Cancer attrition immunotherapy and diet

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Abstract
Harnessing the natural power of the immune system to inhibit advanced cancer is in its infancy. The research investigates a potential synergism of cellular and humoral immunity in cancer immunotherapy. Specifically, cancer attrition immunotherapy uses inactivated vaccines and hyper-allergenic skin creams to hyper-activate the adaptive immune system and inhibit metastasis. In support, this review discusses an immunonutrition approach to managing essential fatty acids, proteins, carbohydrates, vitamins, minerals, and hydration.

Keywords: Atopy; Ketogenic; Functional medicine; Metastasis; Skin Cream; Vaccine

1. Introduction
This review explores how dietary intervention may support immunity and starve out metastatic cancer. We will present evidence for and against the consumption of select nutrients. Finally, we discuss how functional medicine may improve clinical outcomes during cancer attrition immunotherapy.

Solid tumor stage-iv cancer, or advanced cancer, spreads throughout the body from the original site. Cancer cells break away from the primary tumor and enter the bloodstream or lymphatic system. About 68% of solid-tumor cancer deaths involved metastases as a contributing cause [1]. During stage IV cancer, escalation of conventional cancer treatments like surgery, chemotherapy, hormonal therapy, and radiation therapy often fails to benefit the patient and can expedite death.

Cancer attrition immunotherapy is a type of cancer treatment that uses the power of the body's adaptive immune system to inhibit cancer. It is immunologically robust, metabolically expensive, innocuous, and financially inexpensive [2]. Non-infectious vaccines (virus/bacteria) and hyper-allergenic skin creams (specific allergens) stimulate the cellular and humoral arms of the adaptive immune system. Cancer patients diagnosed with stage IV cancer have an opportunity to self-medicate and affect metastasis through immune-metabolic interference [3].

Immunonutrition modulates the activity of the immune system by interventions with specific nutrients [4]. Managing amino acid and limited vitamin intake is a dietary intervention for cancer attrition immunotherapy [5,6]. A ketogenic diet that nourishes adaptive immunity while starving out metastatic cells may improve the survival rate of patients with advanced cancer. Diet-based therapies augment the adaptive immune system to enhance the production of immune cells, antibodies, and mediators. At the same time, increased immunometabolism may starve out solid-tumor metastatic cancer by affecting nutrient availability.

A functional medicine approach to cancer attrition immunotherapy is a model of care that considers the entire body. Examples of functional medicine include massage, acupuncture, and naturopathy. Massage and acupuncture may enhance immunogenicity during cancer attrition immunotherapy. A study has shown that local massage after
vaccination was associated with better immunogenicity [7]. Acupuncture may improve immunostimulation during cancer attrition immunotherapy in that systemic contact dermatitis has been caused by acupuncture [8]. A naturopathy diet-based approach preferably means eating organic foods that do not contain artificial ingredients and are substantially free of preservatives [9] and pesticides [10]. Plant substances such as carotenoids, flavonoids, and certain spices are not recommended during cancer attrition immunotherapy because they influence effector cells in humoral immunity [11].

2. Essential Fatty Acids
The essential fatty acids omega-6 (ω-6) and omega-3 (ω-3) cannot be synthesized in the body [12].

ω-6 is a family of polyunsaturated fatty acids that have in common a final carbon-carbon double bond in the n-6 position, that is, the sixth bond, counting from the methyl end [13]. ω-6 is considered pro-inflammatory. The ω-6 arachidonic acid is a precursor to several potent pro-inflammatory mediators like prostaglandins and leukotrienes [14]. Foods that are high in ω-6 may benefit cancer attrition immunotherapy. A daily intake of ω-6 greater than 15 grams is recommended [15]. Foods that are high in ω-6 include Atlantic salmon, Brazil nuts, cashews, avocado, carrots, corn, corn chips, hemp seeds, sunflower seeds, firm tofu, walnuts, almonds, seeds, peanuts, soybeans, roasted chicken thigh, pepperoni, creamy soups, and egg yolk.

ω-3 are polyunsaturated with a double bond three atoms away from the terminal methyl group. ω-3 are considered anti-inflammatory [16]. A limited intake of ω-3 may benefit cancer attrition immunotherapy. The recommended quantity of ω-3/day is no greater than 2 grams. Foods low in ω-3 include bass, tilapia, cod, shellfish, and corn-fed beef.

A diet having a high ω-6/ω-3 ratio is recommended. For example, corn oil has a high ω-6/ω-3 ratio of 58/1. Other oils with a high ω-6/ω-3 ratio include cottonseed, safflower, soybean, and sunflower.

