

Nutrition and wound care

Nutritional status plays an essential role in the prevention and treatment of wounds. The body requires energy, protein, and micronutrients for optimal wound healing. It is well documented that malnutrition is associated with slower postoperative healing and increased complications.

Good nutritional status prior to surgery can enhance wound healing and minimise complications. Malnutrition is associated with higher morbidity and mortality rates compared with well-nourished patients. As well, poor nutritional intake increases the risk of developing pressure ulcers. Energy, protein, vitamins A, C and E, and the mineral zinc all have an effect on wound healing. There are three stages of wound healing:

- the inflammatory stage (resolution),
- the proliferation stage (sloughing) and
- the remodelling stage (repair).

Each of these stages requires adequate intake of energy, protein, and specific vitamins and minerals for tissue repair. Otherwise, healing may be prolonged or disrupted.

Energy and protein

An adequate intake of energy and protein is required for tissue repair. Adequate caloric intake is essential for cellular growth and leukocyte functioning. When insufficient calories are taken, the body resorts to skeletal and visceral protein as its source for energy. Protein is required for fibroblast proliferation, collagen and proteoglycan synthesis and wound remodelling. Inadequate protein intake can deplete lean tissue, reduce circulating proteins and increase risk of infection. In addition, the inflammatory and wound remodelling stages of wound healing are lengthened as a result of protein malnutrition. When energy and protein intake are low, patients in hospital and in the community are at greater risk of developing pressure ulcers. Hypoalbuminemia reflects the body's protein losses and is a risk factor for developing pressure ulcers. Protein-calorie malnutrition may also cause anaemia. Anaemia may promote ulcer formation and delay wound healing by impairing oxygen delivery to tissues. It should be noted that one of the indicators of protein malnutrition is peripheral oedema. However, the associated swelling may lead to protein malnutrition being overlooked. Practitioners must be alert to the possibility of protein malnutrition not withstanding the absence of a gaunt, wasted appearance of the patient. Preoperative protein supplementation has been shown to be more effective than postoperative supplementation to improve wound healing when patients are protein malnourished. In a healthy adult person, the normal needs are approximately 25-35 Calories/kg and 0.8-1.0 g protein/kg. Patients with pressure ulcers and other stress factors have increased calorie and protein requirements. Recommendations for protein in the treatment of pressure ulcers are 1.25-1.5 g/kg/d up to 2.0 g/kg for positive nitrogen balance, collagen synthesis and for visceral protein needs. Caloric needs may be as high as 40 Cal/kg/d.

Vitamin A

Vitamin A is involved in the normal epidermis and synthesis of glycoproteins during the inflammatory process of healing and fibroblast differentiation, as well as collagen deposition during the proliferation stage. Vitamin A deficiency delays collagen synthesis, which in turn delays wound healing and increases susceptibility of infection. Patients with chronic leg ulcers have shown to have decreased serum levels of vitamin A and carotenes (vitamin A precursor). Vitamin A deficiency is common in hospitalised patients, especially in those that are severely injured or burned. Good sources of vitamin A include liver, egg yolk, dairy, dark green and yellow vegetables and yellow and orange fruits. Vitamin A supplementation aids in reversing impaired wound healing. Supplementation for seven days post-surgery improves collagen synthesis and scar strength.

Vitamin C

Vitamin C is an essential component of the amino acids, lysine and proline in collagen synthesis and is therefore essential for wound healing. Vitamin C also helps leukocyte transport to wounds, increasing infection resistance. Adequate nutritional intake and vitamin C and zinc intake have been associated with improvement in the stage and size of pressure ulcers. Vitamin C depletion is associated with the formation of pressure ulcers, while vitamin C deficiency can lead to the breakdown of wounds that have already healed. Vitamin C requirements are higher for smokers and for burns, fractures and surgery. Vitamin C supplementation accelerates collagen synthesis, helping in the treatment of leg ulcers and other wounds. Vitamin C should be supplemented in severely ill patients by 1-2 mg/d. Large doses of vitamin C can cause complications including the formation of oxalate stones which may lead to kidney failure. Supplementation must be carefully monitored.

