

**Nutrition in Oncology:
The case of Micronutrients**

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KEY POINTS FROM THIS ARTICLE:

- 1) Many cancer patients develop a tumor-associated malnutrition characterized by an insufficient supply of macro- and micronutrients.
- 2) Supportive nutrition care of the cancer patient with vitamins, minerals and long-chain omega-3 fatty acids are becoming more and more relevant in oncology.
- 3) "In the case of reduced food intake and/or inappropriate food choice the use of a multi-vitamin multi-mineral supplement administered in physiological doses, i.e. nutrient quantities approximately corresponding to the recommended daily allowances, can be generally recommended."
- 4) To enhance postoperative wound healing, "cancer patients require higher amounts of micronutrients than healthy individuals."
- 5) "Because vitamin D deficiency is highly prevalent in oncological patients, improvement of vitamin D status is of special interest."
- 6) About 11 million people develop malignant tumors worldwide every year.
- 7) Due to the ageing population, the number of new cancer cases is expected to double until the year 2030.
- 8) Eating habits and/or individual nutrition factors modify the risk of developing cancer.
- 9) "The inadequate nutrition status and the cancer anorexia-cachexia syndrome combined with it are clinically relevant because they not only diminish the response to anti-neoplastic measures, such as radiation and chemotherapy, but also aggravate their side effects and have a negative impact on the patient's quality of life and prognosis. Thus, an adequate nutritional intervention can have a beneficial influence on the progress of the disease and the patient's condition."
- 10) "Supportive nutrition therapy should be an integral part of cancer care."
- 11) "Micronutrients" includes vitamins and mineral substances and omega-3 fats.

- 12) Cancer patients typically suffer from malnutrition, characterized by rapid weight loss.
- 13) Cancer patients usually have significant malnutrition, and many patients have nutrition deficits before diagnosis.
- 14) "Malnutrition is particularly severe in patients with a tumor of the gastrointestinal tract."
- 15) Malnutrition rises when anti-neoplastic procedures are initiated.
- 16) Radiation and chemotherapy affect the patient's food selection, nutrient absorption, and nutrient utilization.
- 17) Cancer malnutrition involves activation of the enzyme phospholipase A2, which leads to increased release of arachidonic acid (AA) from the cell membranes. Arachidonic acid then increases the formation of reactive oxygen species (superoxide radicals), causing upregulation of NF- κ B (nuclear factor kappa B), which enhances the pro-inflammatory state.
- 18) Cachexia [physical wasting and loss of muscle mass caused by disease] is the most frequent cause of death of cancer patients.
- 19) "The malnutrition of many cancer patients is not limited to macronutrients, but the supply of various vitamins and minerals also is often inadequate."
- 20) Micronutrient deficiency occurs in most cancer patients, especially if the chemo and radiation therapy induce vomiting and diarrhea.
- 21) "The status of vitamins C, D and E and of some B vitamins is significantly lowered in many tumor patients compared with healthy individuals."
- 22) Cancer patients are also low in the trace elements selenium and zinc.
- 23) Cancer patients are low in many antioxidant micronutrients and consequently suffer from increased oxidative stress [free radical damage].
- 24) Micronutrient deficiency in cancer patients:
 - A) Compromises wound healing.
 - B) Increases depressive symptoms.
 - C) Compromises immune competence, as immune cells have an increased nutrient need.
- 25) Many cancer patients have a multiple nutrient deficit, and "using micronutrient supplements can make sense in these cases."

26) "Clinical studies have actually shown that the nutritional status of tumor patients can be improved by giving them vitamins and mineral substances."

27) After reviewing 23 studies, these authors comment on the controversy as to whether antioxidant supplements (vitamins C, E and selenium), are safe during chemo and/or radiation therapy because micronutrients with antioxidants can capture reactive oxygen species (ROS); the tumor-destroying effect of chemo or radiation therapy is partly due to an increased formation of ROS. "It is therefore possible that the adjuvant administration of antioxidants during chemo and radiation therapy will weaken the therapeutic effect and thus worsen the tumor patient's prognosis." The American Institute for Cancer Research concludes it is safe for patients under chemo or radiation therapy to consume vitamins or mineral substances that do not exceed the upper limits of safe intake (vitamin C, 2000 mg/day, vitamin E, 250 mg/day tocopherol equivalents, and selenium 400 g/day). "Taking dietary supplements during chemo or radiation therapy is to be considered safe as long as such supplements contain amounts of vitamins and mineral substances that are in the range of the recommended daily allowance according to the RDA recommendations."