During cancer attrition immunotherapy, it is recommended that fatty acids make up 65% to 85% of daily calories.

3. Carbohydrates
Carbohydrates are sugar molecules; your body breaks down carbohydrates into glucose.

For healthy individuals, carbohydrates preferably make up 45% to 65% of total daily calories [17]. Limited glucose intake from carbohydrates may enhance the efficacy of cancer attrition immunotherapy. Due to the Warburg effect, glucose in dietary carbohydrates acts as a primary metabolic fuel for many tumors. Restriction-induced glucose deprivation may slow tumor progression [18].

A ketogenic diet based on high fat, adequate protein, and low carbohydrates may be helpful during cancer attrition immunotherapy [19]. Foods low in carbohydrates include meat, fish, eggs, butter, oils, avocados, and coconut. Beverages with low carbohydrates include coconut water, sugar-free soft drinks, and wine.

During cancer attrition immunotherapy, it is recommended that carbohydrates make up 1% to 5% of daily calories.

4. Proteins
Proteins and amino acids are the building blocks for the biosynthesis of effector cells and immunoglobulins and develop and maintain the adaptive immune system. Atopy induced by a hyper-allergenic skin cream can affect amino acid metabolism [20].

Amino acid competition between immune system cells and metastatic cells can influence their growth, survival, and function. A fierce competition likely exists between cells in the tumor microenvironment, as the demand for resources in this niche is high. There is evidence for the metabolic interplay between cancer cells and immune cells [21].

The amino acid arginine can enhance the immune response against cancer, allowing an expanded population of immune cells to consume glutamine [22]. Many foods that are natural sources of arginine include nuts (like walnuts, hazelnuts, pecans, peanuts, almonds, cashews, pine nuts, and Brazil nuts), seeds (like watermelon, pumpkin, sesame, sunflower), oats, corn, cereals, buckwheat, brown rice, and chocolate. Food sources high in arginine include turkey, chicken, beef, milk, yogurt, cheese, and eggs [23]. Amino acid supplements to avoid during cancer attrition immunotherapy are
tryptophan, glutamic acid, and glutamate [24]. Cancer research shows that tumors increase their consumption of tryptophan to evade immune control [25]. Glutamic acid and the sodium salt of glutamic acid (i.e., glutamate) modulate cancer cell development, proliferation, and metastasis by regulating cell signaling pathways [26].

During cancer attrition immunotherapy, it is recommended that dietary proteins make up 10% to 35% of daily calories.

5. Vitamins A, B, C, D, E, and K

Vitamins are essential for the cellular growth and nutrition of metastatic cancer. The bioavailability of vitamins may affect the immune system's ability to fight metastatic cancer. Research efforts investigate the complex interplay of vitamins, immune cells, and cancer cells to improve treatment outcomes [27].

5.1. Vitamin A

Vitamin A is a fat-soluble vitamin. It is a group of compounds that includes retinol, retinal, retinoic acid, and several provitamin-A carotenoids.

Limited intake of vitamin A may enhance the efficacy of cancer attrition immunotherapy. In a study from the journal of Clinical and Experimental Allergy (2020), the researchers concluded, "Vitamin A deficiency can exacerbate extrinsic atopic dermatitis by augmenting Th2-mediated inflammation and mast cell activation" [28].

The recommended daily vitamin A intake is no greater than 700 mcg for adult women and no greater than 900 micrograms for adult men. Foods with high levels of vitamin A include apricots, butter, cantaloupe, carrots, cheese, cream, eggs, fortified margarine, fortified milk, liver, pumpkin, sweet potatoes, and winter squash [29].

5.2. Vitamin B

Vitamin B is a class of water-soluble vitamins: B1 (thiamine); B2 (riboflavin); B3 (niacin); B5 (pantothenic acid); B6 (pyridoxine); B7 (biotin); B9 (folic acid); and B12 (cabalamin).

Vitamin B nutritional supplements and foods high in vitamin B enhance cancer attrition immunotherapy. Studies have demonstrated that vitamin B deficiency impairs aspects of both humoral and cell-mediated immunity [30, 31, 32].

Foods with high levels of vitamin B include beef, brewer's yeast, chicken, clams, leafy greens, legumes, mussels, oysters, pork, sunflower seeds, and turkey [33].

5.3. Vitamin C

Vitamin C (ascorbic acid) is a water-soluble vitamin.

Limited intake of vitamin C may enhance the efficacy of cancer attrition immunotherapy. Vitamin C deficiency can support atopy. For example, plasma levels of vitamin C are decreased in atopic dermatitis [34].

