J. Downregulation of Drp1, a fission regulator, is associated with human lung and colon cancers. Acta Biochim Biophys Sinica (Shanghai). 2018 Feb 1;50(2):209-215.

[22] Amirian ES, Zhou R, Wrensch M R, Olson SH, Scheurer ME, Il'yasova D, Lachance D, Armstrong GN, McCoy LS, Lau CC, Claus EB, Barnholtz-Sloan JS, Schildkraut J, Ali-Osman F, Sadetzki S, Johansen C, Houlston RS, Jenkins RB, Bernstein JL, Merrell RT, Bondy ML. Approaching a Scientific Consensus on the Association between Allergies and Glioma Risk: A Report from the Glioma International Case-Control Study. Cancer epidemiology, biomarkers & prevention: a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology, 2016; 25(2), 282–290.

[23] Lu C, Chen X, Wang Q, Xu X, Xu B. TNFα promotes glioblastoma A172 cell mitochondrial apoptosis via augmenting mitochondrial fission and repression of MAPK-ERK-YAP signaling pathways. Onco Targets and Therapy. 2018 Oct 18;11:7213-7227. doi: 10.2147/OTT.S184337. Retraction in: Onco Targets and Therapy. 2024 Apr 03;17:297-298.

[24] Kim JA, Park SJ, Choi S, Chang J, Jeong S, Ahn J, Lee G, Son JS, Park SM. Association of the presence of allergic disease with subsequent risk of liver cancer in a nationwide retrospective cohort among Koreans. Science Reports. 2022 Jun 14;12(1):9856.

[25] Li M, Wang L, Wang Y, Zhang S, Zhou G, Lieshout R, Ma B, Liu J, Qu C, Verstegen MMA, Sprengers D, Kwekkeboom J, van der Laan LJW, Cao W, Peppelenbosch MP, Pan Q. Mitochondrial Fusion Via OPA1 and MFN1 Supports Liver Tumor Cell Metabolism and Growth. Cells. 2020 Jan 4;9(1):121.

[26] Komulainen J, Siiskonen H, Haimakainen S, Kanasuo E, Harvima RJ, Harvima IT. Patients with a history of atopy have fewer cutaneous melanomas than those without atopy: a cross-sectional study in 496 patients at risk of skin cancers. Melanoma Research. 2023;33(3):218-229.

[27] Huang C, Radi RH, Arbiser JL. Mitochondrial Metabolism in Melanoma. Cells. 2021 Nov 16;10(11):3197.

[28] Mills PK, Beeson WL, Fraser GE, Phillips RL. Allergy and cancer: organ site-specific results from the Adventist Health Study. American Journal of Epidemiology. 1992;136(3):287-295.

[29] Ashraf, R., Tankay, K., Raina, M. *et al.* Mfn1-mediated imbalanced mitochondrial dynamics promote ovarian cancer stemness by inducing metabolic reprogramming. Journal of Physiology and Biochemistry 2026; 82, 28.

[30] Cotterchio M, Lowcock E, Hudson TJ, Greenwood C, Gallinger S. Association between allergies and risk of pancreatic cancer. Cancer Epidemiol Biomarkers and Prevention. 2014;23(3):469-480.

[31] Ježek J, Cooper KF, Strich R. The Impact of Mitochondrial Fission-Stimulated ROS Production on Pro-Apoptotic Chemotherapy. Biology (Basel). 2021 Jan 6;10(1):33.

[32] Bosetti C, Talamini R, Franceschi S, Negri E, Giacosa A, Vecchia C. Allergy and the risk of selected digestive and laryngeal neoplasms. European Journal of Cancer Prevention. 2004;13(3):173-176.

[33] Heilig R, Lee J, Tait SWG. Mitochondrial DNA in cell death and inflammation. Biochemical Society Transactions. 2023 Feb 27;51(1):457-472.