Zinc

Zinc is essential in the wound healing process, as it is a component of hundreds of enzymes, including those involved in collagen synthesis and cell proliferation. Zinc deficiency is linked with delayed healing of wounds and ulcers and lower breaking strength on incisions. It also weakens the immune system, causing lymphocytopenia. Zinc is one of the most common micronutrients taken in inadequate amounts. This is especially true in women, the elderly and in lower income households. Zinc is found mainly in beef, pork, dark poultry, shellfish, dairy and beans, which are high in protein but often expensive, this may be why both protein and zinc are often found low simultaneously. Zinc deficiency occurs in many populations, including people with increased metabolism, diabetes, high gastrointestinal losses, malabsorption and malnutrition.

Medications that are chelating agents and diuretics may also cause zinc deficiency. Zinc deficiency may cause decreased taste sensation, further limiting nutritional intake. Preoperative zinc supplementation improves healing in deficient patients, and is more effective than postoperative supplementation. Adequate zinc intake has been also associated with improvement in the stage and size of pressure ulcers. Recommended dosage for zinc supplementation is 25-50 mg elemental zinc/d (110-220 mg zinc sulphate). Zinc supplementation may have its adverse effects. Excess zinc (> 100 mg elemental zinc) may negatively affect immune response and lipid profiles. Zinc supplementation may also result in copper deficiency due to competitive absorption in the small intestine. Zinc should therefore only be supplemented in the recommended levels for a specified duration, e.g. two – three months, then stopped for four – six weeks. High levels of zinc have also been known to cause nausea and vomiting. Consequently, zinc should be taken with meals to minimise side effects. Note that iron supplements may decrease zinc absorption and should therefore be taken between meals, not with meals.

Vitamin E

Patients with chronic leg ulcers have shown to have decreased serum levels of vitamin E. Vitamin E's role in wound healing, however, is controversial and not completely understood. Vitamin E does seem to have an anti-inflammatory response and an immune enhancing effect, increasing antibody production. Vitamin E has been shown to improve wound healing in some studies. In animal studies, vitamin E supplementation may impair wound healing while in other studies it has been shown to increase healing rates in some patients with leg ulcers.

Summary

Patients with wounds have increased Calorie and protein requirements and may also benefit from supplementation of specific vitamin and minerals to help improve the healing process. People with the noted deficiencies may also have other risk factors for malnutrition such as decreased intake, limited mobility and access to food, taste changes, swallowing and chewing difficulty. Chronic leg ulcers have a significant impact on mobility and therefore food accessibility. Oral supplements can increase the Calorie and protein intake of patients. Nutritional supplements with protein, energy, and micronutrients may help prevent the development of pressure ulcers in high-risk individuals. A special supplement, such as Ensure HP, is a good source of nutrition for people with high protein needs. It contains 225 Calories per can with 21% of total energy coming from protein. Ensure Plus contains 355 Calories per can with 15% of total energy coming from protein, useful for people needing extra Calories and protein in a limited volume. Both contain 25% of the recommended daily vitamin and mineral intake per can. It is important to remember that wounds, nutrient deficiencies and other medical problems should be diagnosed by a physician and treated on their advice.

NUTRITION REQUIREMENTS

Nutrient Healthy individuals Increased requirements

Energy 25-30 Calories/kg/d

30 Calories/kg/d stage I and II ulcers

35-40 Calories/kg/d stage III & IV ulcers, burns

Protein 0.8-1.0 g/kg/d 1.0-2 g/kg/d varying with level of ulcer or injury

Vitamin A 800-1000 IU/d 5000 IU/d

Vitamin C 30-40 mg/d 100-1000 mg/d post-op

500-1500 mg/d burns

Vitamin E 6-9 mg/d No recommendations

Zinc 9-12 mg/d 25-50 mg/d for 3 months

THE ROLE OF NUTRIENTS IN WOUND HEALING

Protein

Tissue formation

Collagen synthesis

Wound remodelling

Immune support

Vitamin A

Collagen synthesis

Epithelialisation

Immune support

Vitamin C

Collagen synthesis

Antioxidant

Immune support

Capillary integrity

Vitamin E

Antioxidant

Zinc

Collagen synthesis

Protein synthesis