The recommended daily vitamin C intake is no greater than 90 milligrams. Foods that are high in vitamin C include citrus (oranges, kiwi, lemon, grapefruit), bell peppers, strawberries, tomatoes, cruciferous vegetables (broccoli, Brussels sprouts, cabbage, cauliflower), and white potatoes [35].

5.4. Vitamin D

Vitamin D is a group of fat-soluble compounds: D1 (ergocalciferol and lumisterol); D2 (calciferol); D3 (colecaciferol); D4 (22-dihydroergocalciferol); and D5 (sitocalciferol).

Limited intake of vitamin D may enhance the efficacy of cancer attrition immunotherapy. Studies indicate that the vitamin D effect on adaptive immunity is mainly inhibitory [36, 37]. Vitamin D deficiency is associated with atopic dermatitis [38].

The recommended daily vitamin D intake is no greater than 600 IU. Foods that are high in vitamin D include beef liver, canned tuna, cod liver oil, egg yolk, fortified cereal and oatmeal, fortified cow's milk, fortified orange juice, fortified soy milk, and herring, mushrooms, salmon, sardines, and swordfish [39].
5.5. Vitamin E

Vitamin E is a group of eight fat-soluble compounds.

Limited intake of vitamin E may enhance the efficacy of cancer attrition immunotherapy. A study showed that higher concentrations of vitamin E intake were associated with lower serum IgE concentrations and a lower frequency of allergen sensitization [40].

The recommended daily vitamin E intake is no greater than 15 milligrams. Foods with high levels of vitamin E include almonds, asparagus, avocados, beet greens, mango, peanuts, peanut butter, pumpkin, safflower oil, spinach, soybean oil, sunflower oil, sunflower seeds, and wheat germ oil [41].

5.6. Vitamin K

Vitamin K is a fat-soluble vitamer: vitamin K1 (phytomenadione); and vitamin K2 (menaquinone).

Limited intake of vitamin K may enhance the efficacy of cancer attrition immunotherapy. A study showed that Vitamin K2 suppresses proliferation and inflammatory cytokine production in mitogen-activated lymphocytes of atopic dermatitis patients through the Inhibition of mitogen-activated protein kinases [42].

The recommended daily vitamin K intake is no greater than 120 mcg for men and no greater than 90 mcg for women [43]. Foods with high levels of vitamin K include kale, collard greens, spinach, turnip greens, animal livers, and bacteria-fermented foods like cheese [44].

6. Nutrient Minerals

Minerals are those elements on the earth and in food that our bodies need to develop and function properly. Minerals are not synthesized biochemically by living organisms [45].

Limited intake of the minerals selenium and zinc may enhance the efficacy of cancer attrition immunotherapy. A study indicates that a deficiency of selenium and zinc may exacerbate atopic dermatitis [46].

6.1. Selenium

The recommended daily selenium intake is no greater than 55 mcg for adults. Foods with high levels of selenium include Brazil nuts and yellowfin tuna.

6.2. Zinc

The recommended daily zinc intake is no greater than 11 mg for men and no greater than 8 mg for women. Foods with high levels of zinc include meat, shellfish, and legumes [47].

7. Hydration

Cancer patients have unique hydration needs based on age, gender, weight, and the cancer treatment plan; the recommended daily ingestion of water is sixty-four (64) ounces.

Beverages that are substantially free of sugar and caffeine-free enhance cancer attrition immunotherapy. Sugar-free supports a low-carbohydrate diet. A study indicates that caffeine acts to suppress inflammation [48]. Beverages and food with high levels of caffeine include coffee, energy drinks, espresso, sodas, green tea, black tea, coffee liqueur, dark chocolate, and chocolate frosting.

8. Qualified Immunity

In cancer attrition immunotherapy, qualified immunity is a series of tests to evaluate antibody formation and specificity. Qualified immunity results set a standard of treatment that ensures safety and efficacy. Blood tests determine antibody titers and allergen sensitivity. A skin prick test also determines allergen sensitivity. After forced immunity to a specific
antigen/allergen, elimination of the immunologically sensitized antigen/allergen reduces the possibility of anaphylactic shock during treatment.

9. Conclusion

Cancer attrition immunotherapy uses the natural power of the body’s adaptive immune system (humoral and cellular.) The research explores if immunomodulation and immunonutrition can starve out advanced cancer. The complex interplay of diet, adaptive immunity, and metastasis encourage researchers to find metabolic solutions to cancer inhibition. In support, a functional medicine approach and naturopathic therapies (e.g., acupuncture and massage) may safely and effectively stimulate immunometabolism for improved clinical outcomes.

Compliance with ethical standards

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Disclosure of conflict of interest

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