28) Micronutrient supplementation can:

- A)) Enhance wound healing
- B)) Counteract tumor cachexia
- C)) Improve the patient's quality of life and prognosis

29) Post-surgical wound closure and tissue regeneration depend on an adequate supply of micronutrients. "Vitamins A, C, E and B6 in particular, but also the trace elements zinc, manganese and copper, as enzyme cofactors, are involved in biochemical-physiological processes that are directly related to wound healing."

30) The postoperative need for vitamin C is higher than normal.

31) Supplemental vitamin C of 1000 mg/day is recommended for post-surgical patients and for the optimization of wound healing.

32) Because micronutrients work synergistically, they should be used in combinations.

33) Micronutrient supplements are important in controlling cachexia, especially:
Antioxidants (vitamins C and E)

N-acetylcysteine
Alpha-lipoic acid
Fish oils

34) "The fish oil components relevant in this context are the long-chain omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)."

- 35) Importantly, the "synthesis of EPA and DHA from ALA [plant derived omega-3 fatty acid] is extremely slow and low yielding."
- 36) "It is estimated that an intake of approximately 20 g pure ALA is necessary to obtain 1 g EPA."
- 37) Long-chain omega-3 supplementation can significantly increase survival time of cancer patients.
- 38) In lung cancer patients, taking micronutrients reduced the risk of death by 20%. "The mean survival time of the patients taking micronutrient supplements was 4.3 years, whereas it was only 2 years for the patients who did not take any."
- 39) Blood vitamin D3 levels are significantly associated with the survival of patients with breast cancer and colorectal cancer.

SUMMARY

- 1) The use of a multivitamin-multimineral supplement in physiological doses, i.e. nutrient amounts that approximately equal to the recommended daily allowance, is useful and safe. This also applies to oncological patients during chemo and radiation therapy.
- 2) In general, the use of single high dose micronutrients should be avoided. An exception is vitamin D. The vitamin D supply should amount to 1800-4000 IU/ day in order to reach the desirable plasma concentration of >75 nmol/l.
- 3) To improve postoperative wound healing, an increased micronutrient supply is recommended:

| | |
|------------|-----------------|
| Vitamin C | 500-2000 mg/day |
| Vitamin A | 3 mg/day |
| Vitamin B6 | 10-15 mg/day |
| Folic acid | 0.4-1.0 mg/day |
| Zinc | 4-10 mg/day |
| Copper | 1-2 mg/day |
- 4) The administration of long-chain omega-3 fatty acids (1.5-2.0 g/day) to patients with weight loss and tumor cachexia is recommended.
- 5) "The intake of micronutrient supplements can improve both the quality of life and the prognosis of tumor patients."

MICRONUTRIENTS FOR WOUND HEALING:

Vitamin C

Essential for the synthesis of collagen and its interlinkage in the connective tissue.

Recommended Daily Dose: 500-2000 mg/day

Vitamin A

Essential for epithelial-dermal integrity.

Recommended Daily Dose: 10000 IU/day

Vitamin B6 (Pyridoxal phosphate):

Essential for connective tissue protein synthesis.

Recommended Daily Dose: 10-15 mg/day

Folic acid

Essential for connective tissue protein synthesis.

Involved in amino acid, purine and pyrimidine synthesis.

Recommended Daily Dose: 0.4-1.0 mg/day

Zinc

Essential for the synthesis of collagen and its crosslinking in connective tissues.

Essential for wound healing.

Recommended Daily Dose: 4-10 mg/day

Copper

Essential for the synthesis of collagen and its crosslinking in connective tissues.

Essential for angiogenesis in the wound area.

Recommended Daily Dose: 1-2 mg/day